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Alliance Ecology™

Assessment of Ecological Effects: Terrestrial Ecology

BENDIGO-OPHIR GOLD PROJECT

Prepared for Matakanui Gold Limited

alliance ecology.co.nz

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Glossary of terms

Acronyms and abbreviations

Abbreviation	Term	Description
ARA	Ardgour Restoration Area	An approximately 1,263 hectare area at Ardgour station, north-east of the DDF, which has been managed for grazing for almost a decade. The area will be subject to ecological enhancement in accordance with the Ardgour Restoration Area Management Plan.
ARP	Applied Research Plan for Conservation Management, Rehabilitation and Expansion of Cushionfield	Applied Research Programme (ARP) for conservation management, rehabilitation and expansion of cushionfield. Maanaki Whenua-Landcare Research. The ARP is to improve understanding of cushionfield and spring annual distribution and effects management.
BOGP	Bendigo-Ophir Gold Project	Is the topic of this resource consent application and covers approximately 610 ha.
BOAM	Biodiversity offset accounting model	A quantitative model used evaluate biodiversity offsetting proposals in New Zealand, applied in accordance with the User Guide (Maseyk et al 2016).
CIT	Come-in-Time	23.26 ha of land with gold resource containing a Mineral Resource Estimation (MRE) (2021) of 59,000oz of gold at a grade of 1.5g/t
CODC	Central Otago District Council	
CODP	Central Otago District Plan	
DDF	Direct Disturbance Footprint	610 ha area of land within the ESA covering BOGP gold mining and ancillary activity areas that cause direct habitat loss through vegetation clearance and/or earthworks. Includes Ardgour Rise (Thomson Gorge Road realignment) and the construction zone for proposed predator proof fences. The DDF is the total maximum potential disturbance. Buffers vary from 0-10 m in width for different component parts. For the purposes of the Terrestrial Invertebrate Survey and Mammalian Pest Report (Habitat NZ, 2025), an additional buffer was described.

Abbreviation	Term	Description
		The DDF includes the 23.26 ha Come-In-Time open pit, where open-casting mining will proceed in accordance with outcomes demonstrated in the ARP, with the exception of a 2.7 ha early-disturbance area required for enabling works.
DDZ	Potential Dewatering Drawdown Zone	Approximately 142 ha zone with potential to dewater because of indirect influence from the DDF.
DOC	Department of Conservation	
EcIAG	Ecological Impact Assessment Guidelines	The Ecological Impact Assessment Guidelines prepared by the Environment Institute of Australia and New Zealand (Roper-Lindsay et al, 2018)
ED	Ecological District	A local part of New Zealand where the topographical, geological, climatic, soil and biological features, including the broad cultural pattern, produce a characteristic landscape and range of biological communities
EIANZ	Environment Institute of Australia and New Zealand	
ELF	Engineered Landform	Overburden rock stack where rock is placed, engineered to achieve geochemical outcome.
EPA	Environmental Protection Authority	
ESA	Ecological Study Area	5386 ha area of land composed of a mix of grazing lands, leasehold Crown land, and Crown land. It is divided into DDF, DDZ and SL areas.
LMU	Landscape Management Unit	Defined area within the ESA used to guide and implement rehabilitation and habitat restoration. LMUs group together modified landforms (disturbed areas) with shared characteristics and include mine regeneration zones (undisturbed areas). This framework enables a systematic, site-specific approach to rehabilitation planning and ecological management.

Abbreviation	Term	Description
MEP	Minerals Exploration Permit	MEP60311 is named Bendigo Ophir to indicate the exploration permit extends from the historic town of Bendigo to Ophir, with an area of 251 km^2(25,162 ha).
MGL	Matakanui Gold Ltd	New Zealand company wholly owned subsidiary of Santana Minerals Ltd
MRE	Mineral Resource Estimation	Evaluation estimating the grade and tonnage of an ore in a deposit.
MRZ	Mine Regeneration Zones	Defined areas adjacent to the DDF in the north, south and east, which will be ecologically enhanced as part of the offsets/compensation package. These enrichment zones also contribute to mitigation by improving ecological connectivity, reducing edge and general disturbance effects, and facilitating rehabilitation via the provision of propagules and fauna.
NPSIB	National Policy Statement for Indigenous Biodiversity 2023	
NPSFM	National Policy Statement for Freshwater Management 2020	
NZTCS	New Zealand Threat Classification System	System used within New Zealand to assess the conservation status of species
ORC	Otago Regional Council	
RAS	Rise and Shine	Area of land with gold resource containing a MRE (2024) of 2,217,000oz of gold at a grade of 2.3g/t
RMA	Resource Management Act 1991	
RM sites	Representative monitoring sites for invertebrates	Invertebrate monitoring sites selected using a stratified random approach.

Abbreviation	Term	Description
SL	Surrounding Landscape	Area within the ESA that is separate from the DDF and DDZ. For the purposes of the terrestrial invertebrate survey, also included a 39 ha satellite site (T6) to the southwest of the ESA.
SLSW	Surrounding Landscape Surveyed for Wetlands	Area within the ESA that is separate from the DDF and DDZ and was surveyed for wetlands. It provides wider and assessed ecological context. The SLSW is a subset of the SL.
SRX	Srex	Area of land with gold resource containing a MRE (2021) of 174,000oz of gold at a grade of 1.1g/t.
SRE	Srex East	Area of land with gold resource containing a MRE (2021) of 11,000oz of gold at a grade of 1.3g/t.
TEC	Threatened Environment Classification	
TM sites	Targeted monitoring sites for invertebrates	Sites where high invertebrate species richness/ diversity was considered likely, based on the qualities of the habitat.
TSF	Tailings Storage Facility	Engineered structures designed and constructed to hold mineral waste (tailings) generated after the gold has been recovered at the processing plant.
WELF	Western Engineered Landform	Permanent engineered landform in an unnamed creek west of RAS pit.
WSA	Wetland Survey Area	The area of the ESA surveyed for wetlands, comprising the DDF, DDZ, and the SLSW

Glossary of technical terms

Term	Description
Applied Research Plan	Applied Research Plan for conservation management, rehabilitation and expansion of cushionfield
Ardgour Sanctuary	An area of Ardgour Station, northeast of the DDF, in which 38 ha of pest exclusion fencing is proposed
Ardgour Rise	An approximately 8 km realignment of part of Thomson Gorge Road, via Ardgour Station, planned to provide public access through to the Manuherikia Valley
Ardgour Terrace Wetland	An approximately 0.4 ha wetland proposed to be created (via salvaged vegetated sods and rehabilitation planting) adjacent to Shepherds creek, in year 1 following mine commencement.
Bendigo Sanctuary	An area of Bendigo Station, west of the DDF, in which 29 ha of pest exclusion fencing is proposed.
Biodiversity uplift	The expected increase in biodiversity value arising from proposed habitat restoration and enhancement measures
Contingency zones	Areas within the DDF that may or may not be stripped for mining, as described in the Landscape and Ecological Rehabilitation Management Plan.
Enrichment planting	Select planting into existing habitats within Mine Regeneration Zones and at offset and compensation sites
Inoculation planting	Rehabilitation planting within the DDF, targeted in areas where survival is likely to be highest e.g., rock stacks/rubble pits,
Irreplaceability	A measure of the uniqueness, replaceability and conservation value of biodiversity and the degree to which the biodiversity value of a given area adds to the value of an overall network of areas. It interacts with vulnerability, complexity and rarity to indicate the

Term	Description
	biodiversity value and level of risk for a given area.
Like-for-like	The degree of similarity in biodiversity values between impact and offset sites across; the type of biodiversity; amount of biodiversity; biodiversity condition; equivalence over time; and spatial context. Biodiversity offsets are designed to ensure biodiversity impacts are offset with biodiversity that is very similar to the biodiversity that is being impacted in that it has the same ecosystems, vegetation, habitats and species.
Lower Shepherds Wetland	A wetland of at least 0.4 ha to be created (via salvaged vegetated sods and rehabilitation planting) in Shepherds Creek within the gorge. It will be established in year 1 following mine commencement.
Net gain	Demonstrated by a like-for-like quantitative loss/gain calculation of the following, and is achieved when the indigenous biodiversity values at the offset site are equivalent to or exceed those being lost at the impact site: (a) types of indigenous biodiversity, including when indigenous species depend on introduced species for their persistence; and (b) amount; and (c) condition (structure and quality).
Net loss	The extent or values gained at the offset or compensation site (measured by type, amount and condition) are less than those being lost at the impact site.
Net positive	Biodiversity benefits gained at the compensation site for an ecological value are expected be greater than those being lost at the impact site.
Pit lakes	Pit lakes will form at the base of the Rise and Shine Pit (14ha) and part of the SRX Pit (4.9 ha).
Sequence	The change in ecosystem composition along environmental gradients. Sequences can contain many gradients and ecosystem

Term	Description
	transitions. They can encompass a full range of alpine to coastal ecosystems, including dunes, wetlands and forests.
Spring annual	A spring annual plant is a plant that completes its entire life cycle in a single growing season, which starts in the spring. These plants germinate from seed, grow, flower, produce new seeds, and then die
TSF wetland	At least 6 ha of wetlands to be created through rehabilitation of the Tailings Storage Facility, including 0.5 ha of open water
Vulnerability	An estimate of the degree of threat of destruction or degradation that indigenous biodiversity faces from change, use or development. It is the degree to which an ecosystem, habitat or species is likely to be affected by, is susceptible to or able to adapt to harmful impacts or changes. It interacts with the irreplaceability, complexity and rarity to indicate the biodiversity value and level of risk for a given area.
Western ELF (WELF)	A permanent engineered landform in an unnamed valley west of RAS pit

Executive summary

Matakanui Gold Limited ("**MGL**") is proposing to establish the Bendigo-Ophir Gold Project ("**BOGP**") in Central Otago. Alliance Ecology has been engaged to provide an assessment of ecological effects to inform the application under the Fast Track Approvals Act 2024 ("**FTAA**").

The BOGP comprises a new gold mine, ancillary facilities and environmental mitigation measures on Bendigo and Ardgour Stations in the Dunstan Mountains of Central Otago. The project site is located approximately 20km north of Cromwell and will have a maximum disturbance footprint of approximately 610 hectares[1].

This report provides an ecological effects assessment on terrestrial and wetland values to support applications for approvals[2] (including resource consent applications) under the FTAA. This assessment of ecological effects includes:

- A description of ecological characteristics and values of the current environment, comprising the Direct Disturbance Footprint ("**DDF**"), Potential Dewatering Drawdown Zone ("**DDZ**") and the Surrounding Landscape ("**SL**"), collectively the 5,386 ha 'Ecological Study Area' ("**ESA**"), based on desktop review and field surveys.
- An assessment of ecological significance against the Otago Regional Policy Statement (Operative and Proposed).
- An assessment of potential ecological effects on those ecological values affected by the proposed mining activities after effects avoidance, minimisation/mitigation and remediation have been taken into account.
- Proposed measures to manage residual adverse effects through offsetting or compensation.
- An assessment of the adequacy of proposed residual effects management measures against the offsetting and compensation principles of the National Policy Statement for Indigenous Biodiversity ("**NPSIB**") and the National Policy Statement for Freshwater Management ("**NPSFM**"), for subsequent use in the application of the FTAA statutory weighting exercise.

The assessment of effects has been undertaken in accordance with the Environment Institute of Australia and New Zealand's Ecological Impact Assessment Guidelines ("**EcIAG**"). It is based on desktop review and comprehensive field investigations of the ecological values within the ESA undertaken over a 20-month period between October 2023 and May 2025. These investigations are detailed in technical reports by RMA Ecology (vegetation, wetlands, birds, and herpetofauna) and Habitat NZ (terrestrial invertebrates, bats, and pest management).

[1] The Direct Disturbance Footprint of approximately 610 ha includes the 23.26 ha Come-In-Time open pit, where —with the exception of a 2.7ha early disturbance area required for enabling works —open-casting mining will proceed only in accordance with outcomes of the ARP as detailed in proposed conditions of consent.
[2] In accordance with the Letter of Engagement between Matakanui Gold and Alliance Ecology Ltd dated 27 March, 2023 and the terms and conditions therein.

Ecological values

The ESA has been heavily altered by the clearance of almost all original native woody vegetation, historic mining, stock browsing, oversowing with non-native pasture grasses, topdressing with fertilisers, repeated burning, and the impacts of invasive plants and animals.

Seven broad terrestrial vegetation communities have been identified—ranging in ecological value from low to very high—along with natural inland wetlands. These communities form an intergrading mosaic shaped by environmental conditions and management practices. Although the landscape is predominantly in exotic vegetation cover[3], native grey scrub, kānuka, tussock, taramea, and *Raoulia* (cushionfield) species are characteristic features. The vegetation communities include:

- Exotic pasture or herbfield: (low value)
- Mixed depleted herbfield (cushionfield) and grassland: (very high value)
- Mixed tussock shrubland and exotic grassland: (moderate value)
- Mixed scrubland: (moderate value)
- Native dominant tussockland: (high value)
- Native taramea herbfield and shrubland: (high value)
- Native dominant scrubland: (very high value)
- Wetlands (including moderate value seepages and fens and high value swamps/marshes).

Overall, these terrestrial and wetland habitats support a diverse assemblage of native flora and fauna species. Many of these species are nationally or regionally 'Threatened' or 'At Risk', including:

- At least 58 vascular plant species, of which at least 48 occur within the DDF.
- At least 10 bird species, including the nationally Threatened New Zealand falcon (eastern), the At Risk New Zealand pipit, various At Risk braided river bird species that may occasionally use cultivated fields or artificial ponds within the DDF, and regionally At Risk species. The nationally At Risk fernbird is also potentially present within the ESA[4] but was not detected.
- Two nationally At Risk lizard species: Kawarau gecko and tussock skink, both present in the DDF.

[3] Exotic vegetation cover for the seven terrestrial vegetation communities in the ESA ranges from 52 to 91 percent as described in the Vegetation Assessment Report (RMA Ecology, 2025a)
[4] Based on a single desktop record

- 18 notable species of invertebrate, including 14 nationally Threatened, At Risk or data deficient species. These include 4 nationally Threatened moth species, and an additional 4 newly identified species[5] also detected.

Distinctive vegetation features also occur within these communities and contribute to ecological value, including relict kōwhai, and rock tors that support distinct vegetation communities and provide high quality habitat for a diversity of indigenous flora and fauna.

All vegetation communities within the ESA and the wider landscape satisfy criteria for recognition as significant indigenous vegetation or significant habitats of indigenous fauna under the NPSIB and the operative and proposed Otago Regional Policy Statements. This is due in part to their provision of habitat for multiple Threatened or At Risk flora and fauna species across most of the site, with several of these species also present in low value habitat such as exotic pasture.

Nevertheless, with the exception of woody vegetation cover, indigenous biodiversity within the landscape is generally in decline due to ongoing habitat loss and degradation through stock browsing, topdressing and aerial oversowing with non-native pasture species, spread of competing non-native plants (including weeds), invasive browsers and grazers (especially rabbits and deer), and predation by introduced mammals. Without intervention, most native species will continue to decline, and several Threatened or At Risk species are likely to become locally extinct over time. A notable exception is the cushionfield ecosystem (which contains threatened plants and invertebrates) and is likely being maintained in areas of the DDF where browsing pressure and the absence of pasture improvement actions have enabled some cushionfield-associated species to persist at relatively high abundances. In addition, the spread of woody mixed exotic-native shrubland across the site and surrounds is evident from aerial photographic analysis and shows that some native plant species are increasing in distribution and abundance (probably to the detriment of others).

Potential effects on ecological values

Potential direct effects of the BOGP include the direct loss of habitat and the associated loss of flora and fauna due to mine construction. Potential indirect effects include fragmentation of habitat and reduced ecological connectivity, loss of altitudinal sequences; and wetland dewatering and degradation resulting from surface water diversion, groundwater drawdown within the DDZ[6], and reduced water quality.

Measures to avoid or minimise/mitigate effects

Key measures proposed to avoid, minimise or mitigate adverse effects include:

[5] Definitive new species classifications would be required for one of these species, while the others would qualify for a Data Deficient, and potentially Threatened, conservation status.
[6] Assessed in the BOGP Wetland Drawdown Assessment (Hydro Geochem Group Limited 2025).

- Realigning Thomson Gorge Road to bypass the Ardgour airstrip, avoiding identified habitat for the Threatened (Nationally Critical) moth *Sporophyla oenospora*.
- Delaying mining of the 23.26 ha CIT Open Pit to markedly reduce effects on *Ceratocephala pungens* (Nationally Critical) and to a lesser degree *Myosotis brevis* (Nationally Vulnerable) which are found at high densities in this location. Except for a 2.7 ha early disturbance area required for enabling works, mining within the CIT Open Pit is proposed to proceed only if populations of these Threatened spring annuals within the CIT Open Pit footprint are less than 1% of the known populations within the Dunstan Ecological District ("**ED**"), demonstrated via either:
  - propagation and species recovery at offset/compensation sites, as informed by the Applied Research Plan for Conservation Management, Rehabilitation and Expansion of Cushionfield ("**ARP**"); or
  - The discovery of further spring annual populations within the wider Dunstan ED.
- Positioning spoil sites and certain infrastructure away from 'mixed depleted herbfield (cushionfield) and grassland' and other high-value habitats where possible.
- Refining stockpile and infrastructure locations to reduce impacts on key ecological features, including kōwhai trees, taramea, and rock outcrops, and to avoid adverse effects on Rise and Shine creek wetlands to the extent possible.
- Design of slopes to minimise infrastructure footprints, including the use of retaining (rather than side-casting) for the approximately 8 km access road; narrowing haul road design to reduce cut faces, and refining pit walls to minimise footprints, e.g. the Rise and Shine (RAS) Open Pit eastern wall.
- Avoiding habitat clearance near nesting birds until chicks have fledged.
- Salvaging and relocating notable plants, invertebrates, lizards, and habitat features (e.g. wood, weathered rock) where possible, with many habitat features stored in stockpiles for later use in rehabilitation. Additionally, a research and captive breeding study for the moth *Sporophyla oenospora,* if detected in pre-salvage surveys*,* is a requirement of the Terrestrial Invertebrate Management Plan.

Ecological management plans—including the Habitat Impact Management Plan coupled with the Avifauna, Lizard and Invertebrate Management Plans, the Landscape and Ecological Rehabilitation Plan and ARP —will guide the implementation of these measures.

Measures to remedy adverse effects that cannot be avoided or minimised/mitigated

After measures to avoid or minimise adverse effects, the BOGP is expected to result in the direct loss and associated effects on 607 ha[7] of terrestrial habitat that includes:

- 79.3 ha of low value exotic pasture and herbfield

[7] Our assessment is based on the full mine design, including mining of the 23.26 ha CIT open pit, where – except for an early disturbance area of 2.7 ha required for enabling works, open-cast mining will proceed only in accordance with outcomes of the ARP as detailed in proposed conditions of consent.

- 103.8 ha of very high value mixed depleted herbfield (cushionfield) and grassland
- 187.4 ha of moderate value mixed tussock shrubland and exotic grassland
- 124.1 ha of moderate value mixed scrubland
- 25.3 ha of high value native dominant tussockland
- 1.86 ha of high value native taramea herbfield and shrubland
- 85.6 ha of very high value native dominated scrubland.
- Loss of individuals of various Threatened plant species, some of which have Very High ecological value.

Additionally, direct impacts on wetlands within the DDF, and indirect drawdown effects on wetlands within the DDZ, will result in the loss of:

- 2.42 ha of high value swamp/marsh wetlands
- 0.19 ha of moderate value seepage wetlands
- 0.84 ha of moderate value gully fen wetlands

Ecological rehabilitation will be implemented across all available areas within the DDF (approximately 480 ha), excluding the majority of the two permanent pit lakes[8] the pit walls, permanent infrastructure (roads and water treatment facilities), and the Ardgour Terraces which will be subject to agricultural (pasture) rehabilitation. Ecological rehabilitation will include:

- Re-establishing four indigenous terrestrial vegetation communities, including native scrubland (230 ha); native tussockland (222 ha); taramea herbfield and shrubland (2 ha); and up to 19 ha of cushionfields though outcomes are uncertain for this habitat type.
- Re-establishing indigenous wetland communities totalling 7.5 ha, comprising at least 2 ha of swamp wetlands (including 0.5 ha of open water) and 4 ha of marshlands on the TSF, along with three smaller areas of marsh/swamp wetland (of at least 0.4 ha each: Ardgour Terrace, Lower Shepherds and Processing Plant.
- Deploying rocky outcrop/scattered rock complexes (at least 1 per ha, totalling ≥1 ha), recreating rock rubble pits (at least 1 per 5 ha, totalling ≥0.5 ha) and including at least 5% rock cover in ecological rehabilitation areas across the DDF Collectively these rock features will provide high-value habitat for lizards and select Threatened or At Risk invertebrates, and a favourable environment for establishing plants.
- Establishment of Threatened or At Risk plant species
- Establishment of reproductively viable kōwhai clusters

In addition to the ecological rehabilitation within the DDF, ecological enhancement of habitats within 889 ha of Mine Regeneration Zones ("**MRZs**") adjacent to the DDF will

[8] The RAS and SRX pit lakes will be deep and steep-sided with minimal marginal vegetation and rock-influenced water chemistry

facilitate ecological rehabilitation of the DDF by providing source populations of fauna and a species-diverse, continuous native seed/propagule source[9] including for nationally Threatened or At Risk plant species.

The Landscape and Ecological Rehabilitation Management Plan for the DDF and surrounding MRZs will guide the implementation of these measures.

Residual adverse effects

Residual effects on terrestrial and wetland ecological values within the BOGP range from no residual effects to Very High residual effects, following implementation of avoidance, minimisation/mitigation, and remediation measures.

Where residual adverse effects are assessed as moderate or greater, efforts to offset or compensate for these effects have been undertaken to the extent practicable (**Table 1**). These measures are also expected to provide benefits to many values in the wider ESA that are not impacted, as well as to those within the DDF where residual adverse effects are assessed as 'low' or lower.

Proposed biodiversity offsets/compensation

The overarching objective and intended biodiversity outcome for addressing residual effects is to achieve, where possible, demonstrable benefits to indigenous terrestrial and wetland biodiversity that outweigh impacts within 35 years of granting of approvals.

These benefits are assessed from a starting point of, and relative to, the current pre-BOGP mining condition.

Biodiversity offsetting is proposed to address residual adverse effects on ecological values where Net Gain outcomes can be demonstrated through offset modelling. For ecological values where no contemporary like-for-like replacement or enhancement is available, biodiversity compensation is proposed.

Proposed offset and compensation measures include ecological restoration and habitat enhancement across 2,219 ha of habitat within the ESA, in the landscape surrounding the mine footprint. These measures aim to reverse the ongoing decline of native habitat in the surrounding landscape, supporting a large-scale transition from exotic-dominated to native-dominated ecosystems. In doing so, they will deliver additional benefits beyond directly addressing residual adverse effects of the BOGP.

Restoration efforts will prioritise the reinstatement of species that are rare, under-represented, or locally extirpated, as well as resilient native species capable of persisting under harsh and variable conditions. Long-term biodiversity outcomes will be supported by a combination of extensive weed and animal pest control, animal pest exclusion, habitat enhancement, and browsing pressure management, tailored to the specific

[9] Mine Regeneration Zones will supply a source of seeds and other propagules

requirements of each area. This proposed restoration and enhancement programme surrounding the DDF includes:

- The 889 ha MRZ adjacent to the DDF, through native enrichment planting, livestock management, mammalian pest control, and ecological weed control (the MRZ also serves to facilitate ecological rehabilitation within the DDF).
- The 1263 ha proposed Ardgour Restoration Area **("ARA")** adjacent to the DDF. Ecological uplift will occur via native enrichment planting, livestock management, mammalian pest control, weed control and habitat enhancement within select Ecological Management Units ("**EMUs**") at Ardgour Station currently used for grazing.
- Approximately 67 ha of proposed predator-exclusion fenced areas: the 38 ha Ardgour Sanctuary and the 29 ha Bendigo Sanctuary. Within these areas, measures include construction of predator-exclusion fences, eradication of mammalian predators, browser management, ecological weed control, deployment of salvaged rock habitat, native revegetation and enrichment planting, and translocation of locally extirpated (extinct) Threatened or At Risk species.

Ecological management plans—including the Landscape and Ecology Rehabilitation Management Plan (in relation to the MRZs), the ARA Management Plan, and the Matakanui Sanctuary Management Plan—will guide the implementation of these measures. These management plans will be accompanied by clear, enforceable and measurable conditions of approvals.

Additionally, a $5 million biodiversity and heritage enhancement fund [10] is proposed to support the protection and enhancement of cushionfield habitat or other threatened species and ecosystems within the Dunstan ED and historic values beyond BOGP within Central Otago. While this is expected to provide biodiversity benefits, the type, quantum, location and timing of benefits is not certain and on this basis this fund is not considered to be part of the residual effects management package. Providing such a fund does, however, demonstrate the commitment of the Applicant to providing positive outcomes that extend beyond like-for-like offsetting and similar ecological compensation in the hope that a decision maker may consider these beneficial in a weighing exercise of overall losses and overall gains to the ecological values subject to the project.

Assessment against offsetting and compensation principles

The proposed residual effects management package has been designed in accordance with good practice and, where possible, to align with the biodiversity offsetting and compensation principles in the NPSIB and NPSFM.

As relevant to the subsequent weighting exercise under the FTAA, proposed offsetting and compensation as described above is generally consistent with the suite of offsetting and compensation principles set out in the NPSIB[11] and NPSFM[12]. However, certain principles —

[10] To be paid to the Department of Conservation in annual instalments, as proposed as a condition of consent.
[11] In accordance with NPSIB Appendices 3 and 4, principle 2
[12] 'In accordance with NPSFM Appendices 6 and 7, principle 2

notably the 'limits to offset/compensation' and 'leakage' principles—are unlikely to be satisfied for a relatively small number of species and habitat types, based on current information.

Specifically, the limits to offsetting/compensation principles contained in National Policy Statements are unlikely to be met for a limited number of ecological values due to[13]:

a) their irreplaceability[14] or vulnerability[15]

b) the significance of adverse effects

c) the technical infeasibility of demonstrating that adequate ecological gains will be achieved.

The affected ecological values include:

- Cushionfield habitat
- The nationally Threatened (nationally vulnerable) spring annual *Myosotis brevis*
- The newly identified ground beetle *Harpalus* sp.

Additionally, the principle is potentially not met based on current information for the newly identified weevil *Inophloeus sp* and the nationally Threatened (nationally critical) spring annual *Ceratocephala pungens*.

The deferral of mining the CIT Open Pit will allow further research to address technical feasibility and may provide sufficient certainty that ecological gains can be achieved for cushionfields and *M. brevis*, in which case the limits to offsetting/compensation principles may be met for these ecological values.

However, for *C. pungens*, this cannot be established. The enabling works within the 2.7 ha early-disturbance area of the CIT Open Pit are proposed to proceed irrespective of this deferral. While current understanding suggests that *C. pungens* populations within this 2.7 ha area are relatively low compared to elsewhere in the CIT, there remains insufficient information at present to provide confidence in this assessment[16].

While the ARP is proposed in the hope of addressing some of the above impacts on cushionfields and spring annuals in the future – and for providing the justification to impact more of these areas in the CIT Open Pit footprint – the uncertainty over finding solutions from this research means that sought-after benefits cannot be relied upon for avoiding, minimising, rehabilitating, offsetting or compensating impacts that are proposed.

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[13] NPSIB Appendices 3 and 4, principle 2, present examples of when biodiversity offsetting/compensation may not be appropriate.
[14] Irreplaceability is defined in the NPSIB as "*a measure of the uniqueness, replaceability and conservation value of biodiversity and the degree to which the biodiversity value of a given area adds to the value of an overall network of areas. It interacts with vulnerability, complexity and rarity to indicate the biodiversity value and level of risk for a given area*".
[15] Vulnerability is defined in the NPSIB as "*an estimate of the degree of threat of destruction or degradation that indigenous biodiversity faces from change, use or development. It is the degree to which an ecosystem, habitat or species is likely to be affected by, is susceptible to or able to adapt to harmful impacts or changes. It interacts with the irreplaceability, complexity and rarity to indicate the biodiversity value and level of risk for a given area*".
[16] The 2.7 ha early-disturbance area of the CIT Open pit was proposed by MGL after completion of 2024 spring annual surveys but before completion of 2025 spring surveys'

The unavoided loss of irreplaceable and vulnerable species or communities will be permanent and either cannot be replaced or balanced by the suite of beneficial actions. Under good ecological practice, such values should not be impacted. For those ecology values, the project will result in significant residual adverse effects that cannot be addressed.

The leakage principle[17] is not met for certain habitats and species (for instance native tussockland and *Carex talboti*), since restoration and enhancement will inevitably benefit some higher priority ecological values at the expense of others. Additionally, while the scale of proposed compensation is considered appropriate such that biodiversity benefits are expected to outweigh effects overall, Net Loss is expected or conservatively assigned for certain ecological values, as described further below.

Biodiversity outcomes

The broader objective of restoring woody native vegetation cover will inevitably prioritise certain species over others, with emphasis on reinstating those that are rare, under-represented, locally extirpated, or resilient to harsh and variable conditions. Biodiversity outcomes should also be considered in the context of wider benefits associated with the restoration and enhancement of:

- Ecological connectivity across a broad area of the northern faces of the Dunstan Mountains. This is achieved by linking existing public conservation land at Bendigo Scenic Reserve and Bendigo Historic Reserve to the west, with Bendigo Conservation Area and Ardgour Conservation Area to the south, and Neinei i kura Conservation Area and Dry Creek Conservation Areas to the north-east.
- Altitudinal sequences across a large scale, which build both climate resilience and cater for life stages of species that shift on the landscape.
- Rare or locally extirpated species.

As set out in the Biodiversity Outcome Monitoring Plan, comprehensive biodiversity outcome monitoring is proposed to verify that stated outcomes are achieved and to inform adaptive management or contingency actions as needed.

Following the implementation of proposed offset/compensation measures, biodiversity outcomes for values impacted by the BOGP are expected to range from Net Loss to Net Gain within 35 years from the granting of approvals, depending on the specific ecological value.

In broad terms, the proposed biodiversity offset/compensation package is expected to kick-start a large-scale transition from exotic-dominated to native-dominated ecosystems, reversing the ongoing decline of key native habitats and many associated species outside the DDF, while maintaining cushionfield ecosystems beyond the mine footprint.

[17] NPSIB Appendices 3 and 4, principle 5 and NPSFM Appendices 6 and 7, principle 5.

As a result, Net Gain or Net Positive outcomes are anticipated for all 'very high' or 'high' value ecosystems except cushionfields; specifically:

- Native-dominated scrubland
- Native tussockland
- Native taramea herbfield and shrubland
- Swamp and marsh wetlands.

Net gain or net positive outcomes are also expected for a range of threatened or otherwise ecologically important species that are associated with these habitat types. These include species targeted for reinstatement that are rare, under-represented, or locally extirpated (locally extinct). Examples include:

- Plants such as *Carmichaelia crassicaulis crassicaulis*, *Coprosma virescens*, *Olearia lineata*, and *O. odorata*.
- Threatened or At Risk lizards[18] not impacted by mining activity such as the nationally and regionally Threatened-endangered Otago skink and grand skink, and the At Risk jewelled gecko (subject to translocation approvals).

Although significant restoration efforts are proposed for cushionfield habitat and associated species, these outcomes have conservatively been assigned as Net Loss, as their success depends on research that has yet to be completed. In practice, the **ARP** is expected to strengthen and inform biodiversity outcomes for the proposed offset and compensation measures; however, effectiveness will not be known until after some impacts have commenced.

a) The biodiversity outcomes expected within 35 years of the granting of approvals are set out in Table 1 below, including outcomes for: Threatened, At Risk or otherwise notable biodiversity values impacted by the BOGP, with species grouped according to whether residual adverse effects are assessed as moderate or higher, or low, very low or 'positive'.

b) Biodiversity values not directly impacted by the project but expected to benefit from the proposed offset/compensation package.

Expected outcomes are assigned as follows:

- Net Gain: biodiversity offsetting can be demonstrated.
- Net Positive: biodiversity compensation is expected to deliver a positive outcome for the ecological value[19].
- Uncertain: the success of an action cannot be predicted with sufficient confidence to assign as Net Positive or Net loss.

[18] Jarvie et al 2025b.
[19] This expectation is based on professional judgement, rather than the application of a biodiversity offset accounting model, due to challenges in in obtaining or interpreting quantitative data or measurable responses to habitat restoration or enhancement measures

- Net Loss: where, based on current information, a negative outcome is assumed. In such cases—despite proposed restoration or enhancement measures—the benefits cannot be demonstrated (without further research) to adequately address the residual adverse effects. This applies particularly to cushionfield habitat and some associated species.

Table 1: Expected biodiversity outcomes within 35 years for vegetation/habitats and Threatened, At Risk or otherwise notable species

Ecological value	Level of residual effect	Expected outcome following offset/ compensation actions
Vegetation/habitat type		
Exotic pasture or herbfield	Low	Net gain for native elements
Mixed depleted herbfield (cushionfield) and grassland	Very high	Net loss
Mixed tussock shrubland and exotic grassland	Moderate	Net gain for native elements
Mixed scrubland	Moderate	Net gain for native elements
Native-dominant tussockland	High	Net loss in extent and net gain in condition
Native taramea herbfield and shrubland	Moderate	Net gain in extent and condition
Native-dominant scrubland	Very High	Net gain in extent and condition
Seepage wetlands within DDF and DDZ	Moderate	Net loss
Gully fens within DDF and DDZ	Moderate	Net loss
Swamp/marsh wetlands in DDF	Positive	Net gain in extent and condition
Alluvial podocarp forest	Not impacted or currently present	Net gain in extent and condition

Species	National threat status	Regional threat status	Level of residual effect	Expected outcome following offset/ compensation actions
Species for which level of residual effect is assessed as Moderate or higher				
Plant species				
Tiny forget-me-not - *Myosotis brevis*	Threatened – Nationally Vulnerable	Threatened - Regionally Endangered	Very high	Net loss
Carex talboti	At Risk – Declining	Threatened - Vulnerable	Very high	Net loss

Species	National threat status	Regional threat status	Level of residual effect	Expected outcome following offset/ compensation actions
Colobanthus brevisepalus	At Risk – Declining	Threatened - Vulnerable	Very high	Net loss
Raoulia beauverdii	At Risk – Declining	Threatened - Vulnerable	Very high	Net loss
Hypericum involutum	At Risk – Declining	Data deficient	Very high	Net loss
Desert poa - *Poa maniototo*	At Risk – Declining	At Risk - declining	Very high	Net loss
Ceratocephala pungens	Threatened – Nationally Critical	Threatened – Regionally Critical	Potentially Very High[20]	Net loss
Lagenophora barkeri	At Risk – Declining	Threatened - Regionally Endangered	High	Net loss
NZ Mousetail - *Myosurus minimus n-z*	At Risk – Declining	Threatened - Endangered	High	Net loss
Celadon mat daisy - *Raoulia parkii*	At Risk – Declining	Threatened - Vulnerable	High	Net loss
Rytidosperma maculatum	At Risk – Declining	Threatened - Vulnerable	High	Net loss
Common scabweed - *Raoulia australis*	At Risk – Declining	At Risk - declining	High	Net loss
Rytidosperma buchananii	At Risk – Declining	At Risk - declining	High	Net loss
Colobanthus strictus	Not Threatened	At Risk - declining	High	Net loss
Pincushion grass - *Agrostis muscosa*	Not Threatened	At Risk - declining	High	Net loss
Poa lindsayi	Not Threatened	At Risk - declining	High	Net loss
Bladder Fern - *Cystopteris tasmanica*	Not Threatened	At Risk - Naturally Uncommon	Moderate	Net loss
Luzula leptophylla	At Risk – Naturally Uncommon	At Risk - Naturally Uncommon	Moderate	Net loss
Myosotis antarctica subsp. antarctica	At Risk – Naturally Uncommon	At Risk - Naturally Uncommon	Moderate	Net loss

[20]The term 'potentially' reflects impacts associated with the 2.7 ha early disturbance area within the CIT footprint required for enabling works, for which impacts are currently uncertain.

Species	National threat status	Regional threat status	Level of residual effect	Expected outcome following offset/ compensation actions
Hot rock fern - *Pellaea calidirupium*	At Risk – Naturally Uncommon	At Risk - Naturally Uncommon	Moderate	Net loss
Myriophyllum pedunculatum ss novae-zelandiae	Not Threatened	At Risk - Naturally Uncommon	Moderate	Net loss
Rock fern - *Cheilanthes sieberi sieberi*	Not Threatened	At Risk - Naturally Uncommon	Moderate	Uncertain
Bird species				
New Zealand falcon – eastern form*	Threatened, nationally vulnerable	Threatened, vulnerable	Moderate	Net positive
New Zealand pipit*	At Risk, declining	Not threatened	Moderate	Net positive
Silvereye*	Not threatened	At Risk, declining	Moderate	Net positive
Lizard species				
Tussock skink	N/A†	At Risk - declining	High	Net loss
Kawarau gecko	At Risk - declining	At Risk - declining	High	Net loss
Invertebrate species‡				
Pseudocoremia cineracia (moth)	Threatened: Nationally Vulnerable	N/A	Very high	Uncertain
Harpalus new sp. (ground beetle)	Potentially Threatened	N/A	Very high	Uncertain
Inophloeus new sp. (weevil)	Potentially Threatened	N/A	Very high	Uncertain
Phaulacridium otagoense (grasshopper)	At Risk, declining	N/A	Very high	Uncertain
Elachista helonoma (moth)	At Risk, declining	N/A	Very high	Uncertain
Ichneutica toroneura (moth)	At Risk, declining	N/A	Very high	Uncertain
Megadromus new sp. 1 (ground beetle)	Potentially Threatened	N/A	High	Uncertain
Megadromus new sp. 2 (ground beetle)	Potentially Threatened	N/A	High	Uncertain

Species	National threat status	Regional threat status	Level of residual effect	Expected outcome following offset/ compensation actions
Scythris sp. 1 (moth)	Not assessed, of importance	N/A	High	Uncertain
Sporophyla oenospora (moth)	Threatened – nationally critical	N/A	Moderate	Uncertain
Homodotis sp. A (NZAC (CO)) (moth)	Threatened – nationally endangered	N/A	Moderate	Uncertain
Pasiphila sp. 'Olearia' pug moth	Threatened: Nationally Vulnerable	N/A	Moderate	Uncertain
Species for which level of residual effects is assessed as low, very low or positive				
Plant species				
Coastal woodrush - *Luzula banksiana var. rhadina*	Data Deficient	At Risk - Naturally Uncommon	Low	Net loss
Feldmark grass - *Rytidosperma pumilum*	Not Threatened	At Risk - declining	Low	Net loss
Vittadinia australis	Not Threatened	At Risk - Naturally Uncommon	Positive	Uncertain
Kōwhai *Sophora microphylla*	Not threatened	Not threatened	Low	Net positive
Chaerophyllum ramosum	Data Deficient	Not Threatened	Low	Uncertain
Juncus distegus	Not Threatened	At Risk - declining	Positive	Net positive
Mikimiki - *Coprosma virescens*	At Risk – Declining	Threatened - Vulnerable	Positive	Net positive
Blue Wheat Grass - *Anthosachne aprica*	At Risk – Naturally Uncommon	Threatened - Vulnerable	Positive	Net positive
Olearia lineata	At Risk – Declining	At Risk - declining	Positive	Net positive
Scented tree daisy *Olearia odorata*	At Risk – Declining	At Risk - declining	Positive	Net positive
Epilobium hectorii	At Risk – Declining	At Risk - declining	Positive	Net positive
Styphelia nana	At Risk – Declining	N / A	Positive	Net positive
Pimelea aridula aridula	At Risk – Declining	Threatened - Vulnerable	Positive	Net positive

Species	National threat status	Regional threat status	Level of residual effect	Expected outcome following offset/ compensation actions
Rytidosperma corinum	Data Deficient	Not Threatened	Low	Net positive
Carex diandra	Not Threatened	At Risk - Naturally Uncommon	Positive	Net positive
Festuca mathewsii subsp. mathewsii	Not Threatened	Data deficient	Positive	Net positive
Buchanan's Sedge - *Carex buchananii*	At Risk – Declining	Threatened - Vulnerable	Positive	Net positive
Geranium potentilloides	Not Threatened	Data deficient	Positive	Net positive
Rumex flexuosus	Not Threatened	At Risk - Naturally Uncommon	Positive	Net positive
Bidibid / piripiri - *Acaena buchananii*	At Risk – Declining	Threatened - Vulnerable	Positive	Net positive
Spineless Acaena - *Acaena inermis*	Not Threatened	At Risk - declining	Positive	Net positive
Carex kaloides	At Risk – Declining	Threatened – Regionally Endangered	Positive	Net positive
Carmichaelia petrei	At Risk – Declining	At Risk - declining	Positive	Net positive
Geranium aff. microphyllum	At Risk – Naturally Uncommon	Not Threatened	Positive	Net positive
Olearia bullata	Not Threatened	At Risk - Naturally Uncommon	Positive	Net positive
Pimelea notia	Not Threatened	At Risk - Naturally Uncommon	Positive	Net positive
Pimelea prostrata subsp. prostrata	Not Threatened	Threatened, regionally vulnerable	Positive	Net positive
Bird species				
Black-fronted tern	Threatened, nationally endangered	Threatened, regionally endangered	Low	Uncertain
Black-billed gull	At Risk, declining	Threatened, regionally vulnerable	Low	Uncertain
South Island pied oystercatcher*	At Risk, declining	Threatened, regionally vulnerable	Very low	Uncertain

Species	National threat status	Regional threat status	Level of residual effect	Expected outcome following offset/ compensation actions
Tomtit	Not threatened	Not threatened (but locally uncommon)	Low	Net positive
Bellbird	Not threatened	Not threatened (but locally uncommon)	Very Low	Net positive
Black shag	At Risk, relict	Threatened, regionally endangered	Very low	Uncertain
Little shag	At Risk, relict	At Risk, relict	Very low	Uncertain
Lizard species				
McCanns skink	Not threatened	Not threatened	Low	Net loss
Invertebrate species‡				
Agrotis admirationis (moth)	At Risk, declining	N/A	Low	Uncertain
Asaphodes recta (moth)	At Risk, declining	N/A	Low	Uncertain
Nyctemera annulata (moth)	At Risk, declining	N/A	Low	Uncertain
Ichneutica sistens (moth)	Uncommon	N/A	Low	Uncertain
Meterana exquisite (moth)	Uncommon	N/A	Low	Uncertain
Paranotoreas fulva (moth)	At Risk, declining	N/A	Very low	Uncertain
Examples of species which are not impacted by the project but are expected to benefit				
Plant species				
Stout dwarf broom *Carmichaelia monroi*	At Risk – Declining	Threatened – Regionally Critical	No effect	Net gain
Coprosma brunnea	At Risk – Declining	Threatened - Regionally Endangered	No effect	Net gain
Coral broom *Carmichaelia crassicaulis crassicaulis*	Threatened – Nationally Vulnerable	Threatened – Regionally vulnerable	No effect	Net gain
Olearia cymbifolia	Not Threatened	At Risk - Naturally Uncommon	No effect	Net gain
Veronica rakaiensis	Not Threatened	At Risk - Naturally Uncommon	No effect	Net gain

Species	National threat status	Regional threat status	Level of residual effect	Expected outcome following offset/ compensation actions
Carmichaelia nana	Threatened – Nationally vulnerable	Threatened – Regionally vulnerable	No effect	Net gain
Tussock bindweed *(Convolvulus verecundus subsp. Verecundus)*	At Risk - declining	At Risk - declining	No effect	Net gain
Lizard species (subject to granting of translocation permits)				
Otago skink	Nationally Threatened – endangered	Threatened – regionally endangered	No effect	Net gain
Grand skink *Oligosoma grande*	Nationally Threatened – endangered	Threatened – regionally endangered	No effect	Net gain
Jewelled gecko *Naultinus gemmeus*	At Risk declining	At risk declining	No effect	Net gain

* Bird species detected in avifauna surveys
† Described after the NZTCS assessment for reptiles (Hitchmough et al. 2021; Jewell 2022c)
‡The threat classification for New Zealand *Lepidoptera* (moths and butterflies) is currently under review, with publication pending. Data is based on this pending classification update.

Conclusion

Substantial measures are proposed to address the ecological effects of the BOGP. Within the DDF, efforts focus on directly minimising effects on the highest value habitats and species. Additionally, rehabilitation of all 480 ha of the post-mining landform[21] is proposed, to reinstate key terrestrial vegetation communities and habitat features.

For those effects that cannot feasibly be minimised or remedied, extensive biodiversity offsetting and compensation is proposed across 2,219 ha surrounding the mine footprint. Proposed measures aim to reverse the ongoing decline of native habitat, fostering a large-scale transition from exotic-dominated to native-dominated ecosystems. Careful design ensures the measures, including extensive weed and pest control, pest exclusion, habitat enhancement, and browsing pressure management, are tailored to the specific requirements of each area.

Expected biodiversity outcomes for impacted ecological values, assessed individually, range from Net Loss to Net Gain. Notably, for certain values—including cushionfield habitat, one threatened plant species, and one terrestrial invertebrate species—residual

[21] 480 ha is the available area of the DDF to be rehabilitated

effects are unlikely to be effectively addressed in accordance with the limits to offsetting/compensation principles as set out in the NPSIB [22]. This reflects their irreplaceability or vulnerability, the magnitude of impact, and inherent uncertainty regarding demonstrable offsetting or compensation outcomes. For a further two species (one threatened plant and one invertebrate) these principles are potentially not addressed.

The unavoided loss of these irreplaceable and vulnerable species or communities will be permanent and cannot be replaced, outweighed or balanced by different, alternative, or larger actions elsewhere and remain as an effect of the project, irrespective of the considerable scope, scale, robustness and beneficial nature of the other ecology actions combined that the project will deliver.

The net result is therefore a comprehensive package of actions that will provide broad, long-lasting benefits that balance most ecological impacts.

[22] In contrast, proposed aquatic offsetting and compensation for residual effects on wetlands is considered to meet the equivalent principles of the NPSFM.

1. Introduction

This assessment of ecological effects accompanies an application by Matakanui Gold Limited ("**MGL**") under the Fast Track Approvals Act 2024 ("**FTAA**") for the Bendigo-Ophir Gold Project ("**BOGP**").

1.1 Project overview

MGL is proposing to establish within the BOGP, a new gold mine, ancillary facilities and environmental mitigation measures, on Bendigo and Ardgour Stations in the Dunstan Mountains of Central Otago. The project site is located approximately 20 km north of Cromwell.

The BOGP is located within the footprint of Minerals Exploration Permit ("**MEP**") 60311, which overlays several pastoral stations that have grazed sheep and cattle in the area for over 100 years. MEP60311 is held by MGL under the Crown Minerals Act 1991. MGL has land access agreements with Bendigo and Ardgour Stations. The BOGP is located adjacent to land administered by the Department of Conservation ("**DOC**"), including the Bendigo Historic Reserve, the Bendigo Conservation Area and the Ardgour Conservation Area. The BOGP planned operations do not directly impact these areas.

The BOGP's exploration has discovered numerous soil geochemical anomalies and extensive drill evaluation has defined four (4) gold deposits worthy of economic extraction. The most significant is the Rise and Shine ("**RAS**") discovery, which MGL cites as the most significant gold discovery in New Zealand in the past four decades. The other discoveries at Come in Time ("**CIT**"), Srex ("**SRX**") and Srex East ("**SRE**") are smaller in size and tenor.

The defined orebodies are planned to be mined by open pit methods. Underground mining is planned for the deeper parts of the RAS orebody in the later years of development.

The majority of the mining activities, ancillary facilities and associated infrastructure will be located in the Shepherds Valley somewhat hidden from the view of the public. Access, and service and administration offices are planned to be located on the adjoining Ardgour Terrace.

Appendix 1, Figure 1 provides an overview of the footprint associated with the establishment, operation and rehabilitation within the BOGP. This footprint includes a range of buffers from 0 – 100m, with widths varying for different components of the design. An additional 13.09 ha (approximately) of disturbance will be required to establish the Thomson Gorge Road alternative alignment (Ardgour Rise), and a further 2.75 ha (approximately) for construction of predator-proof fences. The total maximum potential disturbance—referred to as the Direct Disturbance Footprint ("**DDF**") (**Appendix 1, Figure 2**)—including contingency, Ardgour Rise, and predator-proof fencing, is 610 ha[23].

[23] A larger footprint was used for the invertebrate assessment to account for uncertainty

Aspects of the project that are not included in the DDF are the pipeline, borefield, and walking route to the CIT battery (**Appendix 1, Figure 1**) as these will be undertaken as permitted activities (pipeline and borefield) or will have nil impact (walking route).

