To: Toby Wilkes

From: Threatened Ecosystems & Species Unit Technical Staff
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Date: 26 February 2019

Subject: Access and Wildlife Act applications for 8-hole exploratory drilling programme, Denniston Plateau

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Summary

- Past and already-consented future industrial activity on Denniston Plateau has reduced the extent of many of the highly-valued sandstone plateau ecosystems to less than 60%. The risk of species loss and ecosystem change increases exponentially if less than 60% of the original extent of an ecosystem survives.

- Existing developments have already so adversely affected the naturalness of Denniston Plateau, it failed to meet criteria for an Outstanding Natural Environment, decreasing the likelihood of protection and increasing the likelihood of further industrial activity.

- Through incremental damage from both minor and major industrial activity, large-scale negative ecological effects have already accumulated on Denniston Plateau, to the extent that valued ecosystems and species are beyond assured sustainability.

- Weed spread on Denniston Plateau is at a tipping point, whereby the ecological integrity and naturalness of the remaining intact communities is highly threatened.

- The application proposes 8 x 144m2 drill sites plus an unspecified area for associated activities. These sites are in addition to 5 recently-approved drill sites, 51 historic drill sites, roading, communication towers, a quarry, a network of high voltage powerlines, a hydro pipeline, many underground mines and approval for major open cast mining at Escarpment and Sullivan's. Cumulatively these activities reduce the viability of threatened ecosystems and species on the Plateau.

- Seven of the proposed drill sites are beyond the edge of already disturbed ground in the Mt Rochfort Recommended Area for Protection (RAP). This would lead to the least-disturbed part of the last-remaining RAP on Brunner coal measures becoming more susceptible to weed invasion and less suitable for protected area status.

- The plateau is 1750 ha, 630 ha (36%) of which can be considered to be already disturbed by previous human activity or about to be disturbed under existing permits for industrial development. The remainder, including the application area, is to varying degrees, essentially intact.

- Allowing drilling of these new areas:
  - carries a high risk of triggering the complete loss of the rare Denniston sandstone plateau environment through a reduction in its ecological significance

  - Would result in the loss of individuals of the Denniston form of *Powelliphanta patrickensis*, Speckled skink, West Coast green gecko, forest gecko and loss of great spotted kiwi eggs or chicks. These are "threatened" species and require a substantially intact plateau for on-going persistence there.

  - "At risk" or "declining" species that would also be deleteriously affected include South Island fernbird, New Zealand pipit, the moth (*Tmetlophota blenheimensis*), the forest ringlet butterfly (*Dodonidia helmsii*), the caddisfly (*Kokira miharo*). Notable large-bodied invertebrates such as the mountain stick insect endemic to Denniston Plateau, the West Coast forest weta, and 3 species of peripatus would also be affected.

- The accumulation of many small and a few very large disturbances has already caused a significant decline in almost all valued components of the Denniston Plateau. This overshoot needs to be addressed if this is to be reversed.

- Ecologically, the proposed drilling would have significant adverse effects including:
  - Its disturbance of one of the few relatively untouched areas on the Plateau;
  - Tree removal at 5 of the 8 sites which would take decades to repair;
  - The death of threatened lizards and large land snails where the vegetation was crushed;
  - Degradation of the currently-intact west Whareatea area by a scattering of disturbed sites throughout it;
  - An increased risk of weeds along the new network of drill sites, access tracks and pipelines;
  - Reduction in the ability for the Department of Conservation to protect the remaining conservation values due to perceived degradation of the last substantial area of undisturbed Brunner coal measure vegetation on Denniston Plateau.

- No sites have low ecological value. Site EP-60 has both very high weed risk and high snail numbers and drilling is most undesirable there, as indeed it is at EP-53, EP-55, EP-56, EP-57 and EP-61 where vegetation would have to be felled and value to kiwi and lizards is high (Table 5).

- If access for drilling is granted, conditions should be set relating to minimisation of weed risk and to confinement of drilling to outside the kiwi breeding season (Appendix 1)

- Due to its ecological impact, the application for more drilling at Whareatea should be declined.

Context

Bathurst Ltd have applied for access to public conservation land to conduct further activities related to coal mining on the Denniston Plateau. The Terrestrial Ecosystems and Species Unit have been asked to provide advice on the biodiversity values at site and provide a balanced and concise report about the conservation values of proposed drill sites and the general area, the impacts of the proposed activity on the biodiversity values, including cumulative impacts, and a focus on sites containing the highest conservation values. Provision of a list of recommended special conditions should the project be approved was also requested.

This request follows an application by Bathurst for the same activity (exploratory drilling) in the same local area for 5 other drill sites, for which only Wildlife Act information was requested by the decision maker. All five of those initial drill sites are in a Schedule 2 wetland as is one of the current drill sites.

All 8 of the sites to which access is requested are in untracked ground distant from existing tracks or roads. As is best-practice in this situation, a helicopter would be used to deliver the drilling rigs to the site. Drilling would involve construction of a wooden platform at each site on which a drilling rig would be lifted using a helicopter. A small shed, fuel drums, metal baskets for storage of equipment and a 1000 L water container would also sit next to the drilling platform. A pipeline (using 40mm LDPE) would be laid either by helicopter or hand from each drilling site to the nearest suitable stream. In this area most pipelines will need to be around 1 km in length. For one or two of the drill sites (EP-57 and EP-54) on ridges between forest filled gullies, this will probably involve laying pipe through forest inhabited by great spotted kiwi. A diesel pump & fuel will be placed near the pipe intake. Up to 25,000 litres of water will be pumped per day up to the drill rig and drilling muds & surplus water discharged to land. Sediment from the discharge area will be caught by silt trap and removed for off-site disposal. Workers will walk to each drill site daily through untracked land.

This report provides advice on the terrestrial vegetation and flora values, the lizard fauna, the large land snail fauna and advice on some of the threatened bird species of the Denniston Plateau. This is a desktop exercise relying on extensive experience and knowledge of the site, along with the description of the site and activity by WPS Opus (2018).

The report is in two parts, the first a single project impact assessment and the second a cumulative impact assessment.

