May 2019

Simons Pass Pastoral Lease Additional Conservation Advice

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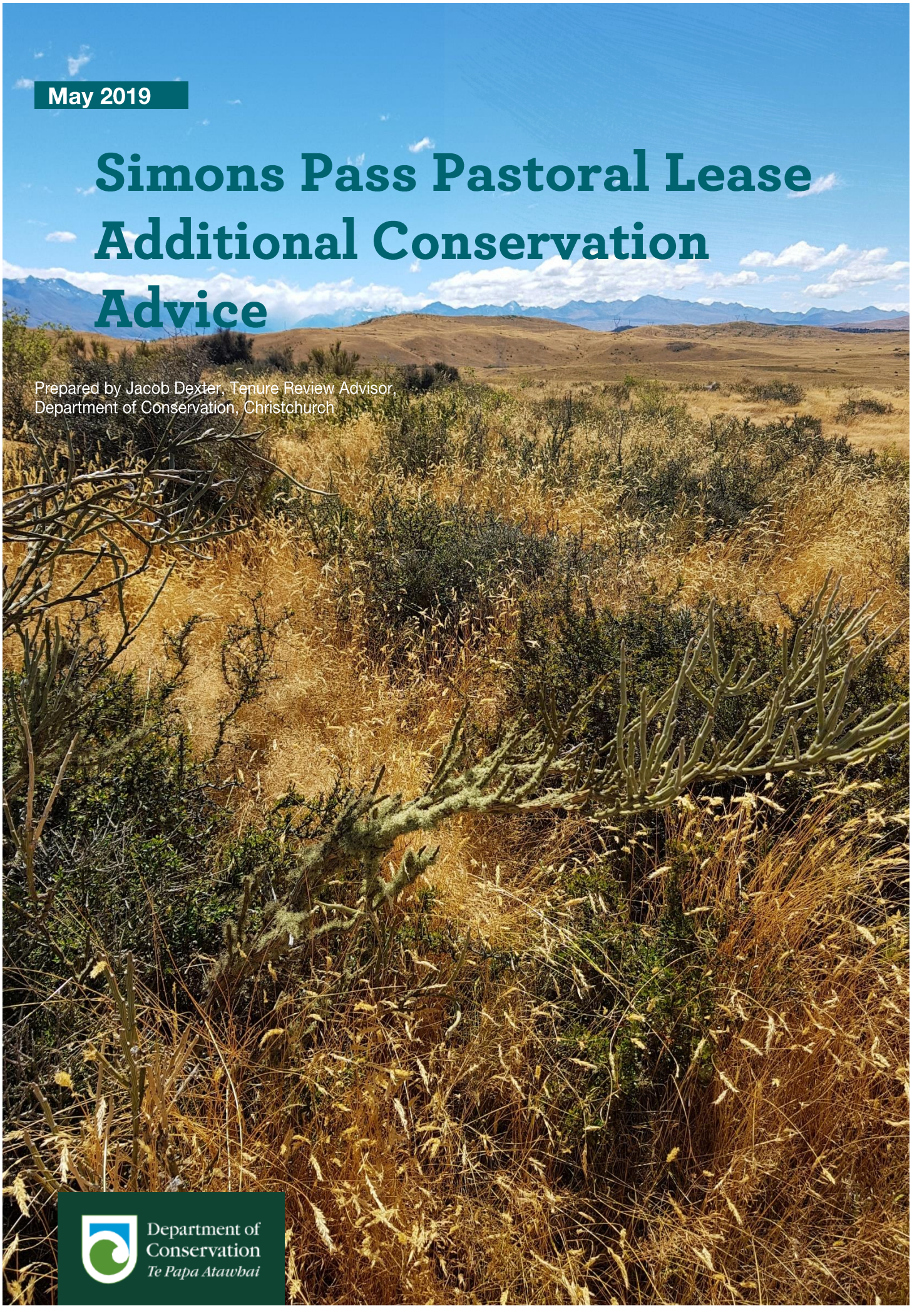

Department of Conservation
Te Papa Atawhai

Cover photo (Dexter, February 2019) – Native dominated fescue tussock grassland and shrubland on Pukaki terminal moraine, on land proposed to become unencumbered freehold (FH1) under the Simons Pass Preliminary Proposal dated April 2017

Acknowledgements – The following had input into this document: - Te Rūnanga o Ngāi Tahu: Sophie McGregor (Environmental Advisor). Department of Conservation: Warren Chinn (Technical Advisor, Animal Ecology), Jane Gosden (Technical Advisor, Plant Ecology), Debbie Lewis (Technical Advisor, Partnerships), Dr. Richard Maloney (Technical Advisor, Systems Development), David Rhodes (Acting Tenure Review Manager), Jeremy Severinsen (Principal Advisor, Mackenzie), Kate Wardle (Botanist, Ecological Services), Dave Wilkins (Acting Tenure Review Manager), Nardia Yozin (Resource Management Act Planner).

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1. Introduction

This report provides additional advice regarding significant inherent values (SIVs) on Simons Pass Pastoral Lease (Simons Pass). A re-evaluation of various SIVs on this part of the property is necessary because:

- The surveys that informed the Department of Conservation's (DOC) Conservation Resources Report (CRR) (DOC, May 2008) and associated SIV maps was conducted prior to farm development that has occurred since 2008. This report discusses the effects of farm development on SIVs.

- Under the SIV criteria used for drafting the CRR, the central Farm Block, some of the outwash plain in the southwestern part of the property, hillslopes behind the old homestead and developed terraces at the eastern Lease boundary were not considered at that time to have significant inherent botanical values. Parts of the outwash plain and Farm Block were not surveyed in depth during the CRR surveys.

- New ecological assessment criteria have been developed since the CRR was published (Appendix 3). These criteria are derived from ecological research that emphasizes New Zealand's rarest and most threatened ecosystems and species and consequently identifies the most important protection priorities. These include Threatened Land Environments of New Zealand (Walker *et al.* 2007) and naturally rare and threatened ecosystems (Williams *et al.* 2007; Holdaway *et al.* 2012).

- The threat status of many plants has changed since the CRR was published; the latest status of New Zealand's flora (de Lange *et al.* 2017) and fauna has been applied.

- Concerns relevant to SIVs assessment and protection were raised during the PP public consultation process were considered, specifically the following matters:

    - Technical information supplied by Submitter 11 (point 26 of the Analysis) being the report by Walker (2017a, paragraph 58) noted that the original ecological assessments may be incomplete for the south-western outwash plain and Farm Block, in particular because these areas provide significant value in terms of ecological connectivity, notwithstanding botanical values that may, or may not, remain.

    - Recommendation by Submitter 6 (Point 5 of the Analysis) that land below the terrace and adjacent to the Pukaki River required protection to ensure ecological sustainability and protection of water quality in the context of conversion of the

balance of the property into a dairy unit.

- Recommendation by Submitter 7 (Point 6 of the Analysis) that freeholding of land visible on both sides (north and south) of State Highway 8, including any land in the designated Scenic View 16 in the Mackenzie District Plan, may result in significant and irreversible landscape changes.

Information in this document has been drawn from, and should be read in conjunction with, the following:

- Key recommendations and context from Te Rūnanga o Ngāi Tahu
- A re-evaluation of previous information supplied regarding SIVs for Simons Pass, being the CRR and associated SIVs maps which are available on the LINZ website and linked in Appendix 1.
- Further field survey undertaken by DOC representatives, 20-21 February 2019.
- Additional botanical (Wardle, 2019) and Invertebrate (Chinn, 2019) assessments.
- Knowledge held within DOC relating to ecological, scientific, landscape and recreational values of South Island high country, the Mackenzie basin and Simons Pass in particular.
- A review of previous DOC advice and recommendations to the CCL, LINZ and its service providers, held on file.
- An analysis undertaken by DOC of District and Regional Planning protective mechanisms under the Resource Management Act 1991.
- Technical information regarding SIVs supplied within submissions for the Preliminary Proposal (PP), primarily the technical botanical (Walker, 2017a) and landscape (Lucas, 2017) reports submitted by Submitter 11.
- Literature listed in the References.
- Reports provided by LINZ: Simons Pass Ecological Values Assessment (Harding 2018); Bird Baseline Surveys, Simons Pass Dryland Reserve, September – October 2018 (Ryder Environmental Ltd, 2018); Dryland Recovery Area Threatened Vascular Plant Baseline Survey and Monitoring (Norton, 2018); Woody and Related Weeds Baseline Survey Simons Pass Dryland Recovery Area (Norton, 2018).

2. Context of the Mackenzie Basin

The Mackenzie Basin is an iconic area of New Zealand characterised by "big sky", expansive dry-brown landscapes, rolling tussock grasslands, glaciation and outwash features, mountain backdrops, large braided rivers and unique biodiversity. Many natural ecosystems and indigenous species present in the Basin are not found elsewhere in the world.

The Mackenzie holds a special place in the national psyche of New Zealanders. Te Manahuna -the Mackenzie region- holds cultural significance to Ngāi Tahu. The lands and waters of Te Manahuna were hunted and foraged for resources for survival, while Ngāi Tahu's paramount ancestor, Aoraki, stood watch at the head of Lake Pūkaki. The oral traditions passed down through generations of Māori living and traversing through the Mackenzie country are supported by recorded sites and cultural history. Ngāi Tahu seek to protect and restore the natural values of what is still a significant area to Ngāi Tahu Whānui.

It is also associated with European heritage of extensive pastoralism that characterised New Zealand farming in the past and identified New Zealand as a farming nation (Hutchings and Logan, 2018). The Basin is readily identifiable to most New Zealanders as a key iconic landscape and because of this, a popular tourism destination.

The socio-political environment in the Mackenzie Basin is complex and has recently been characterised by ongoing challenges between agricultural, conservation and tourism interests. The Basin is a hotspot for nationally and internationally significant landforms and biodiversity values, however in the past 20 years it has gone through a very rapid loss of ecological and natural landscape values. There has been a trend of intensive development, fragmentation and loss of ecological values, particularly on the basin floor. The Mackenzie dryland zone is now at an ecological and landscape tipping point (*Federated Farmers of New Zealand (INC) Mackenzie Branch v Mackenzie District Council* [Decision No. [2017] NZEnvC 53), where an increasing proportion of natural areas have already been intensively modified. Consequently, there are now few opportunities to ensure the protection of the natural character of the landscape and the biodiversity values it contains. Conversely, increased emphasis is being placed on ensuring protection of key landscapes and remaining ecological values, as evidenced in comments by the Parliamentary Commissioner for Environment and the recent Judge Jackson decision on the Mackenzie Basin (*Federated Farmers of New Zealand (INC) Mackenzie Branch v Mackenzie District Council* [Decision No. [2017] NZEnvC 53). Both highlighted concerns about the direct, indirect, and cumulative impacts of farming development and spread of wilding trees.

Between June and September 2018, DOC undertook an analysis of the current pattern of the

remaining ecological and landscape values in the Mackenzie Basin and the wider Waitaki catchment, their protection status and scenarios under which protection could be improved. This analysis identified a series of principles (Appendix 3) which provide for stronger acknowledgement of SIVs, a greater level of recognition of ecological connectivity and sequences across the landscape and an enhanced appreciation of the rarity and diversity of Basin floor ecosystems. Implementation of the principles would provide for the full range and coherence of remaining natural landscapes and landforms. It would protect the landscape 'gateways' to the Basin and the ecosystems and habitats for Threatened and At Risk species. Additionally, it would contribute to protecting important ecosystem services and providing recreational and economic opportunities through tourism.

This analysis has led DOC to take a strategic approach to recommending protection of a functional and connected series of landscape and biodiversity values present. The contribution of these components in the wider landscape sense are a significant inherent value of pastoral lease properties across the Basin. Ecological context beyond a property boundary is a standard assessment criteria; for example, the national threat status for a species is determined based on its national population size and trends, rather than its status and trend within any individual property. In this sense, ecological connectivity and sequences are no different.

3. Te Rūnanga o Ngāi Tahu context

Te Rūnanga o Ngāi Tahu have provided the following recommendations and cultural context (verbatim):

3.1 Te Rūnanga o Ngāi Tahu recommendations to the Commissioner of Crown Lands for the Substantive Proposal for Simons Pass Pastoral Lease

Under the Crown Pastoral Land Act 1998 (CPLA), Te Rūnanga o Ngāi Tahu (Te Rūnanga) are not required to be consulted with regarding discretionary consents/actions. When Te Rūnanga submitted on the Preliminary Proposal for Simons Pass Pastoral Lease (submission dated 14-07-2017), neither Te Rūnanga or Papatipu Rūnanga were aware of a range of dairy farm conversion activities that had been made to the pastoral lease via discretionary consents, over several years. Considering new information Te Rūnanga did not have available at the time of our submission, we make the following recommendations for the final substantive proposal and designations plans for Simons Pass Pastoral Lease:

1. The area referred to as The Necklace should be retained in Full Crown Ownership and Control to protect the values associated with the area.

2. In order to protect the values associated with The Necklace from runoff and associated effects of farming, grazing restrictions and the removal of irrigation on freehold, or Full Crown Ownership and Control (for better management and access) needs to be applied to the land surrounding The Necklace, specifically the Farm Block Basin. The ephemeral wetlands within the Farm Block are particularly at risk due to the alterations that have either been made to the area or are planned for this area. Although the Farm Block Basin has been modified the values associated with this area are likely to recover if retired from intensive farming practices.

3. Te Rūnanga o Ngāi Tahu seeks an archaeological assessment of Simons Pass pastoral lease. Based on the new knowledge of a taonga find[1] on the lease in the early 1900s (see Appendix 2), the vast cultural history associated with the Lake Pūkaki area and the detrimental effects intensive farming have on archeological sites/material, further assessments are required.

4. Te Rūnanga supports The Department of Conservation in their assessment and technical advice to the Commissioner of Crown Lands, for the development of a substantive proposal, in relation to the protection and future regeneration of native vegetation, flora and fauna within the property of Simons Pass Pastoral Lease.

Te Rūnanga appreciates the Department of Conservation and the Commissioner of Crown Lands for the opportunity to provide this further information.

3.2 Cultural History associated with the Lake Pūkaki Area

Before European settlement, Ngāi Tahu moved around nearly the whole of Te Waipounamu (the South Island) hunting and gathering the island's resources. Movements were according to the seasons following the lifecycles of animals and plants, and the high country was a fundamental element of these systematic seasonal food gathering patterns. Ngāi Tahu undertook seasonal migrations to the high country to gather food resources such as weka, kākāpō, kiore and tuna (eels).

The most treasured of all-natural resources for Ngāi Tahu was pounamu (also known as greenstone, jade or nephrite). The principal deposits of pounamu are in the Taramakau and

[1] This find is not recorded under the New Zealand Archaeological Association and Te Rūnanga was only made aware of its existence after our submission had been made.

Arahura Rivers in Westland, coastal South Westland and the Whakatipu-wai-Maori (Lake Wakatipu) area. Pounamu is not only entrenched in mythology and spirituality but was essential for survival, and was manufactured to make tools such as adzes, chisels and knives, which were essential for daily living. Items of personal adornment were also made from pounamu, such as amulets and hei tiki (human neck pendant), which were also treasured by Ngāi Tahu.

Ngāi Tahu used a comprehensive integral network of trails which ensured the safest journey to the high country and through to Te Tai Poutini (the West Coast) from settlements on the eastern coastline of Te Waipounamu. Trails were from north to south and east to west crossing plains and following rivers, valleys and coastlines. Trails followed food resources which were consumed by travelers on their journeys. This was critical to their survival. These trails were the arteries of economic and social relationships[2].

Trails followed significant food resources, which were critical for survival, and overhanging rock faces provided a night's recovery before the next day's journey. Ngāi Tahu Whānui established settlements, both seasonal and permanent, in strategic positions in the high country, especially around the high-country lakes. Trails were memorized and passed on through careful learning and practice. After generations of walking along these trails Ngāi Tahu developed extensive knowledge of the place-names, stories, food resources, resting places and natural features on the trail.

The Pūkaki region is an area of rich cultural significance to Ngāi Tahu Whānui (see Map One in Appendix 2). For one, it is the final resting place of Aoraki, a tribally significant maunga (mountain) to Ngāi Tahu Whānui. The significance of Aoraki is recognised through a Statutory Acknowledgement granted under the Ngai Tahu Claims Settlement Act 1998 (NTCSA98)[3] which acknowledges Ngāi Tahu's cultural, spiritual, historic and traditional association with Aoraki/Mount Cook. "To Ngāi Tahu, Aoraki represents the most sacred of ancestors, from whom Ngāi Tahu descend and who provides the iwi with its sense of communal identity, solidarity, and purpose. It follows that the ancestor embodied in the mountain remains the physical manifestation of Aoraki, the link between the supernatural and the natural world. The tapu association with Aoraki is a significant dimension of the tribal value and is the source of the power over life and death which the mountain possesses."[4]

Secondly the area was a highly utilised mahinga kai. There are several recorded mahinga kai sites around the lake and area surrounds. These sites would have been utilised by travelling

[2] Brailsford 1984:35.
[3] Schedule 14, Ngāi Tahu Claims Settlement Act 1998.
[4] Schedule 14, Ngāi Tahu Claims Settlement Act 1998.

Māori either passing through, or those coming specifically to the area to gather recourses. In the immediate vicinity to Simons Pass Pastoral Lease are Oma Pū[5], Niho Kiore[6], Punatahu[7], and Te Awa Tangata Minaka[8]. Supporting the recorded history of the Lake Pūkaki area being utilised by Māori are several sites recorded by the New Zealand Archaeological Association (NZAA). Within close approximation to Simons Pass Pastoral Lease are five sites of Māori origin. Two sites record artefacts including three adzes[9] being found, one site records a cave/rock shelter[10], and two sites are recorded as ovens/middens[11] with one of the sites containing a moa bone. (see Map Two in Appendix 2) The significance of the midden with a moa bone is that the Lake Pūkaki area has been recorded as being populated with moa. The Department of Conservation Resources Report for The Wolds Pastoral Lease (June 2004) noted moa bones and gizzard stones being found in a "site at the southern side of a small pond in the triangle of land to the north of the Tekapo Canal"[12]. These finds tie in with the taonga found on Simons Pass Pastoral Lease which is made of a Nelson deposit serpentine utilised by moa-hunter Māori before pounamu was discovered, and the traditions of an ancient village called Rauru established near Simons Pass (Appendix 2). The village would have utilised the abundance of resources in the area for survival.

Further signifying the cultural importance Ngāi Tahu has on the Lake Pūkaki area are the outcomes of the NTCSA98. Under section 206, through a Statutory Acknowledgement[13], the Crown acknowledges Ngāi Tahu's cultural, spiritual, historic and traditional association to Lake Pūkaki. Lake Pūkaki is one of the principle lakes of Te Wai Pounamu dug out by Rakaihautu, the captain of the Uruao waka. "Pūkaki is referred to in Ngāi Tahu tradition as the basin that captures the tears of Aoraki: a reference to the melt waters that flow from Aoraki into the lake in the springtime. As well as its association with Aoraki, Pūkaki is also a mahinga kai, noted particularly for its waterfowl. The tūpuna had considerable knowledge of whakapapa, traditional trails and tauranga waka, places for gathering kai and other taonga, ways in which to use the resources of the lake, the relationship of people with the lake and their dependence on it and tikanga for the proper and sustainable utilisation of resources. All

[5] A mahinga kai located on the Pūkaki River where tuna (eels) and birds were gathered. (Taiaroa 1880:179_58; Beattie (MPC) 1945:22).
[6] A mahinga kai located on the Pūkaki River where tuna (eels) were gathered. (Taiaroa 1880:179_57; Beattie (MPC) 1945:22).
[7] A mahinga kai located at the outlet of Lake Pūkaki where tuna and birds were gathered. (Taiaroa 1880:179_55; Beattie (MLLAF) 1945:15).
[8] A mahinga kai located at the south-east corner of Lake Pūkaki where ārehu (fernroot), pūtakitaki (paradise duck), weka, kōareare, taramea and hinu was gathered. (Taiaroa 1880:180_63; Beattie (MLLAF 1945:14&15).
[9] NZAA H38/5 – artefact find; NZAA H38/6 – artefact find, 3 adzes.
[10] NZAA H38/2 – cave/rock shelter.
[11] NZHH H38/3 – oven; NZAA H38/1 – midden with a moa bone.
[12] Conservation Resources Report, The Wolds, June 2014, Pg 30
[13] Schedule 34, Ngai Tahu Claims Settlement Act 1998.

these values remain important to Ngāi Tahu today”[14].

Nohoanga entitlements were created and granted under the NTCSA98 for the purpose of permitting members of Ngāi Tahu Whānui to occupy temporarily land close to waterways on a non-commercial basis, to have access to waterways for lawful fishing and gathering of other natural resources[15]. The sites granted were based on traditional settlement areas or areas of cultural significance[16]. The Lake Pūkaki nohoanga entitlement recognises the cultural and spiritual association with Aoraki and the use of the wider Pūkaki area as temporary and permanent settlement areas and a major mahinga kai utilised by many.

Although Ngāi Tahu use and occupation has diminished since the land purchases by the Crown in the nineteenth century the Ngāi Tahu spiritual, cultural and historical values are still present in the high country today. The locations of ancient settlements deemed in Ngāi Tahu traditions and stories are still standing, while the ancient place names and whakapapa that is entrenched in the high-country landscape still exist.

The combination of Ngāi Tahu values, such as tribally significant mountains, large flowing rivers, the great inland lakes, pounamu and the trails make the high country a place of significance to Ngāi Tahu. Not only are all these values interlinked but when combined they tell us great stories that forms together a significant part of New Zealand’s history. The descendants of those first people of Te Waipounamu, Waitaha, Ngāti Mamoe and Ngāi Tahu, are seeking to preserve these historical and spiritual sites, and areas of mahinga kai for future generations.

[14] Statutory Acknowledgement for Lake Pūkaki, Schedule 34, Ngai Tahu Claims Settlement Act 1998.
[15] Schedule 256, Ngāi Tahu Claims Settlement Act 1998.
[16] Based on available Crown land at the time.