Approximately 52 ha of the DDF is in the agricultural area on Ardgour Terrace. This area will be used for offices, security, medical, laboratory, laydown, storage, contractor areas, topsoil storage, emulsion manufacture and magazine facilities plus aggregate pits and roading.

Ecological work will include rehabilitation on direct disturbed areas, ecological uplift activities and pest exclusion area(s) adjacent to the footprint on nearby areas such as Ardgour and Bendigo Stations.

A full description of the various activities comprising the establishment, operation and rehabilitation within the BOGP is provided in the Assessment of Environmental Effects prepared by Mitchell Daysh Limited. However, by way of summary, the BOGP includes the following components:

- The establishment of the RAS Open Pit and SRX Open Pit, which are planned to form partial pit lakes at closure.
- The establishment of RAS Underground which utilises backfill with cement paste.
- The establishment of the CIT Open Pit, which is the smallest of footprints and is planned to be progressively backfilled with waste rock from the RAS Open Pit and profiled to integrate with the surrounding terrain. Rehabilitation will potentially enable nearby cushionfields to be re-established at the completion of mining activities.
- The establishment of the small SRE Open Pit, which will be backfilled with waste rock before being covered with overburden and root zones to form the engineered landform for the adjoining SRX Open Pit ("**SRX ELF**").
- A conventional hard rock gold processing plant (1.2 million tonnes per annum expandable to 1.8Mtpa) applying modern Carbon-in-Leach ("**CIL**") technology constructed in the lower reach of Shepherds Valley. The plant will operate in a closed water circuit with the TSF. Residual chemicals in the tailings slurry will be detoxified and/or precipitated with specialist plant.
- The operation of the process plant will be supported by ancillary facilities such as maintenance workshops, raw material and process chemical storage, fuel depot, laboratory and warehousing. Mine offices, carparking and security services will also be established.
- The construction of the plant in the lower reaches of the Shepherds valley will include the realignment of Shepherds Creek.
- The establishment of water storage dams and tankage for use in the process plant, dust suppression and drinking water supply.

- The establishment of a Tailings Storage Facility ("**TSF**") in the upper reach of Shepherds Valley (including clean water diversion drains), which will utilise waste rock from mining activities within the project site.
- The establishment of permanent engineered landforms in the Shepherds Valley ("**Shepherds ELF**") and an unnamed creek west of RAS pit ("**WELF**").
- The establishment of temporary topsoil, vegetation, large rock (for habitat creation) and brown rock stockpiles around the project site.
- The extraction of groundwater from the Bendigo Aquifer for use in mining-related activities as well as supplying BOGP drinking water and replacing small irrigation water takes from Shepherds Creek. Bore water will be pumped to the processing plant via a pipeline over a distance of approximately 6.5 km. This groundwater will also be provided to augment flows for swamp and marsh wetlands to address drawdown impacts as set out in the Water Management Plan.
- The establishment of supporting infrastructure / activities for the project, such as the upgrade of Ardgour Road and parts of Thomson Gorge Road to provide improved access to the BOGP, internal mine access and haul roads, water pipelines and underground utilities, and electricity supply to the project site from Lindis Crossing via a new 66kV overhead powerline that will follow the existing road reserve corridor.
- A realignment of part of Thomson Gorge Road, via Ardgour Station (Ardgour Rise) is planned to maintain public access through to the Manuherikia Valley.
- Main explosives magazines and emulsion mixing facilities and two aggregate pits (located outside the project site on Ardgour Terrace).
- The establishment of non-operational infrastructure associated with the BOGP on the Ardgour Terrace, including security, first aid and administrative offices, geology facilities, high voltage substation and temporary construction workers accommodation.
- Ecological rehabilitation of all available areas within the DDF.
- The establishment of Mine Regeneration Zones for ecological enhancement and to facilitate ecological rehabilitation processes within the DDF.
- The establishment of the Ardgour Restoration Area **("ARA"**).
- The establishment of the Matakanui sanctuary, comprising the Ardgour and Bendigo pest exclusion areas, for ecological enhancement activities.

1.2 Report scope

MGL requested that Alliance Ecology prepare an ecological effects assessment report to support approvals[24] (including resource consent applications) under the FTAA. This assessment of ecological effects includes:

- A description of ecological characteristics and values within the DDF and the Surrounding Landscape ("**SL**"), collectively the 5,386 ha 'Ecological Study Area' ("**ESA**"), based on desktop review and field surveys.
- An assessment of ecological significance against the Otago Regional Policy Statement (**ORPS**)(operative and proposed).
- An assessment of potential ecological effects on those ecological values affected by the proposed mining activities.
- Proposed measures to avoid, minimise or remedy these adverse effects.
- An evaluation of the residual effects that remain after measures to avoid, minimise/mitigate or remedy adverse effects.
- The habitat restoration and enhancement measures proposed to offset or compensate for these residual adverse effects on terrestrial and wetland ecological values.
- An assessment of the proposed offset/compensation measures against the relevant principles of the **ORPS**, the National Policy Statement for Indigenous Biodiversity ("**NPSIB**") and the National Policy Statement for Freshwater Management ("**NPSFM**"), to inform the FTAA statutory weighting exercise in the main application.

Notably, all effects on freshwater streams are addressed in the Assessment of Freshwater Ecological Effects prepared by Boffa Miskell and sit outside the scope of this report.

1.3 Ecological study area

The ESA (**Appendix 1, Figure 2**) covers approximately 5,386 ha, comprising:

- the 610 ha direct disturbance footprint (DDF)
- variable-width buffers surrounding different components of the project
- the potential dewatering drawdown zone ("**DDZ**"), an approximately 142 ha area with potential to impact wetlands because of indirect influence from the DDF.
- the surrounding landscape (SL), including land for proposed offsetting and compensation.

The DDF is completely contained within the ESA and encompasses the proposed BOGP gold mining and ancillary activity areas, the Ardgour Rise (Thomson Gorge Road realignment), and the construction zone for the proposed pest exclusion fences.

[24] In accordance with the Letter of Engagement between Matakanui Gold and Alliance Ecology Ltd dated 27 March, 2023 and the terms and conditions therein.

The wider ESA, within which field studies were undertaken, includes both agricultural and conservation land. It includes a mix of private, leasehold Crown land, and Crown land administered by the Department of Conservation (DOC). The ESA is described further in Section 3.2.1 below.

1.4 Information sources

This report has been informed by the following ecological survey reports, which are included as appendices:

- RMA Ecology 2025a. Bendigo-Ophir Gold Project Vegetation Values Assessment. Report prepared for Matakanui Gold Ltd, October 2025 ('Vegetation report').
- RMA Ecology 2025b. Bendigo-Ophir Gold Project Wetland Values Assessment. Report prepared for Matakanui Gold Ltd, October 2025 ('Wetland report').
- RMA Ecology 2025e. Bendigo-Ophir Gold Project, Avifauna Values Assessment. Report prepared for Matakanui Gold Ltd, October 2025 ('Avifauna report').
- Habitat NZ Ltd. 2025a. Bendigo-Ophir Gold Project: Native Bat Survey. Habitat NZ Ltd., February 2025, Auckland. 18 p ('Bat report').
- RMA Ecology 2025c. Bendigo-Ophir Gold Project, Lizard Values Assessment. Report prepared for Matakanui Gold Ltd, October 2025 ('Lizard report').
- Habitat NZ Ltd. 2025b. Bendigo-Ophir Gold Project: Terrestrial Invertebrate Survey Report prepared for Matakanui Gold, May 2025 ('Invertebrate report').
- Habitat NZ Ltd. 2025c. Bendigo-Ophir Gold Project: Mammalian Pest Survey Report prepared for Matakanui Gold, February 2025.
- Hydro Geochem Group Ltd. 2025. BOGP Wetland Drawdown Assessment.
- Manaaki Whenua Landcare Research (MWLR), Habitat NZ Ltd and Boffa Miskell Limited (BML). October 2025. Landscape and Ecological Rehabilitation Management Plan.
- RMA Ecology Ltd 2025d. Memo titled 'Bendigo-Ophir Mine: biodiversity offset modelling for terrestrial ecology values' and dated 22 October 2025 ('Biodiversity Offset Report').

1.5 Statutory context

1.5.1 Overview

The statutory and planning documents that provide the framework for this assessment of ecological effects under the FTAA are detailed in the Assessment of Environmental Effects for the proposal. In brief these documents include:

- The FTAA and the relevant legislation referred to therein, including:
  - The Resource Management Act ("**RMA**"), and relevant matters for ecological assessment under Schedule 5 of the FTAA.

  - The Wildlife Act 1953 ("**WA**")
  - The Heritage New Zealand Pouhere Taonga Act 2014
  - Freshwater Fisheries Regulations 1983
- The Resource Management (Freshwater and Other Matters) Amendment Act 2024
- The Resource Management (National Environmental Standards for Freshwater) Regulations 2020 ("**NES Freshwater**")
- The NPSFM amended October 2024
- The NPSIB amended October 2024
- Otago Regional Policy Statement 2019 (operative March 2024)
- Proposed Otago Regional Policy Statement 2021 (Decisions version)
- The operative Regional Plan: Water for Otago
- The operative Central Otago District Plan 2008 ('CODP').

The following non-statutory documents are also relevant:

- The Environment Institute of Australia and New Zealand (EIANZ) Ecological Impact Assessment Guidelines (EcIAG) (Roper Lindsay et al, 2018).
- The Wetland Delineation Protocols (WDP) (MfE, December 2022) which set out criteria for identifying and delineating wetlands. The NPSFM requires regional councils to have regard to the WDP in cases of uncertainty or dispute about the existence or extent of a natural wetland.
- Kāi Tahu ki Otago Natural Resource Management Plan 2005.
- Otago Conservation Management Strategy 2016 (incorporating the 2022 partial review).

The application of the FTAA statutory weighting exercise is detailed in the main application. This report does not apply the FTAA statutory tests but provides ecological information to inform their subsequent application.

1.5.2 National Policy Statement for Indigenous Biodiversity

Subject to weighting under the FTAA, the NPSIB provides direction to councils on managing indigenous biodiversity in the terrestrial environment. Its specific relevance to the BOGP and statutory weighting under the FTAA is addressed in the AEE. In summary:

- The NPSIB requires that indigenous biodiversity that is not protected by a Significant Natural Area (SNA) is managed by applying the effects management hierarchy (avoid, minimise, remedy, offset, compensate), where those effects are significant. Where those effects are not significant, it requires that indigenous biodiversity is managed to give effect to its objectives and policies.

- The NPSIB requires that adverse effects on SNAs must be avoided, except where clause 3.11 applies. Clause 3.11 (1)(a)(ii) allows for mineral extraction that delivers significant national or regional benefits which cannot be achieved using other resources within New Zealand. The AEE details how the BOGP meets the requirements of this clause.
- The offsetting and compensation principles of the NPSIB are relevant to the proposed residual effects management approach.

2. Methodology

The ecological assessment of the ESA has been undertaken using a combination of desktop analysis and field surveys as detailed below. An assessment of ecological effects was then undertaken in accordance with the Environment Institute of Australia and New Zealand ('**EIANZ**') Ecological Impact Assessment Guidelines ('**EcIAG**') (Roper-Lindsay et al., 2018).

2.1 Desktop investigations

The methodology and approach to the ecological assessments, along with the wider ecological context of the site, were informed by a desktop review. The detailed findings of this review are presented in the appended technical ecology reports.

In summary, this review comprised published and unpublished reports, papers, and records from the following databases:

- eBird database (https://ebird.org)
- Department of Conservation (DOC) amphibian and reptile database
- DOC national bat database
- NZ Herpetofauna Atlas Webmap
- iNaturalist Otago database
- Global Biodiversity Information Facility
- Historic and present-day aerial images including from sources such as Retrolens
- Publicly available GIS layers including:
  - Land Cover Database (LCDB), Land Environments New Zealand (LENZ), and Threatened Environment Classification (TEC) from Manaaki Whenua Landcare Research
  - Otago Wetland Mapping and Otago Ecosystems and Habitat Mapping from the Otago Regional Council website
- New Zealand Plant Conservation Network plant lists including lists for:
  - Bendigo Goldfields Reserve (BNDI)
  - Bendigo kanuka first loop of track (BENK)
  - Bendigo kanuka second loop of track (BEN2)
- Naturally Uncommon Ecosystems list from Manaaki Whenua Landcare Research
- Journal articles and other publications including consent applications
- Previous ecological reports prepared for Matakanui Gold Ltd, including:

  - Central Environmental Services (2023). Wetland Ecosystem Survey: Rise & Shine & Jean Creek Catchments, Bendigo & Ardgour Stations. Report prepared for Santana-Matakanui Gold Ltd, March 2023
  - Central Environmental Services (2023). *Poa cita* Ecology & Biodiversity Update: Thomson's Gorge, Bendigo & Ardgour Stations. Report prepared for Santana-Matakanui Gold Ltd, April 2023
- Previous ecological reports and surveys for the area, including but not limited to:
  - DOC Protected Natural Areas Programme reports for the Dunstan Ecological District (Grove et al 1995 and Ward et al 1987).

2.2 Field surveys

2.2.1 General overview

This section summarises the field survey methodologies undertaken within the 5,386 ha ESA, which includes the DDF and the SL (**Appendix 1, Figure 2**). Detailed survey methodologies, locations and dates are provided in the technical ecology reports.

In summary, surveys across the ESA were undertaken from October 2023 to March 2025. These surveys aimed to characterise ecological values and inform the ecological assessment of effects and proposed effects management. The surveys were conducted by RMA Ecology (terrestrial vegetation, wetlands, avifauna and lizards) and Habitat NZ (bats, invertebrates and mammalian pests).

Surveys are summarised in **Table 2** below and included:

- Terrestrial and wetland mapping, broad classification and habitat assessments to determine the extent and condition of habitat types, including the use of the NPSFM Wetland Delineation Protocol, and Pasture Exclusion Methodology to delineate natural wetlands.
- Fauna and vegetation surveys to determine habitat quality/value and the presence or likely presence of nationally 'Threatened', 'At Risk' or otherwise notable species, including:
  - Vegetation surveys at integrated monitoring stations and targeted rare plant surveys, including for wetlands.
  - Long-tailed bat surveys using Automatic Bat Monitoring Devices (ABMs).
  - Terrestrial bird surveys based on five-minute bird counts (5MBCs) at integrated survey stations, wetland bird surveys, waterfowl surveys, falcon nest surveys, and incidental observations.
  - Lizard surveys using Artificial Cover Objects (ACOs), pitfall trapping, Gee minnow funnel trapping, manual searching, and aerial drone surveys.

  - Terrestrial invertebrate surveys using light trapping (moths), pitfall trapping, foliage beating (arboreal insects), wooden discs, and manual searches.

- Mammalian pest surveys to evaluate the presence and relative abundance of pest populations, and their potential predation on native species within the ESA. The surveys used chew cards, camera traps, and aerial surveys. eDNA analysis of gut samples from key predator groups was conducted to identify predation risks to protected native fauna.

2.2.2 Integrated monitoring stations

Integrated monitoring stations for vegetation, birds, lizards, and invertebrates were placed on an 800m grid extending across the ESA using GIS. Additional vegetation and bird monitoring stations were then established on a 400m grid surrounding each of these primary stations (**Appendix 1, Figure 3)**.

These integrated monitoring stations were used for the range of ecological field surveys undertaken across the ESA (**Table 2** below), as described in the relevant technical reports.

Table 2: Summary of ecological field surveys undertaken across the ESA

Ecological value	Method	Plots/sites	Timing/survey effort
Terrestrial vegetation	Vegetation classification, mapping and habitat assessments Quantitative surveys at integrated monitoring plots	148 monitoring stations, each with: • a 10m x 10m woody plot (also used for % cover survey) • four 2m x 2m plots Additional offsite vegetation investigations at 9 locations for Threatened and At Risk species (outside the ESA)	October 2023 to January 2025. 106 person-days for vegetation plots*. Multiple site visits, plots measured at each station
	Targeted threatened plant surveys	In the DDF and ESA, targeting areas not covered by other methods; known suitable habitat including wetlands; and unique sites such as tors and spring annual herb habitat/cushionfields.	29 person-days 11-15, 25-29 March 2024 4-8, 11-15, 19-21 November 2024 Included 9 hours within wetlands.
Wetlands	Wetland delineation, mapping & assessments of wetland condition.	136 assessments (123 wetland vegetation plots, 13 rapid tests)	31 person days between February 2024 and January 2025
Bats	Automatic bat monitors	28 ABM sites	November 2023 - December 2024, March - April 2024. 1,111 valid survey nights
Avifauna	Five-minute bird count surveys	133 bird monitoring stations (100 in ESA, 33 in the surrounding landscape).	October 2023 to January 2025, (predominantly January and February 2024)
	Falcon nesting survey (walkovers, drone)	In high-quality nesting habitat in and around the DDF	November 2024
	Targeted wetland bird surveys (call playbacks)	In suitable wetland habitat	September to November 2024
	Waterfowl survey	In open waterbodies in and around ESA	
	Incidental observations		Various
Lizards	ACOs	400 Onduline triple stacks	Checked during summer and spring 2024

Ecological value	Method	Plots/sites	Timing/survey effort
	Pitfall trapping	6 transect lines, each with 20 traps	Set over set over summer 2024
	Gee minnow funnel traps	6 transect lines, each with 4 traps	Set over summer 2024.
	Arboreal gecko basking daytime search	6 sites by binocular search and foliage search	Searched twice, summer 2024
	Drone aerial survey of tors	Entire ESA	Spring 2024
	Tor/rock area large skink basking survey	6 sites surveyed by binoculars twice	Summer 2024
	Manual timed search	59 sites spread across the DDF, Ardgour & Bendigo stations	Summer 2024, spring 2024, summer 2025.
Invertebrates	Light trapping	16 representative sites (Dec 2023), 12 representative sites (Mar/Apr 2024)	Multiple nights per site, across two field seasons
	Pitfall traps	20 representative sites, 5 pits each 6 targeted sites, 20 pits each	March/April 2024
	Foliage beating	12 representative sites	March/April 2024
	Manual searches	20 representative sites, 1 hr each 6 targeted sites (2 hrs to 2hrs 20min)	March/April 2024
	Targeted manual searches	Sites based on habitat and vegetation	Feb/March 2024, Nov 2024, March 2025
	Wooden discs	20 representative sites, 5 discs each 6 targeted sites, 20 discs each	Installed late winter 2024, checked spring 2024
Mammalian pest surveys	Chew card lines	41 lines (410 cards)	February 2024 (7 nights per line)
	Camera traps	14 lines (56 cameras)	March/April 2024 (21 nights per camera)
	Aerial surveys	Pre-determined helicopter flight path	Two days, September - December 2024
	eDNA samples	76 animals	December 2023 - November 2024

*** 106 person-days for vegetation plots also included 5-minute bird counts**

2.2.3 Wetland delineation

Wetland characteristics and values within the DDF, DDZ and the majority of the ESA were assessed by RMA Ecology Ltd through a desktop review followed by systematic ground-based surveys (RMA, 2025b).

Wetland identification followed the New Zealand Wetland Delineation Protocol (MfE, 2022), applying a stepwise approach to determine wetland status in accordance with the NPSFM definition. This process included:

- Preliminary habitat screening for potential presence of threatened species;
- Application of the Rapid Pasture Test to exclude areas clearly dominated by exotic pasture species;
- Use of the full suite of delineation tools—vegetation, soils, hydrology, and the rapid test—where wetland indicator species were present.

Vegetation composition was assessed using standardised plot sizes (Clarkson, 2013): 2 × 2 m herbaceous plots, 5 m radius shrub plots, and 10 m radius tree plots. Plots were placed along vegetation and topographic gradients to support boundary delineation.

In total, 123 wetland vegetation plots were completed across the DDF, DDZ and Surrounding Landscape Surveyed for Wetlands ("**SLSW"**), with approximately 270 person-hours dedicated to field mapping. Of these, 64 wetland vegetation plots were completed within the DDF and approximately 140 person-hours applied to field mapping.

Wetland types were classified by wetland class (after Johnson and Gerbeaux 2004), with reference to the primary landforms in which they occur. Three broad wetland types were identified:

- Seepages (on hillslopes and drainage lines),
- Fens (typically in gullies), and
- Swamps and marshes (predominantly in valley floors and riparian settings).

Wetland condition was assessed for all wetlands with vegetation plots, for nine indicator components.

2.2.4 Terrestrial vegetation

Terrestrial vegetation values across the ESA were surveyed by RMA Ecology, as detailed in the Vegetation Report (RMA Ecology, 2025a).

Although ecological values are best understood at the whole-site scale[25] (RMA Ecology 2025a), disaggregation into distinct communities was also necessary for assessing effects, and to support transparent evaluation for offset modelling.

[25] Linkages, ecotones, and broader ecosystem context are critical components of ecological value and significance, with many functions arising from the interaction of vegetation communities rather than from isolated units. Mapped boundaries often represent

Vegetation communities on site were classified and mapped based on structure (woody vs herbaceous), and composition (native-dominant vs exotic-dominant). Seven broad vegetation communities were distinguished in addition to wetlands.

A botanical field survey was undertaken to:

- Identify the presence, distribution and relative abundance of vascular plant species within the DDF, and, at a broader scale, within the ESA; and
- Provide quantitative data on the structure and diversity of vegetation communities across the ESA.

Survey methods included:

- **Randomised vegetation plots:** At each of the 100 integrated monitoring stations described above, vegetation was surveyed using a 10m x 10m plot for woody species and four 2m x 2m plots for herbaceous species, at the plot centroid. This dual-scale approach allowed for comprehensive data collection on species composition, richness, and relative abundance across different vegetation types. Percentage cover was also established.
- **Targeted wetland plots:** As described above.
- **Targeted threatened plant surveys**: A total of 29 person days were expended, with more intensive effort in the DDF. The survey targeted areas not assessed by other methods, known suitable habitat for undetected Threatened and At Risk species, and unique environments such as tors and grazed herbfields. It also aimed to improve understanding of habitat preferences and estimate populations; however, comprehensive estimates and fine-scale mapping were not possible due to the site's scale, complexity, and the cryptic nature of some target species.
- **Drone surveys**: to capture photos and videos to assist with assessment.
- **Offsite investigations:** Undertaken at nine locations outside the ESA to better understand the environmental niches of Threatened and At Risk species, the effects of different management regimes, and the succession trajectories of different vegetation communities.
- **Incidental observations:** Obtained while undertaking surveys and investigations as described above.

2.2.5 Bat surveys

The bat surveys undertaken over the ESA are detailed in the Bat Report by Habitat NZ (2025a). Surveys were undertaken in two periods: 27 November to 22 December 2023, and 4 March to 5 April 2024. The objective was to detect the presence of bats in the ESA based

coarse approximations of complex mosaics; however, disaggregating vegetation into distinct communities is necessary in practice for assessing ecological effects, as different types carry different values and require transparent evaluation to inform offset modelling and biodiversity outcome assessments. A more detailed discussion of this approach is provided in the Vegetation Report prepared by RMA Ecology (RMA Ecology 2025a).

on a single isolated DOC record indicating potential bat activity nearby[26], despite limited suitable roosting habitat.

The long-tailed bat (*Chalinolobus tuberculatus*) is classified as Threatened (nationally critical) due to population decline from predation, habitat loss and disease. Colonies have extensive home ranges (over more than 10,000 hectares) and use linear features such as forest edges, creeks, and valleys to commute between roosting and foraging sites.

The lesser short-tailed bat (*Mystacina tuberculata*), classified as "Threatened – Nationally Increasing," has only three known populations remaining in the South Island, including one in the Eglinton Valley, about 100km from the study area. Because the ESA lacks old-growth indigenous forest, short-tailed bat calls were not anticipated.

The acoustic bat survey used stationary Automatic Bat Monitors (ABMs) to record 'bat passes' for all native bat species, alongside the date and time of occurrence. The ABMs were programmed to record from one hour before sunset until one hour after sunrise each night.

ABMs were deployed at 28 sites across the ESA to thoroughly target potential bat habitats including roosting trees, flyways and foraging grounds. The monitors were strategically positioned near open ponds, streams, wetlands, valleys and ridges to detect bat passes. Acoustic recordings from both survey periods were analysed in Anabat Insight to identify any bat calls. Valid survey nights were determined based on defined temperature and rainfall thresholds.

2.2.6 Avifauna

The avifauna surveys undertaken across the ESA are detailed in the Avifauna Report prepared by RMA Ecology (2025e). Surveys included:

- **Five minute bird counts:** At survey stations established across the ESA on the 800m monitoring grid, as well as on the surrounding 400m grid. A further 33 five-minute bird count stations were strategically located in the SL to sample under-represented vegetation communities, including within the proposed offset/compensation sites. A single five-minute bird count was conducted at each of these stations, primarily in January and February 2024, following standard protocol to record all bird species seen and heard.
- **Targeted wetland bird surveys**: To determine the potential presence of cryptic wetland bird species such as fernbird, marsh crake, spotless crake, and Australasian bittern, six wetlands in the surrounding landscape of Ardgour Station were surveyed using call playback. Call playback surveys at Rise and Shine Creek were replicated three times from September to November 2024. The survey was undertaken at 10 points approximately 200 m – 400 m apart along the boundary of the wetland.
- **Waterfowl survey**: Open water bodies in and around the ESA were surveyed for waterfowl by visual counts with binoculars from viewpoints where the entire

[26] The record was erroneously entered into bat database immediately prior to our investigation, then removed before second round.

waterbody was visible. At least five minutes was spent with binoculars at each waterbody, which was sufficient due to their small size and lack of vegetation.

- **Falcon nesting surveys**: Targeted rapid assessments of falcon presence and nesting were conducted in high-quality habitat across the DDF and surrounds using visual searches, call playback, drone flyovers, and field observations. The surveys were conducted in November 2024, during the breeding season when falcon are likely to be highly territorial.

2.2.7 Lizards

The lizard surveys undertaken across the ESA are detailed in the Lizard Report prepared by RMA Ecology (2025c).

In summary, multiple methods were employed to survey lizards (and any incidental sightings of frogs) throughout the DDF, and across comparable, representative, areas of the surrounding ESA, including the use of active and passive methods during late spring 2023, summer 2024, autumn 2024, and spring 2024.

Survey methods included:

- Artificial Cover Objects (ACOs): 400 Onduline triple stacks; checked during summer and spring 2024;
- Pitfall trapping: 6 transect lines, each with 20 traps set over summer 2024;
- Gee minnow funnel traps: 6 transect lines, each with 4 traps set over summer 2024;
- Arboreal gecko basking daytime search: 6 sites by binocular search and foliage search, searched twice; summer 2024;
- Drone aerial survey of tors to detect basking skinks in spring 2024;
- Tor/rock area large skink basking survey: 6 sites surveyed by binoculars twice; summer 2024; and
- Manual timed search: 59 sites spread across the DDF, Ardgour Station and Bendigo Station and searched over summer 2024, spring 2024, and summer 2025.

In total, approximately 620 person hours were expended searching for lizards across the ESA and associated areas.

2.2.8 Invertebrates

The invertebrate surveys undertaken across the ESA are detailed in the Invertebrate Report prepared by Habitat NZ (2025b).

A desktop review of Central Otago invertebrate literature informed survey methods and identified potentially present notable species, including the Threatened 'Nationally Critical' moth *Sporophyla oenospora*, last recorded in Thomsons Gorge in 2008 (R. Hoare, pers. comm., December 2024).

Invertebrate surveys were conducted across the ESA[27] over two field seasons (2023/2024 and 2024/2025) to assess species presence, richness, diversity, and community composition. Surveys were carried out at:

- Representative monitoring sites (RM sites), selected using a stratified random approach from the 800 m integrated monitoring grid (refined from 24 to 20 sites);
- Targeted monitoring sites (TM sites), chosen for high habitat quality and likely invertebrate diversity; and
- Ad hoc sites, to cover under-represented areas or locations with potential for target species.

Survey techniques aimed to sample various terrestrial invertebrates in different habitats **(Table 3 below):**

- **Light trapping** — for moths and night-flying insects
- **Pitfall traps** — for ground-dwelling invertebrates including beetles
- **Foliage beating** — for vegetation-dependent species that are unlikely to be trapped with light traps or pitfall traps, targeting Olearia bushes (*Olearia arborescens*) known for their high species diversity (Derraik et al, 2001).
- **Systematic manual searches** —for airborne species active during the daytime, and other insects that might be missed by other methods. Timed manual searches at each RM and TM site included hand searching (logs, rocks, leaf litter, cow dung), visual searches of vegetation, and sweep netting.
- **Ad hoc manual searches** — for target species or across specific habitat types, and near Olearia bushes. Included manual light trapping.
- **Wooden discs** — for ground-dwelling terrestrial invertebrates and longer-term monitoring.

Malaise trapping was excluded due to taxonomic constraints.

Survey techniques followed DOC best practice protocols (Patrick, 2016, Sherley and Evan 2016, Bowie and Frampton, 2024), and species identification was undertaken by a team of nine species experts/taxonomists. Where NZTCS classifications were unavailable, species were categorised as:

- Probable new species
- Not assessed – of importance
- Not assessed – likely not threatened
- Not assessed.

[27] For the purposes of the invertebrate survey:
- the DDF was surveyed with the addition of a 150-metre buffer to allow for potential effects on invertebrates beyond the boundary of the mining activities; and
- The Surrounding Landscape (SL), being the balance of the ESA outside the DDF, included a discontinuous area (T6) to the southwest.

Species classifications for lepidoptera (moths and butterflies) reflect pending updates to the relevant NZTCS publication (**in press**).

Table 3: Target species, timing and number of sites/locations surveyed for each survey method

Method	Target species	Survey period	No. Representative Monitoring Sites		No. Targeted Monitoring Sites	
			DDF	SL	DDF	SL
Light trapping	Moths and night-flying insects	Dec 2023	6	6	N/A	N/A
		Mar/Apr 2024	5	7	N/A	N/A
Pitfall traps	Ground-dwelling invertebrates including beetles	Mar/Apr 2024	11 x 5 pits each	9 x 5 pits each	3 x 20 pits each	3 x 20 pits each
Foliage beating	Vegetation-dependent species that are unlikely to fall into a pit	Mar/Apr 2024	5	7	N/A	N/A
Timed manual searches	Airborne species active during the daytime, and other insects that might be missed by other methods	Mar/Apr 2024	11 x 1hr each	9 x 1hr each	3 x 2hr each	3 x 2hr each
Wooden disc habitat	Ground-dwelling terrestrial invertebrates and longer-term monitoring	Nov 2024	11 x 5 each	9 x 5 each	3 x 20 each	3 x 20 each
Ad hoc manual searches	Target species or habitat types	Feb/March 2024: 28 collection locations in DDF, 12 in SL Nov 2024: 5 locations in DDF, 18 in SL March 2025: 1 location in DDF, 2 in SL.				

2.2.9 Mammalian pests

A range of mammalian pests are known or expected across the BOGP site, including feral cats, deer (fallow and red), goats, pigs, hares, hedgehogs, mice, mustelids (ferrets, stoats, weasels), possums, rabbits, and rats (ship and brown rats).

Baseline surveys were conducted across the ESA during summer 2023–2024 (Habitat NZ, 2025c), when pest species are typically most active and abundant. Four survey methods were used to collectively assess presence, relative abundance of mammalian species, and dietary behaviour (**Table 4** below):

- Chew card lines (targeting possums, rats, and mice)
- Camera traps (targeting feral cats, mustelids, and hedgehogs)
- Aerial surveys (targeting ungulates such as goats, pigs, and deer)
- eDNA sampling (to identify the diet of mammalian predators)

2.2.9.1.1 Chew card lines

Chew cards are corflute cards baited with peanut butter to entice mammalian pests to bite them. A total of 410 chew cards were distributed in 41 lines across the ESA from 19 to 28 February 2024 (**Table 4**). Deployment generally followed the seven-night monitoring specifications outlined in best practice guidelines (Bionet 2020), with 'fine weather nights' defined accordingly.

2.2.9.1.2 Camera traps

To target feral cats, mustelids, and hedgehogs, 56 motion-activated trail cameras were deployed at bait stations along 14 lines across the ESA, from 11 March to 4 April 2024 (**Table 4** below). Deployment generally following best practice guidelines (Gillies 2023). Cameras were secured to 1-metre waratahs due to limited trees and livestock presence. Following standard protocols, cameras were arranged in lines of four, spaced 200 m apart, and deployed for 21 nights.

2.2.9.1.3 Aerial surveys

Aerial surveys were undertaken to count ungulates such as feral goats, pigs and deer. A helicopter was flown on a predetermined flight path across both the DDF and SL, on two fine weather days from September to December 2024. To minimise observer bias (Mitchell and Balogh 2007), the same observer and pilot were used, both of whom were experienced in locating ungulates. Species and numbers of observed animals were recorded, noting physical identifiers where possible to differentiate individuals.

2.2.9.1.4 eDNA samples

The diets of feral pigs, ferrets, mice, hedgehogs, possums and feral cats were examined using eDNA analyses to better understand the predation risks these species pose to indigenous fauna. This method is especially useful for investigating predation on cryptic species including lizards and invertebrates. eDNA samples were taken from mammalian pests that had been captured, euthanised and then dissected. Animals were captured using leghold traps and mouse trap lines (for ferrets, hedgehogs, mice and possums), live capture traps (for feral cats and ferrets), shooting (for ferrets & cats), including from a helicopter (for pigs), or caught with dogs (pigs). The gut/faecal content of 76 animals was sampled between December 2023 and November 2024.

Table 4: Target species for camera traps and chew cards, with the number of lines and devices in each survey zone (DDF* or surrounding landscape)

Monitoring Method	Target Species	No. of lines (Total no. of devices)		
		DDF*	SL	Total
Camera trap	• Feral cat (*Felis catus*) • Ferret (*Mustela putorius furo)* • Stoat (*M. erminea*) • Weasel (*M. nivalis*) • Hedgehog (*Erinaceus europaeus*)	6 (24)	8 (32)	14 (56)
Chewcard	• Possum (*Trichosurus vulpecula*) • Rat (*Rattus rattus* and *R. norvegicus*) • Mouse (*Mus musculus*)	16 (160)	25 (250)	41 (410)
Aerial surveys	• Feral deer (*Dama dama* and *Cervus elaphus*)	Pre-determined flight path		n/a
	• Feral goat (*Capra hircus*)			
	• Feral pig (*Sus scrofa*)			

*The DDF as defined at the time of this ecological survey.

2.3 Assessment of ecological effects

The assessment of ecological effects has been undertaken in accordance with the EcIAG. The EcIAG were developed by EIANZ to provide a nationally consistent framework for assessing ecological impacts, while maintaining the critical role of expert judgement. The guidelines are widely used to assess ecological effects and effects management requirements for infrastructure projects.[28]

2.3.1 Step one: assigning ecological value

'Ecological values' were assigned on a scale of 'Negligible' to 'Very High' based on species and habitat values, using criteria in the EcIAG (see **Appendix 2**, **Tables B.1** and **B.2**).

For habitats, ecological values are assessed against four sub-criteria including representativeness, rarity/distinctiveness, diversity and pattern; and ecological context.

For species, ecological value relates directly to threat status (see **Appendix 2, Table B.1**). However, for certain species such as kōwhai that are classified as Not Threatened, we have assigned a value of 'Moderate' due to the ecological importance of their role in the ecosystem, e.g. providing floral resources and large stature.

2.3.2 Step two: assessing the magnitude of effects

The 'Magnitude of Effect' is a measure of the extent or scale of the effect of an activity and the degree of change that it will cause after measures to avoid, minimise or remedy for adverse effects.

The 'Magnitude of Effect' after efforts to avoid, minimise or remedy for effects was scored on a scale of 'Positive ' to 'Very High' (**Appendix 2, Table B.3**) and was assessed in terms of:

- Spatial scale of the effect;
- Duration and timescale of the effect;
- The relative permanence of the effect;
- Time lag between effect and remediation outcomes in respect of key ecological factors; and
- Level of confidence in understanding the expected effect.

2.3.3 Step three: assessing the level of effects

An overall 'Level of Effect' (after efforts to avoid, minimise or remedy for effects) was identified for each habitat/fauna type using a matrix approach. This approach combines the ecological values with the magnitude of effects resulting from the activity (**Appendix 2 Table B.4**).

[28] For example the proposed Auckland Regional Landfill, and NZTA projects including Transmission Gully, MacKays to Peka, Ara Tūhono Project Puhoi to Warkworth and Warkworth to Wellsford Sections

The matrix describes an overall 'Level of Effect' after efforts to avoid, minimise or remedy effects on a scale from 'Positive' to 'Very High'.

The EcIAG specifies that:

a) This 'Level of Effect' is used to guide the extent and nature of measures to demonstrably offset and/or compensate for residual effects.

b) Offsetting or compensation measures are considered necessary where the level of effects is assessed as 'Moderate' or higher.

2.3.4 Residual effects assessment

2.3.4.1 Overview

Of the potential adverse effects of the project that could not be avoided, minimised or remedied, those ecological values for which offsetting is an appropriate approach were identified (**Appendix 3**: Biodiversity Offset Report,RMA Ecology). This excluded values that could not be addressed through an offsetting pathway primarily because insufficient knowledge exists regarding the distribution of the species across the site, or insufficient knowledge exists on how to salvage, relocate, restore, conserve or manage that ecological feature.

Biodiversity Offset Accounting Models (BOAM)(Maseyk et al. 2015) were then used to determine Net Gain outcomes for those biodiversity values for which residual effects were assessed as Moderate or higher and that could be quantifiably measured and predicted with adequate certainty (Biodiversity Offset Report, RMA Ecology 2025d). Net gain was assessed based on both extent and condition (ecological value).

For values that could not be demonstrably offset, the degree to which residual effects could be compensated for via the type and quantum of compensation proposed was based on professional opinion.

2.3.4.2 Assessment against offsetting and compensation principles

The degree to which project effects adhere to the biodiversity offsetting and compensation principles in Appendices 3 and 4 of the NPSIB was assessed.

For wetlands, proposed habitat restoration and enhancement measures were evaluated against the aquatic offsetting and compensation principles as set out in Appendices 6 and 7 of the NPSFM.

2.3.4.3 Limits to offsetting assessment

In accordance with the relevant principles for biodiversity offsetting and compensation under the NPSIB[29] and NPSFM[30], a limits to offsetting assessment was undertaken (Pilgrim et al 2013) which then needs to be applied through the FTAA regime.

[29] NPSIB Principle 2 of Appendices 3 and 4.
[30] NPSFM Principle 2 of Appendices 6 and 7

The limits to offsetting (and compensation) principles recognise that some impacts on vulnerable or irreplaceable species or communities cannot be effectively offset or compensated for, and form limits to offsetting.

The assessment considers:

- The irreplaceability[31] or vulnerability[32] of the biodiversity value
- The 'magnitude of effect' (section 2.3.2 above), after measures to avoid, minimise, or remedy effects are considered.
- The biodiversity offset/compensation opportunity, technical feasibility, and outcome certainty.

While limits to offsetting and compensation were considered for all residual adverse effects, ecological values were selected for specific assessment where greater scrutiny was warranted based on the parameters outlined above. In particular, based on the potential for project effects to exacerbate local (or wider) extirpation of a habitat type or population.

2.4 Ecological significance assessment

Section 3.2.2 below outlines the areas identified by Central Otago District Council or Otago Regional Council as SNAs or their equivalents. For example, this includes Ecological Areas of Significant Natural Value mapped by CODC[33].

In addition, the ESA was assessed against the four ecological significance criteria in Appendix 1 of the NPSIB and Appendix 2 of the proposed Otago RPS 2021 (pORPS). These criteria are broadly reflected in Schedule 4 of the Operative Otago RPS 2019 (ORPS), being:

- Representativeness
- Rarity and distinctiveness
- Diversity and pattern, and
- Ecological context.

Although the wording and emphasis of the criteria differ slightly across the three documents, importantly, each requires that a site need only meet one criterion to be considered ecologically significant.

Key distinctions between the approaches in the NPSIB, pORPS and ORPS include:

- Rarity and distinctiveness: Under the operative ORPS 2019, an area qualifies as significant if it supports a single indigenous species that is Threatened, At Risk, or uncommon—either nationally or within the ecological district (Schedule 4, criterion 2a ('rarity')). In contrast, the NPSIB and pORPS exclude areas that provide habitat solely

[31] Terminology defined in the glossary
[32] Terminology defined in the glossary
[33]The pORPS adopts the criteria in the NPSIB, but expands on the ecological context criterion, including the addition of a new subcriterion (e): "*an area that is important for a population of indigenous fauna during a critical part of their lifecycle, either seasonally or permanently, e.g. for feeding, resting, nesting, breeding, spawning or refuges from predation.*".

for a single At Risk (declining) indigenous fauna species if that species is widespread in at least three other regions, unless the exemptions in Appendix 1, clause (1)(2) apply.

- Ecological context – the pORPS expands on the definition in both the ORPS and the NPS-IB.

The criteria were applied collectively with the most stringent interpretation used as the threshold for significance.

Ecological context is particularly important for a project of this scale, as it considers how the size, shape, and configuration of an area within the broader landscape contribute to its ability to maintain indigenous biodiversity or influence the surrounding landscape's capacity to do so.

To account for ecological context at the scale of the project, the Vegetation Report assesses ecological significance of vegetation at a broad scale across two landscape units—the hilly landscape unit and the cultivated basin unit. The Wetland Report assesses ecological significance for each wetland type.

Notably, the assessment of ecological value under the EcIAG for each vegetation community applies criteria that broadly align with those used to identify ecological significance—specifically, representativeness, rarity and distinctiveness, diversity and pattern, and ecological context. These criteria were applied to each vegetation community and wetland type to inform the ecological value ratings, as explained above.

3. Ecological context

3.1 Dunstan ecological district

The project area is located on the northwestern side of the Dunstan mountains in the Dunstan Ecological District (ED), within the Central Otago Ecological Region. The site is approximately equidistant between the east and west coasts of the South Island. It is generally northwest facing (i.e. highly exposed to drying influences) and lies between 400 and 800 m elevation.

The Dunstan Mountains are typical of the flat-topped mountain ranges of Central Otago, which differ markedly from the steep, jagged, dissected mountains of the western Otago alps. Similar ranges lie to the northwest (Pisa Range) and south (Old Man Range). These ranges extend above 1600 m a.s.l. and are separated by large valleys between 200 – 400 m a.s.l. (Lee 2018, Pole 2022). The underling geology of the Dunstan Mountains comprises variably schistose quartzofeldspathic sandstones and related rocks of the Rakaia Terrane.

Notably, the project area (up to the Rise and Shine Fault) is mapped as Haast Schist Zone TZ3, characterised by well-developed foliation and slight segregation. In contrast, the area to the southwest, including the Bendigo Scenic Reserve, is mapped as Haast Schist Zone TZ4, exhibiting strong foliation and marked segregation. This geological variation may influence current vegetation patterns and habitat suitability for some fauna, e.g. lizards.

The climate of the Dunstan Mountains is semi-continental, characterised by relatively low precipitation, warm summers and cold winters. Typically, valley bottoms have strong frosts in winter and high temperature summers, while at higher elevations, precipitation is higher, including snow on the range tops in winter, and summers are cooler (McGlone 1995). There are also marked microclimatic differences associated with aspect. Data from a weather station at Bendigo[34] recorded an average annual rainfall of 445 mm (range: 281–575 mm). Monthly rainfall ranged from 24 mm to 46 mm, with no strong seasonal pattern. Extremes included 0 mm in June 1964 and 172 mm in September 1970. However, summer dry periods can be particularly challenging due to high temperatures and elevated evapotranspiration.

Climate change, driven by rising greenhouse gases, is expected to alter temperature (and therefore evapotranspiration) and precipitation patterns. NIWA (2019) projects increases in average temperatures and extreme heat days, with a slight increase in annual rainfall and more frequent extreme rainfall events for the wider area.

Environmental gradients of altitude, aspect, soils, and moisture, coupled with historic and ongoing pressures from increased fire frequency, exotic browsing animals, farming practices, and mining activities, have shaped the current composition and spatial dynamics of vegetation communities and microhabitats.

The Vegetation Report provides a detailed account of pre-human vegetation in the ED. In summary, prior to human settlement, a mosaic of forest and woodland covered the

[34] 500 m a.s.l., NIWA station no. 5242, 1955-1979.

slopes of the ranges in the Dunstan ED up to the lower limits of the alpine zone (McGlone 2001; Walker et al. 2003). Species composition was likely driven by microsite, elevation, aspect and disturbance.

Vegetation would have included closed-canopy forest, woodland, shrubland, wetland and open dry sites (including areas where spring annuals could persist). The original forest types likely included Hall's tōtara, mountain celery pine, broadleaved forest of which only fragmented relicts remain in the wider landscape (none onsite) and kānuka, olearia scrub/treeland. Bog pine was also likely an important pre-settlement shrubland species, with kāpuka and mountain fivefinger probably common. Local, small stands of matai and other tall podocarps may have occurred in deep gullies, as well as on fertile fans and talus slopes given its relative drought-intolerance. There is some evidence that kōwhai were dominant at lower elevations[35].

Much of the area has been affected by repeated burning, (both Māori and European), stock grazing, historic gold mining, introduced weeds, and mammalian pests (McGlone 2001; Wardle 2001b; Wells 1972). As illustrated by aerial photos in the vegetation report, woody species are now expanding within fire-protected refugia such as steep gorges, rock outcrops, and screes, particularly on dissected range slopes.

3.2 Site description

3.2.1 Ecological Study Area

The ESA spans approximately 5,386 hectares (**Appendix 1, Figure 2**) and is presently dominated by a mosaic of native and exotic scrub, native tussockland, mixed depleted herbfields (cushionfields) and grassland, and exotic pasture. As described in Section 1.3 above, it includes private land, leasehold Crown land, and areas administered by the Department of Conservation (DOC), including:

- Ardgour Conservation Area, on the western side of the ridgeline in the Thomsons saddle area
- Bendigo Conservation Area, on the upper western slopes of the Dunstan range to the southwest of Mt Moka
- Neinei i kura Conservation Area, which adjoins Ardgour Conservation area to the east.

The ESA is largely composed of semi-arid, extensive sheep and beef grazing land with a significant history of gold mining. The ESA was defined to extend well beyond the DDF to provide landscape context for assessing ecological values, and to encompass proposed habitat restoration and enhancement sites.

The terrain ranges from approximately 300 m to 1,300 m above sea level, with lower elevation areas and sites nearer the Lindis/Clutha valley more heavily modified than higher elevation areas such as those near Thomsons Saddle on the southeastern

[35] Pole 2022

boundary. Vegetation reflects both environmental gradients and the cumulative effects of historical and ongoing disturbances—both natural and anthropogenic.

The ESA contains areas of high terrestrial value based on the presence of native-dominated habitats and of nationally Threatened or At Risk flora and fauna. However, indigenous biodiversity has been heavily modified by past and current land use practices, along with the ongoing effects of invasive weeds, introduced mammalian predators, and browsers. While some localised pest control occurs, there is no coordinated, site-wide pest management programme in place.

In broad terms the ESA includes seven vegetation communities[36] (described in **Section 4.1**) and wetlands, supporting a diverse array of flora and fauna. The vegetation communities exist as an intergrading mosaic, driven by environmental conditions and management practices. Key ecological characteristics include:

- Native-dominant vegetation communities characterised by grey scrub, kānuka, tussock, taramea, and *Raoulia* (cushionfield) species
- A diverse assemblage of indigenous plant species including at least 58 Threatened or 'At Risk' vascular species
- Small wetland habitats including hillside seeps, gully fens and swamps/marshes
- Perennial, intermittent and ephemeral streams
- Several nationally Threatened or At Risk fauna, including terrestrial birds, lizards and numerous species of invertebrates, particularly moths. Some invertebrate species are undescribed.

The DDF, entirely contained within the ESA, covers 610 ha and includes all areas of proposed BOGP gold mining and associated activities—mine pits, infrastructure, road realignment (Ardgour Rise), and proposed predator-proof fence construction zones. The DDF has been defined to accommodate minor future refinements through detailed design, and it is conservatively assumed that all vegetation within the DDF will be cleared or modified through earthworks though this is unlikely to be the case[37].

3.2.2 Identified areas of ecological significance

Three areas within the ESA have been mapped by Central Otago District Council as 'Ecological Areas of Significant Natural Value' (**Appendix 1, Figure 4**).

No regionally significant wetlands listed in the Regional Plan: Water for Otago are present in the ESA, nor in the wider Dunstan Range. However:

- Wetlands over 800m asl are classified as regionally significant wetlands (policy 10.4.1A). The presence of wetlands over 800m asl within the DDF and DDZ is assessed below.

[36] Comprising seven terrestrial vegetation communities and wetlands (fens, seepages and swamps/marshes)
[37] particularly if the Come in Time pit is not mined, as addressed in Section 7.3.2 below

- Nearby Bendigo Wetland is a 154 ha Regionally Significant wetland located at the head of Lake Dunstan, and is also an area of Significant Natural Value. It is located approximately 8.5 km to the west of the DDF and 1.8km from the closest road construction at the intersection of SH8 and Ardgour Road.