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Part 2. Cumulative Impact Assessment of Whareatea drilling

Introduction

For consideration of mineral permit applications on Public Conservation Land (PCL), the Crown Minerals Act (section 61) requires assessment as to whether an exploration activity is **significant**, in terms of:

- the effects it is likely to have on conservation values for the land concerned;
- the effects the activities are likely to have on other activities on the land; and
- the activities' net impact on the land, either while the activity is taking place or after its completion.

Despite this definition specifically including **net** impact at the time and afterwards, and on other activities, to date most project impact assessments undertaken on the Buller sandstone plateau of Denniston and Stockton have involved only consideration of immediate impact at individual sites at one point in time. This is problematic as even small impacts can over time or in concert with other impacts erode environmental quality.

The legislative framework

Cumulative impact assessment (CIA) protocols have been developed and are requirements in some Canadian, American and Australian legislation. In New Zealand, evaluation of cumulative impact is required by the Resource Management Act, but while it is considered a crucial part of the sustainable management regime, to date its application has been limited. DOC routinely considers the cumulative impact of additional tourist activities on public conservation land but has less often attempted assessments of the cumulative impact of other commercial activity on PCL. This is partly due to the paucity of relevant ecological information at most sites, a problem which is less applicable at the extensively-studied Denniston Plateau.

Cumulative Impact Assessment

Cumulative Impact Assessment recognises explicitly that, in any area or region, the effects of a particular activity on its own may be environmentally acceptable, but similar effects over time of many activities may not be acceptable (Smit & Spaling 1995). Cumulative impacts include those already evident and future impacts that are inevitable and predictable (Ross 1998, Jones 2016).

From the point of view of ecological sustainability, the most important characteristic is reversibility (Taylor Barnes Associates). The cumulative nature of many effects suggests that reversible effects may become irreversible if their cumulative impact reaches a threshold level. Cumulative impacts may interact such that they trigger or are associated with other impacts. They may reach 'tipping points' after which major changes in environmental systems may follow (Contant & Wiggins 1991, Damman et al. 1995; Canter & Kamath, 1995, Brereton et al. 2008). In CIA, impacts are measured not in terms of the intensity of the stress added by a given development but in terms of the response of the valued components of the ecosystem, and, ultimately, any significant changes to its condition (IFC 2013, Jones 2016).

Four requirements of CIA (Ross 1998, Franks et al. 2010, Harding 2015) are:

(1) to identify valued indicator ecosystem components affected by the proposed project and thresholds of acceptable change in value (scoping);

(2) determine what other past, present and future human activities have affected or will affect these components;
(3) predict the impacts of the proposed project in combination with other human activities and ongoing changes and determine the significance of the cumulative impacts;
(4) suggest how to mitigate, manage or avoid the cumulative impacts

A cumulative impact assessment of the proposed drilling programme

1) Scoping

Spatial and temporal scale

The first step of cumulative impact assessment is identification of a relevant scale in space and time over which impacts will be assessed. In the case of Bathurst's proposed drilling programme, Denniston Plateau is the relevant spatial area. Denniston Plateau differs from neighbouring Stockton Plateau in its vegetation, elevation, landform and degree of disturbance by mining (Lloyd 2012) and has been identified in many ecological assessments as unique (Overmars et al. 1998, Overmars 2012, Lloyd 2012, Mark 2012).

The relevant time frame is more equivocal, as the timing of fire which caused changes to the vegetation patterns is unknown (Overmars 2012). Underground mining and human occupation of the Plateau began in the 1880's. It changed in the 1950's to fully mechanized coal mining and road-making with fewer people but increasing scale of above-ground impact. The height of human occupation of the plateau—1900— is probably an appropriate start date, as better records of the changes to the environment began to be kept, and 20 years from now— 2039—an appropriate finish date as plans for this time period are already well advanced and known.

Valued indicator ecosystem components (VEC's)

1) High quality mosaic of unmodified mountain beech-pink pine forest, manuka bog shrubland, sandstone erosion pavement, red tussock fen and other non-woody wetlands, bound together by extensive ecotonal vegetation.
2) Strong populations of the endemic Denniston form of the land snail *Powelliphanta patrickensis.*
3) High community diversity and strong populations of West Coast green gecko *Naultinus tuberculatus*, Forest gecko *Mokopirirakau granulatus*, Speckled skink *Oligosoma infrapunctatum*.
4) Strong populations of Great spotted kiwi (*Apteryx haastii*) and Fernbird (*Bowdleria punctata*)
5) High numbers of large-bodied and notable archaic species in a strong and distinct assemblage of native terrestrial invertebrates
6) Negligible invasive species
7) Outstanding Natural Landscape

Limits of acceptable change

The threshold beyond which further change is not acceptable is the point at which a significant part of Denniston Plateau could not accurately be described as an intact, weed and pest-free natural environment with such high landscape, botanical and wildlife values, that it readily fulfils significance criteria, including that of outstanding natural landscape.

2) Past, present and predictable future activities likely to affect VEC's

Past

2.1) "Comparison of historical and current aerial photos (1943, 1959, 1974, 1982, 2011) reveals a time sequence of modification associated with human activities, more especially in the northern and eastern parts of the Denniston Plateau (Denniston township, Burnetts Face, Coalbrookdale to former Escarpment Mine). This includes vehicle and foot tracks, quarry and other clearings, buildings and other structures, and water bodies" (Overmars 2012)

2.2 "An extensive vehicle track network, associated with coal prospecting and with the installation of the first Inangahua-Waimangaroa high-voltage powerline, was created between 1943-1959. This was extended between 1974-1982 for access to the Sullivan West Mine and the second high-voltage power transmission line. The Mt Rochfort access road was formed beyond the Whareatea Mine between 1959-1974. Vehicle tracks east and west of Conglomerate Stream appeared between 1974-1982" (Overmars 2012.)

2.3 Underground, fully mechanized, and latterly hydro mining of coal at Sullivans, Whareatea and Escarpment from the 1950s to 1990s, requiring above-ground mine entrance area infrastructure and road and cableway transport links (Whybrew 2011). Acid mine drainage into Rapid Stream below Sullivan West Mine (Trumm 2007).

2.4 An extensive exploratory drilling programme of up to 51 drill holes in west Whareatea between 2002 and 2014 (BCL 2018) with a smaller drilling programme in central Denniston Plateau around Sullivans Mine over the same period.