4. Additional information on SIVs on Simons Pass

4.1 Bio-geomorphological attributes

Lake Pukaki is one of the better-known glacial lakes in New Zealand, lying in what was once the bed of an ice age glacier (Barrell and Read 2014). The last major ice advance of the Pukaki Glaciers and subsequent onset of retreat occurred during New Zealand's late Otiran Glaciation occurring c. 45,000 to 18,000 years ago (cal yr BP) (Barrell and Read 2014, Barrell *et al.* 2011). Simons Pass is the only property in the Mackenzie basin to encompass a complete geomorphological and associated ecological sequence. The sequence occurs along a geomorphic and climatic gradient of water vapor pressure deficits that are part of a larger connected series of glacial landforms within the Mackenzie Basin. Simons Pass straddles a complete sequence of terminal moraines and outwash gravels, thereby giving it regional significance in terms of diversity and pattern, and rarity.

Glacial landforms include ablation (landforms caused by glacial melt) and terminal moraine ridges, moraine dumps and outwash features associated with older (early Otiran) Balmoral moraine and outwash, more recent (late Otiran) Mt John moraine and post-glacial alluvial landforms associated with the Pukaki River (Figures 1 and 2).

Glacial landforms around Lake Pukaki including Simons Pass, are spectacularly well preserved (Barrell and Read 2014, Barrell 2011, Speight, 1963). These landforms are a globally significant paleoclimatic record of glacial fluctuations (Barrell and Read 2014, Kaplan *et al.* 2013, Putnam *et al.* 2010a, b, Schaefer *et al.* 2009, 2006, Porter, 1975). The glacial landforms on Simons Pass comprise approximately 3.7% of the total area of these landforms across the entire Mackenzie Basin.

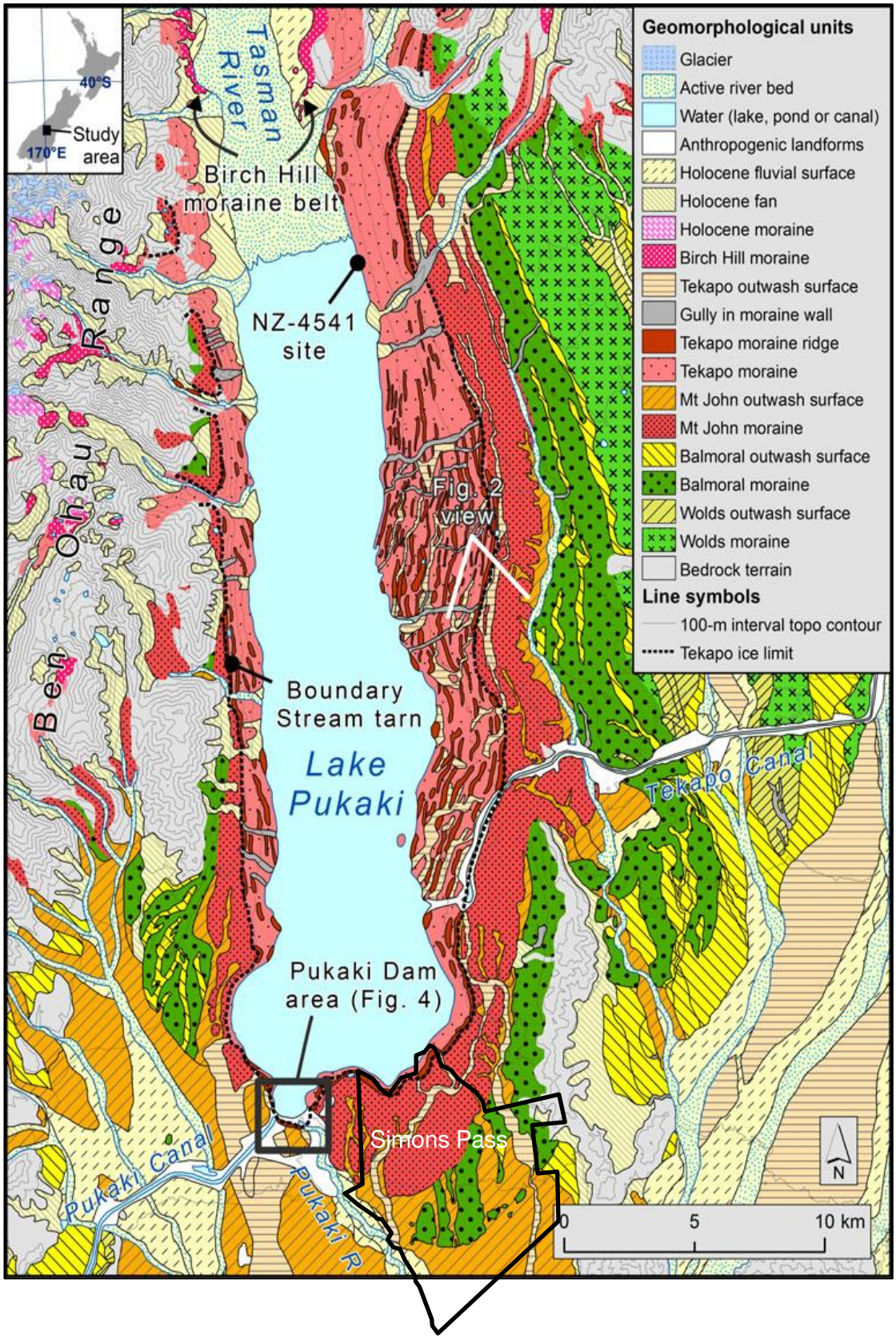

Figure 1. Generalised geomorphological map showing glacial landforms of the Lake Pukaki glacier trough (from Barrell and Read 2014), including those within Simons Pass Pastoral Lease.

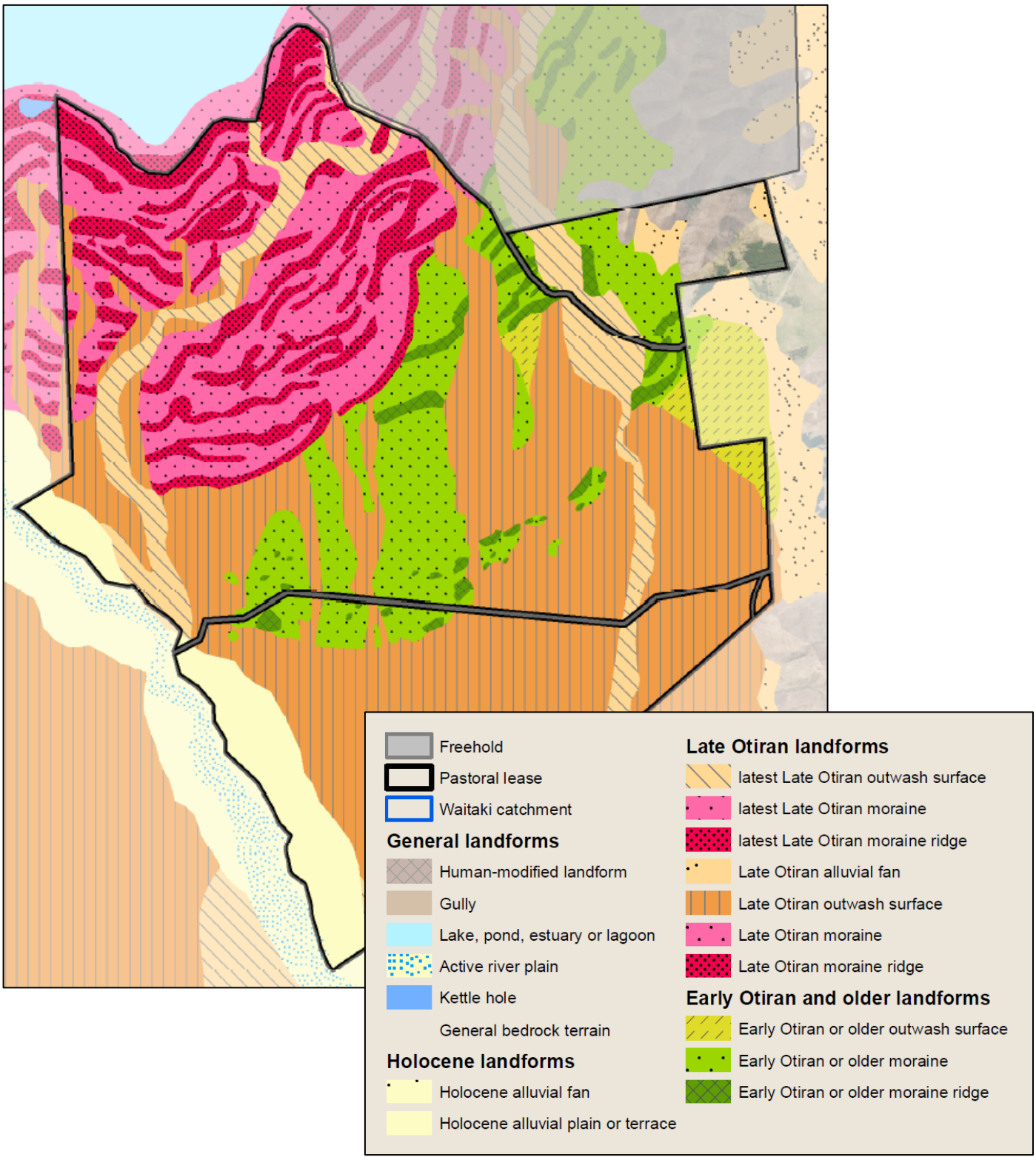

Figure 2. Geomorphological map of Simons Pass Pastoral Lease (adapted from DOC, 2018).

4.2 Uncommon ecosystems

The first comprehensive assessment of botanical significance arose through the Protected Natural Areas Survey Programme (PNAP) which surveyed the Mackenzie Ecological Region in the 1980s (Espie *et al.* 1984). The northernmost part of Simons Pass is located within the Tekapo Ecological District, while the southern part lies within the Pukaki Ecological District. Only one Recommended Area for Protection (RAP) partially occurs on the Lease. This is RAP 6: Southern Lake Pukaki Scrub, a 340-hectare area of shrubland on the Pukaki terminal moraine, much of which is already protected within the adjacent Lake Pukaki Terminal Moraine Conservation Area.

However, the Mackenzie PNAP survey was regarded as a pilot, being the first survey undertaken in the programme. As a result, its recommendations were generally conservative and excluded many high values that justified recognition and protection.

Subsequent ecological research has further established the uniqueness and importance of the Mackenzie Basin's distinctive ecological character and as a stronghold for naturally rare glacial derived dryland ecosystems and species which are not replicated to such an extent elsewhere in New Zealand (Williams *et al.* 2007). In an assessment of threat status of New Zealand's naturally rare ecosystems (Holdaway *et al.* 2012), a large proportion of the Mackenzie Basin comprises naturally rare ecosystems. Those represented on Simons Pass are inland outwash gravels (critically endangered), ephemeral wetlands (critically endangered) and moraines (vulnerable) (Holdaway, *et al.* 2012) (Figure 3).

Most of Simons Pass lies on the intermontane basin floor (415 m - 600 m a.s.l.), with a small portion extending up the foot slopes of Mary Range, to 680 m a.s.l. Despite this narrow attitudinal range, there is a nationally significant ecological gradient that reflects the complete geomorphic sequence of moraines of different ages through to dry outwash surfaces.

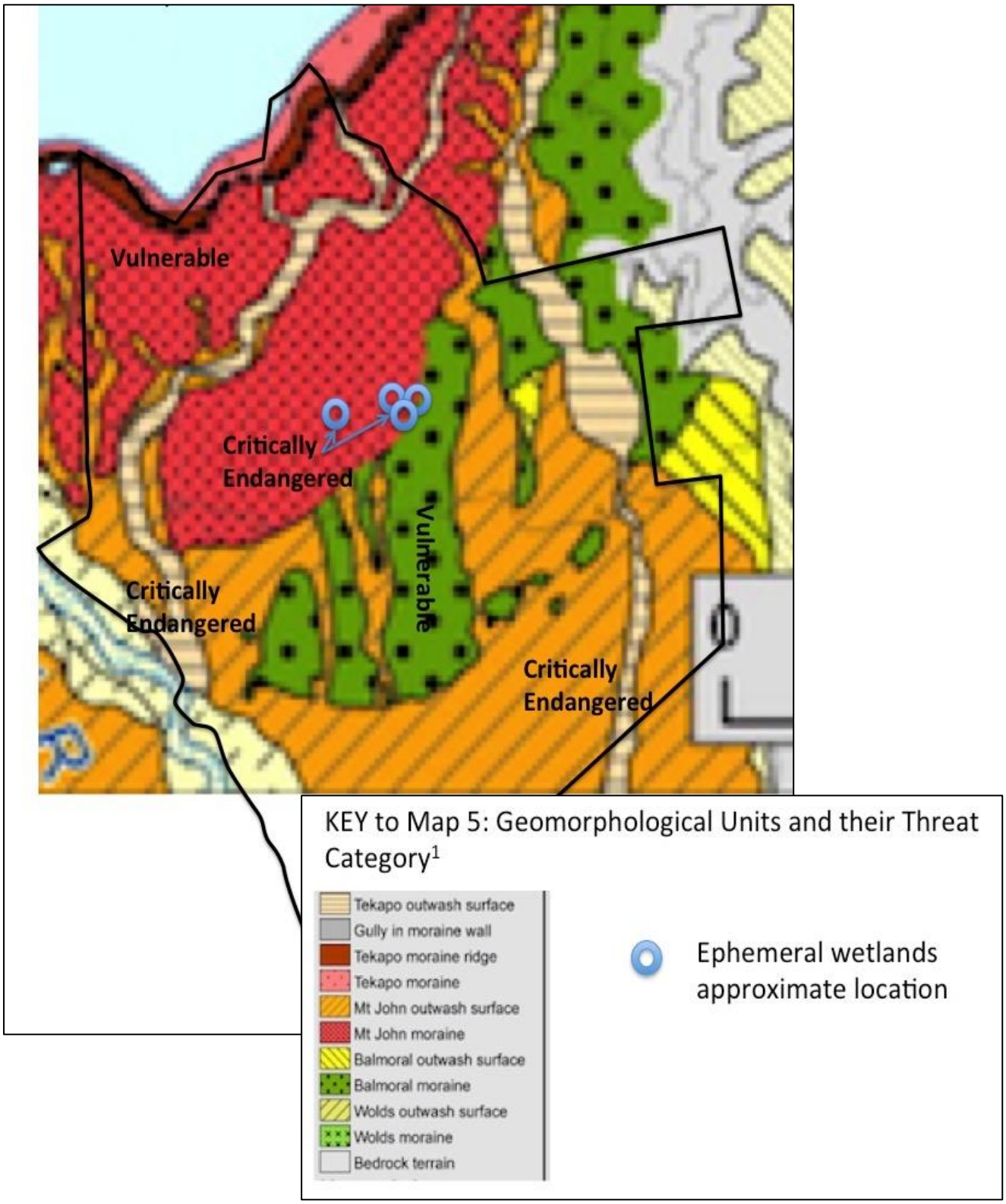

Figure 3. Geomorphological units on Simons Pass and their threat categories from Holdaway, *et al.* 2012 (adapted from Barrell and Read, 2014), being inland outwash gravels (critically endangered), ephemeral wetlands (critically endangered) and moraines (vulnerable).

4.3 Landscape

4.3.1 Landscape SIVs

The CRR and Landscape SIV map (Appendix 1) recognised that the majority of Simons Pass has iconic high county landscape or scenery. The Mackenzie Basin as a whole is a generally recognised 'iconic' landscape. The significant areas of Simons Pass contain key elements that contribute fundamentally to the special landscape character of the Mackenzie Basin - rolling moraine terrain, large well-defined meltwater channels, outwash plains, dry river terraces and scarps. The homogenous low tussock grassland cover, even though degraded and full of exotic species is characteristic, imparting the distinctive sense of large scale, openness and naturalness. Native species, including tussocks and native shrublands, contribute to the overall value of these elements. In particular, the 'pass' is a transitional area, a distinct and memorable place.

The CRR noted that important components of landscape integrity and distinctive character is the continuum of the glacial landscape and linkages between the moraines and outwash surfaces enclosing Lake Pukaki beyond the Simons Pass boundary (refer Figure 1). The CRR also noted that the natural open grassland and shrubland setting are important landscape elements, as is the clarity of their inter-relationships with other landforms. The significant landscapes on Simons Pass were noted as having a high degree of naturalness, coherence and legibility.

4.3.2 Effects of farm development on landscape character

The CRR noted the following common threats to the landscape character of different landscape units identified on Simons Pass

- Cultivation/vegetation removal on the easier rolling terrain would result in permanent loss of tussock and shrub cover and would greatly reduce natural character. Small landforms could also be destroyed.
- Pastoral intensification would result in the greening of the land, loss of tussocks and shrubland species, making the area feel less remote and natural, and more domesticated. The meltwater channels and areas west of the main channel are most threatened.
- Sub-divisional fencing and tracking would result in the visual fragmentation of the landscape over the whole unit.
- Oversowing and topdressing will interfere with natural vegetation patterns of some of the smaller more subtle landforms, thereby homogenising these subtle patterns.
- Grazing has an adverse effect on the tarns and wetland areas.
- The development of areas within the visual corridor would significantly detract from the

landscape appreciation experience. The naturalness of the area is also important for the historic rabbit fence setting.

The adverse effects to landscape SIVs described above have occurred to varying degree across property as a result of farm development, as shown in photos in Appendix 5.

4.4 Vegetation

4.4.1 Description and effects of farm development

For a full description of vegetation on Simons Pass, refer to the CRR (2008). The CRR identified botanical SIVs being present over most of the property (refer to SIV maps linked in Appendix 1), i.e. all the recent Pukaki terminal moraine, the Pukaki River terraces, outwash channels, and some of the outwash plain. SIVs include shrubland communities, fescue tussock grassland communities, ephemeral wetlands, and extensive herbfield-loamfield communities over outwash surfaces that provide habitat to many threatened and rare species.

For a full description of vegetation present on Simons Pass in February 2019, refer to the vegetation description and flora list in Appendix 4 (Wardle 2019). To assist in the description of vegetation, the property has been divided into seven 'Vegetation Units':

1. Pukaki terminal moraine and western outwash surface, proposed as CA1 in the Preliminary Proposal (PP).
2. Pukaki River lower river terraces
3. SH8 northern corridor
4. Foot slopes of Mary Range and associated terrace and outwash channel
5. High central moraines and Farm Block (referred to by the Simons Pass lessee as 'Node A')
6. East and immediately south of Farm Block– Old moraines and moist outwash surfaces. Much of this area is a portion of an area referred to as 'Dryland Recovery Area (DRA)' in Environment Canterbury irrigation resource consent CRC082311
7. Southern Dry Outwash Plain including an area referred to by the lessee as 'Node C'

The seven Vegetation Units are shown on the map in Figure 4. Farm development mostly coincides with proposed pivot irrigator footprints that have also been numbered and shown on the map in Figure 4.

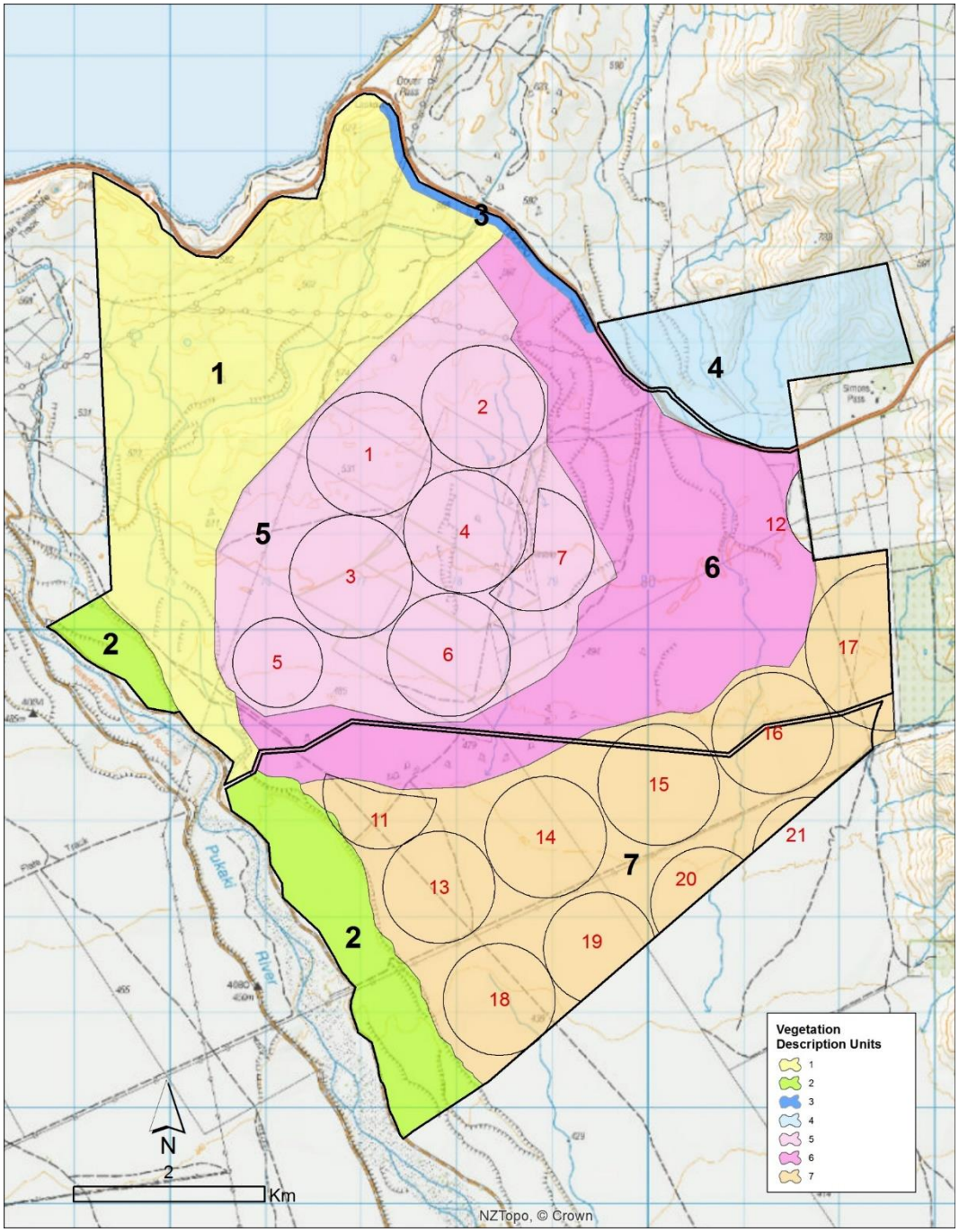

Figure 4. Units (areas) of vegetation, numbered 1-7 and proposed pivot irrigator footprints numbered (in red) (refer previous page for explanation) used to assist in the description of vegetation in this report.

