Before a joint hearing of the

Otago Regional Council
Waitaki District Council

**RM 20.024**

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| Under | the Resource Management Act 1991 |
| In the matter of | applications by Oceana Gold (New Zealand) Limited for resource consents for the Deepdell North Stage III Project |

**Statement of evidence of Michael James Thorsen for Oceana Gold (New Zealand) Limited**

4 August 2020

**Qualifications and experience**

1 My name is Michael James Thorsen.

2 I am Director and Principal Ecologist with Ahika Consulting Ltd.

3 I have been working professionally in the biodiversity management field since 1990 for a number of organisations including the Department of Conservation (17 years), Mauritian Wildlife Foundation, United States Fish and Wildlife Service, St Helena National Trust, Landcare Research, Birdlife International, and as a freelance ecologist on a wide variety of flora and fauna restoration and protection projects throughout New Zealand, in Hawaii, Mauritius, Seychelles, Marquesas, St Helena and Kiribati. I have a PhD in Ecology from The University of Otago.

4 I have been providing support on biodiversity issues to OceanaGold at Macraes Mine since 2013. I am familiar with the area of the Macraes Mine and the general surrounds, having worked on vegetation and reptile studies in nearby areas for the Department of Conservation since 2005. My work with OceanaGold includes assisting the company to identify biodiversity values in its areas of operation; to advise on options to avoid, remedy, mitigate, offset and compensate for adverse effects on biodiversity arising from its mining operations; to assist with the implementation and monitoring the effectiveness of the company's biodiversity management activities; and to assist the company and other stakeholders develop enduring and socially acceptable biodiversity enhancements in the wider Macraes Ecological District.

5 I am familiar with many of the Macraes Ecological District's terrestrial ecological values, having undertaken various detailed surveys in parts of the district since 2004. While I am generally familiar with the whole Macraes Ecological District there are large parts of it that I have not surveyed in detail.

6 Although this is a Council hearing, I have read the Expert Witness Code of Conduct set out in the Environment Court's Practice Note 2014. I have complied with the Code of Conduct in preparing this evidence. Except where I state that I am relying on the evidence of another person, this written evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in this evidence.

**Background**

7 I provided OceanaGold with ecology advice after the 2013 Coronation Project had been consented. I was involved in formulating and implementing the Ecological Management Plans (**EMP**) that OceanaGold operates for Coronation and Coronation North and have monitored the ecological mitigation that has been undertaken. The Coronation North project involved a suite of mitigation measures and offset-like compensation that was subsequently expanded to include new ecological features discovered in the footprint.

8 I have been involved in the following terrestrial ecology work for the Deepdell North Project:

(a) In December 2019 providing an ecological impact assessment of effects associated with the Deepdell North Project on vegetation, avifauna and herpetofauna, which was included in Appendix D of the Assessment of Environmental Effects (**AEE**) submitted in support of the resource consent applications;

(b) In December 2019 providing a report regarding impact management of the Project's ecological effects and a proposed Impact Management Plan, which was included in Appendix D of the AEE;

(c) In responding to requests for further information from Waitaki District Council (**WDC**); and

(d) Throughout the project, providing OceanaGold with advice and support on biodiversity issues, including as the company has formulated a suitable mitigation response to address issues raised by the Department of Conservation and worked toward obtaining other authorities it needs for the Deepdell North Project, like a Wildlife Act authority.

9 In preparing this evidence I have reviewed:

(a) Existing resource consents for OceanaGold's Coronation North Project including WDC land use consent 201.2016.779 & 201.2013.360.1 and DCC land use consent LUC-2016-234 & LUC-2013-225A (the Coronation North consent conditions);

(b) The AEE lodged as part of the application for the Deepdell North Project including reports of other experts relevant to my area of expertise;

(c) The planning requirements relevant to my area of expertise in the Waitaki District Plan, and the Otago Regional Council (**ORC**) Regional Policy Statement (**RPS**) and Proposed Otago Regional Policy Statement (**PORPS**);

(d) The Kai Tahu ki Otago Natural Resource Management Plan 2005;

(e) Submissions from DOC, ORC and KTKO relevant to my area of expertise;

(f) The WDC Recommending Report including a Wildlands report on ecological matters; and

(g) The statements of evidence of other experts giving evidence relevant to my area of expertise. This evidence includes that of Mr Lee on project design and evaluations of alternatives, Mr Kyle and Ms Hunter on planning matters and conditions, Dr Ryder on freshwater values, Dr Tocher on reptiles and Dr Ussher on the adequacy of the proposed mitigation package,

**Scope of evidence**

10 I have been asked by OceanaGold to prepare evidence on terrestrial ecology for the Deepdell North project. In my evidence I:

(a) Summarise the vegetation and terrestrial fauna surveys carried out;

(b) Summarise the significant botanical and terrestrial fauna values in the Deepdell North Project Impact Area (**PIA**);

(c) Summarise the ecological values of the area affected by the Deepdell North Project;

(d) Assess the effects of the Deepdell North Project on these values;

(e) Outline options for mitigating the effects;

(f) Consider submissions raising issues relevant to my areas of expertise;

(g) Respond to the WDC Recommending Report;

(h) Provide comment on the appropriateness of the relevant proposed consent conditions in addressing the terrestrial ecological impacts of the Deepdell North Project; and

(i) Provide an overall conclusion.

11 My evidence is a summary of key points contained in the reports I provided in support of the Deepdell North application. For full detail I refer the panel to those reports.

**Assessment of project effects**

12 The information that was gathered during inventory surveys was used to evaluate the ecological importance of the vegetation, birds and reptiles and their habitats, against the widely used and accepted criteria recommended in the Environment Institute of Australia and New Zealand's 2018 Ecological Impact Assessment Guidelines (2nd edition):

(a) Representativeness of communities;

(b) Distinctiveness of communities;

(c) Ecological functionality of communities (intactness, connectivity, buffering);

(d) Rarity of communities;

(e) Community diversity;

(f) Role in ecosystem servicing;

(g) Sites or communities of significance at:

(i) National (Threatened Land Environments, National Priorities for Conservation, Historically Rare or Threatened Ecosystems, Wetlands of National Importance, Ramsar Sites);

(ii) Regional (as identified in the Regional Plan); or

(iii) Local (as identified in District Plans) scales;

(h) Sites identified as worthy of protection;

(i) Presence of rare, At Risk or Threatened species;

(j) Presence of species of biogeographical interest; and

(k) Presence of genetically or morphologically distinct forms.

13 In assessing the Deepdell North project I reviewed all available literature on the natural history of the Macraes area and unpublished databases. I also assessed the PIA (including alternative locations proposed for the WRS) using expert walk-through surveys.

14 The PIA includes the Pit and WRS zones where all ecological features will be lost to mining activities and a 100 m wide buffer surrounding these zones where some impact is possible, but the impact can be managed using standard practices.

**Ecological status of PIA**

*Botanical features*

15 I identified seven vegetation communities within the revised Deepdell North PIA. Their extent is summarised in Table 1.

| Vegetation Community | Pit | WRS | Buffer | Total |
|---|---|---|---|---|
| **Exotic vegetation communities** | | | | |
| Cultivated Pasture | 29.16 | 24.93 | 26.39 | 80.49 |
| Shelterbelts & Exotic Trees | | 0.53 | 0.08 | 0.61 |
| **Semi-natural vegetation communities** | | | | |
| Ephemeral Wetland | | 0.30 | 0.02 | 0.31 |
| Low producing grassland | 8.76 | 39.47 | 24.82 | 73.04 |
| Seepage | | 0.07 | | 0.07 |
| Shallow Ephemeral Drainage System | 0.50 | 1.91 | 1.79 | 4.20 |
| Shrublands | 0.08 | 3.65 | 7.36 | 11.09 |
| **Total** | **38.49** | **70.85** | **60.46** | **169.81** |

*Table 1. Areas (in hectares) of vegetation communities within the WRS and Pit areas of the PIA and a surrounding 100m wide buffer.*

16 The PIA is representative of the general vegetation patterns in this area of the Macraes Ecological District (**ED**). The vegetation of the Macraes ED is of a highly modified nature with a large amount of improved pastureland. The majority of the PIA is cultivated pasture, low-producing grassland (unimproved pasture dominated by pasture grasses but containing indigenous grasses and herbs) and low species diversity shrubland. The level of modification is evident in that the cultivated pasture has been recently induced for pastoral purposes. Typical of this area, shrubland is restricted to rockier areas. Shallowly incised seasonally wet gullies support a low diversity of wetland species. The area is heavily grazed.

17 The PIA has a moderate botanical diversity with 72 indigenous species and 78 exotic species.

18 Overall, the vegetation communities within the PIA are assessed as: of high rarity and moderate representativeness, botanical diversity importance, having moderate integrity and having a minor ecosystem services role.

19 The Deepdell North PIA does not contain any wetlands of National Importance or Ramsar sites. There are no wetlands identified by the ORC in its planning documents as Regionally Significant within the Deepdell North Area.

*Avifauna*

20 Ten indigenous species and eleven exotic species have been recorded in the PIA. Overall, the ecological importance of the avifauna is classified as moderate-low.

*Herpetofauna*

21 Three reptile species have been recorded in the PIA (the McCann's skink *Oligosoma maccanni,* the southern grass skink *Oligosoma polychroma* and gecko *Woodworthia* "Otago large" - the latter two species are classified as 'At Risk - Declining'). The ecological importance of the lizard populations within the Deepdell North Project area is categorised as moderate on the basis of; the presence of two At Risk species, the presence of genetically distinct lineages, the role they are likely to be playing in ecosystem function, and the low species diversity and abundance. As Dr Tocher discusses in her evidence, habitat for an additional reptile species – cryptic skink – has also been noted in the PIA, although whether this species is present and in what numbers is uncertain.

*Invertebrates*

22 The invertebrate communities of the site are relatively unknown, but 78 species (both indigenous and exotic) were recorded during surveys of the PIA and surrounding area. The ecological importance of the invertebrate communities within the Deepdell North Project area is categorised as moderate.

**Significant values in PIA**

23 There are 7 At Risk, one Data Deficient and three rare plant species and two At Risk reptile species within the Deepdell North PIA.

24 The ephemeral wetlands are degraded examples of a Historically Rare and Nationally Critical ecosystem.

25 The seepage wetland is a degraded example of a Historically Rare and Nationally Endangered ecosystem

26 Several ecological features are assessed as significant using the criteria in either the operative or proposed ORPS or the WDC District Plan. These features are summarised in Table 2.

| Vegetation Community | Significant under operative RPS? | Significant under OPRPS? | Significant under WDC District Plan? |
|---|---|---|---|
| **Cultivated Pasture** | | | |
| **Ephemeral Wetland** | ✓ (habitat of rare species) | ✓ (representativeness, distinctiveness, rarity) | ✓ (representativeness, rarity) |
| **Low-producing grassland** | ✓ (habitat of rare species) | ✓ (rarity) | ✓ (representativeness, rarity) |
| **Seasonal gully drainage** | | ✓ (representativeness, rarity, distinctiveness) | |
| **Shrublands** | ✓ (habitat of rare species) | ✓ (representativeness, rarity) | ✓ (representativeness, rarity) |
| **Seepage** | ✓ (habitat of rare species) | ✓ (representativeness, rarity) | ✓ (representativeness, rarity) |
| **Plant species** | | ✓ (rarity) | ✓ (rarity) |
| **Avifauna** | | ✓ (rarity) | ✓ (rarity) |
| **Herpetofauna** | | ✓ (rarity) | ✓ (rarity) |
| **Invertebrates** | | | |

**Effects on values**

27 I outline the key points from my assessment of effects because they are largely accepted

28 I consider the overall impact of the project on:

(a) Avifauna is moderate-low;

(b) Herpetofauna is moderate;

(c) Invertebrates is moderate (but poorly known) and

(d) Botanical features is mostly moderate, but impact on ephemeral wetlands and seepages is by definition considered high because of their Historically Rare status. This definition does not account for the degraded condition of these features and their current actual low ecological value.

**Proposed mitigation of project effect's on terrestrial ecology features**

29 Under my guidance OceanaGold has followed an appropriate approach to mitigation, using an implementation hierarchy of: avoid where possible, then remedy or minimise (mitigate) before an offset or finally ecological compensation activities can be considered.

*Avoid*

30 Mining, by its very nature, makes it difficult to avoid an ecological feature where it overlays the targeted resource. For this reason, opportunities to avoid ecological features overlying the proposed extent of the Deepdell North Pit were not possible. However, there were opportunities to avoid impacts arising from some mine activities. As described in Mr Lee's evidence, OceanaGold has chosen to re-site the Deepdell North WRS to avoid some significant vegetation and impacts on waterways (and heritage features). I support this approach. Further, once the project is underway OceanaGold can also take steps to delineate any ecological features that fall within 20m of the proposed WRS margin and identify the tip-point to notify the relevant operator of the need to unload carefully.

31 Avoidance will also be achieved through staging construction of the WRS and by isolating important ecological features in the buffer zone.

*Remedy*

32 The western clearwater drain will be rehabilitated to provide habitat for indigenous aquatic species, including freshwater crayfish (koura).

33 Rock flake 'bridges' will be provided to facilitate lizards crossing drains.

34 The new pit lake and rehabilitated WRS are expected to produce replacement habitat for the individuals of spur-winged plover and NZ pipit and for the breeding colony of black-backed gulls.

*Minimise*

35 The impact of the Project on terrestrial ecology values will be minimised or mitigated by use of methods OceanaGold already undertakes at the Mine such as dust suppression; weed surveillance (regular [every two years] inspection of the area around mine operations for new weed species); fire response (a site fire avoidance protocol and rapid response to any suspected fires); and rescue of ecological features (removing them [or propagating parts of them such as seeds or cuttings] and establishing them in a new location).

36 This latter method has been utilised in the mitigation package OceanaGold is volunteering, with all thirteen rare plant species to be rescued, cultivated, and replanted into safe sites.

37 These thirteen species that have been identified for 'rescue' are:

three species which will be subject to follow-up monitoring:

The Locally Uncommon shrub *Melicope simplex* from the eleven trees in the WRS to twenty individuals at one site in the nearby OceanaGold Highlay Creek Shrubland Covenant to create a new population there.

The Locally Uncommon shrub *Myrsine divaricata* from the two individuals in the WRS to 10 individuals at one site in the nearby OceanaGold Highlay Creek Shrubland Covenant to create a new population adjacent to an existing population.

The Naturally Uncommon wetland rush *Juncus distegus* from approximately 370 $m^2$ to 50 plants in the Redbank EEA.

The success of moving the following ten, lower importance, species will not be monitored:

The Declining wetland sedge *Carex tenuiculmis* from the 10 plants in the buffer area to 20 individuals planted in the Cranky Jims Wetland Covenant to enhance the population there.

The Declining coral broom *Cramichaelia crassicaulis* from the 2 plants in the WRS area to 10 individuals in the adjacent Highlay Creek Shrubland Covenant to create a new population there.

The Declining desert broom *Carmichaelia petriei* from the 7 plants in the WRS area to 15 plants in the adjacent Highlay Creek Shrubland Covenant to bolster the population there.

The Declining small wetland rush *Juncus pusillus* from the $1m^2$ patch in the WRS to 10 plants in the Ephemeral Wetland EEA to create a new population there.

The Declining button daisy *Leptinella perpusilla from the $1m^2$ in the WRS to 10 plants in the adjacent Highlay Creek Shrubland Covenant to create a new population there.*

The Declining small wetland herb *Lobelia ionantha* from the $0.5m^2$ in the WRS to 10 plants in the Ephemeral Wetland EEA to create a new population there.

The Declining grass *Rytidosperma buchananii* from the 1 plant in the WRS to 5 plants in the adjacent Highlay Creek Shrubland Covenant to create a new population there, if the sole individual can be refound.

The Naturally Uncommon hookgrass *Carex subtilis* from the 1 plant in the WRS to 5 plants in the adjacent Highlay Creek Shrubland Covenant to supplement the population there, if the sole individual can be refound.

The Data Deficient liane *Parsonsia capsularis* var. *tenuis* from 1 plant in the buffer area to 10 plants in the adjacent Highlay Creek Shrubland Covenant to create a new population there.

The Locally Uncommon small sedge *Carex resectans* from the $1.6m^2$ area in the WRS area to 10 plants in the Ephemeral Wetland EEA to create a new population there.

*Offset*

38 Following adoption of the Avoid, Remedy, Mitigate actions, there are expected to be some more-than-trivial residual adverse effects on terrestrial ecology values and therefore the feasibility of employing offsets was investigated.

39 To address these residual adverse effects it is planned to implement offsets at two sites, one to address the effects on the ephemeral wetlands, the other to address all other remaining residual effects, both with protective covenants.

40 The Redbank Ecological Enhancement Area (EEA), 6.5 km southeast of Macraes township, will include site(s) for offsetting of project effects on both the shrublands and the seepage wetlands.

41 The shrubland offset will involve addressing the project's effects on the 3.73 ha of shrubland with an estimated 40% canopy cover that will be lost from the pit and WRS zones by permanently fencing, supplementary planting and diversifying 12 ha of shrubland with an estimated 33% canopy cover in the EEA to produce and maintain a shrubland with a 75% canopy cover inhabited by 18 species and no exotic shrubs within 10 years and increasing in height to 2 m average canopy height within 20 years. This offset will result in NNL and has an average Net Present Biodiversity Value of 0.18.

42 The seepage offset will involve addressing the project's effects on the 0.07 ha of seepage with an estimated 33% cover of indigenous species that will be lost from the WRS zone by permanently fencing and controlling wetland weeds in a 0.8 ha seepage with an estimated 50% canopy cover in the EEA to produce and maintain a seepage with a 70% cover of indigenous species within 10 years. This offset will result in NNL and has an average Net Present Biodiversity Value of 0.10.

43 The Ephemeral Wetland EEA, on Mt Stoker Road near Middlemarch 30 km southwest of Macraes township, is a 4.8 ha ephemeral wetland (the largest in the E.D.) with an estimated 5% cover of indigenous species that will offset for project effects on 0.3 ha of degraded ephemeral wetlands with an estimated 20% cover of 15 indigenous species in the WRS zone and a small connected area in the buffer zone by first implementing a research programme involving examining the utility of sheep grazing, mechanical and chemical weed control, and restoring lost avian function, to identify the most effective management mechanism(s) that can then be employed to produce and maintain a 20% cover of 15 indigenous species over at least 2 ha of the ephemeral wetland.

Planning of these offsets has advanced considerably since the lodging of the application, and as discussions with the Department of Conservation in particular have proceeded. Comments from Dr Lloyd on behalf of the Waitaki District Council have also informed the development of the offsets. Advanced drafts of Ecological Enhancement Area Management Plans (EEAMP) for both offset sites have been produced. The current drafts of the offset EEAMPs are attached as Appendices to my evidence.

*Compensation*

44 The inclusion of 23.6 ha of low-producing grassland in the Redbank EEA is in recognition of the role this primarily exotic vegetation community has in harbouring indigenous biodiversity.

45 It is considered that creation of the covenant at the Redbank EEA provides adequate compensation for the project's impact on invertebrate communities, matagouri, the Naturally Uncommon grass *Anthosachne falcis* and broom *Carmichaelia petriei*,

46 The protection by covenant of the seepage wetlands and gully wetlands in the Redbank EEA provide adequate compensation for the loss of area occupied by the wetland rush *Juncus distegus.*

*Nil actions*

47 No action is planned for the remaining avifauna features or the seasonal gully drainage vegetation community as the overall project effect is considered to be very low for both, and the seasonal gully drainage vegetation community is dominated by exotic species.

48 Following consultation with experts from DOC and WDC, the offered mitigation package has been modified, in particular by including all rare plant species except matagouri and the grass *Anthosachne falcis* in the plant rescue mitigation package, modifying the actions planned at the offset sites to include permanent fencing and addressing lizard impacts through the LMP. I believe the attached documents adequately address the concerns expressed, except:

(a) concern has been expressed by both DOC and in the WDC recommending report about retaining grazing within the Redbank EEA. There are several reasons why grazing is being proposed:

(i) the Macraes ED has a very diverse and numerous flora and this is likely a result of over 700 years of human activity, including burning by Maori and settlers and low-intensity grazing by sheep and cattle that has promoted the development of novel human-induced near-natural habitats such as extensive narrow-leaved tussock grassland and a mosaic of habitat patches.

(ii) Many of the plant species of conservation concern (some of which have nationally important populations in the Macraes ED) are small herbaceous species that are particularly vulnerable to competition from taller exotic vegetation. Grazing helps reduce this competition, allowing these species to persist.

(iii) It is well known that when a major ecological modifier (such as grazing mammals) are removed from an ecosystem there follows a cascade of ecological changes, many of which are hard to predict, that can cause unintended negative consequences.

(iv) It is my strong belief, based on 20 years of working on the Macraes flora, that removal of grazing from the Redbank EEA will eventually result in the loss of diversity of both vegetation communities and indigenous species. For example, nearly all the narrow-leaved tussock grassland will be lost through colonisation by shrubland and depauperate forest the low-producing grassland vegetation type will also be lost to shrubland succession and weed competition will result in decreased population sizes or local extinction of some plant species, including several of high conservation concern.

I do recognise that grazing also has negative impacts on native flora, and for this reason it is proposed that 1) sensitive areas are fenced to exclude stock, and 2) the effects of grazing on the biodiversity values of the EEA are carefully monitored and management changed if required to achieve the intended outcomes (which could include removing stock and fencing the covenant). I believe this is adequate safeguard.

Another benefit of retaining grazing under appropriate ecological oversight is that there will be learnings on how to incorporate farming practices into biodiversity management of farms in the Macraes and wider dryland Otago area.

(b) There is some concern from DOC that shrubland expansion in the Redbank EEA may be controlled once targets are reached. The sole reason for this is to prevent the succession of narrow-leaved tussock-grassland and low producing grassland into shrubland. The most appropriate methods of shrubland control will be employed that protect other important biodiversity values. This activity will also be under the oversight of the oversight group.

49 These actions will, I believe, result in maintaining the ecological features and will probably result in improvement in condition of some features.

50 The management of project effects on aquatic values is addressed in Dr Ryder's evidence and on lizard values in Dr Tocher's evidence (which also addresses Wildlife Act (1953) matters).

51 An overall evaluation of the adequacy of the proposed remediation package was undertaken by Dr Ussher, who considers it consistent with current best practices.

52 Updated versions of the Impact Management Plan, Redbank Ecological Enhancement Area Management Plan and Ephemeral Wetland Ecological Enhancement Area Management Plan including the changes in response to submitters are attached as Appendices.

**Submissions**

Additional comments raised by submitters are addressed here

*DOC*

53 The Director-General of Conservation has lodged a submission in opposition to the project on the basis that as notified OceanaGold's application did not adequately avoid, remedy or mitigate adverse effects of the proposed activity. Representatives of the Department of Conservation (**DOC**) have since been provided with further information by OceanaGold and have had discussions regarding the effects management package and conditions of consent.

54 DOC (at 2b) proposes rehabilitation of the WRS, Pit and Pit Lake. This was not proposed in the IMP (except over areas of the WRS to mitigate the impact on lizard populations) because it is the community's wish that the site be rehabilitated to farmland and the technical difficulty of rehabilitating heavily modified land back to a natural vegetation community.

55 DOC (at 4a) suggest the Project will affect Threatened plants in the wetland areas, but I have not found any Threatened species in the PIA and believe inclusion of this term is an error.

56 DOC (at 4) raises concerns with how lizard species are addressed. To address these concerns a specialist herpetologist, Dr Mandy Tocher (Ryder Environmental Limited), was engaged to review the lizard information in the AEE and her review is attached as Appendix XXX). She is also producing a Lizard Management Plan that I believe will address DOC's concerns.

57 DOC (at 4d) suggests using an index of indigenous invertebrate diversity to exotic invertebrate diversity. Using information presented at Appendix 9.1.5 of the EcIA this index is 64 indigenous species to 4 exotic species.

58 DOC (at 4e) state that perimeter drains around the WRS may exclude lizards from an area. I am not aware of any New Zealand literature on this effect, but agree they may act to some extent as a barrier to movement and suggest that the use of rock flake bridges at intervals along the drain is an appropriate approach.

59 At the time of writing this evidence consultation on an appropriate suite of management and mitigation measures acceptable to both OceanaGold and DOC is ongoing.

*Otago Regional Council Policy Team*

60 The ORC Policy Team consider that the values of the ephemeral wetlands would qualify them as 'regionally significant wetlands' under the Regional Plan: Water (RPW).

61 I have considered the fit of the impacted ephemeral wetlands and seepage wetland with the criteria for regionally significant wetlands at 10.4.1. in the RPW and their relative merit compared with the published information of the regionally significant wetlands in Otago.

62 I found that there is a degree of fit to criteria A1 and A5. A1 refers to rare or threatened species – threatened presumably refers to the category Threatened as in the NZ Threat Classification Scheme, in which case there are no Threatened species present. Rare is problematic – there is no definition of rare or list of rare species. Some of the species at Deepdell North could be argued to be rare, and in the AEE (at 6.3.4) 3 species are listed (of these, only *Carex resectans* is inhabiting a wetland) as Rare, so they may fulfil part of this provision. The other part of the provision is that the sites are 'habitat', in the Deepdell North the species are of such restricted distribution within an otherwise exotic dominated ecosystem that it is doubtful that they are inhabiting a habitat. ('habitat' being defined as either the typical place where something is found, or a place or environment where something normally lives and that also has some element of quality [degraded habitat or good habitat are phrases often used by ecologists]. In this instance I would think the habitats are of such degraded nature that they no longer qualify as habitat in the sense of the provision.

63 In the case of the Deepdell north ephemeral wetlands only one At Risk species (*Lobelia ionantha*) is present which occurs within a very small 0.56 $m^2$ area and one 'rare' species (*Carex resectans*) which occurs within a very small 40 cm x 40 cm area. Therefore, the populations of these two species at this site are not sufficient to be considered regionally important and would not trigger adoption of the wetland as regionally significant.

64 In the case of the seepage wetland the At Risk rush *Juncus distegus* is present over a 369 $m^2$ area. In my experience this size population is not unusual for this species in the Macraes E.D. where it is present at most semi-natural moist sites. Therefore, the populations of this species at this site is not sufficient to be considered regionally important and would not trigger adoption of the wetland as regionally significant.

65 A5 refers to wetlands scarce in Otago in terms of its physical character. I have mapped at least 1,360 examples of this type of wetland greater than c. 1 ha in size in the Macraes E.D. alone. As Wildland's report in the WDC recommending report notes, they are known from other areas in Otago as well, and the Wildlands report notes 3,000 wetlands overall. In my opinion these wetlands are not 'scarce'.

66 To investigate the ecological quality of the wetlands in the PIA relative to other qualifying regionally significant wetlands I used the technical documents that were used to compile the initial list[1]. The wetlands on this list show good agreement with one or several of the criteria in 10.4.1, and size, complexity and intactness are recurring attributes. There are a few sites that are based more on the species present (such as Paddy's Rock ephemeral tarn), but the number of species of conservation interest at these sites is much higher and usually include Threatened (Nationally Critical, Endangered or Vulnerable) species, or a notable diversity of wetland species (such as Paddy's Tarn). In the case of the wetlands in the PIA, it is clear to me that these are nowhere near the significance of the wetlands already identified, as they have limited expressions of mostly Not Threatened indigenous species and are heavily dominated by exotic species.

67 I conclude that the ephemeral wetlands and the seepage wetland in the PIA are not regionally significant wetlands based on the limited values they contain.

68 It should be emphasised, contra ORC (at 11) that the application followed the Avoid, Remedy, Mitigate hierarchy and that offsetting was only considered after the opportunities to Avoid, Remedy and Mitigate had been considered (see Sections 5 and 9.4 of IMP).

69 In my opinion the proposed offsets align with the offsetting policy 5.4.6 pORPS (and including Environment Court decision NZEnvC41 of 15 March 2019)[2]:

1. *The offset achieves no net loss and preferably a net gain in indigenous biological diversity;*

Most of the individual components of these offsets produce a Present Biodiversity Value (PBV) above zero and therefore will result in a net gain in biodiversity. The only exception is the shrubland 'purity' (absence of exotic shrub species) , while ecologically positive, do not in itself result in positive PBV.. This offset still results in NNL.

2. *The offset ensures there is no loss of individuals of rare or vulnerable species as defined in reports published prior to 14 January 2019 under the New Zealand Threat Classification System ("NZTCS");*[3]

Neither offset will result in the loss of individuals of Threatened or At Risk species as the impact on these species is being addressed through mitigation activities.

3. *The offset is undertaken where it will result in the best ecological outcome, preferably:*

*Close to the location of development; or*

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[1] Ausseil, A-G; Newsome, P; Johnson, P. 2008. Wetland mapping in the Otago Region. Landcare Research Contract Report LC0608/115 to Otago Regional Council.

[2] Note the offset described in the pORPS does not require use of any offset guidance such as that provided by BBOP, DOC or in recent guidance to Councils.

[3] This clause is currently before the Environment Court with a nearly agreed wording of "The offset ensures there is no loss of individuals of ~~rare or vulnerable species as defined in reports published prior to 14 January 2019~~ Threatened taxa, and no reasonably measurable loss within the ecological district to an At Risk-Declining taxon under the New Zealand Threat Classification System ('NZTCS' ) other than Myrtaceae." The exclusion of some or all members of Myrtaceae is the only unresolved issue, and for the purposes of the offset being proposed in this case is not of any consequence.

*Within the same ecological district or coastal marine biogeographic region;*

Both offsets are within the same Ecological District, and result in positive ecological outcomes. The requirement that an offset be undertaken where it will result in the "best" ecological outcome is practically impossible to demonstrate for any offset. I am satisfied that both offset sites are appropriate sites to be used for the intended offset activities.