2.5 In 2013 construction of a 1.9 km buried penstock and associated access road from near sealevel to Rochfort Reservoir and across to Whareatea Stream as part of the Kawatiri Energy hydro scheme.

2.6 In late 2014 open cast-mining at the eastern end of Escarpment Mine, before it was put into care & maintenance in 2016.

Predictable future impacts

2.7 Permanent loss of ~186 ha of Brunner coal measures ecosystem (~9% of the Denniston Plateau) through full use of Escarpment Mining Permit

2.8 Permanent loss of 318 ha of Brunner coal measures ecosystem through open cast coal extraction in Sullivan Mining Licence area

2.9 Substantial and permanent reductions in each of the identified Valued Ecosystem Components due to direct loss of populations and habitat and the transformative changes in topography, ground permeability, acidity, vegetation type associated with opencast coal mining.

2.10 Displacement of indigenous plants and invertebrates in low and open environments by the exponential spread of the weed *Juncus squarrosus* due to recent and reliably predicted future expansion of the area of open disturbed ground and increase in traffic.

Some of the effect of these impacts on VECs are summarized in Table 6 below.

Table 6. Existing and reliably predicted future damage to Valued Ecological Components on Denniston Plateau in the period 1900-2039

Existing damage	Extent	Effects
Radio translators & associated roading	Mt Rochfort summit and access route:	• Reduction in area of habitat available for native fauna & flora • Death of individuals living in affected areas • Degradation of adjacent areas through alterations in hydrology caused by road construction. This includes smothering of the ground by gravel or silt flow, arrival in roading gravel or on machinery new weed species, and spread of weeds down new water courses • Loss of natural character
Power pylons & associated roading	North & north-eastern sections of Plateau	• Reduction in area of habitat available for native fauna & flora • Death of individuals living in affected areas • Degradation of adjacent areas through alterations in hydrology caused by road construction. This includes smothering of the ground by gravel or silt flow, arrival in roading gravel or on machinery new weed species, and spread of weeds down new water courses • Loss of natural character
Coal mines & associated roading	Burnett's Face Banbury Coalbrookdale Sullivans Whareatea Escarpment	• Reduction in area of habitat available for native fauna & flora • Death of individuals living in affected areas • Degradation of sandstone pavement ecosystem through subsidence and splintering from underground mining. • Degradation of adjacent areas through alterations in hydrology caused by road construction. This includes smothering of the ground by gravel or silt flow, arrival in roading gravel or on machinery new weed species, and spread of weeds down new water courses • Loss of natural character
Exploratory drilling	Central, eastern & south-eastern sector	• Compaction, crushing and felling of woody vegetation • Death of sedentary invertebrates and lizards • Kiwi, fernbird & pipit breeding attempts aborted • Weed transport on machinery and foot
Gravel quarry	North east sector	• Death of individuals living in affected areas • Reduction in area of habitat available for native fauna & flora • Degradation of adjacent areas through altered hydrology and spread of weeds brought in by machinery • Loss of natural character

Weeds		• Invasion of rare ecosystems, red tussock fen & sandstone erosion pavement by *Juncus squarrosus* • Invasion of gorse, scotch thistle and introduced native plants along roads, tracks and human structures • Loss of food and shelter for invertebrates, including land snails • Loss of natural character
Water take & associated roading	Whareatea River	• Loss of river flow and freshwater habitat • Death of individuals living in the access road area • Degradation of adjacent habitat through altered hydrology and transport of weeds • Fragmentation of habitats by pipeline and road • Loss of natural character
Water pollution- acid mine drainage	Rapid Stream	• Loss of benthic communities • Loss of natural character
Water reservoirs	Lake Rochfort, 3 historic near Denniston	• Death of individuals living in the areas which were flooded • Degradation of adjacent land through increased drainage, causing a change in vegetation community • Loss of natural character
Predictable additional impact	**Extent**	**Effects**
Myrtle Rust	Widespread	• Ill-thrift or death of manuka (dominant species in~40 % of the vegetation) and southern rata • Increased light levels in manuka-dominated communities increases invasion by heath rush • Decline of *Powelliphanta patrickensis*
Opencast mining	Escarpment Mine Sullivans Mine	• Death of individuals living in affected areas • Reduction in area of habitat available for native fauna & flora • Degradation of adjacent areas through alterations in hydrology • Changed land form post-mining • Major alteration in vegetation structure and species composition • Additional large-scale roading • Major extension of weed species • Loss of natural creeks and streams • Loss of natural character

Predicted but currently un-consented future impacts

The above impacts have all either already occurred or have all or most of the consents necessary for full implementation. Additional impacts reliably predicted to occur within the next 20 years but for which consents have not yet been obtained include open cast mining of west Whareatea (including the area being considered in this drilling application) and construction of a major new haul road across the eastern Denniston Plateau from Whareatea to Burnetts Face and beyond (Figure 13).