The survey undertaken in February 2019 confirmed that vegetation cover has changed as a result of farm development (detail in Table 1) since the surveys for the CRR. According to the lessee's representative (20 February 2019) the areas under the proposed pivot footprints and beyond have been sprayed with herbicide. The pivot areas were subsequently topdressed and oversown, aerially and mechanically drilled with rye corn and triticale (arid tolerant crops), followed up in late December 2018/ early January 2019 with a second rotation of turnips

and/or pasture grasses and clovers over some areas. The lower altitude deeper soils at the eastern side of the Lease have been cultivated, direct drilled, or have been over-sown and top-dressed and irrigated with pivots to support exotic permanent pasture species. The central Farm Block, located over deep and more fertile soils, has also been the focus of farm development.

Native vegetation left remaining on Simons Pass comprises extensive areas of herbfield-loamfields, fescue tussock (*Festuca novae-zealandiae*) grasslands, small-leaved shrublands, and scattered ephemeral wetlands.

Table 1: Changes in vegetation cover on Simons Pass after farm development 2019 (Wardle, 2019)

Location	Activity[17]	Resultant Change
Dry Outwash Surface at South of Lease		
South east corner of Lease: 'Node C'	Construction of milking shed, farm buildings, effluent ponds, tracks, roads, pipe trenching	Area previously identified as having SIVs (2006) - loss of known habitat for dryland biodiversity including *Lepidium solandri*
Pivot Areas, numbered 17 and 21	Conversion of dryland herbfield-loamfield to permanent pasture. Being pivot irrigated	Much of area previously identified as having SIVs (2006) - loss of dryland herbfield-loamfield community and associated threatened and declining plant species
Between Pivots 12 and 17	Pivots 12 and 17 appear to have sprayed water into an unfenced area of depression.	Area previously identified as having SIVs (2006) – seasonally wet habitat of a threatened Spring annual - NZ mousetail - is being converted into a permanently wet area with exotic grasses and nutrient enrichment. Associated fescue tussockland has more exotic grass cover.
Pivot Area 16	Conversion to permanent pasture	Area previously identified as having SIVs (2006) - Loss of dryland herbfield-loamfield community and associated threatened & declining species
Pivot Areas 15, 20	Dryland ryecorn	Parts of Pivot Areas 15, 18 and 20 previously identified as having SIVs (2006). Herbfield-loamfield converted to dryland crop. Scattered native species persist.
Pivot Areas 13-14; 18-19	Cultivated; dryland triticale sown	

[17] Types and dates of development were observed and advised by a representative of the lessee of Simons Pass, 21 February 2019.

Farm Block		
Pivot Area 5	Sprayed and direct drilled with ryecorn (January 20019)	Area previously identified as having SIVs (2006) - Reduction in native species cover
Pivot Area 3	Direct drilled with ryecorn	Parts of these areas previously identified as SIVs (fescue tussockland) in 2006.
Pivot Areas 1 & 2	Sprayed and direct drilled with dryland ryecorn; second rotation of turnips and grass (Jan 2019)	

4.4.2 Areas retaining botanical SIVs

Notwithstanding farm development that has occurred since 2008, extensive botanical SIVs persist across Simons Pass, as shown on the map in Figure 5.

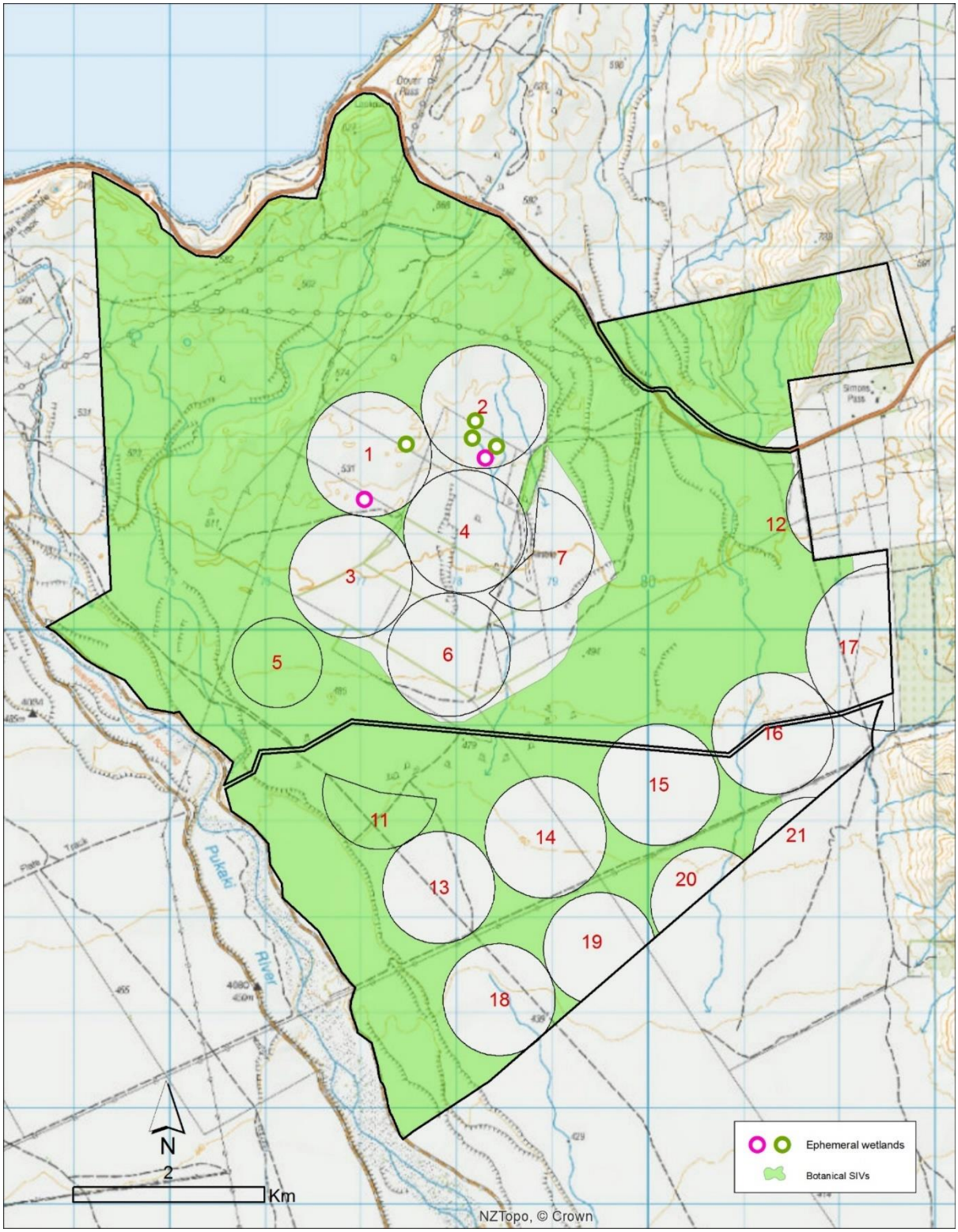

Figure 5. Botanical SIVs identified in February 2019. The locations of the ephemeral wetlands are approximate; Pink denotes wetlands where botanical values are unconfirmed but that contain possible spring annual habitat.

Botanical SIVs are present across a large part of Pukaki terminal moraine and western outwash surfaces (Vegetation Unit 1 – proposed CA1 in the PP), the Pukaki River low river terraces (Vegetation Unit 2), the SH8 corridor (Vegetation Unit 3) and moist outwash surfaces some of the older moraines (Vegetation Unit 6).

Botanical SIVs are also retained in partially- and non-developed areas of terraces and foot-slopes of Mary Range (Vegetation Unit 4), high central moraines and Farm Block basin (Vegetation Unit 5) and Southern Dry Outwash Plain (Vegetation Unit 7).

As shown in Table 1, farm development has been concentrated on the high central moraines, the Farm Block and southern dry outwash plain including an area referred to by the lessee as 'Node C' (i.e. Vegetation Units 5 and 7). Notwithstanding this, these units retain fragmented areas of botanical SIVs, being undeveloped native herbfield-loamfield and shrubland communities that persist at the periphery of the pivot areas and in the inter-pivot zones. These fragments provide habitat for four Threatened and ten At Risk plant species and act as a native seed source for regeneration.

At least four ephemeral tarns are located on the high central moraines within proposed pivots numbered 1 and 2 and support native turf communities, characteristic of seasonally wet wetlands and included one At Risk-Naturally Uncommon herb- *Montia angustifolia*. These ephemeral tarns would be suitable habitat for threatened spring annual plants, particularly the New Zealand mousetail (*Myosurus minimus* subsp. *minimus*), although their presence would require confirmation during spring months.

The original CRR survey (DOC 2007) recorded 18 plant species classified as Threatened or At Risk. The revision of New Zealand's threatened species undertaken by de Lange *et al.* (2017) has classified species' threat status by aligning the likelihood of their extinction to the rarity of and threats to their habitat. The rarity and threat to the Mackenzie's ecosystems and the distinctiveness of associated dryland biodiversity means the Mackenzie Basin has emerged as the national stronghold for a disproportionate number of New Zealand's rare and threatened plant species. Simons Pass now provides habitat for 31 threatened and declining plant species (Table 2). The protection of the habitats for Threatened and At Risk species is essential to halt the decline of New Zealand biota (Ministry for the Environment (MfE) 2007, MfE 2005) which emphasizes the importance of protecting these ecosystems on Simons Pass.

The dry outwash gravel ecosystem is of particular national significance due to the fact that it supports a disproportionate number of threatened and declining plant species, not only within the Mackenzie Basin, but also within Simons Pass - over 66% of Threatened and At Risk species recorded on the property, occur on the outwash gravels. According to Walker (2017a)

this ecosystem to be the ecologically and biologically distinctive because it and the biota it supports is found nowhere else and are under great threat from clearance and loss and are the last remaining examples of the evolutionary response of native biota to protracted arid conditions in New Zealand. The presence of the non-threatened prostrate kowhai (*Sophora prostrata*) on Simons Pass is also notable as it occurs almost at its southern distributional limit, while the herb *Montia erythrophylla* (At Risk – Naturally Uncommon) is at its western distributional limit.

Table 2: Threatened and At Risk plant species on Simons Pass Pastoral Lease (Wardle 2019)

Threat Category	Species	Common Name	Location on Lease (year recorded in brackets)
Threatened			
Nationally Critical	*Ceratocephala pungens*		Gentle depressions on old terminal moraine surfaces of eastern outwash plain utilised as sheep/rabbit camps (2006).
	Lepidium solandri	NZ Cress	On bouldery phases of outwash plain including terrace risers; edge of Pukaki River escarpment (2006, 2018, 2019).
Nationally Vulnerable	*Carmichaelia nana*	Mat broom	Edge of escarpment - Pukaki River terraces (2018)
	Convolvulus verecundus	Trailing bindweed	Bouldery interfluve and stony outwash plain surface on eastern and western outwash plain (2006, 2018, 2019).
	Myosotis brevis (previously named *Myosotis pygmaea* var. *minutiflora)*	Tiny Forget-me-not	Ephemeral wetland meltwater channel at foot of Mary Range (2006)
	Myosurus minimus subsp. minimus	NZ Mousetail	Ephemeral wetland depressions at foot of Mary Range (2006); in ephemeral depression in outwash channel at eastern side of Lease (2018). Historcally present in manmade depression in corner of eastern outwash plain beside what is now irrigated Pivots 12 and 17 (2006)
	Muehlenbeckia ephedroides		Pukaki River terraces (2018)
	Pimelea serico-villosa subsp. *pulvinaris*	Cushion daphne	Pukaki River terraces, outwash plain (2006, 2018, 2019)
	Raoulia monroi	Mat broom	Bouldery interfluves – eastern and western outwash plain (not recorded since 2006 but habitat still present at eastern outwash plan site.

At Risk			
Declining	*Acaena buchananii*	Buchanan's bidibid	Short tussockland of hummocky and gently sloping moraines (2006, 2019), and associated with *Ceratocephala pungens* sheep camp habitat on old glacial surfaces (2006)
	Aciphylla subflabulata	Swamp speargrass	Foothills of Mary Range, in short tussockland and at shrubland margins (2006, 2018).
	Anthosachne falcis	Bluewheat grass	On bouldery moraines; old glacial surfaces present on outwash plain.
	Carex kaloides	Sedge	Upper tarn margins-Pukaki terminal moraine (2006)
	Carmichaelia crassicaule subsp. *crassicaule*	Coral broom	Short tussockland and tussockland/ shrubland on moraine ridge west of Farm Block (2019); within SH8 road strip (2006).
	Carmichaelia petriei	Desert broom	SH8 road corridor 2006); shrublands on moraines in Terminal Moraine block and Farm Block (2006, 2019); Marys Range foothills, outwash channel and terraces (2006, 2018, 2019)
	Carmichaelia vexillata	Mat broom	Outwash channel, north of SH8; moraine ridge near Trig TT (2006).
	Colobanthus brevisepalus	Pin cushion	Stony sites on dry outwash plain (2018).
	Coprosma intertexta	Shrub	Shrublands throughout property including on Mary Range footslopes, terminal moraine, moraine ridges further south, and shrublands on terrace risers near Pukaki River (2006, 2018, 2019)
	Coprosma virescens	Shrub	Shrublands on Pukaki Terminal Moraine (2006).
	Discaria toumatou	Matagouri	Scattered across Lease: component of relictual shrublands growing on Pukaki terminal Moraine, on moraine ridges in Farm Block; outwash channels, Pukaki River Terraces and Mary Range footslopes (2006, 2018, 2019).
	Hypericum involutum	Grassland hypericum	On moraine ridge and moraine necklace, east of Farm Block (2018).
	Leptinella serrulata	Button daisy	Sheep/rabbit camps in short tussockland on moraine surfaces; bouldery interfluves of eastern outwash plain (2006).
	Leucopogon nanum	Mat broom	Dry stony outwash surfaces (2006, 2018).
	Luzula celata	Wood-sedge	Damp turfland margin of kettlehole ephemeral wetland in hummocky moraines (2006).
	Luzula ulophylla	Wood-sedge	Pukaki River Terraces, outwash channel in Mary Block, stony parts of outwash plain e.g. SW of moraine necklace (2018, 2019)
	Pterostylis tristis	Orchid	Depleted short tussockland of hummocky moraines, and eastern outwash plain (2006)

	Raoulia australis	Scabweed	Scattered across Lease, mainly in open areas e.g. outwash channel, outwash plain, Pukaki River Terraces (2006, 2018, 2019)
	Raoulia beauverdii	Beauverd's mat daisy	Scattered throughout outwash plain, and bony areas of terminal moraine, hummocky moraines, low river terraces, and terrace risers (2006, 2018, 2019).
	Raoulia parkii	Celadon mat daisy	Common across outwash plain; also, in open areas of moraines (2006, 2018, 2019)
	Rytidosperma buchananii	Danthonia	On dry outwash surface at S of Lease (2019)
	Rytidosperma exiguum	Grass	On dry rocky outwash surfaces and dry open areas of moraine (2006, 2018, 2019)
Naturally Uncommon	*Epilobium angustum*	Willowherb	Turf margins of ephemeral tarns in terminal moraine (206)
	Montia angustifolia	Herb	Turf margins of ephemeral tarns in terminal moraine (2006) and Farm Block (2019)
	Montia erythrophylla	Herb	Two populations in bare ground associated with outwash channel cutting through hummocky moraine south of SH8 (2006).

Of high significance is the relatively diverse and natural shrubland community of the Pukaki terminal moraine (Vegetation Unit 1 and western periphery of Vegetation Unit 5), as it constitutes a remnant of the original pre-human vegetation cover (Leathwick *et al.* 2003). Part of this shrubland was identified as RAP 6 Southern Lake Pukaki Scrub during the PNA Survey of the Mackenzie Ecological Region (Espie *et al.* 1984). This small RAP (340 ha) was noted for having prostrate kowhai present with desert broom, in a fescue sward. These SIVs are still present and the shrubland community provides habitat for many declining species (*Coprosma intertexta*, *C. virescens*, desert broom, scabweed, Celadon mat daisy). This shrubland extends well beyond the area of proposed CA1 in the PP.

Remnants of lowland shrubland on the foot slopes of Mary Range, on moraine ridges, boulder fields at low terrace risers by Pukaki River, and within the fluvial channel at the eastern side of the property, are also significant. Although this community lacks the structural dominants of the earlier predicted woodland (Leathwick *et al.* 2003) it retains species thought to reflect the understorey composition of such a forest. Restoration of a greater woody component of the native vegetation of intermontane basins, including shrubland communities that were determined by cold-air inversion, edaphic factors, and flooding disturbance during pre-human times, are considered desirable biodiversity conservation outcomes (Walker *et al.* 2003).

The matagouri shrubland-fescue tussockland community located within the strip along SH8 is significant, as pollen samples and soil charcoal suggest mixed grassland and shrubland, dominated by non-*Chionochloa* grasses and small-leaved shrubs would have been present in pre-human times, in parts of the Mackenzie Basin not recently disturbed (McGlone 2001).

The ephemeral wetlands that occupy the high moraines of the Farm Block (Vegetation Unit 5) retain reasonable native species diversity including an At Risk plant species. They are also considered to be suitable habitat for the Threatened Spring annual herb, the New Zealand mousetail. This distinctive class of wetland is found in closed depressions lacking a surface outlet, in climates where seasonal variation in rainfall and evaporation leads to ponding in winter and spring, and with fluctuation so pronounced that it can lead to complete drying in summer months or in dry years. When surveyed in 2007 and again in 2019, it was noted that some ephemeral tarn depressions had been severely modified and disturbed. Those tarns viewed in February 2019 had surface water ponding and recently exposed margins were dominated by native turf community species. Vegetation surrounding the tarns is mostly dominated by pastoral grasses or rye corn. The recently exposed shallow mud floor of at least one tarn within the Farm Block has recently been direct drilled with ryecorn. As already noted, ephemeral wetlands are critically endangered ecosystems.

Native species diversity on Simons Pass is high. 69% of the 185 vascular plant species recorded on the property are indigenous, and there is an additional suite of native moss and lichen species, of which only 5 were identified. Moss and lichens appear to play a significant role in the recovery of dryland environments elsewhere in the Mackenzie Basin (e.g. at Tekapo Scientific Reserve- Walker pers. comm.). This high native species diversity reflects the diversity of ecosystems present, but it is particularly high on the outwash surfaces.

4.5 Fauna and fauna habitat

The CRR and SIV maps (Appendix 1) provide a comprehensive description of birds, lizards, invertebrates and aquatic fauna and extent of fauna SIVs on Simons Pass. Areas identified as supporting significant lizard and aquatic fauna values have largely been unaffected by farm development, which has largely occurred elsewhere on the property. Farm development has been focused in areas identified as supporting invertebrate and bird fauna SIVs, on the high central moraines, the Farm Block and southern dry outwash plain (Vegetation Units 5 and 7).

4.5.1 Effects of farm development on Invertebrate SIVs

In regard to the effect of farm development on invertebrate SIVs, the effect of sowing the first rotation of crop probably had a minor effect on the invertebrates since it represents a single disturbance event (Chinn, 2019). Throughout the growing season however, crop growth is likely to shade out suitable habitat - an undesirable state for many indigenous invertebrates. Herbicide use has eliminated most of the native vegetation in affected areas which support various native invertebrates particularly moths, butterflies, beetles and hover flies. The cumulative effect of repeated annual drilling, sowing, possible burning and irrigation will

eventually eliminate the extant suite of indigenous invertebrates at the locations shown. Trap door and tunnelling spiders will almost certainly be lost as disc depths are deeper than the animal's burrows.

In places where habitat is a little more diverse, i.e. where patches of fescue tussock, scattered shrublands and slightly more shade and channelling (particularly the old glacial outwash channels), the effect of farm development is a subtle shift in the suite of invertebrates found in the area. To that extent, sowing and irrigation will have additional negative effects on the invertebrate communities at those locations, perhaps even localised extinctions.

In most cases, the disturbance on the outwash surface is localised and the invertebrate communities are likely to persist adjacent to and beyond, the modified areas. Nevertheless, with time the above-described impacts will be cumulative, and the populations of endemic species will reduce. The cumulative effects of land use change on Simons Pass, by modifying the semi-arid surfaces to one with a high moisture and energy regime (via irrigation), could drive local endemic invertebrate species to localized extinctions, perhaps to extinctions at a landscape scale. The reason for this is due to a physiological shift beyond the tolerances of the invertebrates already adapted to semi-arid loess surfaces. Irrigation specifically, is equivalent to a wetter climate, in which most of the species cannot survive, e.g. dryland soil invertebrates will drown.

Ecological replacement comes with habitat change or loss. Entire invertebrate communities can be replaced by new guilds of water tolerant species. This is a well-recognised effect and is often promoted as a case of increased biodiversity (including native species). While this may be true certain circumstances (e.g. the native grass grub has achieved pest status in exotic pasture), it is the reduction of endemism that is the greatest adverse impact, not an increase of species diversity, since the latter represents homogenisation of biodiversity at the regional (and wider) scales. A key point of conservation biology is the retention of community diversity, not an increase in biomass.

The Canterbury Plains are the best example of complete extirpation (local extinction) of native invertebrates; it is almost impossible to find any native species present today in areas developed for intensive farming and once known for native moths, grasshoppers, beetles and others. A very similar scenario is unfolding in today's Mackenzie Basin and protection of the few remaining yet extensive habitats (like the Simons Pass outwash surface) will provide some ecological insurance as dryland habitats are replaced through farm development (Chinn, 2019).