4. *The offset is applied so that the ecological values being achieved are the same or similar to those being lost;*

The ecological values within the Redbank EEA includes the habitat types and many (77%) of the same species as in the impact area and is therefore considered similar. The ecological values of the Ephemeral Wetland EEA contain highly degraded ephemeral wetland vegetation with little representation from indigenous species and are therefore considered similar as being ephemeral wetland vegetation occurring in landforms characteristic of ephemeral wetlands, even though there is little similarity between the indigenous species present at the impact site and the EEA.

5. *The positive ecological outcomes of the offset last at least as long as the impact of the activity, preferably in perpetuity;*

The management activities associated with these offsets are being planned to a 50 year horizon with intention to continue longer and therefore are considered as in perpetuity.

6. *The offset will achieve biological diversity outcomes beyond results that would have occurred if the offset was not proposed; and*

The planned offset actions would not occur without the offsets.

7. *The delay between the loss of biological diversity through the proposal and the gain or maturation of the offset's biological diversity outcomes is minimised.*

The longest delay before realising the outcomes is 10 years. This timeframe is considered reasonably short in ecological terms. This timeframe could not be reasonably shortened.

*KTKO*

70 KTKO lodged a neutral submission on the project. KTKO is interested in ensuring that the objectives and policies of the Kai Tahu ki Otago Natural Resource Management Plan (2005) are given effect and have prepared a Cultural Impact Assessment (**CIA**). KTKO have asked to be involved in the drafting of ecological management plans and OceanaGold are currently working with them on this.

**WDC Recommending Report**

71 The WDC recommending report summarises the situation well with respect to biodiversity, though it records seasonal gully drainage as "gully or swamp wetland".

72 I believe that the issues raised in the recommending report and supporting Wildland's report are addressed in the LMP and updated IMP and EEAMPs.

73 The Wildland's report refers to the four unusual invertebrate species recorded. These species were not included in the mitigation package as all were found on the Taieri Ridge slope above Horse Flat and are not thought to be occurring within the current PIA.

74 The Wildland's report implies that weed control in the seepage offset area of the Redbank EEA will cease at year 10. This is incorrect. I believe the Wildlands report may be confusing the timeframe for achieving the desired state (the 'endpoint') with cessation of management. Both the Redbank EEA and the Ephemeral Wetland EEA will require ongoing management to maintain their offset targets in perpetuity.

75 While there are some differences in my assessment of the degree of ecological importance of the PIA and the assessment made by Wildlands for the Council, overall I consider that the mitigation that has been incorporated into the proposed conditions of consent adequately covers the adverse ecological effects of the Deepdell North project.

**Comment On Draft Consent Conditions**

76 I have read the draft consent conditions and consider that overall they adequately address the actions that are required to address the adverse ecological effects of the Deepdell North project.

77 The proposed Redbank and Ephmeral Wetland EEA Covenants will protect a number of ecological features in perpetuity including regenerating shrubland, narrow-leaved tussock grassland, the largest ephemeral wetland in the Macraes E.D., a number of indigenous plant and fauna species including some considered rare, Threatened and At Risk. There are undoubtedly further ecological values contained within these sites that remain to be discovered – as has been found within the existing OceanaGold covenants.

78 The rescue of all rare plant species from within the project footprint could, if well managed, reconstitute or bolster populations in nearby protected areas. While there is always some uncertainty involved in this type of plant rescue work, these individuals would otherwise be lost to mine activities, and therefore it is worth including this condition. It should be noted that cultivation of some of these species has rarely been attempted and will require input from suitably experienced experts.

**Unresolved Issues**

79 Here is where I differ from other experts:

(a) I maintain that retention of grazing in part of the Redbank EEA is appropriate. See paragraph 49(a) for my explanation for this view.

(b) Shrubland removal may be required in parts of the Redbank EEA to protect other vegetation communities. See paragraph 49(b) for my explanation of my view.

(c) The ephemeral wetlands and seepage wetland are not worthy of consideration as Regionally Significant on the basis of the limited values they contain. See paragraphs 61 -68 for my justification of this view.

(d) There is disagreement with Wildlands on the level of project effects on some species, but this does not materially affect the mitigation being proposed.

**Conclusion**

80 If the mitigation recommendations outlined in my evidence and in proposed conditions of consent are carried out I consider the impacts of the proposed Deepdell North mining activity will be adequately addressed from an ecological perspective resulting in a No Net Loss of biodiversity and maintenance of biological diversity in the area. Further, based on the offset calculations and in my experience in working with many of these species and habitats in the Macraes ED I expect the project will actually result in a number of worthwhile net gains in overall biodiversity values.

**Michael James Thorsen**
4 August 2020

APPENDIX 1. CURRENT DRAFT OF IMPACT MANAGEMENT PLAN AND SUMMARY SPREADSHEET (CHANGES FROM VERSION ATTACHED TO AEE TRACKED).

APPENDIX 2. CURRENT DRAFT OF REBANK ECOLOGICAL ENHANCEMENT AREA PLAN (CHANGES FROM ORIGINAL VERSION TRACKED).

APPENDIX 3. CURRENT DRAFT OF EPHEMERAL WETLAND ECOLOGICAL ENHANCEMENT AREA PLAN (CHANGES FROM ORIGINAL VERSION TRACKED).

Oceana Gold (NZ) Ltd
Macraes Gold Project

Ahika Consulting
Rm. 2, Third Floor,
2 Dowling St, Dunedin
PO Box 1320, 9054

03 477 0242
info@ahika.co.nz
www.ahika.co.nz

# Deepdell North III Project

## Impact Management Plan v2.1
## (incorporating WDC & DOC comments)

August 2020

Report prepared for Oceana Gold (New Zealand) Ltd by Dr M. J. Thorsen,

3 August 2020

Report number: 0219-20



2 Dowling Street

Dunedin 9016

New Zealand

Ahika Consulting Ltd guarantees its work as free of political bias and as grounded in sound ecological principles based on quality knowledge.

## 1 Contents

**Document Summary**

The Deepdell North III project will remove 54.79 ha of indigenous vegetation comprising of low producing grassland, shrubland, seasonal gully drainages, ephemeral wetlands and a seepage wetland and inhabited by 71 indigenous plants (including 13 rare species), twenty bird species (nine indigenous and one rare species), four reptile species (three rare species) and a largely unknown invertebrate community. The vegetation communities are underlain by 3 Threatened LENZ. The ephemeral wetland vegetation community is Historically Rare and Critically Endangered and the seepage wetland is Historically Rare and Endangered. Both are priorities for protection. The indigenous vegetation communities are generally of low species diversity and most are characterised by high weed representation. The populations of the 17 At Risk or Rare species are mostly small, except for the Declining Matagouri which is dominant in the shrubland vegetation community and frequent in the low producing grassland plant community.

The project will also impact on 54.09 ha of cultivated pasture and shelterbelts. There may be some effect on a further 88.71 ha of indigenous vegetation and 26.47 ha of cultivated pastures, but these effects are expected to be minimal if appropriate controls are employed.

Mostly the Deepdell North III project is assessed to having low to very low effect on most of the terrestrial ecological features. Exceptions to this are a moderate impact on the plant communities together (mainly a result of the presence of the LENZ, rare species, and the Nationally Critical ephemeral wetland) and a high impact on the seven Historically Uncommon Nationally Critical ephemeral wetlands. These effects will be addressed through an Impact Management Plan.

To address these impacts OceanaGold (New Zealand) Limited (OceanaGold) proposes to support the activities within this Impact Management Plan. These activities include avoiding effects by evaluating siting of infrastructure and by isolating higher-value ecological areas in the buffer zone, mitigating general environmental effects such as dust, noise and weeds, salvage of rare plants, a lizard management programme and implementing an ecological management programme under an offset design at two sites. Once implemented, this Impact Management Plan will result in avoiding, minimising and rehabilitating all significant adverse ecological effects arising from the Deepdell North III Project.

This document is laid out so that the general condition and threats to biodiversity in the Macraes Ecological District are described (Sections 0 and 0), the predicted impact of the project (Section 0) are summarised from the project Ecological Impact Assessment, the regulatory framework within which the Impact Management Plan must fit (Section 0), a general evaluation of impact management options in Section 0 and how to quantify these (Section 0), the preferred mitigation options selected for this project in Section 0 and the Impact Management Plan (Section 0) that will give effect to the preferred mitigation options.

**General Ecological Setting**

The general ecological setting of the Deepdell North III project is described in the Ecological Impact Assessment and is summarised here as it provides important context for the Impact Management Plan.

Past vegetation cover of the Macraes ED is thought to have comprised montane short tussockland grading into subalpine tall tussockland, with areas of mixed hardwood and podocarp forest, kanuka forest and *Coprosma*-flax scrub (Bibby 1997). In Otago, much of the original vegetation cover has been dramatically altered as a result of anthropogenic factors (McGlone et al. 1995), and this massive vegetation change has also occurred at Macraes (Whitaker 1996). Since European settlement in the 1850's (Thompson 1949), areas have been burnt (sometimes repeatedly) and exotic grasslands induced by ploughing, oversowing, and applying fertiliser (Whitaker 1996). The present vegetation of the Macraes ED is of a highly modified nature, with approximately 75% of the district dominated by exotic vegetation types (mainly improved pastureland) and the remainder of the vegetation types being indigenous and comprised of varying density narrow-leaved tussockland, copper tussock-based wetlands and grey shrubland interspersed with remnants of original forest cover and scattered ephemeral wetlands (Bibby 1997, Thorsen pers. obs.). The remaining native vegetation communities currently present within the Macraes area are botanically diverse (Thorsen 2008) and is comprised of 592 indigenous (including 15 Data Deficient, 61 At Risk and 27 Threatened species) and 216 exotic species. The remaining vegetation communities are likely to be derived from the original vegetation communities that existed before human colonisation of the region, but many are likely to be considerably reduced in extent and species diversity. Invasion by exotic shrub and tree species, particularly gorse and broom, is an increasing problem in the area.

Of the fauna, fifty-four species of birds have been recorded from the Macraes E.D., of which thirty four are indigenous and twenty are introduced. The area's indigenous avifauna are likely being predated by exotic mammals, though the impact of this predation pressure on population dynamics is not known. They are also being impacted by changes to their habitats, however the nature of these changes and their impacts on the species is again not known. The area is noted for its high diversity of seven lizard species (Whitaker et al. 2002) and the invertebrate communities are diverse (for a region at moderate altitude) and contains some species that are rare or of biogeographic interest (Patrick 1997). The lizard species is being similarly impacted as birds by exotic mammals and habitat change, though the severity of predation is somewhat moderated by the abundance of rocky habitats offering safer retreat sites. This is thought to be at least part of the reason why Central Otago retains a high density and diversity of lizard species. Some catchments provide habitat for populations of non-migratory galaxiids, freshwater crayfish and longfin eel, which are being affected through predation by trout and changes to their habitats, particularly in the lower reaches of watercourses.

**Threats to biodiversity**

Many of the species of conservation concern in the Macraes E.D. retain good population sizes probably at least in part because of past farming practices, but current conversion of narrow-leaved tussockland and dryland herbfield by discing or spraying are reducing the extent of some plant communities. Oversowing and topdressing of areas of indigenous vegetation also alters the species composition, usually at the expense of the indigenous species (matagouri being a notable exception to this). Burning of indigenous grasslands is not now commonly practiced in the area, but escaped fires are very detrimental to grasslands and shrublands. Predation by introduced mammals and invasion by exotic herb, grass, shrub and tree species, (particularly gorse and broom and weed invasion of

wetlands) is insidious but difficult to quantify and likely impacts species differently and some "pest" species may be beneficial to some species in some situations.

Efforts to protect the biodiversity in the Macraes E.D. include a DOC skink protection programme in the Redbank-Nenthorn area and conservation activities associated with past OceanaGold projects including the creation of six covenants between 16 and 290 ha in size. The Department of Conservation (DOC) has undergone a process of identifying Ecological Management Units (EMU)[4]: the sites where conservation management would provide the most conservation gain. The Macraes DOC reserves and Mt Watkins are two EMU that are close to the PIA.

The current protected area network protects a full range of the habitat types present in the Macraes E.D., but much of the biodiversity inhabiting these habitat types is of restricted occurrence so a focus needs to be on protecting the under-represented habitat types reflective of this biogeographic pattern.

There are large outstanding conservation needs in the Macraes E.D., particularly for in the conservation of plants, fish and invertebrates.

[4] See http://www.doc.govt.nz/about-us/our-role/managing-conservation/natural-heritage-management/identifying-conservation-priorities/

**Project Impacts on Ecological Features**

The ecological assessments of the Deepdell North III project (Ahika Consulting Ltd 2019, Ryder Consulting Ltd 2019) identified the following ecological features within the Project Impact Area (PIA) will be impacted by project activities:

| Ecological Feature Class | Ecological Feature Type | Ecological Feature | Classification of Feature | Buffer | Pit | WRS | PIA | Unit of Measurement | Accuracy of measurement | Ecological Importance of Feature | Magnitude of Project Impact on Feature | | Overall Project Effect |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Local Scale | National Scale | |
| **Bird** | Community | Ecological function | | | | | | | | Moderate | Moderate | Negligible | Very Low |
| Bird | Species | Pipit | Declining | | | | 2 | individuals | Counted | Moderate | Low | Negligible | Very Low |
| Bird | Species | Black-backed gull | | | | | 45 | individuals | Counted | Low | Moderate | Negligible | Very Low |
| Bird | Species | Grey teal | | | | | 6 | individuals | Counted | Low | Moderate | Negligible | Very Low |
| Bird | Species | Grey warbler | | | | | 10 | individuals | Estimated | Low | Moderate | Negligible | Very Low |
| Bird | Species | Harrier hawk | | | | | 1 | individuals | Counted | Low | Moderate | Negligible | Very Low |
| Bird | Species | Paradise shelduck | | | | | 6 | individuals | Counted | Low | Moderate | Negligible | Very Low |
| Bird | Species | Spur-winged plover | | | | | 8 | individuals | Estimated | Low | Moderate | Negligible | Very Low |
| Bird | Species | Welcome swallow | | | | | 5 | individuals | Estimated | Low | Moderate | Negligible | Very Low |
| Environment | LENZ | Cultivated Pasture | < 10% indigenous cover left | 26.39 | 29.16 | 24.93 | 80.49 | Hectares | Measured | | | | |
| Environment | LENZ | Ephemeral Wetland | < 10% indigenous cover left | 0.02 | | 0.3 | 0.31 | Hectares | Measured | | | | |
| Environment | LENZ | Low producing grassland | < 10% indigenous cover left | 13.24 | 7.8 | 29.11 | 50.15 | Hectares | Measured | | | | |
| Environment | LENZ | Seasonal gully drainage | < 10% indigenous cover left | 1.79 | 0.5 | 1.91 | 4.2 | Hectares | Measured | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Environment | LENZ | Seepage | < 10% indigenous cover left | | | 0.07 | 0.07 | Hectares | Measured | | | | |
| Environment | LENZ | Shelterbelts & Exotic Trees | < 10% indigenous cover left | 0.08 | | 0.53 | 0.61 | Hectares | Measured | | | | |
| Environment | LENZ | Shrublands | < 10% indigenous cover left | 3.17 | 0.08 | 2.79 | 6.04 | Hectares | Measured | | | | |
| Environment | LENZ | Threatened LENZ with indigenous vegetation | < 10% indigenous cover left | 5.26 | 1.7 | 15.14 | 22.09 | Hectares | Measured | | | | |
| Environment | LENZ | Threatened LENZ with indigenous vegetation | < 10% indigenous cover left | 12.95 | 6.68 | 19.04 | 38.67 | Hectares | Measured | | | | |
| Environment | LENZ | Low producing grassland | 10-20% indigenous cover left | 11.58 | 0.96 | 10.36 | 22.89 | Hectares | Measured | | | | |
| Environment | LENZ | Shrublands | 10-20% indigenous cover left | 4.2 | | 0.86 | 5.05 | Hectares | Measured | | | | |
| Environment | LENZ | Threatened LENZ with indigenous vegetation | 10-20% indigenous cover left | 15.77 | 0.96 | 11.21 | 27.94 | Hectares | Measured | | | | |
| Flora | Community | Ephemeral Wetland | Critically Endangered Historically Uncommon ecosystem type | 0.02 | | 0.3 | 0.31 | Hectares | Measured | High | High | Moderate | High |
| Flora | Community | Seepage | Endangered Historically Uncommon ecosystem type | | | 0.07 | 0.07 | Hectares | Measured | High | Moderate | Low | Low |
| Flora | Community | Cultivated Pasture | | 26.39 | 29.16 | 24.93 | 80.49 | Hectares | Measured | Negligible | Low | Negligible | Very Low |
| Flora | Community | Low producing grassland | | 24.82 | 8.76 | 39.47 | 73.04 | Hectares | Measured | Moderate | Moderate | Low | Low |
| Flora | Community | Seasonal gully drainage | | 1.79 | 0.5 | 1.91 | 4.2 | Hectares | Measured | Low | Moderate | Low | Very Low |
| Flora | Community | Shelterbelts & Exotic Trees | | 0.08 | | 0.53 | 0.61 | Hectares | Measured | Negligible | Low | Negligible | Very Low |
| Flora | Community | Shrublands | | 7.36 | 0.08 | 3.65 | 11.09 | Hectares | Measured | Moderate | Low | Negligible | Very Low |
| Flora | Community | Ecosystem services | | | | | | | | Minor | | | |
| Flora | Community | Historically Rare or Threatened Ecosystems | | | | 2 | 2 | Communities | | | | | |
| Flora | Community | Integrity | | | | | | | | Moderate | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Flora | Community | National Priorities for Protection | | | | 2 | 2 | Communities | | | | | |
| Flora | Community | Rarity | | | | | | | | High | Moderate | Moderate | Moderate |
| Flora | Community | Representativeness | | | | | | | | Moderate | Moderate | Moderate | Moderate |
| Flora | Community | Sites recommended for protection | | | | | 0 | Sites | | Nil | | | |
| Flora | Community | Wetlands of National Importance or Ramsar sites | | | | | 0 | Sites | | Nil | | | |
| **Flora** | Species | Carex tenuiculmis | Declining | 10 | | | 10 | Individuals | Estimated | Moderate | Low | Low | Very Low |
| Flora | Species | Carmichaelia crassicaulis Hook.f. subsp. crassicaulis | Declining | 15 | | 2 | 17 | individuals | Counted | High | Very Low | Negligible | Very Low |
| Flora | Species | Carmichaelia petriei Kirk | Declining | 10 | | 7 | 17 | individuals | Counted | High | Low | Negligible | Very Low |
| Flora | Species | Discaria toumatou Raoul | Declining | 7.36 | 0.08 | 3.65 | 3.73 | Hectares | Estimated | High | Negligible | Negligible | Very Low |
| Flora | Species | Juncus pusillus Buchenau | Declining | | | 1 | 1 | $m^2$ | Estimated | Moderate | Moderate | Low | Very Low |
| Flora | Species | Leptinella pusilla Hook.f. | Declining | | | 1 | 1 | $m^2$ | Estimated | High | Low | Negligible | Very Low |
| Flora | Species | Lobelia ionantha Heenan | Declining | | | 0.561 | 0.561 | $m^2$ | Estimated | High | Moderate | Low | Low |
| Flora | Species | Rytidosperma buchananii (Hook.f.) Connor & Edgar | Declining | | | 1 | 1 | individuals | Counted | Low | Very Low | Negligible | Very Low |
| **Flora** | Species | Parsonsia capsularis var. tenuis | Data Deficient | 1 | | | 1 | Individuals | Counted | Low | Low | Low | Low |
| Flora | Species | Carex resectans Cheeseman | Locally Uncommon | | | 1.6 | 1.6 | $m^2$ | Estimated | Moderate | Moderate | Low | Low |
| Flora | Species | Melicope simplex A.Cunn. | Locally Uncommon | | | 11 | 11 | individuals | Counted | Moderate | Moderate | Negligible | Very Low |
| Flora | Species | Myrsine divaricata A.Cunn. | Locally Uncommon | | | 2 | 2 | individuals | Counted | Moderate | Moderate | Negligible | Very Low |
| Flora | Species | Anthosachne falcis (Connor) Barkworth & S.W.L.Jacobs | Naturally Uncommon | | | | 100 | individuals | Estimated | High | Moderate | Low | Low |
| Flora | Species | Carex subtilis K.A.Ford | Naturally Uncommon | | | 1 | 1 | individuals | Counted | Moderate | Moderate | Negligible | Very Low |
| Flora | Species | Juncus distegus Edgar | Naturally Uncommon | | | 369 | 369 | $m^2$ | Estimated | Moderate | Moderate | Low | Low |

**Commented [MT1]:** Recorded by M. Tocher July 2020

**Commented [MT2]:** Discovered 2020

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Flora | Species | Juncus distegus Edgar | Naturally Uncommon | | | 56 | 56 | individuals | Estimated | Moderate | Moderate | Low | Low |
| Flora | Species | Diversity | | | | | | | | Moderate | Moderate | Moderate | Moderate |
| Invertebrates | Community | Overall importance | | | | | | | | Moderate | Moderate | Low | Low |
| Reptiles | Community | Overall importance | | | | | | | | Moderate | Moderate | Low | Low |
| Reptiles | Species | *Oligosoma inconspicuum* | Declining | | 1 | | | individuals | Counted | High | Moderate | Negligible | Very Low |
| Reptiles | Species | *Oligosoma polychroma* (clade 5 genotype) | Declining | | | | 5 | individuals | Estimated | High | Moderate | Negligible | Very Low |
| Reptiles | Species | *Woodworthia* "Otago/Southland large" | Declining | | | | 30 | individuals | Estimated | High | Moderate | Low | Low |
| Reptiles | Species | *Oligosoma maccanni* (clade 4 genotype) | Not Threatened | | | | 150 | individuals | Estimated | Moderate | Moderate | Low | Low |
| Freshwater | Community | Watercourse length | | | | | 480 | Metres | Measured | | | | |
| Freshwater | Species | Potential *Paranephrops zealandicus* habitat | Declining | | | | 120 | Metres | Measured | | | | |

Other matters requiring consideration are:

- A proportion of the PIA has been classified as a Threatened LENZ environment.
- The ephemeral wetlands are a Critically Endangered Naturally Uncommon ecosystem.
- The shrubland and ephemeral wetland vegetation communities present in the PIA are considered significant under proposed Otago Regional Policy Statement and the Waitaki District Plan.

**Impact Management Approach**

The following impact management approach has been followed for managing the effects of the GPUG Infrastructure project on biological diversity. This approach is consistent with Policies 5.4.6 *Offsetting for indigenous biological diversity* and 5.4.8 *Adverse effects from mineral and petroleum exploration, extraction and processing* of the partially operative ORPS (pORPS) (and including Environment Court decision NZEnvC41 of 15 March 2019). For the purposes of giving effect to these policies "significant adverse effects" are considered those where the overall project effect (last column in Section 0) is moderate or greater.

These options follow a Mitigation Hierarchy of first seek to avoid the impact, then remediate residual ecological effects[5], then mitigate residual ecological effects, then employ an offset to address as much of the remaining residual ecological effects as practicable, and finally compensate for the outstanding balance of the ecological effects. Moving to the next step in the hierarchy is only possible once the possibility of employing the higher-order option has been fully explored and documented and the residual ecological effects calculated.

The relevant wording in pORPS (and including Environment Court decision NZEnvC41 of 15 March 2019), and which this Impact Management Plan has been formulated, is:

*For project impacts on areas of significant indigenous vegetation and significant habitats of indigenous fauna, or where there are significant adverse effects:*

- Avoid where practicable locating activities in areas of significant indigenous vegetation and significant habitats of indigenous fauna;
- Where it is not practicable to avoid locating in areas of significant indigenous vegetation and significant habitats of indigenous fauna avoid, remedy or mitigate, as necessary, adverse effects on values in order to maintain the outstanding or significant nature of the significant indigenous vegetation or habitat of indigenous fauna;
- Consider first biological diversity offsetting, and then biological diversity compensation if significant adverse effects on indigenous biological diversity cannot be practicably remedied or mitigated.

*Consider the offsetting of indigenous biological diversity offsetting, when:*

- Adverse effects of activities cannot be avoided, remedied or mitigated;
- The offset achieves no net loss and preferably a net gain in indigenous biological diversity;
- The offset ensures there is no loss of individuals of rare or vulnerable species as defined in reports published prior to 14 January 2019 under the New Zealand Threat Classification System ("NZTCS");
- The offset is undertaken where it will result in the best ecological outcome, preferably:

**Commented [MT3]:** Need current draft wording

[5] Residual adverse ecological effects, are the remainder of a project's predicted impact on all of the ecological features within the PIA that would not be addressed once the actions under consideration for that mitigation option have been employed as designed.

  - Close to the location of development; or
  - Within the same ecological district or coastal marine biogeographic region;
- The offset is applied so that the ecological values being achieved are the same or similar to those being lost;
- The positive ecological outcomes of the offset last at least as long as the impact of the activity, preferably in perpetuity;
- The offset will achieve biological diversity outcomes beyond results that would have occurred if the offset was not proposed; and
- The delay between the loss of biological diversity through the proposal and the gain or maturation of the offset's biological diversity outcomes is minimised

*Consider the use of biological diversity compensation when:*

- Adverse effects of activities cannot practicably be avoided, remedied, mitigated or offset;
- The residual adverse effects will not result in:
  - The loss of an indigenous taxon (excluding freshwater flora and flora) or of any ecosystem type from an ecological district or coastal marine biogeographic region;
  - Removal or modification of habitat of a threatened or at risk indigenous species of fauna or flora under the New Zealand Threat Classification System ("NZTCS");
  - Removal or loss of viability of an originally rare uncommon ecosystem type that is associated with indigenous vegetation or habitat of indigenous fauna;
  - Worsening of the NZTCS conservation status of any threatened or at risk indigenous freshwater fauna.
- By applying the following criteria:
  - The compensation is proportionate to the adverse effect;
  - The compensation is undertaken where it will result in the best practicable ecological outcome, preferably;
    - Close to the location of development;
    - Within the same ecological district or coastal marine biogeographic region;
  - The compensation will achieve positive biological diversity outcomes that would not have occurred without that compensation;
  - The positive ecological outcomes of the compensation last for at least as long as the adverse effects of the activity; and
  - The delay between the loss of biological diversity through the proposal and the gain or maturation of the compensation's biological diversity outcomes is minimised.

In considering the above approaches, the following assumptions have been made:

**Avoidance** refers to changing a project's activity so that it no longer impacts on an ecological feature. Mining, by its very nature, makes it difficult to avoid an ecological feature where it overlays the targeted resource, but there are opportunities to avoid impacts arising from some mine activities, such as placement of road and building infrastructure, but this needs to be balanced against other values (including economics, heritage, cultural and other stakeholder concerns). Avoidance can also include staging of project activities – for example by depositing WRS material into lower-value areas first – where there is some uncertainty in the extent of the Project Design.

**Remedying** refers to undertaking activities, following cessation of the impact, that rehabilitate or restore the site back to an acceptable ecological state. The opportunities to restoring a mining project's impact are limited

by the technical challenges associated with rehabilitating mine workings in this location to a functioning natural ecological state, and the previously-expressed wish of the local community that the mine is rehabilitated to farming pasture.

**Mitigating (or minimising)** refers to adopting a practice that reduces a project's impact on an ecological feature. Minimisation includes salvaging of species from the Project footprint and either translocating directly to a new site, or cultivating for later planting at an appropriate site. It also includes Standard Operating Procedures adopted to reduce the effects of dust, noise, weeds, fire, etc.

**Biological Diversity Offsetting** refers to measurable conservation outcomes resulting from actions designed to address residual adverse biodiversity impacts arising from project development after appropriate avoidance, minimisation and remediation measures have been taken. The goal of biodiversity offsets is to achieve no net loss and preferably a net gain of biodiversity on the ground. The ability to utilise an offset is included in the pORPS as part of a mitigation hierarchy and the pORPS includes guidance on the necessary features of an offset. There are a number of guiding documents available to guide the design of an offset in NZ including the approaches adopted internationally by Business & Biodiversity Offsets Programme (BBOP), and nationally by DOC and the Biodiversity Working Group's (BWG) guidance to Councils. For this project the BWG guidance to Councils[6] is used as the guiding document for the design and evaluation of the offset with the offset calculations following a disaggregated biodiversity offset accounting model[7,8] as this is considered the current best practice for the use of offsets in NZ.

**Compensation** involves undertaking activities that will result in a gain in ecological value outside the project footprint or off-site. Compensation differs from Offsetting in that the biodiversity outcomes are 'like for unlike'. A number of compensatory activities can be undertaken, either separately or in combination, to address a project's impacts, ranging from legal covenanting, enhancing habitat of plants or wildlife, through weed or pest control, research to better understand how to manage ecological features, habitat creation, education and interpretation, supporting community-led biodiversity projects, and undertaking activities that protect rare species.

**Biobanking** is the undertaking of conservation actions now, that are then used to address the effects of a future project.

*The following evaluation considerations are also used to help select the most appropriate activities:*

- Where possible align compensatory activities with the greatest conservation need.
- The ecological gain that could be achieved, including gains in knowledge that increase ability to effectively manage conservation issues here or elsewhere.

[6] Maseyk, F; Ussher, G; Kessels, G; Christensen, M; Brown, M. 2018. Biodiversity Offsetting under the Resource Management Act: A guidance document. BioManagers Group for the Biodiversity Working Group.

[7] Maseyk, F.J.F; Barea, L.P; Stephens, R.T.T; Possingham, H.P; Dutson, G; Maron, M. 2016. A disaggregated biodiversity offset accounting model to improve estimation of ecological equivalency and no net loss. Biological Conservation 204: 322-332.

[8] Maseyk, F; Maron, M; Seaton, R; Dutso, G. 2015. A Biodiversity Offsets Accounting Model for New Zealand: User Manual. Department of Conservation, Hamilton.