The NPSIB requires that adverse effects on indigenous biodiversity within a SNA be avoided, except where required for the purposes of mineral extraction that provides significant national or regional public benefit which cannot be otherwise achieved using resources within New Zealand (NPSIB clause 3.11 (1a) ii). The AEE describes how the BOGP meets this exception.

3.2.3 Threatened Environment Classification

The full range of Threatened Environment Classifications (TEC) exist across the ESA, from <10 % indigenous cover remaining in the cultivated basin, to > 30 % indigenous cover remaining and > 20 % indigenous cover remaining in the higher altitude parts of the ESA (**Appendix 1, Figure 6**).

4. Vegetation and habitats

4.1 Habitat/vegetation types

Vegetation and habitat types within the ESA are described in detail in the Vegetation Report (RMA, 2025a). The seven broad terrestrial vegetation types classified across the ESA are summarised in **Table 5** below and shown in **Appendix 1 Figure 7**. Further information on the composition and characteristics of each habitat type is provided in the full report. Wetland characteristics and values are described in **Section 4.2** below.

Importantly, the vegetation communities exist as a mosaic, driven by environmental conditions and management practices. Gradients between vegetation communities are usually gradual and there are often elements of one vegetation community within another. Grey scrub, kānuka, tussock, taramea, and *Raoulia* (cushionfield) species are characteristic features.

Cushionfields cover about 10% of the ESA and 17% of the DDF and are the most valuable ecosystem with respect to biodiversity values. They support a disproportionately large number of plant species ranked as Nationally Threatened and At-Risk (21 species, including spring annual herbs) as well as nationally Threatened or At Risk fauna.

Table 5: Vegetation/habitat characteristics of the ecological study area

Habitat type	Aerial extent	Description
Exotic pasture or herbfield	1147 ha ESA 79 ha DDF	Exotic-dominated pasture grasses (>50% cover), with substantial cover of exotic herbs and weedy species. Remnant native tussocks and shrubs are present in areas that have not been cultivated. Occurs widely across lower elevations of the ESA, but is also found at higher elevations, particularly on gentle/gentle to moderate south-facing slopes. Exotic herbs form dense swards in places.
Mixed depleted herbfield (cushionfield) and grassland	553 ha ESA 104 ha DDF	Occurs mainly on gentle to moderate north-facing slopes below 700 m, with smaller patches above 1000 m. Limited in overall extent (10%) but more common within the DDF (17%). It is structurally depleted, with the highest proportion of bare ground and rock (38%) and sparse, low-growing grasses and herbs. Scabweed cushions (*Raoulia australis*) are distinctive, though often senescent[38]. Exotic grasses are common (18%), while native tussocks are rare. Annuals—both native and exotic—are disproportionately important, and woody species, mainly exotic, are very sparse. Supports several nationally Threatened and At Risk plants, including *Ceratocephala pungens*, *Myosotis brevis*, *Myosurus minimus* subsp. *novae-zelandiae*, and *Pimelea aridula*.

[38] Showing signs of dieback and reduced vigour.

Habitat type	Aerial extent	Description
Mixed tussock shrubland and exotic grassland	1392 ha ESA 187 ha DDF	Occurs at low to mid elevations (<900 m) on moderate to steep slopes. Most widespread type in ESA (26%) and DDF (31%). Dominated by exotic grassland, with native tussocks and scattered to patchy shrubland. Aerially oversown and fertilised; clovers often present. Native tussocks locally common. Shrub cover (native and exotic) varies with grazing and woody weed control, but remains sparse (19%). Moderate bare ground cover (~11%).
Mixed scrubland	457 ha ESA 124 ha DDF	Occurs mainly in gullies (<700 m) and on north-facing slopes. Limited in overall extent (9%) but more common within DDF (20%). Dominated by dense scrubland (39%), with exotic grassland (34%) and bare ground (11%) between patches. Scrub includes both native and exotic species (unlike native-dominant scrubland). Pasture grasses similar to mixed tussock grassland; shade-tolerant exotics present due to higher scrub cover. Clover relatively unimportant. Grades into native scrubland at higher elevations and shadier aspects, where native shrub diversity increases and exotic species decline.
Native-dominant tussockland	1026 ha ESA 25 ha DDF	Occurs at higher elevations (900–1100 m) on gently sloping sites, mainly in the south of the ESA. Widespread in the ESA (19%) but limited in the DDF (4%) due to elevation. Dominated by grasses, tussocks, and herbs (80% cover). Shrubs (both native and exotic) are sparse. Best described as depleted short tussock grassland. Native tussocks *Festuca novae-zelandiae*, *Poa cita*, and *Poa colensoi* are conspicuous (20%). Large native herb *Aciphylla aurea* can be locally common. Evidence of past fertilisation (e.g., presence of clovers).
Native taramea herbfield and shrubland	162 ha ESA 2 ha DDF	Confined to highest elevations (>900m); minor type overall (3% of study area, <1% of DDF). Structurally herbaceous; dominated by native herbs (especially *Aciphylla aurea* which is extensive) within depleted grassland and scattered short tussocks. Native short tussocks present including *Festuca novae-zelandiae, Poa cita, Poa colensoi.* Other native herbs locally common: Raoulia spp., Acaena spp., *Stellaria gracilenta*. Native shrubs: *Discaria toumatou*, *Melicytus alpinus*, *Pimelea oreophila* (10% cover). *Pilosella officinarum* (exotic herb) widespread; exotic grasses rare. Lack of clover suggests minimal past fertiliser input.

Habitat type	Aerial extent	Description
Native dominant scrubland	639 ha ESA 86 ha DDF	Occurs mainly in gullies at higher elevations and on south-facing slopes. Notable examples in two main tributaries of Bendigo Creek and upper Dry Creek. Often dense shrubland, structurally dominated by native species. Key native shrubs include *Coprosma propinqua*, *Olearia odorata*, *Discaria toumatou*. Vines occasionally present. *Olearia lineata* (regionally and nationally rare) also occurs in this community. *Rosa rubiginosa* (exotic) present but less dominant than in mixed scrubland. Exotic grasses and herbs present but least abundant in this type.

4.2 Wetland characteristics and values

Within the DDF, 3.12 ha of wetlands are present, comprising three wetland types (**Table 6** below):

- Swamp/marsh (2.51 ha): the predominant type, occurring in valley floors and gullies
- Fen (0.49 ha): located primarily in gullies
- Seepages (0.13 ha): small pockets found on hillsides.

Within the DDZ, 2.37 ha of wetlands are present, comprised primarily of swamp/marsh (1.94 ha), and smaller scatterings of fen (0.37 ha) and seepages (0.06 ha).

Most of the 290 wetlands within the Wetland Survey Area are relatively small, aside from a string of larger swamps/marshes along the valley floor of Rise and Shine Creek. All are defined as natural inland wetlands under the NPS-FM.

Wetlands within the DDF, DDZ and SLSW are almost exclusively dominated by herbaceous vegetation, and woody vegetation is rare. Exotic grasses and herbs dominate in most wetlands, but some wetlands are dominated by native sedges.

Within the DDF, 14 wetlands covering 0.16 ha are higher than 800 m asl, and therefore meet the significance criterion under Policy 10.4.1A of the Otago Regional Water Plan. Similarly, in the DDZ there are 7 wetlands covering 0.16 ha higher than 800 m asl. Regionally significant wetlands mapped in the wider vicinity beyond the ESA are described above.

A total of ten nationally or regionally Threatened, At Risk and Data Deficient wetland plant species were detected in the ESA. This includes three Regionally Threatened (and Nationally At Risk) species detected in wetlands in the DDF and in the SLSW. A further four regionally or nationally At-Risk species were detected in wetlands in the DDF and three in the SLSW.

Table 6: Wetland habitat types within the ESA Wetland Survey Area (DDF, DDZ and SLSW)

Habitat type	Aerial extent	Description
Seepages	0.13 ha DDF, 0.06 ha DDZ 0.57 ha in SLSW	Small and relatively sparse in the ESA, but larger and more common on the south-facing slopes above Shepherds Stream, where they commonly grade into gully fens and marshes. Dominated by: • Exotic grassland/sedgeland (*Juncus articulatus*, *J. effusus, Lolium perenne, Holcus lanatus* and silver tussock *(Poa cita)* on hummocks. Often affected by grazing and pugging • Mossfield/grassland (creeping bent, clover) and • Herbfield/rushland (watercress, *J. articulatus*) where water tables and flow rates are higher.
Fens	0.49 ha DDF, 0.37 ha DDZ; 2.67 ha in SLSW	Occur mostly in gully landforms within the ESA. Primarily palustrine[39], with some grading into riverine systems where influenced by adjacent stream flood events. Dominated by: • Exotic grassland: creeping bent with blue sweetgrass in wetter areas. Also Yorkshire fog and white clover. • Exotic rushland: (*Juncus articulatus*, *J. effusus* var. *compactus*). Also creeping bent. • Native sedgeland (*Carex coriacea*, *C. kaloides*, *C. sinclairii*) interspersed with exotic grasses and herbs. Communities often intergrade, with mixed vegetation common across gully wetlands.
Swamps/ marshes	2.51 ha DDF, 1.94 ha DDZ; 2.56 ha in SLSW	Located in valley floors and the lower end of some larger gullies. Onsite swamps/marshes are primarily riparian palustrine systems, with riverine influence from annual flood events. Dominant communities include: • Native sedgeland (*Carex coriacea*, *C. sinclairii*, *C. geminata*) with exotic grasses; • Exotic grassland dominated by creeping bent, blue sweetgrass and Yorkshire fog. Also *Carex coriacea*, C. *geminata* and *J. effusus*. • Exotic herbfield dominated by watercress and duckweed, Other swamp/marsh communities include: • Mixed tussockland in riparian swamps with *Carex secta*, watercress and duckweed, as well as creeping bent and *J. articulata*; • Mixed low exotic grassland/native herbfield, with native species including *Ranunculus* spp., *Montia fontana*, and *Hydrocotyle novae-zeelandiae*.
Total wetlands	3.12ha in DDF;	Within the DDF, 0.16 ha of wetlands are > 800m asl Within the DDZ, 0.16 ha of wetlands are >800m asl

[39] Inland wetlands, not directly part of a river or lake system, but may occasionally be influenced by nearby streams or floodwaters

Habitat type	Aerial extent	Description
	2.37 ha in DDZ; 5.81 ha in SLSW	Within the SLSW, 2.34 ha of wetlands are > 800m asl

Within wetland plots, 94 plant species were identified, including 32 native species. A chart of the cumulative species detection over the 123 plots levels off, providing confidence that survey effort was sufficient to detect the majority of wetland plant species onsite.

Wetlands assessed in the DDF were in significantly poorer condition, had a greater introduced species cover (lower score), and experienced higher levels of animal disturbance compared to wetlands assessed in the DDZ and SLSW. Wetlands in the WSA under 800 m had lower overall condition, and more animal damage and introduced species.

Seepages were more degraded than other wetland types, with lower overall condition and higher levels of animal disturbance through grazing and pugging. The vegetation communities and condition of wetlands in the WSA mirror the generally degraded state of lowland and montane wetlands in the wider Central Otago Ecological Region, due in large part to many decades of fire and grazing.

Many wetlands within the ESA are heavily degraded by cattle pugging, with cattle often observed in wetlands in spring when ground conditions are very wet. This high level of disturbance favours rapid plant colonisers such as exotic pioneer species.

Fauna assessments relevant to wetlands detected no fish life within the DDF, very limited fish life within the SL, and no wetland specialist avifauna in the ESA. Wetland habitat is generally of low quality for wetland birds, primarily due to the absence of shallow open water, and the lack of tall vegetation during the breeding season, resulting from seasonal die-off and stock grazing.

4.3 Threatened flora species

4.3.1 Overview

The ESA supports an exceptionally high number of plant species that are classified as Threatened or At Risk, either nationally or regionally, with 58 such species detected in the ESA, of which at least 48 are in the DDF.

While no Nationally Threatened plant species have been recorded exclusively within the DDF, it does contain locally, regionally, and nationally significant populations (or parts of populations) of nationally or regionally Threatened or At Risk species.

Four Nationally Threatened species are found within the ESA, two of which are within the DDF: *Ceratocephala pungens* (Threatened – Nationally Critical) and *Myosotis brevis* (Threatened – Nationally Vulnerable). These species are described further below.

Overall, the high diversity of Threatened and At Risk flora species in the ESA reflects both the inherent high native plant diversity of the ED and the landscape-scale changes to vegetation in the region. Despite extensive landscape-scale modification and degradation of native vegetation communities, many of these species have persisted in fragmented habitats and some ecosystems (cushionfields and short-tussocks) have been able to expand. In general, the Dunstan Range represents a diverse and ecologically varied landscape, where incomplete transformation through land use change have allowed a high number of native species to survive.

As described above, cushionfields support a disproportionately large number of plant species ranked as Nationally Threatened and At-Risk (21 species, including spring annual herbs).

Some species are very rare across the ESA, such as blue wheat grass, *Olearia bullata*, Māori dock / runa (*Rumex flexuosus*), *Geranium aff. microphyllum*, and *Geranium potentilloides*, for which less than ten individuals were encountered. Other species have substantial populations within the ESA, such as rock fern (*Cheilanthes sieberi* subsp. *sieberi*), *Colobanthus brevisepalus*, *Hypericum involutum*, scented tree daisy (*Olearia odorata)*, *Poa maniototo*, common scabweed (*Raoulia australis*) and *Raoulia beauverdii* which have over 5000 individuals within the DDF alone.

4.3.2 Nationally threatened spring annuals

The two nationally Threatened spring annuals found within the DDF are described in detail in the Vegetation Report. In summary:

- *Ceratocephala pungens* (Threatened – Nationally Critical): A tiny annual herb (<30 mm tall) in the buttercup family, found in saline sites and hillslope herbfields of Central Otago and the Mackenzie Basin. It prefers bare ground on gentle slopes and does not compete well with weedy species. It was detected only in the Shepherds Creek catchment.
- *Myosotis brevis* (Threatened – Nationally Vulnerable): A small annual herb in the forget-me-not family, found in scattered locations across both the North and South Islands. Several thousand individuals of *M. brevis* and the closely related *Myosotis antarctica* subsp. *antarctica* were recorded across the ESA, with most found within the DDF.

As annuals, these species show year-to-year variation in population size and distribution. Current data suggest that the DDF populations may comprise up to 33% (*Ceratocephala pungens*) and 80% (*Myosotis brevis*) of their respective local populations. However, these estimates are uncertain and to address this, further surveys over the wider landscape and within the Ecological District are proposed as set out in the **ARP**. Despite this uncertainty, the populations of *C. pungens* and *M. brevis* represent important strongholds for both species, are important for their long-term persistence, and are ecologically significant at local, regional, and national scales.

4.3.3 Summary of threatened plant species

A summary of nationally and regionally 'Threatened' or 'At Risk' flora species present in vegetation communities, and their abundance in the Direct Disturbance Footprint or Surrounding Landscape is set out in **Table 7** below.

Table 7: Nationally or regionally 'Threatened' or 'At Risk' flora species present in vegetation communities, and abundance in the DDF or Surrounding Landscape

Species	Abundance within vegetation communities in the DDF and surrounding landscape (SL)	National threat Status (NZTCS)	Regional threat status (2025)[40]
Ceratocephala pungens (a spring annual)	Rare in Mixed depleted herbfield (cushionfield) and grassland in both the DDF and SL. Mixed depleted herbfield is relatively limited in extent (10.6%) in the ESA, but more widespread within the DDF (17%).	Threatened – Nationally Critical	Threatened - Regionally Critical
New Zealand carrot *Daucus glochidiatus*	Not detected in the DDF; occasional presence in the SL in mixed depleted herbfield and grassland.	Threatened – Nationally Vulnerable	Threatened - Regionally Critical
Tiny forget-me-not *Myosotis brevis* (a spring annual)	Occasional presence in the DDF; Rare in SL. Detected in mixed depleted herbfield & grassland, which is more widespread within the DDF (17%).	Threatened – Nationally Vulnerable	Threatened - Regionally Endangered
Coral broom *Carmichaelia crassicaulis crassicaulis*	Not detected in the DDF. Rare in the SL, within native-dominant tussockland which is more common in the ESA (19%) than the DDF (4.2%)	Threatened – Nationally Vulnerable	Threatened – regionally vulnerable
Carex kaloides	Present in wetland plots in both the DDF and SLSW, and frequent in fens within the SLSW. Rare in native-dominant scrubland in the DDF.	At Risk – Declining	Threatened - Regionally Endangered
Lagenophora barkeri	Occasional presence in wetland within the DDF. Not detected in the SL	At Risk – Declining	Threatened - Regionally Endangered
Coprosma brunnea	Not detected in the DDF. Rare in Mixed tussock shrubland/exotic grassland in the SL.	At Risk – Declining	Threatened - Regionally Endangered

[40] Jarvie et al, 2025a.

Species	Abundance within vegetation communities in the DDF and surrounding landscape (SL)	National threat Status (NZTCS)	Regional threat status (2025)[40]
New Zealand Mousetail *Myosurus minimus novae-zelandiae* (a spring annual)	Rare in both the DDF and SL, in mixed depleted herbfield and grassland	At Risk – Declining	Threatened - Regionally Endangered
Carex talboti	Rare in wetlands within both the DDF and SL. Also rare within Mixed tussock shrubland and exotic grassland in the DDF.	At Risk – Declining	Threatened - Regionally Vulnerable
Bidibid / piripiri *Acaena buchananii*	Rare within both the DDF and the SL, occurring in all habitats except wetland.	At Risk – Declining	Threatened - Regionally Vulnerable
Buchanan's Sedge *Carex buchananii*	Occasional presence in the DDF within five vegetation communities (native-dominant tussockland, native-dominant scrubland, mixed scrubland, wetland, mixed tussock shrubland).	At Risk – Declining	Threatened - Regionally Vulnerable
Colobanthus brevisepalus	Occasional presence within both the DDF and SL, in mixed depleted herbfield (cushionfield) and grassland	At Risk – Declining	Threatened - Regionally Vulnerable
Mikimiki *Coprosma virescens*	Occasional presence in both the DDF and the SL in native-dominant scrubland. Rare in the DDF and SL in native-dominant tussockland, native herbfield and shrubland, mixed scrubland, mixed tussock shrubland	At Risk – Declining	Threatened - Regionally Vulnerable
Pimelea aridula aridula	More widespread within the DDF than the SL. Within the DDF, common within mixed depleted herbfield, rare in all other terrestrial vegetation communities except exotic pasture/herbfield. Within the SL, rare in native-dominant tussockland, and occasional in mixed depleted herbfield.	At Risk – Declining	Threatened - Regionally Vulnerable
Raoulia beauverdii	Within both the DDF and SL, abundant in Mixed depleted herbfield, frequent in native-dominant tussockland and mixed tussock shrubland. Occasional presence in other terrestrial vegetation communities.	At Risk – Declining	Threatened - Regionally Vulnerable

Species	Abundance within vegetation communities in the DDF and surrounding landscape (SL)	National threat Status (NZTCS)	Regional threat status (2025)[40]
Celadon mat daisy *Raoulia parkii*	Occasional or rare in both the DDF and SL within all terrestrial vegetation communities except exotic pasture/herbfield .	At Risk – Declining	Threatened - Regionally Vulnerable
Rytidosperma maculatum	Occasional presence in both the DDF and SL in mixed depleted herbfield (cushionfield) and grassland	At Risk – Declining	Threatened - Regionally Vulnerable
Blue Wheat Grass *Anthosachne aprica*	Occasional or rare in all terrestrial vegetation communities in the DDF except exotic pasture/herbfield. Rare in three vegetation communities in the SL (native-dominant tussockland, native-dominant scrubland, and native herbfield and shrubland).	At Risk – Naturally Uncommon	Threatened - Regionally Vulnerable
Carmichaelia petriei	Detected in both the DDF and SL. Frequent in native-dominant tussockland and, native-dominant scrubland; Occasional presence in other terrestrial vegetation communities.	At Risk – Declining	At Risk - Regionally declining
Epilobium hectorii	Occasional presence in both the DDF and SL in Mixed depleted herbfield (cushionfield) and grassland Rare in native-dominant tussockland and mixed tussock shrubland in both the DDF and SL.	At Risk – Declining	At Risk - Regionally declining
Olearia lineata	Occasional presence in native-dominant scrubland in both the DDF and SL; Rare in other terrestrial vegetation communities except native herbfield and shrubland.	At Risk – Declining	At Risk - Regionally declining
Desert poa *Poa maniototo*	Abundant in both the DDF and SL in mixed depleted herbfields; and rare in native-dominant tussockland and mixed tussock shrubland.	At Risk – Declining	At Risk - Regionally declining
Common scabweed *Raoulia australis*	Abundant in both the DDF and SL in mixed depleted herbfields; frequent in native-dominant tussockland and mixed tussock shrubland; occasional presence in other terrestrial vegetation communities.	At Risk – Declining	At Risk - Regionally declining

Species	Abundance within vegetation communities in the DDF and surrounding landscape (SL)	National threat Status (NZTCS)	Regional threat status (2025)[40]
Rytidosperma buchananii	Rare in both the DDF and SL in mixed depleted herbfields and mixed tussock shrubland.	At Risk – Declining	At Risk - Regionally declining
Hypericum involutum	Common in the DDF and occasional presence in the SL, within mixed depleted herbfields and grassland	At Risk – Declining	Regionally data deficient
Scented tree daisy *Olearia odorata*	Abundant in the DDF and common in the SL within native-dominant scrubland. Also frequent in both the DDF and SL in native-dominant tussockland, mixed scrubland and mixed tussock shrubland. Occasional or rare in other terrestrial vegetation communities (DDF and SL).	At Risk – Declining	At Risk, regionally declining
Styphelia nana	Occurs in both the DDF and SL. Occasional or rare in all terrestrial vegetation communities.	At Risk – Declining	N / A
Stout dwarf broom *Carmichaelia monroi*	Not detected in the DDF. Rare in the SL, where it was detected in mixed tussock shrubland.	At Risk – Declining	Threatened, regionally critical
Pimelea prostrata subsp. prostrata	Rare in both the DDF and SL in four vegetation communities: native-dominant tussockland, native-dominant scrubland, native herbfield and shrubland, and mixed tussock shrubland.	Not Threatened	Threatened regionally vulnerable
Colobanthus strictus	Frequent in both the DDF and SL within mixed depleted herbfield and native herbfield and shrubland; occasional or rare in all other vegetation communities	Not Threatened	At Risk - Regionally declining
Feldmark grass *Rytidosperma pumilum*	Occasional presence within both the DDF and SL in mixed depleted herbfield; and rare in other terrestrial vegetation communities except exotic pasture.	Not Threatened	At Risk - Regionally declining
Juncus distegus	Occasional in fens within both the DDF and SL & observed only within Jean Creek. Within the DDF also occasional within mixed tussock shrubland, and within the SL, occasional in native dominant tussocklandand rare in mixed tussock shrubland/exotic grassland.	Not Threatened	At Risk - Regionally declining

Species	Abundance within vegetation communities in the DDF and surrounding landscape (SL)	National threat Status (NZTCS)	Regional threat status (2025)[40]
Pincushion grass *Agrostis muscosa*	Occasional presence in both the DDF and SL within Mixed depleted herbfield and grassland.	Not Threatened	At Risk - Regionally declining
Poa lindsayi	In both the DDF and SL. Occasional presence within mixed depleted herbfield and grassland. Rare in four other habitat types (exotic pasture/herbfield, native-dominant tussockland, native-dominant scrubland and mixed tussock shrubland).	Not Threatened	At Risk - Regionally declining
Spineless acaena *Acaena inermis*	Rare in both the DDF and SL. In the DDF, present within native-dominant tussockland, native-dominant scrubland, and mixed tussock shrubland. Within the SL, rare within mixed depleted herbfield and native-dominant tussockland.	Not Threatened	At Risk - Regionally declining
Luzula leptophylla	Rare in wetland habitat within the DDF and SL.	At Risk – Naturally Uncommon	At Risk - Regionally Naturally Uncommon
Myosotis antarctica subsp. *antarctica*	Present in mixed depleted herbfield in both DDL and SL; occasional in DDF and rare in SL.	At Risk – Naturally Uncommon	At Risk - Regionally Naturally Uncommon
Hot rock fern *Pellaea calidirupium*	Occasional presence in both the DDF and SL in mixed depleted herbfield and grassland, and rare in mixed tussock shrubland.	At Risk – Naturally Uncommon	At Risk - Regionally Naturally Uncommon
Poa incrassata	Not detected within the DDF. Rare within the SL in native-dominant tussockland.	At Risk – Naturally Uncommon	At Risk - Regionally Naturally Uncommon
Geranium aff. microphyllum	Occasional or rare within both the DDF and SL in all vegetation communities including wetland.	At Risk – Naturally Uncommon	Regionally Not Threatened
Coastal woodrush *Luzula banksiana var. rhadina*	Occasional presence within both the DDF and SL in all terrestrial vegetation communities except exotic pasture/herbfield, where it was rare.	Data Deficient	At Risk - Regionally Naturally Uncommon
Carex diandra	Present in wetlands across the ESA. Was classified as Not Threatened at the time of	Not Threatened	At Risk - Regionally

Species	Abundance within vegetation communities in the DDF and surrounding landscape (SL)	National threat Status (NZTCS)	Regional threat status (2025)[40]
	survey. Regional population trend is stable ±10%. Occasional in DDF and rare in SL.		Naturally Uncommon
Rock fern *Cheilanthes sieberi sieberi*	Abundant within the DDF and SL in Mixed depleted herbfield; occasional or rare in all other terrestrial vegetation communities.	Not Threatened	At Risk - Regionally Naturally Uncommon
Bladder Fern *Cystopteris tasmanica*	Occasional presence in both the DDF and SL in native-dominant tussockland and mixed tussock shrubland. Rare in mixed depleted herbfield, native-dominant tussockland and mixed scrubland	Not Threatened	At Risk - Regionally Naturally Uncommon
Euchiton traversii	Not detected in the DDF. Rare within the SL in three vegetation communities: mixed depleted herbfield, native-dominant tussockland and mixed tussock shrubland.	Not Threatened	At Risk - Regionally Naturally Uncommon
Isolepis praetextata	Not detected in the DDF. Within the SL, rare in mixed tussock shrubland.	Not Threatened	At Risk - Regionally Naturally Uncommon
Myriophyllum pedunculatum subsp. novae-zelandiae	Occasional presence in wetlands within both the DDF and SL.	Not Threatened	At Risk - Regionally Naturally Uncommon
Olearia bullata	Rare in both the DDF and SL, within native-dominant tussockland and mixed tussock shrubland.	Not Threatened	At Risk - Regionally Naturally Uncommon
Olearia cymbifolia	Not detected in the DDF. Rare within the SL, within mixed tussock shrubland.	Not Threatened	At Risk - Regionally Naturally Uncommon
Pimelea notia	Rare in both the DDF and SL Detected in native-dominant scrubland and within the SL, also within native-dominant tussockland.	Not Threatened	At Risk - Regionally Naturally Uncommon
Māori dock /runa *Rumex flexuosus*	Present in the DDF at Lower Shepherds Creek artificial pond. In vegetation plots, rare in exotic pasture and occasional	Not Threatened	At Risk - Regionally Naturally Uncommon

Species	Abundance within vegetation communities in the DDF and surrounding landscape (SL)	National threat Status (NZTCS)	Regional threat status (2025)[40]
	within wetland in the DDF. Not detected in the SL.		
Hebe *Veronica rakaiensis*	Not detected within the DDF. Rare in the SL, within native-dominant scrubland.	Not Threatened	At Risk - Regionally Naturally Uncommon
White fuzzweed *Vittadinia australis*	Occasional or rare within both the DDF and SL, in all vegetation communities except wetland	Not Threatened	At Risk - Regionally Naturally Uncommon
Festuca mathewsii subsp. mathewsii	Occasional in three vegetation communities within both the DDF and SL (native-dominant tussockland, Native herbfield and scrubland, and Mixed tussock shrubland/exotic grassland.	Not Threatened	Regionally data deficient
Geranium potentilloides	Occasional or rare in all vegetation communities within both the DDF and SL.	Not Threatened	Regionally data deficient
Deschampsia chapmani	Not present in DDF; rare within the SL in native-dominant tussockland.	Not Threatened	Regionally data deficient
Bristle grass *Rytidosperma corinum*	Within both the DDF and SL, occasional or rare in all vegetation communities except wetland	Data Deficient	Regionally Not Threatened
Chaerophyllum ramosum	Occasional presence in both the DDF and SL in native-dominant scrubland and mixed tussock shrubland.	Data Deficient	Regionally Not Threatened

5. Fauna

5.1 Overview

The results of field investigations are detailed in the individual survey reports and summarised below.

5.2 Bats

5.2.1 Desktop assessment

The DOC national bat database included a single isolated long-tailed bat record approximately 2 kilometres south of the ESA, which was deemed unreliable and removed in late 2023. Following this update, the nearest known bat activity was at least 60 kilometers from the ESA.

5.2.2 Field survey results

The acoustic monitoring surveys found no evidence of long-tailed (*Chalinolobus tuberculatus*) or lesser short-tailed bats (*Mystacina tuberculata*) using the BOGP bat survey area for any purpose, including resting, foraging, or commuting, during the 2023 – 2024 summer survey periods.

No bat activity was recorded over the 28 ABM locations during the 1,111 valid survey nights of the acoustic surveys. This is despite surveys being conducted in periods of likely high bat activity and in areas with habitat features expected to be used by bats if they were present in the BOGP bat survey area.

While potential occasional presence in the BOGP survey area cannot be ruled out, it is unlikely that long-tailed bats are regularly present and extremely unlikely that lesser short-tailed bats are present. This is based on the results of the National Bat Database review, acoustic monitoring surveys, and relative lack of suitable roosting habitat.

5.3 Avifauna

Desktop assessment indicates 28 native species of which three are Threatened and eight are At Risk may be present in the ESA.

Field surveys detected 11 native species in the DDF, including one Threatened species (New Zealand falcon, eastern form) and two nationally At Risk species (New Zealand pipit and black shag) (**Table 8** below).

An additional five Threatened or At Risk bird species are likely to be present as residents or as occasional visitors. Three of these species are associated with braided riverbeds and occasionally feed in cultivated fields.

The Threatened (nationally vulnerable) Eastern New Zealand falcon nest on cliff ledges or ground ledges[41]. As outlined in the Avifauna Report (RMA, 2025e), suitable nesting habitat exists within the ESA, particularly among the rock bluffs and tors of the DDF and surrounding landscape.

No Threatened or At Risk wetland birds or waterfowl were detected, aside from a single vagrant Black Shag observed flying over the site. Despite repeated surveys in the highest-quality habitats during the optimal time of year, no wetland birds were recorded within the ESA. Overall, habitat quality for wetland birds is poor, with no shallow open water or fringing vegetation present. Similarly, no Threatened or At Risk waterfowl were detected in any of the four waterbodies within or adjacent to the ESA.

Table 8: Notable avifauna species present or potentially present in the DDF (*= detected in surveys)

Notable species	Habitat use	National threat status (NZTCS)	Regional threat status
New Zealand falcon – eastern form*	One pair likely nesting at the margin of the DDF in Shepherds Valley (exhibited behaviour indicative of breeding). Nests in rock outcrops and bluffs. The DDF is of sufficient size to support up to one pair, and combined with the wider potential disturbance area has the potential to support one to two pairs. Tussockland, scrub, herbfield, exotic pasture, herbfield and wetland.	Threatened, nationally vulnerable	Threatened, regionally vulnerable
South Island fernbird	Recorded in desktop assessment only (one isolated record in SL). Potentially present on occasion in wetland, scrub and shrubland, but not detected.	At Risk, declining	Regionally At Risk, declining
New Zealand pipit*	Open vegetation communities including exotic pasture, native tussockland and mixed grassland/tussockland/shrubland throughout DDF and ESA. An estimated 5-15 pairs in DDF.	At Risk, declining	Regionally not threatened
Black shag*	Occasional use of ponds likely. Two artificial ponds provide low-quality habitat for occasional foraging but are not suitable for breeding. One individual detected flying overhead.	At Risk, relict	Threatened, regionally endangered
Silvereye*	Scrub, shrubland, exotic pasture	Not threatened	Regionally At Risk, declining
Tomtit*	Forest & scrub	Not threatened	Not threatened (but locally uncommon)
Bellbird	Forest & scrub	Not threatened	Not threatened

[41] Fox, Nicholas C. 1977. The biology of the New Zealand Falcon (Falco novaesee- landiae Gmelin 1788). Ph.D. thesis. University of Canterbury, Christchurch, New Zealand. 421pp.

Notable species	Habitat use	National threat status (NZTCS)	Regional threat status
			(but locally uncommon)
South Island Pied Oystercatcher*	Occasional use of cultivated fields likely, esp. after ploughing	At Risk, declining	Threatened, regionally vulnerable
Little shag	Occasional use of ponds likely	At Risk, relict	At Risk, relict
Black-fronted tern	Occasional use of cultivated fields likely, esp. after ploughing	Threatened, nationally endangered	Threatened, regionally endangered
Black-billed gull	Occasional use of cultivated fields likely, esp. after ploughing	At Risk, declining	Threatened, regionally vulnerable

Many of the above species are defined as 'specified highly mobile fauna' in the NPSIB, namely NZ falcon, South Island fernbird, NZ pipit, South Island pied oystercatcher and black-fronted tern.

5.4 Lizards

Three native lizard species were recorded within the ESA, including two nationally and regionally 'At Risk' species—the tussock skink and Kawarau gecko—and one non-threatened species (**Table 9** below).

The same three species were detected within the DDF and across other surveyed areas in the ESA, including Ardgour Station, Bendigo Station, Bendigo Scenic Reserve, and Bendigo Historic Reserve. Additional surveys along road margins, vineyards near Bendigo Loop Road, and land overlooking Lake Dunstan (10 km west) also recorded the same three species.

No frogs or exotic lizards were detected within or adjoining the DDF, or within areas searched for lizards within the wider ESA.

No additional native lizard species were found, including other geckos or cryptic, large-bodied skinks, despite targeted methods and significant search effort. Surveys focused on the best examples of regenerating scrubland, tor vegetation, and valley tussock/scree to detect rare species such as green skink, jewelled gecko, Otago skink, and grand skink. None were detected, despite multiple methods and repeat visits across seasons. In all areas surveyed for these species, one or more common species (McCann's skink, tussock skink, or Kawarau gecko) were observed.

Table 9: Lizard species found within the DDF and ESA

Lizards	Habitat use	National threat status (NZTCS)	Regional threat status (Jarvie 2025b)
Tussock skink *Oligosoma chionochloescens*	Sparse across the ESA	Not assigned (species identified after publication of most recent threat classification)	At Risk, declining
Kawarau gecko (*Woodworthia Cromwell*)	Common across the ESA	At Risk, declining	At Risk, declining
McCann's skink *(Oligosoma maccanni*)	Abundant across the ESA	Not threatened	Not threatened

5.5 Invertebrates

A total of 29,565 terrestrial invertebrate specimens were collected during surveying across the ESA. These represented at least 119 families across 25 orders. Of these, 222 species were native, 29 were introduced, and the remaining taxa were not determinable at the species level[42].

In total 18 notable species were found (**Table 10** below), including moths (Lepidoptera), grasshoppers (Orthoptera), beetles and weevils (Coleoptera). These comprised:

- Four 'Threatened' species of moth (one 'Nationally Critical', one 'Nationally Endangered' and two 'Nationally Vulnerable')
- Four new species: one species of weevil and three species of ground beetles[43]
- Nine 'At Risk' species: eight moth species (six 'Declining' and two 'Uncommon') and one 'Declining' species of grasshopper.
- One unassessed species of moth thought to be of conservation importance.

Of these, one species was found only within the DDF – the 'At Risk – Declining' grasshopper *Phaulacridium otagoense*. Nine notable species were found in both the DDF and SL areas, including Threatened, At Risk, and new species. Eight notable species were only found within the SL, three of which were threatened species represented by only one or two specimens each. These were the moths *Sporophyla oenospora* 'Threatened – Nationally Critical', *Homodotis* sp. A (NZAC (CO)) 'Threatened – Nationally Endangered' and *Pasiphila* sp. '*Olearia*' 'Threatened – Nationally Vulnerable'.

[42] i.e. only able to be identified to genus, family, or order level
[43] Definitive new species classifications would be required for one of these species, while the others would qualify for a Data Deficient, and potentially Threatened, conservation status.

S. oenospora was only found within an area considered part of the DDF at the time of the initial terrestrial invertebrate survey, in a location planned for development of the Ardgour Rise Road. This small, threatened moth was previously thought to be extinct, and is 'Nationally Critical', the highest possible threat category under the NZTCS. Following modification of the project design and development planning, the Ardgour Rise Alignment has relocated a minimum of 250m away to the north of the area where *S. oenospora* were found, and the boundary of the DDF adjusted accordingly. Subsequently, this moth is now recorded as being found in the SL.

The overall community structure and diversity were similar between the DDF and the surrounding landscape. Targeted monitoring sites (TM sites) showed richer and more diverse invertebrate populations compared to representative survey sites (RM sites). Significant seasonal variations were observed for moth communities, with higher species richness and abundance recorded in late summer compared to early summer.

Some of the notable species identified have specific plant associations, such as the threatened *Pseudocoremia cineracia* moth, which is closely associated with *Olearia odorata*, and a potential new weevil species (*Inophloeus)* thought to be closely associated with taramea. The specific host-plant of the critically endangered moth *Sporophyla oenospora* remains unknown.

Table 10: Summary of notable invertebrate species (*=revised NZTCS category, for NZ lepidoptera currently undergoing review)

Species	Threat status	Habitat description and known distribution
Sporophyla oenospora	Threatened – nationally critical	A very rare pyralid moth. Dry short-turf habitats with bare ground and low vegetation; two specimens found near Ardgour airstrip (SL). Possibly one of the species' last extant populations, as last known occurrence was in Thomson Gorge Road.
Homodotis sp. A (NZAC (CO)) (moth)	Threatened – nationally endangered*	A poorly known, officially unnamed moth species. One specimen found in Bendigo Historic Reserve (SL) during light trapping in October 2024. Previously found in early 1980s south of Cromwell and in Kawarau Gorge. Likely restricted to dry inland shrublands of Central Otago; likely of high conservation status (R. Hoare, *pers comm*, Dec 2024).
Looper moth *Pseudocoremia cineracia*	Threatened: Nationally Vulnerable	Inhabits small-leaved Olearia shrublands in Western Otago and the Mackenzie Country. Population currently stable but has declined due to habitat modification. Two specimens found in DDF. Closely tied to presence of *Olearia odorata*.
Olearia pug moth *Pasiphila sp. 'Olearia'*	Threatened: Nationally Vulnerable	Found in Otago and eastern Fiordland. High local abundance in suitable habitats. Restricted to areas with small-leaved Olearia species. One specimen found in Bendigo Historic Reserve (SL) in October 2024.

Species	Threat status	Habitat description and known distribution
Harpalus new sp.	Potentially threatened	A new species of nocturnal ground beetle; one specimen found inside the DDF and two found in the SL. Various terrestrial habitats, hiding under stones, logs or in soil crevices during the day. Would currently qualify for 'data deficient' and potentially threatened status under NZTCS (D Seldson, *pers comm*, Dec. 2024).
Inophloeus new sp.	Potentially threatened	A new species of weevil recorded from various locations across the ESA (61 specimens across the DDF and SL) and wider landscapes. Potential classification as Threatened under NZTCS (S Brown, *pers comm*, November 2024). Appears closely associated with taramea plants.
Megadromus new sp. *1*	Potentially threatened	Previously undescribed carabid beetle. Four specimens of Species 1 and two of Species 2 were collected, all within the SL. Both species would currently qualify as 'Data Deficient' and potentially Threatened under the NZTCS, pending further investigation (D. Seldson, pers. comm., Dec. 2024).
Megadromus new sp.2	Potentially threatened	
Phaulacridium otagoense	At Risk, declining	A short-horned grasshopper inhabiting dry, semi-arid alpine grasslands. Population is large but sparse and threatened by habitat modification. The only species found exclusively within the DDF (15 specimens collected at six sites within DDF).
Agrotis admirationis	At Risk, declining*	A nocturnal moth favouring open areas, widespread in NZ but in decline. Life history and plant host species unknown. Detected at multiple sites (4 sites in DDF and two sites in SL) via overnight light trapping in early summer
Asaphodes recta	At Risk, declining*	Uncommon moth found mainly in South Island bogs, particularly south of the Mackenzie Country. Larvae likely feed on herbaceous plants, including *Ranunculus* species. Specimens collected at 3 sites in the SL and one in the DDF in March 2024.
Elachista helonoma	At Risk, declining*	Locally common moth found in South Island tussock and grasslands; has significantly declined in range. Associated with silver tussock (*Poa cita).* One specimen found in the DDF and two in the SL.
Ichneutica toroneura	At Risk, declining*	Endemic moth, specialist of inland dry tussocklands; restricted to Central Otago and MacKenzie Country. Larvae feed on silver tussock (*P. cita*), fescue tussock (*Festuca novae-zelandiae*), and potentially other native tussock species. ~160 individuals found across 10 sites in the ESA; found in both the DDF and the SL.
Nyctemera annulata	At Risk, declining*	Dayflying moth. Larvae feed on daisies in open habitats throughout NZ. One specimen hand collected from SL in Feb 2024.

Species	Threat status	Habitat description and known distribution
Paranotoreas fulva	At Risk, declining*	Endemic moth. Dry, open habitats with exposed soil, often in saltpan-like areas; 5 specimens collected at Ardgour airstrip (SL) in November 2024.
Ichneutica sistens	At Risk, uncommon*	Local grass and shrubland moth occurring in both North and South Islands. Larvae feed on grasses. Found in very high numbers in both the DDF and SL.
Meterana exquisita	At Risk: uncommon*	Locally common moth which has significantly declined in range. Linked to small-leaved Olearia shrublands. Two specimens found in DDF and one in SL.
Scythris sp.1	Not Assessed – of importance	A slender-bodied moth. Associated with *Carmichaelia*; larvae collected in the SL during night search in November 2024.

5.6 Mammalian pests

In broad terms, the mammalian pest survey provides a detailed baseline of the presence and relative abundance of mammalian pests within the ESA. The findings highlight the presence of mammalian pests across the area and the potential negative impacts they are having on native species.

5.6.1 Survey results

All target species of mammalian pests were detected during the 2024 mammalian pest survey. Mammalian pests found across the ESA included feral cats, feral deer, feral goats, feral pigs, hares, hedgehogs, mice, mustelids (ferrets, stoats and weasels), possums, rabbits, and rats (species unknown although assumed to be ship rat and/or Norway rat).

All species except weasels and rats were found across both survey zones (PSA and SL). Weasels and rats were found only in the SL.

Target species were found at similar levels across the ESA, with no difference in relative abundance between the PSA and the SL for both camera trap and chewcard surveys.

A chewcard survey showed rats were sparse across the site, with none found in the PSA. This was corroborated by the lack of rats identified on cameras during the camera trap survey and the absence of rats from gut analyses of ferrets and feral cats. Stoats and weasels were also detected in low numbers across the ESA. Weasels were only found in the SL, and while stoats were only detected on cameras in the PSA, they were visually sighted in the SL while fieldwork was being carried out.

A total of 51 target ungulates from nine groups/herds were recorded during two rounds of aerial surveying. All observed animals were identified to species level and their numbers recorded.

5.6.2 Diet analysis

5.6.2.1 Impact on native fauna

eDNA diet analyses of target species indicates predation of native skinks by feral cats, ferrets, and hedgehogs across the site. This included the eDNA detection and gut remains of several Southern Grass skinks ('At Risk – Declining') in the gut of one ferret and one cat. Additionally, McCann's skink ('Not Threatened') remains were found in one feral cat, three ferrets and three hedgehogs.

All target mammalian pests, particularly hedgehogs and mice, are predating on a variety of native invertebrates. This includes an *Agrotis* moth (one 'At Risk' species recorded on site), a *Harpalus* beetle (only one new species recorded on site), as well as other species such as endemic ground wētā. The taramea consumed by feral pigs is also an important habitat for native weevils, including a new species of *Inophloeus*.

5.6.2.2 Impact on vegetation

Feral pigs were not found to have predated any threatened plants but were found to eat taramea which has cultural significance and is important for invertebrate habitat.

eDNA diet analyses indicated hedgehogs and mice were eating *Olearia traversiorum*[44] (At Risk – Declining). Multiple pest species showed evidence of consuming plants from genera containing 'Threatened' and 'At Risk' species that are recorded across the ESA, although species level identification was not possible. Native beech trees[45] from two genera were recorded from diet analyses of mice and possums.

[44] This is an unexpected record and possibly from planted trees
[45] Ibid

6. Ecological significance assessment

The entire ESA satisfies criteria for recognition as significant indigenous vegetation or significant habitats of indigenous fauna under Appendix 1 of the NPSIB, Schedule 4 of the ORPS and Appendix 2 of the pORPS.

Areas are considered significant where they meet one (or more) of the following criteria, noting that in line with Section 6(c) of the RMA for a habitat to be considered ecologically significant due to the presence of nationally Threatened or At Risk species, the habitat must be considered important for that species rather than of only marginal value:

- Representativeness
- Rarity and distinctiveness
- Diversity and pattern
- Ecological context.

All terrestrial habitat within the ESA is considered to meet criteria for rarity and distinctiveness[46] (**Table 11** below), as all areas potentially support more than one At Risk (declining) fauna species[47]. Notably, the New Zealand pipit, tussock skink and Kawerau gecko – all classified as At Risk (declining)—have been recorded in habitats assessed as having low ecological value, including exotic pasture. Their presence cannot be confidently ruled out in any vegetated sites within the ESA nor in the wider landscape.

Specifically, and despite degradation, each vegetation type supports distinctive native species assemblages. Olearia shrubland has highest invertebrate diversity, tussocklands support grass skinks, taramea herbfields support threatened invertebrates, and cushionfields support spring annuals, lizards and at-risk invertebrates. The native ecosystem mosaic with rocks and tors creates diverse habitat conditions.

All wetlands within the ESA are considered ecologically significant as detailed in the Wetland Report (RMA Ecology, 2025b). Wetlands also meet the criteria for rarity and distinctiveness[48] as they are naturally uncommon ecosystems on a national scale (which have been reduced to less than 20% of their former extent), and each wetland type contains at least two Threatened or At Risk flora species.

A more comprehensive evaluation of the ecological values of each vegetation community against EIANZ ecological value criteria —which are fundamentally the same criteria, being representativeness, rarity and distinctiveness, diversity and pattern, and ecological context — is provided below.

[46] While the ORPS 2019 separates the rarity and distinctiveness criteria, whereas the NPSIB and proposed RPS 2021 do not, this distinction is immaterial for the purposes of this assessment, as meeting any one criterion is sufficient to trigger ecological significance.
[47] The ORPS 2019 requires only that an area support one indigenous species that is threatened, at risk, or uncommon, nationally or within an ecological district to meet the Schedule 4, criterion 2a 'rarity'. In contrast, the NPSIB excludes an area from qualifying as an SNA solely on the grounds that it provides habitat for a single indigenous fauna species that is At Risk (declining), if that species is widespread in at least three other regions, unless exemptions in NPSIB clause Appendix 1 (1)(2) apply.
[48] See #17 above.

Table 11: Assessment of ecological significance for terrestrial habitat and vegetation types in the ESA

Vegetation/habitat type	Represent-ativeness	Rarity and distinctive-ness	Diversity and pattern	Ecological context
Exotic pasture or herbfield		✓		
Mixed depleted herbfield (cushionfield) and grassland	✓	✓	✓	✓
Mixed tussock shrubland and exotic grassland		✓	✓	✓
Mixed scrubland		✓	✓	✓
Native-dominant tussockland	✓	✓	✓	✓
Native taramea herbfield and shrubland	✓	✓	✓	✓
Native dominant scrubland	✓	✓	✓	✓
Seepage wetlands		✓		
Gully fens		✓		
Swamps and marshes	✓	✓	✓	✓

In addition to assessing the ecological significance of individual vegetation communities, an evaluation of their ecological context in the landscape is important for a project of this scale. Ecological context considers how the size, shape, and configuration of an area within the broader landscape contribute to its ability to maintain indigenous biodiversity or influence the surrounding landscape's capacity to do so.

The detailed ecological significance assessments in the Vegetation Report have therefore been applied to the two broad landscape units that make up the ESA (**Appendix 1, Figure 5**): the hilly landscape unit, which comprises the majority of the ESA, and the cultivated basin unit. This broader landscape-scale assessment highlights, for example:

- That the lowland cultivated basin, while meeting ecological significance are considerably less ecologically significant than the rest of the ESA.
- The high level of physical diversity as a result of geology and substrate (fractured rock substrate, deep soils, and hydric soils all present across the ESA), aspect (especially important at this site for the expression of certain vegetation communities and specific species assemblages), and altitude (ranging from 270 m to 1,222 m a.s.l.).
- The changes in vegetation communities that occur along landform / environmental gradients in the ESA. Important ecological patterns and sequences include the transition from 'Native dominant scrubland' development on south facing slopes, to 'mixed depleted herbfield (cushionfield) and grassland' on north facing slopes, and

the emergence of 'Native dominant tussockland' and 'Native taramea herbfield and shrubland' communities at high montane elevations.