4.5.2 Effects of farm development on bird SIVs

The likely impacts of farm development on bird species is likely to be variable, depending on the species. Widespread scrub removal will result in a reduction in numbers or loss of non-threatened grey warbler/ riroriro and silvereye/ tauhou from the property, as these species typically utilise woody vegetation for habitat, nesting and feeding.

The southern outwash plain is notable habitat for ground-nesting banded dotterel/ tūturiwhatu (Nationally Vulnerable) and black fronted tern/ tarapirohe (Nationally Endangered) seen flying over this area, feeding on insects and lizards as they went.

In the Mackenzie, banded dotterels breed on riverbeds and gravels and soils with minimal vegetation, such as those occurring on the southern outwash plains of Simons Pass. Banded dotterel pairs are solitary and territorial, but there can be high concentrations of birds in suitable habitat. Birds begin to arrive on the breeding grounds and set up territories in July to August. First eggs are laid in August to early November, in shallow scrapes in open gravels, sand or soil, usually lined with tiny stones. During winter, after chicks have fledged, dotterels will migrate to Australia or coastal estuaries elsewhere in the South Island. An increase in the cover abundance and stature of vegetation on outwash surfaces, e.g. through rotation of tall crops, such as ryecorn or permanent pasture is likely to mean a reduction in open gravelly nesting habitat, available for breeding banded dotterels. Tall vegetation can also provide cover for predators, such as stoats and cats (Robertson, 2012).

Two reports by Robertson *et al.* (1983) on the Waitaki and Ahuriri Rivers contain in-depth discussion on feeding preferences for black fronted terns. This species is known to forage extensively over tussock grassland and shrub areas, especially when nearby rivers are in flood (e.g. O'Donnell and Hoare 2009). For example, O'Donnell and Hoare (2009) showed that terns made extensive use of valley floor native grasslands adjacent to waterbodies for feeding on skinks and this behaviour has been observed elsewhere. However, conversion of native grassland and shrubland to exotic pasture or crops is unlikely to have a significant impact on black fronted terns, as this species has also regularly been observed feeding over farmland under pasture or crops (Bell, 2013).

4.6 Ecological Functioning SIVs

4.6.1 Ecological Functioning - Explanation

Ecosystem functioning is defined as "*the joint effects of all processes (fluxes of energy and matter) that sustain an ecosystem*" over time and space through biological activities (Naeem and Wright, 2003; Reiss *et al.*, 2009, as cited in Truchy, *et al.*, 2015).

In its definition of 'intrinsic values', Section 2 of the Resource Management Act 1991 (RMA) states that *"those aspects of ecosystems and their constituent parts which have value in their own right, including (a) their biological and genetic diversity, and, (b) the essential characteristics that determine an ecosystem's integrity, form, functioning, and resilience."* This provision complements the objective in section 5(2)(b) of the RMA of safeguarding the life-supporting capacity of ecosystems. Therefore, both abiotic and biotic component parts of an ecosystem are essential characteristics that determine an ecosystem's integrity, form, functioning, and resilience.

Protection of large interconnected areas over representative biodiversity and ecosystems aligns with the requirement to provide for the ecological sustainability of SIVs as an object of the Crown Pastoral Land Act (CPLA) and for good reserve design generally (Margules & Pressey, 2000). Moreover, protection of low lying under-represented ecosystems is a national priority generally.

4.6.2 Areas of Ecological Functioning on Simons Pass

For the purposes of describing ecological functioning on Simons Pass, the property is divided into three Zones; Zone A, B and C, shown on the map in Figure 6.

This property is of national importance for its full sequence of internationally threatened ecosystems present along a gradient of glacial landforms and climate; and its large array of threatened and declining flora and fauna. Notwithstanding the changes to vegetation that have occurred as a result of farm development, ecological functioning SIVs encompass virtually the whole property (Figure 6).

The almost full glacial landform sequence of connected ecosystems, and indigenous vegetation along a marked climatic, environmental and biological gradient, is of particular significance, as this is now only one of two such sequences of indigenous vegetation remaining nationally (Walker 2017a).

Remaining areas supporting botanical SIVs (primarily in Zone A) include many threatened plant species. Their survival is dependent on the preservation of the full sequence of

ecosystems, habitats and landforms to provide resilience in the face of climate change. Protection of the complete sequence would be important for the long-term persistence of indigenous flora and fauna, especially in the face of climate change, where species' survival will be dependent on their ability to migrate along the gradient between Zones A to C.

Areas that have been modified by farm development (herbicide spraying, over sowing, topdressing and direct drilling, but not irrigated) have low botanical SIVs, however they still retain highly significant ecological functioning values. These areas, which include the south and western parts of the high central moraine and Farm Block (Zone B) and the western side of dry outwash (Zone C) are central to ecological connectivity of the whole geomorphic sequence of moraines of different ages and ecological characteristics. They also provide essential buffering for adjacent areas with botanical SIVs (Zone A) from the effects of farm activities.

If areas that have been dry-cropped (in Zones B and C) are left fallow and unirrigated it is likely that indigenous vegetation will regenerate naturally, albeit at a slow rate, eventually to regain dominance in the landscape. These areas are key to protecting a continuous western corridor of natural ecosystems from the terminal moraine to outwash surfaces and river terraces, which is necessary for threatened species to survive and respond to climate change.

Given the importance of these areas, ecological restoration efforts could also be considered in appropriate areas such as in the Farm Block (Wardle, pers. comm.). The use of direct drilling machinery for establishment of fescue tussock, blue tussock and bluewheat grass across outwash and moraine surfaces has been tested at nearby Tekapo Scientific Reserve[18] , while a Burford Tree seeder drilling machine has been successfully tested by DOC in Central Otago[19] for the establishment of native shrub species and may be applicable for the reestablishment of sub-shrubs and shrubs.

[18] Espie, P.R.,1997.Tekapo Scientific Reserve : ecological restoration.Conservation Advisory Science Notes No. 149,Department of Conservation, Wellington.

[19] https://blog.doc.govt.nz/2018/04/13/planting-by-machine/

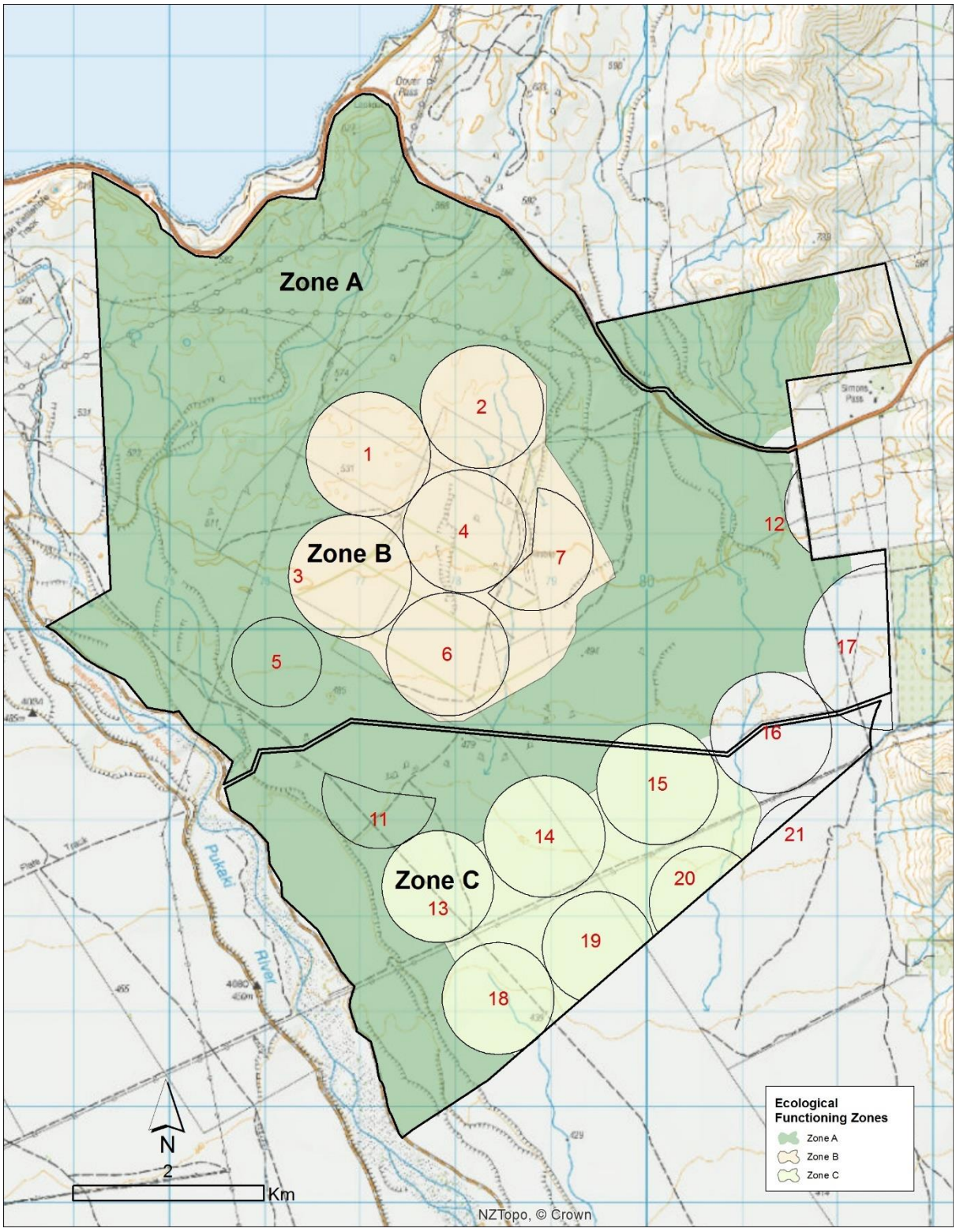

Figure 6. Ecological functioning 'zones' for the purposes of this report

Zone A

Zone A contains the least developed parts of the Lease including:

- Pukaki Terminal Moraine & Outwash channel
- Fescue tussock grasslands and shrublands associated with the high central moraine west of Farm Block Pivot Areas
- Moist Outwash channel that starts north of SH8 and continues south
- Terrace & Foothills of Mary Range
- Moraine Necklace
- Pukaki River low terraces
- Dry Outwash Surface- small parts that retain botanical SIVs and contiguous with the Pukaki River terraces and Moraine Necklace.

Zone A (in conjunction with Zone B and C) comprises an almost full glacial landform sequence of connected naturally uncommon ecosystems, indigenous vegetation along a marked climatic, environmental and biological gradient, found on the Lease. This sequence is of particular significance, as there is now only one of two such sequences of indigenous vegetation remaining nationally (Walker 2017a). This makes this sequence extremely important for the long-term persistence of indigenous flora and fauna, especially in the face of climate change, and substantially increases the overall significance of these values. Zone A supports many threatened and declining plant species; acutely and chronically threatened land environments; and an important ecotone at the moraine/outwash boundary. These are significant botanical and ecological values

Zone A by itself provides an incomplete sequence of threatened naturally uncommon ecosystems. It does not include the critically endangered dry outwash gravel ecosystem that is present in Zone B and Zone C and which supports more threatened species than the moist outwash surface in Zone A.

Zone B

Zone B comprises the high central moraines and Farm Block and is entirely surrounded by Zone A. It is predominantly comprised of moraine surfaces with a limited area of moraine dumps and moist outwash to the east. This Zone is part of a connected ecologically significant sequence but has been modified through dryland cropping establishment. It has scattered native biodiversity at the margins of proposed pivot areas where farm development has been concentrated.

Zone B supports the following SIVs:

- Naturally uncommon ecosystems that include nationally vulnerable moraines of the intermediate (Mt John Advance) and older (Balmoral Advance) age; and critically endangered ephemeral wetlands (kettleholes) that provide habitat to dominantly native

plant species, including an At Risk species

- Fragmented remnants of vegetation communities that would have once been more widespread immediately prior to human arrival (fescue tussock grassland and shrublands)
- Declining plant species (matagouri, desert broom, scabweed, *Rytidosperma exiguum, Anthosachne falcis*)
- Significant ecological functioning values. Zone B, in conjunction with Zone A and C, represents an almost complete sequence of ecosystems that are predominantly underpinned by glacial landforms, being different aged vulnerable moraine and outwash ecosystems.
- The value of much of Zone B is in terms ecological functioning of adjacent areas with high botanical SIVs (Zone A) that require connectivity, as well as buffering from the significant effects of intensively farmed land (refer s.5 Threats for discussion).
- Indigenous vegetation in developed areas has potential to recover naturally through the slow process of native regeneration from seed retained in the seedbank and from nearby seed sources. Active restoration effort could also be considered.

Zone C

Zone C entirely comprises of outwash gravel surfaces at the southern end of Simons Pass. This Zone is part of the important connected sequence present on the property but has been modified through dryland cropping establishment within the proposed pivot areas. The extent of farm development is least to the west; increasing eastwards towards Farm 'Node C' where the dairy farm buildings and irrigated pasture have been established. Native plant diversity is concentrated in the undeveloped inter-pivot areas. Zone C adjoins Zone A to the west and north.

Zone C supports the following SIVs:

- Entirely comprised of naturally uncommon ecosystem- inland outwash gravels that have the highest threat category of Critically Endangered (Holdaway, *et al.* 2012).
- Is an important and key part of the connected sequence of threatened ecosystems found across the entire property.
- Provides habitat for Threatened plant species including *Lepidium solandri*, *Convolvulus verecundus, Pimelea serico-villosa* subsp. *pulvinaris, Raoulia monroi*, and many declining plant species, recorded in inter-pivot areas. The outwash surface supports a disproportionate number of threatened and at risk plant species compared with other ecosystems present on the Lease
- This area supports significant bird and invertebrate fauna (see SIV maps in Appendix 1),

including Threatened and regionally significant species, and their habitats.

- Remnants of pre-human vegetation (shrubland dominated by matagouri) persists along the ephemeral channel at the eastern side of the zone
- Significant ecological functioning values. Zone C (in conjunction with Zone A and B) represents an almost complete sequence of ecosystems that are predominantly underpinned by glacial landforms, being different aged vulnerable moraine and outwash ecosystems.
- While of large areas of the outwash surface have been tilled and sown with ryecorn and triticale causing fragmentation of botanical SIVs, these areas retain importance as parts of the whole sequence. The developed (cropped) areas would revert to habitat suitable for nesting banded dotterel and invertebrate fauna reasonably quickly, if left fallow and unirrigated (Walker 2017b).
- The value of much of Zone C is in terms ecological functioning of adjacent areas with high botanical SIVs (Zone A) that require connectivity, as well as buffering from the significant effects of intensively farmed land (refer s.5 Threats for discussion).
- Indigenous vegetation in developed areas has potential to recover naturally through the slow process of native regeneration from seed retained in the seedbank and from nearby seed sources. Active restoration effort could also be considered.

4.7 Ecosystem Services

Ecosystem services are the non-intrinsic social or economic benefits to people and society provided by functioning indigenous ecosystems. Examples are water and soil conservation, water yield (Ingraham *et. al.* 2008, Waugh 2005, Otago Regional Council 1999), water purification, natural hazard mitigation and carbon storage. These are inherent values, being attributes of the land and its natural resources.

New Zealand's response to global climate change includes reducing greenhouse gas emissions and maximising CO2 storage. Growing plants extract CO2 from the air and store it in their tissues. If tussock grassland and shrubland recovers in the absence of vegetation removal and grazing, the carbon remains sequestered either in the woody parts of plants or in the soil. Tenure review can assist in increasing carbon storage by removing grazing pressure, allowing shrublands to expand, tussock grasslands to increase in stature and promoting indigenous woody species as a component of grasslands. The native vegetation on Simons Pass also makes a significant contribution, in the context of the whole property, to the sequestration of atmospheric carbon. If the land is managed in an ecologically sustainable way, the future benefits from these values to ecosystem services will accrue.

4.8 Extent of SIVs

The full extent of all SIVs, as identified in the CRR (2008), associated SIV maps (Appendix 1) and discussed in this report, are shown Figure 7. SIVs include areas of cultural value to Te Rūnanga o Ngāi Tahu; Bio-geomorphological attributes; Naturally uncommon ecosystems; Landscape; Vegetation, fauna and fauna habitat including Threatened and At Risk species; Ecosystem functioning and Ecosystem services.

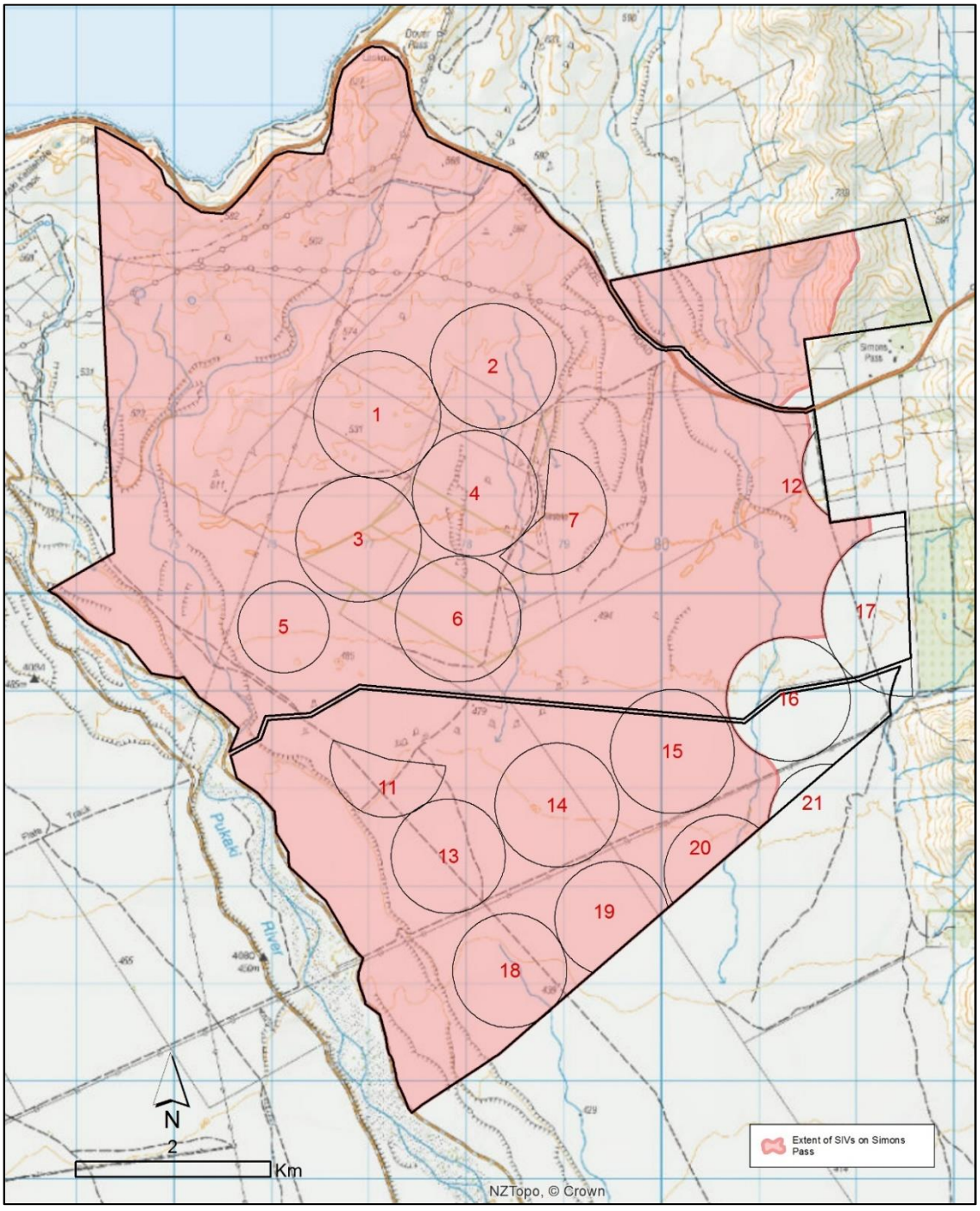

Figure 7. Extent of all SIVs layers on Simons Pass Pastoral Lease

5. Threats to SIVs

5.1 Farm Development

Farm development on Simons Pass has included herbicide spraying, cultivation/ discing, top-dressing, over-sowing and/or direct drilling of seed and possibly limited irrigation. These activities are also referred to as 'pastoral intensification'.

Pastoral intensification can have significant adverse effects on indigenous biodiversity, especially with conversion to irrigated pasture as indigenous vegetation is totally removed. Native habitats such as herbfield, cushionfield and stonefield, tussock grassland and shrubs are replaced with exotic grassland (pasture) or crops. Habitats for Threatened or At Risk plant species and indigenous fauna such as lizards, invertebrates and nesting banded dotterel are altered or destroyed.

The wider ecological effect of pastoral intensification is reduction in the wider extent of the vegetation/habitat for indigenous plant and animal species typical of the Mackenzie Basin, including Threatened and At Risk species. Remaining indigenous vegetation/habitat becomes more fragmented. These smaller, fragmented areas have a higher boundary to area ratio and are therefore more vulnerable to the adverse effects of activities on adjoining land or 'edge effects'. Cumulatively, these effects increase the vulnerability of Threatened and At Risk species. The effects of pastoral intensification are evident on Simons Pass.

5.2 Irrigation

Sprinkler irrigation, as one of the technologies to increase crop production and water use efficiency, has been extensively used in eastern South Island high country including the Mackenzie basin. There is very little research related to the season-long microclimatic changes under sprinkler irrigation in New Zealand. An overseas study (Liu and Kang, 2006) examined the long-term effects (April 2001 to June 2003) of sprinkler irrigation on microclimate in fields of winter wheat (*Triticum aestivum* L.) and compared microclimate changes under sprinkler irrigation with surface irrigation at two experimental stations on the North China Plain. Results from that study showed air temperatures, air temperature gradient from 1 to 2 m above ground surface and vapor pressure deficit (VPD) were significantly lower ($P < 0.05$) while relative humidity, or RH (the total water vapor potential that the air can hold at a given temperature), was significantly higher in the sprinkler-irrigated fields after the first sprinkler irrigation during three winter wheat seasons. Cumulative water surface evaporation was also significantly lower in sprinkler irrigated fields. These differences were more pronounced during hot, dry and windy periods with concentrated precipitation. In summary, Liu and Kang

(2006) found that the humidity effects of irrigation cause fundamental changes to the climatic character of naturally dry habitats. These changes can have relatively widespread and evenly distributed effects across naturally arid sites, i.e. the effects may not show any clear attenuation with distance from the irrigator-source (Walker, 2017b).