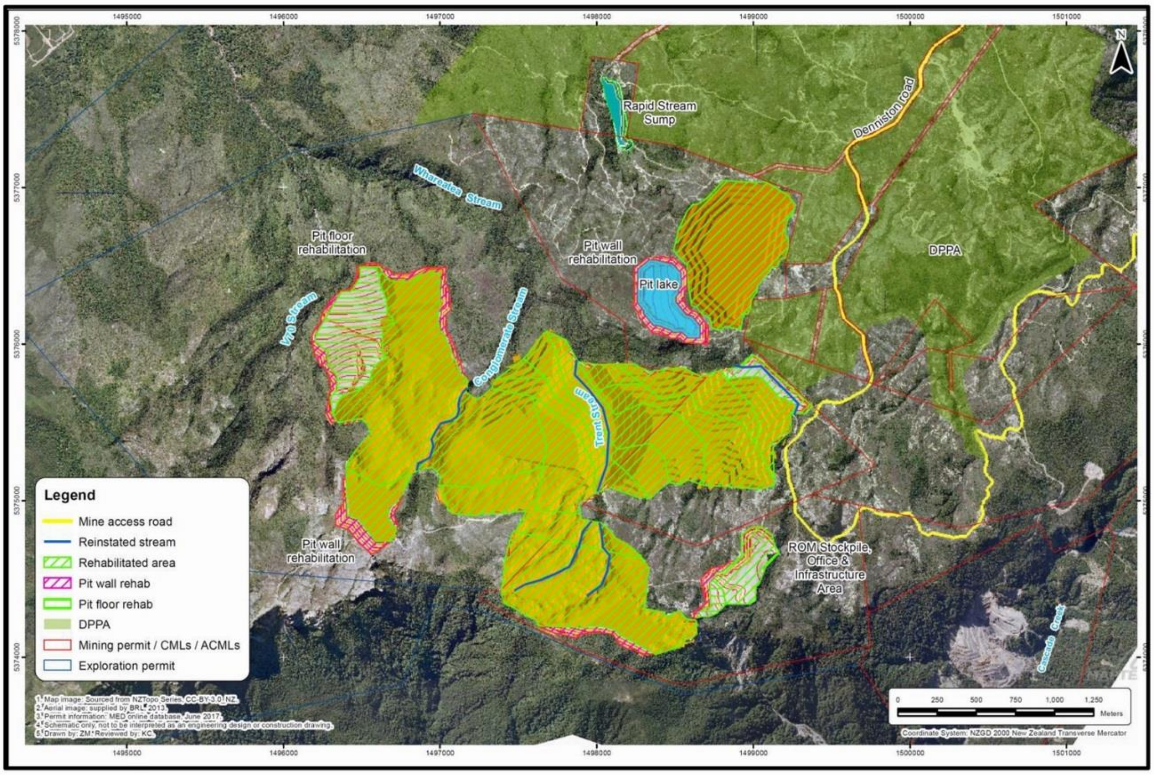

Figure 13. Conceptual development plan for Denniston Plateau, prepared for potential investors in Bathurst Resources in June 2018, showing the landform changes associated with already-consented open cast mining at Sullivan's (pit lake, high walls and mined land in the headwaters of Whareatea Stream in centre of map) and Escarpment (including the not fully-consented Trent Stream portion, bottom of map). In addition, BCL aspirations for open-cast mining in west Whareatea and associated infrastructure (a new haul road across the eastern Denniston Plateau) are shown. The latter do not have necessary consents so are uncertain but indicate impacts likely to occur within the next 20 years. Data from BCL accessed at http://bathurst.co.nz/assets/reports/Investor-presentation-June-2019.pdf

These still-to-be-consented activities have not been included in the current calculations of cumulative impact.

Current status of VECs given past and reliably predicted future impacts

Declines in vegetation communities

The present state of threatened species and rare communities on Denniston Plateau depend in large part on the changes to the extent and quality of the environment over the time period under consideration. The historic vegetation cover on Denniston Plateau was described and mapped by Lloyd (2012). Fire changed the nature and extent of the vegetation communities on Denniston Plateau (Lloyd 2012) but just when this occurred was unclear (Overmars 2012). The changes in the extent of each vegetation/habitat type that are anticipated from open-cast mining at Escarpment and Sullivans and the proportion of each ecosystem's original historic extent which will remain after this mining were calculated by Lloyd (2012) (Table 7).

Table 7. Total extent (ha) and proportion (%) of historic extent of important Denniston Plateau vegetation/habitat types which will remain once already-consented mining permits/licenses at Escarpment and Sullivans are fully utilized (adapted from Lloyd 2012).

Red tussock fen	0.7 ha	14%
Mountain beech-pink pine forest	243 ha	25%
Manuka shrubland	247 ha	49%
Plateau margin forest	65 ha	67%
Sandstone erosion pavement (small examples)	29 ha	69%
Other wetlands	33 ha	72%
Sandstone erosion pavement (large examples)	63 ha	76%
Chionochloa juncea fens and bogs	442 ha	88%

The main changes that are already set in train are thus significant reductions in the extent of red tussock fen, mountain beech-pink pine forest and manuka shrubland to historically low levels. There are smaller reductions in plateau margin forest, sandstone erosion pavement and other wetlands, the latter two particularly significant due to their national rarity (Lloyd 2012, Overmars 2012, Mark 2012). As described below, such reductions in ecosystem extent can be expected to have major impacts on biodiversity persistance

Ecosystem representation targets for long-term persistence of biodiversity

The Department estimated from the results of numerous studies in the literature that in general, when 60% of an ecosystem type remains, only around 80% of the species that rely on that ecosystem will remain (Gruner 2013). When less than 60% habitat remains, the proportion of species that persist rapidly decreases (Figure 14) until at 30%, most of the species that rely on the habitat will no longer be present (Gruner 2013).

Those species that will be lost through a decrease in ecosystem extent are unknown without specific study. So even if 60% of an ecosystem remains, a species that now relies exclusively on that habitat may be the one that is lost and thereby go extinct (for example large-bodied invertebrates) (Gruner 2013).