- Mosaic communities result in nodes of nationally or regionally At Risk or Threatened plant species populations across wide areas which contributes to their resilience and genetic diversity across the landscape.
- Gradual transitional areas between vegetation community types (ecotones) provide for higher diversity and long-term oscillation of community boundaries and species populations as a result of environmental change.

7. Assessment of ecological effects

7.1 Introduction

This section assesses the potential effects of the project on terrestrial and wetland ecological values using the EcIAG methodology (Roper-Lindsay et al., 2018).

7.2 Ecological values assessment

The assessment of ecological value for habitat types under the EcIAG broadly aligns with criteria used to assess ecological significance[49].

The ecological values associated with each habitat type in the ESA were assessed in accordance with the EcIAG as shown in **Table 12** below. Ecological values of the seven terrestrial vegetation communities range from low to very high, while wetlands ranged from moderate to high ecological value. The ecological context of these vegetation communities in the broader landscape is particularly relevant to ecological value for a project of this scale, as described above and detailed in the Vegetation and Wetland reports (RMA, 2025a; RMA, 2025b).

Ecological values for species are based on the national conservation status under the New Zealand threat classification system (NZTCS) or regional conservation status[50], whichever is higher.

Table 12: Ecological values assessment for habitat types within the ESA based on EIANZ guidelines

Habitat type	Assessment of ecological value attributes based on EIANZ guidelines	Assigned ecological value
Exotic pasture or herbfield	**Representativeness: Very Low.** Poorly representative of any historic or present-day indigenous vegetation community. Some areas comprehensively cultivated with no native component. Dunstan ED heavily modified; this vegetation community contains small scale patches or sparsely scattered native tussock, scrub, or herbs. **Rarity and distinctiveness: Moderate** Dominated by exotic species but contains nine nationally or regionally Threatened or At Risk plant species, including the At Risk-Declining *Acaena buchananii*, scented tree daisy, and desert broom. The tussock skink, Kawerau gecko and pipit, all At Risk Declining, are the only threatened fauna species expected to be present in this habitat type. **Diversity and pattern: Low**	**Low** 'Very low' for one matter, 'low' for two matters and 'moderate' for one matter

[49] Being based on representativeness, rarity and distinctiveness, diversity and pattern, and ecological context.
[50] Under the Otago Threat Classification Series

Habitat type	Assessment of ecological value attributes based on EIANZ guidelines	Assigned ecological value
	Contains 75 native flora species, albeit mostly rare in occurrence and only covering 9%. If this community contained no or only few native species, then it would score as Very Low. **Ecological context: Low** This community often contains elements of other communities (i.e., herbfield, scrub, tussock), especially on margins, but at levels of sufficient for it to be mapped as such (except lower cultivated slopes which are comprehensively exotic). These margins of scattered scrub or tussock or herbfield form a buffer and essentially expand the coverage of individual native species populations. These scattered individuals also contribute to linkages between populations and community.	
Mixed depleted herbfield (cushionfield) and grassland	**Representativeness: Moderate** Pre-human, this vegetation community may have been most prevalent on the post-glacial Upper Clutha inland outwash gravels and moraines. This community has a high proportion of exotic vegetation (69 %), although it is still representative of present day cushionfield community within the ED which has been severely impacted by irrigation, subdivision and viticulture developments **Rarity and distinctiveness: High** This community exists due to unique conditions (including high moisture stress and northerly aspect), and some species (e.g., spring annuals) are restricted to specific sites within the community that have a particular subset of conditions. The community provides a habitat for 32 nationally or regionally At Risk or Threatened plant species, including a regional and even national stronghold for spring annuals (*Ceratocephala pungens*, Threatened – Nationally Critical; Myosotis brevis, Threatened – Nationally Vulnerable; *Myosurus minimus* subsp. *novae-zelandiae*, At Risk – Declining). Also contains regionally significant populations of the Threatened – Nationally Vulnerable New Zealand carrot, and the At Risk – Declining *Colobanthus brevisepalus*, *Hypericum involutum*, *Pimelea aridula subsp. aridula*, *Poa maniototo*, and Myosotis *antarctica* subsp. *antarctica*, among others. Provides variable-quality habitat for a diverse array of Threatened and At Risk fauna species. **Diversity and pattern: High** This community spans spectrums of elevation, aspect, slope, and moisture which creates conditions that suit stenotopic species, especially spring annuals. Ninety-one native flora species recorded including at least 20 species which are most common in this community within the ESA **Ecological context: High** This vegetation community includes a substantial contiguous area in the Shepherds Creek catchment and other smaller areas in	**Very High:** High for three matters and 'moderate' for one matter.

Habitat type	Assessment of ecological value attributes based on EIANZ guidelines	Assigned ecological value
	Ardgour Station that are critical for maintaining populations of native species which are (1) not tolerant of other conditions, (2) mostly dispersed by gravity and water (as opposed to animals), and (3) have a short life span such as spring annuals or other short perennial native herbs. Satellite areas of this community provide resilience and genetic diversity for some species. This community is highly sensitive to changes in management practices and weed invasion. For example, over-sowing and topdressing can radically alter botanical composition and lead to local extirpation of species	
Mixed tussock shrubland and exotic grassland	**Representativeness: Low** This vegetation community is unlikely to have existed in any similar form pre-human and is heavily dominated by exotic species. **Rarity and distinctiveness: High** Thirty-three Nationally or Regionally At Risk or Threatened plant species. Provides variable-quality habitat for a diverse array of Threatened and At Risk fauna species **Diversity and pattern: Moderate** Mosaic of botanical assemblages as a result of environmental conditions (e.g., aspect, moisture availability, slope, shelter) and farming practices (e.g., stock accessibility, over-sowing and topdressing. This community contains elements of tussockland, shrubland, and herbfield resulting in a high native diversity (107 species) but is also dominated by exotic pasture (having only 26 % native coverage). **Ecological context: Moderate** This community, characterised by its heterogeneous structure, forms a buffer and connection between most other core communities of scrub or tussock. As conditions suit, this community has the capability to transform into other community types given its high diversity.	**Moderate** 'High' for one matter, 'moderate' for two matters, and low for one matter
Mixed scrubland	**Representativeness: Low** Mixed scrubland at the site has a total woody vegetation coverage of 39 % and of that 61 % is exotic and 39% is native. This vegetation community is not representative of grey shrubland in the ED elsewhere where coverage and native dominance can be higher. **Rarity and distinctiveness: High** Twenty-one Nationally or Regionally At Risk or Threatened plant species recorded including important populations of several At Risk – Declining species including *Olearia lineata*, scented tree daisy, *Coprosma virescens*, and desert broom. Provides variable-quality habitat for a diverse array of Threatened and At Risk fauna species. **Diversity and pattern: Moderate**	**Moderate** 'High' for one matter, 'moderate' for two matters, and low for one matter

Habitat type	Assessment of ecological value attributes based on EIANZ guidelines	Assigned ecological value
	Ninety native plant species recorded. Limited heterogeneity and no sequences within this community. **Ecological context: Moderate** This community functions as a buffer to the 'Native dominant scrubland' which helps to restrict stock access to the core native dominant scrub areas, and can be an area for native recruitment. This community also forms an approximately 400-700 m wide corridor between the grey scrub in Bendigo Creek and Clearwater Creek and the kānuka scrubland in Bendigo Historic Reserve.	
Native dominant tussockland	**Representativeness: Moderate** In pre-human times, short tussockland would likely have been restricted to dry basins and river valleys (McGlone, 2001; Walker & Lee, 2000). This vegetation community expanded following anthropogenic deforestation and is now typical for the ED, despite usually containing a high proportion of exotic pasture grasses amongst interstitial spaces. Twenty-eight Nationally or Regionally At Risk or Threatened plant species, including the At Risk – Declining celadon mat daisy and *Festuca mathewsii* subsp. *mathewsii* which are most common in this vegetation community within the ESA. Tussock is 28 % coverage in this vegetation community, likely limited by grazing, and 33 % native plant species overall. A site containing higher coverage of tussock and of native species overall would score high. **Rarity and distinctiveness: High** Twenty-eight Nationally or Regionally At Risk or Threatened plant species recorded including the At Risk - Declining *Carex buchananii* which is most common in this community. Provides variable-quality habitat for a diverse array of Threatened and At Risk fauna species. **Diversity and pattern: Moderate** Ninety-two native plant species recorded. Limited heterogeneity and no sequences within this community **Ecological context: High** Most of this community within the ESA is higher altitude (above 700 m asl) and connected to a large tract of high montane / sub-alpine tussockland across Bendigo Station and extending further south along the Dunstan Range. The other large tract of this community is along the ridge between Shepherds Creek and Dry Creek catchments. The size, shape, and connectivity of these tracts allows for the protection and exchange of genetic material.	**High** 'High' for two matters and 'moderate' for two matters.
Native taramea herbfield and shrubland	**Representativeness: Moderate** This vegetation community, encompassing mainly taramea-tūmatakuru / matagouri but variable, has likely expanded following anthropogenic deforestation and loss of most tall tussocklands	**High** 'High' for two matters,

Habitat type	Assessment of ecological value attributes based on EIANZ guidelines	Assigned ecological value
	and is now typical in some high montane and low alpine areas of the ED. Highest proportion of native species coverage (48 %) compared to the rest of the vegetation communities within the ESA. **Rarity and distinctiveness: High** Contains 20 Nationally or Regionally At Risk or Threatened plant species including important populations of At Risk – Declining *Styphelia nana* and the regionally threatened *Pimelea prostrata subsp. Prostrata.* Provides variable-quality habitat for a diverse array of Threatened and At Risk fauna species. **Diversity and pattern: High** Eighty native plant species recorded in this community. Diversity of structure and species assemblage associated with aspect and management practices whereby exposed areas gradually transition to native tussock dominance, and sheltered areas or areas with more moisture transition to a more complete native scrub cover. **Ecological context: Moderate** Across the ESA, covers only small areas and so these have elevated importance locally. The most substantial tract is at the top of the Rise and Shine catchment	'moderate' for two matters.
Native dominant scrubland	**Representativeness: Moderate** There is no original forest left in the ED. The two forms of native dominant scrubland within the ESA (kānuka scrubland and grey shrubland), while not likely to be representative of an original ecosystem, are highly typical of present-day native vegetation communities within the ED. **Rarity and distinctiveness: High** Twenty-seven Nationally or Regionally At Risk or Threatened plant species recorded including the following species which were most common in this community: scented tree daisy (At Risk – Declining), desert broom (At Risk – Declining), *Coprosma virescens* (At Risk – Declining), and *Anthosachne aprica* (At Risk – Naturally Uncommon). Within the ESA, this community does not however contain expected woody species that are present in other areas of native scrub in the ED such as weeping matipo (*Myrsine divaricata*) and mountain akeake. Provides variable-quality habitat for a diverse array of Threatened and At Risk fauna species. **Diversity and pattern: High** High native diversity (107 plant species). Sequences most obvious on a gradient of moisture where gullies, riparian margins, and wetland margins contain elevated native diversity including	**Very High** 'High' for three matters and 'Moderate' for one matter.

Habitat type	Assessment of ecological value attributes based on EIANZ guidelines	Assigned ecological value
	species such as prickly shield fern (*Polystichum vestitum*), *Veronica salicifolia* and *Veronica rakaiensis*. Nodes of unique assemblages around tors and rock outcrops including species such as *Anthosachne aprica* (At Risk – Naturally Uncommon), *Carex penalpina*, creeping mapou (*Myrsine nummularia*), and Richard's spleenwort (*Asplenium richardii*). **Ecological context: High** The kānuka scrub within the ESA connects to one of the largest contiguous areas of *Kunzea serotina* in the Ecological Region. The native dominant grey scrub is well established in the incised gullies of Bendigo Creek and Clearwater Creek within Bendigo Historic Reserve and Bendigo Station, spanning for around 3 km in each gully from 600-1,000 m asl and up to 500 m wide, ensuring a resilient reservoir of species and genetic diversity. A tract of native-dominant scrubland in Shepherds Creek valley spans essentially unbroken for approximately 6 km from 400-800 m asl, enabling plant species to not only move within the community as it continues to mature, but for species to spread into pastoral areas to the north and south of the tract where conditions allow. Other small patches are also important nodes for recruitment of woody species and contribute to a wider network of stepping stones throughout the ESA. In the context of historic anthropogenic change and the virtual complete loss of native woody vegetation across the ED, this vegetation community forms an important component of local biodiversity.	
Seepage wetlands	**Representativeness: Moderate** Condition and 'naturalness' are low to moderate, with high stock impacts and high coverage of exotic species greater than typical for lowland wetlands in the Dunstan ED and Central Otago ER. **Rarity and distinctiveness: High** Indigenous vegetation in wetlands is National Priority 2 for protection. Only 10% of the original extent remains on a national level. Seepages are an endangered naturally uncommon ecosystem on a national scale, and therefore National Priority 3 for protection. **Diversity and pattern: Low** Low-moderate species and community diversity, with three dominant community types, primarily exotic. Grades into dryland and fen communities, but moderately-highly impacted by stock. **Ecological context: Moderate** Primarily small and compact, or moderate size and not compact. Vegetation or habitat of indigenous fauna that provides or contributes to an important ecological linkage or network, or	**Moderate** 'High' for one matter, 'moderate' for two matters and 'low' for one matter.

Habitat type	Assessment of ecological value attributes based on EIANZ guidelines	Assigned ecological value
	provides an important buffering function. Does not provide suitable habitat for mobile avifauna.	
Gully fens	**Representativeness: Low** Low to moderate condition and 'naturalness'. Degraded condition is fairly typical of lowland/montane wetlands in the Dunstan ED and Central Otago ER. **Rarity and distinctiveness: High** Indigenous vegetation in wetlands is National priority 2 for protection. Only 10% of the original extent remains on a national level. Three Regionally Threatened and two At Risk species were detected. **Diversity and pattern: Moderate** Moderate species and community diversity, primarily exotic. Grades into dryland, seepage and swamp/marsh communities, but moderately-highly impacted by stock. **Ecological context: Moderate** Primarily moderate in size and not compact (elongated). Unlikely to provide suitable habitat to mobile avifauna.	**Moderate** 'High' for one matter, 'moderate' for two matters and 'low' for one matter**.**
Swamps and marshes	**Representativeness: Moderate** Condition and 'naturalness' is moderate relative to other wetlands in the Dunstan ED and Central Otago ER, with native Carex sedgelands common, and stock impacts mostly moderate. **Rarity and distinctiveness: High** Indigenous vegetation in wetlands is National priority 2 for protection. Only 10% of the original extent remains on a national level. Swamps/marshes are uncommon in the ED and threatened nationally (only 6% of their original extent remains). Three Regionally Threatened species were detected. **Diversity and pattern: Moderate** Moderate species and community diversity. Gradients into marsh, dryland and fen communities, but moderately impacted by stock. **Ecological context: High** Moderate to large in area relative to other likely swamps/marshes in the valley floors in the ED. Potential to provide seasonal habitat to mobile avifauna and wetland invertebrates, but none detected (noting invertebrates were not specifically surveyed in wetlands).	**High** 'High' for two matters and 'Moderate' for two matters

Fifty-eight Nationally or Regionally Threatened or At Risk plant species were detected within the ESA, of which 48 were detected in the DDF. Ecological value is assigned for Threatened or At Risk flora species and notable fauna species in **Table 13** below.

Table 13: Ecological value for species present or potentially present in the ESA, based on EIANZ guidelines (*= fauna species presence detected in surveys)

Species	National threat status (NZTCS)	Regional threat status	Assigned ecological value (based on threat status)
Threatened and At Risk Flora			
Ceratocephala pungens	Threatened – Nationally Critical	Threatened - Regionally Critical	Very high
New Zealand Carrot *Daucus glochidiatus*	Threatened – Nationally Vulnerable	Threatened - Regionally Critical	Very high
Tiny forget-me-not *Myosotis brevis*	Threatened – Nationally Vulnerable	Threatened - Regionally Endangered	Very high
Coral broom *Carmichaelia crassicaulis crassicaulis*	Threatened – Nationally Vulnerable	Threatened – Regionally vulnerable	Very high
Stout dwarf broom *Carmichaelia monroi*	At Risk – Declining	Threatened – regionally critical	Very high
Carex kaloides	At Risk – Declining	Threatened - Regionally Endangered	Very High
Lagenophora barkeri	At Risk – Declining	Threatened - Regionally Endangered	Very High
Coprosma brunnea	At Risk – Declining	Threatened - Regionally Endangered	Very High
New Zealand Mousetail *Myosurus minimus novae-zelandiae*	At Risk – Declining	Threatened - Regionally Endangered	Very High
Carex talboti	At Risk – Declining	Threatened - Regionally Vulnerable	Very High
Bidibid / piripiri *Acaena buchananii*	At Risk – Declining	Threatened - Regionally Vulnerable	Very High
Buchanan's Sedge *Carex buchananii*	At Risk – Declining	Threatened - Regionally Vulnerable	Very High
Colobanthus brevisepalus	At Risk – Declining	Threatened - Regionally Vulnerable	Very High
Mikimiki *Coprosma virescens*	At Risk – Declining	Threatened - Regionally Vulnerable	Very High
Pimelea aridula aridula	At Risk – Declining	Threatened - Regionally Vulnerable	Very High
Raoulia beauverdii	At Risk – Declining	Threatened - Regionally Vulnerable	Very High

Species	National threat status (NZTCS)	Regional threat status	Assigned ecological value (based on threat status)
Celadon mat daisy *Raoulia parkii*	At Risk – Declining	Threatened - Regionally Vulnerable	Very High
Rytidosperma maculatum	At Risk – Declining	Threatened - Regionally Vulnerable	Very High
Blue Wheat Grass *Anthosachne aprica*	At Risk – Naturally Uncommon	Threatened - Regionally Vulnerable	Very High
Pimelea prostrata subsp. prostrata	Not Threatened	Threatened, regionally vulnerable	Very High
Carmichaelia petriei	At Risk – Declining	At Risk - Regionally declining	High
Epilobium hectorii	At Risk – Declining	At Risk - Regionally declining	High
Olearia lineata	At Risk – Declining	At Risk - Regionally declining	High
Desert poa *Poa maniototo*	At Risk – Declining	At Risk - Regionally declining	High
Common scabweed *Raoulia australis*	At Risk – Declining	At Risk - Regionally declining	High
Rytidosperma buchananii	At Risk – Declining	At Risk - Regionally declining	High
Hypericum involutum	At Risk – Declining	Regionally data deficient	High
Scented tree daisy *Olearia odorata*	At Risk – Declining	At Risk - Regionally declining	High
Styphelia nana	At Risk – Declining	N / A	High
Colobanthus strictus	Not Threatened	At Risk - Regionally declining	High
Feldmark grass *Rytidosperma pumilum*	Not Threatened	At Risk - Regionally declining	High
Juncus distegus	Not Threatened	At Risk - Regionally declining	High
Pincushion grass *Agrostis muscosa*	Not Threatened	At Risk - Regionally declining	High
Poa lindsayi	Not Threatened	At Risk - Regionally declining	High
Spineless acaena *Acaena inermis*	Not Threatened	At Risk - Regionally declining	High
Luzula leptophylla	At Risk – Naturally Uncommon	At Risk - Regionally Naturally Uncommon	Moderate
Myosotis antarctica subsp. *antarctica*	At Risk – Naturally Uncommon	At Risk - Regionally Naturally Uncommon	Moderate

Species	National threat status (NZTCS)	Regional threat status	Assigned ecological value (based on threat status)
Hot rock fern *Pellaea calidirupium*	At Risk – Naturally Uncommon	At Risk - Regionally Naturally Uncommon	Moderate
Poa incrassata	At Risk – Naturally Uncommon	At Risk – Naturally Uncommon	Moderate
Geranium aff. microphyllum	At Risk – Naturally Uncommon	Regionally Not Threatened	Moderate
Coastal woodrush *Luzula banksiana var. rhadina*	Data Deficient	At Risk - Regionally Naturally Uncommon	Moderate
Carex diandra	Not Threatened	At Risk - Regionally Naturally Uncommon	Moderate
Rock fern *Cheilanthes sieberi sieberi*	Not Threatened	At Risk - Regionally Naturally Uncommon	Moderate
Bladder Fern *Cystopteris tasmanica*	Not Threatened	At Risk - Regionally Naturally Uncommon	Moderate
Euchiton traversii	Not Threatened	At Risk - Regionally Naturally Uncommon	Moderate
Isolepis praetextata	Not Threatened	At Risk - Regionally Naturally Uncommon	Moderate
Myriophyllum pedunculatum subsp. novae-zelandiae	Not Threatened	At Risk - Regionally Naturally Uncommon	Moderate
Olearia bullata	Not Threatened	At Risk - Regionally Naturally Uncommon	Moderate
Olearia cymbifolia	Not Threatened	At Risk - Regionally Naturally Uncommon	Moderate
Pimelea notia	Not Threatened	At Risk - Regionally Naturally Uncommon	Moderate
Māori dock/runa *Rumex flexuosus*	Not Threatened	At Risk - Regionally Naturally Uncommon	Moderate
Hebe *Veronica rakaiensis*	Not Threatened	At Risk - Regionally Naturally Uncommon	Moderate
White fuzzweed *Vittadinia australis*	Not Threatened	At Risk - Regionally Naturally Uncommon	Moderate
Deschampsia chapmanii	Not Threatened	Regionally data deficient	Moderate
Festuca mathewsii subsp. mathewsii	Not Threatened	Regionally data deficient	Moderate
Geranium potentilloides	Not Threatened	Regionally data deficient	Moderate
Bristle grass *Rytidosperma corinum*	Data Deficient	Regionally Not Threatened	Moderate

Species	National threat status (NZTCS)	Regional threat status	Assigned ecological value (based on threat status)
Chaerophyllum ramosum	Data Deficient	Regionally Not Threatened	Moderate
Birds			
New Zealand falcon – eastern form*	Threatened, nationally vulnerable	Threatened, regionally vulnerable	Very high
Black-fronted tern	Threatened, nationally endangered	Threatened, regionally endangered	Very high
Black-billed gull	At risk, declining	Threatened, regionally vulnerable	Very high
South Island pied oystercatcher*	At Risk, declining	Threatened, regionally vulnerable	Very high
New Zealand pipit*	At Risk, declining	Regionally not threatened	High
Silvereye*	Not threatened	Regionally At Risk, declining	High
Black shag*	At Risk, relict	Regionally At Risk, relict	Moderate
Little shag	At Risk, relict	At Risk, relict	Moderate
Tomtit*	Not threatened	Not threatened (locally uncommon)	Moderate[51]
Bellbird	Not threatened	Not threatened (locally uncommon)	Moderate
Lizards			
Tussock skink *Oligosoma chionochloescens*	N/A *(Described after the NZTCS assessment for reptiles (Hitchmough et al. 2021; Jewell 2022c)*	At Risk, declining	High
Kawarau gecko (Woodworthia 'Cromwell')	At Risk, declining	At Risk, declining	High
McCann's skink *(Oligosoma maccanni)*	Not threatened	Not threatened	Low
Invertebrates			
Sporophyla oenospora	Threatened – nationally critical	N/A	Very high

[51] Tomtit is locally uncommon, and has therefore been assigned an ecological value of Moderate in accordance with EcIAG.

Species	National threat status (NZTCS)	Regional threat status	Assigned ecological value (based on threat status)
Homodotis sp. A	Threatened – nationally endangered	N/A	Very high
Pseudocoremia cineracia	Threatened: Nationally Vulnerable	N/A	Very high
Pasiphila sp. 'Olearia'	Threatened: Nationally Vulnerable	N/A	Very high
Harpalus new sp.	Potentially Threatened	N/A	Potentially high to very high
Inophloeus new sp.	Potentially Threatened	N/A	Potentially very high
Megadromus new sp. 1	Potentially Threatened	N/A	Potentially high to very high
Megadromus new sp. 2	Potentially Threatened	N/A	Potentially high to very high
Phaulacridium otagoense	At Risk, declining	N/A	High
Agrotis admirationis	At Risk, declining	N/A	High
Asaphodes recta	At Risk, declining	N/A	High
Elachista helonoma	At Risk, declining	N/A	High
Ichneutica toroneura	At Risk, declining	N/A	High
Nyctemera annulata	At Risk, declining	N/A	High
Paranotoreas fulva	At Risk, declining	N/A	High
Ichneutica sistens	Uncommon	N/A	High
Meterana exquisita	Uncommon	N/A	High
Scythris sp. 1	Not Assessed – of importance	N/A	High

7.3 Magnitude of effects assessment

The magnitude of effects on ecological values is assessed based on the extent, intensity, duration and timing of effects associated with the project. This 'Magnitude of Effects' assessment (**Appendix 2, Table B.2**) is independent of the 'Ecological Value' assigned to each habitat/vegetation type and species.

A general overview of the types of adverse effects potentially associated with the Project is provided below. Section 7.3.2 then details corresponding measures to further avoid, minimise/mitigate or remedy these effects. This is followed by a comprehensive assessment of the 'Magnitude of Effects' for each value (Section 0). Magnitude is assessed

after implementation of the proposed avoidance, minimisation/mitigation or remediation measures.

7.3.1 Potential ecological effects

The construction and operation of the BOGP has the potential to result in a range of adverse effects on terrestrial and wetland ecological values pre application of the effects management hierarchy.

In broad terms, potential adverse effects of mine construction may include:

- Loss of vegetation and terrestrial and wetland habitats due to vegetation clearance, soil stripping, earthworks, and the deposition of overburden, waste rock, or tailings.
- Habitat fragmentation and loss of ecological connectivity. For flora, this can potentially lead to smaller, isolated populations which are less resilient and more prone to degradation, disturbance, and local extinction. This may be particularly relevant to species that already have a small and /or vulnerable population within the ESA or the ED such as *Acaena inermis*, *Anthosachne aprica*, *Carex talbotii*, *Ceratocephala pungens*, *Hypericum involutum*, *Myosotis brevis*, *Myostis antarctica* subsp. *antarctica*, *Olearia bullata*, *Olearia lineata*, *Pimelea aridula* subsp. *aridula,* and Māori dock / runa.
- Reduced wetland condition resulting from altered surface and groundwater flows (e.g. dewatering halos around mine pits), vegetation removal, and potential declines in water quality and flow regimes affecting seepages and wetlands.
- Creation of habitat edge effects and altering of the composition and health of adjacent vegetation (i.e. habitat degradation), which may affect habitat suitability for flora and fauna.
- Loss of or harm to species associated with vegetation clearance or earthworks activities, including loss of individual plants (nationally or regionally 'Threatened and 'At Risk' species) and loss of seed bank.
- Risk of nest destruction during habitat clearance, and loss of eggs and chicks.
- Disturbance associated with construction-related noise, vibrations, dust and lighting. This includes artificial night lighting (areas of the mine are 24/7 operations and the area otherwise has no artificial light) and the potential for disruption of ecological processes.
- Alteration to farming practices that may result in change to vegetation communities. For instance reduced grazing intensity may result in exotic species coverage increasing and vulnerable native species coverage decreasing, particularly for the 'Mixed depleted herbfield (cushionfield) and exotic grassland' community. Removal of cattle is expected to reduce pugging and disturbance to wetlands but may decrease wetland extent.
- Secondary (indirect) habitat loss through changes to local hydrology, including dewatering of surface-water-fed and groundwater-fed wetlands (seepages, fens,

swamps, and marshes) due to mine pit drainage, water abstraction, road drainage, or diversion of ephemeral stream flows. De-watering halos around mine pits are estimated by the DDZ (BOGP Wetland Drawdown Assessment).

- Facilitation or exacerbation of the spread of exotic/invasive plants or animals through the landscape.

Pre mitigation, potential long-term ongoing adverse ecological effects during mining operations may include:

- Ongoing terrestrial and wetland habitat degradation associated with habitat loss, edge effects, fragmentation and loss of connectivity, which permanently affect movement of some species, with possible effects on meta-population dynamics and increased vulnerability to local extinction.
- Ongoing disturbance effects through noise, vibration (including blasting) and dust. Blasting is expected 4–5 times per week, generating noise levels up to 114 dB L_{Zpeak} at 1 km from the source and 90–100 dB L_{Zpeak} up to 4 km, covering most of the ESA except Dry Creek catchment. Vibration is predicted at 2 mm/s up to 2.7 km. Topography is likely to reduce noise levels in some areas. For birds, this disturbance can potentially reduce breeding success or displace individuals. Mine blasting can also create potential disturbance effects on the high avifauna values at the Bendigo wetland and Lake Dunstan, located 8.5 kilometres west.
- Effects of artificial light at night on invertebrates and crepuscular/nocturnal birds.
- Mortality or injury associated with road kills or blasting.
- Potential electrocution risk to falcon from transmission lines, and to black shag and little shag where those lines are near wetlands.
- Direct mortality through collision, particularly for falcon which may collide with high fences, windows, and power lines.
- Risk of nest destruction during habitat clearance, and loss of eggs and chicks.
- Decreased resilience of remaining nearby ecosystems where introduced weeds and animal pests have become established due to mining activities.
- Ongoing effects on water quality in wetlands through sedimentation or contamination.
- Any biophysical effects of the proposal may also affect mana whenua values.

The magnitude of potential effects for key flora and fauna species, following effects avoidance, minimisation/mitigation and rehabilitation measures, is assessed below.

7.3.2 Effects avoidance, minimisation/mitigation and remediation

The proposal has been designed to avoid adverse effects on terrestrial and wetland values to the extent practicable, and to otherwise remedy or minimise effects.

7.3.2.1 Effects avoidance and minimisation/mitigation measures

The avoidance or minimisation of adverse effects is limited by the functional constraints of the four identified gold deposit locations, and in turn the mining footprint. Additionally, the placement of waste rock and tailings is restricted to potential sites near the mining pit(s).

Measures to avoid or minimise potential adverse effects on terrestrial and wetland values include:

- Avoiding impacts on high-value habitats and associated 'Threatened' and 'At Risk' plant species by refining the DDF—within the functional constraints of the identified gold deposit locations—and carefully siting infrastructure such as access roads, sediment ponds, the processing plant, and other ancillary components. This refinement includes:
  - Design refinement of the relocated section of Thomson Gorge Road (Ardgour Rise Alignment) to avoid the airstrip area where the nationally Threatened moth *S. oenospora* was recorded. The new alignment is a minimum of 250 m from the originally proposed alignment and traverses habitat with markedly different vegetation structure and plant species composition, reducing the likelihood of adverse effects on this species.
  - Delaying open-cast mining of the 23.26 ha CIT Pit to allow implementation of a cushionfield and spring annuals research programme. The CIT pit and associated haul road provide habitat to the endemic spring annuals *Ceratocephala pungens* (Threatened, nationally critical) and *Myosotis brevis* (Threatened, nationally vulnerable). Population estimates within the CIT Pit are at least 111 individuals (*C. pungens*) and at least 500 individuals (*M. brevis*), comprising 19.2% and 2.75% of the known national populations respectively. Except for a 2.7 ha early-disturbance area required for enabling works, mining within the CIT Open Pit is proposed to proceed only if populations of these Threatened spring annuals within the CIT Open Pit footprint are less than 1% of the known populations within the Dunstan Ecological District ("**ED**"), demonstrated via either:
    - Propagation and species recovery at offset/compensation sites, as informed by the Applied Research Plan for Conservation Management, Rehabilitation and Expansion of Cushionfield ("ARP"); or
    - The discovery of further spring annual populations within the wider Dunstan ED.

    While the numbers within and outside the footprint are heavily influenced by survey effort and inter-seasonal variation, this CIT delay has reduced the magnitude of impact considerably.
  - Avoidance of wetland loss where feasible. Through an iterative process, infrastructure plans have been altered significantly to avoid loss of most of the 2.59 ha swamp/marsh habitat in the Rise and Shine Creek Valley floor.

  - Minimising potential drawdown effects on surface-water fed swamp/marsh wetlands in the RAS Valley floor by augmenting flows to these wetlands as detailed in the Mine Impacted Water Management Plan[52].
  - Positioning spoil sites and certain infrastructure away from 'mixed depleted herbfield (cushionfield) and grassland' and other high-value habitats where possible.
  - Refining stockpile and infrastructure locations to reduce impacts on key ecological features, including kōwhai trees, taramea, and rock outcrops.
  - Design of slopes to minimise infrastructure footprints, including the use of retaining (rather than side-casting) for the approximately 8 km Ardgour Road Realignment; and refining pit walls to minimise footprints, e.g. RAS Open Pit eastern wall.
  - Minimising road width through use of single lanes (rather than double carriage).
- Measures to minimise risk of electrocution and collision with buildings, high fences and power lines.
- Surveying indigenous bird nests prior to vegetation clearance during the bird breeding season (September to March inclusive) and establishing buffers to minimise the loss of native bird nests, eggs and chicks. Vegetation clearance will cease within the following buffer widths until chicks have fledged:
  - 200m for kārearea / eastern falcon
  - 50m for pīhoihoi/pipit or any other 'Threatened' and 'At Risk' (or higher) bird species; and
  - 30m for all indigenous bird species with a non-threatened classification.
- Lighting management protocols to minimise effects on wildlife that are specific to operational areas including:
  - Fixed Lighting - Camp and Office Areas:
    - Low-output, warm-coloured LED lighting at 3,000K
    - Discrete building-mounted lighting with bollard support to limit horizontal and vertical light spill
    - Automated timing controls, dimming functions, and movement sensors to reduce unnecessary luminance.
  - Fixed Lighting - Plant and Infrastructure Areas:
    - Horizontal and upward lighting fixture controls to contain light spill where feasible.
  - Mobile Wide Area Lighting - Plant, Infrastructure, Access Roads, and Mining Areas:

[52] Other wetlands within the DDZ, such as hillside seepages or gully fens, are excluded from this augmentation plan and are assumed to be impacted

- Salvaging specific notable plant species, lizards (tussock skink, Kawarau gecko and McCann's skink) and certain invertebrates to appropriate relocation sites that have been enhanced, which include all rehabilitation and offset/compensation areas. Salvaging will occur in high-value lizard habitat during warmer months when lizards and invertebrates are active and easier to detect, and when their chances of survival in relocation sites are highest.
- Salvage of non-threatened plant species as live transplants to wetlands and tussocklands into the ecological rehabilitation areas with a minimum of 0.5 ha for wetlands and 25,000 tussocks salvaged[53].
- Salvaging and relocating of habitat features (e.g. wood, weathered boulders), with their direct use to enrich edges of contingency zones (where nearby) and available rehabilitation areas, and otherwise their storage in stockpiles for later use in rehabilitation and deployment in offset/compensation sites.
- Constructing stockpiles with an outer-most layer of stripped vegetation and soil and maintaining stockpiles in ways to promote regeneration of native plant species.
- Development of a mine schedule that provides for stripping and storage of soil, root zones, and rehabilitation resources on areas of engineered landform (ELF).
- Minimising the potential for sedimentation and erosion; and the use of sediment settling ponds.
- Minimising heavy metal contamination in the waste rock and tailings stack runoff. Ensuring water quality in receiving waters and water quality and hydrology in wetlands support the planned native plant establishment and growth, and wetland ecological values.

Details on effects avoidance and minimisation methodologies will primarily be required by conditions requiring compliance with the following management plans:

- Habitat Impact Management Plan
- Avifauna Management Plan
- Lizard Management Plan
- Terrestrial Invertebrate Management Plan
- Landscape and Ecological Rehabilitation Management Plan
- Biosecurity and Plant Pest Management Plan
- Matakanui Sanctuary Management Plan

[53] Salvage of live Threatened or At Risk plants from the DDF is restricted to wetland plants and some shallow-rooted grasses, as most woody plants have deep root systems (1-3m or more) that cannot be salvaged intact. The large MRZ is the source of most plant propagules and is managed to enhance the health and natural expansion of many threatened plant species. This provides flexibility for seed collection that is likely to maintain the local genetic variability of most plant species except for wetland species. The MRZ therefore acts an enhanced 'nursery stock population' of mature plants with their natural pollinators. The exception is the three spring annual herbs listed in the ARP as a large proportion of their populations is within the DDF.'

- Ardgour Restoration Area Management Plan
- Mammalian Pest Control Management Plan
- Erosion and Sediment Control Management Plan
- Water Management Plan
- Biodiversity Outcome Monitoring Plan
- Applied Research Plan for conservation management, rehabilitation and expansion of cushionfield.

7.3.2.2 Remediation measures

7.3.2.2.1 Overview of approach and constraints

After efforts to avoid or minimise adverse effects, the project will still result in the loss of 610 ha[54] of variable quality habitat and associated species that includes:

- 79.3 ha of low value exotic pasture and herbfield
- 103.8 ha of very high value mixed depleted herbfield (cushionfield) and grassland (or up to 81 ha if the CIT pit mining does not proceed under the proposed consent conditions relating to spring annual populations (section 7.3.2.1 above).)
- 187.4 ha of moderate value mixed tussock, shrubland and exotic grassland
- 124.1 ha of moderate value mixed scrubland
- 25.3 ha of high value native dominant tussockland
- 1.86 ha of high value native taramea herbfield and shrubland
- 85.6 ha of very high value native dominated scrubland
- 0.19 ha of moderate value seepage wetlands
- 0.84 ha of moderate value gully fen wetlands
- 2.42 ha of high value swamp/marsh wetlands.

Proposed remediation measures within the DDF are detailed in the Landscape and Ecological Rehabilitation Management Plan ('**LERMP**').

The ecological objective of the rehabilitation proposed is to enhance biodiversity and ecological resilience within the DDF and adjacent MRZ[55] relative to pre-BOGP mining conditions, with the caveat that rehabilitation outcomes for cushionfields and spring annual herbs are highly uncertain and may result in losses. Landforms and land cover will

[54] The 23.26 ha CIT Open Pit is included in the DDF but, with the exception of a 2.7 ha early disturbance area required for enabling works, will be mined only in accordance with outcomes of the ARP as detailed in proposed conditions of consent.
[55] The habitat restoration and enhancement measures undertaken in the MRZ is treated as offsetting/compensation though these effects will also contribute to the ecological rehabilitation of the mine footprint and will also serve to minimise edge and disturbance-related effects that will occur in habitats adjacent to the DDF.

be rehabilitated to reflect the coarse, heterogeneous mosaics typical of native-dominated Central Otago ecosystems.

Rehabilitating native-dominated Central Otago ecosystems requires tailored management across the ESA, reflecting the mosaic of vegetation types. For example, removing browsing mammals can support the recovery of some native plants and invertebrates but may also encourage woody weed and non-native pasture growth. Similarly, continued grazing may help maintain cushionfields and spring annual herbs, but degrades other ecosystems by limiting native regeneration. Management strategies are therefore varied to seek to enhance overall ecological values across the landscape relative to what is currently present.

Ecological rehabilitation will be guided by site constraints and stressors, including climate—particularly drought, cold temperatures, high summer heat, and elevated evapotranspiration—along with fire risk and topographic challenges such as aspect, slope, and elevation. Building resilience to climate change is a guiding principle.

This approach will support the recovery of native plant, bird, lizard and invertebrate communities—including species that are nationally Threatened or At Risk, or of cultural importance.

7.3.2.2.2 Rehabilitation in the DDF

Key ecological remediation measures will be implemented across all available areas (480 ha) within the DDF (**Appendix 1, Figure 8**), excluding the majority of the two permanent pit lakes[56], the majority of pit walls, and permanent infrastructure (roads and water treatment facilities).

In summary, ecological rehabilitation will involve targeted actions in specific land management units (LMUs), and the 480 ha of ecological rehabilitation within the DDF will include:

- Re-establishing four indigenous terrestrial vegetation communities, including native grey shrubland (230 ha); tussockland (222 ha); taramea-dominated herbfield (2 ha); and cushionfields (19 ha experimental habitat restoration as guided by the applied research programme).
- Re-establishing indigenous wetland communities totalling 7.5 ha, comprising at least 2 ha of swamp wetlands (including 0.5 ha of open water) and 4 ha of marshlands on the TSF, along with three smaller areas of marsh/swamp wetland (of at least 0.4 ha each): Ardgour Terrace, Lower Shepherds and Processing Plant.
- Deployment of at least 1 rocky outcrop /scattered rock complex per ha of DDF, totalling at least 1 ha across the DDF along with the creation of at least 1 rock rubble pit per 5 ha of DDF totalling 0.5 ha across the DDF. Collectively the deployment of these rock features will provide high value habitat for lizards, select threatened or at risk

[56] The RAS and SRX pit lakes will be deep and steep-sided with minimal marginal vegetation and rock-influenced water chemistry

invertebrates, and favourable environment for establishing plants. Deliver at least 5% rock cover excluding wetlands and pit lakes.

- Returning viable lizard and invertebrate habitat including using plant species with known associations for Threatened and At Risk invertebrates where feasible.
- Establishing at least 24 reproductively functional kōwhai clusters in the DDF[57]. There are currently approximately 40 individuals currently surviving within the ESA and 12 individual trees or clusters in the DDF from which seeds can be propagated.
- Efforts to re-establish up to 19 ha of cushionfield vegetation, including:
  - Initial cushionfield trial slopes in the Western Engineered Landform (WELF) – a maximum 5 ha area[58] located west of RAS pit, constructed within the first two years of mine life.
  - If the WELF trials are successful, cushionfield trials will also be established on suitable areas of Shepherds ELF (large areas) and potentially on soil stockpiles.

Cushionfield re-establishment in all other areas, including the CIT pit (if mined in accordance with the ARP), will be dependent on the success of the trials and other outputs of the **ARP**. The **ARP** includes development of techniques for propagation and establishment of both spring annuals and *Raoulia* (cushionfield) species alongside understanding suitable root zones and landforms. If mined, the CIT pit will include a minimum 4.5 ha of the 13.8 ha backfilled Pit that has the greatest potential to support cushionfields and spring annuals.

Rehabilitation outcomes within the DDF will be supported by management actions including specific pest animal and browser management, targeted pest plant control, establishment of salvaged and nursery-grown plants, and facilitation of natural establishment and spread of targeted native plants, including control of competing plants and specific micro-site preparation if needed.

7.3.2.2.3 Rehabilitation of adjacent Mine Regeneration Zones

Ecological enhancement of habitats within the adjacent MRZs (889 ha) is designed to facilitate DDF rehabilitation by providing a continuous and diverse source of native propagules and colonising fauna, and limiting sources of undesirable plants (**Appendix 1, Figure 9).**

This approach recognises that in this relatively harsh environment successful and timely remediation is facilitated by natural regeneration from adjacent high-quality (unstripped) areas, and this regeneration is enhanced where existing pressures that limit propagule production are removed (e.g. by reducing predation and browsers and enhancing populations of native animals – pollinators and dispersers). Although enhancement of the MRZ supports recovery of the DDF, enrichment planting of the MRZ is primarily considered

[57] There are approximately 40 individuals currently surviving within the ESA that will be lost and of these there are 12 individual trees or clusters in the DDF from which seeds can be propagated.
[58] The initial cushionfield trial area in the WELF is restricted to suitable aspects and slopes, which comprise a maximum 5 ha of the WELF.

biodiversity offset/compensation for the purposes of this report, as the benefits do not directly reduce the severity of adverse effects at the point of impact (i.e. within the DDF). As such, enhancement within the MRZs is addressed primarily in Section 8.3.3 below.

7.3.2.2.4 Timing and outcomes of rehabilitation

The outcomes of rehabilitation at closure are strongly influenced by actions undertaken in the first few years (including the quality of vegetation, root zones and habitat features stripped in these years); therefore early implementation is planned where possible. The timing of rehabilitation in relation to mining commencement is detailed in the LERMP, and is broadly as follows:

- Rehabilitation will occur progressively as final edges and landforms become available, beginning with stream diversions and enhancement of final edges.
- Initial rehabilitation — including the 18 ha Western ELF in which cushionfield and spring annual field trials will take place and methods for constructed rock stacks and rubble pits refined — will be completed within the first 2–3 years, with the SRX – Elf (15.8 ha) then completed.
- Lower Shepherds and Ardgour Terrace wetlands (both ca. 0.5 ha) will be established in year 1.
- Enrichment of MRZs will begin early and continue throughout the life of the consent.
- Most rehabilitation will occur post-mining, including the majority of the Shepherd's ELF, the TSF and associated soil and brown rock sources (some of which are sourced from Shepherd's ELF), which cannot begin until tailings deposition ceases. At least 6 ha of wetlands including 0.5 ha of open water will be established on the TSF at mine closure.
- Ongoing rehabilitation management is planned for at least 20 years post-mining and throughout the life of the mine (35 years total). Due to Central Otago's harsh and variable climate, planting and seeding success will vary from year to year across the site, i.e, planting success on exposed sites likely lower in dry years and seeding success potentially lower in more fertile sites in wet years due to increased competition from pasture.

Within the 480 ha rehabilitation area of the DDF, ecological outcomes are expected to vary across habitat types. An overall increase in the extent and quality of indigenous-dominated habitats—particularly grey scrub, native tussockland, rock tors, wetlands, and ecologically-important features such as taramea herbfields and kōwhai groves—is anticipated. Quality is quantified as enhanced native species diversity, dominance and structural complexity in scrub-dominated habitats. A notable exception, however, is that outcomes for depleted herbfield/cushionfield communities remain more uncertain.

These outcomes are subject to time lags and natural variability, and there is an inherent degree of uncertainty—particularly regarding cushionfields and, more broadly, for terrestrial invertebrate fauna.

Table 14 below summarises the proposed rehabilitation measures for the ecological values in the ESA. Detailed ecological rehabilitation methods and the rehabilitation programme are set out in the LERMP.

It is also acknowledged that there will likely be both gains and losses for individual Threatened or At Risk plant and fauna species at mine closure, as outlined in **Table 15,** particularly for species that have very low densities and that are not planned to be introduced as nursery seedlings. In particular, there may be losses of spring annual herbs.

Section 8 addresses residual effects management (biodiversity offset and compensation) for species that cannot be rehabilitated

Table 14: Summary of remediation measures for ecological values in the DDF

Rehabilitation type	Areal extent	Conservation actions/ rehabilitation approach
Native grey shrubland	230 ha	Shrubs are established as small clusters or 'nodes' throughout the majority of the DDF, i.e. all areas other than cushionfield, highwalls, pit lakes or wetlands and generally centred on rock stacks and rubble pits (which created sheltered microsites). Kowhai nodes and 0.5 ha of 'forest' in deeper soils on protected sites on lower slopes and valley floor respectively will also be established. Over time shrubs are expected to spread along with tussock under the management regime of no grazing, with shrubs dominating in less drought-stressed (shadier, wetter parts of the landscape with deeper root zones and shelter, e.g. south-facing slopes of Western ELF). While mixed shrubland will be the dominant outcome for the first 20 to 35 years, these areas are expected to transition to 'native dominant scrubland' over 50 to 100 years[59].
Tussockland	222 ha	Short tussock will be re-established across the site in scattered patches rather than forming large tussock-dominated areas. Establishment will occur through small clusters or 'nodes' planted throughout most of the DDF—excluding cushionfield areas, highwalls, pit lakes[60], and wetlands. At least 25,000 large tussocks will be salvaged from the DDF and transplanted into rehabilitated areas. These will be supplemented with planting of nursery-grown tussock. Tussocks are expected to spread and expand over time, particularly in the drier, more exposed parts of the landscape, under a no-grazing management regime to reach a minimum 20% cover by closure.