- That the ecological gain is sufficiently worthwhile.
- That the compensatory activities are technically feasible with an acceptable chance of achieving their desired outcome.
- That the compensatory activity is affordable and delivers benefits appropriate to the cost.
- That ecological resilience is considered when selecting a site for an activity, to ensure that gains are not eroded over time due to ecological processes that are difficult to manage (e.g. lost ecosystem function).
- That land tenure allows certainty of access to undertake the activity over time.
- The ability to maintain the gain achieved by the activity over the term of the project impact.
- That the ecological gain can be monitored to ensure that the compensatory activity is achieving its planned outcome.
- There is an ability to add additional mitigation measures in response to additional OceanaGold projects.
- That the process of evaluation and implementation is transparent and of high quality.
- That the outcomes of compensatory activities do not unnecessarily constrain future commercial endeavours of either OceanaGold and/or the local community, particularly farming.

**Options for Impact Management in a Macraes Context**

The options available to address a project's impacts in the Macraes context are described here in the order of the Mitigation Hierarchy.

*Avoidance options*

The opportunity to avoid ecological features includes siting of all, or part, project infrastructure, staging construction, and excluding (by using temporary fencing) areas in buffer areas, depending on the operational and financial constraints of the sites.

*Remedial options*

Remediating an area back to its pre-impact ecological condition is possible in some situations, but is limited by the technical challenges associated with rehabilitating mine workings in this location to a functioning natural ecological state, the timescale to replicate some ecological features (such as old-growth shrubland), the paucity of examples of successful site rehabilitation, and the previously-expressed wish of the local community that the mine is rehabilitated to farming pasture.

*Mitigation options*

The opportunities to minimise the impact of this project includes measures to reduce dust, noise, disturbance, and sediment, contaminant suppression, weed surveillance, fire response and rescue (removal to a safe site) of ecological features. These are discussed further here.

Dust suppression

Dust-fall can be a problem for plants as it inhibits their photosynthetic capacity. Supressing dust that is created during construction activities is a standard mine operating procedure and will minimise this effect.

### 6.3.2 Noise and minimising disturbance

Operating heavy machinery and construction activities creates considerable noise and disturbance which is likely to create a negative reaction in animal species, though this reaction will vary depending on species. Minimising noise is a standard mine operating procedure and will minimise this effect, though there is likely to be displacement of some animal species from the vicinity of the mine site.

Weed surveillance

Importation of new weed species into the area during construction and operations could, depending on the species, have a huge impact on the area's biodiversity. Regular inspection of the area for new weed species can alleviate this risk. Areas of OceanaGold land are regularly inspected for new weed incursions and new environmental weeds that are found are subject to OceanaGold's annual environmental weed control operation.

Fire response

The Macraes area is often very dry and any fires that do start have the potential to cover large areas and harm large areas of natural vegetation, as well as farm assets. A site fire avoidance protocol and rapid response to any suspected fires is a standard operating procedure and will minimise this effect.

Sediment Control

Ground works associated with buildings and roadway construction disturbs land, removes vegetation and soil cover and so increases the risk of fine sediment discharges to watercourses. Sediment control measures are routinely employed by OceanaGold at Macraes Mine and will continue to be applied to minimise this effect.

Manage accidental contaminants spills

The presence of construction machinery in and around waterways presents a risk of contaminants entering watercourses with potential to harm aquatic life. OceanaGold will continue to address this effect by operating an appropriate on-site contaminant management plan.

Protect against nuisance weed/algae introduction into waterways

Machinery and personnel involved in construction can potentially transfer nuisance weeds/algae to local watercourses. OceanaGold complies with notices and guidelines issued by Biosecurity New Zealand regarding nuisance weeds/algae and will continue this practice.

Rescue of ecological features

Some of the higher-importance ecological features such as some plant species and lizards can be rescued by removing them (or propagating parts of them such as seeds or cuttings) following (for plants) OceanaGold's Plant Propagation, Translocation and Management Procedure and establishing them at suitable areas within existing habitat (for instance nearby DOC and OceanaGold protected areas) (Figure 1. Location of OceanaGold (blue) and DOC (green) protected areas relative to the Deepdell III project (purple).). Salvage options for lizards are difficult and technical and require careful consideration before adopting.



*Figure 1. Location of OceanaGold (blue) and DOC (green) protected areas relative to the Deepdell III project (purple).*

*Offsetting and Compensation options*

Offsetting and compensation can employ the same mechanisms, and these mechanisms are described here. The main difference between Offsetting and Compensation under the pORPS is that that there is less focus on the 'like-for-like' component in a compensation scenario. Both offsetting and compensation, either in full or partially, of residual adverse effects may be a useful tool to address impacts of a project. The opportunity to employ an offset is determined by the availability of comparable sites in which to undertake the offset, the technical challenges of employing the offset, the ability to set a reference baseline and to measure progress towards a No Net Loss situation, and the cost of these activities. There are some local constraints on establishing protected areas as an 'averted loss' offset (see 0), which is a commonly applied offsetting approach. Compensation has limitations in that there is reduced certainty in the ecological gain under this approach. Preference is given to adopting an offset over utilising a compensation approach to address the projects residual ecological effects unaddressed following implementation of the Avoid, Remediate and Mitigate Hierarchy.

Land protection

Protecting areas of high conservation value, which may have different ecological values to those being impacted, via a legal covenant has been used in previous OceanaGold projects. While land protection is a valuable tool to remediate a project's impacts, and their benefits are long-lasting, care needs to be taken when pursuing a covenant as they can unintentionally constrain land use if they are sited on an area of land that has commercial value (for instance for mining or farming). There is also a need for on-going management to maintain the covenant's biodiversity features, which requires landowner support and both funds and labour over the life of the covenant (usually in-perpetuity) otherwise the covenant's 'degrade' in value over time and become reservoirs for pests. OceanaGold manages the covenants on its land to appropriate standards, but when that land changes ownership (the intention of OceanaGold) then management of the covenant becomes the responsibility of the new landowner. There has been concern expressed in the local farming community about this as in their view a covenant decreases the area of land available to farming and causes impediments to farming operations in adjacent areas. This is of concern as there is increasing evidence that social support is critical in achieving the objectives of establishing a protected area[9].

OceanaGold currently manages six ecological covenants covering a total of 655 ha. Other protected lands in the vicinity include the 590 ha Deighton Creek Nature Reserve, the 1,452 ha Redbank Scenic Reserve and the 332 ha Manuka Stream Conservation Area (**Error! Reference source not found.**), giving a total of 3,029 ha of legally p rotected land in the Macraes Ecological District. This equates to 2.4% of the Ecological District's land area and is similar to the proportion protected of the ecologically similar nearby Manorburn Ecological District (Ahika Consulting Ltd unpub. data).

Habitat enhancement

Enhancing the habitat of indigenous plants or wildlife (usually through enrichment planting, pest control or weed control) as a compensatory measure can provide benefit to both a habitat and its inhabitants by removing predators that are limiting populations, removing weed species that are displacing plants or animals from their preferred habitat, or by creating barriers to movement of trout into high-value aquatic environments.

Protecting or enhancing rare habitats can provide high ecological benefit. A number of New Zealand's habitats are considered rare, either because they were always of very limited distribution (see Williams et al. 2007) or because human activity has reduced their extent and/or intactness. Also, some habitats are now considered Threatened (Holdaway et al. 2012). Several examples of these rare and threatened habitats are present in Otago, and in the Macraes E.D. there are Critically Endangered saline sites and ephemeral wetlands as well as Endangered seepages and flushes. Other important communities are the schist bluff communities, dryland shrubland (grey scrub) and riparian margin vegetation as these are of limited extent and host a number of rare species. Without conservation attention many of these habitats and communities will be lost.

[9] See for example Oldekop, J.A; Holmes, G; Harris, W.E; Evans, K.L. 2015. A global assessment of the social and conservation outcomes of protected areas. Conservation Biology 30: 133-141.

Invasive weed and animal pest control

Removing or controlling aggressive environmental weeds or animal pests can be a compensatory measure. The NZ Biodiversity Strategy regards invasive introduced species which have become animal pests and weeds as a more serious threat to biodiversity than ongoing habitat loss and modification. Some weeds that have the potential to transform local wetlands are known from just one locality within the Macraes E.D. and are of very limited occurrence in Otago. There are other species that have recently arrived in the Macraes E.D. and which could become a nuisance to agriculture and biodiversity. Eradicating these species will save a large amount of biodiversity protection work into the future. Instigating a weed surveillance programme together with the capacity to remove newly arrived weed species would have benefit to protecting both biodiversity areas and agricultural areas.

Invasive animal control in the Macraes E.D. has been shown to benefit local lizard populations and there are opportunities to employ predator control to benefit other lizard populations as well as populations of birds and large invertebrates. The high cost of predator control, uncertainty of level of effectiveness and population responses of the protected fauna, and the rapid loss of benefit when predator control ceases needs to be considered.

Protecting species of conservation concern

In New Zealand, a number of plant and animal species are considered at risk of extinction. Of plants, there are 402 species which are considered Threatened (i.e. of high risk of extinction) and a further 885 are considered At Risk (de Lange et al. 2018). Many more are rare in a local context.

The Macraes E.D. is known to contain the highest diversity of rare plants of any site in New Zealand (Bibby 1997, Thorsen 2008, Figure 3). However, the known distributions of the rare species in this area reflects the location of past survey effort, including those conducted by OceanaGold around mine projects. In the Macraes E.D. are populations of 6 Nationally Critical plant species, 10 Nationally Endangered plant species, 12 Nationally Vulnerable plant species, 35 Declining plant species, 26 Naturally Uncommon plant species, and 15 Data Deficient plant species, with populations of some of these being the largest known nationally. Many of the plant species and the rarer plant communities are facing considerable threat from weed competition and exotic animals.



*Figure 2. Location of protected areas in the Macraes vicinity.*

The Macraes E.D. also contains the last wild populations of Critically Endangered grand and Otago skinks, and important populations of 3 At Risk lizard species. The invertebrate fauna of the Macraes E.D. has been poorly explored, but is known to include at least 412 indigenous species, including 2 Threatened, 6 At Risk, and 7 Data

Deficient Species. It is also home to a number of indigenous freshwater fauna that are of conservation concern: the Declining freshwater crayfish *Paranephrops zealandicus* and long-finned eel *Anguilla dieffenbachii*, and the Nationally Vulnerable non-migratory roundhead galaxias *Galaxias anomalus* and Taieri flathead galaxias *Galaxias depressiceps*.

There is a large conservation programme nearby focussed on protecting the grand and Otago skink populations between Redbank and Nenthorn, and this project is also providing benefit to other lizard and bird species. However, there is currently little focus on management of the area's aquatic fauna, invertebrates, rare plants or vegetation communities beyond control of some woody weed species and pests at a few sites. The Macraes E.D. has extensive potential for plant and freshwater species-focussed conservation programmes using specific tools such as translocation, cultivation and replanting in order to enhance populations, and to protect populations through building trout barriers, or controlling weeds, browsing mammals, and pest insects.

### Research

Research on topics that inform our ability to manage ecosystems or species successfully is a valuable remediation tool. Currently, there is little available research to help guide management of most of New Zealand's rare species or habitats. In the Macraes area there is an opportunity to build on past research projects (e.g. ephemeral wetlands by Johnson and Rogers (2003)), as well as build research into the adaptive management component of other compensatory activities.

### Environmental education and awareness

Education and awareness on conservation issues, particularly on the importance of biodiversity and its management in a mine environment, is in line with the New Zealand Biodiversity Strategy and Action Plan and can be a valuable compensation activity when well-designed.

### Community conservation

Local communities undertake a number of important biodiversity projects throughout New Zealand. All of them struggle to be financially sustainable, primarily due to the temporary nature of most funding arrangements, and this factor alone frequently leads to project failure. There are no active biodiversity conservation groups in the Macraes area, but the Landscape Connections Trust[10] is planning pest control activities in the east Otago area and the Central Otago Ecological Trust[11] runs a lizard conservation project centred on the Mokomoko Dryland Sanctuary near Alexandra. Funding of a reputable trust to provide sustainable support for the ongoing efforts of community groups and other conservation organisations in the Macraes region is an option.

[10] See http://www.beyondorokonui.org.nz/

[11] See http://www.coet.org.nz/

- Biobanking

Biobanking is the undertaking of conservation actions now, that are then used to address the effects of a future project. While there are a number of potential approaches to biobanking, we advocate for adopting an approach that encapsulates the features of a biodiversity offset, as this is conceptually simpler and the measurement metrics can be the same. In the Macraes situation undertaking any project mitigation, offsetting or compensation at a greater scale than required or in anticipation of a future project is considered a biobank. There are advantages to biobanking in that ecological gains are often realised and measurable before a project's impact occurs, giving greater certainty of a positive ecological outcome.



*Figure 3. Locations of Threatened, At Risk and rare plant species in the vicinity of the Macraes E.D. Note, clustering of dots reflects survey effort more than actual distribution of rare plant species.*

**Quantifying the loss**

Calculating the quantity and 'value' of the biodiversity likely to be lost and therefore replaced under an effects mitigation approach, such as the one used in this Impact Management Plan, is difficult. Measures that are most frequently used are often simplistic: 'like for like' (i.e. 10 *Carex tenuiculmis* plants predicted to be lost from the project site and 10 *Carex tenuiculmis* planned to be planted at a nearby proposed mitigation site), or with additional consideration given to the condition of the feature (i.e. 25 hectares of narrow-leaved tussock grassland of 1m stature and 60% ground cover at both the project site and at a nearby proposed mitigation site). The emergence of disaggregated offset calculations and replacement multipliers is increasing the accuracy of these evaluations. Calculating the value of biodiversity loss when considering a number of features, or features that are 'like for unlike', becomes even more problematic. This approach is best termed 'value for value'. The most frequently used measure (or metric) in these situations consists of combining expert opinions with cross-party negotiation in order to reach a consensus that the projected gain at the mitigation site is appropriate to the value of the ecological loss of the different features in the project site. In these types of calculations, it is important to incorporate consideration of uncertainties and the baseline condition and trend of the feature: for example, halting or slowing a declining trend is a conservation gain.

Another method is to adopt a value of land approach, in which the area of the impact is calculated and then either an equivalent area is protected or payment made at the purchase price of an equivalent area of land in that district. Similar methods have been used in previous OceanaGold projects at Macraes and Reefton.

The impact management plan should adequately address the value of the lost ecological features.

**Preferred Approach**

A range of mitigation and compensatory measures for the project's impacts on ecological features (Section 0) were evaluated against the considerations in Sections 0, 0, 0 (see Appendix 1). For the reasons explained in this evaluation, and the forecast project impacts, OceanaGold's preferred approach to addressing the Deepdell North III project's impact on ecological features is:

**Avoid effects by:**

2) Siting infrastructure away from areas with high ecological value wherever possible.
3) Staging deposition of rock material into WRS areas.

**Remedy effects by:**

4) Constructing areas of the margins of the final WRS to provide habitat for lizards.
5) Creating freshwater crayfish habitat in the western clean water drain.

**Mitigate impacts by:**

6) Minimising project effects of dust, noise, weeds, fire, sediment, contaminants on the surrounding area.
7) Rescuing those plant species that are of moderate or high ecological importance or that are of restricted distribution within the Macraes E.D., to safe site(s) in Ecological Enhancement Areas (EEA) (such as the nearby OceanaGold covenants).
8) Salvage of lizard species.
9) Provision of lizard crossing bridges across drains

As there are forecast to be residual adverse effects of the project on the site's biodiversity after implementation of the Avoid, Remedy and Mitigate (see Section 0), an offset will be provided to address remaining significant residual adverse effects.

**Offset all residual effects by:**

10) Creating two multi-outcome offset EEA at sites within the Ecological District with similar or better ecological values and provide funds for the ecological management of these areas.
11)

**Compensate for final residual adverse effects by:**

12) Preparing and implementing a Lizard Management Plan.
13) Planting of freshwater crayfish habitat along the margin of the Camp Creek reservoir.

OceanaGold has overall responsibility for undertaking this work as described in Section 0.

**Ecology Impact Management Plan**

The following are the activities that Oceana Gold (New Zealand) Limited propose to undertake as recompense for the predicted impact on the area's ecological features resulting from implementation of the Deepdell North III project. Task descriptors and responsibilities are provided in Appendix 2. OceanaGold has overall responsibility for undertaking this work as described in this Impact Management Plan.

*Avoiding impact*

The opportunity to avoid ecological features in the Deepdell North III project is limited by operational necessities to placement and re-configuring the waste rock stack (WRS) margins and re-routing access routes.

Siting of WRS and infrastructure

Three alternative locations for part of the WRS were proposed on 15 November 2017 (Figure 4). None of the options would avoid areas of significant indigenous vegetation and habitats of indigenous fauna. Of these configurations Option A has the least impact on ecological features but is not considered practicable due to other effects on the environment, especially from noise. Options B and C have similar impact on ecological features with higher impact on plants in Option B and higher impact on waterways in Option C. The total area of disturbance is larger in Option C. Because of this a fourth option was developed (the current design) which is sited predominantly on pasture and avoids the effects of the 3 previous options, but has an impact on a Critically Endangered Naturally Uncommon ecosystem, some areas of indigenous vegetation that is habitat to plants and fauna (including some rare species). It is thought that the effects on these ecological features can be managed through implementation of this Impact Management Plan.

*Figure 4. Three original options (A, B, C) considered for siting part of the WRS of the Deepdell North III project.*

Staging WRS construction

The WRS will be constructed in sequential stages to delay impacts on higher biodiversity areas. The first stage will be infilling of the original Deepdell South pit backfill WRS, the second stage will be deposition of material on the flat areas of the Horse Flat. This action avoids impacts on significant ecological features if the project is halted before completion.

Isolating high ecological value areas in the Buffer

Areas in the buffer area with higher ecological values will be isolated from unintended effects (such as vehicle movements) by clearly delineating in maps provided to mine operations staff and on the ground by using well-maintained flagging tape, temporary fencing and signage.

*Remedy impact*

The opportunities to remedy this project's impact are limited by the technical challenges associated with rehabilitating mine workings in this location to a functioning natural ecological state, and the wish of the local community that the mine is rehabilitated to farming pasture. However, there is opportunity to undertake some rehabilitation on the WRS margin. Opportunity to utilise the post-excavation Deepdell North III pit lake is limited by the future grazing of this site, and so is not pursued here.

WRS margin and Pit rehabilitation

There is some opportunity to rehabilitate the WRS margin and other surfaces such as roadways to provide habitat for lizards by depositing larger aggregate and boulders in identified areas under expert guidance. These rocky areas will be naturally colonised by lizards from the surrounding area, and the population density at these sites should increase as habitat quality increases with plant growth, particularly if vegetation regrowth includes fruit-bearing plants. It is not planned to monitor lizard colonisation of these sites as previous work has shown that similar created rock habitats such as other waste rock stacks and the lizard rock piles are colonised by lizard species (EcoGecko 2013, OceanaGold unpub. data).

Undertaking this action will provide benefit in 1) creating habitat that will be occupied mainly by populations of the skinks *Oligosoma maccanni* (clade 4 genotype), and also possibly small numbers of *Oligosoma polychroma* (clade 5 genotype), and the Declining gecko *Woodworthia* "Otago large", 2), creating a safer refuge for these lizard populations by decreasing the hunting efficiency of cats in these areas.

**Commented [MT4]:** Update from LMP

The rehabilitated Deepdell North III WRS is expected to produce replacement habitat of very similar nature to the impacted existing Deepdell WRS which is utilised by one pair of Declining pipits and an estimated six Not Threatened spur-winged plover.

Likewise, the new pit lake in the Deepdell North III pit will produce replacement habitat similar to that occupied by the breeding colony of black-backed gulls in the backfilled existing Deepdell North pit.

Rehabilitation of the western cleanwater drain

The western cleanwater drain will be constructed to provide appropriate habitat for freshwater crayfish by including schist flakes on a clay drain bed and with riparian planting of overhanging indigenous plants.

Lizard access across these drains will be facilitated by placement of schist flakes across the drain.

*Mitigate impact*

The opportunities to minimise the impact of this project are controls on dust, noise, disturbance, sediment, contaminant suppression, weed surveillance, fire response and rescue (salvage) of ecological features.

Dust suppression

Dust-fall can be a problem for plants as it inhibits their photosynthetic capacity. Though none of the species present in the PIA is thought to be particularly susceptible to dust, supressing dust that is created during mine activities is a standard operating procedure and will minimise this effect.

Noise and minimising disturbance

Blasting and operating heavy machinery creates considerable noise and disturbance which is likely to create a negative reaction in animal species. Though this reaction will vary, most of the bird species recorded at this site appear to acclimate to regular disturbance. Minimising noise is a standard operating procedure and will minimise this effect, though is likely that harrier hawks will avoid hunting the nearby surrounding area, and that paradise shelducks will not nest within sight of the project.

Weed surveillance

Importation of new weed species into the area during mine operations could, depending on the species, have a huge impact on the area's biodiversity. To minimise this risk an inspection of the area around mine operations for new weed species every two years by a qualified ecologist will alleviate this risk. New environmental weeds that are discovered in the area will be subject to OceanaGold's annual environmental weed control operation.

Fire response

The Macraes area is usually very dry and any fires that do start have the potential to cover large areas and harm large areas of natural vegetation. A site fire avoidance protocol and rapid response to any suspected fires is a standard operating procedure and will minimise this effect.

Sediment Control

Mining disturbs land, removes vegetation and soil cover, and so increases the risk of fine sediment discharges to watercourses. Sediment control measures are routinely employed by OceanaGold at Macraes Mine and will continue to be applied to minimise this effect. Specific efforts on sediment control in the Deepdell North III development are contained in the Erosion and Sediment Control Report (EGL, 2019).

Manage accidental contaminants spills

The presence of construction machinery in and around waterways presents a risk of contaminants entering watercourses with potential to harm aquatic life. OceanaGold will continue to address this effect by operating an appropriate on-site contaminant management plan.

Protect against nuisance weed/algae introduction into waterways

Machinery and personnel involved in construction can potentially transfer nuisance weeds/algae to local watercourses. OceanaGold complies with notices and guidelines issued by Biosecurity New Zealand regarding nuisance weeds/algae and will continue this practice.

Rescue of ecological features

Some of the higher-importance ecological features identified in Section 0 and in Appendix 1 will be rescued by a suitably experienced operator removing them (or propagating parts of them such as seeds or cuttings) following OceanaGold's Plant Propagation, Translocation and Management Procedure (updated to include the species listed below) and establishing them at EEA sites with existing suitable habitat (for instance DOC and OceanaGold protected areas) (Figure 2). The plants will receive post-introduction care where necessary including watering and suppression of competing vegetation for two years.

The success of moving the following species will be monitored by counting number of plants at the recipient site on an annual basis for three years:

1) The Locally Uncommon shrub *Melicope simplex* from the eleven trees in the WRS to twenty individuals at one site in the nearby OceanaGold Highlay Creek Shrubland Covenant to create a new population there.

2) The Locally Uncommon shrub *Myrsine divaricata* from the two individuals in the WRS to 10 individuals at one site in the nearby OceanaGold Highlay Creek Shrubland Covenant to create a new population adjacent to an existing population.
3) The Naturally Uncommon wetland rush *Juncus distegus* from approximately 370 $m^2$ to 50 plants in the Redbank EEA.

The success of moving the following, lower importance, species will not be monitored:

1) The Declining wetland sedge *Carex tenuiculmis* from the 10 plants in the buffer area to 20 individuals planted in the Cranky Jims Wetland Covenant to enhance the population there.
2) The Declining coral broom *Cramichaelia crassicaulis* from the 2 plants in the WRS area to 10 individuals in the adjacent Highlay Creek Shrubland Covenant to create a new population there.
3) The Declining desert broom *Carmichaelia petriei* from the 7 plants in the WRS area to 15 plants in the adjacent Highlay Creek Shrubland Covenant to bolster the population there.
4) The Declining small wetland rush *Juncus pusillus* from the 1$m^2$ patch in the WRS to 10 plants in the Ephemeral Wetland EEA to create a new population there.
5) The Declining button daisy *Leptinella perpusilla from the 1$m^2$ in the WRS to 10 plants in the adjacent Highlay Creek Shrubland Covenant to create a new population there.*
6) The Declining small wetland herb *Lobelia ionantha Juncus pusillus* from the 0.5$m^2$ in the WRS to 10 plants in the Ephemeral Wetland EEA to create a new population there.
7) The Declining grass *Rytidosperma buchananii* from the 1 plant in the WRS to 5 plants in the adjacent Highlay Creek Shrubland Covenant to create a new population there, if the sole individual can be refound.
8) The Naturally Uncommon hookgrass *Carex subtilis* from the 1 plant in the WRS to 5 plants in the adjacent Highlay Creek Shrubland Covenant to supplement the population there, if the sole individual can be refound.
9) The Data Deficient liane *Parsonsia capsularis* var. *tenuis* from 1 plant in the buffer area to 10 plants in the adjacent Highlay Creek Shrubland Covenant to create a new population there.
10) The Locally Uncommon small sedge *Carex resectans* from the 1.6$m^2$ area in the WRS area to 10 plants in the Ephemeral Wetland EEA to create a new population there.

These species have been selected on the basis of their importance in the local situation, and their probable amenity to being rescued, whilst taking into account the extent of the project impact upon them that was identified in Section 0. The recipient sites have been chosen on the basis of their proximity to the project area and the availability of suitable habitat there, or that the site will be managed in a manner that will benefit the species.

Undertaking this action will provide benefit in 1) preventing a reduction in population density of these species in this area, and 2) removing these species to a safer environment within nearby protected areas to create new populations or to bolster existing populations.

*Residual adverse effects subsequent to Avoid, Remedy and Minimise actions*

The residual adverse effects remaining subsequent to implementation of Avoid, Remedy and Minimise, are detailed here:

| Biodiversity Class | Biodiversity Type | Biodiversity Component | Ecological Importance of Feature | Magnitude of Project Impact on Feature Locally | Magnitude of Project Impact on Feature Nationally | Overall Project Effect on Feature | Overall Loss | Loss Unit |
|---|---|---|---|---|---|---|---|---|
| **Bird** | **Community** | **Ecological function** | Moderate | Moderate | Negligible | Very Low | | |
| **Bird** | **Species** | **Grey teal** | Low | Moderate | Negligible | Very Low | 6 | individuals |
| **Bird** | **Species** | **Welcome swallow** | Low | Moderate | Negligible | Very Low | 5 | individuals |
| **Flora** | **Community** | **Ephemeral Wetland** | High | High | Medium | High | 1.8383 | Hectares |
| **Flora** | **Community** | **Seepage** | High | Medium | Low | Low | 0.0651 | Hectares |
| **Flora** | **Community** | **Low producing grassland** | Moderate | Medium | Low | Low | 49.46519 | Hectares |
| **Flora** | **Community** | **Seasonal gully drainage** | Low | Medium | Low | Very Low | 2.50069 | Hectares |
| **Flora** | **Community** | **Shrublands** | Moderate | Low | Negligible | Very Low | 4.09766 | Hectares |
| | | | | | | | | |
| | | | | | | | | |
| **Flora** | **Species** | **Discaria toumatou Raoul** | High | Negligible | Negligible | Very Low | 3.803212 | Hectares |
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|---|---|---|---|---|---|---|---|---|
| **Invertebrates** | **Community** | **Ecological function** | Moderate | Medium | Low | Low | ? | ? |

*Offsetting*

As there are forecast to be residual adverse effects of the project on the sites biodiversity after implementation of the Avoid, Remedy and Mitigate (see Section 0), an offset as described under the pORPS will be provided to address remaining significant adverse effects. This offset will have several components: an averted loss multiuse offset in an Ecological Enhancement Area (EEA) on Redbank Station to address the impact on shrublands and the seepage wetland, and an ephemeral wetland enhancement offset and supporting research project at sites in a an Ephemeral Wetland EEA near Middlemarch in the south of the Ecological District to address the impact on ephemeral wetlands. There are local constraints on how an offset can be realised in the Macraes situation (see comments in Sections 0 and 0) and these have been considered in the design of the offset package. The implementation and management of the EEA sites will be documented in an EEA Management Plan (sometimes also termed an Offset Plan).

Offset design

This offset is designed to fulfil an offset as prescribed in the pORPS (and including Environment Court decision NZEnvC41 of 15 March 2019)[12]: The offset achieves no net loss and preferably a net gain in indigenous biological diversity;

- The offset ensures there is no loss of individuals of rare or vulnerable species as defined in reports published prior to 14 January 2019 under the New Zealand Threat Classification System ("NZTCS");
- The offset is undertaken where it will result in the best ecological outcome, preferably:
    - Close to the location of development; or
    - Within the same ecological district or coastal marine biogeographic region;
- The offset is applied so that the ecological values being achieved are the same or similar to those being lost;
- The positive ecological outcomes of the offset last at least as long as the impact of the activity, preferably in perpetuity;
- The offset will achieve biological diversity outcomes beyond results that would have occurred if the offset was not proposed; and
- The delay between the loss of biological diversity through the proposal and the gain or maturation of the offset's biological diversity outcomes is minimised.

The disaggregated accounting model[13] was used to calculate the extent of works required within the EAAs to achieve a state of No Net Loss of biodiversity (NNL) using the March 2015 user manual and spreadsheets.

[12] Note the offset described in the pORPS does not require use of any offset guidance such as that provided by BBOP, DOC or in recent guidance to Councils.

[13] Maseyk, F.J.F; Barea, L.T; Stephens, R.T.T; Possingham, H.P; Dutson, G; Maron, M. 2016. A disaggregated biodiversity accounting model to improve estimation of ecological equivalency and no net loss. Biological Conservation 204: 322-332.