In a statement of evidence dated 27 October 2017 before the Environment Court regarding irrigation effects on a property near Simons Pass, Walker (2017b) noted that irrigation considerably exacerbates and intensifies the edge effects of dryland cropping. This is likely due to raised humidity caused by irrigation being favourable for the growth of exotic species that take advantage of the increased moisture to grow throughout summer and not die back. This results in little or no bare ground, leading to the complete or near complete competitive exclusion and loss of arid-adapted native flora (Wardle, 2019; Walker 2017b). Walker (2017b) noted considerably greater extent of invasion of exotic pasture species, grasses and weeds on naturally dry terrace risers adjacent to spray irrigators for some distance (~500m) downwind, compared to drylands nearby adjacent to unirrigated cropping.

Moisture is carried from irrigators by wind or air, and in overland and shallow subsurface moisture flows. Extensive (several kilometres) moisture drift can occur when a thermal inversion combines with high humidity, thereby impacting on arid-adapted native flora over significant distances (Wardle, 2019). Any spray irrigation that occurs on Simons Pass is most likely to have similar adverse effects on adjacent indigenous dryland ecosystems, possibly also to a similar extent (~500m) beyond the land directly being irrigated.

White rust

Irrigation may lead to loss of the Threatened (Nationally Critical) endemic peppercress *Lepidium solandri*. White rust (*Albugo candida*) is a fungus that has recently infected *Lepidium solandri* on Simons Pass. White rust is a serious threat to the persistence of *L. solandri,* as it has already eliminated most of the last remaining *L. solandri* populations in Central Otago within the past decade, leaving the Mackenzie Basin as the national stronghold for this species (Wardle 2019).

White rust is known to proliferate in humid environments such as irrigated areas. The spread and prevalence of white rust is exacerbated by the presence of host plants such as brassica (e.g. turnip) crops and agricultural weeds such as shepherd's purse, as these act as vectors for the fungi to spread. Widespread conversion of dryland to irrigated pasture will result in higher humidity conducive to the persistence and spread of white rust, which in turn may cause the demise of the endemic and threatened *L. solandri* across the Basin floor (Wardle 2019; Walker, pers. comm. 2019).

5.3 Pastoral Activities

Pastoral intensification activities described above result in immediate and acute loss of terrestrial indigenous vegetation and habitats. Other farming activities may result in less immediate and more chronic changes, including degradation. Degradation is more complex and can be caused by activities such as grazing, burning, browsing/predation by introduced animals, invasion by exotic plant species, over-sowing and top-dressing. Of these activities, grazing and browsing have been the most pervasive causes of degradation in the Mackenzie Basin (Harding, 2016), especially in drier eastern parts of the basin. Overall, fire, pastoral farming and exotic species have been the major causes of vegetation changes in the eastern South Island high country (Harding, 2016; Young *et al.* 2016), including the Mackenzie basin and Simons Pass.

Grazing animals selectively remove palatable plant species, reducing the stature of taller vegetation e.g. by pulling out tillers of tussocks (Mark, 1993), exposing shade-adapted low-growing plants to direct sunlight, trampling ground-cover species and transferring nutrients from plants consumed to elsewhere through defecation, e.g. at stock camps. Heavier animals, such as cattle and deer, cause limb breakages in woody vegetation (King, 2005) and damage to soils and sensitive ecosystems such as ephemeral wetlands. The effect of grazing, especially when accompanied by spraying and burning, is the conversion of shrubland and tall tussockland plant communities to short stature tussockland, herbfield and bare ground (Harding, 2016). In addition to damaging indigenous plant communities, grazing reduces the habitat available to native invertebrates and reptiles and contributes to dispersal of weed seeds, followed by selective advantage to exotic species better able to cope with trampling and browsing. Degraded vegetation provides favourable habitat for rabbits and invasive naturalised plants such as mouse-ear hawkweed (*Pilosella officinarum*), sheep's sorrel (*Rumex acetosella*) and exotic grasses. The extent and rate of degradation at any given site on Simons Pass will depend on a range of factors.

5.4 Woody Weeds

Woody weeds, such as Scotch broom (*Cytisus scoparius*) and gorse (*Ulex europeaus*), are locally present near SH8 in the Homestead Block, while wilding pines are scattered, especially close to SH8 (in proposed CA 1) but also elsewhere. Stopping the spread of pest trees and woody weeds on Simons Pass, would result in long term ecological benefits on Simons Pass. Wilding conifers have the potential to become a significant issue on Simons Pass if remedial action and follow-up control over successive years is not undertaken over the medium term.

Controlling wilding conifers in the Waitaki catchment is also of national interest to protect the

hydro resource. In the Waitaki catchment, an intermediate conifer control proposal is predicted to save $3.57 million per year (Wyatt, 2018). This dollar figure is for the hydro resource only and does not include any flow-on impact on other industries, or on the wider NZ economy. An inter-agency programme for widespread wilding pine control is underway, and the tools for removal of large areas of wilding pines are now available and have been field tested.

5.5 Activities under the Resource Management Act 1991

DOC has undertaken an in-depth analysis of activities allowed for in the Mackenzie Basin under the Mackenzie District Plan (MDP), including on Simons Pass Pastoral Lease. The full analysis report is in Appendix 6, planning maps are in Appendix 7.

The MDP contains provisions relating to the management of indigenous vegetation clearance and non-vegetation habitat disturbance. The analysis concludes that there is no absolute protection of indigenous vegetation in the wider Mackenzie Basin and only limited controls on non-vegetation habitat disturbance. The MDP is due for a review and is currently undergoing plan changes to improve provisions, however, all plans generally have a life of 10 years, and are subject to change. This means that what may be protected through a plan provision currently, may not be protected in 10+ years' time.

The Mackenzie District Council has sought to improve the provisions relating to indigenous vegetation clearance and effects of landscape and amenity through Plan Change 13 and Plan Change 18 (PC18). However, there is still limited protection for indigenous vegetation in terms of how 'improved pasture' is identified under PC18. Areas of indigenous grassland, cushion and herbaceous vegetation, habitat and threatened species may be at risk of being captured under this definition and are therefore susceptible to clearance.

Indigenous vegetation clearance within the Mackenzie District can occur as either a permitted or consented activity, so protection is not absolute. While PC18 significantly improved the indigenous vegetation provisions, the lack of provision for protecting non-vegetation habitat from disturbance and permitted clearance for utilities (including irrigation pipe lines) remain risks which could lead to biodiversity losses. Further plan changes would need to occur to mitigate risks relating to the identification of 'improved pasture', non-vegetation habitat disturbance and disturbance to areas where significant vegetation is only apparent periodically (e.g. native spring annuals). The Mackenzie Basin floor also contains a rich diversity of non-vascular plant flora (mosses, lichens etc) and an equally rich diversity of terrestrial invertebrates, including endemic grasshoppers, moths, weta species. Although the MDP recognises these as ecological components of the natural landscape character of the

Basin (Appendix X of the MDP), they are not specifically protected in plan provisions. To protect these components, it is important for the tenure review to recognise ecosystem elements beyond the vascular plant communities.

Farm development adversely affecting SIVs has already occurred on Simons Pass, which demonstrates that protection of SIVs under District and Regional planning instruments is not absolute, nor guaranteed.

Further changes in farm management on Simons Pass can facilitate increased stocking densities and grazing pressure or provide an opportunity for permitted or consented vegetation clearances within MDP rules. As stocking densities and stock type are not matters considered in the District Plan, such permitted or consented activities would likely cause decline in the health and functioning of indigenous vegetation, with consequent losses in fauna populations and ecosystem services.

Intensified grazing or vegetation clearance causes fragmentation in indigenous ecosystems, causing them to be less resilient to wider environmental changes such as climate change or adverse weather events. This is because smaller areas of indigenous vegetation are not well buffered and experience greater edge effects relative to their extent.

6. Analysis of the Preliminary Proposal

The Preliminary Proposal (Figure 8) includes full Crown ownership and control for conservation purposes (proposed CA 1) only over a portion of the late Otiran (Mt John) moraine and the meltwater channel. The balance of the property, including extensive SIVs identified in the CRR (2008) and further described in this report (Figure 7), are proposed to be disposed of as unencumbered freehold.

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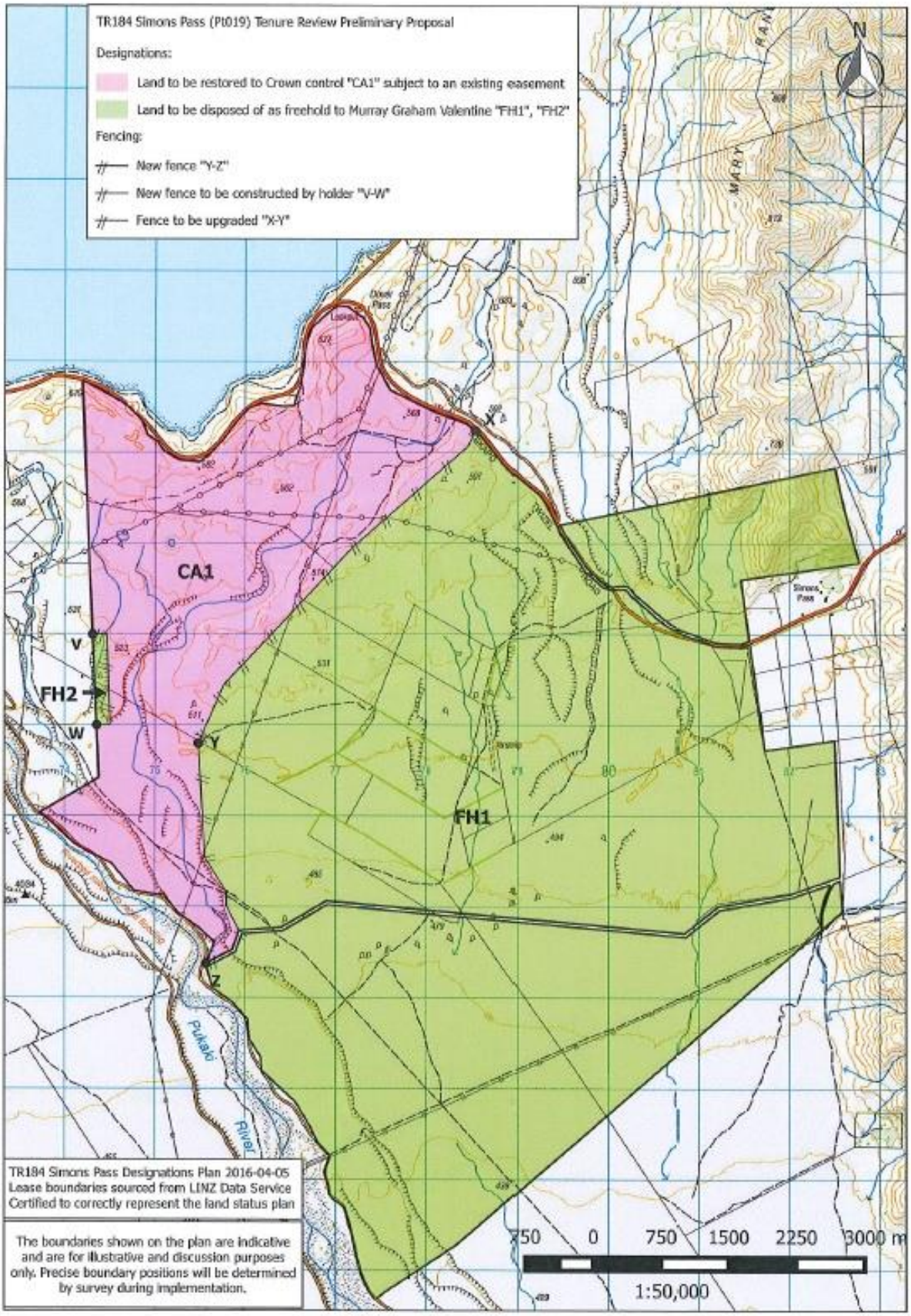

Figure 8. Preliminary Proposal designations, dated April 2017

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Appendix 1 – Links to Simons Pass Pastoral Lease CRR (2008) and associated SIV maps

Simons Pass Pastoral Lease Conservation Resources Report:
https://www.linz.govt.nz/system/files_force/media/crown-property-attachments/tenure-review/ig/simons-pass-con-res.pdf?download=1

Topo/cadastral map. Note area identified as 'Farm Block':
https://www.linz.govt.nz/system/files_force/media/crown-property-attachments/tenure-review/ig/simons-pass-con-res-map1.pdf?download=1

Landscape Units & Landscape Values Map:
https://www.linz.govt.nz/system/files_force/media/crown-property-attachments/tenure-review/ig/simons-pass-con-res-map2.pdf?download=1

Land Environments of New Zealand (LENZ):
https://www.linz.govt.nz/system/files_force/media/crown-property-attachments/tenure-review/ig/simons-pass-con-res-map3.pdf?download=1

Botanical values. Note; areas identified as Farm Block and some of the outwash plain in the southwestern part of the property were not surveyed in detail during the CRR surveys:
https://www.linz.govt.nz/system/files_force/media/crown-property-attachments/tenure-review/ig/simons-pass-con-res-map4.pdf?download=1

Bird values: https://www.linz.govt.nz/system/files_force/media/crown-property-attachments/tenure-review/ig/simons-pass-con-res-map5.pdf?download=1

Lizard values: https://www.linz.govt.nz/system/files_force/media/crown-property-attachments/tenure-review/ig/simons-pass-con-res-map6.pdf?download=1

Aquatic values: https://www.linz.govt.nz/system/files_force/media/crown-property-attachments/tenure-review/ig/simons-pass-con-res-map7.pdf?download=1

Invertebrate values: https://www.linz.govt.nz/system/files_force/media/crown-property-attachments/tenure-review/ig/simons-pass-con-res-map8.pdf?download=1

Historic and recreation values: https://www.linz.govt.nz/system/files_force/media/crown-property-attachments/tenure-review/ig/simons-pass-plan-9.pdf?download=1

Appendix 2– Te Rūnanga o Ngāi Tahu Cultural Values information

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Appendix 3– Protection Guidelines for Key Ecosystem and Features

Feature/Ecosystem	Importance	Proposed Restrictions	Minimum conservation values required	Minimum Protection Type
Outwash gravel plains	Inherent ecological values, landscape, landform	No development/ intensification, no exotic trees, setback from intensive development	Intact landform and soil structure	Full protection (PCL)
Alluvial terraces, fans & flats (including terrace risers)	Inherent ecological values, landscape, landform	No development/ intensification, no exotic trees, setback from intensive development	Intact soil structure, some level of indigenous values	Full protection (PCL)
Wetlands	Water quality, inherent ecological values, landscape, dynamic processes	No grazing, no exotic trees, no impediments to natural flow, pest fish free, no abstraction, no discharge, no sedimentation, no draining, no interference of inherent ecological values, setback from intensive development	Any, including potential to restore previous wetlands	Full protection (PCL)
Tarns including kettleholes	Inherent ecological values, landform, landscape	No development/ intensification, no exotic trees, setback from intensive development, no grazing in margins or beds.	Any condition - Protection level may depend on size and level of modification, and surrounding landscape	Full protection (PCL)
Rivers and streams (including braided rivers)	Water quality, fish passage, inherent ecological values, landscape, dynamic processes, landform	No exotic trees (including willows), no impediments to natural flow (instream structures), maintain trout free zone, no extractions (water and gravel), no discharge (nutrients/sedimentation) , no impeding function and potential of braided river, no interference with inherent values (e.g. fish spawning), human use (e.g. 4wd)	Any	Full protection (PCL)
All lake margins	Inherent ecological values, dynamic processes, landform, landscape	No exotic trees or structures, no conspicuous exotics, no grazing, no intensification development, human use e.g. vehicles	Any	Full protection (PCL)
Land above 900m	Inherent ecological values, landscape	No development/ intensification, no exotic trees, no grazing	Intact landform and soil structure and indigenous vegetation cover	Full protection (PCL)
Significant ecological values	Inherent ecological and landscape values	No development/ intensification, no exotic trees, no grazing	Retention of the values for which the SIV was identified	Full protection (PCL)
Screes	Inherent ecological	No development/ intensification, no exotic	Intact landform	Full Protection (PCL)

	values, landscape	trees, no grazing, setback from development		
Moraines	Inherent ecological values, landscape, landform	No development/ intensification, no exotic trees, setback from intensive development	Intact landform and soil structure, at least some level of indigenous flora/fauna value	Full protection with potential grazing concession
Hill country	Inherent ecological values, landscape	No exotic trees, no development/intensification, setback from intensive development	Any for landscape. Otherwise requires intact landform and soil structure and at least some level of indigenous flora/fauna value	Full protection (PCL) with potential grazing concession
Gateway sites	Landscape	No exotic trees, no structures, no conspicuous exotics, no intensification/development	Any	Full protection (PCL) with potential grazing concession
Roadsides	Landscape, potential inherent ecological values	No exotic trees, no built-up human features, no conspicuous exotics	Developed but at risk of further intensification or tree planting	Full protection (PCL) with potential grazing concession
Extensive farmland	Inherent ecological values, landscape connectivity, across border impacts, inherent ecological values, restoration potential	No exotic trees, setback from intensive development, no development or intensification	Intact landform and soil structure, at least some level of indigenous flora/fauna value	Full protection with potential grazing concession
Geopreservation sites	Landform, landscape	No exotic trees, no structures, no conspicuous exotics, no intensification/development	Any	Full protection with potential grazing concession
Intensive farmland	Landscape connectivity, across border impacts, potential for inherent ecological values	No more exotic trees, sensitive build environs, additional natives locally sources appropriate woody okay	Developed but at risk of further intensification or tree planting	Freehold with covenants
Major structures on pastoral land	N/A	Sensitive additional build environs	Any	Freehold with covenants

Appendix 4 – Vegetation descriptions (Wardle, 2019)

To assist in the description of vegetation, the property (Figure 4) has been divided into the following units:

1. Pukaki terminal moraine and western outwash surface, proposed as CA1 in the Preliminary Proposal (PP).
2. Pukaki River lower river terraces
3. SH8 northern corridor
4. Foot slopes of Mary Range and associated terrace and outwash channel
5. High central moraines and Farm Block (referred to by the Simons Pass lessee as 'Node A')
6. East and immediately south of Farm Block– Old moraines and moist outwash surfaces. Much of this area is a portion of an area referred to as 'Dryland Recovery Area (DRA)' in Environment Canterbury irrigation resource consent CRC082311
7. Southern Dry Outwash Plain including an area referred to by the lessee as 'Node C'

Since 2006, there has been a notable increase in vegetation cover. This is likely to reflect climatic conditions. Climatic conditions had been very dry for the three years prior to 2006 that favoured rabbits resulting in open dry areas on the moraine. In contrast, the exceptionally wet conditions in spring/summer of 2018-19 have favoured tussock and grass growth, with less open ground across the entire property, and elsewhere in the Mackenzie Basin.

Introduced species are denoted with an asterisk (*); Threatened and At Risk species are underlined.

1. Pukaki terminal moraine & Western outwash surface

This area includes the ice scoured Pukaki terminal moraine located near Lake Pukaki, and the hummocky moraine deposits further south. These are the youngest moraines from the Tekapo and Mt John Advances and have been downcut by a meltwater channel.

(i) Pukaki Terminal Moraine

The generally north facing slopes of the terminal moraine ridge between Hayman Road junction and Lake Pukaki Terminal Moraine Conservation Area support native shrubland of variable species composition[20] and density (15->70% cover), with depleted fescue tussock grassland, rock and bare ground occupying open areas within the shrubland. Species characteristic of these dryland environments are present including mat daisies (scabweed, Celadon mat daisy and *Raoulia hookeri*), orchids, and fescue tussock, and tufts of blue tussock, danthonia sp., and *Rytidosperma pumilum.*

The westernmost extent of the moraine shrubland was identified as a RAP (RAP6: Southern Pukaki Scrub-1984), where shrub diversity is high, shrub height can reach 3m, and cover exceeds 50%. These values are still present.

The complicated topography of the terminal moraine provides habitats with a range of aspects, slope and soil depth. Scented tree daisy and *Coprosma rigida* favour sites with deeper soils.

Ephemeral wetlands occupy kettleholes, boulderfield lag tarns and other closed depressions. At one of the more indigenous tarns, the damp turf community at the margins of the tarn included a diverse array of low growing herbs and sedge including at risk species: wood-sedge *Luzula celata*, willowherb *Epilobium angustum* and herb *Montia angustifolia*.

Immediately south of the main ice-scoured moraine ridge is a large area of hummocky topography, created when ice-transported material was deposited during the Mt John Advance. Fescue tussock grassland dominates with 30-40% cover. Exotic species dominate the intertussock spaces; native intertussock species diversity is

[20] Prostrate kowhai dominates the steeper rubbly slopes especially above the Haymans Road turnoff. Other common shrub species include porcupine shrub, mingimingi, and scrub pohuehue. Less common species include *Coprosma intertexta, C. virescens*, mountain wineberry, matagouri, and the lianes clematis and bush lawyer (DOC 2007).

greatest at the northern end where fescue tussockland rises up onto moraine outcrops.

Native shrubland is present on an isolated steep sided rocky moraine ridge, on slopes exposed to the north-westerly wind, where removal of the loess mantle has exposed the stony/boulder till. Desert broom, porcupine shrub, mingimingi and *Coprosma intertexta* are common, while *C. cheesemanii* is more local.

(ii) Western outwash surface

A meltwater channel associated with the Tekapo Advance has been carved through the moraine forming a flat-bottomed valley, which trends north-east to south-west. The light gravelly soils have not been prioritised for pastoral development. Native species diversity is patchy, being concentrated within depleted fescue tussockland; and matfields in ephemeral depressions and lag tarns. Erratic boulders provide refuge for native ferns and herbs.