[59] Given the absence of case studies/data on rehabilitation in these areas, outcomes are inferred from aerial photographs showing natural regeneration of grey shrubland from aerial imagery that shows an increase of 10-60 % in woody vegetation cover in suitable locations (i.e., some existing woody vegetation, and not north facing) over an 18-year period between 2003 and 2021 in grazed (Dry Creek Conservation Area) and ungrazed areas (Ardgour Station)(RMA Ecology Vegetation report Appendix 2).
[60] The RAS and SRX pit lakes will be deep and steep-sided with minimal marginal vegetation and rock-influenced water chemistry

Rehabilitation type	Areal extent	Conservation actions/ rehabilitation approach
Taramea-dominated shrubland	2 ha	Targeted area established with native taramea being dominant. (Excludes Ardgour Rise Rd) *Note: Additional 4 ha of taramea-dominated shrubland to be established in MRZ A1 and B3 through combination of removal browsers, facilitating natural expansion and planting of nursery-raised seedlings.*
Cushionfields and spring annual herbs	Up to 19 ha of experimental trials	Cushionfield and spring annual field trials will be undertaken initially in the Western Engineered Landform (WELF) – a maximum 5 ha area located to the west of RAS pit, with trials on suitable slopes and aspects to be undertaken by year 3. If the WELF trials are successful, cushionfield trials will also be established on suitable areas of Shepherds ELF (large areas) and potentially on soil stockpiles, bringing the total trial area to 19 ha. Cushionfield re-establishment in all other areas will be dependent on and guided by the success of the ARP. This includes cushionfield establishment in the backfilled CIT open pit – a minimum 4.5 ha of suitable landforms and aspect within the 13.8 ha area (if CIT pit is mined in accordance with the ARP). Rehabilitation also includes most notably the control of competing plants such as brier.
Swamps and marshes	7.5	A minimum of three 0.4-0.5 ha wetlands established using salvaged material in years 1 and 2 (Lower Shepherds Wetland and Ardgour Terrace Wetland) At least 6 ha of wetlands to be established at TSF at the end of mining (2 ha swamp and 4 ha marsh) within which 0.5 ha of open water will be present at the seasonal maxima (spring). Pest plant control initially to help native plants to establish and ongoing control of all woody non-native plants in perpetuity to ensure stability of capping layers
Kowhai clusters	At least 24 nodes with 480 kowhai trees	At least 24 Kowhai nodes, each containing a minimum of 24 established, genetically-diverse kowhai seedlings (actively growing over 5 years and >1 m height). Each node will contain seedlings grown from at least 10 different clusters which includes clusters outside the DDF and clusters outside Ardgour. Kōwhai provide important habitat for lizards and native nectar-feeding birds—key seed dispersers for several native plant species. At least 0.5 ha of 'forest' in valley floor.
Rock outcrops, rocks stacks and rubble pits	1.5 ha	Deployment of at least 1 rocky outcrop /scattered rock complex per ha of DDF, totalling at least 1 ha across the DDF along with the creation of at least 1 rock rubble pit per 5 ha of DDF totalling 0.5 ha across the DDF. Collectively the deployment of these rock

Rehabilitation type	Areal extent	Conservation actions/ rehabilitation approach
		features will provide high value habitat for lizards, select threatened or at risk invertebrates, and favourable environment for establishing plants

Table 15: Rehabilitation approach for Threatened and At Risk flora species in ESA, and expected outcome[61] within DDF (within 35 years of approval being granted)

Species	Rehabilitation approach, type, and quantum of effort within the DDF	Expected outcome within DDF
Bidibid / piripiri *Acaena buchananii*	Not planted in MRZ as existing seed sources in most vegetation associations. Colonisation from existing seeds sources that are present in most vegetation associations in the MRZ is expected.	Rehabilitated
Spineless acaena *Acaena inermis*	Establishment of at least 50 plants within the DDF	Rehabilitated
Blue Wheat Grass *Anthosachne aprica*	Salvaged within tussock sods (*Festuca nz*) which are innoculated into DDF; Grown from division to establish 10 seedlings in DDF	Rehabilitated
Buchanan's Sedge *Carex buchananii*	The establishment of 300 nursery-grown plants into DDF moist areas (e.g. TSF swales); Increase in MRZ in short term with grazing removal; readily available	Rehabilitated
Carex diandra	Establishment of 400 plants within created wetlands in the DDF (obligate wetland)	Rehabilitated
Carex kaloides	Salvage within 0.5 ha of direct transfer to Ardgour Terrace wetland. 200 nursery-grown seedlings planted in rehabilitated wetlands on DDF (obligate wetland)	Rehabilitated
Stout dwarf broom *Carmichaelia monroi*	Not present in the DDF but will be part of the rehabilitation via the Establishment of 10 plants into the DDF coupled with natural from the MRZ by removal of browsing pressure	Rehabilitated
Desert broom *Carmichaelia petriei*	Establishment of at least 2,000 plants within rock stacks and rabbit proof exclosures in the DDF	Rehabilitated
Coprosma brunnea	Not present in the DDF but will be part of the rehabilitation via the he establishment of 500 plants into the DDF rock stacks and rubble pits	Rehabilitated
Festuca mathewsii subsp. mathewsii	Establishment of at least 500 plants within the DDF; commonly grown by nurseries	Rehabilitated
Mikimiki *Coprosma virescens*	The establishment of at least 500 plants into DDF	Rehabilitated

[61] Species have only been proposed for establishment where there is evidence that propagation by seed or division using nursery plants, or transplants are likely to be successful, that the plant material sources can be found in the DDF (divisions/transplants) or MRZ (seed/cuttings) and that the root zones and microsites planned will include areas favourable for the species to establish.

Species	Rehabilitation approach, type, and quantum of effort within the DDF	Expected outcome within DDF
Geranium aff. microphyllum	Establishment of at least 100 plants within the DDF. Small herb, also likely to self-establish as it is in all 7 terrestrial vegetation associations including pasture.	Rehabilitated
Geranium potentilloides	Not targeted. Small herb, likely to self-establish as it is in all 7 terrestrial vegetation associations including pasture	Rehabilitated
Juncus distegus	This 25 to 75 cm rush with tightly packed stems is likely to persist and could expand with removal of grazing; Easily propagated by fresh seed and division but has very specific site preferences. Establishment of at least 100 plants within the DDF and spread from existing plants in the Mine Regeneration Zone' (the spread may not be from seed but from vegetative expansion)	Rehabilitated
Olearia bullata	Establishment of 10 plants in the DDF and also planted in MRZ and seeds spread by wind so expected to recolonise DDF	Rehabilitated
Olearia cymbifolia	Not present in the DDF but will be part of the rehabilitation via the as it will be planted into MRZ and seeds spread by wind so expected to recolonise DDF	Rehabilitated
Olearia lineata	Establishment of 500 plants within the DDF	Rehabilitated
Scented tree daisy *Olearia odorata*	Establishment of 10,000 plants within the DDF	Rehabilitated
Pimelea aridula aridula	The establishment of at least 500 plants in DDF rock stacks	Rehabilitated
Pimelea prostrata subsp. prostrata	Establishment of at least 500 plants within rock stacks in the DDF	Rehabilitated
Pimelea notia	Establishment of at least 50 plants within rock stacks in the DDF	Rehabilitated
Māori dock/runa *Rumex flexuosus*	Tall herb to 25 cm. Establishment of at least 10 plants; transplant rhizomes within large sods (>0.5 by 0.5*0.5 m).	Rehabilitated
Bristle grass *Rytidosperma corinum*	A minimum of 500 propagated plants will be established in the DDF and plants are expected to self-establish in suitable areas of DDF through wind-blown seed from adjacent MRZ as this species has a wide distribution	Rehabilitated
Styphelia nana	Establishment of 500 plants within rock stacks in the DDF	Rehabilitated
White fuzzweed *Vittadinia australis*	Establishment of at least 100 plants in the DDF/ Also this species may be palatable so likely to increase in areas with reduced grazing, wind-dispersed seed.	Rehabilitated

Species	Rehabilitation approach, type, and quantum of effort within the DDF	Expected outcome within DDF
Epilobium hectorii	Small herb. Establishment of a minimum of 100 plants through propagation and re-introduction will be undertaken, also this species is wind dispersed and grows readily in suitable conditions (open stony ground) so expect to naturally self-establish to suitable areas of DDF	Rehabilitated
Rock fern *Cheilanthes sieberi sieberi*	Not planted, wind-dispersed spores allow self-establishment and existing seed sources in most vegetation associations; Trial rhizome salvage to DDF rock stacks	Uncertain
Bladder Fern *Cystopteris tasmanica*	Establishment of at least 100 plants within the DDF. Also probably palatable (10-40cm leaves) and wind-dispersed spores will self-establishment with existing seed sources in most vegetation associations so likely to expand in DDF rock outcrops where grazing is stopped	Uncertain
Rytidosperma maculatum	Applied Research Management for cushionfields	Uncertain
Feldmark grass *Rytidosperma pumilum*	Planted in low numbers in DDF with rock stacks. Orange fruited so if established may be lizard-dispersed. Not commercially propagated so will be a trial species. Likely to gradually reduce in sites where grazing is withheld.	Uncertain
Coastal woodrush *Luzula banksiana var. rhadina*	Not attempted (small herb, likely to self-establish as it is in all 7 terrestrial vegetation associations including pasture)	Uncertain
Pincushion grass *Agrostis muscosa*	Cushion grass spread by wind and water. Likely overtopped by taller native species when seepages are destocked	Assumed to not be rehabilitated
Carex talboti	Very small sedge, will not be propagated, on the basis it is likely to be overtopped in areas where grazing is stopped.	Assumed to not be rehabilitated
Ceratocephala pungens	Intensive Applied Research Plan (research programme for spring annuals and cushionfields, to refine criteria for protection or salvage and rehabilitation).	Assumed to not be rehabilitated
Chaerophyllum ramosum	Not attempted (small herb often in wetter sites, rehabilitation not attempted as it is likely to decrease in seepages when stock are removed).	Assumed to not be rehabilitated
Colobanthus brevisepalus	Applied Research Management for cushionfields with propagation of species by division.	Assumed to not be rehabilitated

Species	Rehabilitation approach, type, and quantum of effort within the DDF	Expected outcome within DDF
Colobanthus strictus	Applied Research Management for cushionfields	Assumed to not be rehabilitated
Hypericum involutum	Open herb up to 25 cm, wind-dispersed. Easily grown but not commercially available. Propagation and re-introduction of 100 plants will be undertaken though the outcomes of ecological rehabilitation are uncertain	Assumed to not be rehabilitated
Lagenophora barkeri	Not attempted (very small herb, probably propagated by transplanting but rehabilitation not attempted as difficult to maintain free of competition). Wind-dispersed daisy which may self-establish in suitable sites.	Assumed to not be rehabilitated
Luzula leptophylla	Not attempted (very small herb, probably propagated by transplanting but rehabilitation not attempted as it is difficult to maintain free of competition)	Assumed to not be rehabilitated
Myosotis antarctica subsp. *antarctica*	Applied Research Management for cushionfields	Assumed to not be rehabilitated
Tiny forget-me-not *Myosotis brevis*	Intensive Applied Research Plan (research programme for spring annuals and cushionfields, to refine criteria for protection or salvage and rehabilitation).	Assumed to not be rehabilitated
New Zealand Mousetail *Myosurus minimus novae-zelandiae*	Intensive Applied Research Plan for cushionfields	Assumed to not be rehabilitated
Myriophyllum pedunculatum subsp. novae-zelandiae	Not attempted (mat forming herb, easily propagated by divisons/stems and seed but difficult to maintain free of competition)	Assumed to not be rehabilitated
Hot rock fern *Pellaea calidirupium*	Not planted, wind-dispersed spores allow self-establishment. Cushionfields Applied Research Plan	Assumed to not be rehabilitated
Poa lindsayi	Small fine grass similar to *P. maniototo*, not proposed for management, as it is likely to reduce in areas where stock grazing is reduced as other plants thicken and be maintained in MRZ B1	Assumed to not be rehabilitated
Desert poa *Poa maniototo*	Small fine grass, not proposed for management,	Assumed to not be rehabilitated
Common scabweed *Raoulia australis*	Applied Research Management for cushionfields	Assumed to not be rehabilitated

Species	Rehabilitation approach, type, and quantum of effort within the DDF	Expected outcome within DDF
Raoulia beauverdii	Applied Research Management for cushionfields	Assumed to not be rehabilitated
Celadon mat daisy *Raoulia parkii*	Applied Research Management for cushionfields	Assumed to not be rehabilitated
Rytidosperma buchananii	Applied Research Management for cushionfields	Assumed to not be rehabilitated

Expected outcomes for the ecological rehabilitation programme will be verified where feasible via a biodiversity outcome monitoring programme as described further in Section 9 and detailed in the Biodiversity Outcome Monitoring Plan.

7.3.3 Magnitude of residual effects assessment

The magnitude of residual effects on ecological values associated with the Project has been assessed based on the extent, intensity, duration, and timing of adverse effects. Project effects on terrestrial values in general terms are outlined above, and the magnitude of residual effects on each of these values is evaluated after efforts to avoid, minimise/mitigate or remedy the effects.

The categories for assessing magnitude of residual effects, in ascending order, include 'positive,' 'negligible,' 'low,' 'moderate,' 'high,' and 'very high'. A magnitude of residual effects assessment was conducted for those habitat/vegetation types where the Project was expected to have 'negligible' or higher effects.

Magnitude of residual effects is considered separately below for vegetation communities and flora, and for species of birds, lizards and invertebrates that are classified as Threatened or At Risk, either nationally or regionally.

Magnitude of effect was assigned based on the full mine design, and assuming the CIT pit is mined. This is despite mining of the CIT pit being unable to proceed (with the exception of a 2.7 ha early-disturbance area required for enabling works) if success criteria cannot be demonstrably achieved, via implementation of the ARP, for the two nationally and regionally threatened spring annuals, *Ceratocephala pungens* and *Myosotis brevis*.

7.3.3.1 Magnitude of residual effects on vegetation communities

Table 16 below presents the magnitude of residual effects assessment for the seven broad terrestrial vegetation communities and three wetland habitat types, following measures to avoid, minimise, mitigate or remedy adverse effects.

These magnitude of residual effects assessments have directly or indirectly factored in:

- The extent of habitat loss per se as well as proportional loss relative to the ESA, and more broadly.
- Effects on vegetation and habitats adjacent to the DDF including habitat degradation through edge effects and general disturbance and the loss of ecological sequencing and connectivity of vegetation/habitats within the local landscape.
- The time lag between impact and rehabilitation for those values that can feasibly be rehabilitated (assuming that proposed rehabilitation within the DDF will be achieved within 35 years of impacts but not before)[62].

Table 16: 'Magnitude of residual effects' assessment for broad vegetation communities

Biodiversity value	Assigned magnitude of residual effect after measures to avoid, minimise or remedy adverse effects
Exotic pasture or herbfield	**Moderate** magnitude of residual effect overall. • High magnitude of effect per se due to loss of 79 ha of low value vegetation/habitat, and associated edge effects. • Moderate proportion of effect based on the proportionate loss of 6.9% of this vegetation community present in the surrounding landscape. • Negligible effect based on the proportion of loss in the ED
Mixed depleted herbfield (cushionfield) and grassland	**High** magnitude of residual effect overall (with CIT pit mined). • Very high magnitude of effect per se due to loss of up to 104 ha of very high value vegetation/habitat, and associated edge effects. This would still constitute a high magnitude of effect per se if the CIT pit were not mined, in which case the loss of mixed depleted herbfield (cushionfield) and grassland habitat would be reduced by 23 ha (excluding the 2.7 ha early-disturbance area), i.e. to a loss of up to 81 ha. • Moderate proportion of effect based on the proportionate loss of 18.8% of this vegetation community present in the surrounding landscape. • Proportional loss in the ED unknown • There is potential for ecological rehabilitation of this habitat type to be successful and to reduce the magnitude of effect however there is a lack of demonstrable evidence.
Mixed tussock shrubland and exotic grassland	**Moderate** magnitude of residual effect overall. • High magnitude of effect per se due to loss of 187 ha of high value vegetation/habitat, and associated edge effects. • Moderate proportion of effect based on the proportionate loss of 13.5% of this vegetation community present in the surrounding landscape. • Proportional loss in the wider ED assumed to be negligible. • A reduction in magnitude of effect of native elements within this habitat type in the medium to longer term via the ecological rehabilitation of 222 ha of native tussockland and 230 ha of native

[62] This 35 year timeframe is in accordance with the LERMP which seeks that rehabilitation criteria in the DDF are met within 20 years of initial revegetation, i.e. by year 22 for Western ELF and later for areas revegetated at mining end (TSF, parts of the Shepherd's ELF, associated stockpiles and plant area)

Biodiversity value	Assigned magnitude of residual effect after measures to avoid, minimise or remedy adverse effects
	dominated scrubland within the DDF within 35 years of approvals being granted.
Mixed scrubland	**High** magnitude of residual effect overall. • High magnitude of effect per se due to loss of 124 ha of vegetation/habitat and associated edge effects. • High proportion of effect based on the proportionate loss of 27.1% of this vegetation community present in the surrounding landscape. • Proportional loss in the wider ED assumed to be negligible • A reduction in the magnitude of effect on native elements of this habitat type in the medium to longer term via the ecological rehabilitation of 230 ha of native dominated scrub-land within the DDF within 35 years of approvals being granted.
Native-dominant tussockland	**Moderate** magnitude of residual effect overall. • High magnitude of effect per se due to loss of 25.3 ha of vegetation/habitat and associated edge effects. • Low proportion of effect based on the proportionate loss of 2.5% of this vegetation community present in the surrounding landscape. • Proportional loss in the wider ED assumed to be negligible • A reduction in the magnitude of effect on this habitat type in the medium to longer term via the ecological rehabilitation of 222 ha of native tussockland within the DDF within 35 years of approvals being granted.
Native herbfield and shrubland	**Low** magnitude of residual effect overall. • High magnitude of effect per se due to loss of 1.9 ha of vegetation/habitat and associated edge effects. • Low proportion of effect based on the proportionate loss of approximately 1.2% of this vegetation community present in the surrounding landscape. • Proportional loss in the wider ED assumed to be negligible • A reduction in the magnitude of effect of this habitat type in the medium to longer term via the ecological rehabilitation of 2 ha of native herbfield and shrubland within the DDF within 35 years of approvals being granted.
Native-dominant scrubland	**High** magnitude of residual effect overall. • Very high magnitude of effect per se due to loss of 85.6 ha of vegetation/habitat and associated edge effects. • Moderate proportion of effect based on the proportionate loss of approximately 13.4% of this vegetation type present in the surrounding landscape. • Proportional loss in the wider ED assumed to be negligible • A reduction in the magnitude of effect of this habitat type in the medium to longer term via the ecological rehabilitation of 230 ha of

Biodiversity value	Assigned magnitude of residual effect after measures to avoid, minimise or remedy adverse effects
	native-dominated scrubland within the DDF within 35 years of approvals being granted.
Seepage wetlands	**Moderate** magnitude of residual effect overall • Low magnitude of effect per se due to loss of 0.19 ha of habitat • Moderate proportion of effect, since this represents a low proportion of loss of this wetland type present in the surrounding landscape. • Proportional loss in the wider ED assumed to be negligible
Gully fens	**Moderate** magnitude of residual effect overall • Low magnitude of effect per se due to loss of 0.84ha of habitat • Moderate proportion of effect, since this represents a low proportion of loss of this wetland type present in the surrounding landscape. • Proportional loss in the wider ED assumed to be negligible
Swamps/marshes	No residual magnitude of effect overall • Moderate magnitude of effect per se associated with the loss of 2.42 ha of habitat. • Moderate proportion of effect based on the proportionate loss of this wetland type present in the surrounding landscape. • Negligible magnitude of effect in the ED • A reduction in the magnitude of effect of this habitat type in the medium to longer term via the ecological rehabilitation of 7.5 ha of swamp/marsh wetland within the DDF within 35 years of approvals being granted.

7.3.3.2 Magnitude of residual effects on nationally Threatened or At Risk flora

Table 17 below provides a magnitude of effects assessment for Threatened and At Risk flora species. Twenty-six of the 48 Threatened or At Risk plant species impacted within the DDF are expected to be ecologically rehabilitated through targeted plantings or re-establishment that is made possible by ecological rehabilitation measures such as livestock exclusion, control of mammalian browsers and weed control. For some of these species, rehabilitation outcomes can be reasonably predicted. However, for others—such as those associated with cushionfields and spring annual herbs—there is little precedent for successful rehabilitation, and re-establishment outcomes remain uncertain. Nevertheless, the cushionfield research programme in the **ARP** is expected to enhance baseline knowledge and inform effects management, including rehabilitation.

Table 17: Magnitude of residual effects assessment for notable flora species[63]

Species	Assigned magnitude of residual effect (EcIAG)
Tiny forget-me-not *Myosotis brevis*	**Very high** magnitude of residual effect overall. • Very high magnitude of effect per se due to the loss of 156 ha of confirmed, likely or possible threatened herb habitat within the DDF, and a minimum of >1,500 specimens in the DDF (excluding Come in Time Pit which contains an estimated >500 specimens) • Very high proportional effect relative to the SL [>1,500DDF/>2500SL] or >2,000DDF/>2,500SL if the CIT pit is mined. • Moderate effect on the total population • No certainty that this species can be ecologically rehabilitated
Carex talboti	**High** magnitude of residual effect overall. • High magnitude of effect per se due to loss of up to 187 ha of potential habitat in the DDF with an estimated minimum of 100 plants present • Very high proportion of effect relative to the surrounding landscape as this species has only been found in the DDF • The proportional effect in the Ecological District is unclear and on the total population is negligible • No reduction in the severity of effect as not included in the ecological rehabilitation programme
Rock fern *Cheilanthes sieberi sieberi*	**High** magnitude of residual effect overall. • Very high magnitude of effect per se due to loss of up to 607 ha of potential habitat within an estimated minimum of 5000 plants present • Very high proportional effects relative to the surrounding landscape [>5000DDF/>2000SL] • The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible • Expected reduction in the severity of effect within the DDF through the establishment of 500 plants and colonisation from existing seed sources in the Mine Regeneration Zone
Colobanthus brevisepalus	**High** magnitude of residual effect overall. • Very high magnitude of effect per se due to loss of up to 103.82 ha of potential habitat with the DDF with an estimated minimum of 5,000 plants present • Very high proportional effect relative to the SL [>5000DDF/>2000SL] • The proportional effect on the wider landscape is unclear and on the total population is assumed to be negligible • It is assumed there will be no reduction in the severity of effect as the outcomes of ecological rehabilitation are uncertain

[63] Numbers and areas may change for some plant species based on the more detailed baseline surveys undertaken in accordance with management plans and the ARP. Further surveys may identify presence of new species in the DDF.

Species	Assigned magnitude of residual effect (EcIAG)
Hypericum involutum	**High** magnitude of residual effect overall. • Very high magnitude of effect per se due to loss of up to 104 ha of potential habitat in the DDF with an estimated minimum of 5000 plants • Very high proportional effects relative to the surrounding landscape [>5,000DDF/>2,000SL] • The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible • It is assumed there will be a reduction in the severity of effect through the propagation and re-introduction of 100 plants though the outcomes of ecological rehabilitation are uncertain
Raoulia beauverdii	**High** magnitude of residual effect overall. • Very high magnitude of effect per se due to loss of up to 607 ha of potential habitat in the DDF with an estimated >5000 plants present • Very high proportional effect relative to the surrounding landscape [>5000DDF/>2000SL] • The proportional effect on the wider landscape is unclear and on the total population is assumed to be negligible • It is assumed there will be no reduction in the severity of effect as the outcomes of ecological rehabilitation in the DDF are uncertain
Pincushion grass *Agrostis muscosa*	**Moderate** magnitude of residual effect overall. • Very high magnitude of effect per se due to loss of up to 103.82 ha of potential habitat in the DDF within an estimated minimum of 100 plants present • High to Very High proportional effects relative to the surrounding landscape [>100DDF/>100SL] • The proportional effect in the wider landscape is unclear and the proportional effect on the total population is assumed to be negligible • It is assumed there will be a small reduction in the severity of effect via the establishment of 200 plants grown from nursery seedlings
Ceratocephala pungens	**High** potential magnitude of residual effect overall if CIT not mined, since the 2.7 ha early-disturbance area is proposed to proceed regardless. A high magnitude of residual effect overall if CIT mined (noting that this would only occur if net gain outcomes could be demonstrably achieved via the ARP). Excluding the 2.7 ha early-disturbance area, within which populations of C. pungens are unknown but understood to be low compared to elsewhere in the CIT pit[64]: • High magnitude of effect per se due to loss of 156 ha of confirmed, likely or possible threatened herb habitat within the DDF. Excluding the 2.7 ha early disturbance area, this equates to a minimum loss of 18 known plants if CIT is not mined, and a minimum loss of > 129 plants if CIT is mined. • Low proportional effect (3.6%) relative to the Surrounding landscape (SL) within the Ecological Study Area (ESA) if CIT is not mined [>18 plants DDF; >392 plants SL], excluding the early-disturbance area. High proportional

[64] Since the 2.7 ha early-disturbance area of the CIT Open pit was proposed by MGL after completion of terrestrial vegetation surveys and the Vegetation report (RMA Ecology 2025).

Species	Assigned magnitude of residual effect (EcIAG)
	effect (33%) if CIT was mined [>129 plants DDF; 392 plants SL]. The degree to which the proportional effect increases due to the 2.7 ha of works in the early-disturbance area is unknown. • Low proportional effect (3.6%) on the population in the wider landscape and total population if CIT not mined and high proportion of effect (33%) if mined – particularly given that the CIT constitutes the highest known densities of this species nationally. The degree to which the proportional effect increases due to the 2.7 ha of early-disturbance area is unknown. • No certainty that this species can be rehabilitated
Colobanthus strictus	**Moderate** magnitude of residual effect overall. • Very high magnitude of effect per se due to loss of 610 ha of potential habitat in the DDF within an estimated minimum of 10 plants present • High to Very high proportional effects relative to the surrounding landscape [>10DDF/>10SL] • The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible • It is assumed there will be no reduction in the severity of effect as the outcomes of ecological rehabilitation are uncertain
Bladder Fern *Cystopteris tasmanica*	**Moderate** magnitude of residual effect overall. • Very high magnitude of effect per se due to loss of up to 526 ha of potential habitat within an estimated minimum of 500 plants present • High proportional effects relative to the surrounding landscape [>500DDF/>1000SL] • The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible • Expected reduction in the severity of effect within the DDF through establishment of at least 100 plants within the DDF and colonisation from existing sources in the Mine Regeneration Zone enhanced by reduction of browse
Lagenophora barkeri	**Moderate** magnitude of residual effect overall. • Moderate magnitude of effect per se due to loss of up to 3 ha of potential wetland habitat in the DDF with an estimated minimum of 5 plants • High/Very high proportional effect relative to the SL [>5DDF/>5SL] • The proportional effect on the wider landscape is unclear and on the total population is assumed to be negligible • No reduction in the severity of effect as not included for specific management in the ecological rehabilitation programme and is likely to be outcompeted as taller plants are able to grow when grazing by stock is halted.
Luzula leptophylla	**Moderate** magnitude of residual effect overall. • Moderate magnitude of effect per se due to loss of up to 3 ha of potential habitat within an estimated minimum of 5 plants present • High to Very High proportional effects relative to the surrounding landscape [>5DDF/>5SL]

Species	Assigned magnitude of residual effect (EcIAG)
	• The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible • No expected reduction in the severity of effect within the DDF
Myosotis antarctica subsp. antarctica	**Moderate** magnitude of residual effect overall. • Very high magnitude of effect per se due to loss of up to 104 ha of potential habitat within an estimated minimum of 1000 plants present • High to Very high proportional effects relative to the surrounding landscape [>1000DDF/>1000SL] • The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible • It is assumed there will be no reduction in the severity of effect as the outcomes of ecological rehabilitation are uncertain
New Zealand Mousetail *Myosurus minimus novae-zelandiae*	**Moderate** magnitude of residual effect overall. • High magnitude of effect per se due to loss of up to 103.82 ha of potential habitat in the DDF with an estimated minimum of 100 plants present • High/Very high proportional effect relative to the SL [>100DDF/>100SL] • The proportional effect on the wider landscape is unclear and on the total population is assumed to be negligible • It is assumed there will be no reduction in the severity of effect as the outcomes of ecological rehabilitation are uncertain
Myriophyllum pedunculatum subsp. novae-zelandiae	**Moderate** magnitude of residual effect overall. • Moderate magnitude of effect per se due to loss of up to 3.12 ha of potential habitat within an estimated minimum of 10 plants present • High to Very High proportional effects relative to the surrounding landscape [>10DDF/>10SL] • The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible • No expected reduction in the severity of effect within the DDF
Hot rock fern *Pellaea calidirupium*	**Moderate** magnitude of residual effect overall. • Very high magnitude of effect per se due to loss of up to 291 ha of potential habitat within an estimated minimum of 1000 plants present • High proportional effects relative to the surrounding landscape [>1000DDF/>2000SL] • The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible • It is assumed there will be a reduction in the severity of effects via the establishment of at least 100 plants from wind-dispersed spores that self-establish
Poa lindsayi	**Moderate** magnitude of residual effect overall. • Very high magnitude of effect per se due to loss of up to 481.52 ha of potential habitat within an estimated minimum of 50 plants present • High to Very High proportional effects relative to the surrounding landscape [>50DDF/>50SL] • The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible

Species	Assigned magnitude of residual effect (EcIAG)
	• No expected reduction in the severity of effect within the DDF
Common scabweed *Raoulia australis*	**Moderate** magnitude of residual effect overall. • Very high magnitude of effect per se due to loss of up to 608 ha of potential habitat in the DDF with an estimated minimum of 5,000 plants • High to Very high proportional effects relative to the surrounding landscape [>5000DDF/>5000SL] • This is the most common of the Raoulia species and proportional effect in the wider landscape is assumed to be negligible • It is assumed there will be no reduction in the severity of effect as the outcomes of ecological rehabilitation are uncertain
Celadon mat daisy *Raoulia parkii*	**Moderate** magnitude of residual effect overall. • Very high magnitude of effect per se due to loss of up to 528 ha of potential habitat in the DDF with an estimated >500 plants present • High to Very high proportional effect relative to the surrounding landscape [>500DDF/>1000SL] • The proportional effect on the wider landscape is unclear and the proportional effect on the total population is assumed to be negligible • It is assumed there will be no reduction in the severity of effect as the outcomes of ecological rehabilitation are uncertain
Rytidosperma buchananii	**Moderate** magnitude of residual effect overall. • Very high magnitude of effect per se due to loss of up to 608 ha of potential habitat in the DDF with an estimated minimum of 5,000 plants • High to Very high proportional effects relative to the surrounding landscape [>5000DDF/>5000SL] • The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible • It is assumed there will be no reduction in the severity of effect as the outcomes of ecological rehabilitation are uncertain
Rytidosperma maculatum	**Moderate** magnitude of residual effect overall. • Very high magnitude of effect per se due to loss of up to 104 ha of potential habitat in the DDF with an estimated >100 plants present • High to Very high proportional effect relative to the surrounding landscape [>100DDF/>100SL] • The proportional effect on the wider landscape is unclear and on the total population is assumed to be negligible • It is assumed there will be no reduction in the severity of effect as the outcomes of ecological rehabilitation are uncertain (likely to be maintained in MRZ B1 with maintenance of grazing and reduce in areas where grazing is stopped)
Chaerophyllum ramosum	**Low** magnitude of residual effect overall. • Moderate magnitude of effect per se due to loss of up to 273.06 ha of potential habitat within an estimated minimum of 100 plants present • Moderate proportional effects relative to the surrounding landscape [>100DDF/>1000SL]

Species	Assigned magnitude of residual effect (EcIAG)
	• The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible • No expected reduction in the severity of effect within the DDF
Coastal woodrush *Luzula banksiana var. rhadina*	**Low** magnitude of residual effect overall. • Moderate magnitude of effect per se due to loss of up to 607.47 ha of potential habitat within an estimated minimum of 5 plants present • High to Very high proportional effects relative to the surrounding landscape [>5DDF/>5SL] • The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible • Expected reduction in the severity of effect within the DDF through colonisation from existing seed sources in the Mine Regeneration Zone
Feldmark grass *Rytidosperma pumilum*	**Low** magnitude of residual effect overall. • Very high magnitude of effect per se due to loss of up to 528.16 ha of potential habitat in the DDF within an estimated minimum of 500 plants present • High to Very high proportional effects relative to the surrounding landscape [>500DDF/>500SL] • Common in the wider landscape and the effect on the total population is assumed to be negligible • It is assumed there will be a reduction in the severity of effect via the establishment of 500 plants from nursery seedlings
Bidibid / piripiri *Acaena buchananii*	**Positive** effect overall. • Very high magnitude of effect per se due to loss of up to 607 ha of potential habitat in the DDF with an estimated minimum of 500 plants present • Very high proportional effect relative to the SL [>500DDF/>200SL] • The proportional effect on the wider landscape is expected to be low and on the total population is assumed to be negligible • Expected reduction in the severity of effect within the DDF through the colonisation from existing seeds sources that are present in most vegetation associations in the MRZ
Spineless acaena *Acaena inermis*	**Positive** effect overall. • High magnitude of effect per se due to loss of up to 402.21 ha of potential habitat within an estimated minimum of 10 plants present • Moderate proportional effects relative to the surrounding landscape [>10DDF/>100SL] • This species is widespread in the wider landscape and the effect on the total population is assumed to be negligible • Expected reduction in the severity of effect within the DDF through the establishment of at least 50 plants and colonisation from existing seed sources in the Mine Regeneration Zone
Blue Wheat Grass	**Positive** effect overall. • High magnitude of effect per se due to loss of up to 528 ha of potential habitat in the DDF with at least 1 plant present

Species	Assigned magnitude of residual effect (EcIAG)
Anthosachne aprica	• Very high proportional effect relative to the surrounding landscape [>1DDF/0SL] • The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible • Expected reduction in the severity of effect within the DDF through the establishment of at least 10 plants, colonisation from existing seed sources in the Mine Regeneration Zone and salvage within tussock sods (Festuca nz) which are innoculated into DDF.
Buchanan's Sedge *Carex buchananii*	**Positive** effect overall. • Very high magnitude of effect per se due to loss of up to 425 ha of potential habitat in the DDF with an estimated minimum of 100 plants present • High to Very high proportional effect relative to the SL [>100DDF/>100SL] • The proportional effect on the wider landscape is unclear and on the total population is assumed to be negligible • Expected reduction in the severity of effect within the DDF through the establishment of at least 300 plants into moist areas
Carex kaloides	**Positive** effect overall. • Moderate magnitude of effect per se due to loss of up to 89 ha of potential habitat in the DDF within an estimated minimum of 100 plants present • High/Very high proportional effect relative to the SL [>100DDF/>100SL] • The proportional effect on the wider landscape is unclear and on the total population is assumed to be negligible • Remediation is expected to result in a net increase of this species within the direct disturbance footprint in rehabilitated wetlands; plants will be salvaged and propagated by division and seed to produce nursery seedlings for planting
Desert broom *Carmichaelia petriei*	**Positive** effect overall • Very high magnitude of effect per se due to loss of up to 528 ha of potential habitat in the DDF with >1000 plants present • Very high proportional effect relative to the surrounding landscape [>1000 DDF/>1,000 SL] • The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible • Establishment of at least 2000 plants into rock stacks and rabbit-proof exclosures within the DDF
Mikimiki *Coprosma virescens*	**Positive** effect overall. • Moderate magnitude of effect per se due to loss of up to 424 ha of potential habitat and with at least one plant present within the DDF • A moderate proportional effect relative to the surrounding landscape [>1DDF/>10SL] • The proportional effect on the wider landscape is unclear and the proportional effect on the total population is assumed to be negligible • Expected reduction in the severity of effect within the DDF through the establishment of at least 500 plants and colonisation from existing seed sources in the Mine Regeneration Zone combined with lack of grazing.
Epilobium hectorii	**Positive** effect overall.

Species	Assigned magnitude of residual effect (EcIAG)
	• Very high magnitude of effect per se due to loss of up to 395.9 ha of potential habitat in the DDF with an estimated minimum of 50 plants present • High to Very high proportional effects relative to the surrounding landscape [>50DDF/>50SL] • The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible • Expected reduction in the severity of effect within the DDF through the establishment of 100 plants and colonisation from existing seed sources in the Mine Regeneration Zone as this small herb is wind dispersed and grows readily in suitable conditions (open stony ground)
Geranium aff. microphyllum	**Positive** effect overall. • Low magnitude of effect per se due to loss of 610 ha of potential habitat within an estimated minimum of 1 plant present • Very High proportional effects relative to the surrounding landscape [>1DDF/>0SL] • The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible • Expected reduction in the severity of effect within the DDF through the establishment of at least 100 plants and colonisation from existing seed sources in the Mine Regeneration Zone
Geranium potentilloides	**Positive effect** overall. • Low magnitude of effect per se due to loss of 610 ha of potential habitat within an estimated minimum of 1 plant present • High to Very High proportional effects relative to the surrounding landscape [>1DDF/>1SL] • The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible • Expected reduction in the severity of effect within the DDF through colonisation from existing seed sources in the Mine Regeneration Zone
Juncus distegus	**Positive** effect. • Very high magnitude of effect per se due to loss of up to 212.77 ha of potential habitat in the DDF within an estimated minimum of 100 plants present • Very high proportional effects relative to the surrounding landscape [>100DDF/>10SL] • The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible • Expected reduction in the severity of effect within the DDF through the establishment of at least 100 plants and spread from existing plants in the Mine Regeneration Zone' (the spread may not be from seed but from vegetative expansion)

Species	Assigned magnitude of residual effect (EcIAG)
Olearia lineata	**Positive** effect overall. • Very high magnitude of effect per se due to loss of up to 607 ha of potential habitat in the DDF with an estimated 50 plants within the DDF • Very high proportional effects relative to the surrounding landscape [>50DDF/>50SL] • The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible • Expected positive effect within the DDF through establishment of at least 500 plants and colonisation from existing seed sources in the Mine Regeneration Zone
Scented tree daisy *Olearia odorata*	**Positive** effect overall. • Very high magnitude of effect per se due to loss of up to 607.47 ha of potential habitat in the DDF with an estimated minimum of 5,000 plants • High to Very high proportional effects relative to the surrounding landscape [>5000DDF/>5000SL] • This species is common in the wider landscape and the effect on the total population is assumed to be negligible • Expected reduction in the severity of effect within the DDF through the establishment of at least 10,000 plants in the DDF and colonisation from existing seed sources in the Mine Regeneration Zone
Pimelea aridula aridula	**Positive** effect overall • Very high magnitude of effect per se due to loss of up to 528 ha of potential habitat in the DDF with an estimated >200 plants present • Very high proportional effect relative to the surrounding landscape [>200DDF/>100SL] • The proportional effect on the wider landscape is unclear and on the total population is assumed to be negligible • Expected reduction in the severity of effect within the DDF through the establishment of at least 500 plants in rock stacks and new seedlings and expansion of adults in MRZ due to reduction in grazing where individuals are fenced (MRZ B1) and where grazing is stopped (MRZ B2, B3, A)
Pimelea prostrata subsp. prostrata	**Positive** effect overall. • Very high magnitude of effect per se due to loss of up to 300 ha of potential habitat within an estimated minimum of 50 plants present • High proportional effects relative to the surrounding landscape [>50DDF/>100SL] • The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible • Expected reduction in the severity of effect within the DDF through the establishment of at least 500 plants in rock stacks and colonisation from existing seed sources in the Mine Regeneration Zone
Bristle grass *Rytidosperma corinum*	**Positive** effect overall. • Very High magnitude of effect per se due to loss of up to 607.47 ha of potential habitat within an estimated minimum of 500 plants present • High to Very High proportional effects relative to the surrounding landscape [>50DDF/>500SL]

Species	Assigned magnitude of residual effect (EcIAG)
	• The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible • A minimum of 500 propagated plants will be established in the DDF and plants are expected to self-establish in suitable areas of DDF through wind-blown seed from adjacent MRZ as this species has a wide distribution
Styphelia nana	**Positive** effect overall. • Very high magnitude of effect per se due to loss of up to 607.47 ha of potential habitat in the DDF with an estimated minimum of >500 plants • High to Very high proportional effects relative to the surrounding landscape [>500DDF/>500SL] • The proportional effect in the wider landscape is unclear and the proportional effect on the total population is assumed to be negligible • Expected reduction in the severity of effect within the DDF through the establishment of at least 500 plants into rock stacks and colonisation from existing seed sources in the Mine Regeneration Zone
Carex diandra	**Positive** effect overall. • High magnitude of effect per se due to loss of up to 3 ha of potential wetland habitat within an estimated minimum of 200 plants present • Moderate-high proportional effects relative to the surrounding landscape [>200DDF/>1000SL] • The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible • Expected reduction in the severity of effect within the DDF through the establishment of at least 400 plants in the DDF
Olearia bullata	**Positive** effect overall • Moderate magnitude of effect per se due to loss of up to 213 ha of potential habitat within an estimated minimum of 1 plant present • Very high proportional effects relative to the surrounding landscape [>1DDF/>0SL] • The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible • Expected reduction in the severity of effect through the establishment of at least 10 plants and colonisation of DDF from existing and planted seed sources in the Mine Regeneration Zone
Pimelea notia	**Positive** effect overall • High magnitude of effect per se due to loss of up to 110.95 ha of potential habitat within an estimated minimum of 10 plants present • Moderate proportional effects relative to the surrounding landscape [>10DDF/>100SL]

Species	Assigned magnitude of residual effect (EcIAG)
	• The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible • Expected reduction in the severity of effect within the DDF through the establishment of at least 50 plants in the DDF rock stacks
New Zealand dock *Rumex flexuosus*	**Positive** effect overall. • Moderate magnitude of effect per se due to loss of up to 82.43 ha of potential habitat within an estimated minimum of 2 plants present • High to Very High proportional effects relative to the surrounding landscape [>2DDF/>2SL] • The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible • Expected reduction in the severity of effect within the DDF through the establishment of at least 10 plants and transplanting of rhizomes
White fuzzweed *Vittadinia australis*	**Positive** effect overall. • Moderate magnitude of effect per se due to loss of up to 607 ha of potential habitat within an estimated minimum of 50 plants present • Moderate proportional effects relative to the surrounding landscape [>50DDF/>500SL] • The proportional effect in the wider landscape is unclear and on the total population is assumed to be negligible • Expected reduction in the severity of effect within the DDF through the establishment of at least 100 plants and colonisation from existing seed sources in the Mine Regeneration Zone
Festuca mathewsii subsp. mathewsii	**Positive** effect overall • High magnitude of effect per se due to loss of up to 215 ha of potential habitat within an estimated minimum of 100 plants present • Moderate proportional effects relative to the surrounding landscape [>100DDF/>100SL] • This species is common in the wider landscape is unclear and the effect on the total population is assumed to be negligible • Expected reduction in the severity of effect within the DDF through the establishment of at least 500 nursery-grown seedlings and subsequent expansion through self-established seedlings

7.3.3.3 Magnitude of residual effects on birds

Despite efforts to reduce the severity of effects, the BOGP will result in adverse effects associated with the loss of 610 ha of variable quality habitat for birds, i.e. 607 ha of terrestrial habitat and 3 ha of wetland. This includes:

- Loss of 610 ha of terrestrial and wetland habitat, primarily impacting terrestrial species such as falcon, pipit, and silvereye, through loss of food/prey, nesting sites and shelter/cover. For Threatened and At Risk species, this includes:
  - Loss of very high value nesting habitat for falcon in rock outcrops, tors and bluffs, sufficient to support 1-2 pairs of falcon, and loss of prey resources.
  - Loss of up to 610 ha of variable quality habitat for NZ pipit, which favour open grassland habitat for foraging and nesting.
  - Loss of cultivated fields used occasionally by species associated with braided riverbeds, and artificial ponds.
- Direct loss of ca. 3.12 ha of wetland habitat, which is of poor quality for wetland birds and does not support wetland bird species.
- Potential disturbance effects associated with mine blasting, lighting, dust, and road upgrades. This includes:
  - Potential disturbance of falcon (from blasting) within an estimated 2,000 ha area extending to the Rise and Shine Creek and Shepherds Creek catchment boundaries, likely supporting one to two breeding pairs of falcon based on territory size.
  - Potential disturbance effects of roading upgrades and lighting on indigenous and threatened species at Bendigo Wetland, which is >1.8 km to the west, and birds flying east to/from the wetland. Also disturbance effects on birds at Lake Dunstan, 8.5 km to the west.
- Residual risk of nest destruction and loss of eggs or chicks remains for a small proportion of nests that may not be detected through habitat clearance protocols. Specific protocols developed for falcon nests are expected to reduce this effect to negligible.
- Habitat loss and reduced connectivity, which are expected to have relatively low impacts on birds due to their high mobility. However, disturbance from blasting may alter flight behaviour over or near the site, including use of Thomson Gorge Saddle.
- Disturbance from human activity and machinery, potentially reducing breeding success or displacing individuals.
- A risk of electrocution for New Zealand falcon and other At Risk bird species (e.g. shags near waterbodies) due to insulation of any new power pylons constructed as part of the BOGP.
- A residual risk depends on extent of proposed measures risk of collision with power lines, fences and windows, since these features will be marked to improve their visibility.

Table 18 below sets out the magnitude of residual effects assessment for birds.

Table 18: Magnitude of residual effects assessment for birds

Bird Species	Magnitude of residual effect
New Zealand falcon – eastern form*	**Low** magnitude of residual effect overall. • High magnitude of effect per se due to the loss of 610 ha of foraging habitat, and also very high value nesting habitat for one pair of falcon in rock outcrops, tors and bluffs. Associated disturbance effects, habitat fragmentation and loss of connectivity, and potential risk of collision and electrocution. • Moderate proportional effect on the population relative to the surrounding landscape. • Negligible magnitude of effect relative to the wider landscape and region population. • Low effect associated with disturbance from blasting • Reduction in the severity of effect through avoidance/minimisation of effects on nesting birds, insulation of power-lines to minimise the risk of electrocution and through the ecological rehabilitation of the DDF in the moderate to long-term
New Zealand pipit*	**Low-Moderate** magnitude of residual effect overall. • High magnitude of effect per se due to the loss of 610 ha of suitable habitat for 5-20 pairs of pipit. • Moderate proportional effect on the local population relative to the surrounding landscape • Low proportional effect on the local population relative to the wider landscape • Low effect associated with disturbance from blasting • Reduction in the severity of effect through avoidance/minimisation of effects on nesting birds and through the ecological rehabilitation of the DDF in the moderate to long-term
Silvereye*	**Low** magnitude of residual effect overall. • High magnitude of effect per se due to the loss of 610 ha of suitable habitat in which birds are frequently observed • Moderate proportional effect on the local population relative to the surrounding landscape • Negligible proportional effect on the local population relative to the wider landscape • Low effect associated with disturbance from blasting • Reduction in the severity of effect through avoidance/minimisation of effects on nesting birds and through the ecological rehabilitation of the DDF in the moderate to long-term
Tomtit	**Low** magnitude of residual effect overall. • High magnitude of effect per se due to the loss of 610 ha of suitable habitat in which birds are frequently observed • Moderate proportional effect on the local population relative to the surrounding landscape • Negligible proportional effect on the local population relative to the wider landscape • Low effect associated with disturbance from blasting

Bird Species	Magnitude of residual effect
	• Reduction in the severity of effect through avoidance/minimisation of effects on nesting birds and through the ecological rehabilitation of the DDF in the moderate to long-term
Black-fronted tern	**Negligible** magnitude of residual effect overall • Low magnitude of effect per se due to the loss of cultivated fields potentially used for occasional foraging: this habitat is common in the surrounding basin landscape. • Negligible proportion of effect relative to the proportion of suitable habitat in the surrounding landscape. • Negligible effect associated with disturbance from blasting
Black-billed gull	**Negligible** magnitude of residual effect overall • Low magnitude of effect per se due to the loss of cultivated fields potentially used for occasional foraging: this habitat is common in the surrounding basin landscape. • Negligible proportion of effect relative to the proportion of suitable habitat in the surrounding landscape. • Negligible effect associated with disturbance from blasting
South Island Pied Oyster Catcher	**Negligible** magnitude of residual effect overall • Low magnitude of effect per se due to the loss of cultivated fields potentially used for occasional foraging: this habitat is common in the surrounding basin landscape. • Negligible proportion of effect relative to the proportion of suitable habitat in the surrounding landscape. • Negligible effect associated with disturbance from blasting
Black shag* Little shag	**Negligible** magnitude of residual effect overall. • Negligible magnitude of effect due to the loss of a small area of open water wetland • Low proportional effect on the local population relative to the surrounding landscape • Negligible proportional effect on the local population relative to the wider landscape • Negligible effect associated with disturbance from blasting • Reduction in the severity of effect through the insulation of power-lines to minimise the risk of electrocution and through the ecological rehabilitation of the DDF • Reduction in the severity of effect through avoidance/minimisation of effects on nesting birds and through the ecological rehabilitation of the DDF in the moderate to long-term
Bellbird	**Negligible** magnitude of residual effect overall. • Low magnitude of effect per se due to the loss of 610 ha of low quality habitat in which birds are infrequently observed • Low proportional effect on the local population relative to the surrounding landscape • Negligible proportional effect on the local population relative to the wider landscape

Bird Species	Magnitude of residual effect
	• Low effect associated with disturbance from blasting • Reduction in the severity of effect through avoidance/minimisation of effects on nesting birds and through the ecological rehabilitation of the DDF in the moderate to long-term

7.3.3.4 Magnitude of residual effects on lizards

Despite efforts to reduce the severity of effects, the BOGP will result in adverse effects associated with the loss of 607 ha of variable quality habitat for lizards (**Table 19** below). This includes:

- Temporary loss of up to 607 ha of lizard habitat within the DDF, with restoration through rehabilitation of most habitat types and the expectation that within the 480 ha of ecological rehabilitation in the DDF (excluding wetland habitats), lizard carrying capacity will be similar to baseline prior to impacts within 35 years through the proposed ecological rehabilitation.
- Disruption to lizard communities through salvage and relocation of lizards into the 1,263 ha ARA which will be subject to mammalian pest control.
- Injury and death to a high proportion of native lizards that are not salvaged and relocated or fail to survive the relocation and release process. Due to uncertainties around the likelihood of relocation success, it is conservatively assumed that no relocated lizards would survive relocation[65]. Similarly, it is assumed that resident lizards are not impacted by relocated lizards, and that overall, salvage and relocation neither reduces the severity of effects on lizards, nor impacts resident lizard populations within the relocation area (ARA). While it is assumed that salvage and relocation will not reduce the severity of effects, there is a greater chance that relocated lizards will survive than if they were not salvaged and it is also a requirement of the Wildlife Act.