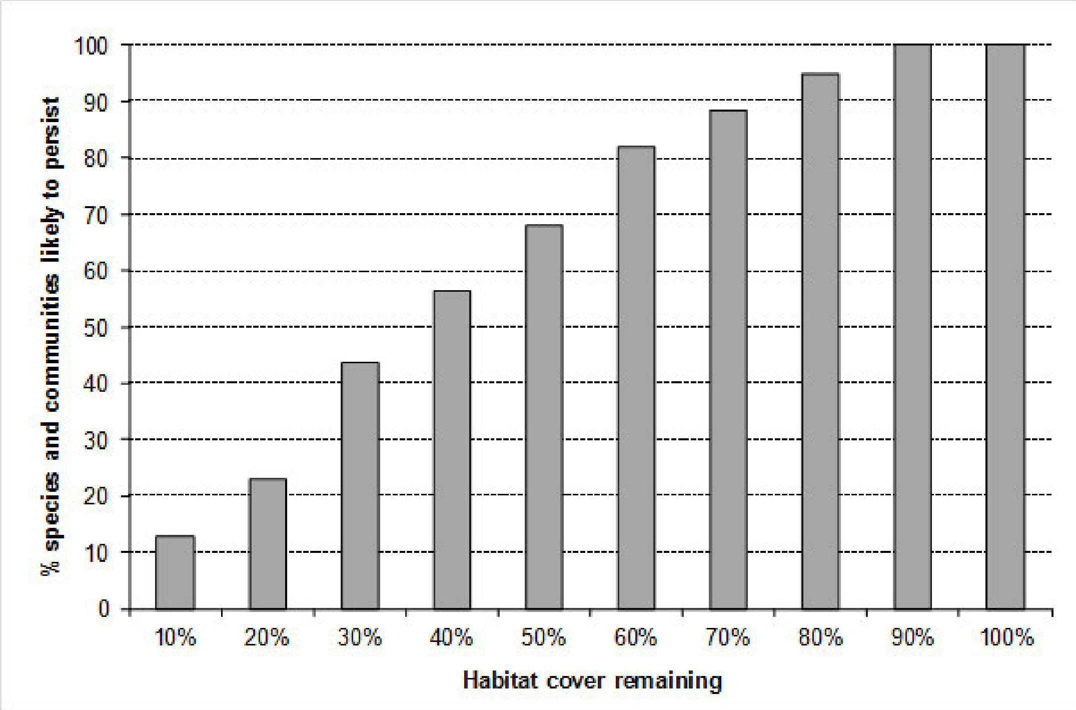

Figure 14. Cumulative percentage of species and communities likely to persist at increasing levels of remaining habitat cover, based on data in Price et al. 2007; Swift & Hannon 2010; Betts et al. 2007; Betts et al. 2010; Denoel and Ficetola 2007; Pardini et al. 2010; Rhodes et al. 2008; Zurita and Bellocq 2010; Zuckerberg & Porter 2010; Carlson 2000 (reproduced from Gruner 2013).

Declines in fauna

Only some birds, lizards and large land snails, and not the wider invertebrate communities on which this fauna depends, have been studied in any depth on Denniston Plateau. All faunal valued ecosystem components on Denniston Plateau have undergone decline at varying rates since 1900, primarily in terms of the loss of individuals as habitat disappeared, and the loss of carrying capacity of remaining habitat as it has become degraded. Habitat degradation is gradual and hard to quantify, so the scale of faunal declines is conservatively estimated from the extent of loss of their prime habitat, with losses from habitat degradation excluded.

Large land snails

1) The highest densities of *Powelliphanta patrickensis* occur in manuka-dominated communities, particularly where they form ecotones between forest and sandstone pavement and wetland.
2) Manuka shrubland was particularly impacted by fire and with the opencast mining predicted, will be at only 49% of its original extent, even if the newly-arrived disease myrtle-rust has no impact on manuka on the Plateau.
3) Loss of over 50% of its most important habitat is significant, particularly as this form is found only on Denniston Plateau.

Lizards

1) West Coast green gecko and Forest gecko use the full range of habitats on the plateau, so gecko decline in each habitat is proportional to the scale of the loss of each vegetation type. Overall, there is less than 58% of the original habitats remaining (Table 2).

2) Speckled skink use more open habitats present on the plateau. The ~30% decline in sandstone erosion pavement and the 50% decline in manuka shrubland equates to a significant decline in speckled skink.

Great Spotted Kiwi

1) Kiwi nest in forest but forage in forest, shrubland and red tussock wetland.
2) The major decline in the extent of mountain beech-pink pine forest and red tussock fen and smaller losses in the remaining vegetation types will have reduced the size of the population significantly.

Effectiveness of mitigation for Escarpment Mine impacts.

The losses detailed above were recognized by the Environment Court in 2013 which imposed conditions aimed at increasing the populations of birds, lizards and snails through exotic predator control. However, tracking studies by DOC have since confirmed that predator numbers are naturally at such low levels on Denniston Plateau that very limited increases in lizards, snails and birds can be expected from this approach.

Reductions in natural landscape character through weed spread

The recent disturbances have created bare ground where previously there was intact native vegetation. The use of machinery has spread the seeds of weed species, particularly the invasive species heath rush (*Juncus squarrosus*), whilst creating the open disturbed ground favoured by such weeds (Figure 15).

Figure 15. *Juncus squarrosus* growing abundantly on vehicle access track near Whareatea -Mt Rochfort Road turn-off on 19/03/2011. Photo reproduced from Overmars 2015.

Heath rush can form dense swards (Figure 15), displacing indigenous plants (Overmars 2015) and the invertebrates that shelter and feed on them. It may also disrupt successional pathways (Johnston 1993, Fenner et al. 2014) by trapping sediment, and stabilising eroded surfaces (demonstrated at Stockton and Millerton), so may facilitate succession to woody species (Bramley 2017).

Despite having slow growth and poor competitive ability in taller vegetation, its large production of long-lived (30-40 years) small sticky seeds, good seed dispersal ability by wind, water and attachment to human footwear and machinery, its ability to also reproduce via rhizomes, and tolerance to flooding, drought and multiple habitat types, make it highly invasive (Overmars 2015).

Overmars (2015) found heath rush to be mainly concentrated (Figure 16) in the two modified vegetation units (vegetation cleared by mining, roading or with a significant exotic component) which occupy about 120 ha (6.9%) in the east of Denniston Plateau (Lloyd 2010).