Terraces within the channel support a *mouse-eared hawkweed herbfield-loamfield with scattered fescue tussocks. Key native species include Celadon mat daisy, *Montia erythrophylla*, dwarf patotara, mat coprosma and desert poa.

The western meltwater channel then spreads out to form an outwash plain at the south western corner of this unit. Healthy regenerating fescue tussockland with up to 30% tussock cover was recorded on these reworked deposited derived from older Mt John' outwash and Balmoral moraines (DOC 2007). The tussocks occupy both shade fluve risers and the interfluves. Intertussock native species cover and diversity is good with 20% blue tussock cover, sub-shrubs, grasses and tumbling lichen present. Notable plants present include the threatened cushion daphne and at risk grass *Rytidosperma exiguum*. *Sweet briar is scattered throughout.

2. Pukaki River Terraces

This description is derived from the Conservation Resources Report (DOC 2007) and a recent report outlining threatened plant monitoring in parts of the Lease including the Pukaki river terraces. (Norton 2018).

A series of very dry stony and sandy Holocene fluvial surfaces present as low terraces occur as strips of land adjoining the bed of the Pukaki River. The driest most stony parts support a notably intact woolly moss mossfield-herbfield that includes scattered *mouse-eared hawkweed porcupine shrub, *Pimelea oreophila,* cushion daphne and several 'at risk- declining' species (wood sedge *Luzula ulophylla*, scabweed, dwarf patotara and Celadon mat daisy).

Monitoring of cushion daphne has recently taken place (Norton 2018). An average plant density of 43 individuals/ha were recorded on the Pukaki River terraces, which gives a conservative estimate of around 9000 plants within this part of the Lease.

Matagouri, together with *briar, is most common on bouldery phases close to the river, and near the old Bullock Track midway along the Terraces. Threatened *Muehlenbeckia ephedroides* is relatively abundant on stony substrates near here. Based on Norton's (2018) estimate of average density being 5 patches/ha, there are likely to be a minimum of 325 patches (and therefore more plants) on the Pukaki terraces here alone.

Terrace risers support depleted fescue tussock grasslands with sparse fescue tussock and occasional threatened mat broom (*Carmichaelia nana*), blue tussock, little hard fern and bidibid.

The threatened NZ cress *(Lepidium solandri*- previously named *Lepidium sysimbrioides* subsp. *sysimbrioides*) was recently recorded at the southern end of the Pukaki River Terraces on stable stone areas along the upper edge of the escarpment (Norton 2018). He notes that vegetation cover is usually sparse, and that *Carmichaelia nana* can be associated with it.

Native shrublands occur along the bottom of terrace risers on boulderfield, and within the outwash channel gully near the historic bullock track. Species composition is typical of the Lease and includes several 'at risk-declining' species matagouri, desert broom and *Coprosma intertexta*.

The southernmost terrace is dominated by *briar.

3. SH8 Northern Corridor

This area encompasses a triangle of land at the SH8-Hayman Road junction, and a narrow strip of land, which lies between the old Mackenzie Basin gravel legal road, and the existing alignment of SH8, extending some three kilometres along SH8 from Dover Pass.

The triangle of land, once dominated by exotic pine trees, has been cleared. In 2006, there was a small wetland with permanent water, characterized by numerous dead pedestals, presumably of purei (*Carex secta),* and live sedges (including *oval sedge *Carex ovalis, C. flaviformis and C. kaloides)* and *soft rush.

This road corridor area supports fescue tussock grassland with 30-40% cover and good native species diversity[21] that included several coral broom and matagouri shrubs. The fescue tussockland grades into a healthy tussockland-shrubland where matagouri is more common, together with desert broom, coral broom, and mingimingi. At the western end of the strip, there was a large pine plantation and areas of wilding pines. This plantation, and wilding pines have subsequently been felled and controlled. Parts of the strip have also been disturbed during the installation of irrigation pipes.

4. Foot slopes and high terrace of Mary Range & Outwash channel

This zone is located on the north side of SH8 at the north-eastern corner of the Lease. It comprises a broad outwash channel, a high terrace, and the lower slopes of the Mary Range.

(i) Outwash Channel

The channel has variable micro topography. Bouldery outwash risers support stonefield-loamfield and herbfield communities. While mouse-eared hawkweed, mat coprosma, *sheep's sorrel, desert poa and *spring speedwell dominate, other species include sedge *Carex resectans*, creeping pohuehue, *sweet vernal, native moss and lichens. A previous survey (DOC 2007) recorded many declining species: mat daisies (scabweed, Celadon mat daisy, and Beauverd's mat daisy), wood sedge *Luzula ulophylla*, dwarf broom (*Carmichaelia vexillata*), dwarf patotara and threatened cushion daphne (*Pimelea sericeo-villosa ssp. pulvinaris)*. Shrubland within the channel is dominated by *briar, with matagouri, mingimingi and scrub pohuehue.

Native shrubland of similar composition (without prostrate kowhai) as the Lake Pukaki terminal moraine area was recorded on steep boulder moraine slopes to the west of the channel (DOC 2007). Declining bluewheat grass (*Anthosachne falcis*) and uncommon bracken fern were recorded then, while Harding (2018) confirmed the presence of *briar, matagouri, mingimingi, *Coprosma intertexta*, desert broom, scrub pohuehue, short tussock species and various dryland sub-shrub, mat daisy, orchid, moss, lichen and fern species.

(ii) High terrace

A high terrace is located above the outwash channel, extending from SH8 to the foot slopes of Mary Range.

*Browntop-*Chewings fescue grassland dominates the area closest to SH8, although there are localised occurrences of native species e.g. porcupine shrub associated with erratic boulders, and small areas of fescue tussock with 30% cover. A drought prone rise near the SH8 supports dryland species including patotara, desert poa, *Rytidosperma exiguum*, *Xanthoparmeillia semiviridis* lichen, and *mouse-eared hawkweed. There are scattered *European broom and *gorse bushes present.

[21] Intertussock species included pimelea, dwarf patotara, mat coprosma, blue tussock, native plantain, white sun orchid, Mueller's sedge, *king devil's hawkweed, *browntop (DOC 2007).

Further back on the high terrace and valley floor, short tussockland dominated by fescue tussock (to 50% cover) is present. Intertussock vegetation comprises primarily brown top, with scattered *briar, matagouri, desert broom and subshrub species, becoming more common closer to the hill slope.

On the valley floor, meltwater inundation channels and modified kettlehole depressions have formed over moraine deposits. These provide habitat for threatened spring annual species (NZ mousetail *Myosurus minimus subsp. minimus* and forget-me-not *Myosotis brevis*), which were recorded in Spring 2006[22] but have not been resurveyed since then. The main channel continues to the SH8, feeding into a manmade dam where a turf community of oxalis, a small unidentified sedge and *procumbent pearlwort, with *Californian stinkweed and NZ sneezeweed (*Centipeda aeotearoana*) present. This site, visited in February 2019, is potential spring annual habitat that would require re-visiting in Spring to confirm their presence.

(iii) Mary Range Foot slopes

A mosaic of shrubland, short tussockland and grassland and is present depending on aspect and grazing pressure. A healthy native shrubland occupies the south-east facing foot slopes, with matagouri, mingimingi, desert broom and scattered *Coprosma intertexta* and porcupine shrub present. In the valley head shrubland, tree daisy dominates in places, while *briar or scrub pohuehue dominates at others. The often browsed 'at risk' swamp speargrass *Aciphylla subflabulata* was scattered at the shrubland's margins in 2006. There are occasional *wilding pines and *crack willow.

Short tussockland occupies adjacent hillslopes with fescue (to 40% cover) and silver tussocks present. Native intertussock species diversity can be high, and includes golden and swamp speargrass, and scattered matagouri.

Grasslands are dominated by *browntop, *sweet vernal and *Chewings fescue, with *cocksfoot and occasional fescue tussock present.

Immediately behind the shearer's quarters, vegetation cover is predominantly exotic with a mix of exotic *conifers, *briar, *willow, and scattered matagouri, scented tree daisy and scrub pohuehue, with *browntop grassland.

5. High Central Moraines including Farm Block – Node A

This area includes moraines of the intermediate (Mt John) Glacial Advance, and the largest area of moraines from the older Balmoral Advance on the Lease.

(i) North & West of Pivot Areas

This zone is predominantly comprised of Mt John moraines. Most parts of the high central moraines to the north and west of Pivot Areas 1, 2, 3 and 5 support short tussock grassland. The dominant native grass is fescue tussock (*Festuca novae-zealandiae).* Above ~570m asl., tussock cover is between 40-60% in places, with tufts of native Mueller's sedge (*Carex muelleri*), threatened blue wheat grass (*Anthosachne falcis*), and plume grass (*Dichelachne crinita*) also present. Intertussock spaces are dominated by exotic species including grasses (*sweet vernal, *brown top), clovers **(***white clover, *haresfoot trefoil), *mouse-eared hawkweed, *broom rape, and occasional *briar bushes.

Rocks and boulders act as refugia for native herbs and sub-shrubs that include native harebell, mat coprosma, pimelea, patotara, piripiri (*Acaena buchananii)* and creeping everlasting daisy.

Mats of mat daisy *Raoulia apici-nigra*, mat coprosma, patotara, moss, mountain wind grass (*Lachnagrostis lyallii)*, plume grass together with exotic *sheep's sorrel, *silvery hair grass, *haresfoot trefoil and *mouse-eared hawkweed occupies localised open areas with thin soil.

[22] Two forget-me-not plants, and 5 populations of NZ mousetail comprising 5-200 plants each (DOC 2007)

Further downslope towards the pivot areas, fescue tussock cover is variable (5-25%) but is scattered throughout a *browntop/*sweet vernal dominated grassland. Other plants present may include scattered matagouri shrubs and *briar; herbs including native harebell, yam daisy (*Microseris scapigera*) *white clover, *haresfoot trefoil, *spurging flax, *Californian thistle, *broom rape, *mouse eared hawkweed and *kingdevil hawkweed; sedges (*Carex resectans, C. muelleri*); subshrub pimelea; and grasses including blue wheat grass (*Anthosachne solandri, A. falcis*), plume grass, blue tussock, *Kentucky bluegrass and *Yorkshire fog.
At the western end of this sub-zone, there is a ridge of hummocky Mt John moraine that supports greater native species diversity and cover. Fescue tussock cover on the gently sloping moraine face reaches 30%, and tussock recruitment is evident. Native intertussock species include pimelea, plume grass, blue tussock, native harebell, Mueller's sedge and grassland daisy (*Celmisia gracilenta).* Additional native species are present at the base of rocks e.g. creeping everlasting daisy, patotara, and native aniseed. There are matagouri and occasional scented tree daisy shrubs present.

Approaching the top of the moraine ridge there are more extensive patches of native shrubland amongst fescue tussock grassland. This tussock-shrubland community is dominated by matagouri, with mingimingi, desert broom, coral broom, porcupine shrub, scented tree daisy, scrub pohuehue, and localised *Coprosma intertexta* shrubs also present. All shrubs are healthy, with no browse damage evident.

The south-western portion of the high central moraine surface adjacent to Pivot Areas 1 and 3, was surveyed in October 2018 (Harding 2018). This area supports a similar fescue short tussock- *sweet vernal/*browntop grassland as that described above, with 10-40% cover of fescue tussock. Species diversity is higher with *Plantago lanigera, Chaerophyllum novae-zealandiae, Geranium brevicaule*, *St John's wort, *Rytidosperma exiguum, Cladia aggregata* lichen, wire moss and cypress-leaved plaitmoss also being recorded. There are also areas within this sub-zone where mat coprosma is co-dominant with fescue tussock.

(ii) Pivot Areas

Pivot Areas 1, 2, 3, 4, and 6 are located over old fertile Balmoral moraines, while Pivot Areas 5 and 7 are over Mt John outwash surface. This part of the Farm Block has been the focus of farm development that has included vegetation clearance (pine shelterbelt removal; mechanical removal of mainly matagouri shrubs; broadscale spraying); OSTD with ryecorn, followed by direct drilling with ryecorn, pasture grasses and/or turnips and ryegrass in January 2019. None of the Farm Block Pivot Areas are currently irrigated.

At the time of survey, extensive areas of last season's ryecorn were either standing, or had been flattened by subsequent farm development activities. Young recently germinated ryecorn plants were evident along the direct drilling lines. In addition to the Pivot areas, most of the land between Pivots 4, 6 and 7 has been converted to ryecorn.

Within the developed Pivot Areas, there are occasional live fescue tussocks, matagouri shrubs, small native herbs, subshrubs and grasses.

Remnants of native plant communities include ephemeral tarns within developed Pivot Areas, and fragments of undeveloped dryland plant communities within the Farm Block. These are described below.

a) Ephemeral Tarns Within Pivot Area Circles

Aerial photos indicate that there are at least six ephemeral tarns present in the Farm Block. Of these, four tarns were visited - three are located within Pivot Area 2, while one is within Pivot Area 1. Each tarn is surrounded by sown ryecorn or other pasture grasses and white clover, with parts of some of the tarns also having been direct drilled.

The dried mud upper tarn zone supports a turf[23]-loamfield comprised of dried mud colonised by intertwining green patches of *Montia angustifolia*, *Limosella lineata,* selliera *(Selliera radicans)* and prostrate sneezeweed (*Centipeda*

[23] Turf is a vegetation structural type of low stature (<3cm tall) of mainly herbaceous plants that are prostrate and tightly interlacing, forming a ground hugging and often dense carpet of often intertwining plants of numerous species (Johnson & Rogers 2003).

aotearoana); an unidentified liverwort; *toad rush (*Juncus bufonius*) and *pearlwort (*Sagina procumbens).* Large patches of *Glossostigma elatinoides* whose white or pink flowers attract many copper butterflies, are common. Pink prostrate cushions of waterwort (*Elatine gratioloides*) are present in the upper zone and is the most common species to extend onto the tarn floor in places. This semi-aquatic plant grows both under water, and at the margins of these ephemerally wet tarns.

The two tarns that have standing water provide habitat for a large number of paradise ducks. The duck activity (trampling and faeces) appears to be burning off some of the turf vegetation.

These ephemeral trans appear to be suitable habitat for threatened Spring Annual species; this would require confirmation in Springtime.

b) Fescue tussock grassland - Black pine shelterbelt Block

At the eastern side of the Farm Block, there is a long narrow block (~9 ha) with *black pine shelterbelts on both sides. This area supports fescue tussock grassland with 10-25% fescue tussock cover, scattered blue wheat grass tussocks, plume grass and blue tussocks. Intertussock cover is dominated by exotic pasture grasses (including *sweet vernal, *Chewings fescue, *browntop, *Kentucky bluegrass, *Yorkshire fog, and occasional *cocksfoot and *brome grass), and exotic herbs **(***white clover, *haresfoot trefoil, *speedwell, *viper's bugloss). There are scattered *briar bushes and young wilding *pines. Native intertussock species include mat coprosma, harebell and viola.

Native porcupine shrub, blue tussock and scrub pohuehue are associated with an erratic boulder. There are some sizable patches of shrubland growing within the short tussock grassland that are dominated by matagouri, with *briar, scrub pohuehue and occasional mingimingi also present.

*Mouse-eared hawkweed herbfield dominates the northern portion of the area where the two shelterbelts narrow to a point.

c) Fescue Tussock Grassland and Matagouri Shrubland – west and south of black pine shelterbelt Block

There are small localised areas of residual matagouri and fescue tussock grassland, growing at the eastern side of the Farm Block- from the eastern end of Pivot Area 2 south, including immediately west of the shelterbelt block described above, and along a fenceline at the top of an escarpment to the east of Pivot 4 where desert broom is also present.

Some patches of matagouri located between Pivot Areas 2 and 4 have been sprayed, machined and direct drilled.

d) Fescue Tussock Grassland – exotic grassland - Outwash north of Pivot Area 7

This area comprises moraine that is mixed with old outwash that supports exotic dryland species (*sweet vernal, *harefoots trefoil, and occasional *ryecorn), with an occasional fescue tussock. At its western extent, there are localised patches of denser fescue tussock grassland with plume grass, while intertussock species include *Stackhousia minima*, native harebell, *sheep's sorrel, *clovers and *mouse-eared hawkweed.

e) Degraded fescue tussock grassland - Outwash Plain – Pivot Area 5

An area of outwash plain located to the south of Pivot Areas 3 and 6 (i.e. in the vicinity of and including Pivot Area 5) was surveyed in October 2018. Harding (2018) recorded patches of degraded fescue tussock grassland[24] within an extensive *mouse-eared hawkweed dominated herbfield-loamfield community of reasonable native species diversity that includes declining species[25]. When visited in mid-February 2019, this area appeared to

[24] While exotic species such as *sweet vernal, *browntop and *white clover are common in the degraded fescue tussockland, native woody sub-shrubs (pimelea, patotara, mat coprosma) and lichen were also recorded (Harding 2018)

have been recently sprayed and direct drilled with ryecorn. Some native species have survived in dry sandy areas e.g. patotara, creeping pohuehue, desert poa, and NZ wind grass.

f) Fescue tussock- exotic grassland – Interpivot zone between Pivot Areas 1, 3 and 4

Areas of residual native biodiversity persist between Pivot Areas 1, 3 and 4. On a knoll there, scrub pohuehue is common, including young plants amongst the grass. Fescue tussock cover is variable (10-40%) and grows with plume grass, tufts of Mueller's sedge, harebell, mat coprosma, geranium and lichens. *Browntop, *Chewings fescue, *sheep's sorrel, *Kentucky bluegrass, *mouse-eared hawkweed and scattered *briar is also present. Rocks provide refugia for patotara, porcupine shrub, scrub pohuehue and mat coprosma.

6. East and immediately south of Farm Block– Outwash cut moraines, Balmoral moraine necklace and moist outwash surfaces

This area is characterised by two meltwater channels that have carved through Mt John and Balmoral Advance moraine deposits, just south of SH8. These channels coalesce to form an extensive fluvio-glacial outwash plain south of a necklace of localised terminal moraine deposits associated with an older (Balmoral) glacial event.

(i) Moraines

Just south of SH8, a meltwater channel has deeply cut down through the Mt John moraines close to the northernmost part of the Farm Block. A north-facing moraine slope below the new irrigation dam supports regenerating fescue tussockland-matagouri shrubland with 60% fescue tussock cover in places. Native intertussock species diversity is high, with mat daisy (*Raoulia subsericea, R. apici-nigra*), mat coprosma, patotara, desert poa, onion leaved orchid and harebell present. Open dry areas support pimelea, mat coprosma, mat daisies (scabweed and *R. hectorii*) and the small dryland grass *Rytidosperma exiguum)*. Exotic species include occasional *wilding pine, *briar, *sweet vernal and patches of *mouse-eared hawkweed.

When surveyed in 2006, north-west facing moraine ridges at the north eastern end of the Lease were rubbly (50%) with 10% bare ground. Patches of native shrubland were present, with matagouri, mingimingi, porcupine shrub and occasional *Coprosma intertexta* and *C. cheesemanii* present.

A band of old Balmoral terminal moraine, together with numerous erratic boulders, occupies a 3km wide band south of the Farm Block. The boulders support a distinctive flora of blue tussock, scrub pohuehue, creeping viola, and native ferns and provide refuge for desert broom, mingimingi, porcupine shrub, and scrub pohuehue. *Briar is present.

There is a notable ecotone between the old glacial moraine deposits and the outwash surfaces to the south. Here a shady end slope supports regenerating fescue tussock, with mat coprosma, sedge and pimelea. *Mouse-eared hawkweed is present (10% cover). This fescue tussockland community continues north on the hummocky surface, where fescue tussock cover reaches 40% in places. Porcupine shrub, and native herbs are common. Elsewhere exotic grasses and herbs dominate the intertussock spaces.

ii) Necklace Moraines

At the mid-eastern side of the Lease there is a distinctive necklace of Balmoral aged terminal moraine 'dumps' that represents the most southern extension of this older Advance on the Lease. They form bouldery hillocks, with fine soil deposits that are surrounded by outwash. Here four populations of the threatened spring annual species (*Ceratocephala pungens)* growing with Buchanan's bidibid and blue wheat grass (*Anthosachne falcis),* were recorded in the tenure review survey (DOC 2007) on elevated gentle summit depressions. The populations

[25] Harding (2018) recorded greater native species diversity in the herbfield-loamfield, including mat daisies (scabweed and Celadon mat daisy) grasses (blue tussock, *Anthosachne falcis*, desert poa), woody sub-shrubs (mat coprosma, patotara, creeping pohuehue, pimelea), mosses and lichens.

comprised between 5 and 50 plants each. *Ceratocephala pungens* has not been relocated here[26] or at other potential sites further west during more recent surveys here (Norton 2018).

iii) Outwash Surface

The ephemeral meltwater channel (previously described in *Moist Outwash surface and Foot slopes of Mary Range)* continues south of SH8, where little shrubland persists**.** Close to the moraine necklace, a highly modified relic wetland was recorded within the channel that supports native species that are indicative of seasonally inundated depressions, including willowherb, mudwort and *Dichondra brevifolia* (DOC 2007).

Several hundred plants of the threatened spring annual herb NZ mousetail have also been recorded in this locality in a seasonally damp depression (Norton 2018).

The moist outwash surface has patterned micro-topography, which relates to the braiding pattern of meltwater during the time of its creation; this has influenced both soil pattern and distribution of native flora. The dominant plant community is *mouse-eared hawkweed herbfield - *sweet vernal grassland – loamfield. Other common exotic herbs include *haresfoot trefoil, *sheep's sorrel and *speedwell. The moist outwash surface lacks the threatened species diversity associated with the dry outwash surfaces further west and south on the Lease. This patterning in soil phases across the outwash surface has resulted in greater native species diversity being associated with bouldery convex risers between fluves and at the edge of outwash terraces, than on the flatter parts of the outwash surface.

Fescue tussocks tend to be confined to the deeper, moister soil phases associated with the south-east facing sides of fluves. Other native plants recorded on these shady areas include tumbling lichen, mat daisies (Celadon mat daisy and *R. subsericea*), desert poa, sedges, mat pimelea, patotara and dwarf patotara and creeping pohuehue, plume grass and blue wheat grass *Anthosachne falcis*.