Table 19: Magnitude of residual effects assessment for lizards

Lizard Species	Magnitude of residual effect
Tussock skink *Oligosoma chionochloescens*	**Moderate** magnitude of residual effect overall.

[65] There is a notable absence of studies verifying the success of salvage and relocation outcomes due to technical challenges with obtaining and interpreting data. To do so requires:
- High numbers of lizards to be salvaged, relocated and detected at relocation sites;
- The ability to distinguish relocated lizards from resident lizards at relocation sites. This requires either permanent marking of relocated individuals (of which toe-clipping is the most reliable option), or the ability recognise individuals through photographs where this is feasible, and
- A closed population at relocation sites to determine if failure to detect relocated lizards is due to relocation failure or because relocated lizards have moved outside the monitored area.

Lizard Species	Magnitude of residual effect
Kawarau gecko (Woodworthia 'Cromwell')	• High magnitude of effect per se due to the loss of up to 607 ha of suitable habitat and injury or death to high numbers of lizards during vegetation clearance and earthworks. • Moderate proportional effect on the local population of each species relative to the surrounding landscape. • Negligible proportional effect on the local population relative to the wider landscape. • A potential reduction in the severity of effects on lizards through salvage and relocation, however, it is assumed for the purposes of this assessment there will be no reduction. This is primarily because there is a lack of evidence that relocated lizards will survive and because only a moderate proportion of lizards that are assumed to be present will be relocated (estimated at 10 – 30% of the population in the DDF based on proposing to salvage and relocate a minimum of 102,000 individuals coupled with the expectation that approx. 500,000 lizards are present within the DDF as detailed in the Lizard Values Report (RMA Ecology 2025c). • A considerable reduction in the severity of effect through the ecological rehabilitation of the DDF however there will be moderate to long-term a time lag between loss and re-instatement of lizard habitat.
McCann's skink *(Oligosoma maccanni)*	

7.3.3.5 Magnitude of residual effects on invertebrates

Residual effects on invertebrates associated with the loss of 610 ha of variable quality habitat (**Table 20** below) include:

- Loss of up to 610 ha of invertebrate habitat within the DDF, with partial rehabilitation of viable habitat capable of supporting invertebrate populations.
- Net loss of invertebrate habitats that cannot be replicated in the rehabilitation areas, such as depleted herbfield (cushionfield) and grassland. While rehabilitation will include plant species with specific invertebrate associations such as Olearia and taramea, the impact of expected transition to woody vegetation will generally reduce habitat quality for threatened, at risk or otherwise notable invertebrates.
- Injury and death for invertebrates that are not salvaged and relocated, including individuals of threatened and risk moth species.

Table 20: Magnitude of residual effects assessment for notable invertebrates

Species	Magnitude of residual effect
Harpalus new sp.	**Very High** magnitude overall. • New species with no known life history or habitat associations. One specimen found inside DDF and two found in SL. All three specimens were found in 'Mixed Tussock Shrubland and Exotic Grassland'. Given the preferred habitat is unknown, it is not possible to categorically estimate the quantity of habitat throughout the DDF, however, there is

Species	Magnitude of residual effect
	approximately 342 hectares of 'Mixed Tussock Shrubland and Exotic Grassland' in the DDF. • Given this is a new species and very little is known about it, it is not possible to determine the extent to which the project will impact the wider population. • ·Given this is a new species and very little is known about it, it is not possible to determine the extent to which the projects effects could be minimised. • ·Given this is a new species and very little is known about it, it is not possible to determine the extent to which the projects effects could be addressed with rehabilitation.
Phaulacridium otagoense	**Very High** magnitude overall. • Only found in the DDF, though one location is on the proposed replacement for Ardgour Rise. Found over large portion of the DDF, in habitat that covers approximately 742 hectares of the DDF and surrounds. • Lindis Valley and Dunstan Range known strongholds, generally present in fairly low numbers across range. • Although results will be uncertain, this species will be salvaged and released in a sanctuary, with some individuals re-released back into the LMU where it was found after rehabilitation. Although this species has not been translocated previously, another grasshopper (*Brachaspis robustus*) has been successfully translocated. • Although results will be uncertain, this species will be re-released in DDF once rehabilitation has occurred.
Looper moth *Pseudocoremia cineracia*	**High** magnitude overall. • The species shows strong host plant dependency on *Olearia odorata*. This association is evidenced by moth detections in the DDF and SL occurring exclusively at sites where Olearia odorata was recorded. • The project will affect this population; however, given the species' occurrence across both DDF and SL areas, major impacts on the immediate local population are not expected. • The DDF contains approximately 594 hectares of habitat suitable for this moth species. • While the site is not considered a hotspot for the species, the species' restricted distribution to Otago means the project is expected to have some impact, though not at a major level. • Practical minimisation of effects on this species during mining operations is not feasible. Although successful colonisation of newly created habitat during MRZ rehabilitation is not guaranteed, the strategic Olearia planting program across the MRZ is expected to reduce impact severity and offer mitigation potential. • While there is a risk that newly created habitat may not be successfully colonised by *P. cineracia*, the planned *Olearia odorata* planting across the DDF may further reduce impact severity and provide substantial benefit to the population.

Species	Magnitude of residual effect
Inophloeus new sp.	**High** magnitude overall. • New species, closely associated with Taramea. Impacted habitat is located on the edge of the known range, with reasonable numbers found in the SL. However, Taramea habitat within the DDF does appear to be a hotspot for this species. There is approximately 5.5 hectares of 'Taramea' habitat in the DDF. • Given the species' highly localized distribution, project impacts are amplified in their significance. • Although positive results cannot be guaranteed, translocations of similar weevil species (*Anagotis fairburni*) have been successful in the past. • There is a risk that habitat created or enhanced through restoration works in the ARA and MRZs may not be successfully colonised or used by these weevils to the degree expected, planting across the DDF may further reduce impact severity and provide substantial benefit to the population.
Elachista helonoma	**High** magnitude overall. • Associated with Tussock, with *Poa cita* preferred. This habitat covers approximately 396 hectares of DDF. • *E. helonoma* maintains a population exceeding 20,000 individuals and remains locally common throughout the South Island. • Experimental transfer of host plants may minimise effects on *E. helonoma* although this approach has low certainty due to its experimental nature. • We cannot confidently assume rehabilitation efforts will benefit *E. helonoma*, though specific preferred habitat is included in LERMP.
Ichneutica toroneura	**High** magnitude overall. • Found in high numbers both in DDF and SL. Includes tussocks as host plants, which cover approximately 396 hectares of DDF. • Restricted to Central Otago/ McKenzie. The presence of large numbers at this site suggests it may represent an important population stronghold. • Experimental transfer of host plants may minimize effects on *I. toroneura*, although this approach has low certainty due to its experimental nature. • We cannot confidently assume rehabilitation efforts will benefit *I. toroneura*, though specific preferred habitat is included in LERMP.
Megadromus new sp. *1*	**Potentially Moderate** magnitude overall. • New species not detected within the DDF, though presence cannot be definitively excluded. Four specimens were collected from three locations across SL. Host plant associations and life history remain unknown. Habitat preferences cannot be determined conclusively, as specimens were found in diverse vegetation types: two sites supported Native Dominant Tussockland, while the third site contained Mixed Tussock Shrubland and Exotic Grassland/Native Dominant Scrubland. • Project impacts on population remain unknown, as this is new species known only from this study. • Given this is a new species and very little is known about it, it is not possible to determine the extent to which: – potential adverse effects could be minimised.

Species	Magnitude of residual effect
	– potential adverse effects could be addressed with rehabilitation.
Megadromus new sp.2	**Potentially Moderate** magnitude overall. • New species not detected within the DDF, though presence cannot be definitively excluded. Two specimens found at one site in SL. Host plant and life history requirements are unknown, preventing calculation of habitat loss extent. Site where this species was found had Mixed Tussock Shrubland and Exotic Grassland. • Project impacts on population remain unknown, as this is new species known only from this study. • Given this is a new species and very little is known about it, it is not possible to determine the extent to which: – potential adverse effects could be minimised. – potential adverse effects could be addressed with rehabilitation.
Scythris sp.1	**Potentially Moderate** magnitude overall. • Taxonomically unresolved species not detected within the DDF, though presence cannot be definitively excluded as is difficult to find. One specimen recorded from Bendigo Historic Reserve. Habitat types containing host plants cover approximately 525 hectares of the DDF, although host plants are sparse and in poor condition throughout these areas. Host plants occur widely throughout Otago, and with no *Scythris* found in the DDF, the project is assumed to have little impact on the wider population. • Although *Carmichaelia* are included in LMU rehabilitation, there is a risk that habitat created through rehabilitation of the LMU may not be successfully colonised by *Scythris*, as the species may not be present in close enough proximity to the DDF. • There is a risk that habitat created through restoration works in the ARA and MRZs may not be successfully colonised by *Scythris*, as the species may not be present in close enough proximity to these areas.
Meterana exquisita	**Low** magnitude overall. • Known to be closely associated with olearia shrublands though found in one location within DDF and one location in SL Found in low numbers (one at one location in SL and two at one location in DDF. • Although approximately 594 hectares of suitable habitat exists in the DDF, this is minor in scale compared to the population's overall extent. • Practical minimisation of effects on this species during mining operations is not feasible. Although successful colonisation of newly created habitat during rehabilitation is not guaranteed, the strategic Olearia planting program is expected to reduce impact severity and offer mitigation potential. • While there is a risk that newly created habitat may not be successfully colonised by *M. exquisita*, the planned Olearia planting across the MRZs and Ardgour Rehabilitation Area may further reduce impact severity and provide substantial mitigation.

Species	Magnitude of residual effect
Ichneutica sistens	**Low** magnitude overall. • Found in high numbers both in DDF and SL. Preferred habitat covers approximately 996 hectares of DDF. • Widely distributed throughout New Zealand, from the central North Island south. The presence of large numbers at this site suggests it may represent an important population stronghold. • There is no practicable way of minimising effects on this species. • We cannot confidently assume rehabilitation efforts will benefit *I. sistens*.
Agrotis admirationis	**Low** magnitude overall. • 55 found from 4 sites in DDF and 12 found from 2 sites in SL, with unknown host plant host plant(s). Preferred habitat appears to be open areas and cushionfield, which covers approximately 197 hectares of the DDF. • *A. admirationis* is widespread throughout New Zealand, indicating project will not have a significant impact on this moth nationally. • Practical minimisation of effects on this species during mining operations is not feasible. Although successful colonisation of newly created habitat during DDF rehabilitation is not guaranteed, the strategic planting program across the DDF is expected to reduce impact severity and offer mitigation potential. • There is a risk that habitat created through rehabilitation of the DDF may not be successfully colonised by *A. admirationis.*
Asaphodes recta	**Low** magnitude overall. • More found in SL than DDF. Preferred habitat covers approximately 202 hectares of DDF. • Uncommon moth with broad host range, associated with bogs from Mckenzie country south. • There is no practicable way of minimising effects on this species. • We cannot confidently assume rehabilitation efforts will benefit *A. recta.*
Sporophyla oenospora	**Potentially Low** magnitude overall. • Not detected within the DDF, though presence cannot be definitively excluded. • Two adults recorded from a single location bear the proposed realignment of Ardgour Rise, representing the only known population in New Zealand. Without knowledge of preferred habitat requirements, the exact quantity of suitable habitat within the DDF cannot be determined. Previously considered extinct until rediscovered during this project. Was only found well outside main DDF area, on Ardgour rise re-alignment. Road alignment modified so road bypasses area by several hundred metres. Habitat of new road alignment different to where moth was found. • Rehabilitation will provide no benefit as the species is not believed to occur within the DDF.
Homodotis sp. A (NZAC (CO)) (moth)	**Potentially Low** magnitude overall. • Not detected within the DDF, though presence cannot be definitively excluded. One specimen recorded from Bendigo Historic Reserve. Host plant or life history unknown. Although not detected within the DDF, potential negative impacts to this species cannot be ruled out. Given the

Species	Magnitude of residual effect
	host plant is unknown, it is not possible to estimate the quantity of habitat throughout the DDF. • Given the species' widespread distribution throughout New Zealand, potential negative impacts are not anticipated to be significant. • As this moth was not detected within the direct disturbance footprint and the potential impact pathway remains unclear, no specific minimisation measures can be implemented. • With unknown life history and host plant requirements, and no *Homodotis* detected at DDF peripheries for potential recolonisation, rehabilitation efforts offer no demonstrable benefit for this species.
Olearia pug moth *Pasiphila sp. 'Olearia'*	**Potentially Low** magnitude overall. • Not detected within the DDF, though presence cannot be definitively excluded. One specimen recorded from Bendigo Historic Reserve. • ·Host plants occur widely throughout Otago, and with no *Pasiphila* found in the DDF, the project is assumed to have little impact on the wider population. Species dependent on *Olearia odorata* or *Olearia bullata* host plants, which occur throughout approximately 594 hectares of the DDF. • ·Practical minimisation of effects on this species during mining operations is not feasible. Although successful colonisation of newly created habitat during rehabilitation is not guaranteed, the strategic Olearia planting program is expected to reduce impact severity and offer mitigation potential. • There is a risk that habitat created through rehabilitation may not be successfully colonised by *Pasiphila*, as the species may not be present in close enough proximity to the DDF.
Nyctemera annulata	**Potentially Low** magnitude overall. • Not detected within the DDF, though presence cannot be definitively excluded. Preferred habitat for *N. annulata* covers very small proportion of DDF (>10 ha). • Widespread throughout NZ. Includes plant pest species as hosts. • Given this species is unlikely to be impacted, there is little opportunity to minimise impacts. • Given this species is unlikely to be impacted, there is little opportunity to minimise impacts, although careful consideration of pest plant control programme on site leaves key host plants in some areas.
Paranotoreas fulva	**Potentially Negligible** magnitude overall. • Not detected within the DDF, though presence cannot be definitively excluded. Originally found in the DDF at the proposed Ardgour Rise re-alignment site, though the road was subsequently moved to avoid impacts. Preferred habitat for *P. fulva* covers very small proportion of DDF (>10 hectares). • Found in southern half of South Island. • Originally found in the DDF at the proposed Ardgour Rise re-alignment site, though the road was subsequently moved to avoid impacts. • We cannot confidently assume rehabilitation efforts will benefit *P. fulva*, though specific preferred habitat is included in LERMP.

7.4 Level of residual effects assessment

Table 21 below sets out the potential 'Level of Effects' for terrestrial and wetland habitat values after efforts to avoid, minimise or remedy effects, while **Table 22** presents the Level of effects for notable flora and fauna species.

This 'Level of Effects' assessment is based on the more detailed Ecological Values assessment and the Magnitude of Effects Assessment as set out above.

Table 21: Level of residual effects on vegetation/habitat types within the ESA

Vegetation/habitat type	Ecological value	Magnitude of residual effects	Assigned level of effect (EcIAG)
Exotic pasture or herbfield	Low	Moderate	Low
Mixed depleted herbfield (cushionfield) and grassland	Very high	High	Very high
Mixed tussock shrubland and exotic grassland	Moderate	Moderate	Moderate
Mixed scrubland	Moderate	High	Moderate
Native-dominant tussockland	High	Moderate	High
Native herbfield and shrubland	High	Low	Moderate
Native-dominant scrubland	Very high	High	Very High
Wetlands in DDF and DDZ			
Seepage wetlands	Moderate	Moderate	Moderate
Gully fens	Moderate	Moderate	Moderate
Swamps/marshes	High	No residual effect	Positive

Table 22: Level of residual effect on notable flora and fauna species within the DDF

Species	Ecological value	Magnitude of residual effects	Assigned level of residual effect (EcIAG)
Threatened and At Risk Flora			
Tiny forget-me-not *Myosotis brevis*	Very high	Very high	Very high
Carex talboti	Very high	High	Very high
Colobanthus brevisepalus	Very high	High	Very high
Raoulia beauverdii	Very high	High	Very high
Desert poa *Poa maniototo*	High	High	Very High
Hypericum involutum	High	High	Very High
Ceratocephala pungens	Very high	Potentially High[66]	Potentially Very High
Lagenophora barkeri	Very high	Moderate	High
New Zealand Mousetail	Very high	Moderate	High

[66] The term 'potentially' reflects impacts associated with the 2.7 ha early disturbance area within the CIT footprint required for enabling works for which impacts are currently uncertain.

Species	Ecological value	Magnitude of residual effects	Assigned level of residual effect (EcIAG)
Myosurus minimus novae-zelandiae			
Celadon mat daisy *Raoulia parkii*	Very high	Moderate	High
Rytidosperma maculatum	Very high	Moderate	High
Common scabweed *Raoulia australis*	High	Moderate	High
Rytidosperma buchananii	High	Moderate	High
Colobanthus strictus	High	Moderate	High
Pincushion grass *Agrostis muscosa*	High	Moderate	High
Poa lindsayi	High	Moderate	High
Bladder Fern *Cystopteris tasmanica*	Moderate	Moderate	Moderate
Luzula leptophylla	Moderate	Moderate	Moderate
Myosotis antarctica subsp. *antarctica*	Moderate	Moderate	Moderate
Hot rock fern *Pellaea calidirupium*	Moderate	Moderate	Moderate
Rock fern *Cheilanthes sieberi sieberi*	Moderate	High	Moderate
Myriophyllum pedunculatum subsp. *novae-zelandiae*	Moderate	Moderate	Moderate
Chaerophyllum ramosum	Moderate	Low	Low
Coastal woodrush *Luzula banksiana var. rhadina*	Moderate	Low	Low
Feldmark grass *Rytidosperma pumilum*	High	Low	Low
Carex kaloides	Very high	Positive	Positive
Bidibid / piripiri *Acaena buchananii*	Very high	Positive	Positive
Buchanan's Sedge *Carex buchananii*	Very high	Positive	Positive
Mikimiki *Coprosma virescens*	Very high	Positive	Positive
Pimelea aridula aridula	Very high	Positive	Positive
Blue Wheat Grass *Anthosachne aprica*	Very high	Positive	Positive
Pimelea prostrata subsp. prostrata	Very high	Positive	Positive
Carmichaelia petriei	High	Positive	Positive
Epilobium hectorii	High	Positive	Positive
Olearia lineata	High	Positive	Positive
Scented tree daisy *Olearia odorata*	High	Positive	Positive
Styphelia nana	High	Positive	Positive
Juncus distegus	High	Positive	Positive
Spineless Acaena *Acaena inermis*	High	Positive	Positive
Geranium aff. microphyllum	Moderate	Positive	Positive
Carex diandra	Moderate	Positive	Positive
Olearia bullata	Moderate	Positive	Positive
Pimelea notia	Moderate	Positive	Positive
New Zealand dock *Rumex flexuosus*	Moderate	Positive	Positive
Bristle grass *Rytidosperma corinum*	Moderate	Positive	Positive
White fuzzweed *Vittadinia australis*	Moderate	Positive	Positive
Festuca mathewsii subsp. *mathewsii*	Moderate	Positive	Positive

Species	Ecological value	Magnitude of residual effects	Assigned level of residual effect (EcIAG)
Geranium potentilloides	Moderate	Positive	Positive
Birds			
New Zealand falcon – eastern form*	Very High	Low	Moderate
New Zealand pipit*	High	Low-Moderate	Moderate
Silvereye*	High	Low	Moderate
Black-fronted tern	Very High	Negligible	Low
Black-billed gull	Very High	Negligible	Low
South Island pied oystercatcher*	High	Negligible	Very low
Black shag*	Moderate	Negligible	Very low
Little shag	Moderate	Negligible	Very low
Tomtit	Moderate	Negligible	Very low
Bellbird	Moderate	Negligible	Very low
Lizards			
Tussock skink	High	Moderate	High
Kawarau gecko	High	Moderate	High
McCann's skink	Low	Moderate	Low
Invertebrates			
Harpalus new sp. (Ground beetle)	Very high	Very high	Very high
Inophloeus new sp. (weevil)	Very high	High	Very high
Pseudocoremia cineracia (moth)	Very high	High	Very high
Phaulacridium otagoense (grasshopper)	High	Very high	Very high
Elachista helonoma (moth)	High	High	Very high
Ichneutica toroneura (moth)	High	High	Very high
Megadromus new sp. 1 (ground beetle)	Very high	Moderate†	High†
Megadromus new sp. 2 (ground beetle)	Very high	Moderate†	High†
Scythris sp. 1 (moth)	High	Moderate†	High†
Sporophyla oenospora (moth)	Very high	Low†	Moderate†
Homodotis sp. A	Very high	Low†	Moderate†
Pasiphila sp. 'Olearia' pug moth	Very high	Low†	Moderate†
Agrotis admirationis (moth)	High	Low	Low
Asaphodes recta (moth)	High	Low	Low
Nyctemera annulata (moth)	High	Low†	Low†
Ichneutica sistens (moth)	High	Low	Low
Meterana exquisita (moth)	High	Low	Low
Paranotoreas fulva (moth)	High	Negligible†	Very low†

*Bird species observed in avifauna surveys
† Likely potential effect on invertebrate species as detailed in Section 7.3.3.

To the extent feasible, residual effects assessed as 'Moderate' or higher will be addressed through the measures described below. Certain residual adverse effects assessed as 'Very High' are subject to a further 'limits to offsetting' assessment as described **in Section 2.3.4**.

8. Residual effects management

8.1 Residual effects to be addressed

As assessed in Section 7, the project is expected to have residual adverse effects of 'Moderate' or higher (after efforts to avoid, minimise or remedy effects) on a number of habitats (**Table 23**) and species (**Table 24**).

Biodiversity offsetting or compensation is proposed to manage these effects, where feasible, in accordance with the biodiversity and offset principles set out in the NPSIB (Appendix 3 & 4) and NPSFM (Appendix 6 & 7) including adherence to the effects management hierarchy and limits to offsetting or compensation.

Assessment against relevant statutory requirements and weighting under the FTAA is provided in the application and accompanying documents (Mitchell Daysh).

Table 23: Level of residual effects on vegetation/habitat types assessed as moderate or higher

Vegetation/ habitat type	Assigned level of residual effect
Mixed depleted herbfield (cushionfield) and grassland	Very high
Mixed tussock shrubland and exotic grassland	Moderate
Mixed scrubland	Moderate
Native dominant tussockland	High
Native taramea herbfield and shrubland	Moderate
Native dominant scrubland	Very High
Seepage wetlands (excluding effects outside the DDF)	Moderate
Gully fens (excluding effects outside the DDF)	Moderate

Table 24: Level of residual effect on notable flora and fauna species assessed as moderate or higher

Taxonomic group	Species	Level of residual effect
Plant	Tiny forget-me-not - *Myosotis brevis*	Very high
Plant	*Carex talboti*	Very high
Plant	*Colobanthus brevisepalus*	Very high
Plant	*Raoulia beauverdii*	Very high
Plant	*Hypericum involutum*	Very high
Plant	*Desert poa - Poa maniototo*	Very High
Plant	*Ceratocephala pungens*	Potentially Very high[67]
Invertebrate	*Pseudocoremia cineracia* (moth)	Very high

[67] The term 'potentially' reflects impacts associated with the 2.7 ha early disturbance area within the CIT footprint required for enabling works for which impacts are currently uncertain.

Taxonomic group	Species	Level of residual effect
Invertebrate	*Harpalus* new sp. (ground beetle)	Very high
Invertebrate	*Inophloeus* new sp. (weevil)	Very high
Invertebrate	*Phaulacridium otagoense* (grasshopper)	Very high
Invertebrate	*Elachista helonoma* (moth)	Very high
Invertebrate	*Ichneutica toroneura* (moth)	Very high
Plant	*Lagenophora barkeri*	High
Plant	New Zealand Mousetail - *Myosurus minimus novae-zelandiae*	High
Plant	Celadon mat daisy - *Raoulia parkii*	High
Plant	*Rytidosperma maculatum*	High
Plant	Common scabweed - *Raoulia australis*	High
Plant	*Rytidosperma buchananii*	High
Plant	*Colobanthus strictus*	High
Plant	Pincushion grass - *Agrostis muscosa*	High
Plant	*Poa lindsayi*	High
Lizard	Tussock skink	High
Lizard	Kawarau gecko	High
Invertebrate	*Megadromus* new sp. 1 (ground beetle)	High†
Invertebrate	*Megadromus* new sp. 2 (ground beetle)	High†
Invertebrate	*Scythris* sp. 1 (moth)	High†
Plant	Bladder Fern *Cystopteris tasmanica*	Moderate
Plant	*Luzula leptophylla*	Moderate
Plant	*Myosotis antarctica* subsp. *antarctica*	Moderate
Plant	Hot rock fern - *Pellaea calidirupium*	Moderate
Plant	Rock fern - *Cheilanthes sieberi sieberi*	Moderate
Plant	*Myriophyllum pedunculatum* subsp. *novae-zelandiae*	Moderate
Bird	New Zealand falcon – eastern form*	Moderate
Bird	New Zealand pipit*	Moderate
Bird	Silvereye*	Moderate
Invertebrate	*Sporophyla oenospora* (moth)	Moderate†
Invertebrate	*Homodotis* sp. A (NZAC (CO)) (moth)	Moderate†
Invertebrate	*Pasiphila* sp. 'Olearia' pug moth	Moderate†

*Bird species observed in surveys
†Potential category for invertebrates as described in Section 7.3.3.

8.2 Biodiversity offsetting and compensation

8.2.1 Overview

Management of residual effects remaining after efforts to avoid, minimise/mitigate or remedy adverse effects falls to offsetting or compensation where this can be demonstrably achieved. This involves implementing ecological restoration and/or habitat

enhancement measures that provide net gain (offsets) or net positive (compensation) benefits for biodiversity.

Under the NPSIB a biodiversity offset is a 'measurable conservation outcome' that meets offset requirements set out in Appendix 3 of the NPSIB and addresses more than minor residual effects to a Net Gain standard. Net gain must be demonstrated through the application of a like-for-like quantitative loss/gain calculation.

Conversely, biodiversity compensation is any conservation action that meets compensation requirements set out in Appendix 4 of the NPSIB and addresses more than minor residual adverse effects through positive effects that outweigh adverse effects. There is no requirement for a like-for-like quantitative loss/gain calculation.

For this project, habitat restoration and enhancement measures outside the DDF are classified as 'offsets' or 'compensation', as they provide ecological benefits but do not directly reduce the severity of adverse effects at the point of impact. A notable exception is the proposed measures within the MRZs adjacent to the project footprint which —while generally considered offset/compensation —also function as mitigation, as they reduce the severity of the relevant environmental effect by:

- minimising ecological or disturbance-related edge effects
- supporting ecological rehabilitation of the DDF by providing ongoing seed sources, propagules and colonising fauna.

Biodiversity offsetting and compensation for the BOGP was assessed relative to a baseline of the current state, as detailed in the Biodiversity Offset Report (RMA Ecology, 2025).

8.2.2 Application of biodiversity offsetting

In accordance with the effects management hierarchy, biodiversity offsetting was considered and tested in the first instance for all residual adverse effects assessed as Moderate or higher—i.e. those remaining after avoidance, minimisation, mitigation, or remediation efforts.

Of the potential adverse effects of the project that cannot be avoided or mitigated, and setting aside impacted values that should not occur (limits to offsetting), there are four[68] ecological values on the site for which offsetting is an appropriate approach. Most other values cannot be addressed through an offsetting pathway primarily because insufficient knowledge exists regarding the distribution of the species across the site, or insufficient knowledge exists on how to salvage, relocate, restore, conserve or manage that ecological feature. This is especially true of most plants and terrestrial invertebrates of conservation importance found on the site.

Offsetting was determined to be a potentially appropriate approach for the following four biodiversity values (Biodiversity Offset Report, RMA Ecology, 2025d):

- Native-dominant tussockland (High value)

[68] The Biodiversity Offset Report applies offsetting to eight biodiversity values in total, not all of which achieveNo Net Loss.

- Native taramea herbfield and shrubland (High value)
- Native-dominant scrubland (Very high value)
- Swamp and marsh wetlands (High value)

For these values, Biodiversity Offset Accounting Models (BOAMs; Maseyk et al. 2015) were applied to demonstrate that Net Gain outcomes could be achieved with sufficient certainty. The results of this modelling by RMA Ecology are described in Section 8.2.3 below.

However, for the majority of ecological values affected, offsetting was not considered feasible. This was primarily due to insufficient knowledge of species distribution or the technical infeasibility of salvage, relocation, restoration, or management—particularly for most threatened plants and terrestrial invertebrates present at the site. In many cases, the proposed restoration and enhancement measures could not be quantified with adequate precision or certainty, or they involved like-for-unlike exchanges that fall outside the definition of offsetting. For example, translocation of nationally endangered lizards into the Bendigo Sanctuary to compensate for residual effects on less threatened lizard species.

Where offsetting was not viable, a compensation approach was adopted (Section 8.3 below). Compensation measures were based on expert ecological judgement and informed by field investigations. They could not be modelled using a Biodiversity Compensation Model (Baber et al. 2021a,b; and 2025) — either because of the degree of uncertainty in expected outcomes[69], or because proposed compensation measures were predominately like-for-unlike exchanges which fall outside the scope of the model.

8.2.3 Biodiversity offset accounting models

Measures for describing biodiversity features included in the BOAMs use data collected from across the DDF and ESA. The data collection methods used were standard techniques and allow duplication at offset sites so that baseline and trajectory information can be collected in a consistent manner across time.

The BOAMs predicted Net Gain outcomes in relation to both extent and value (condition) for three of the six habitat types assessed **Table 25** below), being native taramea herbfield and shrubland, native dominant scrubland, and swamp/marsh wetlands.

For these habitat types, the model predicts that indigenous biodiversity values at the offset site are equivalent to or exceed those being lost at the impact site, including:

a) types of indigenous biodiversity

b) amount (i.e. areal extent); and

c) condition (structure and quality).

[69] In accordance with the BCM User Guide

For native-dominant tussockland, however, although an improvement in ecological value (i.e. condition) is expected, a loss in areal extent is also anticipated.

Table 25: Application of Biodiversity Offset Accounting Models for Habitat Types

Will the proposed rehabilitation, restoration, enhancement works result in a Net Gain outcome?		
Habitat type	**Extent**	**Values (condition)**
Native-dominant tussockland	No	Yes
Native taramea herbfield and shrubland	Yes	Yes
Native dominant scrubland	Yes	Yes
Swamp/marsh wetlands	Yes	Yes
Seepage wetlands	No	No
Fen wetlands	No	No

8.3 Proposed residual effects management package

8.3.1 Overview

Indigenous biodiversity in the landscape is in a state of decline due to ongoing habitat loss and degradation through stock browsing, topdressing and aerial oversowing with non-native pasture species, spread of competing non-native plants (including weeds), invasive browsers and grazers (especially rabbits and deer)[70] and predation by introduced mammals (Habitat New Zealand Ltd, 2025c). Without intervention, most native species will continue to decline, and several Threatened or At Risk species are likely to become locally extinct over time. A notable exception is the cushionfield ecosystem (which contains threatened plants and invertebrates) and is likely being maintained in areas of the DDF where browsing pressure and the absence of pasture improvement actions have enabled some cushionfield-associated species to persist at relatively high abundances.

Overall, the declining state of biodiversity within the ESA and surrounds provides a unique opportunity to restore the landscape at scale in the long-term. While returning to a pre-human state is neither feasible nor desirable due to extinctions, invasive species and climate change, it remains possible to restore native biodiversity to a more indigenous dominated, species-rich and structurally diverse tussock, shrubland, forest, and potentially, cushionfield ecosystem.

8.3.2 Proposed approach

Proposed offset and compensation measures include ecological restoration and habitat enhancement across 2,219 ha of habitat within the ESA, in the landscape surrounding the mine footprint.

[70] Mammalian pest survey (Habitat New Zealand Ltd, 2025c)

These measures aim to reverse the ongoing decline of native habitat, supporting a large-scale transition from exotic-dominated to native-dominated ecosystems. Restoration efforts will prioritise the reinstatement of species that are rare, under-represented, or locally extirpated, as well as resilient native species capable of persisting under harsh and variable conditions. Long-term biodiversity outcomes will be supported by a combination of extensive weed and pest control, pest exclusion, habitat enhancement, and browsing pressure management, tailored to the specific requirements of each area.

In broad terms, exotic habitats will be converted to a range of native ecosystems depending on aspect, altitude and potential natural regeneration of natives in response to removal/changing of browsing pressure primarily from cattle, sheep, rabbits, and hares including:

- cushionfield in dry, exposed sites;
- native dominated scrubland in south-facing shaded sites,
- native taramea herbfield and shrubland
- native dominated tussockland in all other areas.

Specifically, proposed ecological restoration and habitat enhancement will occur across four areas within the surrounding landscape:

- The 889 ha MRZ surrounding the DDF (**Appendix 1, Figure 9**), through native enrichment planting, livestock management, mammalian pest control, and ecological weed control.
- The 1263 ha ARA (**Appendix 1, Figure 10**), via native enrichment planting, livestock management, mammalian pest control, and weed control within select Ecological Management Units (EMU) at Ardgour Station currently used for grazing; and
- Approximately 67 ha of pest-exclusion fenced areas, being:
  - The c. 38 ha Ardgour Sanctuary (**Appendix 1, Figure 11**) and
  - The c. 29 ha Bendigo Sanctuary (**Appendix 1, Figure 12**).

    Within these areas, measures include construction of predator-exclusion fences, eradication of mammalian predators, browser management, ecological weed control, deployment of salvaged rock habitat, native revegetation and enrichment planting, and translocation of locally extirpated (extinct) Threatened or At Risk species.

The available habitat types within the collective offset/compensation areas that will be restored and enhanced include:

- Exotic pasture or herbfield (387 ha) – will be progressively replaced by native regenerating shrubland and forest species through restorative management.
- Mixed depleted herbfield (cushionfield) and grassland (395 ha) will be managed to sustain and maintain indigenous biodiversity values with a focus on enhancing habitat for Threatened and At Risk flora, including spring annuals.

- Mixed tussock shrubland and exotic grassland (720 ha) and mixed scrubland (172 ha) will be managed to increase the indigenous dominance and diversity of native shrubland species.
- Native dominant tussockland (350 ha) will be managed to sustain and enhance tussock grassland indigenous dominance and diversity.
- Native taramea herbfield and shrubland (78 ha) will be managed to sustain and enhance indigenous dominance and diversity.
- Native dominant scrubland (262 ha) will be managed to increase indigenous dominance and diversity.

8.3.3 Mine regeneration zones

Within approximately 889 ha of MRZs to the north, south, and east of the DDF, habitat enhancement will be undertaken for the purposes of offsetting/compensation for residual adverse effects on terrestrial biodiversity, but also to support rehabilitation of the DDF. The latter is achieved by providing seed sources and propagules and fauna that can colonise and establish within the DDF during the ecological rehabilitation process.

The large MRZ is the source of most plant propagules and will be managed to enhance the health and natural expansion of many threatened and non-threatened plant species. This provides flexibility for seed collection that is likely to maintain the local genetic variability of most plant species except for wetland species. The MRZ therefore acts an enhanced 'nursery stock population' of mature plants with their natural pollinators. The exception is the three spring annual herbs listed in the ARP[71], as a large proportion of their populations is within the DDF.'

The overall objective of restoration within the MRZs is to enhance native woody vegetation and protect and improve depleted herbfield (cushionfield) and grassland habitats and associated species as detailed in the Landscape and Ecology Rehabilitation Plan.

The current areal extent of vegetation/habitat types within the MRZ includes:

- Exotic pasture or herbfield (125 ha)
- Mixed depleted herbfield (cushionfield) and grassland (88 ha)
- Mixed tussock shrubland and exotic grassland (304 ha)
- Mixed scrubland (38 ha)
- Native dominant tussockland (133 ha)
- Native herbland and shrubland (76 ha)
- Native dominant scrubland (125 ha).

[71] *C. pungens, M. brevis and Myrosurus minimus novae-zelandiae.*

8.3.4 Ardgour restoration area

The c. 1263 ha ARA will be managed in accordance with the Ardgour Restoration Area Management Plan.

The objective of the ARA is to enhance both woody ecosystems and sustain indigenous dominated herbfield (cushionfield) ecosystems to compensate for residual adverse effects on native biodiversity from the BOGP project.

The areal extent of habitats within the ARA includes:

- Exotic pasture or herbfield (241 ha)
- Mixed depleted herbfield (cushionfield) and grassland (228 ha)
- Mixed tussock shrubland and exotic grassland (350 ha)
- Mixed scrubland (102 ha)
- Native dominant tussockland (202 ha)
- Native herbland and shrubland (2 ha)
- Native dominant scrubland (108 ha).

Key habitat restoration and enhancement measures across the 1263 ha ARA include:

- Targeted enrichment planting of native woody vegetation and facilitation of native woody regeneration through exclusion of livestock and mammalian browsers and grazers.
- 10 ha of restoration planting of alluvial podocarp dominated forest.
- Targeted establishment of kōwhai groves.
- Control of mammalian browsers and predators (except rabbits and mice) to low levels via trapping, shooting or baiting. This includes maintaining ungulates (deer, goats, and pigs) at zero densities, and possums, rats, mustelids, cats and hedgehogs at target densities in woody restoration areas.
- Rabbit-proof fences will be installed selectively (e.g. around kōwhai groves); however, rabbits will be maintained at ORC target densities in areas where ongoing rabbit browsing is beneficial to cushionfield vegetation.
- Selective pest plant control, including control of woody plant pests, and selective control of sweet brier targeting cushionfields.
- Livestock fencing and management, including excluding livestock from areas undergoing woody vegetation restoration, while maintaining targeted sheep grazing in other areas (e.g. cushionfields) to assist with weed and rank grass control and to provide firebreaks that help protect restored woody vegetation.

All plant pest and mammalian pest control activities undertaken in the ARA will also be undertaken on the adjacent northeastern slopes of Shepherds Creek outside the DDF, as detailed in the LERMP.

The ARA Management Plan establishes a site-specific management approach that treats different parts of the ARA as unique Land Management Units, distinguished based on restoration management goals.

Key biodiversity outcomes are outlined in the ARA Management Plan and broadly include ecological uplift through:

- Improved structural and compositional integrity of native shrublands and forest types
- Expanded and enhanced habitat for Threatened and At-Risk plant species
- Reduced browsing and predation pressure on native fauna
- Increased ecological connectivity across the landscape.

Broad objectives for specific land management units within the ARA (as set out in the Management Plan) collectively include, for example:

- 50% increase in native woody vegetation cover relative to the baseline state prior to commencement of habitat restoration actions where natives make up more than half of ground cover.
- Greater native woody diversity, with at least six species (including trees, shrubs, and lianes) on average in regenerating areas.
- At least 30% native woody establishment in previously non-woody areas (excluding cushionfields).
- Bird abundance uplift, with tauhou, korimako, and tūī at least 50% higher in native scrubland and 25% higher in exotic scrubland compared to 2024–2025 levels.
- Evidence of natural regeneration, with unplanted native species present in at least half of monitored sites.
- Natural kōwhai seedling establishment near at least 10 kōwhai groves, including all existing ones.
- >50% survival of planted mataī and tōtara, with individuals reaching over 5 m tall.
- Cushionfield extent maintained, with stable or increasing populations of four key threatened species across three distinct areas.

8.3.5 Ardgour and Bendigo sanctuaries

The overall objective of restoration within the sanctuaries is to protect and improve depleted herbfield (cushionfield) and grassland habitats and associated species, and to enable the translocation of threatened flora and fauna that are dependent on the elimination of introduced mammalian predators and/or intensive management to persist in the landscape.

The residual effects management approach provides for 'trade-up' gains in the restoration of threatened ecosystems or translocation of endangered species that are not impacted by the Project, but that were historically present in the area. For fauna, these

opportunities arise through the proposal to include pest exclusion fences within which introduced mammalian predators will be eliminated. Ultimately, the degree to which these measures contribute to the adequacy of the effects management package would reflect:

- The suite of potential ecosystems or species that are re-created or translocated and their threat status/ extinction risk profile
- The carrying capacity of the pest exclusion fence – i.e. the potential areal extent of recreated ecosystem(s) or the total number of translocated individuals that the pest exclusion fence area could ultimately support
- The degree to which the trade constitutes a trade-up scenario, i.e. benefits to critically threatened ecosystems or species in exchange for impacts to habitat or species that are significantly less threatened.

Such ecosystems or species could potentially include:

- Ecosystem communities that originally existed at the site but are now rare in the Ecological Region, including Hall's tōtara, mountain celery pine, broadleaf forest (CLF1)[72]; Kānuka, Olearia scrub/treeland (TI2); and Narrow-leaved and slim snow tussock tussockland/shrubland (AL1)
- Threatened plants including *Ceratocephala pungens* (Threatened – Nationally Critical), *Ranunculus brevis* (Threatened – Nationally Endangered), white sedge (*Carex albula*; Threatened – Nationally Critical), *Carmichaelia nana* (Threatened – Nationally Vulnerable), and tussock bindweed (*Convolvulus verecundus* subsp. *verecundus*; At Risk - declining)
- Otago skink (nationally Threatened-endangered; regionally endangered)
- Grand skink (nationally Threatened -endangered; regionally endangered)
- Jewelled gecko (nationally and regionally At Risk – declining)
- *Sigaus minutus* (Minute grasshopper)(nationally Threatened - nationally vulnerable)
- *Sigaus childi* (Otago arid grasshopper) – (nationally Threatened – nationally vulnerable)

The 38 ha Ardgour Sanctuary (**Appendix 1, Figure 11**) comprises:

- Exotic pasture or herbfield (11.7 ha)
- Mixed depleted herbfield (cushionfield) and grassland (19.8 ha)
- Mixed tussock shrubland and exotic grassland (3.1 ha)
- Native dominant scrubland (2.8 ha)

The 29 ha Bendigo Sanctuary (**Appendix 1, Figure 12**) comprises:

- Mixed depleted herbfield (cushionfield) and grassland (19.3 ha)

[72] Classifications in brackets refer to Singers and Rogers (2014) terrestrial ecosystem classifications for New Zealand.

- Mixed tussock shrubland and exotic grassland (8.2 ha)

Within both pest-free sanctuaries, the following measures are proposed:

- Construction of pest exclusion fences, and their maintenance until mammalian pests are eradicated in the landscape
- Livestock exclusion
- Eradication of all mammalian predators
- Eradication of all mammalian browsers with the notable exception of rabbits
- Deployment of rock refugia including rock stacks, tors and to improve habitat diversity, especially for invertebrates, lizards and plants.
- Native revegetation focused on restoration of tussock grassland and native-dominated shrubland ecosystem types
- Translocations of locally extirpated nationally Threatened or At Risk flora and fauna that were formerly present in the landscape

8.4 Summary of offset/compensation outcomes

Based on current information, the BOGP is expected to result in biodiversity outcomes ranging from Net Loss to Net Gain, depending on the ecological value (**Table 26** below). Net Gain is anticipated for some values, supported for native habitat types by biodiversity offset modelling (Section 8.2.2), while for others the outcome remains uncertain or is expected—or conservatively assumed, to result in Net Loss. Ongoing efforts under the ARP aim to better understand or improve these outcomes for cushionfield and spring annual species, and to develop methods to achieve Net Gain where feasible.

The offset/compensation outcomes presented here are based on the following assumptions:

- The expected biodiversity outcomes assume that mining of the CIT pit, although delayed, will proceed. While this will only occur if research provides adequate confidence regarding cushionfield restoration and the conservation of threatened cushionfield plant species and habitat, estimates of biodiversity loss are based on the full mine design, rather than a reduced BOGP design (to exclude the CIT open pit) that may result if research objectives are not met. In practice, net loss or uncertain effects will be reduced by not mining the CIT pit, unless outcomes of the ARP are successful for *M. brevis*, *C. pungens* and cushionfield habitat, in accordance with proposed conditions of consent.
- Where a Net Gain outcome is predicted, there is confidence that the unavoidable losses caused by the project can be addressed (offset) to provide an overall positive outcome.

- Where 'uncertain' outcomes are assigned, the success of an action cannot be predicted with sufficient confidence to assign a 'Net Positive' outcome, but nor is a Net Loss expected.[73]
- A Net Loss is assigned where, based on current information, a negative outcome is conservatively assumed. In such cases, there is confidence that—despite proposed enhancements or replacement measures—the benefits cannot be demonstrated (without further research) to adequately address the permanent residual impacts of the project, and a negative outcome must therefore be assumed.
- While the ARP has been proposed to address uncertainty for cushionfields and spring annuals and may improve their outcomes, these outcomes are currently unknown and cannot be quantified. An expected Net Loss outcome has therefore conservatively been assigned for cushionfields and spring annuals.

Table 26: Expected biodiversity outcomes for vegetation/habitats within 35 years of approval being granted including for species not impacted by Project activities

Habitat type	Ecological value	Level of residual effect	Residual effects management measures (offsetting/compensation)	Expected outcome
Vegetation/habitat type				
Exotic pasture or herbfield	Low	Low	Weed management, livestock management, mammalian pest management, native plantings and rock habitat enhancement as detailed in the various Management Plans.	Net gain for native elements
Mixed depleted herbfield (cushionfield) and grassland	Very high	Very high	Weed management, livestock management, and mammalian pest management as detailed in the various Management Plans.	Net loss
Mixed tussock shrubland and exotic grassland	Moderate	Moderate	Weed management, livestock management, mammalian pest management, native plantings and rock habitat enhancement as detailed in the various Management Plans.	Net gain for native elements
Mixed scrubland	Moderate	Moderate	Weed management, livestock management, mammalian pest management, native plantings and rock habitat enhancement as detailed in the various Management Plans.	Net gain for native elements
Native-dominant tussockland	High	High	Weed management, livestock management, mammalian pest management, native plantings and rock habitat enhancement as detailed in the various Management Plans.	Net loss in extent / net gain in condition

[73] The uncertainty may arise because insufficient knowledge exists regarding the distribution of the species across the site, despite extensive study, or insufficient knowledge exists on how to salvage, relocate, restore, conserve or manage that ecological feature.

Habitat type	Ecological value	Level of residual effect	Residual effects management measures (offsetting/compensation)	Expected outcome
Native taramea herbfield and shrubland	High	Moderate	Weed management, livestock management, mammalian pest management, native plantings and rock habitat enhancement as detailed in the various Management Plans.	Net gain in extent and condition
Native-dominant scrubland	Very high	Very High	Weed management, livestock management, mammalian pest management, native plantings and rock habitat enhancement as detailed in the various Management Plans.	Net gain in extent and condition
Seepage wetlands (excluding effects outside the DDF)	Moderate	Moderate	Weed management, livestock management, mammalian pest management, native plantings are likely to benefit indigenous biodiversity values but there is likely to be a loss in extent as many wetlands are fully or partially induced by cattle pugging	Net loss
Gully fens (excluding effects outside the DDF)	Moderate	Moderate	Weed management, livestock management, mammalian pest management, native plantings are likely to benefit indigenous biodiversity values but there is likely to be a loss in extent as many wetlands are fully or partially induced by cattle pugging	Net loss
Marsh/swamp wetlands (including open water)	High	Positive[74]	Not applicable as swamp/marsh wetlands will be rehabilitated to a net gain standard within the DDF so no offsetting/compensation required	Net gain in extent and condition
Re-created Alluvial podocarp forest	Not applicable	Not impacted	Weed management, livestock management, mammalian pest management, native plantings and rock habitat enhancement as detailed in the various Management Plans.	Net gain in extent and condition

Species	National threat status	Regional threat status	Level of residual effect	Residual effects management measures	Expected outcome
Species for which level of residual effect is assessed as Moderate or higher					
Plant species					
Tiny forget-me-not - *Myosotis brevis*	Threatened – Nationally Vulnerable	Threatened -Regionally Endangered	Very high	No evidence that potential residual effects management measures will benefit this species	Net loss

[74] Excludes assessment of the potential for adverse effects on wetlands outside the project footprint that may arise from drawdown or degradation of water quality. It is therefore unclear if the expected net gain outcome in extent and condition would still apply if these effects were taken into account.