Site selection

The upper Waikouaiti River North Branch offset site (Redbank EEA) (Figure 6) has been chosen on the basis of discussions with both landowners who identify it as a site of low farming usefulness and a site examination that shows the site has considerable ecological value in terms of fauna, vegetation communities and as habitat for rare species. This site is part of a farming environment and has no protections beyond that afforded by regional and district plans and therefore ongoing damage to some ecological features is expected and the tussock grassland and shrubland could be actively managed to enhance livestock grazing. Some of the ecological features present are restricted to areas where stock are not able to access.

The Ephemeral Wetland EEA (Figure 5) has been selected as it is the largest example of its type in the Ecological District and is currently of lower ecological value due to its being heavily dominated by exotic plant species with few (four) Not Threatened indigenous species present.

*Figure 5. Location of the Ephemeral Wetland EEA ("offset")*



*Figure 6. Location of Redbank EEA.*

Redbank EEA

A covenant of 126 ha will be established under the Conservation Act in the upper Waikouaiti River North Branch (Figure 1Figure 6) which contains biodiversity that is of similar character to that being lost, but of better quality and with other inherent ecological values. Sensitive parts of this covenanted area will be fenced to exclude stock and limits will be placed on the type of stocking that can occur in the covenanted area and on any activities that could result in damage to the soils or to vegetation of high ecological importance. This land will be managed using the income from a fund held by OceanaGold until cessation of mining when the fund will be ceded to another authority.

Important components of this component of the offset are:

- Have a legal protection.
- Will be farmed as appropriate with the objective of protecting the important biodiversity features.
- Be of sufficient size to compensate for uncertainties in ecological outcomes associated with retaining farming in the covenant.
- Satisfy the offset criteria detailed in the pORPS.
- Will have a fund to support the management of the covenant on an ongoing basis.
- Will involve the farming community together with DOC and Councils in the offset design and placement.

- Will incorporate the Science and Traditional Knowledge offset principle by including farming community knowledge of biodiversity management in the Macraes Area.
- Will incorporate the Equity offset principle by sharing the risks and benefits between the farming community, DOC and Councils.
- Be managed with ecological oversight.
- Will result in a Biobank of additional ecological gains that will be used to address a future project's ecological impact.

This offset will also address the impact on the Declining matagouri, desert broom *Carmichaelia petriei*, Naturally Uncommon grass *Anthosachne falcis*, some components of the invertebrate and bird communities through protecting areas inhabited by these species.



*Figure 7. Location off plant community offset sites in Redbank EEA*

*Shrubland Component*

Offsetting the loss of an estimated 3.73 ha of shrubland from the Deepdell North III site will be through including an equivalent plant community of better ecological integrity in the Redbank EEA (Figure 7). The offset site has a higher diversity of shrub species (22 species), than in the impacted shrubland (15 species), is ecologically more intact with fewer exotic species and denser canopy, and is of a similar nature (though with some species that reflect a higher elevation and damper area). Within the offset site there is currently 4.23 ha of equivalent shrubland. This offset will also involve fencing and planting to facilitate regeneration of 10 ha of shrubland in the offset area that is comprised of at least 18 different shrub species and 75% canopy cover within 10, and keeping these free of exotic shrub species for 10 years. This produces a Net Present Biodiversity Value of 1.31.

*Seepage Wetland Component*

Offsetting the impact resulting in the loss of 0.07 ha of seepage wetland will be through including an equivalent plant community of larger size and managing this to better ecological integrity in the Redbank EEA (Figure 7). This offset is considered to have the elements of both an averted loss offset and an improved condition offset. The averted loss component of the offset is difficult to calculate as there is no available data on loss of these ecosystems in the area, but there have been high reported loss of wetlands from Southland and they are classified as Endangered based on their estimated rate of decline caused by weed invasion of over ≥70% of their extent nationally. This offset will involve using fencing and weed control to achieve a 20% improvement in indigenous species dominance within the 0.82 ha seepage wetland at the offset site by 10 years. This produces a Net Present Biodiversity Value of0.1, but additional to NNL are the gains considered to have been achieved through the averted loss portion of the offset. Protecting this seepage wetland against the background of 70% loss (over an estimated 30 years) would increase the Present Biodiversity Value by c. 70% to0.17. The impact on the Naturally Uncommon rush *Juncus distegus*

will also be addressed by creating conditions in which this species can flourish, supplemented by planting of 50 individuals.

Ephemeral wetland EEA

Offsetting the impact resulting in the loss of 0.31 ha of ephemeral wetlands will be through an improved-condition offset with the improvement work informed by a research project investigating ephemeral wetland form, function and threats. This offset will involve using weed control to produce at least 25% cover by indigenous plant species within 2 ha of the 4 ha Ephemeral Wetland EEA and an improvement in indigenous plant diversity at each site to at least 15 indigenous plant species comprised of at least ten species characteristic of Macraes ephemeral wetlands and five ephemeral wetland species of conservation concern by 10 years. This produces a Net Present Biodiversity Value of 0.18 and NNL is achieved by year 10. The 2 ha target of managed ephemeral wetland is double the 1 ha required to reach NNL, but compensates for current uncertainties in ecological state of these systems and lack of proven management tools[14]. These figures are based on the research project addressing deficiencies in knowledge on the form, function, threats and management of ephemeral wetlands. This research project will establish the physical profile and subsurface nature of the EEA, documenting its hydrological profile over time and measuring changes in the plant communities 3-4 times a year over 5 years. The threat that ephemeral wetlands face will be established by 1) revisiting 20 previously surveyed sites and documenting their current condition, 2) quantifying surrounding land use of all mapped ephemeral wetlands and 3) visiting a random selection of 50 ephemeral wetlands to describe their current condition. The impact on the Declining wetland herb *Lobelia ionantha,* Declining small rush *Juncus pusillus* and Locally Uncommon sedge *Carex resectans* will also be addressed through including these species as three of the 11 indigenous species.

EEA Management Plans

The implementation and management of each of the EEA's will be documented in a management plan (EEAMP). The EEAMP will form a part of a broader project Ecological Management Plan (which will include on-site works to avoid, remedy, and mitigate adverse effects).

The EEAMP will include:

- a description of the offset, the calculation basis, locations and management activities at which enhancements will be generated;
- securing the ability to undertake enhancement works within management sites by way of landowner agreements (e.g. covenants) or acquisitions;
- the technical detail of the offset works;

[14] The actual area if management is 4.8 ha and the non-formal target is to create a preponderant cover of indigenous species as this will make the site more resistant to weed invasion and therefore less difficult to manage into the future.

- the financial costs of site management into bond calculations or other similar instruments as required by Council that secure financial delivery of biodiversity enhancements;
- a monitoring programme to assess the degree to which enhancement targets are being achieved and the ability to adjust biodiversity management to ensure that gains are achieved and maintained for the long term;
- the roles and responsibilities of those carrying out the work, and the governance and management structures relating to the operation of the enhancement site(s); and
- reporting the results of monitoring results and a process for undertaking actions if enhancement targets are not being achieved as anticipated.

*Biobanking*

The proposed covenant in the upper Waikouaiti River North Branch includes 73 ha of narrow-leaved tussock grassland that is additional to that required under this Impact Mitigation Plan. This narrow-leaved tussock grassland is considered a biobank for use when appropriate to address the impact of a future OceanaGold project. The baseline ecological condition and change in condition over time will be measured using vegetation plots. The proposed also provides habitat to an additional 17 plant species of conservation concern which are also considered biobanked (together with any additional species found during future surveys) and their population status will be monitored over time. The reptile, bird and invertebrate communities that inhabit the additional areas are also considered biobanked and their baseline and condition over time.

The ecological condition of these additional communities will be measured as for the offset areas and the biobank will be adjusted to reflect any changes (beneficial or detrimental) in ecological condition.

*Lizard Management Plan*

The impact on the three lizard species known (or suspected) to occur in the PIA will be addressed through implementation of a Lizard Management Plan (LMP). The LMP will also include details on further survey work at the PIA pre-clearance and to form a baseline at the Redbank EEA.

*Ecological compensation*

The inclusion of 23.6 ha of low-producing grassland in the Redbank EEA is in recognition of the role this primarily exotic vegetation community has in harbouring indigenous biodiversity.

It is considered that creation of the covenant at the Redbank EEA provides adequate compensation for the project's impact on invertebrate communities, matagouri, the Naturally Uncommon grass *Anthosachne falcis* and Declining desert broom *Carmichaelia petriei*,

The protection by covenant of the seepage wetlands and gully wetlands in the Redbank EEA provide adequate compensation for the loss of area occupied by the wetland rush *Juncus distegus.*

As there are expected to be no significant residual adverse effects following implementation of the Avoid, Remedy, Mitigate and Offset options, no further activities are proposed as ecological compensation.

*Nil actions*

No mitigatory or compensatory activities are proposed for the Not Threatened grey teal, Not Threatened welcome swallow, seasonal gully drainage plant community, as the impact of the project on these ecological features is predicted to be Very Low.

**Evaluation of adequacy of plan**

These actions will, if implemented correctly, fully address all non-minor project effects excepting some minor impacts on individuals of some common indigenous bird species, or mostly exotic plant-dominated plant communities noted above. It is also considered that benefit of the offset covenant containing a higher quantity of the Macraes biodiversity more than compensates for the impact of the Deepdell North III project on these features. It is considered that overall this Impact Management Plan will maintain the biodiversity in the local area (see Appendix 1). This assessment is based on the actions within the Impact Management Plan (Section 0) being successful.

It is also considered the proposed approach meets the Impact Management principles set out in Section 0, noting in particular that it is not practicable to maintain the significant nature of the biological diversity present at the Deepdell North III project site by avoiding, remedying or mitigating effects, and the proposed offsetting meets the criteria set out in Section 0 for when offsetting can be considered as an appropriate management mechanism.

As a result of the proposed management measures, including the proposed environmental compensation, residual adverse effects on ecological features will be very low, and the affected values will be protected in the local area.

**References**

Ahika Consulting Ltd. 2019. Deepdell North III: impact of project on vegetation, avifauna, herpetofauna & invertebrates. Unpub. report to Oceana Gold (New Zealand) Limited.

Bibby, C.J. 1997. Macraes Ecological District, summary report for Protected Natural Areas Programme. Department of Conservation, Dunedin.

de Lange, P.J; Rolfe, J.R; Champion, P.D; Courtney, S.P; Heenan, P.B; Barkla, J.W; Cameron, E.K; Norton, D.A; Hitchmough, R.A. 2013. Conservation status of New Zealand indigenous vascular plants, 2012. New Zealand Threat Classification Series 3. Department of Conservation, Wellington.

EcoGecko Consultants Ltd. 2013. Lizard survey of the northern gully waste rock stack and western waste rock stack for Oceana Gold (New Zealand) Limited at Macraes Flat, Otago, New Zealand. Unpub. report to Oceana Gold (New Zealand) Limited.

Holdaway, R.J; Wiser, S.K; Williams, P.A. 2012. Status assessment of New Zealand's naturally uncommon ecosystems. Conservation Biology 26: 619-629.

Johnson, P.N; Rogers, G.M. 2003. Ephemeral wetlands and their turfs in New Zealand. Science for Conservation 230. Department of Conservation, Wellington.

Ryder Consulting Ltd. 2019. Deepdell North Stage III Project, Aquatic Ecology Assessment. Unpub. report to Oceana Gold (New Zealand) Limited.

Thorsen, M. 2008. Where in New Zealand is the highest diversity of threatened plants? Trilepidea Newsletter 58: 4-8.

Williams, P.A; Wiser, S; Clarkson, B; Stanley, M.C. 2007. New Zealand's historically rare terrestrial ecosystems set in a physical and physiognomic framework. New Zealand Journal of Zoology 31: 119-128.

APPENDIX 2. CURRENT DRAFT OF REDBANK ECOLOGICAL ENHANCEMENT AREA MANAGEMENT PLAN (CHANGES FROM ORIGINAL DRAFT TRACKED).

Oceana Gold (NZ) Ltd

Macraes Gold Project

Ahika Consulting
Rm. 2, Third Floor,
2 Dowling St, Dunedin
PO Box 1320, 9054

03 477 0242
info@ahika.co.nz
www.ahika.co.nz

# Deepdell North III Project v2 (including WDC & DOC comment)

## Redbank Ecological Enhancement Area Management Plan

July 2020

Report prepared for Oceana Gold (New Zealand) Ltd by Dr M. J. Thorsen,

3 August 2020

Report number: 01015-25-3



2 Dowling Street

Dunedin 9016

New Zealand



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**Contents**

**Document Summary**

The Deepdell North III project will remove 54.79 ha of indigenous vegetation comprising low producing grassland, shrubland, seasonal gully drainages, ephemeral wetlands and a seepage wetland and inhabited by 71 indigenous plants (including 13 rare species), twenty bird species (nine indigenous and one rare species), four reptile species (three rare species) and a largely unknown invertebrate community. The vegetation communities are underlain by 3 Threatened LENZ. The ephemeral wetland vegetation community is Historically Rare and Critically Endangered and the seepage wetland is Historically Rare and Endangered. Both are priorities for protection. The indigenous vegetation communities are generally of low species diversity and most are characterised by high weed representation. The populations of the 17 At Risk or Rare species are mostly small, except for the Declining Matagouri which is dominant in the shrubland vegetation community and frequent in the low producing grassland plant community.

The project will also impact on 54.09 ha of cultivated pasture and shelterbelts. There may be some effect on a further 88.71 ha of indigenous vegetation and 26.47 ha of cultivated pastures, but these effects are expected to be minimal if appropriate controls are employed.

To address these impacts OceanaGold (New Zealand) Limited (OceanaGold) proposes to support the activities within both an Impact Management Plan and this Ecological Enhancement Area Management Plan (EEAMP). These activities include avoiding effects by evaluating siting of infrastructure and by isolating higher-value ecological areas in the buffer zone, mitigating general environmental effects such as dust, noise and weeds, salvage of rare plants, a lizard management programme and implementing an ecological management programme under an offset design at two sites. Once implemented, the Impact Management Plan and EEAMPs will result in avoiding, minimising, rehabilitating or offsetting all significant adverse ecological effects arising from the Deepdell North III Project to achieve ah an overall gain in biodiversity.

This EEAMP focuses on enhancing shrublands, a seepage wetland and low-producing grassland and selected rare plant species using carefully managed grazing with the goal of producing an overall net gain in biodiversity.

This document is laid out with higher-level guiding analysis first and then the EEAMP (Section 0).

**EEA Management Plans**

Ecological Enhancement Areas (EEA) are sites where it is planned to undertake biodiversity offsetting projects. The implementation and management of each of the EEA's will be documented in a management plan (EEAMP, this

document). The EEAMP will form a part of a broader project Ecological Management Plan (which will include on-site works to avoid, remedy, and mitigate adverse effects).

The EEAMP includes:

- a description of the offset, the calculation basis, locations and management activities at which enhancements will be generated;
- securing the ability to undertake enhancement works within management sites by way of landowner agreements (e.g. covenants) or acquisitions;
- the technical detail of the offset works;
- the financial costs of site management into bond calculations or other similar instruments as required by Council that secure financial delivery of biodiversity enhancements;
- a monitoring programme to assess the degree to which enhancement targets are being achieved and the ability to adjust biodiversity management to ensure that gains are achieved and maintained for the long term;
- the roles and responsibilities of those carrying out the work, and the governance and management structures relating to the operation of the enhancement site(s); and
- reporting the results of monitoring results and a process for undertaking actions if enhancement targets are not being achieved as anticipated.

**Guiding documents**

Consent Notice.

Offsetting practice

**Commented [MT5]:** Add these

**Offset design and calculation**

This offset is designed to fulfil an offset as prescribed in the pORPS (and including Environment Court decision NZEnvC41 of 15 March 2019)[15]:

> "The offset achieves no net loss and preferably a net gain in indigenous biological diversity;
>
> The offset ensures there is no loss of individuals of rare or vulnerable species as defined in reports published prior to 14 January 2019 under the New Zealand Threat Classification System ("NZTCS");
>
> The offset is undertaken where it will result in the best ecological outcome, preferably:
>
> > Close to the location of development; or
> >
> > Within the same ecological district or coastal marine biogeographic region;
>
> The offset is applied so that the ecological values being achieved are the same or similar to those being lost;
>
> The positive ecological outcomes of the offset last at least as long as the impact of the activity, preferably in perpetuity;
>
> The offset will achieve biological diversity outcomes beyond results that would have occurred if the offset was not proposed; and
>
> The delay between the loss of biological diversity through the proposal and the gain or maturation of the offset's biological diversity outcomes is minimised."

The disaggregated accounting model[16] was used to calculate the extent of works required within the EAA to achieve a state of No Net Loss of biodiversity (NNL) using the March 2015 user manual and spreadsheets.

In designing the offset consideration was given to both the Biodiversity Offsetting under the Resource Management Act: a guidance document[17] and the Department of Conservation's Guidance on Biodiversity Offsetting[18].

The calculation in the offsets was independently peer reviewed by Graham Ussher.



[15] Note the offset described in the pORPS does not require use of any offset guidance such as that provided by BBOP, DOC or in recent guidance to Councils.

[16] Maseyk, F.J.F; Barea, L.T; Stephens, R.T.T; Possingham, H.P; Dutson, G; Maron, M. 2016. A disaggregated biodiversity accounting model to improve estimation of ecological equivalency and no net loss. Biological Conservation 204: 322-332.

[17] Maseyk, F; Ussher, G; Kessels, G; Christensen, M; Brown, M. 2018. Biodiversity Working Group.

[18] doc.govt.nz/about-us/our-policies-and-plans/guidance-on-biodiversity-offsetting/

**Redbank EEAMP**

*Objectives of Redbank EEA*

The objectives of the Redbank EEA are to:

1. Allow the achievement of OceanaGold's Deepdell North project offset obligations.

Secondary objectives are to:

2. Integrate farming practices and conservation of biodiversity.
3. Measure conservation gains.

*Key targets*

The key targets that the Redbank EEA will achieve are:

- The offsets achieve and maintain their targets.
- A covenant over at least the areas required as offset sites or under the Lizard Management Plan[19].
- Sensitive ecological sites are fenced from stock.
- Ecological condition monitored and management adjusted as necessary to meet target.
- Sparse shrubland areas are supplementary planted and shrublands increase in area to the target amount.
- Weeds controlled in a seepage wetland and 50 rush *Juncus distegus* transplanted from impact site.
- Other gains relative to the surrounding area are documented and considered a biobank

*Description of project*

The role of the Redbank Ecological Enhancement Area (EEA) is to allow for offsetting and compensation of the impacts from OceanaGold's Deepdell North project. There are two offsets to be undertaken here: a shrubland offset and a seepage offset. The EEA also seeks to investigate how to integrate local farming practices and biodiversity conservation in a natural landscape at Macraes with the overall objective of maintaining, and enhancing where necessary, the important indigenous biodiversity within the identified covenant area. This EEA Management Plan

[19] The proposed covenant is 138 ha, but this includes areas additional to that required.

(EEAMP) takes as a starting point that the biodiversity in this area has persisted through 700 years of Maori use and 150 years of farming activities and that removing these very strong influences on local ecology runs the risk of causing a cascading change of potentially unwanted effects that could result in the loss of important biodiversity. The objectives of the EEA will be carefully monitored, and direction set by an oversight group.

It needs to be emphasised that removing grazing will eventually result in the succession of the narrow-leaved tussock grassland and low-producing grassland into a shrubland with an unknown, but possibly severely detrimental, effect on some of the area's species of conservation concern for which the Macraes E.D. is nationally important.

*The Offsets*

Shrubland Offset

The actions within this offset aim to offset the loss of an estimated 3.73 ha of shrubland from the Deepdell North III site by including an equivalent plant community of better ecological integrity in the proposed Redbank Station Covenant. This offset site has a higher diversity of shrub species (22 species), than in the impacted shrubland (15 species), is ecologically more intact with fewer exotic species and denser canopy, and is of a similar nature (though with some species that reflect a damper area due to its more easterly location). Within the offset site there is currently 4.23 ha of equivalent shrubland. This offset will involve promoting shrubland expansion by permanently fencing off the necessary area and supplementary planting to speed expansion and diversify species into 10 ha of shrubland in the offset area with a target that the offset shrubland are comprised of at least 18 different shrub[20] species and 75% canopy cover within 10. This produces a Net Present Biodiversity Value of 1.31.

Seepage Wetland Offset

The actions within this offset aim to offset the impact resulting in the loss of 0.07 ha of seepage wetland by including an equivalent plant community of larger size and managing this to better ecological integrity in the proposed Redbank Station Covenant. This offset is considered to have the elements of both an averted loss offset and an improved condition offset. The averted loss component of the offset is difficult to calculate as there is no available data on loss of these ecosystems in the area, but there have been high reported loss of wetlands from Southland and they are classified as Endangered based on their estimated rate of decline caused by weed invasion of over ≥70% of their extent nationally. This offset will involve using weed control and stock exclusion using a permanent fence to achieve a 20% improvement in indigenous species dominance within the 0.82 ha seepage wetland at the offset site by 10 years. This produces a Net Present Biodiversity Value of 0.1, but additional to NNL are the gains considered to have been achieved through the averted loss portion of the offset. Protecting this seepage wetland against the background of 70% loss (over an estimated 30 years) would increase the Present Biodiversity Value by c. 70% to0.17. The impact

[20] The category shrub here also includes lianes and vines

on the Naturally Uncommon rush *Juncus distegus* will also be addressed by creating conditions in which this species can flourish, supplemented by transplanting of 50 individuals from the impact site.

*Site*

Site selection criteria/process

The Redbank EEA was selected on the basis of proximity to impact site, expected semi-natural vegetation cover and current low usage for farming. The suitability of the site was then assessed using information gained during field surveys to decide similarity of vegetation communities and other ecological features.

All vegetation communities in the EEA are of higher quality than in the impact area. Because of this the offset is treated as a trade-up offset.

Site location(s), access and legal provisions

The Redbank EEA is 6.5 km southeast of Macraes Township (Figure 8). It is on OceanaGold tenure land which is farmed under a lease arrangement.

The proposed Redbank Station Covenant will be covenanted under the Conservation Act (1988) and managed as described in this plan with provisions in the lease to give effect to this plan.

Physical description of EEA

The Redbank EEA comprises the 138 ha proposed Redbank Station Covenant (Figure 8). The terrain is an incised valley with large bluff complexes along part of the Waikouaiti River North Branch and an undulating peneplain surface at about 500m a.s.l. (Figure 9).

Flora of EEA

The vegetation communities of the EEA include narrow-leaved tussock grassland, low-producing grassland, shrubland, gully wetlands and seepages (Figure 10). The areas of each type of vegetation community in the covenant is provided in Table 2 and photographs are in Appendix 3. Site photographs. These vegetation communities are inhabited by at least 217 indigenous plant species and 41 exotic plant species (Appendix 1. Plant species recorded within the Redbank Station Covenant).

Narrow-leaved tussock grassland

The narrow-leaved tussock grassland is dominated by 50-80 cm tall *Chionochloa rigida* subsp. *rigida* at 80-90% ground cover (with areas of taller tussocks) with occasional low matagouri, scattered golden Spaniard *Aciphylla aurea* and hard tussock *Festuca novae-zelandiae* with a ground cover of mainly *Gaultheria macrostigma, Anisotome aromatica,* browntop *Agrostis capillaris*, hawkweed *Pilosella officinarum,* catsear *Hypochoeris radicata,* mosses and lichens.

Shrubland

The shrubland community consist of varying density matagouri, *Coprosma propinqua, Coprosma dumosa* and *Coprosma crassifolia* and *Muehlenbeckia complexa* with an understory of exotic grasses, *Leucopogon fraseri,* blue tussock *Poa colensoi* (tall green form), hawkweed, bracken *Pteridium esculentum* and scattered clumps of golden spaniard. Denser examples centre on rocky outcrops and can include rarer shrub species such as desert broom *Carmichaelia petriei* and *Corokia cotoneaster*.

Seepage

The seepage wetlands are dominated by *Schoenus pauciflorus, Carex testacea* (mountain form), selfheal *Prunella vulgaris* with patches of hard tussock, hard fern *Austroblechnum penna-marina*, Californian thistle *Cirsium arvense*, musk *Erythranthe moschata*, oval sedge *Carex leporina* and water forget-me-not *Myosotis laxa* subsp*. caespitosa.*

Low-producing grassland

The low-producing grassland is dominated by browntop, sweet vernal *Anthoxanthum odoratum* and hawkweed with patches of sparse and low narrow-leaved tussock and matagouri to 50 cm tall. Smaller indigenous herbs and subshrubs such as *Leucopogon fraseri*, *Raoulia subsericea, Deyeuxia avenoides* and dryland mosses and lichens, golden Spaniard and hard tussock. Patches of dry, unvegetated ground are common. They are an important site for orchid species.

| *Vegetation Community* | *Redbank Station Covenant (proposed)* |
|---|---|
| *Gully Wetland* | 0.52 |
| *Low-producing Grassland* | 23.62 |
| *Narrow-leaved tussockland* | 108.77 |
| *Seepage* | 0.95 |
| *Shrubland (dense)* | 0.82 |
| *Shrubland (sparse)* | 3.39 |
| ***Total*** | **138.07** |

*Table 2. Extent[21] of vegetation communities within the covenant.*

*Figure 8. Locations of proposed Redbank Station Covenant.*

*Figure 9. Aerial view of proposed Redbank Station Covenant (green outline).*

[21] Extents have been mapped from aerial image and will be refined once higher-resolution drone images are available.

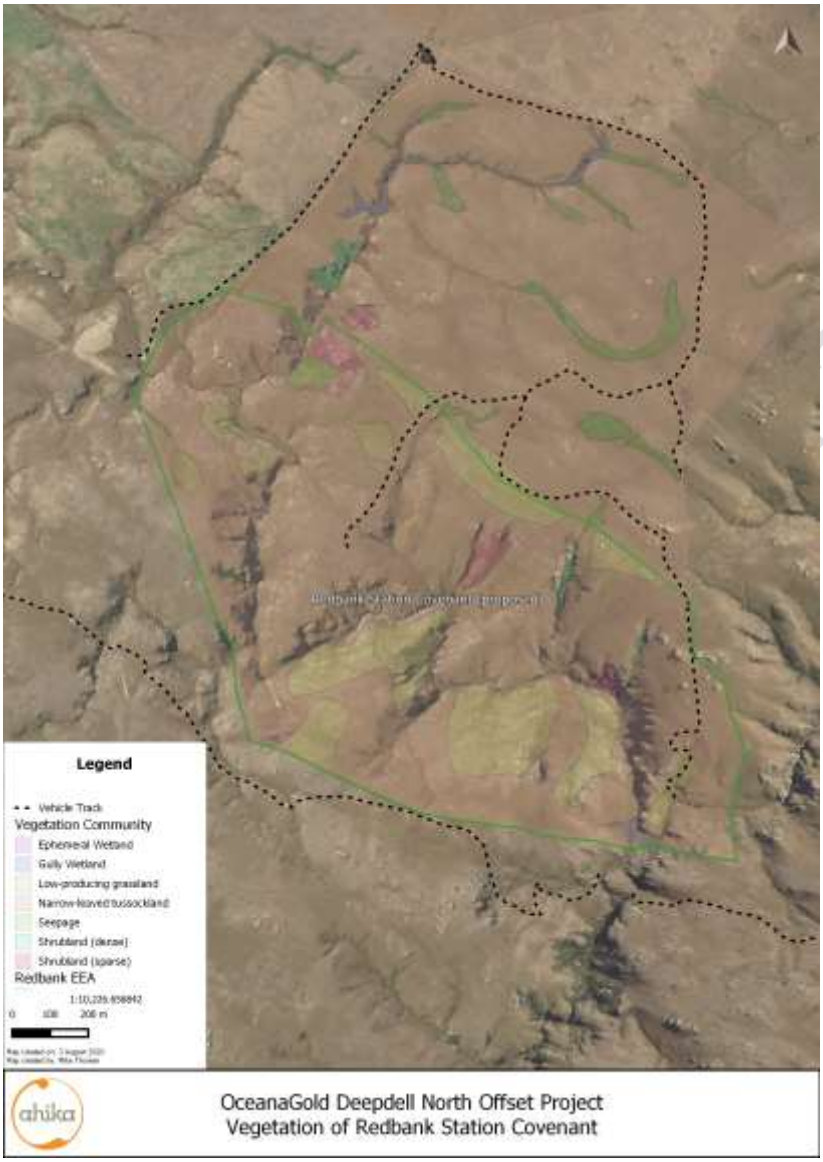


*Figure 10. Vegetation of proposed Redbank Station Covenant.*

Thirty plant species of conservation interest are known from within the covenant, including 2 Nationally Critical species, 3 Nationally Endangered species and 2 Nationally Vulnerable species (Table 3). Population of other species of conservation interest are also likely to be present. The sites inhabited by these species are concentrated in the gullies and bluff systems (Figure 11).

| Plant Species and Threat Status | Redbank Station Covenant (proposed) |
|---|---|
| **Nationally Critical** | |
| Lagenophora montana Hook.f. | 3 sites |
| Simplicia laxa Kirk | 2 sites |
| **Nationally Endangered** | |
| Hypericum rubicundulum Heenan | 1 site |
| Pachycladon cheesemanii Heenan & A.D.Mitch. | 1 site (5 plants, only 3 sites known for this species in Macraes E.D.) |
| Senecio dunedinensis Belcher | 1 site (1 plant) |
| **Nationally Vulnerable** | |
| Myosurus minimus subsp. novae-zelandiae (W.R.B.Oliv.) Garn.-Jones | 1 site (c. 50 plants) |
| Sonchus (b) (CHR 596666; aff. S. novae-zelandiae; "cliff") | 1 site (1 plant) |
| **Declining** | |
| Carex buchananii Berggr. | 1 (1 plant) |
| Carmichaelia petriei Kirk | Locally distributed |
| Discaria toumatou Raoul | Common |
| Epilobium insulare Hausskn. | 2 sites |
| Leptinella pusilla Hook.f. | 4 sites |
| Mentha cunninghamii Benth. | 2 sites |
| Pterostylis tanypoda D.L.Jones, Molloy & M.A.Clem. | 1 site |
| Pterostylis tristis Colenso | 1 site |
| Raoulia australis Hook.f. ex Raoul | 1 site |
| Rytidosperma buchananii (Hook.f.) Connor & Edgar | 1 site |
| **Naturally Uncommon** | |
| Carex purpurata (Petrie) K.A.Ford | |
| Celmisia hookeri Cockayne | 9 sites (100s) |
| Chenopodium allanii Aellen | 1 site |
| Euchiton polylepis (D.G.Drury) Breitw. & J.M.Ward | 2 sites |
| Lagenophora barkeri Kirk | 3 sites |
| Myosotis tenericaulis Petrie | 1 site (One of only two currently known extant populations in Otago) |
| **Relict** | |
| **Data Deficient** | |
| Melicytus aff. alpinus (d) (CHR 541567; "dark") | |
| Myosotis aff. australis (c) (CHR 572827; Lammerlaw) | 1 (3 plants, only site known in Macraes E.D.) |
| **Locally Significant** | |
| Acaena dumicola B.H.Macmill. | 1 site |
| Fuchsia perscandens Cockayne & Allan | 1 Site (2 plants) |
| Griselinia littoralis Raoul | Local |
| Leptecophylla juniperina (J.R.Forst. & G.Forst.) C.M.Weiller subsp. juniperina | Local |

| | |
|---|---|
| Myosotis australis R.Br. | 1 site (6 plants) |
| Myrsine divaricata A.Cunn. | |
| Poa pusilla Berggr. | 1 site |
| Sophora microphylla Aiton | 1 site |

*Table 3. Populations of plants of conservation interest in the proposed covenant.*

*Figure 11. Know locations of plants of conservation interest in the proposed Redbank Station Covenant.*

Fauna of EEA

Reptiles

The skinks *Oligosoma maccanni* (clade 4 genotype) and *Oligosoma polychroma* (clade 5 genotype), and gecko *Woodworthia* "Otago/Southland large" are all known to occur within the Covenant. The latter two species are classified as At Risk-Declining. Densities vary between sites and number of animals seen is very dependent on weather conditions. None of these species were found to be common across the entirety of the covenant with grass skinks and korero geckos relatively abundant in localised patches with the occasional individual encountered between in other areas. Southern grass skinks were found to be particularly abundant in the heath-like short-stature narrow-leaved tussock grassland in the northwest side. Korero gecko were recorded in localised pockets throughout the covenant, primarily on north facing rock outcrops. McCann's skinks are encountered relatively infrequently despite the apparent suitability of the habitat and their high relative abundance within the Macraes ED. Suitable habitat is present for the three species of large skink known from the Macraes ED: the Otago skink (*Oligosoma otagense*), grand skink (*O. grande*) and Otago green skink (*O*. aff. *chloronoton* "Eastern Otago").