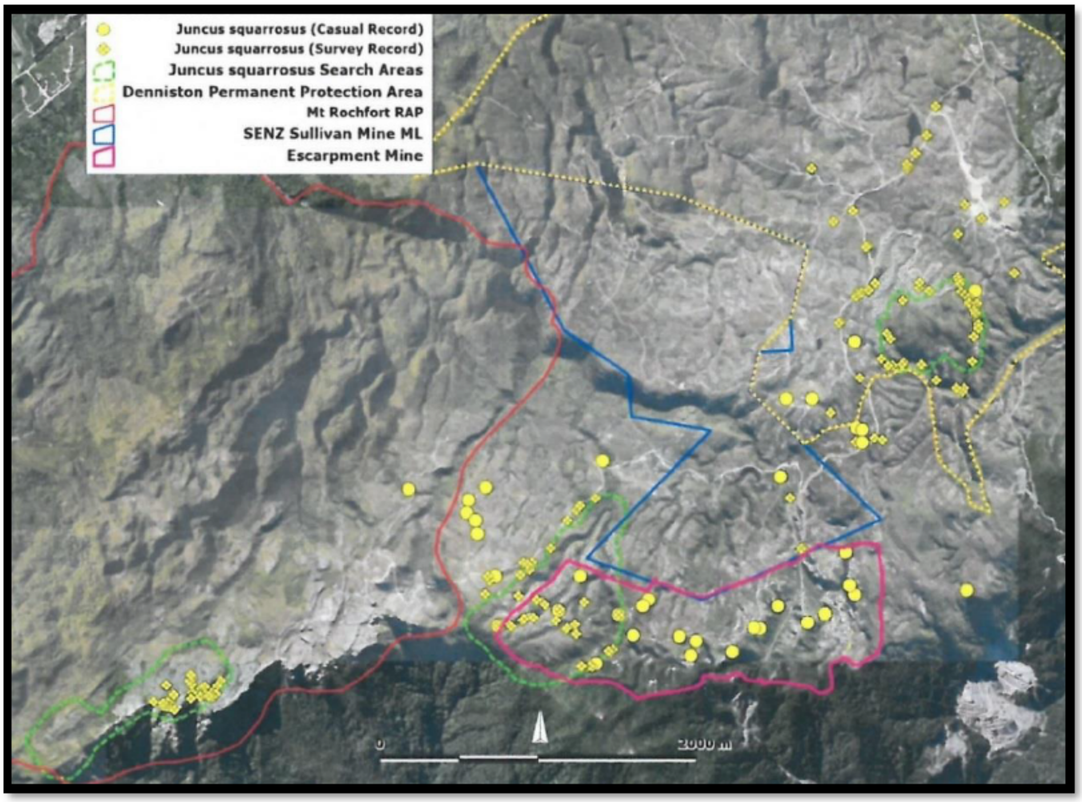

Figure 16. Heath rush records, Denniston Plateau, 2011-2015. Reproduced from Overmars 2015

In three ecologically important areas which it had been hoped could remain *Juncus*-free, plants were found on routes;

- used by lizard and snail surveyors at the "Original Patch"
- on the Mt Rochfort *Powelliphanta augusta* predator trapping line, and
- at Trent Stream at 3 of 8 drill sites and one foot-track to a drill site (Overmars 2015).

While it is still largely absent from substantial parts of Denniston Plateau, especially the southern part, these finds all suggest foot traffic as well as machinery are aiding dispersal of heath rush, despite hygiene efforts (Overmars 2015).

Although heath rush was first recorded from the plateau in 1955, there is much evidence the invasion process has not yet reached its full extent, as successful invasions all pass through a 'lag" phase (Overmars 2015). He considered in time heath rush will spread to all natural open and culturally disturbed sites on the plateau, which in the reliably predicted future includes all the Escarpment and Sullivan CMLs. There is a risk it will spread beyond its current environmental range and establish in the open low manuka pakihi and shrubland with short herb wetland vegetation which currently characterizes the open landscapes of the Plateau (Overmars 2015), particularly if myrtle-rust renders manuka less thrifty and more open.

As eradication is essentially impossible, achievable control options need to be confined to carefully selected topographically buffered localised areas of high conservation values, and would require avoidance of disturbance in such areas, including legal protection from disturbance (Overmars 2015).

3) Impact of an additional 8-hole drilling programme to VEC's

As described in part one, the 8-hole drilling programme would negatively affect by crushing and vegetation compaction the habitat of lizards, snails, kiwi, fernbird and pipit in the affected areas, have the potential to disrupt that season's breeding of kiwi, fernbird and pipit, cause the death of an unknown number of lizards, snails and other sedentary invertebrates. It would also increase the possibly of the invasive heath rush spreading into a currently weed-free area and rendering it less "natural" than it currently looks.

However, the proposed 8-hole drilling programme will have comparatively few long-term impacts on the VECs when compared to the recently-consented Escarpment Mine and the Kawatiri Energy hydro road and pipeline.

Unfortunately, the latter two major new developments, in association with the past and reliably predicted future impacts mean the sustainability balance has already tipped towards unsustainability of VECs on Denniston Plateau. Once already-consented activities are completed, less than 60% of many of the Plateau's most important natural ecosystems will be present.

Prior to the Escarpment Mine, 7% of Denniston Plateau was mapped as modified (Lloyd 2010). The Escarpment Mining Permit allows an additional 188 ha to be highly modified and if the already licensed Sullivan Mine (318 ha) becomes operational, then the total area lost (506 ha) will comprise about 30 percent of the entire extent of the Denniston Sandstone Plateau Ecosystem (Shaw 2012).

The Kawatiri Energy pipeline and access road recently removed an additional 1 ha of sandstone plateau ecosystem. Arguably more importantly, it fragmented the largest remaining weed-free area, and provided habitat for and a source of new weeds. The large-scale drilling programme undertaken since 2002 (Figure 17) has also increased the likelihood of weeds reaching otherwise intact areas in west Whareatea, through small-scale but widely distributed ground disturbance across a large area of otherwise undisturbed sandstone plateau ecosystem.