Species	National threat status	Regional threat status	Level of residual effect	Residual effects management measures	Expected outcome
Carex talboti	At Risk – Declining	Threatened - Vulnerable	Very high	No evidence that potential residual effects management measures will benefit this species and may in fact adversely affect this species within offset/compensation sites	Net loss
Colobanthus brevisepalus	At Risk – Declining	Threatened - Vulnerable	Very high	No evidence that potential residual effects management measures will benefit this species	Net loss
Raoulia beauverdii	At Risk – Declining	Threatened - Vulnerable	Very high	No evidence that potential residual effects management measures will benefit this species	Net loss
Hypericum involutum	At Risk – Declining	Data deficient	Very high	No evidence that potential residual effects management measures will benefit this species	Net loss
Desert poa - *Poa maniototo*	At Risk – Declining	At Risk - declining	Very high	No evidence that potential residual effects management measures will benefit this species	Net loss
Ceratocephala pungens	Threatened – Nationally Critical	Threatened – Regionally Critical	Potentially Very High[75]	No evidence that potential residual effects management measures will benefit this species	Net loss
Lagenophora barkeri	At Risk – Declining	Threatened - Regionally Endangered	High	No evidence that potential residual effects management measures will benefit this species	Net loss
NZ Mousetail - *Myosurus minimus n-z*	At Risk – Declining	Threatened – Regionally Endangered	High	No evidence that potential residual effects management measures will benefit this species	Net loss
Celadon mat daisy - *Raoulia parkii*	At Risk – Declining	Threatened – Regionally Vulnerable	High	No evidence that potential residual effects management measures will benefit this species	Net loss
Rytidosperma maculatum	At Risk – Declining	Threatened – Regionally Vulnerable	High	No evidence that potential residual effects management measures will benefit this species	Net loss

[75] The term 'potentially' reflects impacts associated with the 2.7 ha early disturbance area within the CIT footprint required for enabling works for which impacts are currently uncertain.

Species	National threat status	Regional threat status	Level of residual effect	Residual effects management measures	Expected outcome
Common scabweed - *Raoulia australis*	At Risk – Declining	At Risk - declining	High	No evidence that potential residual effects management measures will benefit this species	Net loss
Rytidosperma buchananii	At Risk – Declining	At Risk - declining	High	No evidence that potential residual effects management measures will benefit this species	Net loss
Colobanthus strictus	Not Threatened	At Risk - declining	High	No evidence that potential residual effects management measures will benefit this species	Net loss
Pincushion grass - *Agrostis muscosa*	Not Threatened	At Risk - declining	High	No evidence that potential residual effects management measures will benefit this species	Net loss
Poa lindsayi	Not Threatened	At Risk - declining	High	No evidence that potential residual effects management measures will benefit this species	Net loss
Bladder Fern - *Cystopteris tasmanica*	Not Threatened	At Risk - Naturally Uncommon	Moderate	Planting, weed control and livestock removal	Net loss
Luzula leptophylla	At Risk – Naturally Uncommon	At Risk - Naturally Uncommon	Moderate	No evidence that potential residual effects management measures will benefit this species	Net loss
Myosotis antarctica subsp. antarctica	At Risk – Naturally Uncommon	At Risk - Naturally Uncommon	Moderate	No evidence that potential residual effects management measures will benefit this species	Net loss
Hot rock fern - *Pellaea calidirupium*	At Risk – Naturally Uncommon	At Risk - Naturally Uncommon	Moderate	No evidence that potential residual effects management measures will benefit this species	Net loss
Rock fern - *Cheilanthes sieberi sieberi*	Not Threatened	At Risk - Naturally Uncommon	Moderate	Planting, weed control and livestock removal	Uncertain
Myriophyllum pedunculatum ss novae-zelandiae	Not Threatened	At Risk - Naturally Uncommon	Moderate	No evidence that potential residual effects management measures will benefit this species	Net loss
Feldmark grass - *Rytidosperma pumilum*	Not Threatened	At Risk - declining	Low	No evidence that potential residual effects management measures will benefit this species	Net loss

Species	National threat status	Regional threat status	Level of residual effect	Residual effects management measures	Expected outcome
Chaerophyllum ramosum	Data deficient	Not Threateend	Low	Planting, weed control and livestock removal	Net loss
Coastal woodrush - *Luzula banksiana var. rhadina*	Data Deficient	At Risk - Naturally Uncommon	Low	No evidence that potential residual effects management measures will benefit this species	Net loss
Juncus distegus	Not Threatened	At Risk - declining	Positive	Planting and expected to expand through removal of livestock	Net positive
Buchanan's Sedge - *Carex buchananii*	At Risk – Declining	Threatened – Regionally Vulnerable	Positive	Planting, weed control and livestock removal	Net positive
Mikimiki - *Coprosma virescens*	At Risk – Declining	Threatened – Regionally Vulnerable	Positive	Planting, weed control and livestock removal	Net positive
Blue Wheat Grass - *Anthosachne aprica*	At Risk – Naturally Uncommon	Threatened – Regionally Vulnerable	Positive	Planting, weed control and livestock removal	Net positive
Epilobium hectorii	At Risk – Declining	At Risk - declining	Positive	No evidence that potential residual effects management measures will benefit this species except for rock and rock rubble deployment	Net positive
Olearia lineata	At Risk – Declining	At Risk - declining	Positive	Planting, weed control and livestock removal	Net positive
Scented tree daisy *Olearia odorata*	At Risk – Declining	At Risk - declining	Positive	Planting, weed control and livestock removal	Net positive
Styphelia nana	At Risk – Declining	N / A	Positive	Deployment of rock stacks and livestock management	Net positive
Pimelea aridula aridula	At Risk – Declining	Threatened - Vulnerable	Positive	Planting, weed control and livestock removal	Net positive
Bristle grass Rytidosperma corinum	Data Deficient	Not threatened	Positive	No evidence that potential residual effects management measures will benefit this species	Net positive
Carex diandra	Not Threatened	At Risk - Naturally Uncommon	Positive	Planting, weed control and livestock removal	Net positive
Festuca mathewsii subsp. mathewsii	Not Threatened	Data deficient	Positive	Planting, weed control and livestock removal	Net positive

Species	National threat status	Regional threat status	Level of residual effect	Residual effects management measures	Expected outcome
Bird species					
New Zealand falcon – eastern form*	Threatened, nationally vulnerable	Threatened, vulnerable	Moderate	Mammalian pest management	Net positive
New Zealand pipit*	At Risk, declining	Not threatened	Moderate	Mammalian pest management	Net positive
Silvereye*	Not threatened	At Risk, declining	Moderate	Mammalian pest management and native plantings	Net positive
Lizard species					
Tussock skink	N/A*	At Risk - declining	High	Mammalian pest elimination and rock deployment noting that evidence on the effectiveness of pest control is lacking and reversion of open or low stature habitats to woody shrubland will reduce habitat suitability in the long term.	Net loss
Kawarau gecko	At Risk - declining	At Risk - declining	High	Mammalian pest elimination and rock deployment noting that evidence on the effectiveness of pest control is lacking and reversion of open or low stature habitats to woody shrubland will reduce habitat suitability in the long term.	Net loss
Invertebrate species					
Pseudocoremia cineracia (moth)	Threatened: Nationally Vulnerable	N/A	Very high	Uncertain whether there will be net loss or net positive outcomes but potential benefits through Olearia plantings (host plants)	Uncertain
Harpalus new sp. (ground beetle)	Potentially Threatened	N/A	Very high	Generally uncertain whether there will be net loss or net positive outcomes - pest elimination may benefit suitability for other species.	Uncertain
Inophloeus new sp. (weevil)	Potentially Threatened	N/A	Very high	Generally uncertain whether there will be net loss or net positive outcomes for invertebrates – mammalian pest elimination may benefit this species.	Uncertain

Species	National threat status	Regional threat status	Level of residual effect	Residual effects management measures	Expected outcome
Phaulacridium otagoense (grasshopper)	At Risk, declining	N/A	Very high	Generally uncertain whether there will be net loss or net positive outcomes for invertebrates – mammalian pest elimination may benefit this species.	Uncertain
Elachista helonoma (moth)	At Risk, declining	N/A	Very high	Generally uncertain whether there will be net loss or net positive outcomes for invertebrates – planting of tussocks (host plants) may benefit this species	Uncertain
Ichneutica toroneura (moth)	At Risk, declining	N/A	Very high	Generally uncertain whether there will be net loss or net positive outcomes for invertebrates – planting of tussocks (host plants) may benefit this species.	Uncertain
Megadromus new sp. 1 (ground beetle)	Potentially Threatened	N/A	High	Generally uncertain whether there will be net loss or net positive outcomes though elimination of mammalian pests may benefit this species.	Uncertain
Megadromus new sp. 2 (ground beetle)	Potentially Threatened	N/A	High	Generally uncertain whether there will be net loss or net positive outcomes though elimination of mammalian pests may benefit this species.	Uncertain
Scythris sp. 1 (moth)	Not assessed, of importance	N/A	High	Generally uncertain whether there will be net loss or net positive outcomes for invertebrates – planting of *Carmichaelia* (host plants) may benefit this species.	Uncertain
Sporophyla oenospora (moth)	Threatened – nationally critical	N/A	Moderate*	Generally uncertain whether there will be net loss or net positive outcomes for invertebrates	Uncertain
Homodotis sp. A (NZAC (CO)) (moth)	Threatened – nationally endangered	N/A	Moderate*	Generally uncertain whether there will be net loss or net positive outcomes for this species	Uncertain

Species	National threat status	Regional threat status	Level of residual effect	Residual effects management measures	Expected outcome
Pasiphila sp. 'Olearia' pug moth	Threatened: Nationally Vulnerable	N/A	Moderate*	Uncertain whether there will be net loss or net positive outcomes but potential benefits through Olearia plantings (host plants)	Uncertain
Species for which level of residual effects is assessed as low, very low, or positive					
Plant species					
Chaerophyllum ramosum	Data Deficient	Not Threatened	Low	No evidence that potential residual effects management measures will benefit this species	Uncertain
Epilobium hectorii	At Risk – Declining	At Risk – Declining	Positive	No evidence that potential residual effects management measures will benefit this species	Net positive
Rytidosperma corinum	Data Deficient	Not Threatened	Low	No evidence that potential residual effects management measures will benefit this species	Net loss
Kōwhai *Sophora microphylla*	Not threatened	Not threatened	Low	Weed management, livestock management, mammalian pest management and native plantings.	Net positive
Geranium potentilloides	Not Threatened	Data deficient	Positive	No evidence that potential residual effects management measures will benefit this species	Net positive
Vittadinia australis	Not Threatened	At Risk - Naturally Uncommon	Positive	No evidence that potential residual effects management measures will benefit this species	Net positive
Rumex flexuosus	Not Threatened	At Risk - Naturally Uncommon	Positive	No evidence that potential residual effects management measures will benefit this species	Net positive
Bidibid / piripiri - *Acaena buchananii*	At Risk – Declining	Threatened - Vulnerable	Positive	Weed management, livestock management, mammalian pest management and native plantings.	Net positive
Spineless Acaena - *Acaena inermis*	Not Threatened	At Risk - declining	Positive	Weed management, livestock management, mammalian pest management and native plantings.	Net positive

Species	National threat status	Regional threat status	Level of residual effect	Residual effects management measures	Expected outcome
Carex kaloides	At Risk – Declining	Threatened – Regionally Endangered	Positive	Weed management, livestock management, mammalian pest management and native plantings.	Net positive
Carmichaelia petrei	At Risk – Declining	At Risk - declining	Positive	Weed management, livestock management, mammalian pest management and native plantings.	Net positive
Geranium aff. microphyllum	At Risk – Naturally Uncommon	Not Threatened	Positive	No evidence that potential residual effects management measures will benefit this species	Net positive
Olearia bullata	Not Threatened	At Risk - Naturally Uncommon	Positive	Weed management, livestock management, mammalian pest management and native plantings.	Net positive
Pimelea notia	Not Threatened	At Risk - Naturally Uncommon	Positive	Weed management, livestock management, mammalian pest management and native plantings.	Net positive
Pimelea prostrata subsp. prostrata	Not Threatened	Threatened regionally vulnerable	Positive	Weed management, livestock management, mammalian pest management and native plantings.	Net positive
Bird species					
Black-fronted tern	Threatened, nationally endangered	Threatened, regionally endangered	Low	Proposed residual effects management measures unlikely to benefit this species	Uncertain
Black-billed gull	At Risk, declining	Threatened, regionally vulnerable	Low	Proposed residual effects management measures unlikely to benefit this species	Uncertain
South Island pied oystercatcher*	At Risk, declining	Threatened, regionally vulnerable	Very low	Proposed residual effects management measures unlikely to benefit this species	Uncertain

Species	National threat status	Regional threat status	Level of residual effect	Residual effects management measures	Expected outcome
Bellbird	Not threatened	Not threatened (locally uncommon)	Very Low	Livestock management, mammalian pest management and native plantings are expected to benefit this species as detailed in the various Management Plans.	Net positive
Black shag	At Risk, relict	Threatened, regionally endangered	Very low	Proposed residual effects management measures unlikely to benefit this species	Uncertain
Little shag	At Risk, relict	At Risk, relict	Very low	Proposed residual effects management measures unlikely to benefit this species	Uncertain
Lizard species					
McCanns skink	Not threatened	Not threatened	Low	Uncertain if proposed residual effects management measures will benefit species overall	Net loss
Invertebrate species					
Agrotis admirationis (moth)	At Risk, declining	N/A	Low	Generally uncertain whether there will be net loss or net positive outcomes for this species.	Uncertain
Asaphodes recta (moth)	At Risk, declining	N/A	Low	Generally uncertain whether there will be net loss or net positive outcomes for this species.	Uncertain
Nyctemera annulata (moth)	At Risk, declining	N/A	Low	Generally uncertain whether there will be net loss or net positive outcomes for this species.	Uncertain
Ichneutica sistens (moth)	Uncommon	N/A	Low	Generally uncertain whether there will be net loss or net positive outcomes for invertebrates – planting of tussocks (host plants) may benefit this species.	Uncertain
Meterana exquisite (moth)	Uncommon	N/A	Low	Generally uncertain whether there will be net loss or net positive outcomes for invertebrates – planting of *Olearia odorata* (host plants) may benefit this species.	Uncertain

Species	National threat status	Regional threat status	Level of residual effect	Residual effects management measures	Expected outcome
Paranotoreas fulva (moth)	At Risk, declining	N/A	Very low	Uncertain whether there will be net loss or net positive outcomes potentially achieved through rock stack and rubble pit creation.	Uncertain
Examples of species not impacted by the project but expected to benefit					
Plant species					
Stout dwarf broom *Carmichaelia monroi*	At Risk – Declining	Threatened – Regionally Critical	No effect	Livestock management, mammalian pest management and native plantings are expected to benefit this species as detailed in the various Management Plans.	Net Gain
Coprosma brunnea	At Risk – Declining	Threatened - Regionally Endangered	No effect	Livestock management, mammalian pest management and native plantings are expected to benefit this species as detailed in the various Management Plans.	Net Gain
Coral broom *Carmichaelia crassicaulis crassicaulis*	Threatened – Nationally Vulnerable	Threatened – Regionally vulnerable	No effect	Livestock management, mammalian pest management and native plantings are expected to benefit this species as detailed in the various Management Plans.	Net Gain
Olearia cymbifolia	Not Threatened	At Risk - Naturally Uncommon	No effect	Livestock management, mammalian pest management and native plantings are expected to benefit this species as detailed in the various Management Plans.	Net Gain
Hebe *Veronica rakaiensis*	Not Threatened	At Risk - Naturally Uncommon	No effect	Livestock management, mammalian pest management and native plantings are expected to benefit this species as detailed in the various Management Plans.	Net Gain
Lizard species (subject to granting of translocation permits)					

Species	National threat status	Regional threat status	Level of residual effect	Residual effects management measures	Expected outcome
Otago skink	Nationally Threatened – endangered	Threatened – regionally endangered	No effect	Elimination of mammalian predators within the Santana Sanctuaries as well as habitat enhancement via rock deployment likely to benefit this species	Net gain
Grand skink	Nationally Threatened – endangered	Threatened – regionally endangered	No effect	Elimination of mammalian predators within the Santana Sanctuaries as well as habitat enhancement via rock deployment likely to benefit this species	Net gain
Jewelled gecko	At Risk	At Risk – regionally endangered	No effect	Elimination of mammalian predators within the Santana Sanctuaries as well as increase in the extent and diversity of native scrubland and habitat enhancement via rock deployment is likely to benefit this species	Net gain

*Likely potential effect on invertebrate species as detailed in Section 7.3.3.

As set out in the Biodiversity Outcome Monitoring Plan (Section 9 below), comprehensive biodiversity outcome monitoring is proposed to verify that stated outcomes are achieved and to inform adaptive management or contingency actions as needed.

8.5 Proposed biodiversity and heritage enhancement fund

Additionally and separately to the proposed residual effects management package[76], a $5 million biodiversity and heritage enhancement fund is proposed as a condition of consent. The purpose of the fund is to enable the Department of Conservation to support the protection and enhancement of cushionfield habitat (or other threatened or at-risk species or ecosystems) within the Dunstan Ecological District and historic values beyond BOGP within Central Otago. As such, the fund is intended to make a significant contribution to the conservation management and recovery of indigenous biodiversity more broadly, under a best-endeavours principle. The following criteria are proposed to guide the administration and prioritisation of this funding, focusing on opportunities that:

- Deliver tangible biodiversity outcomes for the protection and enhancement of cushionfield habitat (or other nationally threatened species or high-value ecosystem types at risk of extinction) in the Ecological District

[76] The fund is not considered compensation for addressing residual effects of project activities that are not fully offset or compensated through the onsite offset/compensation package. It therefore sits outside the proposed effects management package and the conclusions on its adequacy or appropriateness.

- Confer benefits to the same or similar biodiversity values affected by project activities
- Involve established conservation groups with a proven track record, where additional funding is critical to maintain and build on biodiversity gains
- Align with Department of Conservation (DOC) and iwi biodiversity priorities and related funding needs
- Provide for clear legal mechanisms by which funding will be administered, reviewed, re-allocated, or terminated as necessary.

8.6 Assessment against NPSIB and NPSFM offsetting/ compensation principles

8.6.1 Assessment against the NPSIB

For completeness, and for use in the application of the subsequent FTAA statutory weighting exercise, we have assessed the proposed ecological effects management measures against the 13 principles for biodiversity compensation set out in Appendix 3 and 4 of the NPSIB. This assessment combines the 11 principles for biodiversity offsetting and is provided in **Table 27** below.

Proposed offsetting and compensation is generally consistent with the suite of offsetting and compensation principles set out in the NPSIB[77]. However, certain principles —notably the limits to offset/compensation, leakage and 'scale of biodiversity compensation' principles—are unlikely to be satisfied for some species and habitat types, based on current information. The 'limits to offsetting' principle is addressed further in Section 8.6 below.

Table 27: Assessment against biodiversity offset and compensation principles set out in Appendix 3 and 4 of the NPSIB

Principle	NPSIB Explanation (adapted to combine principles for offsetting and compensation)	Assessment
Adherence to the effects management hierarchy	*Biodiversity offsetting should be contemplated only after steps to avoid, minimise, remedy, adverse effects are demonstrated to have been sequentially exhausted.* *Biodiversity compensation is a commitment to redress more than minor residual adverse effects, and should be contemplated only after steps to avoid, minimise, remedy, and offset adverse*	**Principle met**: All practical steps to avoid, minimise, remedy, and offset and compensate for adverse effects on ecological values have been sequentially exhausted where feasible, before moving to the next step in the effects management hierarchy

[77] In accordance with NPSIB Appendices 3 and 4, principle 2

Principle	NPSIB Explanation (adapted to combine principles for offsetting and compensation)	Assessment
	effects are demonstrated to have been sequentially exhausted.	
When biodiversity/ offsetting or compensation is not appropriate	*Biodiversity offsetting or compensation is not appropriate where indigenous biodiversity values are not able to be offset or compensated for. Examples of biodiversity compensation not being appropriate include where:* *(a) the indigenous biodiversity affected is irreplaceable or vulnerable;* *(b) effects on indigenous biodiversity are uncertain, unknown, or little understood, but potential effects are significantly adverse or irreversible;* *(c) there are no technically feasible options by which to secure a proposed net gain within acceptable timeframes.*	**Principle met in part**: This principle is met for the majority of ecosystems and species. However, it is not considered to be met for certain biodiversity values identified in Table 29 (in accordance with the Limits to Offsetting assessment in Section 8.7 below).
Net gain (offsetting only)	*Net gain: This principle reflects a standard of acceptability for demonstrating, and then achieving, a net gain in indigenous biodiversity values. Net gain is demonstrated by a like-for-like quantitative loss/gain calculation of the following, and is achieved when the indigenous biodiversity values at the offset site are equivalent to or exceed those being lost at the impact site:* *(a) types of indigenous biodiversity, including when indigenous species depend on introduced species for their persistence; and* *(b) amount; and* *(c) condition (structure and quality).*	**Principle met in part**. Principle considered to be met for those values for which Net Gain outcomes are expected, as identified in Table 26. For other biodiversity values, the principle does not apply since biodiversity compensation, rather than offsetting, measures, have been proposed, as described in Section 8.2.2.
Scale of biodiversity compensation (compensation principle only)	*The indigenous biodiversity values lost through the activity to which the biodiversity compensation applies are addressed by positive effects to indigenous biodiversity (including when indigenous species depend on introduced species for their persistence), that outweigh the adverse effects*	**Principle met in part.** Principle met for those values that can feasibly be offset/compensated within the surrounding landscape, whereby net gain or net positive outcomes are likely. However, this is not the case for certain values as detailed in Section 8.7 below.

Principle	NPSIB Explanation (adapted to combine principles for offsetting and compensation)	Assessment
Additionality	*Biodiversity offset or compensation achieves gains in indigenous biodiversity above and beyond gains that would have occurred in the absence of the offset/compensation, such as gains that are additional to any minimisation and remediation (and for compensation, any offsetting) undertaken in relation to the adverse effects of the activity*	**Principle met**: Proposed enhancement measures will all be additional (over and above what would have happened in the absence of the BOGP).
Leakage	*Biodiversity offsetting or compensation design and implementation avoids displacing harm to other indigenous biodiversity in the same or any other location*	**Principle not met** for some values: Small wetlands induced by cattle pugging are expected to reduce in extent within the ARA and MRZs once cattle are removed, resulting in a likely Net Loss of wetlands within these areas. However overall, wetland rehabilitation within the DDF is expected to increase the extent of native-dominated wetlands and their ecological integrity. Likewise in some areas tussocklands and associated species are likely to transition into native woody scrubland over time.
Long-term outcomes	*Biodiversity offset or compensation is managed to secure outcomes of the activity that last as least as long as the impacts, and preferably in perpetuity. Consideration must be given to long-term issues around funding, location, management, and monitoring.*	**Principle met**: Benefits will be long-term, as they are intended to last and be actively maintained for 35 years (weed and pest control) with protection in perpetuity through a covenant, and monitored in accordance with the Biodiversity Outcome Monitoring Plan.
Landscape context	*Biodiversity offset or compensation is undertaken where this will result in the best ecological outcome, preferably close to the impact site or within the same ecological district. The action considers the landscape context of both the impact site and the offset/compensation site, taking into account interactions between*	**Principle met**. The proposed habitat restoration and enhancement is undertaken at locations adjacent to and near the impact site. The enhancement sites have been selected to provide habitat connectivity in the landscape, with pest exclusion fenced areas

Principle	NPSIB Explanation (adapted to combine principles for offsetting and compensation)	Assessment
	species, habitats and ecosystems, spatial connections, and ecosystem function	adjoining mine regeneration zones. The BOGP is also located adjacent to land managed by DOC including the Bendigo Conservation Area, and the Ardgour Conservation Area.
Time lags (compensation only)	*The delay between loss of, or effects on, indigenous biodiversity values at the impact site and the gain or maturity of indigenous biodiversity at the offset or compensation sites are minimised so that the calculated gains are achieved within the consent period or, as appropriate, a longer period (but not more than 35 years).*	**Principle met**: For those biodiversity values for which offsetting is proposed, this time lag is factored into offset models. The proposed biodiversity compensation outcomes acknowledge the relatively long timeframes for ecosystem recovery, compared to other ecosystem types in more hospitable regions.
Trading up (compensation only)	*When trading up forms part of biodiversity compensation, the proposal demonstrates that the indigenous biodiversity gains are demonstrably greater or higher than those lost.*	**Principle met in part**: Trading up is a key component of the overall offset/ compensation package. However for some taxa, trading up involves species translocations that have not yet been approved, requiring submission of translocation applications to the Department of Conservation.
Financial contributions (compensation only)	*A financial contribution is only considered if: (a) there is no effective option available for delivering biodiversity gains on the ground; and (b) it directly funds an intended biodiversity gain or benefit that complies with the rest of these principles.*	**Principle met:** a biodiversity and heritage enhancement fund is also proposed for DOC to support the protection and enhancement of cushionfield habitat or other threatened species and ecosystems). However, it is considered to sit outside of offsets or compensation on the grounds that there isn't adequate certainty around the type, quantum and location of benefits.

Principle	NPSIB Explanation (adapted to combine principles for offsetting and compensation)	Assessment
Science and mātauranga Māori	*The design and implementation of biodiversity offsets and compensation is a documented process informed by science, and mātauranga Māori*	**Principle not addressed**: The design and implementation has been informed by Western science but not (prior to lodgement of the FTAA application) by mātauranga Māori.
Tangata whenua and stakeholder participation	*Opportunity for the effective and early participation of tangata whenua and stakeholders is demonstrated when planning for biodiversity offsets and compensation, including its evaluation, selection, design, implementation, and monitoring.*	**Principle not addressed**: planning for biodiversity offsets and compensation— including its evaluation, selection, design, implementation and monitoring— has not yet included participation from tangata whenua and stakeholders under the FTA process.
Transparency	*The design and implementation of biodiversity offsets and compensation, and communication of its results to the public, is undertaken in a transparent and timely manner.*	**Principle addressed in part**: the design and implementation of biodiversity offsets will be presented as part of this application

8.6.2 Assessment against the NPSFM

For completeness, the proposal has been assessed against the NPSFM as it relates to wetlands.

The NPSFM includes policies to avoid the reduction of natural inland wetlands, protect their values and promote their restoration; and to avoid the loss of river extent and values to the extent practicable. A full assessment of the proposal against the provisions of the NPSFM is provided in the application and associated documents (Mitchell Daysh, 2025).

For wetlands within the DDF and DDZ, potential ecological effects on wetlands have been managed such that:

- All 'natural inland wetlands' in the DDF and DDZ have been identified, as have wetlands in select, intensively surveyed areas distant from the DDF.
- The effects management hierarchy has been applied sequentially to manage effects on natural inland wetlands within the DDF and DDZ, focussing first on avoiding potential adverse effects as described above. Potential drawdown impacts on 1.94 ha of swamp/marsh wetlands within the DDZ will be addressed through augmentation of water levels within swamp/marsh wetlands in accordance with the Water

Management Plan. The loss of 2.42 ha of swamp/marsh wetlands within the DDF is proposed to be remedied through the creation of 7.5 ha of wetlands.

- Due to technical challenges in addressing effects of the project on the 0.19 ha of seepage wetlands and 0.84 ha of fen wetlands, a net loss outcomes in extent and value is expected for these wetland habitat types.
- Overall, however, the extent of wetland values to be lost within the DDF and DDZ are considered to be addressed by positive effects on natural inland wetlands that collectively outweigh the adverse effects, as described above.

Policy 6 of the NPSFM requires 'no further loss of extent of natural inland wetlands, their values are protected, and their restoration is promoted'. The proposal acknowledges the loss of 3.12 ha of natural inland wetlands within the DDF, and drawdown impacts on 0.43 ha of wetland outside the DDF but within the DDZ. Remediation, offsetting and compensation are proposed to increase the extent of native-dominated wetland (to approximately 7.5 ha). While these measures will improve the ecological integrity of wetlands overall within the DDF, NPSFM policy 6 is met largely but not in full because:

- Flow augmentation is proposed to address water drawdown impacts on all 1.94 ha of swamp/marsh wetlands (Hydro Geochem 2025) in accordance with the Water Management Plan.
- While positive outcomes are expected for wetlands overall through the proposed wetland rehabilitation within the DDF, there will be a net loss in seepage and fen wetlands in exchange for net gains in swamp/marsh wetland extent and value.
- Conservation measures for terrestrial biodiversity at offset/compensation sites may have unintended adverse effects on the extent of seepage and fen wetlands at those sites, as described. These measures include the exclusion of livestock, which may impact on wetlands induced through cattle pugging, and the recovery of woody shrubland.

The offset/proposed compensation package has been assessed against the aquatic offset/compensation principles of the NPSFM (**Table 28**). Notably, proposed habitat restoration and enhancement measures may impact several small wetlands scattered through the 1263 ha ARA (**Appendix 1, Figure 10**) including seeps, fens and swamps/marshes. These wetlands have been induced through cattle pugging. All are expected to reduce in size once cattle are removed to promote habitat restoration, and therefore lose surface flow and surface wetland vegetation through a natural process of vegetation recovery, succession and restoration. We do not regard this as a dis-benefit of the project, but rather a natural outcome of ecosystems undergoing repair.

Table 28: Assessment against aquatic offset and compensation principles set out in Appendix 6 and 7 of the NPSFM

Principle	NPSFM Explanation (adapted to combine offsetting and compensation principles)	Assessment
Adherence to the effects management hierarchy	*Aquatic offsetting is a commitment to redress more than minor residual adverse effects, and should be contemplated only after steps to avoid, minimise and remedy, adverse effects are demonstrated to have been sequentially exhausted.* *Aquatic compensation is a commitment to redress more than minor residual adverse effects, and should be contemplated only after steps to avoid, minimise, remedy, and offset adverse effects are demonstrated to have been sequentially exhausted.*	**Principle met** The effects management hierarchy has been applied sequentially, focussing first on avoiding potential adverse effects on natural inland wetlands as described above.
When aquatic offset/ compensation is not appropriate	*Aquatic offsetting/compensation is not appropriate where, in terms of conservation outcomes, the extent or values are not able to be offset/compensated for. Examples of aquatic offset/compensation not being appropriate would include where:* *a) the affected part of the natural inland wetland or river bed, or its values, including species, are irreplaceable or vulnerable.* *b) effects on the extent or values are uncertain, unknown, or little understood, but potential effects are significantly adverse.* c) *there are no technically feasible options by which to secure gains within an acceptable timeframe.*	**Principle considered to be met** Impacts on wetlands are not misaligned with this principle.
<u>For offsetting</u>: No Net Loss and preferably Net Gain	*This is demonstrated by a like-for-like quantitative loss/gain calculation, and is achieved when the extent or values gained at the offset site (measured by type, amount and condition) are*	Principle met for impacts on swamp/marsh wetlands. Proposed rehabilitation is expected to result in a Net Gain in both the extent and condition of swamp/marsh

Principle	NPSFM Explanation (adapted to combine offsetting and compensation principles)	Assessment
	equivalent to or exceed those being lost at the impact site.	wetlands (Offset Report, RMA Ecology, 2025)
Scale of aquatic compensation	*The extent or values to be lost through the activity to which the aquatic compensation applies are addressed by positive effects that outweigh the adverse effects.*	**Principle met in part**: Direct impacts on swamp/marsh wetlands within the DDF will be offset to achieve an expected Net Gain outcome as addressed directly above. However it is not feasible to address residual effects on seepage or fen wetlands in the landscape so this principle is not met for these habitat types.
Additionality	*Aquatic offset/compensation achieves gains in extent or values above and beyond gains that would have occurred in the absence of the offset/compensation, such as gains that are additional to any minimisation and remediation or offsetting undertaken in relation to the adverse effects of the activity.*	**Principle met**: There are no instances where proposed offset/compensation would occur in the absence of the proposed project.
Leakage	*Aquatic offset/compensation design and implementation avoids displacing harm to other locations (including harm to existing biodiversity at the offset/compensation site).*	**Principle not met** for some values: Small wetlands induced by cattle pugging are expected to reduce in extent within the ARA and MRZs once cattle are removed, resulting in a likely Net Loss of wetlands within these areas. However overall, wetland rehabilitation within the DDF is expected to increase the extent of native-dominated wetlands and their ecological integrity.
Long-term outcomes	*Aquatic offset/compensation is managed to secure outcomes of the activity that last as least as long as the impacts, and preferably in perpetuity. Consideration must be given to long-term issues around funding, location, management, and monitoring.*	**Principle met**: Benefits will be long-term, as they are intended to last and be actively maintained for 35 years (weed and pest control) with protection in perpetuity through a covenant.

Principle	NPSFM Explanation (adapted to combine offsetting and compensation principles)	Assessment
Landscape context	*An aquatic offset/compensation action is undertaken where this will result in the best ecological outcome, preferably close to the impact site or within the same ecological district. The action considers the landscape context of both the impact site and the offset/compensation site, taking into account interactions between species, habitats and ecosystems, spatial and hydrological connections, and ecosystem function*	**Principle met**. The proposed habitat restoration and enhancement is undertaken at locations adjacent to and near the impact site
Time lags	*The delay between loss of extent or values at the impact site and the gain or maturity of extent or values at the offset/compensation site is minimised so that the calculated gains are achieved within the consent period or, as appropriate, a longer period (but not more than 35 years).*	**Principle met** to the extent possible
Trading up	*When trading up forms part of aquatic compensation, the proposal demonstrates that the aquatic extent or values gained are demonstrably of greater or higher value than those lost. The proposal also shows the values lost are not to Threatened or At Risk/Declining species or to species considered vulnerable or irreplaceable.*	**Not applicable**: trading up does not form part of the compensation package
Financial contributions	*A financial contribution is only considered if it directly funds an intended aquatic gain or benefit that complies with the rest of these principles.*	**Not applicable**: No financial contribution is provided
Science and mātauranga Māori	*The design and implementation of aquatic offset/compensation is a documented process informed by science where available, and mātauranga Māori at place.*	**Principle not met**: The design and implementation has been informed by Western science but not (prior to lodgement of

Principle	NPSFM Explanation (adapted to combine offsetting and compensation principles)	Assessment
		the FTAA application) by mātauranga Māori.
Tangata whenua and stakeholder participation	*Opportunity for the effective and early participation of tangata whenua or stakeholders is demonstrated when planning aquatic offset/compensation, including its evaluation, selection, design, implementation, and monitoring*	**Principle not met**: planning for biodiversity offsets and compensation— including its evaluation, selection, design, implementation and monitoring— has not yet included participation from tangata whenua and stakeholders under the FTAA process.
Transparency	*The design and implementation of aquatic offset/compensation, and communication of its results to the public, is undertaken in a transparent and timely manner.*	**Principle met in part**: the design and implementation of biodiversity offsets will be presented as part of this application

8.7 Limits to offsetting/compensation assessment

8.7.1 Overview

The 'limits to offsetting' principle and the equivalent 'limits to compensation' principle of the NPSIB recognise that for some biodiversity values, residual effects cannot be effectively offset or compensated for, due for example[78] to:

a) their irreplaceability[79] or vulnerability[80]

b) the significance of adverse effects

c) the technical infeasibility of demonstrably achieving adequate ecological gains.

While we applied this principle to the assessment of all residual effects, a full 'limits to offsetting/compensation' assessment[81] is appropriate for the following five ecological values (**Table 29** below):

[78] NPSIB Appendices 3 and 4, principle 2, presents examples of when biodiversity offsetting/compensation may not be appropriate.
[79] Irreplaceability is defined in the NPSIB as "*a measure of the uniqueness, replaceability and conservation value of biodiversity and the degree to which the biodiversity value of a given area adds to the value of an overall network of areas. It interacts with vulnerability, complexity and rarity to indicate the biodiversity value and level of risk for a given area*".
[80] Vulnerability is defined in the NPSIB as "*an estimate of the degree of threat of destruction or degradation that indigenous biodiversity faces from change, use or development. It is the degree to which an ecosystem, habitat or species is likely to be affected by, is susceptible to or able to adapt to harmful impacts or changes. It interacts with the irreplaceability, complexity and rarity to indicate the biodiversity value and level of risk for a given area*".
[81] In accordance with NPSIB Appendices 3 and 4, principle 2

- Cushionfields within the mixed depleted herbfields (cushionfield) and grassland vegetation community
- The threatened (nationally vulnerable, regionally endangered) tiny forget-me-not *Myosotis brevis*
- The threatened (nationally and regionally critical) spring annual *Ceratocephala pungens*
- The potentially threatened ground beetle *Harpalus* new sp.
- The weevil *Inophloeus* new sp.

For these values, adherence to the 'limits to offsetting/compensation principles was based on professional judgement, informed by the examples in the NPSIB and NPSFM of when biodiversity offsetting/compensation may not be appropriate (**Table 29** below).

Adherence to the offset/compensation principles was assessed based on current information, as:

- Likely: meets or is highly likely to meet principles
- Potentially not met: may not meet principles. There is some uncertainty regarding the vulnerability of the species, the significance of impact and the potential to demonstrably offset or compensate for residual effects.
- Unlikely: not expected to meet principles, e.g. there are known limitations in offsetting opportunities or feasible methods; or there is high uncertainty regarding biodiversity outcomes; and effects on a highly vulnerable species or habitat type are significantly adverse.

Table 29: Limits to offsetting/compensation assessment in accordance with relevant NPSIB and NPSFM principles

Ecological value	Limits to offsetting/compensation factors	Adherence to 'limits to offsetting/compensation' principle
Vegetation		
Cushionfield habitat	**Irreplaceability and vulnerability:** • While not formally classified as such, this is a vulnerable ecosystem type subject to a high rate of decline in extent and condition through physical habitat loss and threats from farming practices, invasive weeds and mammalian browsers. • The cushionfield habitat within the DDF is irreplaceable on the basis that it likely supports the highest known diversity of cushionfield plants, including threatened species, in the landscape	Unlikely

Ecological value	Limits to offsetting/compensation factors	Adherence to 'limits to offsetting/compensation' principle
	Magnitude of residual effect: • Assessed as potentially 'Very High' based on the scale of effect per se, the scale of proportional effect, the quality of habitat affected, and the degree of uncertainty regarding impacts of works in the 2.7 ha of early disturbance area of the CIT footprint. • While residual effects would be reduced if the CIT pit were not mined, the 2.7 ha early disturbance works are proposed to proceed regardless. The magnitude of effect is therefore assigned as potentially 'Very high' due to uncertainty on the impacts of these early disturbance works. **Offset/compensation potential:** • There are potentially suitable offset sites in the surrounding landscape at the scale required to offset/compensate for effects • There is no current evidence to indicate that effects can be technically addressed at scale through offsetting/compensating. • There is low certainty that effects can be adequately offset or compensated for due to the lack of demonstrable evidence. The ARP will inform biodiversity outcomes for the proposed offset/compensation measure, but these outcomes will not be understood until after impacts have commenced.	
Tiny forget-me-not *Myosotis brevis*	**Irreplaceability and vulnerability:** • This species is highly vulnerable, being classified as Nationally threatened (nationally vulnerable) and subject to a high rate of decline in extent and condition through physical habitat loss and threats from farming practices, invasive weeds and mammalian browsers. • The DDF is irreplaceable for this species and appears to be a national hotspot in that it includes the highest known densities and a significant proportion of *M. brevis* in the landscape. **Magnitude of residual effect:** • Assessed as 'Very high' with 80% of the known local and regional population and 11% of the national population present within the DDF. If the	Unlikely

Ecological value	Limits to offsetting/compensation factors	Adherence to 'limits to offsetting/compensation' principle
	CIT pit is avoided this reduces the proportional effect to 60% of the known local and regional population and 8.25% of the known national population[82]. **Offset/compensation potential:** • There are potentially suitable offset sites in the surrounding landscape at the scale required to offset/compensate for effects • There is no evidence to indicate that effects can be technically addressed at scale through offsetting/compensating. • There is low certainty that effects can be adequately offset or compensated for due to the lack of demonstrable evidence. The ARP will inform biodiversity outcomes for the proposed offset/compensation measures, but these outcomes will not be understood until after impacts have commenced.	
Ceratocephala pungens	**Irreplaceability and vulnerability:** • This species is highly vulnerable in that it is classified as Nationally threatened (nationally critical) and subject to a high rate of decline in extent and condition through physical habitat loss and threats from farming practices, invasive weeds and mammalian browsers. • The DDF is irreplaceable for this species and appears to be a national hotspot, in that it includes the highest known densities and a significant proportion of the known plants present in the local landscape and region. **Magnitude of residual effect:** • If the CIT remains unmined then the proportional loss of individuals would equate to 3.6% of the known local, regional, national population of this species, (excluding the 2.7 ha early-disturbance area). Overall this is assessed as a potentially high magnitude of effect on the local, regional and national population. **Offset/compensation potential:** • There are potentially suitable offset sites in the surrounding landscape at the scale required to offset/compensate for effects	Potentially not met

[82] The degree to which these proportional effects reductions change considering the early disturbance of 2.7 ha for enabling works is not certain but likely to be relatively low.

Ecological value	Limits to offsetting/compensation factors	Adherence to 'limits to offsetting/compensation' principle
	• There is no current evidence to indicate that effects can be technically addressed at scale through offsetting/compensating. • There is currently low certainty that effects can be adequately offset or compensated for due to a lack of demonstrable evidence. The ARP will inform biodiversity outcomes for the proposed offset/compensation measure and the feasibility of mining the CIT pit based on the potential for demonstrable net gain outcomes.	
Notable invertebrate species		
Ground beetle *Harpalus new sp*	**Irreplaceability and vulnerability:** Newly discovered species, detected in the DDF (one specimen) and SL (two specimens). Given the lack of data around the species range and population size, would currently qualify for a 'Data Deficient', and potentially threatened, conservation status. **Magnitude of residual effect:** Assessed as Very High given the majority of individuals were detected in the DDF and there are no other known populations either locally, regionally or nationally. **Offset opportunity:** It is likely that potential offset sites are available in the surrounding landscape; however, there is little information on habitat and life-history requirements so this is uncertain. **Offset feasibility:** It is likely that the elimination of mammalian pests would benefit this species and that there are ways to enhance habitat to increase suitability; however, there is currently no information or evidence to support this. **Certainty of offset outcomes:** There is no certainty around offset outcomes.	Unlikely
Weevil *Inophloeus new sp.*	**Irreplaceability and vulnerability:** Newly discovered species, treated as Nationally Threatened – nationally critical, with the majority of individuals found in the DDF **Magnitude of residual effect:** Assessed as High since the majority of individuals were detected in the DDF, although the proportion of habitat impacted by the project (5.5 ha) is low	Potentially not met

Ecological value	Limits to offsetting/compensation factors	Adherence to 'limits to offsetting/compensation' principle
	compared to availability in the surrounding landscape. **Offset opportunity:** It is likely that potential offset sites are available in the surrounding landscape; however, limited information on habitat and life-history requirements make this uncertain. **Offset feasibility:** It is likely that the elimination of mammalian pests would benefit this species, and that there are ways to enhance habitat to increase suitability; however, there is insufficient information to conclude this. **Certainty of offset outcomes:** There is currently no certainty regarding offset outcomes.	

8.7.2 Overall assessment of proposed offset/compensation package

Setting aside the limits to offsetting/compensation principles, the proposed offset and compensation package is considered appropriate and well-designed to address the ecological effects of the BOGP. At 2,219 ha, it is extensive in scale and has been carefully tailored to the ecological conditions of the site and its surrounds, with a focus on long-term resilience and delivery of landscape-scale ecological benefits. These include restoring ecological connectivity across a broad area of the northern faces of the Dunstan Mountains by linking adjacent conservation land, re-establishing altitudinal sequences that strengthen climate resilience and support species across life stages, and reinstating rare or locally extirpated species.

While uncertain or Net Loss outcomes have been assigned for some ecological values, applied research is proposed for cushionfields and spring annuals to improve future prospects. The broader objective of restoring woody native vegetation cover will inevitably prioritise certain species over others, with emphasis on reinstating those that are rare, under-represented, locally extirpated, or resilient to harsh and variable conditions.

However, for certain irreplaceable or highly vulnerable species and habitats (e.g., cushionfield habitat, the threatened plant *Myosotis brevis*, and an invertebrate species), residual effects cannot be effectively offset or compensated. This represents a likely breach of the 'limits to offsetting/compensation' principles of the NPSIB, which for cushionfields and the threatened plant *M. brevis*, may be addressed if the outcomes of the ARP are successful. For two further values (one threatened plant and one invertebrate), the limits to offsetting/compensation principles are potentially not met, and compliance with the principle remains uncertain.

Overall, the effects management package includes actions that have a likely or certain beneficial outcome for indigenous biodiversity, and from which we are confident that an ecological gain will be created and sustained; those parts of the package relate to the mitigation, offset and compensation actions on the ground in the areas within and around the DDF.

There are, however, some impacts of the project that have not been avoided, and for which no similar or equivalent or commensurate actions can be assured to deliver like-for-like benefits, and which, under good ecological practice, should not be impacted due to their irreplaceability and vulnerability; those are listed in Table 29. While an applied research programme is proposed in the hope of addressing some of these impacts in the future – and for providing the justification to impact more of these areas in the CIT pit footprint – potential solutions derived from this research are uncertain and cannot be relied upon for avoiding, minimising, rehabilitating, offsetting or compensating impacts that are proposed.

The result is a comprehensive package of actions that will provide broad, long-lasting benefits that balance most ecological impacts, but not all. The residual adverse effects after the full effects management hierarchy has been applied remain significant despite this package. While successful outcomes from the 6+ years of applied cushionfield and rare spring annual research may lessen this scale of residual effect, even that will not balance it entirely.

Similarly, because of the nature of the significant residual effects remaining after minimisation, remediation, offsetting and ecological compensation, there is no ecological action that can provide a balancing benefit with certainty. The financial compensation package for ecological works offsite can provide substantial positive benefits but must be regarded as dissimilar and in ecological terms cannot provide a compensatory or commensurate benefit that balances these significant residual losses.

Providing such additional actions, however, demonstrate the commitment of the Applicant to providing positive outcomes that extend beyond like-for-like offsetting and similar ecological compensation in the hope that a decision maker may consider these beneficial in a weighing exercise of overall losses and overall gains to the ecological values subject to the project.

9. Biodiversity outcome monitoring

Comprehensive biodiversity outcome monitoring is proposed to verify that stated ecological outcomes have been achieved within 35 years, and to inform adaptive management or contingency measures where required. The Biodiversity Outcome Monitoring Plan ('**BOMP**') details methods for achieving this, focussing on monitoring the response of biodiversity metrics to proposed rehabilitation and offsetting/ compensation measures.

Specifically, monitoring is proposed within both ecological rehabilitation and offset/compensation sites to assess species and habitat types and their response to rehabilitation and offset/compensation actions. Biodiversity outcome monitoring is therefore distinct from compliance monitoring, which demonstrates that effects management has been undertaken in accordance with conditions and associated management plans.

The BOMP has developed fit-for-purpose metrics, where possible, to verify all outcomes including stated net loss. These uncertain or net loss outcomes have been predicted in some instances due to a lack of evidence to the contrary. However, since net positive or net gain outcomes may eventuate, these predicted net loss outcomes also warrant verification. In particular, the implementation of the ARP may lead to successful effects management options for cushionfield and spring annuals, ultimately identifying management opportunities that generate tangible benefits.

The BOMP broadly includes the following metrics to verify stated outcomes:

- Habitat type extent (remote sensing)
- Indigenous plant dominance per unit area
- Indigenous plant species richness per unit area
- Occupancy (percentage occurrence across replicates)
- Relative abundance based on counts (plants and fauna) or percent cover (herbaceous plants).

10. Conclusion

Substantial measures are proposed to address the ecological effects of the BOGP. Within the DDF, efforts focus on directly minimising effects on the highest value habitats and species. Additionally, rehabilitation of all 480 ha of the post-mining landform[83] is proposed, to reinstate key terrestrial vegetation communities and habitat features.

For those effects that cannot feasibly be minimised or remedied, extensive biodiversity offsetting and compensation is proposed across 2,219 ha surrounding the mine footprint. Proposed measures aim to reverse the ongoing decline of native habitat, fostering a large-scale transition from exotic-dominated to native-dominated ecosystems. Careful design ensures the measures, including extensive weed and pest control, pest exclusion, habitat enhancement, and browsing pressure management, are tailored to the specific requirements of each area.

Expected biodiversity outcomes for impacted ecological values, assessed individually, range from Net Loss to Net Gain. Notably, for certain values—including cushionfield habitat, the threatened plant species *Myosotis brevis*, and one terrestrial invertebrate species—residual effects are unlikely to be effectively addressed in accordance with the limits to offsetting/compensation principles as set out in the NPSIB, unless successful outcomes can be demonstrated through the ARP [84]. Additionally, the principle is potentially not met based on current information for the newly identified weevil *Inophloeus sp* and the nationally Threatened (nationally critical) spring annual *Ceratocephala pungens*.

This reflects the irreplaceability or vulnerability of these species, the magnitude of impact, and inherent uncertainty regarding demonstrable offsetting or compensation outcomes. For a further two species (one threatened plant and one invertebrate) these principles are potentially not addressed.