7. Southern Outwash Plain including Node C

This area includes the dairy farm Node C zone where there are farm buildings, a milking shed and effluent tanks. The majority of the outwash plain located to the south of the Necklace Moraines has been developed as Pivot Area circles (Pivots 13-21) and are at different stages of development. Only Pivot Areas 12, 17 and 21 are under permanent pasture and are currently irrigated. Pivot Areas 15 and 20 are in *ryecorn, while the eastern pivot areas (13, 14, 18 and 19) have been OSTD, cultivated and *triticale sown.

Within this developed farmed zone, residual native plant diversity is fragmented by the Pivot Areas. Native species diversity, including that of threatened and declining plant species, is greater on the dry outwash surfaces than the moist outwash surface previously described, and located to the north. Key areas that support native plant diversity are described below.

(i) Fescue Tussockland and NZ Mousetail habitat - Old Terrace Soils associated with Maryburn Landform Association

During the original 2006 tenure review inspection, a manmade depression nestled amongst healthy fescue tussockland, was found on a triangle of old fertile terrace soils at the eastern property boundary. The depression supported thousands of New Zealand mousetail, with dryland button daisy and *Crassula sinclairii* (DOC 2007).

Irrigated pasture at Pivot Areas 12 and 17 adjoin this site. Inspection of this area in mid-February 2019 revealed

[26] This may be due to changes in grazing pressure; Roger and Overton (2007) suggest that in Central Otago populations have been lost following removal of grazing animals, which help maintain the open habitats favoured by *Ceratocephala pungens*. Other Central Otago populations 'disappear' for a year, and then reappear in a subsequent year when conditions are right (pers. obs.).

a depression that was regularly being irrigated, with incomplete fencing thus allowing cattle to congregate in the depression, as evidenced by large quantities of cattle dung.

No NZ mousetail was found, although February is the wrong time of the year for this Spring annual to usually be evident. Vegetation is characterised by exotic species including *shepherd's purse, *grass seedlings, *fathen, *Kentucky bluegrass, *mallow and *storksbill. Occasional native starweed and an unidentified sedge are present. On the old sprayed dam wall, along which the pivot wheels run, two seedlings of Buchanan's bidibid (*Acaena buchananii*) and harebell were observed, together with *shepherd's purse. Fescue tussocks persist on the terrace, often in a dense sward of *sweet vernal and *browntop, with occasional wilding pine and matagouri present. This area was not surveyed closely.

(ii) Lepidium solandri habitat: Dry Outwash Surface – West of Pivot Area 17

Immediately to the west of Pivot Area 17, a sequence of boulder convex risers provide habitat for threatened NZ cress *Lepidium solandri*. Twelve patches were recorded, two of which were first recorded and tagged in 2006, showing how long lived these herbs are. Suitable habitat is relatively extensive on this part of the outwash surface but was not surveyed in depth due to time constraints. While the dominant plant community is *mouse-eared hawkweed herbfield-*sweet vernal grassland-rockland, native species diversity is relatively high and includes patotara, mat daisies (scabweed, Celadon mat daisy, *R. subsericea, R. apici-nigra*), patches of mat coprosma and creeping pohuehue, tufts of blue wheat grass (*Anthosachne falcis*) and desert poa; moss and lichens. Four individuals of the threatened native trailing bindweed *Convolvulus verecundus)* were also recorded in February 2019.

(iii) Matagouri Shrubland and Herbfield - Interpivot zone between Pivot Areas 15, 16, 20 and 21

The southern extend of the ephemeral stream channel that commences north of SH8 runs southwards through this area. The channel is dominated by matagouri (to 25%), some of which exceed 2m in height, and *briar. *Chewings fescue and *sweet vernal are common, together with occasional porcupine shrub, tree daisy, creeping pohuehue, plume grass, *Carex breviculmis*, scabweed and onion leaved orchid. Adjacent to the channel, fescue tussocks are present to 10% cover, with many onion leaved orchid, *Anthosachne falcis* and plume grass.

In 2006, boulder convex risers found in the vicinity of this ephemeral stream channel provided habitat for mat coprosma, Beauverd's mat daisy, desert poa, orchid *Pterostylis tristis* and native cress *Lepidium solandri* (DOC 2007). While not re-inspected, it is likely that these species are present in this undeveloped area.

(iv) Herbfield-loamfield - Interpivot zone between Pivot Areas 14, 15, 19 and 20

This area of undeveloped outwash surface supports a mosaic of *mouse-eared hawkweed-*haresfoot trefoil herbfield-loamfield and patches of *sweet vernal-fescue tussock grassland. There are patches of regenerating fescue tussock (cover of 20-30%) with scattered *sweet vernal. Intertussock species are typical of this locality, with notable species being desert broom, danthonia (*Rytidosperma buchananii)* and Celadon mat daisy; and scattered wilding pine.

There are areas with 40% bare ground, with *mouse-eared hawkweed, *sweet vernal and *browntop present. The bouldery swales are characterised by dryland species including scabweed, *Raoulia subsericea*, desert broom, desert poa, *Carex breviculmis*, and scattered *sweet vernal and *haresfoot trefoil.

The fenced Pivot Area 20 includes a triangle of undeveloped outwash surface where stock camp. It comprises a herbfield-loamfield with 30% cover of bare ground, 30% *mouse eared hawkweed, and many low growing plants characteristic of the dryland outwash surface i.e. *Carex breviculmis*, scabweed, desert poa, *Anthosachne falcis*, creeping pohuehue, blue tussock, plume grass, geranium, occasional fescue tussock, native moss and lichen species; *sweet vernal, *sheep's sorrel and *haresfoot trefoil. Over 40 plants of trailing bindweed *Convolvulus verecundus* were recorded here.

(v) Herbfield-loamfield - Interpivot zone between Pivot Areas 13, 14, 18 and 19

The 25ha area of undeveloped outwash surface between Pivot Areas 13, 14, 18 and 19 is dominated by

herbfield-loamfield, with patches of *sweet vernal-fescue tussock grassland.

The herbfield-loamfield comprises up to 50% bare ground with 20-30% mouse eared hawkweed. Other species include *haresfoot trefoil, *sheep's sorrel, *silvery hair grass, pimelea, patorara, desert broom, *Rytidosperma pumilum, Carex breviculmis, Rytidosperma buchananii*, tufts of *Anthosachne falcis*, Caledon mat daisy, creeping pohuehue, and mat coprosma. There are patches of onion leaved orchid. Although no plants were recorded, this habitat is suitable for threatened trailing bindweed.

The localised patches of grassland are dominated by *sweet vernal, with scattered fescue tussock, *briar, *sheep's sorrel, pimelea, patotara, and *mouse-eared hawkweed.

(vi) Fescue tussockland and herbfield-loamfield - North West of Pivot Areas 13 and 14

The most extensive area of dry outwash surface that has not been intensively developed lies to the north-west of Pivot 13 and 14 and is bound by the moraine necklace to the north, and the Pukaki River terraces to the west. It includes Pivot Area 9.

A mosaic of short tussockland, grassland and herbfield-loamfield is present. Short tussockland distribution is patchy. Fescue tussocks dominate, while intertussock vegetation includes the usual dryland exotic species, mat coprosma and patotara. Harding (2018) recorded additional native species including creeping pohuehue, *Carex breviculmis*, field daisy, slender everlasting daisy, *Stackhousia minima*, the tiny grass *Rytidosperma exiguum*, mosses and lichens.

Tussock cover is not consistent- there are areas within the central part of Pivot 9 where fescue tussocks are absent. There are local patches of native danthonia tufts (Harding 2018).

Herbfield-loamfield dominates the north and eastern part of this area, and is dominated by *mouse-eared hawkweed, *sweet vernal, desert poa, *sheep's sorrel and native moss and lichen species. Additional species include woody mats of creeping pohuehue, mountain pimelea, patotara, and mat coprosma; cushions of Celadon mat daisy and scabweed, harebell, native sedge, moss and lichen (Harding 2018).

At stony sites, additional species of interest recorded include native dryland species including *Luzula ulophylla, Convolvulus verecundus, Carex resectans, Colobanthus brevisepalus* and scabweed.

(vii) Herbfield-loamfield between the Pukaki River terraces and Pivot Areas 13 and 18

There are extensive areas of loamfield-herbfield dominated by *mouse-eared hawkweed and haresfoot trefoil, but providing habitat to a regenerating population of at least 31 individuals of the native trailing bindweed (**Convolvulus verecundus*), cushions of mat daisy (scabweed, *Raoulia hectorii*, *R. apici-nigra*); sedge *Carex resectans* and *C. breviculmis*; creeping pohuehue, desert Poa and mosses and lichens. A single cushion of *Pimelea sericeovillosa* subsp. *pulvinaris* was recorded. *Sweet vernal with scattered fescue tussock and clumps of plume grass is more common where deeper soils are present.

Problem Plants

At least 58 exotic species of plants are present on the Lease but relatively few are of conservation concern. Many are plants of agricultural importance or are common pastoral weeds.

Shepherd's Purse

Shepherd's purse (*Capsella bursa-pastoris)* is a known vector for white rust that infects both agricultural brassica crops, and the threatened native cress *Lepidium solandri*. One plant was recorded between Pivots 11 and 17, at the site where thousands of NZ mousetail were originally recorded. This site is close to a population of *Lepidium solandri* growing on the nearby outwash surface. White rust is known to proliferate in humid environments (such as irrigated areas) where host plants are present (Walker 2017b).

Gorse
Small gorse plants are present scattered mainly on the northern side of SH8 in near the Mary Range.

Wilding conifers
Young wilding pines are scattered on the SH8 road strip, and also on moraine slopes on the southern side of SH8. The pine plantation in the strip north of SH8 has been felled, but the seeds are still in the soil, and other live conifer stands are scattered upwind of the Lease. Control will be on-going. Wilding conifers threaten the conservation and landscape values of Simons Pass Pastoral Lease.

Sweet briar
Sweet briar is scattered throughout the undeveloped parts of the property. It is most common along the low terraces beside the Pukaki River bed, but is also present within the terminal moraine shrublands, Mary Range srublands, and scattered on the outwash plain However, some control measures might be required within the Desert Block if the area is released from herbivory, as the stock and rabbits likely suppress young briar plants.

Broom
Broom is not common on the property. A few shrubs are present on the northern side of SH8 road strip; ongoing control will be necessary.

Crack Willow
Crack willow trees are located in the streambed within the Mary Range shrubland, and beside a spring just south of the Farm Block. Crack willow can encroach on waterways and rapidly modify the aquatic habitat by providing greater amounts of shade and leaf drop into the stream. This has implications for native aquatic invertebrate fauna values; the trees should be removed. The crack willow trees planted along the stock water line within the River Block pose little threat to ecological values.

Flowering Currant
A number of flowering currant shrubs are present in the riparian shrubland located behind the shearer's quarters. Flowering currant is an invasive weed of forest and shrubland margins in wetter climates of New Zealand and would be an issue only within the shrublands of the Mary Range.

Exotic pasture species
Where exotic pasture species pose a threat to acutely and chronically threatened flora or uncommon habitats, consideration may have to be given to their control or management. Recent studies of acutely threatened spring annual species, all of which are found on the Lease, indicate that herbivore disturbance aids perpetuation of *Ceratocephala pungens* in its 'desert' pavement habitat, by suppressing taller herbaceous plants (Rogers *et al. 2007*). Vertebrate herbivory may also benefit threatened species within prostrate turf communities of ephemeral wetlands *e.g. Myosotis brevis* and *Luzula celata* by suppressing compositional transitions to taller vegetation and retarding competition of invasive exotic plants (Rogers *et al.* 2007; Johnson & Rogers 2003).

Hawkweeds
Mouse-eared hawkweed is present throughout the property but is most common on the outwash channels and plains, where it can be present to 80% cover. King devil hawkweed is localized, with patches being found in fescue tussockland on the Mary Range, and amongst shrublands.

Plant Species list Simons Pass

Grasses - Native

Agrostis muscosa
Anthosachne falcis
Anthosachne solandri
Chionochloa rigida
Deschampsia chapmanii
Deyeuxia avenoides
Dichelachne crinita

Grasses - Exotic

** Agrostis capillaris*
** Agrostis stolonifera*
**Bromus tectorum*
** Dactylis glomerata*
** Secale cereale*
**Aira caryophylla*
**Anthoxanthum odoratum*

Festuca novae-zelandiae
Lachnagrostis lyallii
Poa cita
Poa colensoi
Poa maniototo
Rytidosperma buchananii
Rytidosperma clavatum
Rytidosperma exiguum
Rytidosperma pumilum
Rytidosperma unarede

**Festuca rubra*
**Glyceria fluitans*
**Holcus lanatus*
**Lolium perenne*
**Poa pratensis*
**Triticale*

Sedges and Rushes - Native

Carex breviculmis
Carex colensoi
Carex flaviformis
Carex kaloides
Carex muelleri
Carex resectans
Carex secta
Carex solandri
Luzula celata
Luzula rufa var. albicomans
Luzula ulophylla
Schoenus concinnus
Schoenus pauciflorus

Sedges & Rushes - Exotic

**Carex ovalis*
**Juncus articulatus*
**Juncus buffonius*
**Juncus effusus*
**Juncus tenuis*

Herbs- Native

Abrotanella caespitosa
Acaena buchananii
Acaena caesiiglauca
Aciphylla aurea
Aciphylla subflabellata
Anisotome aromatica
Argyrotegium mackayi
Celmisia gracilenta
Centipeda aotearoana
Ceratocephala pungens
Chaerophyllum novae-zelandiae
Colobanthus brevisepalus
Colobanthus buchananii
Colobanthus strictus
Convolvulus verecundus
Crassula sinclairii
Dichondra brevifolia
Dichondra repens
Elatine gratioloides
Epilobium angustum
Euchiton audax
Euchiton traversii
Galium perpusillum

Herbs - Exotic

**Aceana agnipila*
**Aphanes arvensis*
**Brassica rapa var. rapa*
**Capsella bursa-pastoris*
**Cerastium fontanum*
**Cirsium arvense*
**Cirsium vulgare*
**Erodium cicutarium*
**Erophila verna*
**Hypericum perforatum*
**Hypochaeris radicata*
**Linum catharticum*
**Marrubium vulgare*
**Myosotis discolor*
**Myosotis laxa subsp caespitosa*
**Pilosella officinarum*
**Pilosella piloselloides subsp. praealta*
**Rumex acetosella*
**Sagina procumbens*
**Taraxacum officinale*
**Trifolium arvense*
**Trifolium dubium*
**Trifolium pratense*

Geranium brevicaule
Glossostigma elatinoides
Helichrysum filicaule
Hydrocotyle heteromeria
Hydrocotyle novae-zeelandiae var. novae-zeelandiae
Lepidium solandri
Leptinella serrulata
Limosella lineata
Lobelia perpusilla
Microseris scapigera
Montia angustifolia
Montia erythrophylla
Myosotis brevis
Myosurus minimus subsp. novae-zelandiae
Oxalis exilis
Plantago lanigera
Plantago novae-zelandiae
Plantago triandra
Ranunculus multiscapus
Raoulia apicinigra
Raoulia australis
Raoulia beauverdii
Raoulia hectorii var. hectorii
Raoulia monroi
Raoulia parkii
Raoulia subsericea
Rumex flexuosus
Scleranthus uniflorus
Sonchus novae-zelandiae
Stackhousia minima
Stellaria gracilenta
Viola cunninghamii
Viola filicaulis
Wahlenbergia albomarginata subsp. albomarginata

**Trifolium repens*
**Verbascum thapsus*
**Veronica arvensis*
**Veronica verna*
**Vittadinia gracilis*

Sub-shrubs, shrubs & trees - Native

Aristotelia fruticosa
Carmichaelia crassicaulis subsp. crassicaulis
Carmichaelia nana
Carmichaelia petriei
Carmichaelia vexillata
Coprosma cheesemanii
Coprosma intertexta
Coprosma perpusilla subsp. perpusilla
Coprosma petriei
Coprosma propinqua var. propinqua
Coprosma rigida
Coprosma virescens
Corokia cotoneaster
Discaria toumatou

Sub-shrubs, shrubs & trees - Exotic

**Cytisus scoparius*
**Larix decidua*
**Pinus contorta*
**Pinus nigra*
**Pinus ponderosa*
**Pseudotsuga menziesii*
**Ribes sanguineum*
**Rosa rubiginosa*
**Salix fragilis*
**Sorbus aucuparia*
**Ulex europeaus*

Leucopogon fraseri
Leucopogon nanum
Melicytus alpinus
Olearia odorata
Ozothamnus vauvilliersii
Pimelea oreophila subsp. lepta
Pimelea prostrata subsp. prostrata
Pimelea sericeovillosa subsp. pulvinaris
Sophora prostrata

Orchids - Native
Microtis unifolia
Prasophyllum colensoi
Pterostylis tristis
Thelymitra longifolia

Lianes- Native
Clematis marata
Muehlenbeckia axillaris
Muehlenbeckia complexa var. complexa
Muehlenbeckia ephedroides
Parsonsia capsularis var. tenuis
Rubus schmidelioides var. schmidelioides

Ferns - Native
Asplenium flabellifolium
Blechnum penna-marina subsp. alpina
Cheilanthes sieberi
Ophioglossum coriaceum
Polystichum vestitum
Pteridium esculentum

Lichens & Mosses - Native
Cladia aggregata
Xanthoparmeillia semiviridis
Hypnum cuppressiforme
Polytrichum juniperinum
Triquetrella papillata

Appendix 5 – Simons Pass Pastoral Lease photos

Vegetation Unit 1: Pukaki Terminal Moraine & western outwash surface

Plate 1: Pukaki terminal Moraine – prostrate kowhai, matagouri-mingimingi shrubland.

Plate 2: Western outwash channel with scattered shrubland on moraine ridge.

Vegetation Unit 2: Pukaki River Low Terraces

Plate 3: The low terraces beside Pukaki River support mossfield and herbfield with variable densities of sweet briar (2006).

Vegetation Unit 3: SH8 Northern Corridor

Plate 4: Healthy desert broom occupies the SH8 corridor.

Plate 5: The pine plantation and wilding pines have been felled, but wilding pines continue to spread across property from here and other sources.

Vegetation Unit 4: Foot slopes and high terrace of Mary Range & Outwash Channel

Plate 6: The moist outwash channel occupies the foreground, with the terrace and footslopes visible in the background.

Plate 7: Ephemeral wetland and channel on the valley floor – threatened NZ mousetail has been recorded in channels upstream of this dam depression.

Vegetation Unit 5: High Central Moraines including Farm Block- Node A

Plate 8: Healthy fescue tussockland at 580m north of Pivot Area 2 in Farm Block. Boulders provide refugia for native species.

Plate 9: Healthy shrubland with desert broom, coral broom, matagouri, mingimingi, *Coprosma intertexta* and scanted tree daisy on moraine ridge to northwest of Pivot Area, Farm Block. Within area currently proposed in the PP as unencumbered freehold (FH1).

Plate 10: Shrubland and fescue tussock-sweet vernal grassland to NW of Pivot Area 1 (top righthand side of the photo where vehicle is parked) that has been direct drilled with ryecorn.

Plate 11: A knoll in the inter-pivot area between Pivot Areas 1, 3 and 4 supports fescue tussock – sweet vernal grassland with porcupine shrub, creeping pohuehue, native grasses and herbs.

Plate 12: Matagouri shrubland and fescue tussock grassland remnant at east side of Farm Block. Damage that is evident caused by vegetation clearance activities (root-raking and rolling).

Plate 13: Undeveloped fescue tussock grassland with matagouri shrubland patches and erratic boulders support native herbs and grasses. Fenced block with black pine shelterbelts at eastern side of Farm Block.

Plate 14: Outwash plain in Pivot Area 5. Fescue tussock- sweet vernal grassland has recently been direct drilled with ryecorn

Plate 15: Moraine and outwash plain in Pivot Area 4 in the Farm Block. Native fescue tussock- sweet vernal grassland has been removed and direct drilled with ryecorn. Tracking is for an irrigation pipeline.

Plate 16: Some native dryland species have survived the direct drilling of open herbfield-loamfield areas that occupies the outwash plain at Pivot Area 5. The green herb *is Geranium brevicaule*.

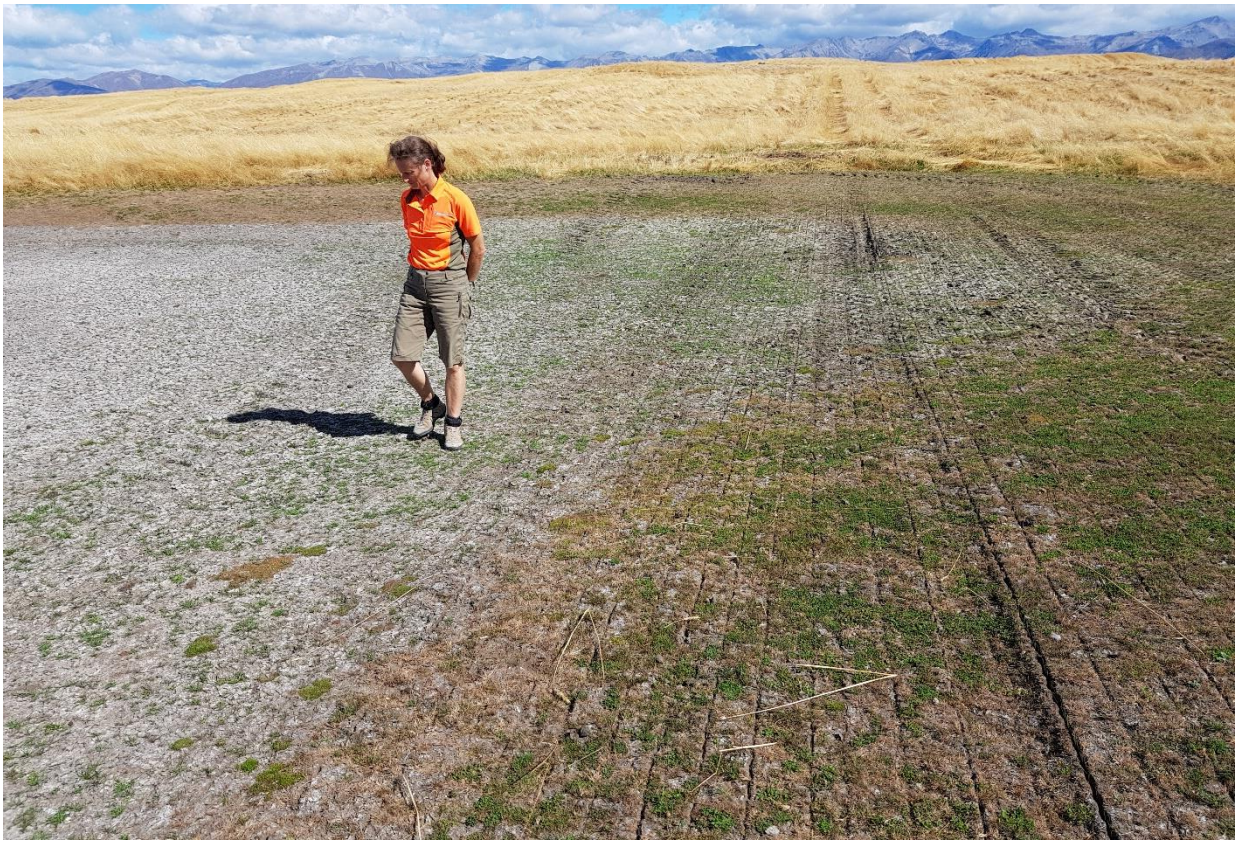

Plate 17: Recently exposed muddy depressions support native turf vegetation *including Montia angustifolia, Glossostigma elatinoides and Elatine gratioloides*. Surrounding vegetation is ryecorn and edges of the depression have been direct drilled with a second rotation of pasture or crops.