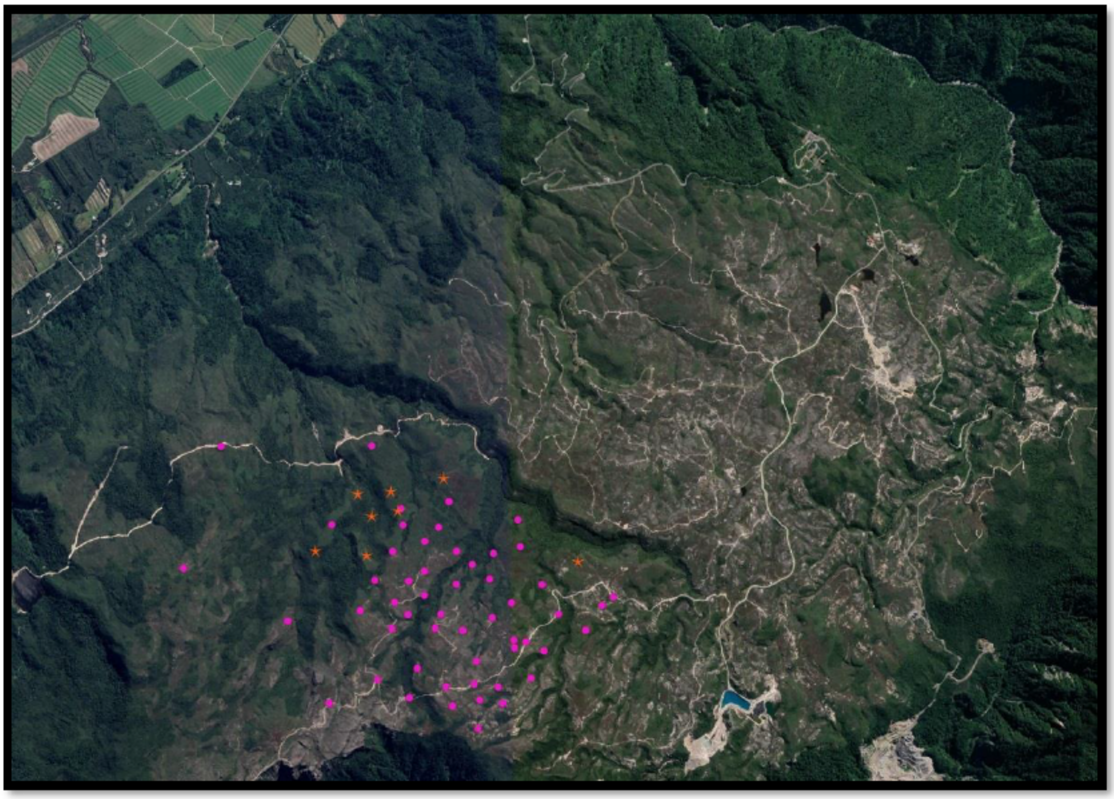

Figure 17. The 51 sites approved for drilling in 2002-2014 (pink dots) of which only the eastern-most were drilled, and the 8 new drill sites (orange stars) for which permission is currently being sought.

There is no evidence that, once lost, the endemic coal measure ecosystems of Denniston Plateau can be re-created (Overmars 2012, Lloyd 2012, Gruner 2013).

Due to existing impacts, industrial development on the Denniston Plateau has already overshot the point where the sustainability of the natural environment can be assured.

That weediness, and other human-induced changes to the Denniston landscape, also matter in legal protection of its ecosystems was highlighted by the Escarpment Mine resource consent appeal hearing in 2012. While the ecological and scientific values of Denniston Plateau were agreed to be "significant" in terms of the RMA, the commissioners hearing the case determined that it was not an "Outstanding Natural Landscape" which would have required protection "from inappropriate subdivision, use, and development" under section 6(B) of the RMA Act.

While the landscape experts for all parties agreed that the Plateau possessed outstanding aesthetic and associative values, the Commissioners hearing the case disagreed with the appellants' landscape expert that the area had moderate to high "naturalness" values, instead stating "that that there were just too many human interventions to turn a blind eye, given their pervasive presence" (Newhook 2013).

Given the differing views of the experts involved, this is an arguable conclusion (Figures 18 & 19). One group of experts says that the landscape has passed the point where it can be considered natural, while another group says that while it might be getting near it is still predominantly natural.

Cumulative Impact Assessments, particularly of public conservation land, usually include the wider community in the process (Brereton et al. 2008, Franks et al. 2010) so the issue of sustaining aesthetic and naturalness values remains relevant to consider.

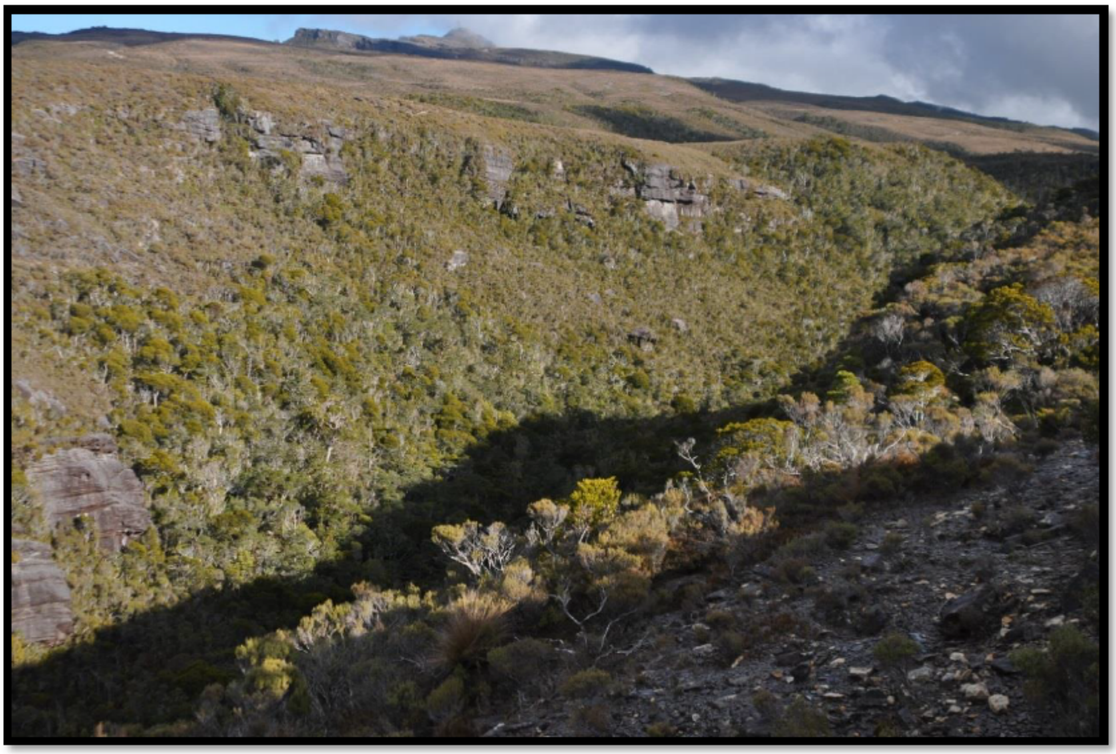

Figure 18. Looking across the Denniston Plateau towards Mt Rochfort and the west Whareatea area in which permission for exploratory drilling is sought. This southern sector of Denniston Plateau is still largely free of human influence, retaining a high level of natural character. Photo Kath Walker

Conclusion on Cumulative Impact Assessment

As a result of past and reliably predicted future human activity on Denniston Plateau over the time period considered:

- Most ecosystems are significantly reduced in extent.

- Pink pine-mountain beech forest, red tussock fen and manuka shrublands are now particularly poorly represented.

- Those vegetation communities provide important habitat for great spotted kiwi and *Powelliphanta patrickensis* and populations of these species will have declined in proportion to the loss of those habitats.