Birds

Indigenous species recorded to date from the covenant are the grey warbler (*Greygone igata*), welcome swallow (*Hirundo neoxena*), paradise shelduck (*Tadorna variegata*) and swamp harrier (*Circus approximans*). Exotic species recorded are yellowhammer (*Emberiza citrinella*), redpoll (*Carduelis flammea*), dunnock (*Prunella modularis*), common starling (*Sturnus vulgaris*) and song thrush (*Turdus philomelos*). The At Risk-Declining New Zealand pipit (*Anthus novaeseelandiae* ssp. *novaeseelandiae*) is likely to be present within the covenant due to the high suitability of the habitat (i.e. tussock grassland, rock outcrops, etc.). It is also likely that the area is at least visited by the At Risk-Recovering New Zealand falcon/kārearea (*Falco novaeseelandiae*) which is frequently encountered within the

Macraes ED. The steep sides of the gorge and numerous rock outcrops within covenant offer potentially suitable nesting habitat for this species.

Invertebrates

The invertebrate fauna of Redbank Covenant is relatively diverse (Appendix 2. Invertebrate species recorded within the Redbank Station Covenant). A single *Peripatoides* specimen was found within the covenant, likely belonging to the undescribed species *Peripatoides* "Dunedin". This species is more typically associated with forest habitat and, to date, this sighting is the only known record from the Macraes ED. Redbank Covenant is the only known location of the grasshopper *Sigaus campestris* on the OceanaGold estate. Several species of weevil belonging to the genus *Peristoreus* were found on *Carmichaelia petriei* within the covenant. All these species appear to be *Carmichaelia* specialists with one notable species possibly restricted to eastern Otago, despite seemingly having escaped the attention of notable entomologists from the area. Given the threat status of *C. petriei* (At Risk-Declining), the aforementioned *Peristoreus* species may also prove to be of conservation concern. Invertebrate browse was found on *Fuchsia perscandens* growing within the covenant, the host plant of the Threatened-Nationally Vulnerable geometrid *Cephalissa siria*; however, further survey work would be required to determine the presence or absence of this species.

Threats to EEA

Weeds are the largest threat to the EEA, particularly the threat from herbaceous weeds to low-growing plant species of conservation interest. Woody weeds such as gorse and willow are rare in the EEA and broom is present nearby. Gorse and broom, if allowed to flourish, will displace the non-woody indigenous vegetation communities.

Pests such as rabbits and predators such as stoats are probably pervasive throughout the EEA and responsible for continuing loss of biodiversity.

Land use change is a threat to the EEA, particularly conversion to exotic forestry.

Farming, while beneficial to some aspects of biodiversity, is likely to have negative impacts on other aspects resulting in the restriction of some species to inaccessible sites, restricting shrubland expansion and physical damage to wetland.

*Comparison of biodiversity values between Redbank EEA and Deepdell North project impact site*

The Redbank EEA contains areas of most of the semi-natural vegetation communities that are in the Deepdell North project impact area (Table 2) with the exceptions of ephemeral wetland (included in the separate ephemeral wetland offset) and shallow ephemeral drainage system. Additional vegetation communities that are present in the EEA are gully wetland and narrow-leaved tussock grassland.

| Vegetation Community | Pit | WRS | Buffer | Total | Redbank EEA |
|---|---|---|---|---|---|
| **Exotic vegetation communities** | | | | | |
| Cultivated Pasture | 29.16 | 24.93 | 26.39 | 80.49 | |
| Shelterbelts & Exotic Trees | | 0.53 | 0.08 | 0.61 | |
| **Semi-natural vegetation communities** | | | | | |
| Ephemeral Wetland | | 0.3 | 0.02 | 0.31 | |
| Gully Wetland | | | | | 0.52 |
| Low producing grassland | 8.76 | 39.47 | 24.82 | 73.04 | 23.62 |
| Narrow-leaved tussock grassland | | | | | 108.77 |
| Seepage | | 0.07 | | 0.07 | 0.95 |
| Shallow Ephemeral Drainage System | 0.5 | 1.91 | 1.79 | 4.2 | |
| Shrublands | 0.08 | 3.65 | 7.36 | 11.09 | 4.21 |
| **Total** | **38.49** | **70.85** | **60.46** | **169.81** | **138.07** |

*Table 4. Extents of vegetation communities at the Deepdell North project impact area (Pit and WRS = areas of total vegetation loss, Buffer = area of some impact) and the Redbank EEA.*

These vegetation communities contain 77% of the indigenous species recorded in the Deepdell North project impact area. Of the 16 species that do not occur in the Redbank EEA, two are inhabitants of ephemeral wetlands. It is highly likely that many of the remainder are also present in the Redbank EEA but have not yet been detected during site visits. The only notable absences are the Declining coral broom *Carmichaelia crassicaulis* subsp. *crassicaulis*, the Data Deficient *Parsonsia capsularis* var. *tenuis* and Locally Uncommon *Melicope simplex*. The Deepdell North project AEE considered the effects on coral broom to be minor and addresses the effects on the other two species by a plant rescue package. The Redbank AEE contains an additional 160 indigenous plant species that are not found in the Deepdell North project impact area.

*Alignment of proposed offset against offset requirements*

This offset meets the conditions prescribed in the pORPS (and including Environment Court decision NZEnvC41 of 15 March 2019)[22]:

8. *The offset achieves no net loss and preferably a net gain in indigenous biological diversity;*

The important individual components of this offset produce a Present Biodiversity Value (PBV) above zero and therefore will result in a net gain in biodiversity. The only exceptions are the gains in shrubland diversity and canopy height, while ecologically positive, do not in themselves result in positive PBV. It is thought this is more a reflection of worksheet design, than a deficiency in the planned offset.

[22] Note the offset described in the pORPS does not require use of any offset guidance such as that provided by BBOP, DOC or in recent guidance to Councils.

9. *The offset ensures there is no loss of individuals of rare or vulnerable species as defined in reports published prior to 14 January 2019 under the New Zealand Threat Classification System ("NZTCS");*[23]

The offset will not result in the loss of individuals of Threatened or At Risk species as the impact on these species is being addressed through mitigation activities.

10. *The offset is undertaken where it will result in the best ecological outcome, preferably:*

*Close to the location of development; or*

*Within the same ecological district or coastal marine biogeographic region;*

This offset is within the same Ecological District.

11. *The offset is applied so that the ecological values being achieved are the same or similar to those being lost;*

The ecological values within the offset includes the habitat types and many (77%) of the same species as in the impact area and is therefore considered similar.

12. *The positive ecological outcomes of the offset last at least as long as the impact of the activity, preferably in perpetuity;*

The management activities associated with this offset are being planned to a 50 year horizon with intention to continue longer and therefore are considered as in perpetuity.

13. *The offset will achieve biological diversity outcomes beyond results that would have occurred if the offset was not proposed; and*

The planned offset actions would not occur without the offset.

[23] This clause is currently before the High Court with a nearly agreed wording of "I suggest amended wording so that clause 5.4.6(c) reads "The offset ensures there is no loss of individuals of ~~rare or vulnerable species as defined in reports published prior to 14 January 2019~~ Threatened taxa, and no reasonably measurable loss within the ecological district to an At Risk-Declining taxon under the New Zealand Threat Classification System ('NZTCS' ) other than Myrtaceae." OceanaGold wording provided. The exclusion of some or all members of Myrtaceae is an unresolved issue. The assessment provided here is against the OceanaGold wording. The assessment would not change if using councils' preferred wording.

14. *The delay between the loss of biological diversity through the proposal and the gain or maturation of the offset's biological diversity outcomes is minimised."*

The longest delay before realising the outcomes is 10 years. This timeframe is considered reasonably short in ecological terms. This timeframe could not be reasonably shortened.

*Covenant condition targets*

The target ecological conditions for each of the main habitats at the site are described below. They are separated into two groups – mandatory offset targets which must be achieved to fulfill the offset objectives and discretionary targets for habitats not associated with achieving an offset that assist with maintaining the ecological health of the covenant.

Within covenant mandatory offset targets

These targets must be achieved to fulfil the objectives of the offsets.

Shrubland

*Extent*

Increasing in extent relative to baseline of current extent to a maximum of 10 ha area inside the Covenant, measured by mapping extent from drone images.

*Canopy cover*

Increasing (to a minimum of 75%) relative to baseline in the 10 ha offset area inside the Covenant, measured by 3 permanently marked 10 x 10 m plots.

*Indigenous shrub diversity*

Increasing (to a minimum of 18 species) relative to baseline in shrubland of the 6 ha offset area inside the Covenant measured by 3 permanently marked 10 x 10 m plots[24].

Seepage

[24] 20 m plots will be too large for the shrubland fragments.

*Extent*

Stable relative to baseline of current extent over the 0.82 ha offset area inside the Covenant measured by mapping extent from drone images.

*Indigenous species cover*

20% improvement relative to a baseline over the 0.82 ha offset area inside the Covenant measured by species cover estimates in ten permanent 0.5 x 0.5 m plots.

*Juncus distegus population*

Population stable relative to a baseline of 50 transplanted individuals within the 0.82 ha offset area inside the Covenant measured by population census.

Low-producing grassland

*Extent*

Stable relative to baseline of current extent over the 24.55 ha offset area inside the Covenant measured by mapping extent from drone images.

*Indigenous plant frequency and diversity*

Stable relative to baseline inside the 24.55 ha offset area inside the Covenant measured by stem presence in 25 squares of four 0.5 x 0.5 m plots in the corners of 5 permanently marked 20 x 20 m plots.

Rare plants

Population size of desert broom *Carmichaelia petriei* and dryland bluegrass *Anthosachne falcis* stable relative to baseline census counts within marked areas.

Extent of matagouri stable relative to baseline extent measured by mapping from drone images.

Reptiles

Population size of skinks *Oligosoma maccanni (clade 4 genotype) and Oligosoma polychroma (clade 5 genotype)*, gecko *Woodworthia* “Otago/Southland large” stable relative to baseline measured using a 3-year average of annual mark-recapture estimates on 3 permanently marked lines of five pitfall and five funnel traps monitored over 3 days within the 88.71 ha core area of Covenant.

**Commented [MT6]:** To be updated from LMP

Birds

Frequency counts of indigenous bird species stable relative to baseline measured using a 3-year average of annual five minute bird counts on 3 permanently marked lines of 10 count stations monitored over 3 days within the 88.71 ha core area of Covenant.

Invertebrates

Frequency counts of indigenous species within Lepidoptera and large ground dwelling invertebrate groups stable relative to baseline measured using a 3-year average of individuals captured on 3 permanently marked lines of 5 sample stations containing one Heath-type light trap and four pitfall traps monitored annually over 3 days within the 88.71 ha core area of Covenant.

Additional targets

In addition to the targets required for the offset programme, additional targets are identified here that relate to maintaining the ecological condition of the Covenant (particularly while grazing continues). The additional actions are required while grazing continues. The measured change in condition can become part of a biobank.

Narrow-leaved tussock grassland

*Extent*

Stable relative to baseline of current extent inside the Covenant measured by mapping extent from drone images.

*Canopy cover*

Stable relative to baseline using a Scott Height Frequency method will be used on three 100 m transects of points every 5 m.

*Inter-tussock indigenous plant diversity*

Stable relative to baseline measured by stem presence in 25 squares of four 0.5 x 0.5 m plots at 5 m intervals along the transect.

*Project management, ecological oversight and Decision Framework*

It is important that the key partners and regulating authorities in this project have confidence in the outcomes that are being achieved. This project will be managed by the Manager, Environment of OceanaGold during the life of the mine. Following mine closure the project will be managed by an oversight trust/or landowner who will direct activities and disburse funds as required. The project will report annually on outcomes to an oversight group[25] comprised of representatives from Iwi, DOC, Macraes Community Incorporated, Waitaki District Council, the funding Trust, the project ecologist and the landowner (or lessee). Delivery of management activities will be by appropriately qualified people and monitoring of outcomes will be by an appropriately qualified ecologist who is ratified by the oversight group. If outcomes do not meet targets then the manager will be given appropriate opportunity to rectify the situation by adjusting the site management activities, and the oversight group can provide input on this. If the outcomes cannot be rectified, then the oversight group can direct the manager to adjust management as they determine. This can include removal of stock and fencing of the Covenant boundary.

**Commented [MT7]:** for discussion

In all decisions the primary objective for this EEA must be given precedence.

*Project budget and ongoing funding*

This project is estimated to have a cost of $$$ for the initial set-up and achieving the gains stage, and $$$ for the maintaining the gains stage.

The funds for the initial set-up and achieving the gains will be provided by OceanaGold on a costs-incurred basis.

*Site management – general*

Site management is separated into two phases – achieving the gains, where the emphasis is on achieving the desired outcome targets and then a maintaining the gains phase where the targets are maintained over time (to at least 50 years time). The management is also split into mandatory actions (those that are required to achieve the offset targets in Section 0) and additional, discretionary, targets (actions designed to achieve the additional targets in Section 0).

*Mandatory site management actions – achieving the gains stage*

[25] The outcomes will also be reported annually as part of OceanaGold's Annual Ecology Report.

Seepage wetland management

The wetland will be permanently fenced and wetland weeds will be controlled with the intention of removing them from the seepage site using application of glyphosate by certified operator at label rates to target weed species that form large patches in seepages: musks *Erythranthe* (*Mimulus*) sp., oval sedge *Carex leporina,* watercress *Nasturtium microphyllum,* tarweed *Parentucellia viscosa.* Control will continue until a 20% improvement in cover by indigenous species has been achieved.

Shrubland recreation

Six hectares including areas of existing shrubland will be permanently fenced as the shrubland offset to encourage natural regeneration and species diversity will be increased to a target of 18 species by planting shrub species from the Macraes E.D. that are currently absent from the site (Table 2) into areas with sparse shrubland in the fenced area. Any exotic shrub or tree species in the mapped shrubland areas will be removed using appropriate techniques over the first 10 years of the covenant. The remainder of shrubland in the EEA will be temporarily fenced where there are naturally protected remnants (such as in the narrower gullies) and maximum protection can be afforded by a short fence. Areas of shrubland outside of fenced area will be left to increase in area to the extent allowed by the presence of stock (to a maximum of a doubling in area [excluding young-growth matagouri]).

Existing matagouri shrubland within the Covenant will be protected from removal.

Androstoma empetrifolium Hook.f.
Aristotelia fruticosa Hook.f.
Calystegia tuguriorum (G.Forst.) R.Br. ex Hook.f.
Carmichaelia crassicaulis Hook.f. subsp. crassicaulis
Carmichaelia kirkii Hook.f.
Clematis quadribracteolata Colenso
Coprosma areolata Cheeseman
Coprosma cheesemanii W.R.B.Oliv.
Coprosma ciliata Hook.f.
Coprosma colensoi Hook.f.
Coprosma cuneata Hook.f.
Coprosma elatirioides de Lange & A.S.Markey
Coprosma intertexta G.Simpson
Coprosma linariifolia Hook.f.
Coprosma pseudociliata G.T.Jane
Coprosma pseudocuneata W.R.B.Oliv. ex Garn.-Jones & Elder
Coprosma rigida Cheeseman
Coprosma rotundifolia A.Cunn.
Coprosma rubra Petrie
Coprosma virescens Petrie

Coprosma wallii Petrie in Cheeseman
Coriaria angustissima Hook.f.
Coriaria plumosa W.R.B.Oliv.
Corokia buddleioides A.Cunn. var. buddleioides
Dracophyllum longifolium (J.R.Forst. & G.Forst.) R.Br. var. longifolium
Gaultheria crassa Allan
Helichrysum lanceolatum (Buchanan) Kirk
Leptecophylla aff. juniperina (a) (AK 322501; "east")
Melicope simplex A.Cunn.
Muehlenbeckia australis (G.Forst.) Meisn.
Olearia fimbriata Heads
Olearia lineata (Kirk) Cockayne
Olearia odorata Petrie
Ozothamnus vauvilliersii Hombr. & Jacquinot ex Decne.
Parsonsia capsularis var. tenuis G.Simpson & J.S.Thomson
Parsonsia heterophylla A.Cunn.
Raukaua simplex (G.Forst.) A.D.Mitch., Frodin & Heads
Rubus squarrosus Fritsch
Teucridium parvifolium Hook.f.

*Table 5. Plant species currently not known in the Redbank EEA which could be considered for diversification plantings.*

Low-producing grassland

Low-producing grassland will be managed under the assumption that it requires grazing to maintain its low stature. The ecological condition of the low-producing grassland offset areas will be increased by removing of selected weeds (excluding *Pilosella*) that are considered to detrimentally affect this vegetation type. (No species currently identified for control).

In the longer term it is expected that this vegetation community will transition into a short tussock grassland vegetation community.

Species of conservation interest

Two plant species of interest – dryland blue grass *Anthosachne falcis* and desert broom *Carmichaelia petriei* will be managed to maintain stable populations within the covenant. Desert broom will be managed, if necessary, by temporary fencing of groups of plants to promote regeneration. Dryland bluegrass will be managed by temporary fencing areas inhabited by this species to promote regeneration. Note: dryland bluegrass is not currently known from the covenant area (though it is considered likely to be present). If it is not found in upcoming baseline surveys then the species will be introduced to the Covenant using the methods described in the Plant Propagation and Management Protocol.

It is not currently envisioned to manage either reptile or bird species as it is thought that their populations are likely to be safeguarded by the legal protection and physical nature (abundance of rocks and bluffs) of the covenant.

**Commented [MT8]:** To be updated from LMP

However, if their populations are not meeting the stable outcome target then management will be initiated, first focussing on habitat improvement (as this gives longer-term benefit) and, if necessary, utilising targeted predator control utilising multicapture lethal traps (Goodnature and AT220 modified for use with carnivores).

It is considered that the habitat improvement and maintenance actions achieved as part of this offset will benefit invertebrate communities. No additional management of invertebrates will occur. Invertebrates will be a component of the Covenant monitoring regime (Section 0).

Species reintroductions

50 plants of the rush *Juncus distegus* will be reintroduced into the seepage offset using direct transfer from the impact site under the guidance of the Plant Propagation and Management Protocol. No other species are planned for reintroduction in this phase (however see dryland bluegrass in Section 0)

*Mandatory site management actions – maintaining the gains stage*

Seepage wetland management

The seepage offset site will be inspected 3-yearly for new weed species. Reinvasions by the target weed species (musks *Erythranthe* [*Mimulus*] sp., oval sedge *Carex leporina,* watercress *Nasturtium microphyllum,* tarweed *Parentucellia viscosa*) will be removed using careful herbicide applications. Any new weed species recorded in the seepage will be assessed as an environmental weed (based on its potential to cause damage to important biodiversity at the site) and if it is considered an environmental weed the feasibility (including cost) of removal or control will be assessed. If it is feasible to remove, contain or control, then appropriate weed management techniques will be employed against the species. Stock will be excluded from the seepage wetland using a fence if the cover by indigenous species drops below 25% above the baseline.

Shrubland recreation

Shrublands, once they reach the target levels will not be managed, but the fences will be replaced as necessary. Once a shrubland (excluding matagouri) extent of double the baseline is reached, any further expansion that is impacting on farm management may be controlled at the discretion of the oversight group. Expansion of young growth matagouri shrubland beyond the existing stands will not be actively managed and if it is impacting on farm management may be controlled using herbicide at the discretion of the oversight group.

Low-producing grassland

Any environmental weeds found in the low-producing grassland offset area will be removed, if feasible.

Species of conservation interest

Population monitoring of the dryland blue grass *Anthosachne falcis* and desert broom *Carmichaelia petriei* in the Covenant will continue and if monitoring indicates a decrease in population size, then appropriate management will be instigated.

Management of bird and reptile species in the Covenant will be as established during the achieving the gains phase and will be continued as necessary into the maintaining the gains phase.

Species reintroductions

The translocated population of the rush *Juncus distegus* will be managed as required to keep its population above 50 individuals.

*Additional management actions*

The following are discretionary actions that will be undertaken by OceanaGold that are outside of the offset and that can be stopped at OceanaGold's discretion. They are actions that are designed to integrate farming and biodiversity outside of the offset areas where improvements in biodiversity can be nominated as a Biobank.

Shrubland management

Higher biodiversity shrublands will be fenced to exclude stock. Proliferation of young matagouri may be controlled using spray.

Narrow-leaved tussock grassland

This vegetation community will be managed to maintain its current extent and stature. A key focus will be on maintaining the inter-tussock indigenous species diversity that has been maintained through past farming practices

(grazing and fire). Grazing of the tussockland area is allowed unless the outcome monitoring indicates otherwise. Burning or mob stocking of the tussock grassland is allowed. Burning or mob stocking may be prescribed if inter-tussock diversity is declining due to increases in tussock plant size or density. Burning will follow established high country best practice based on the Recovery Index for Narrow-leaved Snow Tussock and with appropriate insurances and safety systems including exclusion from offset areas.

Species of conservation interest

The higher priority species of conservation interest will be managed to firstly secure their populations and where feasible to increase population size and/or number of sites inhabited. Priority species are any species assessed as Threatened (excluding the Myrtaceae) and those species that are often impacted by mine operations. The priority list of species and their management actions is provided in Table 6. This list may be changed based on future management work and surveys (i.e. species may be added or removed).

| Plant Species and Threat Status | Redbank Station Covenant (proposed) | Management Actions |
|---|---|---|
| **Nationally Critical** | | |
| Lagenophora montana Hook.f. | 3 sites | Hand removal of competing exotic grass species (cocksfoot and Yorkshire fog) |
| Simplicia laxa Kirk | 2 sites | Hand removal of competing exotic grass species (cocksfoot and Yorkshire fog) |
| **Nationally Endangered** | | |
| Hypericum rubicundulum Heenan | 1 site | Assessment of threats and management as appropriate |
| Pachycladon cheesemanii Heenan & A.D.Mitch. | 1 site<br>(5 plants) | Fencing of dry overhang systems in main bluff using warratahs and sheep netting. Additional planting as part of the Coronation North plant rescue programme using material from Macraes E.D. |
| Senecio dunedinensis Belcher | 1 site<br>(1 plant) | Fencing of dry overhang systems in main bluff using warratahs and sheep netting. Additional planting as part of the Coronation North plant rescue programme using material from Macraes E.D. |
| **Nationally Vulnerable** | | |

| | | |
|---|---|---|
| Myosurus minimus subsp. novae-zelandiae (W.R.B.Oliv.) Garn.-Jones | 1 site (c. 50 plants) | Numbers of this species go through irregular (c. 30 years) irruptions. It is not known if populations in the Macraes E.D. experienced the 2008 irruption and if there is the same seed bank as in other areas. In the interim the species will be managed by creation of additional artificial small shallow hand dug scrapes where seed is introduced. |
| Sonchus (b) (CHR 596666; aff. S. novae-zelandiae; "cliff") | 1 site (1 plant) | This species has proved difficult to manage. When possible viable seed will be collected and cultivation trials continued with the aim of producing sufficient seed to sow into other sites |
| **Naturally Uncommon** | | |
| Myosotis tenericaulis Petrie | 1 site | Establish at further sites by sowing seed or planting seedlings. |
| **Data Deficient** | | |
| Myosotis aff. australis (c) (CHR 572827; Lammerlaw) | 1 (3 plants) | Establish at further sites by sowing seed or planting seedlings. |
| **Locally Significant** | | |
| Fuchsia perscandens Cockayne & Allan | 1 Site (2 plants) | Establish at other sites within fenced areas. |
| Myosotis australis R.Br. | 1 site (6 plants) | Establish at further sites by sowing seed or planting seedlings. |

*Table 6. Priority species for additional conservation management.*

*General site management*

Stock

Stock will maintain access to the Covenant, unless the outcome monitoring indicates otherwise. The primary reason for this is that the biodiversity values at this site have persisted through 150 years of pastoral farming in this area, and sudden removal of such an important ecosystem modifier could easily result in sudden and unexpected changes in the ecology of indigenous biodiversity at sites leading to the loss of important indigenous biodiversity.

During the achieving the mandatory achieving the gains phase stocking by sheep and cattle will be retained at current stock units and seasonal usage.

**Commented [MT9]:** Need to get these from James Preddie

Fencing

The covenant will not be fenced unless the outcome monitoring indicates the need for a fence and a fence is agreed by the oversight group. To fence the boundary will require 1,530 m of standard seven-wire stock fencing. Other areas with higher ecological value will be fenced using either solar-powered electric fencing or waratah and sheep netting.

Fire

Fire is likely to be either beneficial or detrimental to ecosystems in the Macraes E.D. A good study of the effects of fire on biodiversity is a multi-disciplinary study of fire modelling by Scion at Mt Benger (various publications, but see in particular Baillie and Bayne 2019[26]). Short-stature plant communities are likely to benefit by removal of taller competing vegetation. Fire of tall tussock grasslands also appears to be important in maintaining a high diversity of inter-tussock indigenous plants. However, fire does damage shrublands and the higher diversity shrublands in the Macraes E.D. are centred on rocky areas where fire has difficulty penetrating. Fires, if too frequent or in the wrong season, can also be detrimental to tall tussock grasslands and the minimum recommended inter-burning period is 15 years to allow the tussock plants to regenerate and accumulate reserves. Short tussock grasslands in the Macraes E.D. rarely have the ability to 'carry' a fire and so are not majorly harmed during a fire.

Fire has been frequently used in Otago as a tussock management tool to facilitate sheep grazing between tussock plants (and also to feed on tussock 'flush' growth) and it is this practices that has led to the preservation of a high diversity of inter-tussock indigenous plants. Note: cattle grazing during the flush growth can be very damaging to tussock.

Fire also poses a risk to surrounding farm infrastructure (fences and buildings) and if poorly implemented can lead to human fatalities. If they escape from the burn boundary there is also a large insurance bill. For these reasons fire is less frequently used as a tussock management tool.

An alternative tussock management tool is mob stocking an area by cattle. This needs to be finely judged; if the cattle are kept too long at a site there are animal welfare issues.

Currently it is not envisaged to use fire within the covenant, but if monitoring is showing a decline in indigenous species diversity, fire, or deliberate mob stocking by cattle, may be used.



[26] Baillie, B.R; Bayne, K.M. 2019. The historical use of fire as a land management tool in New Zealand and the challenges for its continued use. Landscape Ecology 34: 2229-2244.

Weeds

The weed loading of the Covenant area is generally light (though weeds are more prevalent along the riparian margin of the Waikouaiti River). Of the woody weed species, only a few plants of pine *Pinus radiata*, gorse *Ulex europaeus* and some small stands of crack willow *Salix fragilis* are present. Broom *Cytisus scoparius* is currently absent.

Weed control outside of the offset areas will focus on removal of the existing pine and willow using 'drill and fill' together with an active weed surveillance regime of the covenant conducted annually. Any new weed species (woody or otherwise) recorded in the covenant will be assessed as an environmental weed (based on its potential to cause damage to important biodiversity at the site) and if it is considered an environmental weed the feasibility (including cost) of removal or control will be assessed. If it is feasible to remove, contain or control, then appropriate weed management techniques will be employed against the species.