Plate 18: Some of the ephemeral wetlands are still ponded with water and provide important habitat to paradise ducks and at times, to Threatened (Nationally Critical) kakī / black stilt.

Vegetation Unit 6: East & South of Farm Block- Outwash-cut moraines, Balmoral moraine necklace and moist outwash surfaces

Plate 19: The moist outwash surface (arrowed) is visible just to the south of SH8. The lumps of Balmoral moraines marking the southernmost extent of the moraines on Farm Block are in the middle distance. These provide habitat for *Ceratocephala pungens*, a threatened spring annual herb.

Plate 20: Some of the Balmoral moraines at the western edge of this unit.

Vegetation Unit 7: Southern Outwash Plain including Node C

Plate 21: A sequence of boulder convex risers near the edge of Pivot Area 17 provide habitat for scattered *Lepidium solandri* that grow together with *Convolvulus verecundus*, Celadon's daisy, scabweed, patotara and *Anthosachne falcis*.

Plate 22: An ephemeral channel that drains down the eastern side of the Lease near Node C supports matagouri shrubland with briar, scented tree daisy and creeping pohuehue (a small remnant of shrub species that would have been present in pre- human times. Fescue tussocks, plume grass, *Anthosachne falcis* and orchids occupy the outwash gravels nearby.

Plate 23: The interpivot zone between Pivot Areas 13 & 14 supports areas of healthy fescue tussock with desert broom, *Pimelea*, patotara, plume grass, Celadon's daisy and occasional briar

Plate 24: Other parts of interpivot zones (e.g. between Pivot Areas 19 and 20) have bouldery swales that support more dryland species including mat daisies and *Poa maniototo*.

Plate 25: Healthy fescue tussock grassland just south of the moraine necklace, (Pivot Area 11)

Plate 26: Herbfield-loamfield between Pukaki River and Pivot Area 18. This open habitat *supports Convolvulus verecundus, Pimelea sericio-villosa* subsp. *pulvinaris*, Caledon's daisy, scabweed, mosses and lichens.

Plate 27: Pivot Area 12 (northeastern edge of the property) in the foreground, with Pivot Area 17 beyond. Native herbfield-loamfield dominated risers in the inter-pivot areas, supporting the Threatened (Nationally Critical) *Lepidium solandri* along with *Convolvulus verecundus*, Celadon's daisy, scabweed, patotara and *Anthosachne falcis*.

Appendix 6 – Mackenzie District Plan Analysis

RESOURCE MANAGEMENT INVOVLEMENT SUMMARY

FROM: Nardia Yozin

Assessment of Mackenzie Rules

Conclusion Summary:

There is no absolute protection of indigenous vegetation or habitat in the wider Mackenzie Basin. Both the Mackenzie District Plan (MDP) and Waitaki District Plan (WDP) contain provisions relating to the management of indigenous vegetation clearance and both contain limited control of non-vegetation habitat disturbance. These plans are both due for a review, with the MDP experiencing relevant plan changes to improve provisions, however, all plans generally have a life of 10 years, and are subject to change. This means that what may be protected through a plan provision currently, may not be protected in 10+ years' time.

The Mackenzie District Council has sought to improve the provisions relating to indigenous vegetation clearance and effects of landscape and amenity through Plan Change 13 and Plan Change 18 (PC18). However, there is still limited protection for indigenous vegetation in terms of how 'improved pasture' is identified.

Any indigenous vegetation clearance within the Mackenzie District can occur as either a permitted or consented activity, so protection is not absolute. While PC18 significantly improved the indigenous vegetation provisions, the improved pasture identification, lack provisions about non-vegetation habitat disturbance and permitted clearance for all utilities (including irrigation pipe lines) is still a gap which could lead to biodiversity loss. The Department submitted on PC18 provisions to try and address the gaps relating to improved pasture, however, a further plan change, or review would need to occur to manage non-vegetation habitat disturbance.

Background:

The purpose of this memo is to indicate the level of, or lack of protection for indigenous biodiversity within the wider Mackenzie Basin. This information is sough in relation to the Mackenzie Drylands Park

work which is looking at future options for management.

In terms of the existing planning framework, the area falls within Mackenzie District Council area which controls land use activities, while the Canterbury Regional Council controls discharges, and water takes.

The Mackenzie District Plan (MDP) recently underwent Plan Change 13 (PC13) which focussed on landscape effects within the Mackenzie Basin, and in Late 2017 notified Plan Change 18 (PC18) which introduced (with immediate legal effect) indigenous vegetation clearance rules to address a 'loophole' rule which was seeing uncontrolled and swift loss of indigenous vegetation within the Mackenzie Basin.

This district Plan is due for a review – however in light of PC13 and the loophole rule needing be addressed, the Council has focussed on reviewing those sections of the MDP which need to be reviewed immediately.

This memo only looks at the MDP as the provisions contained in this plan are most relevant in terms of managing biodiversity within the Mackenzie Basin.

This memo also discussed a number of 'Activity Status'. A description of these are outlined below:

- *Permitted:* you can undertake this activity without applying for a resource consent. Sometimes permitted activities have standards which outline the boundaries of the permitted activity (e.g. size/ area/ volume thresholds).
- *Controlled:* You will need to apply for a resource consent to undertake a controlled activity. However, when considering the application, the council must grant the consent and can only place conditions which relate to specific identified matters.
- *Restricted Discretionary:* You will need to apply for a resource consent to undertake a restricted discretionary activity. However, when considering the application, the council can only consider only those effects related to specific matters of discretion and can only apply conditions in relation to these matters. The council has the option to decline the consent.
- *Discretionary:* You will need to apply for a resource consent to undertake a discretionary activity. The council can choose to grant or decline the consent. If the council chooses to grant the consent, they can consider any actual or potential environmental effects.
- *Non-Complying:* You will need to apply for a resource consent to undertake a non-complying activity. The council can only grant the consent if the adverse environmental effects are minor, or if the activity is not contrary to the objectives and policies of the Plan. If the council chooses to grant the consent, they can consider any actual or potential environmental effects.
- *Prohibited:* This activity cannot occur.

The memo focuses on those landuse activities which pose the most risk to indigenous biodiversity. These activities include:

- Vegetation clearance (including indigenous vegetation clearance)
- Earthworks
- Faming and land intensification (oversowing, topdressing, cultivation, discing and irrigation)
- Tree planting (particularly wilding tree species)

Mackenzie District Plan:

The Mackenzie District Plan (MDP) is split into two parts regarding the 'Mackenzie Basin' based on whether or not the activity is occurring within the Mackenzie Basin Subzone (MBS). The MBs was introduced through PC13 and the majority of the MBS (excluding the Dobson Valley) is an Outstanding Landscape (ONL).

Discussion around rules which provide (some) protection measures:

The MDP has a number of overlays which provide additional management. These areas are mapped in the Plan and the mapped areas can only be amended or adjusted through a plan change process. These areas are:

- Significant Natural Area (SNA)
- Lakeside Protection Area (LPA)
- Scenic Grassland (SG)
- Scenic Viewing Area (SVA)
- Land Above 900m

There are generally more restrictive rules within these areas and riparian areas (not mapped – but are generally 20m from the waterbody).

Indigenous vegetation clearance

Within the whole Mackenzie District, all indigenous vegetation clearance is managed through the plan, unless the indigenous vegetation clearance is occurring within an area of improved pasture (this will be discussed in the risk section).

Any indigenous vegetation clearance will require a resource consent as a result of PC18. While the indigenous vegetation clearance provisions in PC18 have immediate legal effect, they are still subject to change pending a hearing which should be held within the next 8 months.

In terms of what clearance can occur-

- Any clearance within 'improved pasture'[27] is permitted.
- Any clearance outside of an SNA, LPA, SVA or on land below 900m, for the construction or maintained of utilities[28], is permitted.
- Where the indigenous vegetation clearance is occurring as part of a Farm Biodiversity Management Plan (FBP) and outside of an SNA, riparian margins or on land below 900m, it is a restricted discretionary activity.[29]
- If there is no FBP, any clearance below 5,000m² is a restricted discretionary activity.[30]
- Utilities (earthworks and clearance) within an SNA, LPA, SVA or on land below 900m are a Discretionary activity.
- Where the clearance is over 5,000m², within an SNA, riparian area or not part of the FBP, a non-complying consent is required.

Land disturbance (including earthworks, farming activities, pastoral intensification and agricultural conversion). Earthworks, farming, agricultural conversion, pastoral intensification provisions also have the potential to impact on indigenous biodiversity – particularly with respect to habitat. Where indigenous vegetation is not present, the vegetation clearance provisions will not be triggers. If a habitat is not identified as an SNA, there is very limited protection.

Within an SVA of SG the only permitted earthworks are for track maintenance. Within an SNA, LPA, Geopreservation Site and Riparian area, up to 10m³ or 20m² of earthworks can occur as a permitted activity, and outside of these areas, up to 300m³ can be disturbed as a permitted activity.

In all other areas, earthworks between 300m³ to 1,000m³ can be undertaken as a controlled activity and none of the matters of control relate to effects on indigenous biodiversity and therefore the consent must be granted and the effects on indigenous biodiversity cannot be a consideration of the council when drafting conditions to manage the effects of the activity.

Outside of the MBS, there are limited controls for farming and land intensification if there is no indigenous vegetation clearance occurring. Irrigators are permitted outside of the MBS, provided it is not occurring

[27] **Improved Pasture**: means an area of pasture where:
a. Species composition and growth have been modified and enhanced for livestock grazing within the previous 15 years, by clearance, cultivation or topdressing and oversowing, or direct drilling; and
b. Exotic pasture species have been deliberately introduced and dominate in cover and composition. For the purposes of this definition the assessment of dominance shall disregard indigenous vegetation which is growing upon land that has previously been modified and enhanced for livestock grazing in accordance with clause a) above and is less than 15 years old.

[28] 'Utility' includes all pipes for the conveyance of water – including irrigation and stock water.

[29] Through PC18, DOC submitted to amend the matters of discretion in relation to FBP's.

[30] Through PC18, DOC submitted to amend the matters of discretion in relation to clearance below 5,000m² undertaken as a restricted discretionary activity.

within an SNA and so is all agricultural conversion and pastoral intensification. Even within an SNA, farming activities can disturb up to 5% of the identified SNA as a permitted activity.

Tree planting (including wilding species)

Those species which have tendency to be wilding are generally managed through restricted discretionary, discretionary, non-complying or prohibited – depending on the location of the planting. The prohibited activity status only relates the wilding species within a Farm Base Area (FBA) which is only in the MBS. The matters of discretion for the discretionary activities do include the consideration of ecological effects.

Risks for Flora and Fauna in the Mackenzie District:

The PC18 provisions relating to Indigenous vegetation clearance may change in the near future, pending the completion of the plan change process. While there is a good level of protection provided by the PC18 rules although not absolute), this protection could be eroded through the hearing process.

There is also limited clarity in the indigenous clearance provisions around spring annual plants and if the land use change (e.g. pastoral intensification) occurs when the spring annuals are not in season.

The identification and management of clearance occurring as a permitted activity as part of maintaining improved pasture is not managed at all. Improved pasture is identified by way of a definition and does not require an assessment to be undertaken by a professional ecologist/ botanist and is up to the discretion of the landowner.

All vegetation clearance and earthworks for utilities outside an SNA, LPA, SVA or on land below 900m is a permitted activity. The trenching corridors for pipelines and utilities can be very wide. For example, the trench excavated for the pipe installed from the Tekapo stilling basin to Simons Pass was in excess of 30m and occurred as a permitted activity.

The indigenous vegetation clearance provisions only cover indigenous 'plant communities' and there is limited clarity around if this includes lichens and other organisms that may not be considered 'vascular plants'. This means that the areas containing non-vascular plant species will only be managed through the earthworks rules and any activities such farming, agricultural conversion and pastoral intensification would be able to occur as a permitted activity in these non-vascular' plant areas if they aren't identified as an SNA.

In terms of habitat where there a limited or no indigenous vegetation. Activities within these habitat areas will only be managed through the earthwork's rules and any activities such farming, agricultural conversion and pastoral intensification would be able to occur as a permitted activity in these habitat areas if they aren't identified as an SNA, LPA, SVA, SG or on land above 900m. More concerning is the

controlled activity status for earthworks between 300m³ to 1,000m³ outside of these areas as there are no matters of control relating to the effects on indigenous biodiversity.

Appendix 7 – Mackenzie District zoning maps, Simons Pass

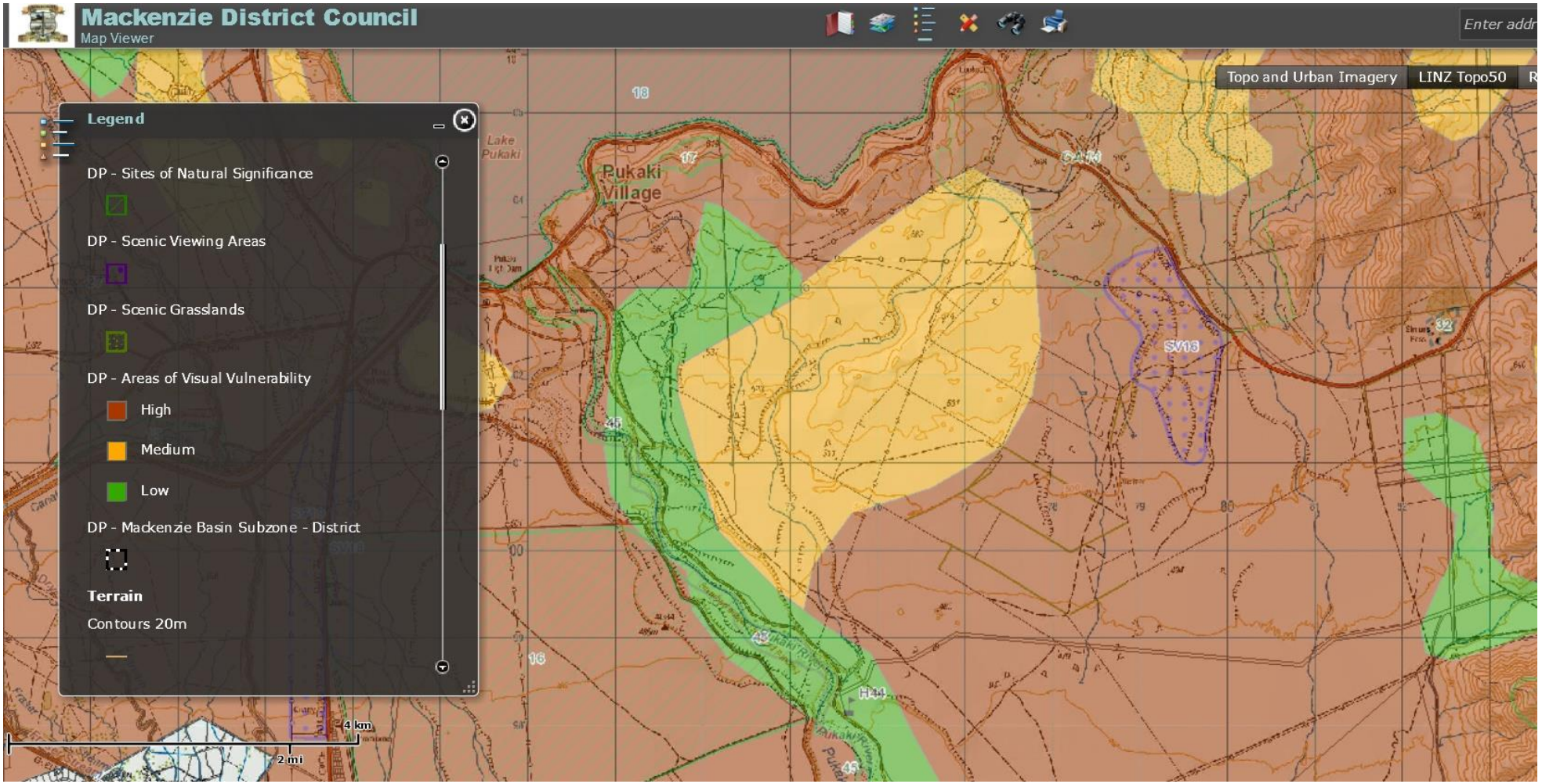

Figure 9. Mackenzie District subzones overlays. Relevant overlays for Simons Pass Pastoral Lease include Lakeside Protection Area, Scenic Viewing Areas, Scenic Grasslands and Areas of Visual Vulnerability (Low to High).

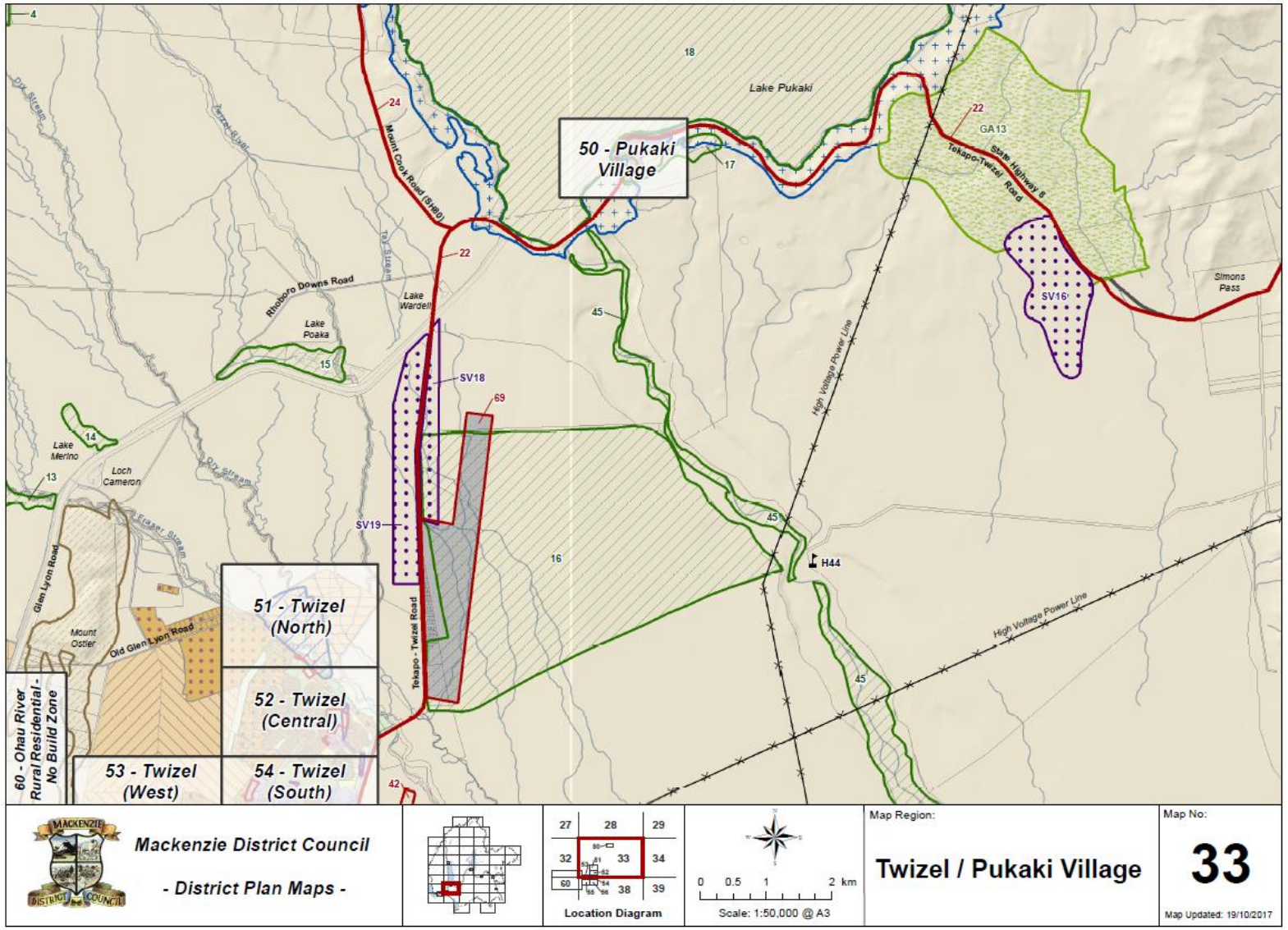

Figure 7. Mackenzie District Plan map. Refer Relevant subzone overlay shown for Simons Pass Pastoral Lease includes Lakeside Protection Area, Scenic Viewing Areas and Scenic Grasslands.