- Significant reductions in sandstone erosion pavement and manuka shrubland will have been accompanied by a proportional reduction in numbers of speckled skink, while populations of West Coast green gecko and forest gecko, which use all the plateau ecosystems, will have halved.

- Populations of less well-known components of the fauna, particularly invertebrates, including those on which kiwi, fernbird, pipit, large land snails and lizards depend for food, will have declined by on average 50%.

- Repeated rounds of exploratory drilling are damaging due to their shot-gun nature, scattering many small holes widely throughout formerly intact areas.

- The problem weed *Juncus squarrosus* is at an invasion state in which occupation of all naturally and culturally disturbed sites appears certain.

- Decades of human activity have fragmented the natural areas on the Buller Plateau and left sufficient mark that its outstanding landscape values are in question.
- The losses to ecosystems that have occurred or are already permitted to occur are irreversible.
- A tipping point has been reached, whereby further small incremental damage to the least disturbed areas carries a high risk of triggering a cascade of negative impact resulting in the loss of this rare environment.

Mitigation, management or avoidance of these impacts

Large-scale negative effects have already accumulated on Denniston Plateau, to the extent that the identified Valued Ecosystem Components are already beyond assured sustainability.

Previous activities—both big and small and including the very recently approved 5-drill hole application— were not considered from a cumulative impact perspective. In this way, a point has inadvertently been reached whereby all additional deleterious impacts, even relatively small-scale exploratory drilling, in a site that is not currently disturbed, which removes existing values and introduces a risk of weed invasion, should be avoided.

Conclusion of Cumulative Impact Assessment process

Cumulative Impact Assessment is better undertaken regionally, rather than at a project-by-project basis (Jones 2016) as here. This is in part because CIA can assist in the Resource Management Act requirement to avoid, remedy or mitigate any adverse effects of activities on the environment by quantifying and optimizing trade-offs.

The information gathered for this CIA provides some idea as to the scale of biodiversity decline which has accumulated on Denniston Plateau through incremental damage. This helps focus attention on how this damage could be mitigated.

One possibility is that future consents could try to deal with old problems (ie the sustainability overshoot on Denniston Plateau) by trade-offs such as relinquishment of existing unactioned rights.

However, such trade-offs, even if they were likely which in the case of Denniston Plateau they are probably not (Figure 13), need to be considered separately to the consenting process for an Access Arrangement to public conservation land.

Figure 19. Sandstone bluffs in the little-modified upper sector of the Mt Rochfort Recommended Area for Protection, outside the drilling application area, which help give the Denniston Plateau its high landscape values. Photo Kath Walker

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Appendix 1:
Recommended conditions should the drilling project be approved

Measures to protect wildlife

As noted in the report, wildlife salvage operations on the Stockton and Denniston Plateau in the past have not been shown to be effective in maintaining populations of the affected species at pre-disturbance levels. Accordingly, they are not recommended here. The focus instead is placed on gaining information by correctly identifying any lizards and invertebrates accidentally encountered and placing them out of the immediate path of activity and providing substantial financial compensation for species conservation elsewhere. Restricting drilling activity to April to June would reduce the impact on nesting of kiwi and other birds, but increase the danger to lizards, so is not recommended.

1. Suggested protocols for accidental discoveries of lizards are provided below.

Conditions

J1. Any lizards found in the course of actions authorised in this Authority must be captured and forwarded to the Buller *Kawatiri* Area Office within 24 hours for identification. Lizards must be housed individually in containers labelled with the capture location coordinates and date.

J2. All lizards must be handled carefully, with hands free from contaminants (e.g. fuel). Handling must be kept to an absolute minimum.

J3. Two litre containers with perforated lids that allow airflow but not the animal to escape must be used to transport lizards. The containers must be clean and contain damp litter 60mm deep (collected from where the lizard was located). Containers must be kept cool at all times.

J4. When requested by the Department, the captured lizards must be collected from the Buller *Kawatiri* Area Office and released at a translocation site as directed. Collection and translocation must occur within 24 hours of the request to do so.

J5. All due care must be taken to minimise stress to lizards during capture and handling. Should any lizard die, the specimen should be retained, stored in a refrigerator and forwarded to the Buller *Kawatiri* Area Office at the earliest opportunity.

2. The recommended protocol for accidental discoveries of snails, weta, peripatus, flatworms or other large bodied invertebrates is to take photographs of sufficient quality that identification of the animals is possible, then to move with contaminant-free hands the animals to a cool shaded and protected position immediately adjacent to the area affected by drilling. Records of the number and type of individuals found and a GPS location of both the area they were found in and the area they were moved to should be made. An electronic report providing these details and the associated photographs taken should be supplied to the Department of Conservation two weeks after drilling is completed at each drill site.

3. It is recommended that financial compensation for the losses to wildlife, including the loss of productivity for kiwi, fernbird and pipit, the death of more sedentary wildlife, and the damage to their habitat and to important vegetation communities, be required. This should be set at a level which provides a disincentive for disturbance to ecologically important sites such as this recommended area for protection.

Measures to protect against weed spread

4. At the applicants expense a quarantine facility must be established where all equipment to be taken to the drill site must be cleaned and then checked and signed off by experienced Department of Conservation quarantine staff before the site is accessed. This includes helicopter, drill rig, piping and other auxillery equipment, and the footwear, clothing and personal belongings of those who will be accessing the site. Once checked, these items must not touch potentially weed-contaminated ground.

5. Repeated visits to the site (eg each day that workers walk into the site) will require the previously-checked footwear, clothing & personal belongings to either be re-checked or left and picked up on following days from a weed-free station kept weed-free by a suitable DOC–approved transition system to be devised by the applicant.

6. A quarantine plan detailing the procedures to be used must be prepared by the applicant and approved by the Department of Conservation's island quarantine experts.

7. Monitoring for the presence of *Juncus squarrosus* should occur bi-annually at all sites for two years, and the person doing this monitoring needs to maintain the strict biosecurity regime for accessing the sites.
8. Any weeds found must be carefully removed in a manner which does not increase the amount of open disturbed ground.
9. A weed checking and removal plan must be prepared, approved and audited regularly by suitably qualified independent weed experts at the applicant's expense and to the satisfaction of the Department of Conservation weed experts.