Soil cultivation

There will be no cultivation of the soil in the EEA.

Topdressing and fertiliser

There will be no addition of fertiliser in the EEA.

Planting of plantation forest

There will be no planting of plantation forestry within the EEA and any plantation forest established near the EEA will be of low invasion risk species.

*Research*

There is no research planned for the Redbank EEA.

*Expected outcomes*

The expected outcomes from the Redbank EEAMP is

- A covenant over at least the areas required as offset sites or under the Lizard Management Plan[27].
- Sensitive ecological sites are fenced from stock.
- An improvement in shrubland diversity and density and a doubling of shrubland area to 10 ha in the Covenant.
- Weeds controlled in 0.82 ha of seepage wetland and 50 rush *Juncus distegus* transplanted from impact site.
- The area and quality of low-producing grassland in the Covenant is stable.
- Populations of reptiles stable.
- Populations of indigenous birds stable.
- Populations of invertebrates stable.
- Populations of 11 plant species of conservation interest managed to improve their local situation.
- 97 ha of narrow-leaved tussock grassland in a stable state.
- Other gains outside of the offset project are documented and considered a biobank.

*Monitoring of outcomes*

Outcome monitoring

Monitoring the outcomes against expected performance in the targets (Section 0) is critical, especially of the outcomes associated with the offset projects. The outcome monitoring used in this EEA are:

Monitoring of vegetation community

Measurement of the baseline extents, and changes to this extent over time, for each vegetation community in the Covenant by manually digitally mapping in GIS community boundaries using expert interpretation of the aerial images obtained by drone. Ground truthing will be employed where there are areas of confusion. Images will be obtained and mapped at the start of the project to establish the baseline extents of each vegetation community, and then every 5 years to establish changes in extent.

Canopy cover

[27] The proposed covenant is 138 ha, but this includes areas additional to that required.

Canopy cover values will be established by estimating percent cover in permanently marked 10 x 10 m plots[28] in shrubland within the Covenant. The canopy cover and stature of narrow-leaved tussock grassland will be established using a Scott Height Frequency method on three 100 m transects of points every 5 m. These values will be obtained and at the start of the project to establish the baseline, and then every 5 years to establish changes.

Vegetation community composition and diversity

Vegetation community composition will be measured by estimating percent ground cover for all species present within permanently marked plots together with frequency of species' stem presence in 25 grid squares of four 0.5 x 0.5 m plots located in the corners of the 10 x 10 m plots used in shrubland and 20 x 20 m plots used in low-producing grassland. In wetlands this value will be established by frequency of species' stem presence in the 25 grid squares of permanent 0.5 x 0.5 m plots only. In narrow-leaved tussock grassland vegetation composition will be measured using frequency of species' stem presence in the 25 grid squares of 0.5 x 0.5 m plots at 5 m intervals along the 100 m Scott Height transects. These values will be obtained and at the start of the project to establish the baseline, and then every 5 years to establish changes.

Plant species population monitoring

Plant population size will be established by population census or measurement of area occupied of each plant species of conservation interest. A subsample of the population may be taken within a marked area. These values will be obtained and at the start of the project to establish the baseline then annually over the first five years and then repeated once every five years.

Reptile monitoring

Population size of the skinks *Oligosoma maccanni (clade 4 genotype) and Oligosoma polychroma (clade 5 genotype)*, gecko *Woodworthia* "Otago/Southland large" will be established using a 3-year average of annual mark-recapture estimates on permanently marked lines of five pitfall and five funnel traps monitored over 3 days. This monitoring will start with the commencement of the project to establish a baseline and then occur for 3 years every 10 years.

**Commented [MT10]:** To be updated from LMP

Bird monitoring

[28] 20 m plots will be too large for the shrubland fragments.

The populations of indigenous bird species will be monitored using an index of frequency counts using a 3-year average of annual five minute bird counts on 3 permanently marked lines of 10 count stations monitored over 3 days. This monitoring will start at commencement of the project to establish a baseline and then occur for 3 years every 10 years.

Invertebrates

The status of the invertebrate community will be monitored using frequency counts of indigenous species within the Lepidoptera and large ground dwelling invertebrate groups stable established using a 3-year average of individuals captured on 3 permanently marked lines of 5 sample stations containing one Heath-type light trap and four pitfall traps monitored annually over 3 days. This monitoring will start at commencement of the project to establish a baseline and then occur for 3 years every 10 years.

Annual inspection

An annual inspection of the Covenant by an experienced ecologist will occur annually. During this inspection notes will be taken of signs of pest impact or of new weed species.

Discretionary monitoring activities

Inventory of biodiversity

An important component of protected areas is their function as a reservoir for biodiversity. Establishing which biodiversity is present in an area in the Macraes context takes about 10 years of survey effort. An inventory of fauna biodiversity (including invertebrates) will occur at the same time as the annual site inspection of the Covenant and will continue for 10 years and then be repeated over 5 days every 10 years.

Analysis of monitoring data

Data will be analysed based on advice from a biometrician at design phase to ensure validity.

*Reporting of outcomes*

A report will be prepared annually on which activities (including additional activities) were undertaken, any changes to methodologies, results of outcome monitoring, an analysis of progress against monitoring and any other relevant matters.

This report will be provided to all project partners in the oversight group, and also be included in OceanaGold's Annual Ecology Report.

The oversight group will evaluate the information in the report and decide changes to this EEAMP, if warranted.

A larger summary report will be prepared after 10 years of management as a source of information for conservation managers.

*Timeframes*

**Commented [MT11]:** To be developed

**Appendix 1. Plant species recorded within the Redbank Station Covenant**

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|---|---|---|---|---|
| Acaena anserinifolia (J.R.Forst. & G.Forst.) J.B.Armstr. | Bidibid, hutiwai, piripiri | DICOTYLEDONOUS HERBS | Rosaceae | Not Threatened |
| Acaena caesiiglauca (Bitter) Bergmans | Glaucus bidibid, piripiri | DICOTYLEDONOUS HERBS | Rosaceae | Not Threatened |
| Acaena dumicola B.H.Macmill. | Bidibid, piripiri | DICOTYLEDONOUS HERBS | Rosaceae | Locally Significant |
| Acaena inermis Hook.f. | Blue mountain bidibid, spineless bidibid | DICOTYLEDONOUS HERBS | Rosaceae | Not Threatened |
| Acaena novae-zelandiae Kirk | red bidibid | DICOTYLEDONOUS HERBS | Rosaceae | Not Threatened |
| Acaena novae-zelandiae Kirk X Acaena inermis Hook.f. | | DICOTYLEDONOUS HERBS | Rosaceae | Hybrid |
| Aciphylla aurea W.R.B.Oliv. | Golden spaniard, golden speargrass | DICOTYLEDONOUS HERBS | Apiaceae | Not Threatened |
| Anaphalioides bellidioides (G.Forst.) Glenny | Hells Bells | DICOTYLEDONOUS HERBS | Asteraceae | Not Threatened |
| Anisotome aromatica Hook.f. | | DICOTYLEDONOUS HERBS | Apiaceae | Not Threatened |
| Azorella haastii subsp. cyanopetala (Domin) G.M.Plunkett & A.N.Nicolas | | DICOTYLEDONOUS HERBS | Apiaceae | Not Threatened |
| Azorella hookeri Drude | | DICOTYLEDONOUS HERBS | Apiaceae | Not Threatened |
| Brachyglottis lagopus (Raoul) B.Nord. | | DICOTYLEDONOUS HERBS | Asteraceae | Not Threatened |
| Callitriche petriei R.Mason subsp. petriei | Petrie's starwort | DICOTYLEDONOUS HERBS | Plantaginaceae | Not Threatened |
| Cardamine corymbosa Hook.f. | | DICOTYLEDONOUS HERBS | Brassicaceae | Not Threatened |
| Cardamine forsteri Govaerts | | DICOTYLEDONOUS HERBS | Brassicaceae | Not Threatened |
| Celmisia gracilenta Hook.f. | common mountain daisy, pekapeka | DICOTYLEDONOUS HERBS | Asteraceae | Not Threatened |
| Celmisia hookeri Cockayne | Hooker's mountain daisy | DICOTYLEDONOUS HERBS | Asteraceae | Naturally Uncommon |
| Cerastium fontanum subsp. vulgare (Hartm.) Greuter & Burdet | | DICOTYLEDONOUS HERBS | Caryophyllaceae | Exotic |
| Chaerophyllum ramosum (Hook.f.) K.F.Chung | | DICOTYLEDONOUS HERBS | Apiaceae | Not Threatened |
| Chenopodium allanii Aellen | | DICOTYLEDONOUS HERBS | Amaranthaceae | Naturally Uncommon |
| Cirsium arvense | Californian thistle | DICOTYLEDONOUS HERBS | Asteraceae | Exotic |
| Cirsium vulgare | Scotch thistle | DICOTYLEDONOUS HERBS | Asteraceae | Exotic |
| Colobanthus apetalus (Labill.) Druce | Colobanthus | DICOTYLEDONOUS HERBS | Caryophyllaceae | Not Threatened |
| Craspedia minor (Hook.f.) Allan | Small craspedia, Woollyhead | DICOTYLEDONOUS HERBS | Asteraceae | Not Threatened |
| Crassula sieberiana (Schult. & Schult.f.) Druce | | DICOTYLEDONOUS HERBS | Crassulaceae | Not Threatened |
| Crepis capillaris | hawksbeard | DICOTYLEDONOUS HERBS | Asteraceae | Exotic |
| Dichondra repens J.R.Forst. & G.Forst. | Mercury Bay weed, Dichondra | DICOTYLEDONOUS HERBS | Convolvulaceae | Not Threatened |
| Digitalis purpurea L. | foxglove | DICOTYLEDONOUS HERBS | Plantaginaceae | Exotic |
| Epilobium brunnescens subsp. minutiflorum (Cockayne) P.H.Raven & Engelhorn | creeping willowherb | DICOTYLEDONOUS HERBS | Onagraceae | Not Threatened |

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| Epilobium insulare Hausskn. | willowherb | DICOTYLEDONOUS HERBS | Onagraceae | Declining |
| Epilobium nerteroides A.Cunn. | Willowherb | DICOTYLEDONOUS HERBS | Onagraceae | Not Threatened |
| Epilobium pubens A.Rich. | Willowherb | DICOTYLEDONOUS HERBS | Onagraceae | Not Threatened |
| Euchiton audax (D.G.Drury) Holub | | DICOTYLEDONOUS HERBS | Asteraceae | Not Threatened |
| Euchiton polylepis (D.G.Drury) Breitw. & J.M.Ward | | DICOTYLEDONOUS HERBS | Asteraceae | Naturally Uncommon |
| Euchiton traversii (Hook.f.) Holub | | DICOTYLEDONOUS HERBS | Asteraceae | Not Threatened |
| Galium propinquum A.Cunn. | | DICOTYLEDONOUS HERBS | Rubiaceae | Not Threatened |
| Geranium brevicaule Hook.f. | | DICOTYLEDONOUS HERBS | Geraniaceae | Not Threatened |
| Geranium homeanum Turcz. | | DICOTYLEDONOUS HERBS | Geraniaceae | Not Threatened |
| Geum leiospermum Petrie | Geum, mountain avens | DICOTYLEDONOUS HERBS | Rosaceae | Not Threatened |
| Gonocarpus incanus (A.Cunn.) Orchard | | DICOTYLEDONOUS HERBS | Haloragaceae | Not Threatened |
| Gunnera monoica Raoul | | DICOTYLEDONOUS HERBS | Gunneraceae | Not Threatened |
| Helichrysum filicaule Hook.f. | Creeping or slender everlasting daisy | DICOTYLEDONOUS HERBS | Asteraceae | Not Threatened |
| Hieracium lepidulum | tussock hawkweed | DICOTYLEDONOUS HERBS | Asteraceae | Exotic |
| Hydrocotyle heteromeria A.Rich. | waxweed, waxweed pennywort | DICOTYLEDONOUS HERBS | Araliaceae | Not Threatened |
| Hydrocotyle moschata G.Forst. var. moschata | Hairy pennywort | DICOTYLEDONOUS HERBS | Araliaceae | Not Threatened |
| Hydrocotyle sulcata C.J.Webb & P.N.Johnson | | DICOTYLEDONOUS HERBS | Araliaceae | Not Threatened |
| Hypericum rubicundulum Heenan | | DICOTYLEDONOUS HERBS | Hypericaceae | Nationally Endangered |
| Hypochaeris radicata | catsear | DICOTYLEDONOUS HERBS | Asteraceae | Exotic |
| Lagenophora barkeri Kirk | | DICOTYLEDONOUS HERBS | Asteraceae | Naturally Uncommon |
| Lagenophora montana Hook.f. | papataniwha | DICOTYLEDONOUS HERBS | Asteraceae | Nationally Critical |
| Lagenophora pumila (G.Forst.) Cheeseman | Papataniwhaniwha | DICOTYLEDONOUS HERBS | Asteraceae | Not Threatened |
| Leptinella pusilla Hook.f. | | DICOTYLEDONOUS HERBS | Asteraceae | Declining |
| Leptinella squalida subsp. mediana (D.G.Lloyd) D.G.Lloyd & C.J.Webb | | DICOTYLEDONOUS HERBS | Asteraceae | Not Threatened |
| Leptostigma setulosum (Hook.f.) Fosberg | | DICOTYLEDONOUS HERBS | Rubiaceae | Not Threatened |
| Limosella lineata Glück | mudwort | DICOTYLEDONOUS HERBS | Plantaginaceae | Not Threatened |
| Linum catharticum L. | purging flax | DICOTYLEDONOUS HERBS | Linaceae | Exotic |
| Lobelia angulata G.Forst. | Pratia | DICOTYLEDONOUS HERBS | Campanulaceae | Not Threatened |
| Lotus pedunculatus Cav. | lotus | DICOTYLEDONOUS HERBS | Fabaceae | Exotic |
| Mentha cunninghamii Benth. | New Zealand mint, Hihoi | DICOTYLEDONOUS HERBS | Lamiaceae | Declining |
| Montia fontana L. subsp. fontana | blinks, blinkswater chickweed, dwarf montia | DICOTYLEDONOUS HERBS | Montiaceae | Not Threatened |
| Montia sessiliflora (G.Simpson) Heenan | | DICOTYLEDONOUS HERBS | Montiaceae | Locally Significant |
| Myosotis "pygmaea" agg. (form intermediate between "drucei" s.s. and "pygmaea" s.s., Lvs green | | DICOTYLEDONOUS HERBS | Boraginaceae | Locally Significant |

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| with brown base, nonwaxy, hairs c.1mm, Central Otago mid-altitude) | | | | |
| Myosotis aff. australis (c) (CHR 572827; Lammerlaw) | | DICOTYLEDONOUS HERBS | Boraginaceae | Data Deficient |
| Myosotis australis R.Br. | | DICOTYLEDONOUS HERBS | Boraginaceae | Locally Significant |
| Myosotis laxa Lehm. subsp. caespitosa (CF Schultz) | water forget-me-not | DICOTYLEDONOUS HERBS | Boraginaceae | Exotic |
| Myosotis tenericaulis Petrie | | DICOTYLEDONOUS HERBS | Boraginaceae | Naturally Uncommon |
| Myosurus minimus subsp. novae-zelandiae (W.R.B.Oliv.) Garn.-Jones | New Zealand mousetail, bearded mousetail | DICOTYLEDONOUS HERBS | Ranunculaceae | Nationally Vulnerable |
| Myriophyllum propinquum A.Cunn. | Common water milfoil | DICOTYLEDONOUS HERBS | Haloragaceae | Not Threatened |
| Myriophyllum triphyllum Orchard | Water milfoil | DICOTYLEDONOUS HERBS | Haloragaceae | Not Threatened |
| Nasturtium microphyllum Boenn. ex Rchb. | one-rowed watercress | DICOTYLEDONOUS HERBS | Brassicaceae | Exotic |
| Nertera depressa Banks & Sol. ex Gaertn. | Nertera, bead plant, fruiting duckweed | DICOTYLEDONOUS HERBS | Rubiaceae | Not Threatened |
| Oxalis magellanica "f. glaucous" | | DICOTYLEDONOUS HERBS | Oxalidaceae | Not Assessed |
| Pachycladon cheesemanii Heenan & A.D.Mitch. | | DICOTYLEDONOUS HERBS | Brassicaceae | Nationally Endangered |
| Parentucellia viscosa (L.) Caruel | tarweed | DICOTYLEDONOUS HERBS | Orobanchaceae | Exotic |
| Pilosella officinarum F.Schultz & Sch.Bip. | hawkweed, mouse-ear hawkweed | DICOTYLEDONOUS HERBS | Asteraceae | Exotic |
| Plantago novae-zelandiae L.B.Moore | | DICOTYLEDONOUS HERBS | Plantaginaceae | Not Threatened |
| Plantago spathulata Hook.f. | Papa Plantain | DICOTYLEDONOUS HERBS | Plantaginaceae | Locally Significant |
| Potentilla anserinoides Raoul | Silverweed | DICOTYLEDONOUS HERBS | Rosaceae | Not Threatened |
| Pseudognaphalium luteoalbum (L.) Hilliard & B.L.Burtt | | DICOTYLEDONOUS HERBS | Asteraceae | Not Threatened |
| Ranunculus amphitrichus Colenso | waoriki | DICOTYLEDONOUS HERBS | Ranunculaceae | Not Threatened |
| Ranunculus flammula L. | spearwort | DICOTYLEDONOUS HERBS | Ranunculaceae | Exotic |
| Ranunculus foliosus Kirk | Grassland buttercup | DICOTYLEDONOUS HERBS | Ranunculaceae | Not Threatened |
| Ranunculus multiscapus Hook.f. | Grassland buttercup | DICOTYLEDONOUS HERBS | Ranunculaceae | Not Threatened |
| Raoulia albosericea Colenso | | DICOTYLEDONOUS HERBS | Asteraceae | Not Threatened |
| Raoulia australis Hook.f. ex Raoul | Common mat daisy | DICOTYLEDONOUS HERBS | Asteraceae | Declining |
| Rumex acetosella | sheep's sorrel | DICOTYLEDONOUS HERBS | Polygonaceae | Exotic |
| Sagina procumbens L. | procumbent pearlwort | DICOTYLEDONOUS HERBS | Caryophyllaceae | Exotic |
| Scleranthus brockiei P.A.Will. | | DICOTYLEDONOUS HERBS | Caryophyllaceae | Not Threatened |
| Sedum acre | stone crop | DICOTYLEDONOUS HERBS | Crassulaceae | Exotic |
| Senecio dunedinensis Belcher | Fireweed | DICOTYLEDONOUS HERBS | Asteraceae | Nationally Endangered |
| Senecio quadridentatus Labill. | cotton fireweed, white fireweed, pahokoraka | DICOTYLEDONOUS HERBS | Asteraceae | Not Threatened |
| Sonchus (b) (CHR 596666; aff. S. novae-zelandiae; "cliff") | | DICOTYLEDONOUS HERBS | Asteraceae | Nationally Vulnerable |

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| Spergula arvensis L. | spurrey | DICOTYLEDONOUS HERBS | Caryophyllaceae | Exotic |
| Stackhousia minima Hook.f. | | DICOTYLEDONOUS HERBS | Celastraceae | Not Threatened |
| Stellaria alsine Grimm | bog stichwort | DICOTYLEDONOUS HERBS | Caryophyllaceae | Exotic |
| Stellaria graminea | stitchwort | DICOTYLEDONOUS HERBS | Caryophyllaceae | Exotic |
| Stellaria media (L.) Vill. subsp. media | chickweed | DICOTYLEDONOUS HERBS | Caryophyllaceae | Exotic |
| Stellaria parviflora Hook.f. | New Zealand chickweed | DICOTYLEDONOUS HERBS | Caryophyllaceae | Not Threatened |
| Trifolium repens | white clover | DICOTYLEDONOUS HERBS | Fabaceae | Exotic |
| Verbascum thapsus L. | woolly mullein, common mullein | DICOTYLEDONOUS HERBS | Scrophulariaceae | Exotic |
| Viola cunninghamii Hook.f. | Mountain violet, white violet | DICOTYLEDONOUS HERBS | Violaceae | Not Threatened |
| Viola filicaulis Hook.f. | Forest violet | DICOTYLEDONOUS HERBS | Violaceae | Not Threatened |
| Wahlenbergia rupestris G.Simpson | White Harebell | DICOTYLEDONOUS HERBS | Campanulaceae | Not Threatened |
| Clematis marata J.B.Armstr. | | DICOTYLEDONOUS LIANES & RELATED TRAILING PLANTS | Ranunculaceae | Not Threatened |
| Fuchsia perscandens Cockayne & Allan | Fuchsia | DICOTYLEDONOUS LIANES & RELATED TRAILING PLANTS | Onagraceae | Locally Significant |
| Muehlenbeckia complexa (A.Cunn.) Meisn. var. complexa | Small-leaved pohuehue, scrub pohuehue, wire vine | DICOTYLEDONOUS LIANES & RELATED TRAILING PLANTS | Polygonaceae | Not Threatened |
| Rubus cissoides A.Cunn. | Tataramoa, bush lawyer | DICOTYLEDONOUS LIANES & RELATED TRAILING PLANTS | Rosaceae | Not Threatened |
| Rubus schmidelioides var. subpauperatus (Cockayne) Allan | Tataramoa, bush lawyer, white-leaved lawyer | DICOTYLEDONOUS LIANES & RELATED TRAILING PLANTS | Rosaceae | Not Threatened |
| Acrothamnus colensoi (Hook.f.) Quinn | | DICOTYLEDONOUS TREES AND SHRUBS | Ericaceae | Not Threatened |
| Carmichaelia petriei Kirk | desert broom | DICOTYLEDONOUS TREES AND SHRUBS | Fabaceae | Declining |
| Coprosma crassifolia Colenso | | DICOTYLEDONOUS TREES AND SHRUBS | Rubiaceae | Not Threatened |
| Coprosma dumosa (Cheeseman) G.T.Jane | | DICOTYLEDONOUS TREES AND SHRUBS | Rubiaceae | Not Threatened |
| Coprosma propinqua var. propinqua A.Cunn. | mingimingi | DICOTYLEDONOUS TREES AND SHRUBS | Rubiaceae | Not Threatened |
| Coprosma rugosa Cheeseman | | DICOTYLEDONOUS TREES AND SHRUBS | Rubiaceae | Not Threatened |
| Coriaria sarmentosa G.Forst. | | DICOTYLEDONOUS TREES AND SHRUBS | Coriariaceae | Not Threatened |
| Corokia cotoneaster Raoul | Korokio, wire-nettting bush | DICOTYLEDONOUS TREES AND SHRUBS | Argophyllaceae | Not Threatened |
| Discaria toumatou Raoul | matagouri, wild Irishman | DICOTYLEDONOUS TREES AND SHRUBS | Rhamnaceae | Declining |
| Dracophyllum rosmarinifolium (G.Forst.) R.Br. | common grass tree, inaka | DICOTYLEDONOUS TREES AND SHRUBS | Ericaceae | Not Threatened |
| Gaultheria antipoda G.Forst. | bush snowberry, fool's beech | DICOTYLEDONOUS TREES AND SHRUBS | Ericaceae | Not Threatened |
| Gaultheria macrostigma (Colenso) D.J.Middleton | prostrate snowberry | DICOTYLEDONOUS TREES AND SHRUBS | Ericaceae | Not Threatened |
| Gaultheria macrostigma (Colenso) D.J.Middleton X Gaultheria antipoda G.Forst. | | DICOTYLEDONOUS TREES AND SHRUBS | Ericaceae | Hybrid |
| Griselinia littoralis Raoul | broadleaf, kapuka, papauma | DICOTYLEDONOUS TREES AND SHRUBS | Griseliniaceae | Not Threatened |

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| Leptecophylla juniperina (J.R.Forst. & G.Forst.) C.M.Weiller subsp. juniperina | Prickly Mingimingi, Mingimingi | DICOTYLEDONOUS TREES AND SHRUBS | Ericaceae | Locally Significant |
| Leucopogon fraseri complex (mountain ecotype) | | DICOTYLEDONOUS TREES AND SHRUBS | Ericaceae | Not Threatened |
| Melicytus aff. alpinus (d) (CHR 541567; "dark") | | DICOTYLEDONOUS TREES AND SHRUBS | Violaceae | Data Deficient |
| Melicytus alpinus (Kirk) Garn.-Jones | Porcupine shrub | DICOTYLEDONOUS TREES AND SHRUBS | Violaceae | Not Threatened |
| Myrsine divaricata A.Cunn. | Weeping matipo, weeping mapou | DICOTYLEDONOUS TREES AND SHRUBS | Primulaceae | Locally Significant |
| Olearia bullata H.D.Wilson & Garn.-Jones | | DICOTYLEDONOUS TREES AND SHRUBS | Asteraceae | Not Threatened |
| Pentachondra pumila (J.R.Forst. & G.Forst.) R.Br. | | DICOTYLEDONOUS TREES AND SHRUBS | Ericaceae | Not Threatened |
| Pimelea oreophila subsp. lepta C.J.Burrows | Pimelea | DICOTYLEDONOUS TREES AND SHRUBS | Thymelaeaceae | Not Threatened |
| Prunella vulgaris | self-heal | DICOTYLEDONOUS TREES AND SHRUBS | Lamiaceae | Exotic |
| Salix fragilis L. | crack willow | DICOTYLEDONOUS TREES AND SHRUBS | Salicaceae | Exotic |
| Sophora microphylla Aiton | Kowhai, weeping kowhai, small-leaved kowhai | DICOTYLEDONOUS TREES AND SHRUBS | Fabaceae | Not Threatened |
| Ulex europaeus | gorse | DICOTYLEDONOUS TREES AND SHRUBS | Fabaceae | Exotic |
| Veronica rakaiensis J.B.Armstr. | Hebe | DICOTYLEDONOUS TREES AND SHRUBS | Plantaginaceae | Locally Significant |
| Veronica salicifolia G.Forst. | koromiko | DICOTYLEDONOUS TREES AND SHRUBS | Plantaginaceae | Not Threatened |
| Asplenium appendiculatum (Labill.) C.Presl subsp. appendiculatum | ground spleenwort | FERNS | Aspleniaceae | Not Threatened |
| Asplenium flabellifolium Cav. | butterfly fern, walking fern, necklace fern | FERNS | Aspleniaceae | Not Threatened |
| Asplenium richardii (Hook.f.) Hook.f. | Richards spleenwort | FERNS | Aspleniaceae | Not Threatened |
| Asplenium trichomanes L. | spleenwort | FERNS | Aspleniaceae | Not Threatened |
| Austroblechnum lanceolatum (R.Br.) Gasper & V.A.O.Dittrich | Lance fern, nini, rereti | FERNS | Blechnaceae | Not Threatened |
| Austroblechnum penna-marina (Poir.) Gasper & V.A.O.Dittrich | little hard fern, alpine hard fern | FERNS | Blechnaceae | Not Threatened |
| Cranfillia fluviatilis (R.Br.) Gasper & V.A.O.Dittrich | kiwikiwi, kiwakiwa, creek ferm | FERNS | Blechnaceae | Not Threatened |
| Cranfillia vulcanica (Blume) Gasper & V.A.O.Dittrich | korokio, mountain hard fern | FERNS | Asteraceae | Not Threatened |
| Cystopteris fragilis (L.) Bernh. | brittle bladder fern | FERNS | Cystopteridaceae | Exotic |
| Cystopteris tasmanica Hook. | bladder fern | FERNS | Cystopteridaceae | Not Threatened |
| Hymenophyllum multifidum (G.Forst.) Sw. | Much-divided filmy fern | FERNS | Hymenophyllaceae | Not Threatened |
| Hypolepis millefolium Hook. | Thousand leaved fern | FERNS | Dennstaedtiaceae | Not Threatened |
| Notogrammitis patagonica (C.Chr.) Parris | strapfern | FERNS | Polypodiaceae | Not Threatened |
| Parablechnum procerum (G.Forst.) C.Presl | small kiokio | FERNS | Blechnaceae | Not Threatened |
| Pellaea calidirupium Brownsey & Lovis | | FERNS | Pteridaceae | Not Threatened |

| | | | | |
|---|---|---|---|---|
| Polystichum neozelandicum subsp. zerophyllum (Colenso) Perrie | shield fern | FERNS | Dryopteridaceae | Not Threatened |
| Polystichum vestitum (G.Forst.) C.Presl | punui, prickly shield fern | FERNS | Dryopteridaceae | Not Threatened |
| Pteridium esculentum (G.Forst.) Cockayne | bracken, rarauhe, bracken fern | FERNS | Dennstaedtiaceae | Not Threatened |
| Pinus radiata D.Don | radiata pine, P Rad | GYMNOSPERM TREES AND SHRUBS | Pinaceae | Exotic |
| Agrostis capillaris L. | browntop | MONOCOTYLEDONOUS HERBS | Poaceae | Exotic |
| Agrostis stolonifera L. | creeping bent | MONOCOTYLEDONOUS HERBS | Poaceae | Exotic |
| Alopecurus aequalis Sobol. | orange foxtail | MONOCOTYLEDONOUS HERBS | Poaceae | Exotic |
| Anthosachne solandri (Steud.) Barkworth & S.W.L.Jacobs | native wheatgrass, blue wheatgrass | MONOCOTYLEDONOUS HERBS | Poaceae | Not Threatened |
| Anthoxanthum odoratum L. | sweet vernal | MONOCOTYLEDONOUS HERBS | Poaceae | Exotic |
| Arthropodium candidum Raoul | Small renga lily | MONOCOTYLEDONOUS HERBS | Asparagaceae | Not Threatened |
| Astelia nervosa Hook.f. | Mountain astelia | MONOCOTYLEDONOUS HERBS | Asteliaceae | Not Threatened |
| Austroderia richardii (Endl.) N.P.Barker & H.P.Linder | Toetoe | MONOCOTYLEDONOUS HERBS | Poaceae | Not Threatened |
| Carex (a) (CHR 282870; aff. C. testacea; "mountain") | | MONOCOTYLEDONOUS HERBS | Cyperaceae | Not Assessed |
| Carex (CHR 586013; aff. C. punicea; Lammerlaw) | | MONOCOTYLEDONOUS HERBS | Cyperaceae | Not Assessed |
| Carex breviculmis R.Br. | grassland sedge | MONOCOTYLEDONOUS HERBS | Cyperaceae | Not Threatened |
| Carex buchananii Berggr. | Buchanans sedge | MONOCOTYLEDONOUS HERBS | Cyperaceae | Declining |
| Carex coriacea Hamlin | cutty grass, rautahi | MONOCOTYLEDONOUS HERBS | Cyperaceae | Not Threatened |
| Carex dipsacea Berggr. | Teasel Sedge | MONOCOTYLEDONOUS HERBS | Cyperaceae | Not Threatened |
| Carex egmontiana (Hamlin) K.A.Ford | Bastard Grass, Hook Sedge | MONOCOTYLEDONOUS HERBS | Cyperaceae | Not Threatened |
| Carex flagellifera Colenso | Glen Murray tussock, Trip Me Up | MONOCOTYLEDONOUS HERBS | Cyperaceae | Not Threatened |
| Carex gaudichaudiana Kunth | Gaudichaud's sedge | MONOCOTYLEDONOUS HERBS | Cyperaceae | Not Threatened |
| Carex geminata Schkuhr | Cutty grass, Rautahi | MONOCOTYLEDONOUS HERBS | Cyperaceae | Not Threatened |
| Carex leporina L. | oval sedge | MONOCOTYLEDONOUS HERBS | Cyperaceae | Exotic |
| Carex purpurata (Petrie) K.A.Ford | Purple Bastard Grass, Tussock Hook Grass | MONOCOTYLEDONOUS HERBS | Cyperaceae | Naturally Uncommon |
| Carex secta Boott | Purei, Pukio, Niggerhead | MONOCOTYLEDONOUS HERBS | Cyperaceae | Not Threatened |
| Carex sinclairii Boott | Sinclair's sedge | MONOCOTYLEDONOUS HERBS | Cyperaceae | Not Threatened |
| Carex wakatipu Petrie | Sedge | MONOCOTYLEDONOUS HERBS | Cyperaceae | Not Threatened |
| Chionochloa rigida (Raoul) Zotov subsp. rigida | narrow-leaved snow tussock | MONOCOTYLEDONOUS HERBS | Poaceae | Not Threatened |
| Corybas hatchii Lehnebach | Spider Orchid | MONOCOTYLEDONOUS HERBS | Orchidaceae | Not Threatened |
| Cynosurus cristatus L. | crested dogstail | MONOCOTYLEDONOUS HERBS | Poaceae | Exotic |
| Dactylis glomerata L. | cocksfoot | MONOCOTYLEDONOUS HERBS | Poaceae | Exotic |
| Deyeuxia avenoides (Hook.f.) Buchanan | mountain oat grass | MONOCOTYLEDONOUS HERBS | Poaceae | Not Threatened |
| Dichelachne crinita (L.f.) Hook.f. | long-hair plume grass | MONOCOTYLEDONOUS HERBS | Poaceae | Not Threatened |

| | | | | |
|---|---|---|---|---|
| Eleocharis acuta R.Br. | sharp spike sedge | MONOCOTYLEDONOUS HERBS | Cyperaceae | Not Threatened |
| Festuca filiformis Pourr. | | MONOCOTYLEDONOUS HERBS | Poaceae | Exotic |
| Festuca novae-zelandiae (Hack.) Cockayne | Fescue tussock, hard tussock | MONOCOTYLEDONOUS HERBS | Poaceae | Not Threatened |
| Festuca rubra L. subsp. rubra | red fescue | MONOCOTYLEDONOUS HERBS | Poaceae | Exotic |
| Glyceria declinata Bréb. | blue sweet grass, glaucous sweet grass | MONOCOTYLEDONOUS HERBS | Poaceae | Exotic |
| Herpolirion novae-zelandiae Hook.f. | grass lily, sky lily | MONOCOTYLEDONOUS HERBS | Xanthorrhoeaceae | Not Threatened |
| Holcus lanatus L. | Yorkshire fog | MONOCOTYLEDONOUS HERBS | Poaceae | Exotic |
| Juncus articulatus L. | jointed rush | MONOCOTYLEDONOUS HERBS | Juncaceae | Exotic |
| Juncus edgariae L.A.S.Johnson & K.L.Wilson | Wiwi, Edgars rush | MONOCOTYLEDONOUS HERBS | Juncaceae | Not Threatened |
| Juncus effusus L. var. effusus | leafless rush | MONOCOTYLEDONOUS HERBS | Juncaceae | Exotic |
| Koeleria novozelandica "broad leaf" | | MONOCOTYLEDONOUS HERBS | Poaceae | Locally Significant |
| Lachnagrostis striata (Colenso) Zotov | Purple wind grass | MONOCOTYLEDONOUS HERBS | Poaceae | Not Threatened |
| Libertia ixioides (G.Forst.) Spreng. | Mikoikoi, NZ iris | MONOCOTYLEDONOUS HERBS | Iridaceae | Not Threatened |
| Luzula picta var. limosa Edgar | | MONOCOTYLEDONOUS HERBS | Juncaceae | Not Threatened |
| Microlaena stipoides (Labill.) R.Br. | meadow rice grass, slender rice grass | MONOCOTYLEDONOUS HERBS | Poaceae | Not Threatened |
| Microtis unifolia (G.Forst.) Rchb.f. | Onion-leaved orchid, microtis | MONOCOTYLEDONOUS HERBS | Orchidaceae | Not Threatened |
| Phormium cookianum Le Jol. subsp. cookianum | Mountain flax, whaririki | MONOCOTYLEDONOUS HERBS | Xanthorrhoeaceae | Not Threatened |
| Poa breviglumis Hook.f. | | MONOCOTYLEDONOUS HERBS | Poaceae | Not Threatened |
| Poa cita Edgar | Silver tussock | MONOCOTYLEDONOUS HERBS | Poaceae | Not Threatened |
| Poa colensoi Hook.f. (small glaucous form with short ligule & scabrid lemma) | | MONOCOTYLEDONOUS HERBS | Poaceae | Not Assessed |
| Poa colensoi Hook.f. (tall green form with long ligule & smooth lemma) | | MONOCOTYLEDONOUS HERBS | Poaceae | Not Assessed |
| Poa pusilla Berggr. | | MONOCOTYLEDONOUS HERBS | Poaceae | Locally Significant |
| Potamogeton cheesemanii A.Benn. | red pondweed | MONOCOTYLEDONOUS HERBS | Potamogetonaceae | Not Threatened |
| Pterostylis tanypoda D.L.Jones, Molloy & M.A.Clem. | | MONOCOTYLEDONOUS HERBS | Orchidaceae | Declining |
| Pterostylis tristis Colenso | | MONOCOTYLEDONOUS HERBS | Orchidaceae | Declining |
| Rytidosperma buchananii (Hook.f.) Connor & Edgar | slender danthonia, bristle grass | MONOCOTYLEDONOUS HERBS | Poaceae | Declining |
| Rytidosperma corinum Connor & Edgar | Bristle grass | MONOCOTYLEDONOUS HERBS | Poaceae | Not Threatened |
| Rytidosperma gracile (Hook.f.) Connor & Edgar | Dainty bristle grass | MONOCOTYLEDONOUS HERBS | Poaceae | Not Threatened |
| Rytidosperma pumilum (Kirk) Connor & Edgar | | MONOCOTYLEDONOUS HERBS | Poaceae | Not Threatened |
| Rytidosperma unarede (Raoul) Connor & Edgar | bristle grass | MONOCOTYLEDONOUS HERBS | Poaceae | Not Threatened |
| Schoenus pauciflorus (Hook.f.) Hook.f. | Bog rush, sedge tussock | MONOCOTYLEDONOUS HERBS | Cyperaceae | Not Threatened |
| Simplicia laxa Kirk | Simplicia | MONOCOTYLEDONOUS HERBS | Poaceae | Nationally Critical |

| | | | | |
|---|---|---|---|---|
| Lycopodium scariosum G.Forst. | Creeping clubmoss | PSILOPSIDS, LYCOPODS & QUILLWORTS | Lycopodiaceae | Not Threatened |

**Appendix 2. Invertebrate species recorded within the Redbank Station Covenant**

| Class | Order | Species | Common name |
|---|---|---|---|
| Turbellaria | Geoplanidae | *Australopacifica sp.* | Flatworm |
| Clitellata | Haplotaxida | Acanthodrilidae sp. | Earth worm |
| Gastropoda | Stylommatophora | *Athoracophoru sp.* | Leaf veined slug |
| Gastropoda | Stylommatophora | Stylommatophora sp. | |
| Udeonychophora | Euonychophora | *Peripatoides* "Dunedin" | Peripatus |
| Diplopoda | Chordeumatida | *Schedotrigona sp.* | Millipede |
| Diplopoda | | Diplopoda sp. 1 | Millipede |
| Diplopoda | | Diplopoda sp. 2 | Millipede |
| Diplopoda | | Diplopoda sp. 3 | Millipede |
| Chilopoda | Geophilomorpha | Geophilomorpha sp. | Soil centipede |
| Chilopoda | | Chilopoda sp. | Centipede |
| Malacostraca | Amphipoda | Talitridae sp. | Landhopper |
| Malacostraca | Isopoda | Isopoda sp. | Woodlouse |
| Malacostraca | Isopoda | *Porcellio scaber* | Common rough woodlouse |
| Malacostraca | Parastacidae | *Paranephrops zealandicus* | Southern koura |
| Arachnida | Acari | Acari sp. | Mite |
| Arachnida | Araneae | *Anoteropsis hilaris* | Garden wolf spider |
| Arachnida | Araneae | *Anoteropsis sp.* | Wolf spider |
| Arachnida | Araneae | Araneidae sp.? | Orbweb |
| Arachnida | Araneae | Araneae sp.? | |
| Arachnida | Araneae | *Argiope protensa* | Tailed grass spider |
| Arachnida | Araneae | *Cambridgea sp.* | Sheetweb spider |
| Arachnida | Araneae | *Clubiona sp.* | Leafcurling sac spider |
| Arachnida | Araneae | *Colaranea verutum* | Orbweb |
| Arachnida | Araneae | *Cycloctenus/Anoteropsis sp.*? | |
| Arachnida | Araneae | *Diaea sp.* | Flower spider |
| Arachnida | Araneae | *Dolomedes minor* | Nurseryweb spider |
| Arachnida | Araneae | *Hemicloea rogenhoferi* | Flattened bark spider |
| Arachnida | Araneae | *Holoplatys apressus* | |
| Arachnida | Araneae | *Novaranea queribunda* | Orbweb |
| Arachnida | Araneae | *Nyssus coloripes* | Spotted ground swift |
| Arachnida | Araneae | *Porrhothele antipodiana* | Tunnelweb spider |
| Arachnida | Araneae | Salticidae sp. | Jumping spider |
| Arachnida | Opiliones | *Phalangium opilio* | European harvestman |
| Insecta | Blattodea | *Celatoblatta sp.* | |
| Insecta | Coleoptera | *Anagotus lewisi* | Tussock weevil |
| Insecta | Coleoptera | *Carabidae sp.* | |
| Insecta | Coleoptera | *Chrysomelidae/Coccinellidae sp. 1* | |
| Insecta | Coleoptera | *Chrysomelidae/Coccinellidae sp. 2* | |
| Insecta | Coleoptera | Corticariinae sp. | Minute brown scavenger beetle |
| Insecta | Coleoptera | Dytiscidae sp. | |
| Insecta | Coleoptera | *Holcaspis sp.* | |
| Insecta | Coleoptera | *Mimopeus opaculaus* | False wireworm |

| | | | |
|---|---|---|---|
| Insecta | Coleoptera | *Odontria sp.* | |
| Insecta | Coleoptera | *Oregus aereus* | |
| Insecta | Coleoptera | *Peristoreus sp. 1* | |
| Insecta | Coleoptera | *Peristoreus sp. 2* | |
| Insecta | Coleoptera | *Pyronota edwardsi* | Kiriwai manuka chafer |
| Insecta | Diptera | Chironomidae sp. | |
| Insecta | Diptera | Diptera sp. 1 | |
| Insecta | Diptera | Diptera sp. 2 | |
| Insecta | Diptera | Diptera sp. 3 | |
| Insecta | Diptera | Diptera sp. 4 | |
| Insecta | Diptera | Diptera sp. 5 | |
| Insecta | Diptera | *Neoitamus sp.* | Robber fly |
| Insecta | Diptera | *Protohystricia sp.* | |
| Insecta | Diptera | Syrphidae sp. | Hoverfly |
| Insecta | Diptera | *Trupanea longipennis* | |
| Insecta | Ephemeroptera | Ephemeroptera sp. | Mayfly |
| Insecta | Forficulidae | *Forficula auricularia* | European earwig |
| Insecta | Hemiptera | Cicadoidea sp. | Cicada |
| Insecta | Hemiptera | *Philaenus spumarius* | Meadow spittlebug |
| Insecta | Hemiptera | Cicadellidae sp. | |
| Insecta | Hemiptera | Saldidae sp. | Shore bug |
| Insecta | Hymenoptera | Braconidae sp. | |
| Insecta | Hymenoptera | Formicidae sp. 1 | Ant |
| Insecta | Hymenoptera | Formicidae sp. 2 | Ant |
| Insecta | Hymenoptera | Ichneumonid sp. | |
| Insecta | Hymenoptera | *Priocnemis sp.* | |
| Insecta | Hymenoptera | *Sphictostethus nitidus* | Golden hunting wasp |
| Insecta | Lepidoptera | *Arctesthes catapyrrha* | |
| Insecta | Lepidoptera | *Argyrophenga antipodum* | Common tussock butterfly |
| Insecta | Lepidoptera | *Asaphodes aegrota* | |
| Insecta | Lepidoptera | *Bityla defigurata* | |
| Insecta | Lepidoptera | *Cephalissa siria* (?possibly) | |
| Insecta | Lepidoptera | Geometridae sp. | |
| Insecta | Lepidoptera | *Gymnobathra sp.* | |
| Insecta | Lepidoptera | *Ichneutica steropastis* | Flax notcher moth |
| Insecta | Lepidoptera | Lepidoptera sp. | |
| Insecta | Lepidoptera | *Lycaena sp.* | Copper butterfly |
| Insecta | Lepidoptera | *Mnesictena flavidalis* | |
| Insecta | Lepidoptera | Noctuidae sp. | |
| Insecta | Lepidoptera | *Orocrambus lewisi* | |
| Insecta | Lepidoptera | *Orocrambus vulgaris* | |
| Insecta | Lepidoptera | *Physetica phricias* | |
| Insecta | Lepidoptera | *Pseudocoremia sp.* | |
| Insecta | Lepidoptera | *Xanthorhoe semifissata* | |
| Insecta | Odonata | *Austrolestes colensonis* | Blue damselfly |
| Insecta | Orthoptera | *Bobilla sp.* | Small field cricket |

| | | | |
|---|---|---|---|
| Insecta | Orthoptera | *Conocephalus sp.* | Long horned grasshopper |
| Insecta | Orthoptera | *Hemiandrus sp.* | Ground weta |
| Insecta | Orthoptera | *Isoplectron armatum* | Cave weta |
| Insecta | Orthoptera | *Phaulacridium marginale* | New Zealand grasshopper |
| Insecta | Orthoptera | *Sigaus campestris* | |
| Insecta | Orthoptera | *Sigaus sp.* | |
| Insecta | Plecoptera | Plecoptera sp. | Stonefly |
| Insecta | Psocoptera | Psocoptera sp. | Barklice |
| Insecta | Thysanoptera | Thysanoptera sp. | Thrip |
| Insecta | Trichoptera | Trichoptera sp. | Caddisfly |

**Appendix 3. Site photographs**

*Figure 12. Narrow-leaved tussock grassland on slopes.*

*Figure 13. Shrubland around rock outcrop.*

*Figure 14. Seepage wetland on slope.*

*Figure 15. Seepage wetland in gully.*

*Figure 16. Low-producing grassland.*

*Figure 17. Gully slopes with rock outcrops, shrubland and willows on river margin.*

*Figure 18. Rocky bluffs along river.*

APPENDIX 3. CURRENT DRAFT OF EPHEMERAL WETLAND ECOLOGICAL ENHANCEMENT AREA PLAN (CHANGES FROM ORIGINAL TRACKED).

Oceana Gold (NZ) Ltd
Macraes Gold Project

Ahika Consulting
Rm. 2, Third Floor,
2 Dowling St, Dunedin
PO Box 1320, 9054

03 477 9242
info@ahika.co.nz
www.ahika.co.nz

# Ephemeral Wetland

## Ecological Enhancement Area Management Plan (incorporating WDC & DOC comments)

August 2020

Report prepared for Oceana Gold (New Zealand) Ltd by Dr M. J. Thorsen,

3 August 2020

Report number: 01015-25-4



2 Dowling Street

Dunedin 9016

New Zealand

Ahika Consulting Ltd guarantees its work as free of political bias and as grounded in sound ecological principles based on quality knowledge.

**Contents**

**Document Summary**

The Deepdell North III project will remove 54.79 ha of indigenous vegetation comprising low producing grassland, shrubland, seasonal gully drainages, ephemeral wetlands and a seepage wetland and inhabited by 71 indigenous plants (including 13 rare species), twenty bird species (nine indigenous and one rare species), four reptile species (three rare species) and a largely unknown invertebrate community. The vegetation communities are underlain by 3 Threatened LENZ. The ephemeral wetland vegetation community is Historically Rare and Critically Endangered and the seepage wetland is Historically Rare and Endangered. Both are priorities for protection. The indigenous vegetation communities are generally of low species diversity and most are characterised by high weed representation. The populations of the 17 At Risk or Rare species are mostly small, except for the Declining Matagouri which is dominant in the shrubland vegetation community and frequent in the low producing grassland plant community.

The project will also impact on 54.09 ha of cultivated pasture and shelterbelts. There may be some effect on a further 88.71 ha of indigenous vegetation and 26.47 ha of cultivated pastures, but these effects are expected to be minimal if appropriate controls are employed.

To address these impacts OceanaGold (New Zealand) Limited (OceanaGold) proposes to support the activities within both an Impact Management Plan and this Ecological Enhancement Area Management Plan (EEAMP). These activities include avoiding effects by evaluating siting of infrastructure and by isolating higher-value ecological areas in the buffer zone, mitigating general environmental effects such as dust, noise and weeds, salvage of rare plants, a lizard management programme and implementing an ecological management programme under an offset design at two sites. Once implemented, the Impact Management Plan and EEAMPs will result in avoiding, minimising, rehabilitating or offsetting all significant adverse ecological effects arising from the Deepdell North III Project to achieve ah an overall gain in biodiversity.

This EEAMP focuses on developing a best practice management technique for ephemeral wetlands by testing four management regimes (sheep grazing, mowing, chemical weed control, and restoring lost avian function) supported by a research programme aimed at obtaining better understanding of ephemeral wetland form, function and threats in the Macraes E.D. with the goal of producing an overall net gain in biodiversity.

This document is laid out with higher-level guiding analysis first and then the EEAMP (Section 0).

**EEA Management Plans**

Ecological Enhancement Areas (EEA) are sites where it is planned to undertake biodiversity offsetting projects. The implementation and management of each of the EEA's will be documented in a management plan (EEAMP, this

document). The EEAMP will form a part of a broader project Ecological Management Plan (which will include on-site works to avoid, remedy, and mitigate adverse effects).

The EEAMP includes:

- a description of the offset, the calculation basis, locations and management activities at which enhancements will be generated;
- securing the ability to undertake enhancement works within management sites by way of landowner agreements (e.g. covenants) or acquisitions;
- the technical detail of the offset works;
- the financial costs of site management into bond calculations or other similar instruments as required by Council that secure financial delivery of biodiversity enhancements;
- a monitoring programme to assess the degree to which enhancement targets are being achieved and the ability to adjust biodiversity management to ensure that gains are achieved and maintained for the long term;
- the roles and responsibilities of those carrying out the work, and the governance and management structures relating to the operation of the enhancement site(s); and
- reporting the results of monitoring results and a process for undertaking actions if enhancement targets are not being achieved as anticipated.

**Guiding documents**

Consent Notice.

Offsetting practice

**Commented [MT12]:** Add these

**Offset calculation**

This offset is designed to fulfil an offset as prescribed in the Otago Regional Council Otago Regional Policy Statement (and including Environment Court decision NZEnvC41 of 15 March 2019)[29]:

> "The offset achieves no net loss and preferably a net gain in indigenous biological diversity;
>
> The offset ensures there is no loss of individuals of rare or vulnerable species as defined in reports published prior to 14 January 2019 under the New Zealand Threat Classification System ("NZTCS");
>
> The offset is undertaken where it will result in the best ecological outcome, preferably:
>
> > Close to the location of development; or
> >
> > Within the same ecological district or coastal marine biogeographic region;
>
> The offset is applied so that the ecological values being achieved are the same or similar to those being lost;
>
> The positive ecological outcomes of the offset last at least as long as the impact of the activity, preferably in perpetuity;
>
> The offset will achieve biological diversity outcomes beyond results that would have occurred if the offset was not proposed; and
>
> The delay between the loss of biological diversity through the proposal and the gain or maturation of the offset's biological diversity outcomes is minimised."

The disaggregated accounting model[30] was used to calculate the extent of works required within the EAA to achieve a state of No Net Loss of biodiversity (NNL) using the March 2015 user manual and spreadsheets.

In designing the offset consideration was given to both the Biodiversity Offsetting under the Resource Management Act: a guidance document[31] and the Department of Conservation's Guidance on Biodiversity Offsetting[32].

The calculations in the offsets was independently peer reviewed by Graham Ussher.

[29] Note the offset described in the pORPS does not require use of any offset guidance such as that provided by BBOP, DOC or in recent guidance to Councils.

[30] Maseyk, F.J.F; Barea, L.T; Stephens, R.T.T; Possingham, H.P; Dutson, G; Maron, M. 2016. A disaggregated biodiversity accounting model to improve estimation of ecological equivalency and no net loss. Biological Conservation 204: 322-332.

[31] Maseyk, F; Ussher, G; Kessels, G; Christensen, M; Brown, M. 2018. Biodiversity Working Group.

[32] doc.govt.nz/about-us/our-policies-and-plans/guidance-on-biodiversity-offsetting/

**Ephemeral Wetland EEA management plan**

*Description of project*

The role of the Ephemeral Wetland Ecological Enhancement Area (EEA) is to allow for offsetting of the impacts on ephemeral wetlands from OceanaGold's Deepdell North project. It also aims to investigate how to integrate local farming practices and biodiversity conservation in a natural landscape at Macraes with the overall objective of maintaining, and enhancing where necessary, the important indigenous biodiversity within the covenant. The objectives of the EEA will be carefully monitored. This EEA Management Plan (EEAMP) takes as a starting point that the biodiversity in this area has persisted through 700 years of Maori use and 150 years of farming activities and that removing these very strong influences on local ecology runs the risk of causing a cascading change of potentially unwanted effects that could result in the loss of important biodiversity. It also looks to examine other ecological contexts, such as replacing lost avian function of ephemeral wetlands as well as testing other management approaches.

This EEAMP has an emphasis on research to support management. This is because the management of ephemeral wetlands is in its infancy, and in the instances where management has been attempted[33], the outcome of improved ecosystem health has been difficult to achieve. The management approach that produces the best outcomes for the least effort will be adopted for managing the offset ephemeral wetland long term.

*Objectives of Ephemeral Wetland EEA*

The primary objectives of the Ephemeral Wetland EEA are to:

4. Allow the achievement of OceanaGold's Deepdell North project offset obligations.
5. Better understand ephemeral wetland form, function, threatening processes and management.

Secondary objectives are to:

6. Integrate farming practices and conservation of biodiversity.
7. Provide safe haven for species moved from other sites.
8. Measure conservation gains.

*Key targets*

- At least 2 ha of ephemeral wetland managed.

[33] Sedgemere tarn, Manawatu dunes, Ashburton Lakes.

- One 4.8 ha site managed to result in a 25% cover by indigenous plants over at least 2 ha.
- Indigenous plant biodiversity to be increased to 15 species at the site and including *Lobelia ionantha, Juncus pusillus* and *Carex resectans*.
- Management supported by an audited research project.
- 20 ephemeral wetlands are revisited and condition assessed against previous.
- 50 randomly-selected ephemeral wetlands visited to describe condition and current threats.

*The Offsets*

Ephemeral Wetland Offset

The actions within this offset aim to offset the loss of 1.84 ha of ephemeral wetlands from the Deepdell North III site by an improved-condition offset with the improvement work informed by a research project investigating ephemeral wetland form, function and threats. This offset will involve using weed control to produce a 25% cover by indigenous vegetation at the offset ephemeral wetland over an area of at least 2 ha (the actual area of the ephemeral wetland at the offset site is 4.8 ha) and an improvement in indigenous plant diversity at the site to at least 15 indigenous plant species comprised of at least ten species characteristic of Macraes ephemeral wetlands and five ephemeral wetland species of conservation concern by 10 years. This produces a Net Present Biodiversity Value of 0.18 and No Net Loss (NNL) is achieved by year 10. The 2 ha target of managed ephemeral wetland is double the 1 ha required to reach NNL, but compensates for current uncertainties in ecological state of these systems and lack of proven management tools[34]. These figures are based on the research project addressing deficiencies in knowledge on the form, function, threats and management of ephemeral wetlands. This research project will establish the physical and subsurface profile of the offset ephemeral wetland, documenting its hydrological profile over time and measuring changes in the plant communities 3-4 times a year over 5 years. The threat that ephemeral wetlands face will be established by 1) revisiting 20 previously surveyed sites and documenting their current condition, 2) quantifying surrounding land use of all mapped ephemeral wetlands and 3) visiting a random selection of 50 ephemeral wetlands to describe their current condition. The impact on the Declining wetland herb *Lobelia ionantha,* Declining small rush *Juncus pusillus* and Locally Uncommon sedge *Carex resectans* will also be addressed through including these species as three of the 11 indigenous species.



[34] The actual area if management is 4.8 ha and the non-formal target is to create a preponderant cover of indigenous species as this will make the site more resistant to weed invasion and therefore less difficult to manage into the future.

*Site*

Site selection criteria/process

The Ephemeral Wetland EEA (Figure 19) was selected on the basis of proximity to impact site (both are within the Macraes E.D.) and because of it's size (the largest example within the Macraes E.D.), its unmodified but highly weed-infested nature, and the support of the land owner. Ephemeral wetlands are also larger and more frequent in the southern portion of the Macraes E.D. and this means that the conservation management is being applied to a site that is both representative and of local relevance. Another, minor, consideration is that it moves some of the conservation activities associated with the mine into a different community, exposing them to new conservation messages. An alternative site on the same property but at lower elevation was discarded because of the high saline content of its soils.

Site location(s), access and legal provisions

The Ephemeral Wetland EEA is located on Mt Stoker Road 30 km southwest of Macraes Township and 10 km southeast of Middlemarch. It is on private tenure land and access is by an agreement.

**Commented [MT13]:** Need full term

The proposed covenant will be covenanted under the Conservation Act (1988), registered on the title to land and managed as described in this plan. It will be fenced for the duration of the research programme. The fence will be removed or altered to top wires only (to exclude cattle), if sheep grazing is found to be beneficial to the indigenous plant species.

Physical description of EEA

The Ephemeral Wetland EEA comprises the 7.4 ha covenant enclosing the 4.8 ha ephemeral wetland and 4 nearby reference ephemeral wetlands with a combined area of 1.34 ha (Figure 20). The ephemeral wetland is on a shallowly-incised, tilted, flat peneplain surface at about 300 m a.s.l. It has a small feeder gully on the eastern side and is near (but is not connected to) a small gully on the western side. The ephemeral wetland is seasonally inundated and is usually full over winter and drying to varying extents over summer.

Flora of EEA

**The vegetation of the EEA shows some zonation, with a zone of taller exotic grasses such as ryegrass *Lolium perenne* and *Phalaris arundinacea*, then a zone of shorter exotic grasses (particularly Yorkshire fog *Holcus lanatus* and *Lachnagrostis filiformis*), then a turf zone dominated by *Alopecurus* with *Pseudognaphalium luteo-album, Rorippa palustris* and *Juncus* species. Over the ddamper area in the middle of the wetland the vegetation is dominated by *Glyceria declinata*, *Alopecurus geniculata* and *Juncus articulatus* with frequent *Lachnagrostis filiformis.* The vegetation is dominated in both ground cover and species diversity by exotic species (24 species) (**

**Appendix 2. Plant species recorded within the EEA,**

Appendix 3. Site photographs). Only seven indigenous species are present in the wetland, but two (the grass *Lachnagrostis filiformis* and cress *Rorippa palustris*) have their largest population for the Macraes E.D. at this site.

Fauna of EEA

The fauna of the EEA has not been evaluated

*Figure 19. Location of Ephemeral Wetland EEA.*

*Figure 20. Aerial view of proposed covenant boundary (green), ephemeral wetland outline (blue) and reference areas (orange).*

*Project budget and ongoing funding*

This project is estimated to have a cost of $$$ for the initial set-up and achieving the gains stage, and $$$ for the maintaining the gains stage.

The funds for the initial set-up and achieving the gains will be provided by OceanaGold on a costs-incurred basis.

*Site management – general*

Site management is separated into two phases – achieving the gains, where the emphasis is on achieving the desired outcome targets and then a maintaining the gains phase where the targets are maintained over time (to at least 50 year's time).

The achieving the gains phase and research programme are expected to span 5 years. After which the maintaining the gains phase will be forecast to be maintained for at least a further 45 years.

*Site targets*

The following are the targets that are to be achieved within the offset part of the EEA.

Indigenous vegetation cover

25% indigenous vegetation cover at the offset ephemeral wetland over at least 2 ha (the actual area of the ephemeral wetland at the offset site is 4.8 ha).

Indigenous species diversity

An improvement in indigenous plant diversity the site to at least 15 indigenous plant species known to inhabit Macraes ephemeral wetlands by 10 years. Three of these species to be the Declining wetland herb *Lobelia ionantha,* small wetland rush *Juncus pusillus* and Locally Uncommon sedge *Carex resectans*.

Ephemeral wetland form and function

A research project establishes the physical and subsurface profile of the offset ephemeral wetland, documenting its hydrological profile over time and measuring changes in the plant communities 3-4 times a year over 5 years.

Ephemeral wetland threats

Three approaches will be taken to better understand the threats that ephemeral wetlands face in the Macraes E.D. so that management at the offset site can better target the current situation. 1) 20 previously surveyed sites will be revisited to document their current condition, 2) the surrounding land use of all ephemeral wetlands mapped in the AEE will be quantified from inspection of recent aerial photographs and 3) a random selection of 50 ephemeral wetlands will be visited to describe their current condition.

*Project management, ecological oversight and Decision Framework*

It is important that the key partners and regulating authorities in this project have confidence in the outcomes that are being achieved. This project will be managed by the Manager, Environment of OceanaGold during the life of the mine. Following mine closure the project will be managed by the delegated oversight trust/or landowner who will direct activities and disburse funds as required. The project will report annually on outcomes to an oversight group[35] comprised of representatives from Iwi, DOC, Macraes Community Incorporated, Waitaki District Council, Dunedin City Council, the funding Trust, the project ecologist and the landowner. Delivery of management activities will be by appropriately qualified people and monitoring of outcomes will be by an appropriately qualified ecologist who is ratified by the oversight group. If outcomes do not meet targets then the manager will be given appropriate opportunity to rectify the situation by adjusting the site management activities, and the oversight group can provide input on this. If the outcomes cannot be rectified, then the oversight group can direct the manager to adjust management as they determine. This can include removal of stock and fencing of the Covenant boundary.

In all decisions the primary objective for this EEA must be given precedence.

[35] The outcomes will also be reported annually as part of OceanaGold's Annual Ecology Report.

*Mandatory site management actions – achieving the gains phase.*

Wetland management through the achieving the gains phase will focus on developing management tools that potentially alter the competitive balance between tall exotic vegetation and smaller stature indigenous vegetation[36] and on reintroduction of rare plant species. Four treatments to alter weed competitive balance (controlled grazing by sheep [both with and without complete weed removal], replacing lost avian function, chemical control of weeds, robot mowing) will be applied (Figure 21) and compared with a non-treatment control. Treatments and control will be spatially separated. Treatment sites will be randomly applied to five fenced sectors in the ephemeral wetland. Treatments do not need to be spatially separated but may need to be physically separated.

A fall-back option if the treatments do not achieve the objective of restoring a natural ephemeral wetland ecosystem is to take back to bare earth using chemical control and re-establish indigenous vegetation.

Stock treatment

In the two stock treatment sectors sheep will have continuous access through a wired-open gate. In one sector larger infestations of weeds will be remove using chemical spray, in the other sector weeds will be left as-is. These sectors will be fenced using waratah and sheep netting.

Chemical treatment

In this sector, spraying of problem weed species will occur during the growth and flowering phases (i.e. before seed can be set) using an appropriate effective herbicide. Spraying will be repeated annually until no problem weeds remain. This sector will be delineated by boundary marker pegs.

Replacing lost avian function treatment

In this sector, the lost avian function[37] hypothesis will be tested using penned fowl in during their 'dry' phase to preferentially remove exotic vegetation[38]. Ducks and/or geese will be used during the 'drying' phase and hens during the 'dry' phase when exotic grasses are germinating and flowering. Animal welfare and safety from predators are

[36] See Andrew J. Tanentzap, William G. Lee, Adrian Monks, Kate Ladley, Peter N. Johnson, Geoffrey M. Rogers, Joy M. Comrie, Dean A. Clarke and Ella Hayman. 2014. Identifying pathways for managing multiple disturbances to limit plant invasions. Journal of Applied Ecology 51: 1015-1023.

[37] See G.M. Rogers & A. Monks. 2016. Restoring lost ecological function: ecological surrogates facilitate maintenance of coastal turf communities. New Zealand Journal of Botany, 54: 393-411.

[38] Author, pers. obs.

important considerations. This sector will be fenced using waratahs and chicken netting and housing, retreat sites and automated feeders will be provided. DOC 250 traps will be deployed to catch ferrets and stoats.

*Figure 21. Schematic layout of management treatment sectors (black) around a central measurement point.*

Robot mowing treatment

In this sector, a geofenced or perimeter fenced robot mower will be used to continually mow vegetation during the 'dry' phase. Suitable units include solar-powered Husqvarna Automower Solar Hybrid or Vitirover (however both may not be in production), or have several units that are cycled through as charge is depleted, or adapt existing mower to solar. During the initial phase, hand mowing will be done to remove taller vegetation that cannot be traversed by the robot mowers.

Pest animals (rabbits)

Pest animals such as rabbits will not be controlled unless there is evidence of extensive negative impact on the indigenous vegetation. If control is needed, the covenant will be fenced with rabbit netting and the rabbits removed by shooting and gassing of burrows.

Species reintroductions

The reintroduction of absent indigenous plant species will be through creating a network of small (1 m x 1 m) bare patches through each of the treatment sectors and planting plugs of the target species during their growth phase. The methodology for reintroduction of each species will be detailed in the Plant Propagation and Management Protocol. While the target biodiversity is 15 indigenous species, reintroduction will be attempted for more than that number as the methods to reintroduce plants into an ephemeral wetland environment is an unknown. Emphasis will be given to those that form extensive ground cover in more natural examples of ephemeral wetlands and to rarer species.

The species that are candidates for reintroduction are all indigenous plant species that are known to inhabit ephemeral wetlands in the Macraes E.D. (68 species). These are listed in

Appendix 1: Indigenous ephemeral wetland plants of the Macraes E.D.

Measuring site change

Change in plant vegetation communities in the different treatment sectors will be evaluated by measuring:

1. Digitally mapping community extents based on high-resolution drone images annually for 5 years.
2. Indigenous species cover values will be established by the frequency of species shoot presence within 25 5 x 5 cm squares of a permanently marked 0.5 x 0.5 m grid at 2 m intervals along a transect bisecting each treatment sector and extending to 6 m beyond wetland margin. Measurements will be taken every three months for five years
3. Inventory of species present and estimate of abundance at site.
4. Location using GPS and measured extent and estimated ground cover over measured extent of plants of conservation interest (those that have been reintroduced to the site, or rare species naturally occurring at the site).

*Mandatory site management actions – maintaining the gains phase.*

Wetland management following the achieving the gains phase will use the most appropriate management approach developed during the achieving the gains phase. This will then be applied as prescribed and with information from the outcome monitoring being 'fed-back' to improve efficiencies and effectiveness. During this phase it is the ambition that the wetland is mostly of natural vegetation and hence naturally resistant to weed invasion. It is expected that ongoing management costs will be minimal and involve costs associated with the selected management approach and monitoring of covenant condition.

Weeds

Weed control during the maintaining the gains stage will focus on prevention of arrival of woody weeds and any other species considered an environmental weed (see OceanaGold's Weed Control Protocol) together with an active weed surveillance regime of the covenant conducted annually. Any new weed species (woody or otherwise) recorded in the covenant will be assessed as an environmental weed (based on its potential to cause damage to important biodiversity at the site) and if it is considered an environmental weed the feasibility (including cost) of removal or control will be assessed. If it is feasible to remove, contain or control, then appropriate weed management techniques will be employed against the species.

Pest animals

It is not planned to undertake any pest animal control work during the maintain the gains phase, unless indicated by outcome monitoring. A watching brief will be kept by the project ecologist on new pest control methodologies and technologies, and if a cost-effective pest control approach is developed, it will be considered for adoption within the Covenant.

*Research*

A research project will support the management regime in Section 0. This research will focus on gaining a better understanding of the form and function of ephemeral wetlands and the threatening processes in the Macraes E.D.

Ephemeral wetland form and function

Research into ephemeral wetland form and function will be by mapping their physical profile (including sub-surface profile) and measuring their hydrological dynamics (water inputs, water loss through evaporation and leakage into surrounding soils and the resulting site water level).

Physical profile mapping

**Commented [MT14]:** School of Surveying students?

On a 1 m grid over the offset ephemeral wetland obtain a surface contour using laser level and depth contour of soil substrate using a probe.

Soil types and chemistry

Sample soils at several ephemeral wetlands and surrounding land to establish soil profiles and chemical composition. Important chemicals to measure include $NO_3^-$, $NH_4^+$, and $PO_4^{3-}$.

**Commented [MT15]:** Look at anion-cation exchange resin bags

Site Hydrology

Documenting the site hydrology (speed of water accumulation and depletion) will be via measuring rain level at the study site, measuring site water level using HOBO U20/Odyssey® Capacitance Water Level Logger at deepest point of the offset ephemeral wetland and measuring soil moisture at 10 points along a transect through the ephemeral wetland and 10 m beyond wetland margin. Wind, temperature and sunshine hours will be collected at a central weather station to calculate monthly evapotranspiration potential. Suitable nearby weather stations are Garthmyll and Ews (both near Middlemarch) accessed through CliFlo.

Ephemeral wetland threats

Three approaches will be taken to better understand the threats that ephemeral wetlands face in the Macraes E.D. so that management at the offset site can better target the current situation. 1) 20 previously surveyed sites will be revisited to document their current condition, 2) the surrounding land use of all ephemeral wetlands mapped in the AEE (Figure 22) will be quantified from inspection of recent aerial photographs and 3) a random selection of 50 ephemeral wetlands will be visited to describe their current condition.



*Figure 22. Mapped locations of ephemeral wetlands in the Macraes E.D.*

*Expected outcomes*

The expected outcomes from the ephemeral wetland EEAMP are:

- A covenant over the largest ephemeral wetland in the Macraes E.D.
- A 25% cover by indigenous plants over 2 ha of the site.
- An increase in indigenous plant biodiversity to 15 species and including *Lobelia ionantha, Juncus pusillus* and *Carex resectans*.
- Development of an ephemeral wetland management approach supported by an audited research project.
- Improved understanding on the form and function of ephemeral wetlands in the Macraes E.D.
- Better understanding of the threats faced by ephemeral wetlands in the Macraes E.D.

*Monitoring of outcomes*

Outcome monitoring

Monitoring the outcomes against expected performance in the targets (Section 0) is critical, especially the outcomes associated with the offset project. The outcome monitoring used in this EEA are:

Monitoring of vegetation community extent

Measurement of the baseline extents, and changes to this extent over time, for each vegetation community in the Covenant will be by manually digitally mapping community boundaries in GIS from aerial images obtained by drone using expert interpretation of the images. Ground truthing will be employed where there are areas of confusion. Images will be obtained and mapped at the start of the project to establish the baseline extents of each vegetation community, then annually for 5 years, and then every 5 years to establish changes in extent.

Indigenous species cover

Indigenous species cover values will be established by frequency of species shoot presence within 25 5 x 5 cm squares of a permanently marked 0.5 x 0.5 m grid at 2 m intervals along a transect bisecting each treatment sector and extending to 6 m beyond wetland margin. Measurements will be taken every three months for five years, and then at 5-yearly intervals during the maintaining the gains phase.

Vegetation community composition and species diversity

Vegetation community and composition will be established by estimating percent ground cover for all species seen during annual walk-through surveys of the site undertaken as part of the annual inspection (Section 0).

Plant species population monitoring

Plant species population monitoring will be though recording location using GPS and measured extent and estimated ground cover over measured extent of plants of conservation interest (those that have been reintroduced to the site, or rare species naturally-occurring at the site) over the five years of the achieving the gains phase.

Annual inspection

An annual inspection of the Covenant by an experienced ecologist will occur annually during the achieving the gains phase and then every 5 years during the maintaining the gains phase. During this inspection notes will be taken of signs of pest impact or of new weed species.

Discretionary monitoring activities

Inventory of biodiversity

An important component of protected areas is their function as a reservoir for biodiversity. Establishing which biodiversity is present in an area in the Macraes context takes about 10 years of survey effort. An inventory of fauna biodiversity (including invertebrates) will occur at the same time as the annual site inspection of the Covenant and will continue for 10 years and then be repeated over 5 days every 10 years.

Analysis of monitoring data

Data will be analysed based on advice from a biometrician at design phase to ensure validity.

*Reporting of outcomes*

A report will be prepared annually on which activities (including additional activities) were undertaken, any changes to methodologies, results of outcome monitoring, an analysis of progress against monitoring and any other relevant matters.

This report will be provided to all project partners in the oversight group, and also be included in OceanaGold's Annual Ecology Report.

The oversight group will evaluate the information in the report and decide changes to this EEAMP, if warranted.

A larger summary report will be prepared after 10 years of management as a source of information for conservation managers.

*Timeframes*

**Commented [MT16]:** To be developed

**Appendix 1: Indigenous ephemeral wetland plants**

The following indigenous plant species have been recorded as inhabiting ephemeral wetlands in the Macraes E.D.

| ***Name*** | **Group** | **Family (Tribe)** | **Threat ranking (2017)** | **Common name** | **Note** |
|---|---|---|---|---|---|
| *Agrostis muscosa Kirk* | MONOCOTYLEDONOUS HERBS | Poaceae | Not Threatened | pincushion grass | |
| *Agrostis pallescens Cheeseman* | MONOCOTYLEDONOUS HERBS | Poaceae | Naturally Uncommon | swamp bent | |
| *Amphibromus fluitans Kirk* | MONOCOTYLEDONOUS HERBS | Poaceae | Nationally Vulnerable | Water brome | |
| *Argyrotegium mackayi (Buchanan) J.M.Ward & Breitw.* | DICOTYLEDONOUS HERBS | Asteraceae | Not Threatened | 0 | |
| *Austroblechnum penna-marina (Poir.) Gasper & V.A.O.Dittrich* | FERNS | Blechnaceae | Not Threatened | little hard fern, alpine hard fern | Habitat may not be suitable |
| *Azolla rubra R.Br.* | FERNS | Salviniaceae | Not Threatened | Pacific azolla, azolla, red azolla | Habitat may not be suitable |
| *Cardamine mutabilis Heenan* | DICOTYLEDONOUS HERBS | Brassicaceae | Nationally Critical | 0 | |
| *Carex dipsacea Berggr.* | MONOCOTYLEDONOUS HERBS | Cyperaceae | Not Threatened | Teasel Sedge | |
| *Carex gaudichaudiana Kunth* | MONOCOTYLEDONOUS HERBS | Cyperaceae | Not Threatened | Gaudichaud's sedge | |
| *Carex resectans Cheeseman* | MONOCOTYLEDONOUS HERBS | Cyperaceae | Not Threatened | Desert Sedge | |
| *Carex sinclairii Boott* | MONOCOTYLEDONOUS HERBS | Cyperaceae | Not Threatened | Sinclair's sedge | |
| *Carex tenuiculmis (Petrie) Heenan & de Lange* | MONOCOTYLEDONOUS HERBS | Cyperaceae | Declining | slender wine sedge | Habitat may not be suitable |
| *Chaerophyllum colensoi var. delicatulum (CHR 73872; Hauhungaroa Range) (Allan) K. F. Chung* | DICOTYLEDONOUS HERBS | Apiaceae | Nationally Endangered | mountain myrrh | |
| *Chionochloa rubra subsp. cuprea Connor* | MONOCOTYLEDONOUS HERBS | Poaceae | Not Threatened | copper tussock | Habitat may not be suitable |
| *Crassula mataikona A.P.Druce* | DICOTYLEDONOUS HERBS | Crassulaceae | Naturally Uncommon | 0 | |
| *Crassula multicaulis (Petrie) A.P.Druce & Given* | DICOTYLEDONOUS HERBS | Crassulaceae | Nationally Endangered | 0 | |
| *Crassula peduncularis (Sm.) F.Meigen* | DICOTYLEDONOUS HERBS | Crassulaceae | Nationally Critical | 0 | |
| *Crassula sinclairii (Hook.f.) A.P.Druce & Given* | DICOTYLEDONOUS HERBS | Crassulaceae | Not Threatened | Sinclairs stonecrop | |
| *Deschampsia cespitosa (L.) P.Beauv.* | MONOCOTYLEDONOUS HERBS | Poaceae | Declining | tufted hair-grass, wavy hair-grass | Habitat may not be suitable |

| | | | | | |
|---|---|---|---|---|---|
| *Dichondra brevifolia Buchanan* | DICOTYLEDONOUS HERBS | Convolvulaceae | Not Threatened | Dichondra | |
| *Elatine gratioloides A.Cunn.* | DICOTYLEDONOUS HERBS | Elatinaceae | Not Threatened | 0 | |
| *Eleocharis acuta R.Br.* | MONOCOTYLEDONOUS HERBS | Cyperaceae | Not Threatened | sharp spike sedge | |
| *Eleocharis gracilis R.Br.* | MONOCOTYLEDONOUS HERBS | Cyperaceae | Not Threatened | slender spike sedge | |
| *Epilobium komarovianum H.Lév.* | DICOTYLEDONOUS HERBS | Onagraceae | Not Threatened | creeping willowherb | |
| *Euchiton ensifer (D.G.Drury) Holub* | DICOTYLEDONOUS HERBS | Asteraceae | Nationally Endangered | Creeping Cudweed | |
| *Euchiton japonicus (Thunb.) Holub* | DICOTYLEDONOUS HERBS | Asteraceae | Not Threatened | 0 | |
| *Euchiton lateralis (C.J.Webb) Breitw. & J.M.Ward* | DICOTYLEDONOUS HERBS | Asteraceae | Not Threatened | 0 | |
| *Euchiton traversii (Hook.f.) Holub* | DICOTYLEDONOUS HERBS | Asteraceae | Not Threatened | 0 | |
| *Ficinia nodosa (Rottb.) Goetgh., Muasya & D.A.Simpson* | MONOCOTYLEDONOUS HERBS | Cyperaceae | Not Threatened | wiwi, knobby club rush, ethel sedge | Habitat may not be suitable |
| *Galium (b) (CHR 469914; aff. G. perpusillum; "lacustrine")* | DICOTYLEDONOUS HERBS | Rubiaceae | Not Assessed | 0 | |
| *Gentianella amabilis (Petrie) Glenny* | DICOTYLEDONOUS HERBS | Gentianaceae | Not Threatened | Gentian | |
| *Glossostigma diandrum (L.) Kuntze* | DICOTYLEDONOUS HERBS | Phrymaceae | Not Threatened | 0 | |
| *Gonocarpus micranthus subsp. micranthus Thunb.* | DICOTYLEDONOUS HERBS | Haloragaceae | Not Threatened | 0 | |
| *Gratiola aff. concinna (AK 251855; South Island)* | DICOTYLEDONOUS HERBS | Plantaginaceae | Data Deficient | 0 | |
| *Gratiola concinna Colenso* | DICOTYLEDONOUS HERBS | Plantaginaceae | Nationally Endangered | 0 | |
| *Herpolirion novae-zelandiae Hook.f.* | MONOCOTYLEDONOUS HERBS | Xanthorrhoeaceae | Not Threatened | grass lily, sky lily | |
| *Hydrocotyle sulcata C.J.Webb & P.N.Johnson* | DICOTYLEDONOUS HERBS | Araliaceae | Not Threatened | 0 | |
| *Hypericum rubicundulum Heenan* | DICOTYLEDONOUS HERBS | Hypericaceae | Nationally Endangered | 0 | |
| *Isolepis basilaris Hook.f.* | MONOCOTYLEDONOUS HERBS | Cyperaceae | Declining | pygmy clubrush | |
| *Juncus distegus Edgar* | MONOCOTYLEDONOUS HERBS | Juncaceae | Naturally Uncommon | two storey rush | |
| *Juncus edgariae L.A.S.Johnson & K.L.Wilson* | MONOCOTYLEDONOUS HERBS | Juncaceae | Not Threatened | Wiwi, Edgars rush | |
| *Juncus pusillus Buchenau* | MONOCOTYLEDONOUS HERBS | Juncaceae | Naturally Uncommon | Dwarf rush | |
| *Lachnagrostis filiformis (G.Forst.) Trin.* | MONOCOTYLEDONOUS HERBS | Poaceae | Not Threatened | New Zealand wind grass | |
| *Lachnagrostis striata (Colenso) Zotov* | MONOCOTYLEDONOUS HERBS | Poaceae | Not Threatened | Purple wind grass | |

| | | | | | |
|---|---|---|---|---|---|
| *Lemna aff. disperma (a) (AK 349142; New Zealand)* | MONOCOTYLEDONOUS HERBS | Araceae | Data Deficient | 0 | |
| *Leptinella (f) (; "seep")* | DICOTYLEDONOUS HERBS | Asteraceae | Not Assessed | 0 | Habitat may not be suitable |
| *Leptinella maniototo (Petrie) D.G.Lloyd & C.J.Webb* | DICOTYLEDONOUS HERBS | Asteraceae | Relict | Maniototo, Maniototo button daisy | |
| *Lilaeopsis novae-zelandiae (Gand.) A.W.Hill* | DICOTYLEDONOUS HERBS | Apiaceae | Not Threatened | 0 | |
| *Lilaeopsis ruthiana Affolter* | DICOTYLEDONOUS HERBS | Apiaceae | Not Threatened | 0 | |
| *Limosella lineata Glück* | DICOTYLEDONOUS HERBS | Plantaginaceae | Not Threatened | mudwort | |
| *Lobelia ionantha Heenan* | DICOTYLEDONOUS HERBS | Campanulaceae | Declining | Hypsela | |
| *Lobelia perpusilla Hook.f.* | DICOTYLEDONOUS HERBS | Campanulaceae | Not Threatened | 0 | |
| *Myosotis glauca (G.Simpson & J.S.Thomson)de Lange & Barkla* | DICOTYLEDONOUS HERBS | Boraginaceae | Not Assessed | 0 | |
| *Myosurus minimus subsp. novae-zelandiae (W.R.B.Oliv.) Garn.-Jones* | DICOTYLEDONOUS HERBS | Ranunculaceae | Nationally Vulnerable | New Zealand mousetail, bearded mousetail | |
| *Myriophyllum pedunculatum subsp. novae-zelandiae Orchard* | DICOTYLEDONOUS HERBS | Haloragaceae | Not Threatened | 0 | |
| *Myriophyllum propinquum A.Cunn.* | DICOTYLEDONOUS HERBS | Haloragaceae | Not Threatened | Common water milfoil | |
| *Ophioglossum coriaceum A.Cunn.* | FERNS | Ophioglossaceae | Not Threatened | adder's tongue | |
| *Oreobolus strictus Berggr.* | MONOCOTYLEDONOUS HERBS | Cyperaceae | Not Threatened | Comb sedge | Habitat may not be suitable |
| *Plantago triandra Berggr.* | DICOTYLEDONOUS HERBS | Plantaginaceae | Not Threatened | Glossy plantain, starweed | |
| *Pseudognaphalium luteoalbum (L.) Hilliard & B.L.Burtt* | DICOTYLEDONOUS HERBS | Asteraceae | Not Threatened | 0 | |
| *Ranunculus amphitrichus Colenso* | DICOTYLEDONOUS HERBS | Ranunculaceae | Not Threatened | waoriki | |
| *Ranunculus ternatifolius Kirk* | DICOTYLEDONOUS HERBS | Ranunculaceae | Nationally Vulnerable | 0 | |
| *Rorippa palustris (L.) Besser* | DICOTYLEDONOUS HERBS | Brassicaceae | Not Threatened | Marsh yellow cress, poniu | |
| *Rytidosperma nigricans (Petrie) Connor & Edgar* | MONOCOTYLEDONOUS HERBS | Poaceae | Not Threatened | Bristle grass | |
| *Stylidium subulatum Hook.f.* | DICOTYLEDONOUS HERBS | Stylidiaceae | Not Threatened | 0 | |

| | | | | |
|---|---|---|---|---|
| *Tetrachondra hamiltonii Petrie ex Oliv.* | DICOTYLEDONOUS HERBS | Tetrachondraceae | Nationally Vulnerable | 0 |
| *Viola cunninghamii Hook.f.* | DICOTYLEDONOUS HERBS | Violaceae | Not Threatened | Mountain violet, white violet |
| *Wurmbea novae-zelandiae (Hook.f. ex Kirk) Lekhak, Survesw. & S.R.Yadav* | MONOCOTYLEDONOUS HERBS | Colchiaceae | Nationally Endangered | 0 |

**Appendix 2. Plant species recorded within the EEA**

| | | | | |
|---|---|---|---|---|
| Capsella bursa-pastoris | shepherd's purse | DICOTYLEDONOUS HERBS | Brassicaceae | Exotic |
| Cerastium fontanum subsp. vulgare (Hartm.) Greuter & Burdet | | DICOTYLEDONOUS HERBS | Caryophyllaceae | Exotic |
| Chenopodium album | fathen | DICOTYLEDONOUS HERBS | Amaranthaceae | Exotic |
| Cirsium arvense | Californian thistle | DICOTYLEDONOUS HERBS | Asteraceae | Exotic |
| Cirsium vulgare | Scotch thistle | DICOTYLEDONOUS HERBS | Asteraceae | Exotic |
| Erodium cicutarium (L.) L''Hér. | storksbill | DICOTYLEDONOUS HERBS | Geraniaceae | Exotic |
| Limosella lineata Glück | mudwort | DICOTYLEDONOUS HERBS | Plantaginaceae | Not Threatened |
| Myriophyllum propinquum A.Cunn. | Common water milfoil | DICOTYLEDONOUS HERBS | Haloragaceae | Not Threatened |
| Pseudognaphalium luteoalbum (L.) Hilliard & B.L.Burtt | | DICOTYLEDONOUS HERBS | Asteraceae | Not Threatened |
| Rorippa palustris (L.) Besser | Marsh yellow cress, poniu | DICOTYLEDONOUS HERBS | Brassicaceae | Not Threatened |
| Scorzoneroides autumnalis (L.) Moench | autumn hawkbit | DICOTYLEDONOUS HERBS | Asteraceae | Exotic |
| Senecio vulgaris L. | groundsel | DICOTYLEDONOUS HERBS | Asteraceae | Exotic |
| Solanum villosum Mill. | red-berried nightshade | DICOTYLEDONOUS HERBS | Solanaceae | Exotic |
| Sonchus asper | prickly sow thistle | DICOTYLEDONOUS HERBS | Asteraceae | Exotic |
| Taraxacum officinale agg. | dandelion | DICOTYLEDONOUS HERBS | Asteraceae | Exotic |
| Trifolium dubium | suckling clover | DICOTYLEDONOUS HERBS | Fabaceae | Exotic |
| Trifolium repens | white clover | DICOTYLEDONOUS HERBS | Fabaceae | Exotic |
| Veronica serpyllifolia | turf speedwell, thyme-leaved speedwell | DICOTYLEDONOUS HERBS | Plantaginaceae | Exotic |
| Agrostis capillaris L. | browntop | MONOCOTYLEDONOUS HERBS | Poaceae | Exotic |
| Alopecurus geniculatus L. | kneed foxtail | MONOCOTYLEDONOUS HERBS | Poaceae | Exotic |
| Cynosurus cristatus L. | crested dogstail | MONOCOTYLEDONOUS HERBS | Poaceae | Exotic |
| Dactylis glomerata L. | cocksfoot | MONOCOTYLEDONOUS HERBS | Poaceae | Exotic |
| Holcus lanatus L. | Yorkshire fog | MONOCOTYLEDONOUS HERBS | Poaceae | Exotic |

| | | | | |
|---|---|---|---|---|
| Juncus articulatus L. | jointed rush | MONOCOTYLEDONOUS HERBS | Juncaceae | Exotic |
| Juncus edgariae L.A.S.Johnson & K.L.Wilson | Wiwi, Edgars rush | MONOCOTYLEDONOUS HERBS | Juncaceae | Not Threatened |
| Juncus effusus L. var. effusus | leafless rush | MONOCOTYLEDONOUS HERBS | Juncaceae | Exotic |
| Juncus effusus var. compactus | | MONOCOTYLEDONOUS HERBS | Juncaceae | Exotic |
| Juncus pallidus R.Br. | giant rush, leafless rush | MONOCOTYLEDONOUS HERBS | Juncaceae | Not Threatened |
| Lachnagrostis filiformis (G.Forst.) Trin. | New Zealand wind grass | MONOCOTYLEDONOUS HERBS | Poaceae | Not Threatened |
| Lolium perenne L. | perennial rye grass | MONOCOTYLEDONOUS HERBS | Poaceae | Exotic |
| Phalaris arundinacea L. | reed canary grass | MONOCOTYLEDONOUS HERBS | Poaceae | Exotic |
| Poa annua L. | annual poa | MONOCOTYLEDONOUS HERBS | Poaceae | Exotic |

**Appendix 3. Site photographs**

*Figure 23. View across offset wetland in EEA, May 2020. Foreground of* Alopecurus*, midground dominated by* Glyceria *and* Juncus articulatus

*Figure 24. View along wetland margin showing zonation from taller grass of margin slopes to turf and central wetter zone on right.*

*Figure 25. View of vegetation dominated by* Glyceria *and* Juncus articulatus *in wetter central area.*