The un-avoided loss of these irreplaceable and vulnerable species or communities will be permanent and cannot be replaced, outweighed or balanced by different, alternative, or larger actions elsewhere and remain as an effect of the project, irrespective of the considerable scope, scale, robustness and beneficial nature of the other ecology actions combined that the project will deliver.

The net result is therefore a comprehensive package of actions that will provide broad, long-lasting benefits that balance most ecological impacts.

[83] 480 ha is the available area of the DDF to be rehabilitated
[84] In contrast, proposed aquatic offsetting and compensation for residual effects on wetlands is not considered to be misaligned with the equivalent principles of the NPSFM.

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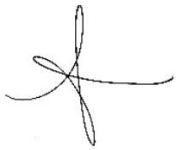
12. Applicability

This report has been prepared for use by our client Matakanui Gold Ltd, with respect to the particular brief given to us.

Report prepared by:



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Dr Matt Baber Principal Ecologist, Alliance Ecology Ltd

Report reviewed by:

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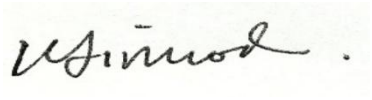
Dr Graham Ussher Principal Ecologist, RMA Ecology Ltd

Technical Review (in relation to weeds and mammalian pest management, invertebrates and habitat restoration and enhancement) by:

.....

Keith Barber, Principal Ecologist, Habitat NZ Ltd

Technical Review (ecological rehabilitation) by:



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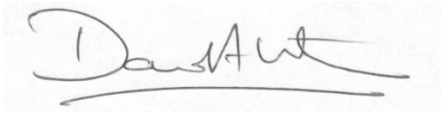
Dr Robyn Simcock. Senior Researcher, Landcare Research Ltd

Technical Review (habitat restoration and enhancement) by:



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Professor David Norton, Biodiversity Solutions Limited

Appendix 1: Figures

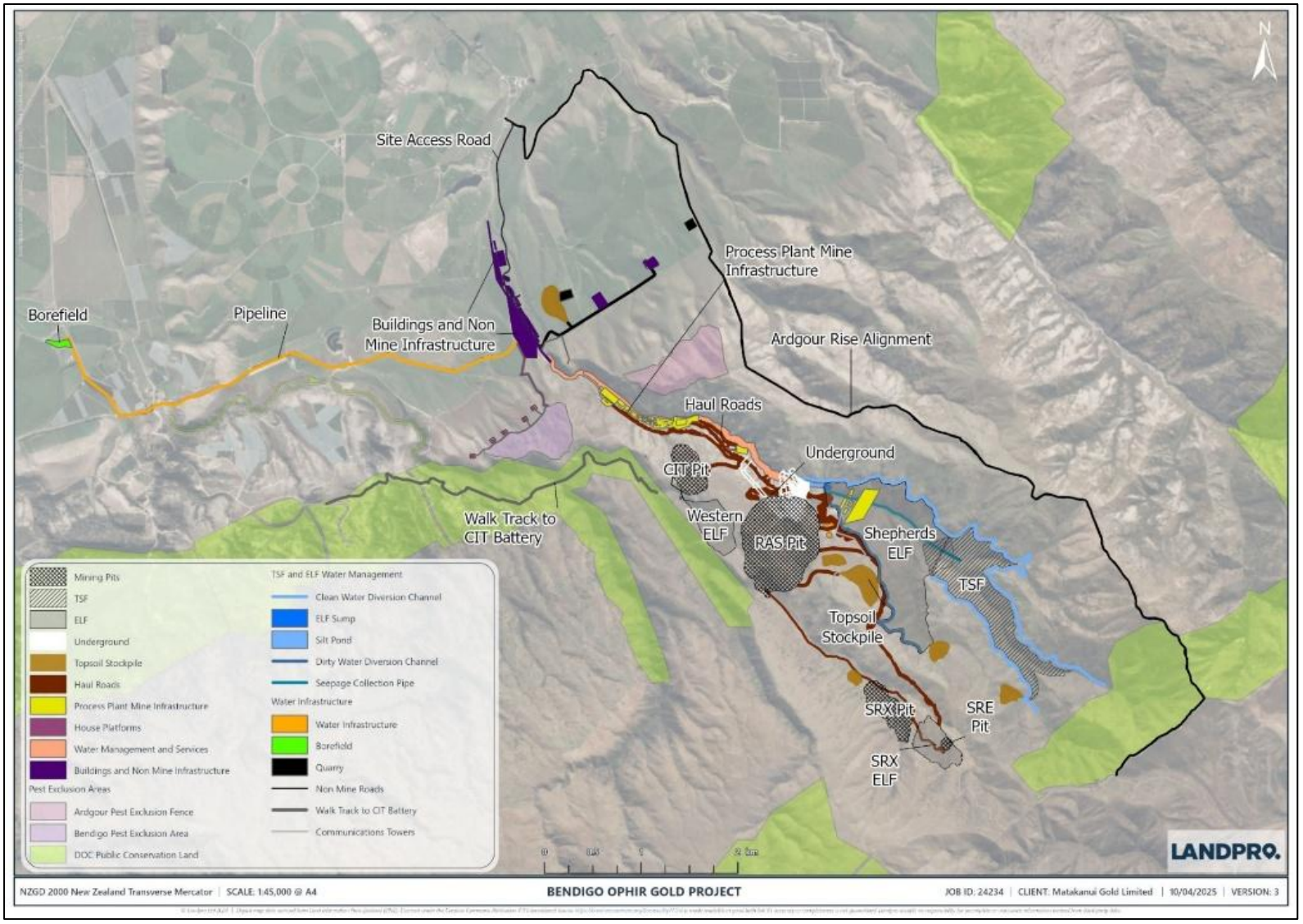

Figure 1: Overview Site Layout of the Bendigo-Ophir Gold Project

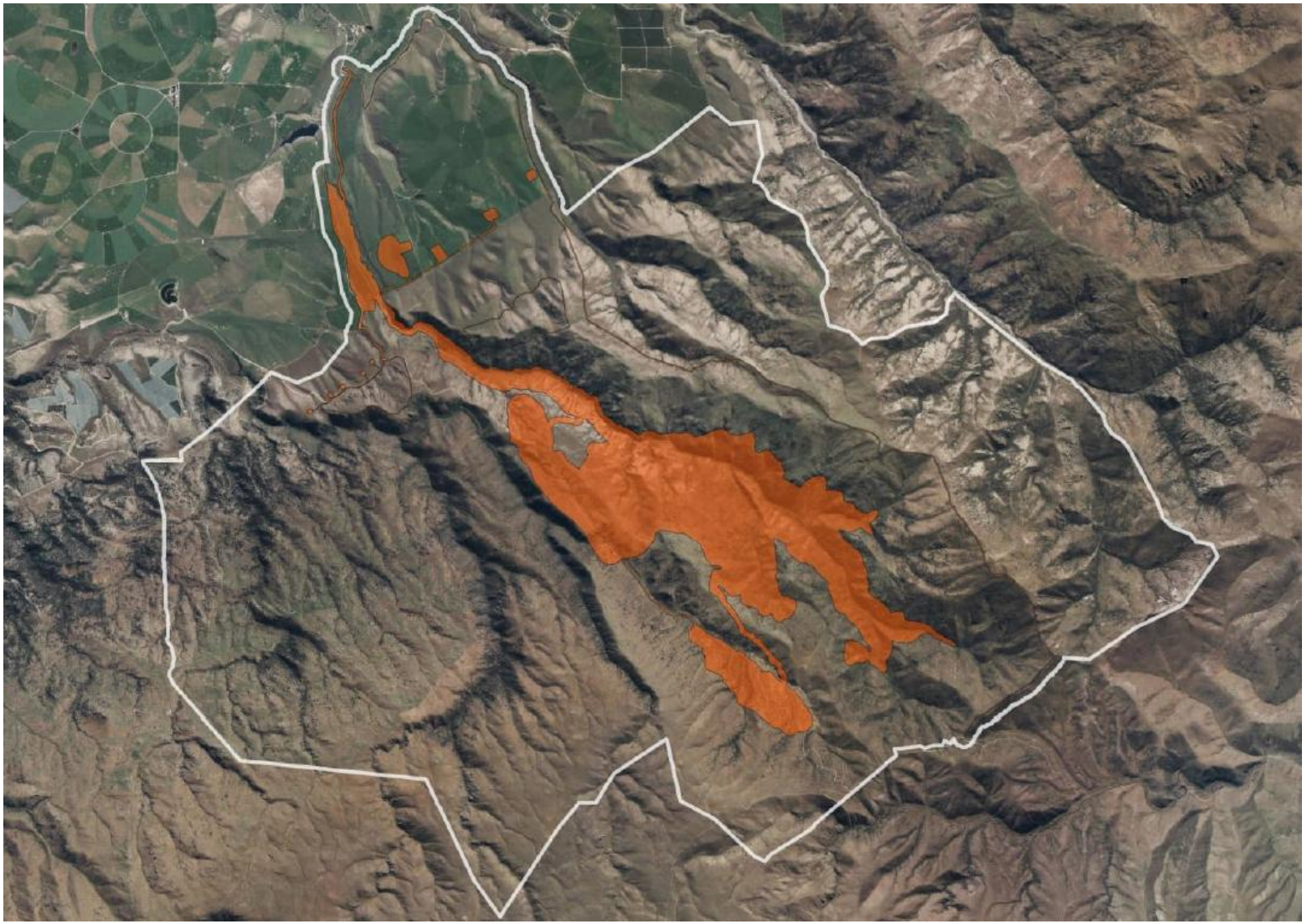

Figure 2: The Direct Disturbance Footprint (DDF)(orange polygon) within the Ecological Study Area (ESA)(white border)

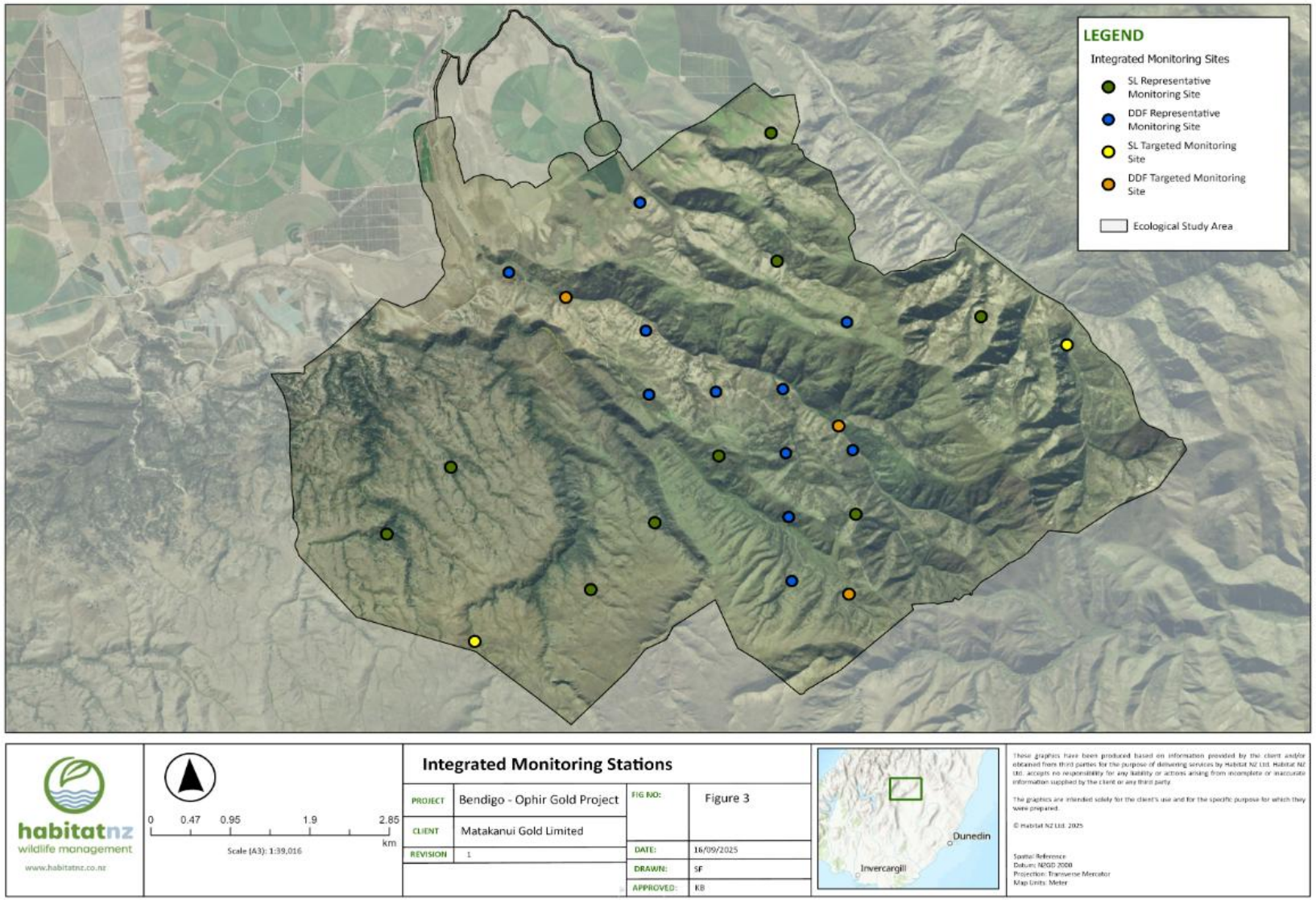

Figure 3: 'Ecological monitoring stations within the Ecological Study Area.

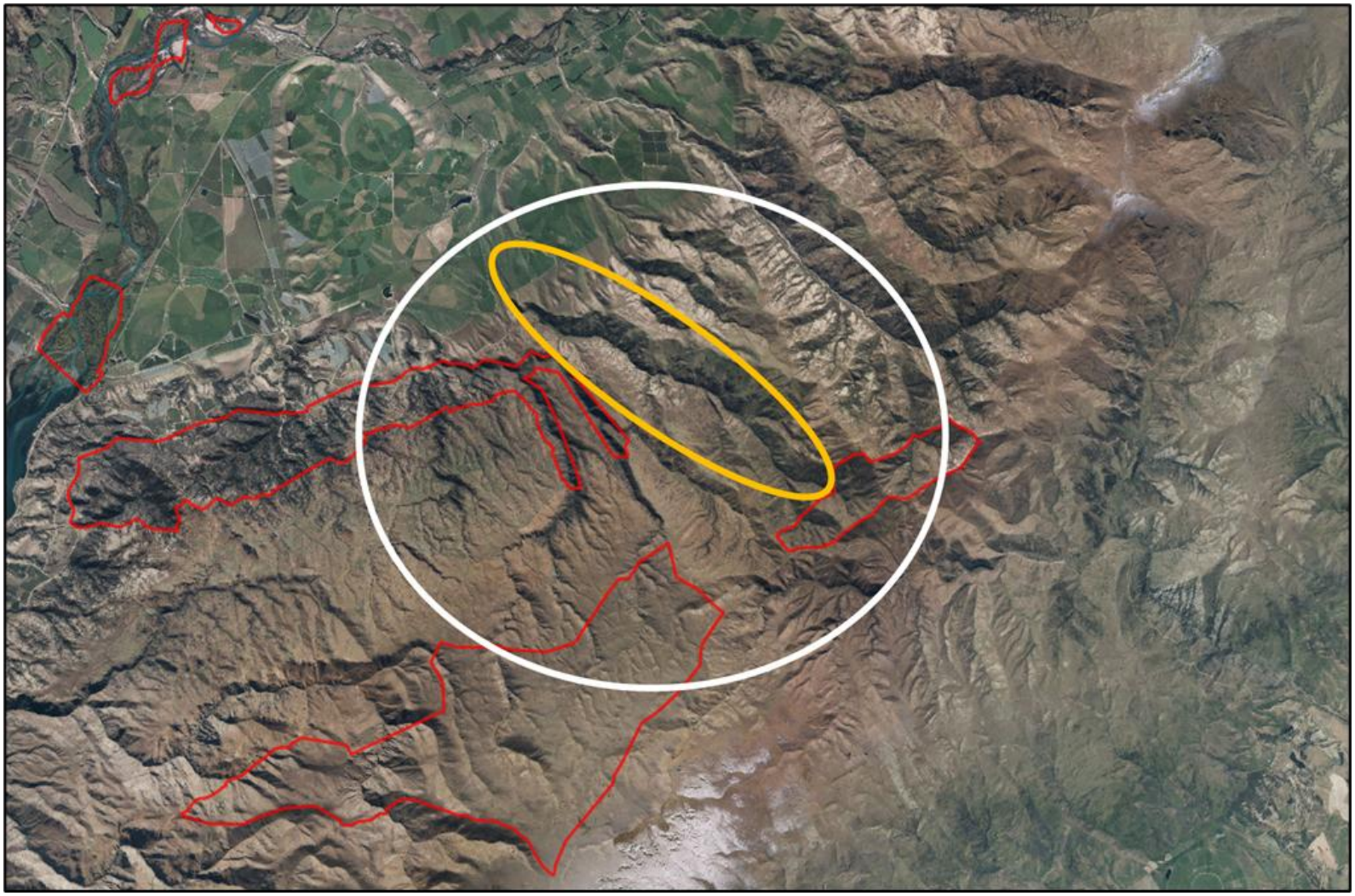

Figure 4: 'Ecological Areas of Significant Natural Value' (red border) as mapped by Central Otago District Council (Source COD Plan Maps). Indicative ESA is shown in white, and indicative DDF is shown in orange.

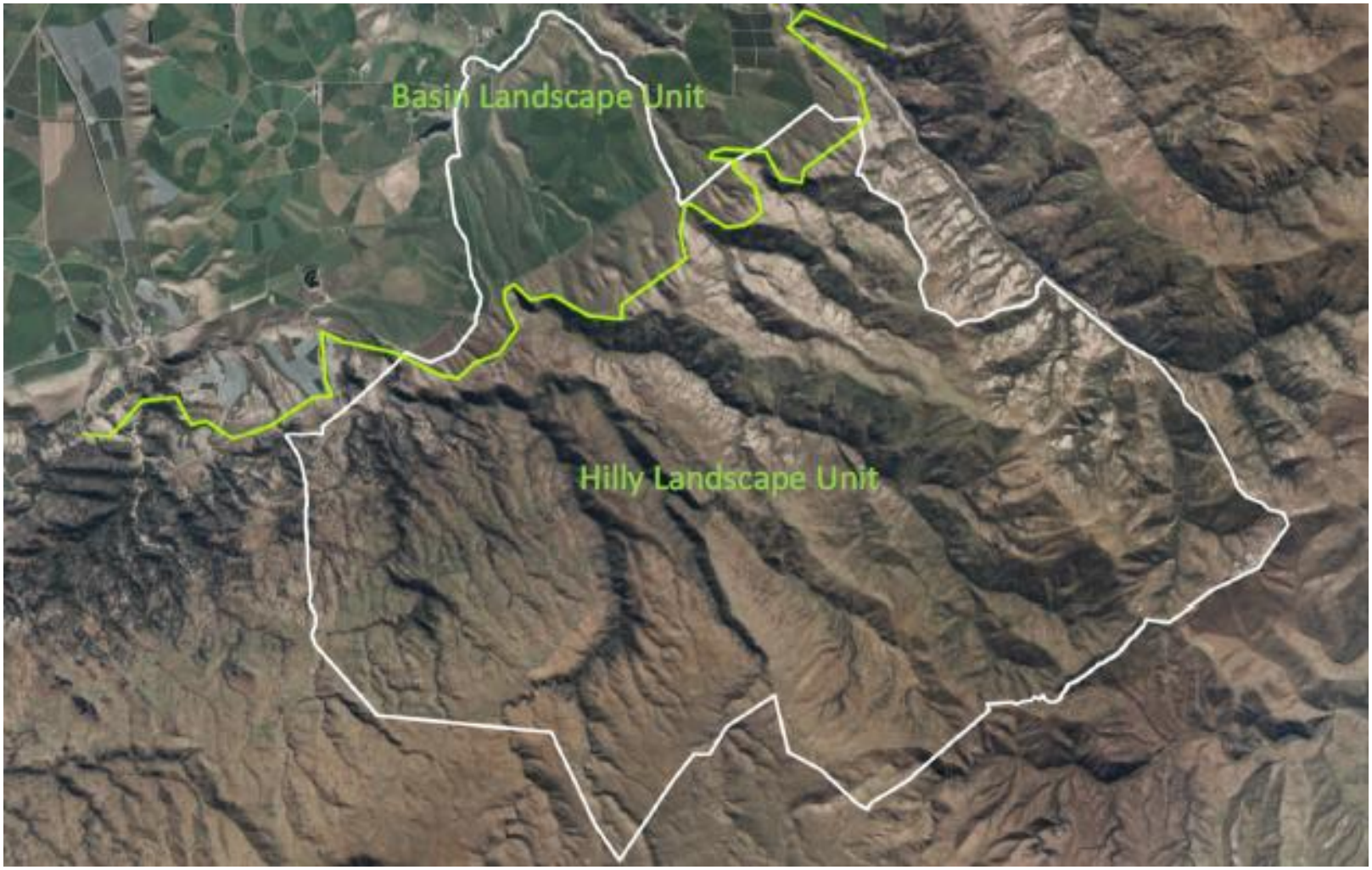

Figure 5: Map showing the ecologically appropriate partitioning of the landscape for assessment of ecological value and significance (green line). The ESA is bordered in white.

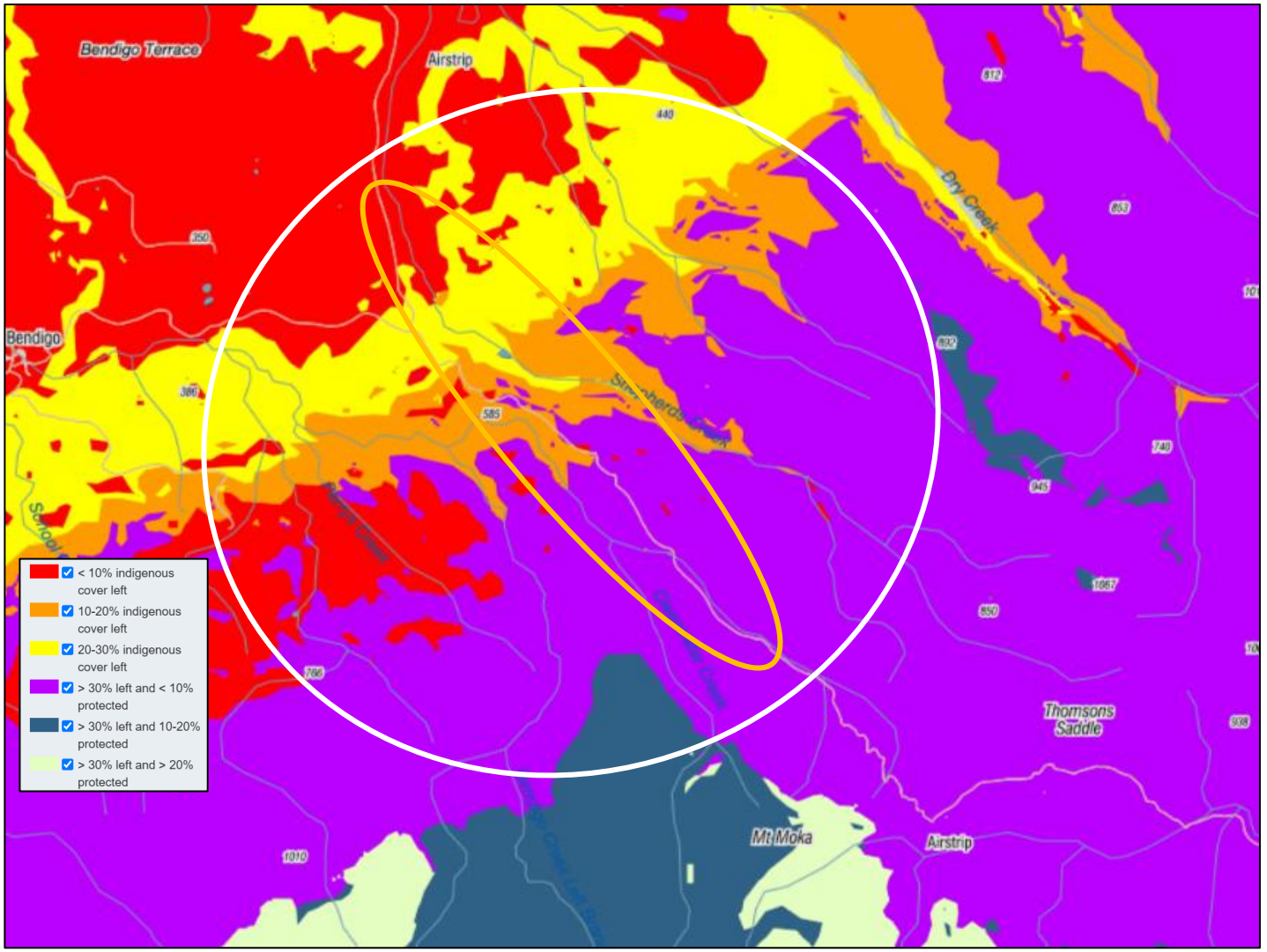

Figure 6: Threatened Environment Classification. Indicative ESA is shown in white, and indicative DDF is shown in orange.

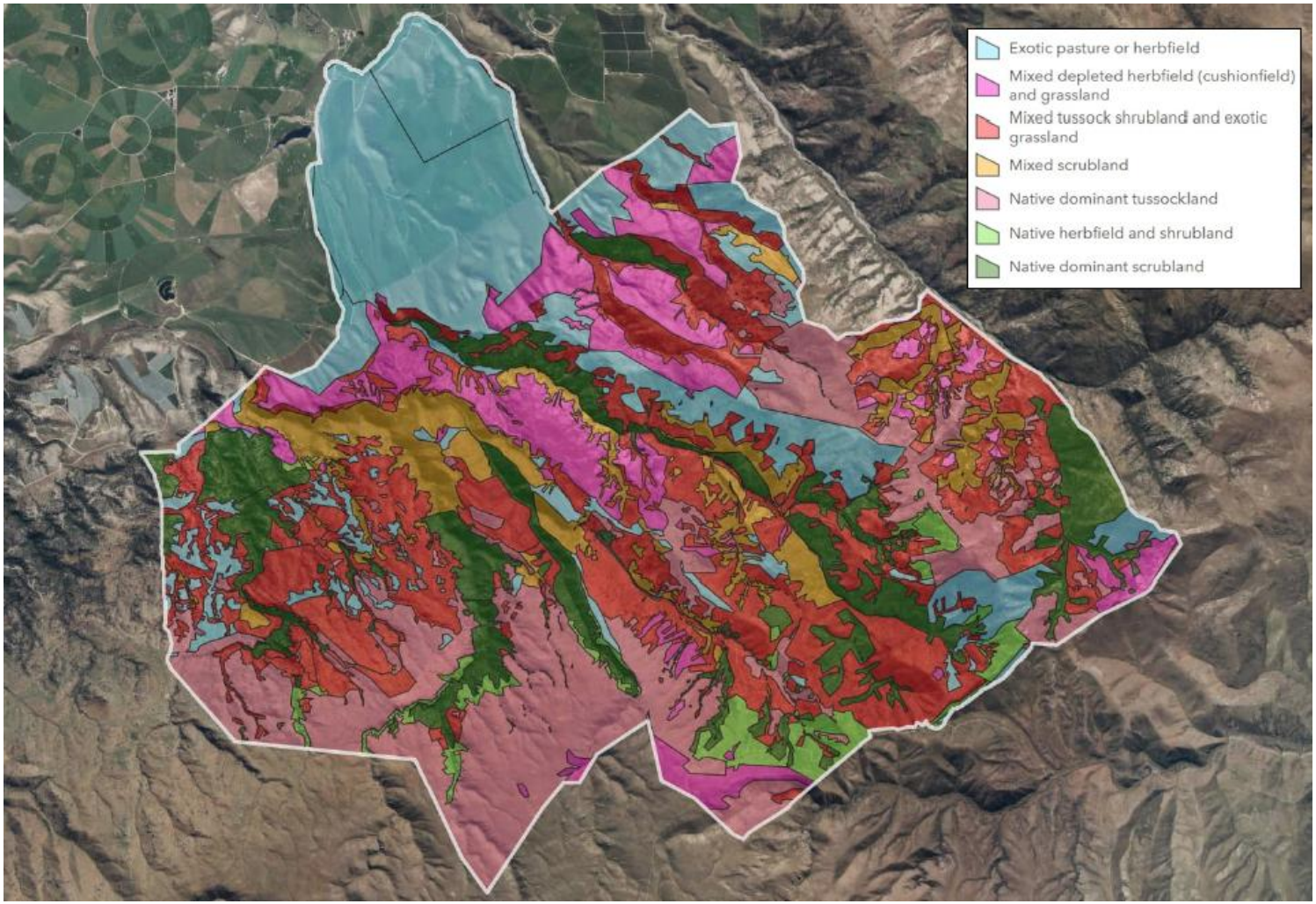

Figure 7: The seven broad terrestrial vegetation types classified across the ESA

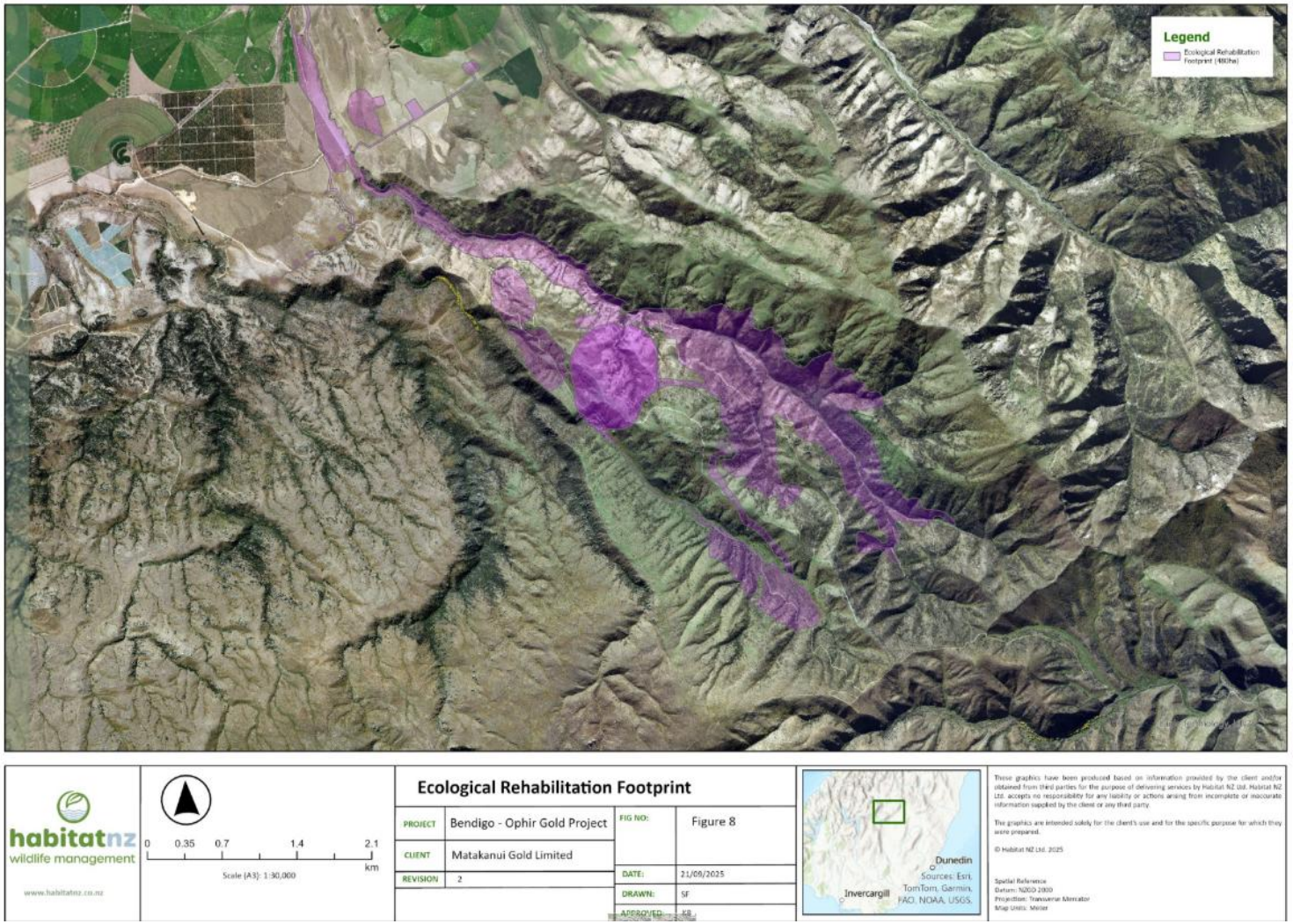

Figure 8: Ecological rehabilitation footprint (480 ha) within the DDF.

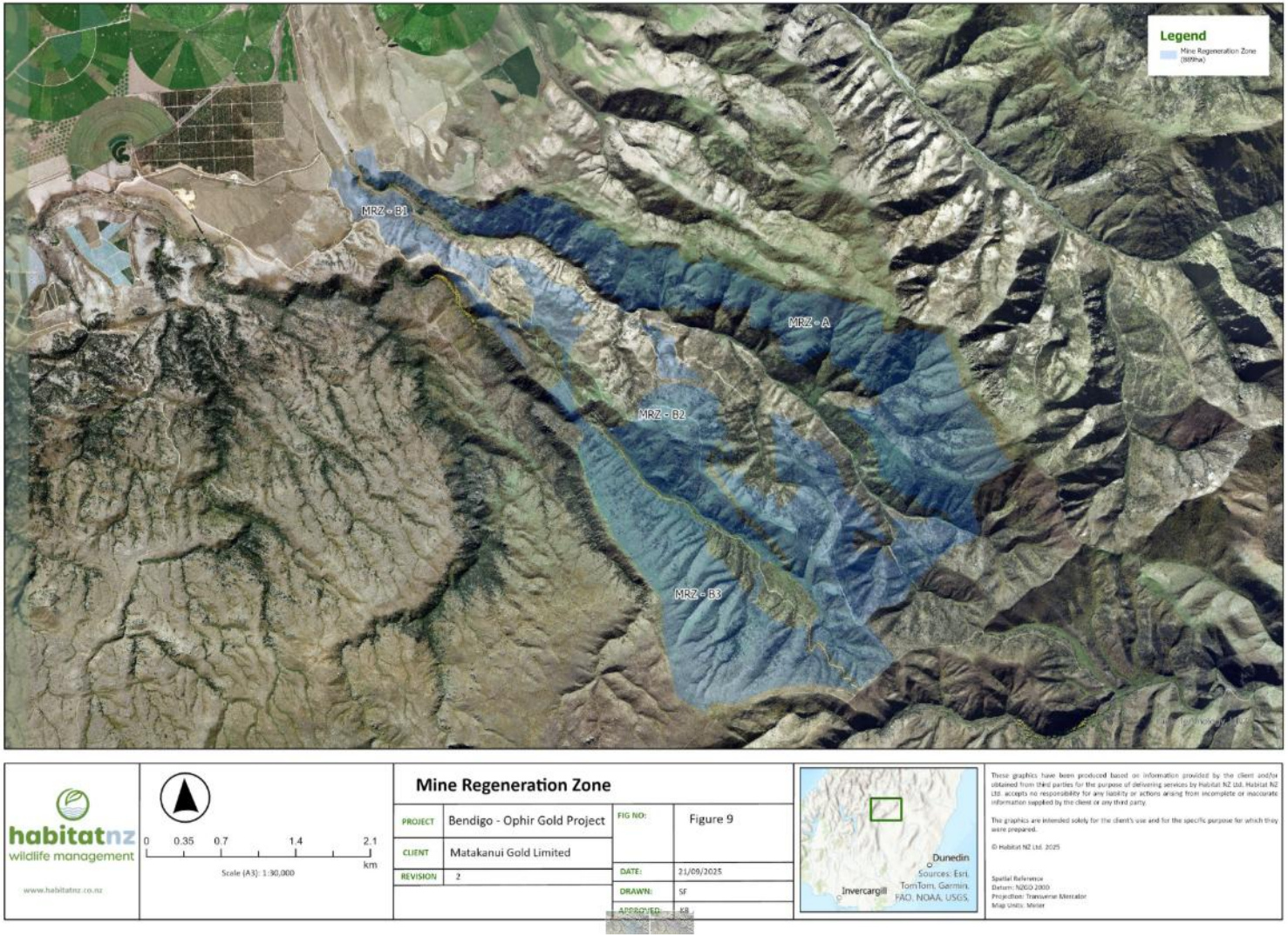

Figure 9: Mine Regeneration Zone (889 ha) offset/compensation area adjacent to the DDF

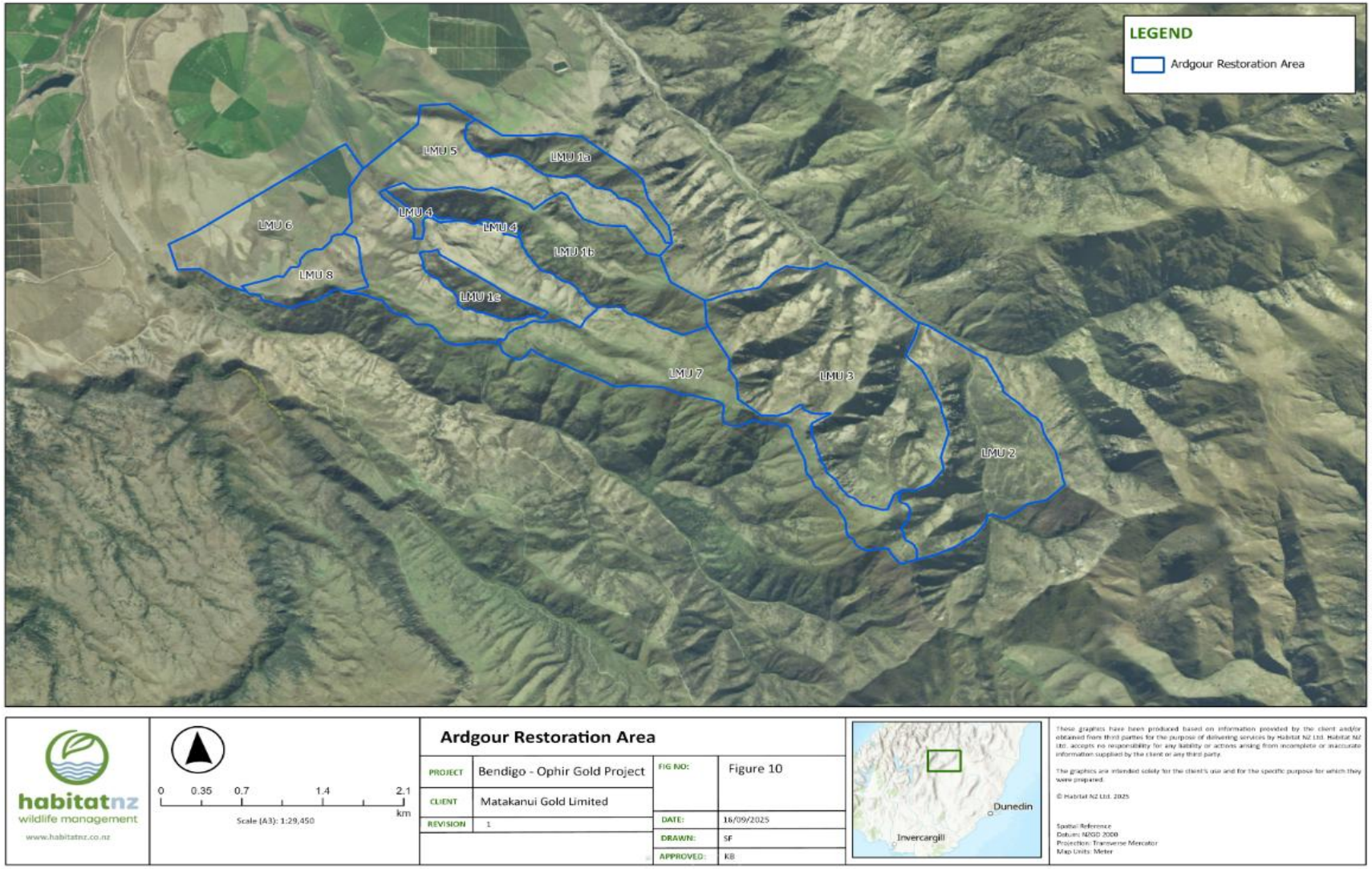

Figure 10: Ardgour Restoration Area Map (1263 ha).

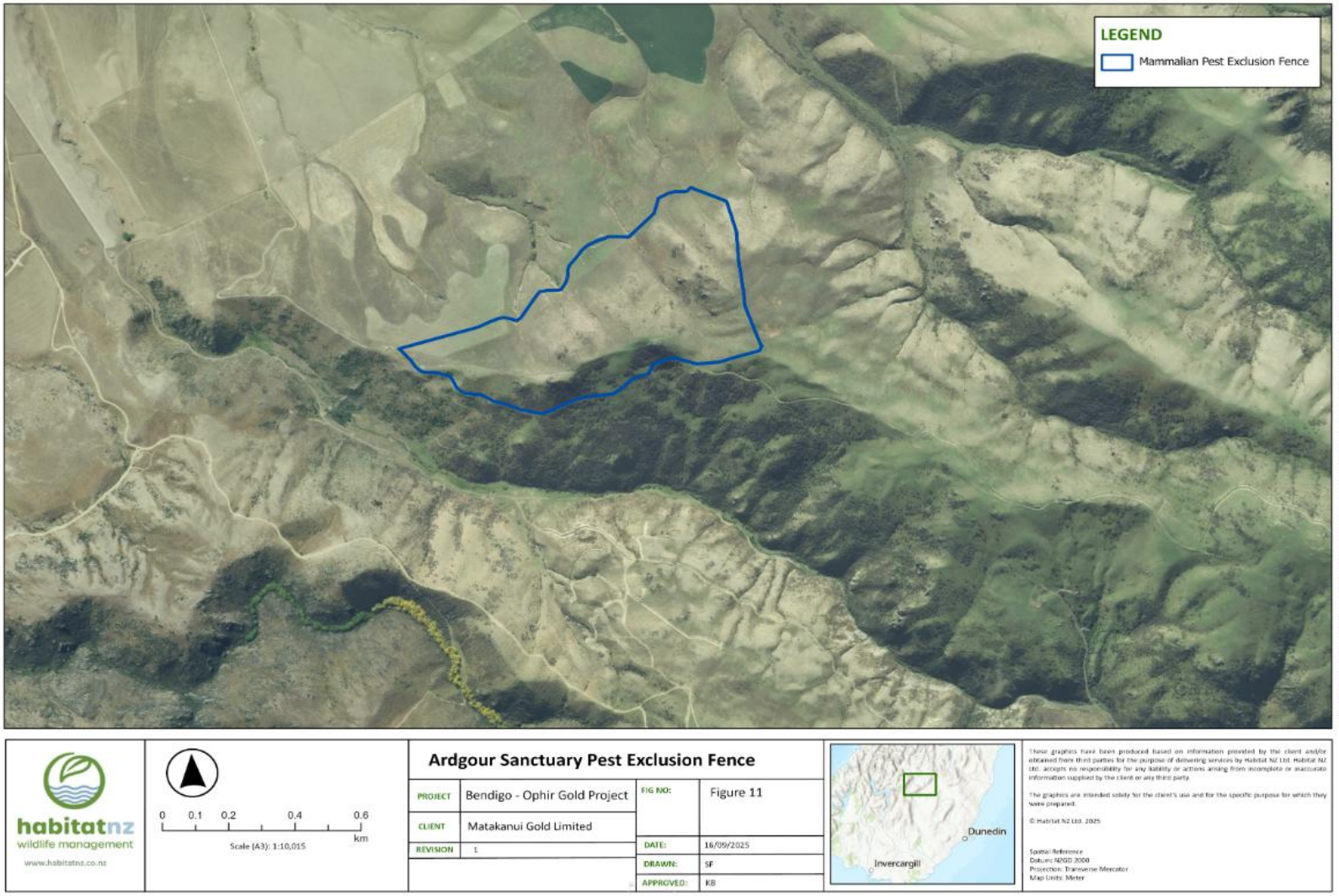

Figure 11:Ardgour Sanctuary (38 ha) Pest Exclusion Fence

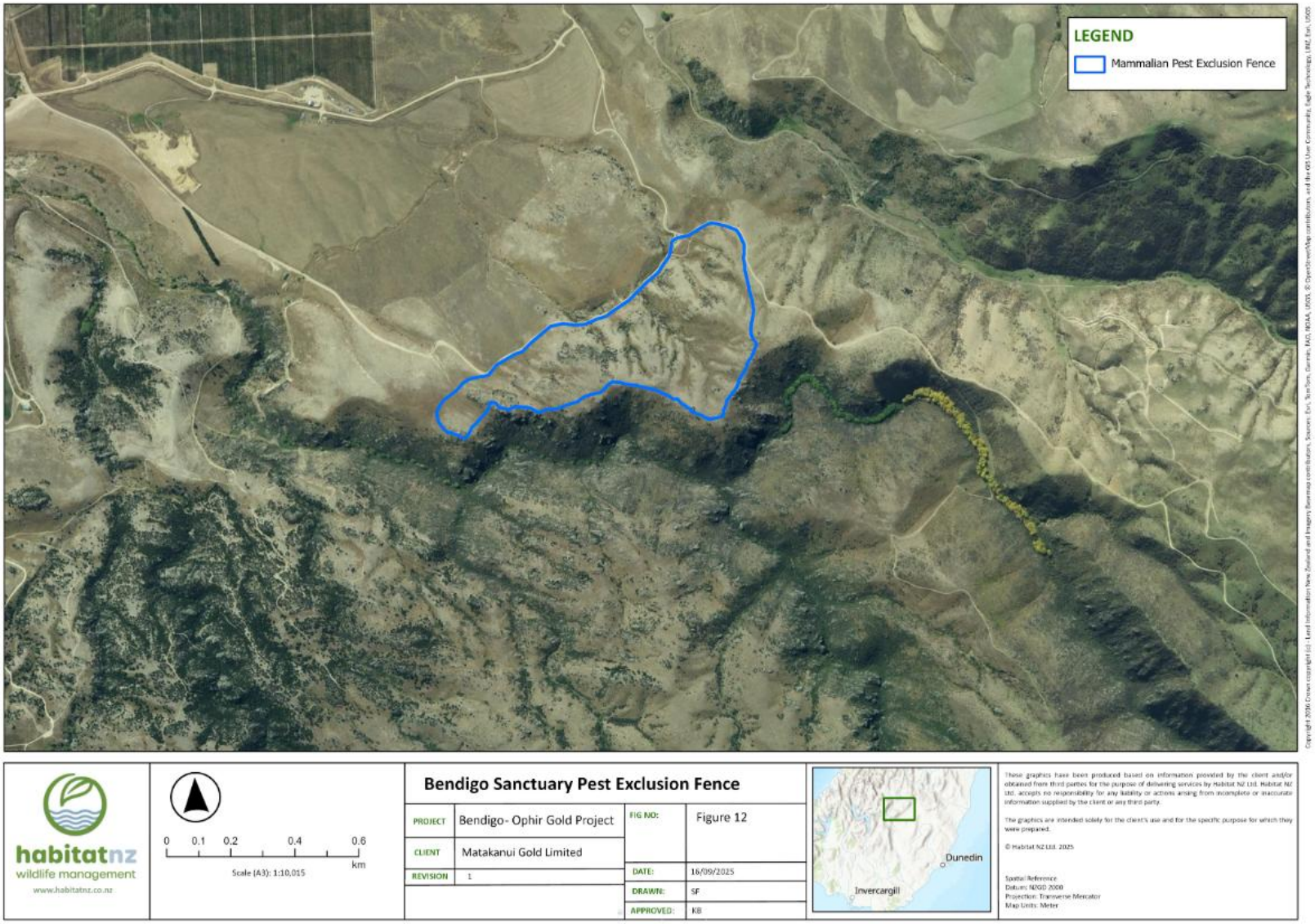

Figure 12: Bendigo Sanctuary (29 ha) Pest Exclusion Fence

Appendix 2: Ecological Impact Assessment guideline tables

Table B.1: Ecological values assigned to species (adapted from EIANZ, 2018 to reflect the most recent NZTCS qualifiers[85])

Value	Species values
Very high	Nationally Threatened - Endangered, Critical or Vulnerable.
High	Nationally At Risk – Declining.
Moderate	Nationally At Risk – Recovering/ Nationally Increasing, Relict or locally uncommon or rare
Low	Not Threatened Nationally, common locally
Negligible	Exotic species, including pests

[85] Rolfe, J. Makan, T. Tait, A. 2021: Supplement to the New Zealand Threat Classification System 2008: new qualifiers and amendments to qualifier definitions, 2021. Department of Conservation, Wellington. 9 p.

Table B.2: Ecological values assigned to habitats (adapted from EIANZ, 2018).

Attributes to be considered when assigning ecological value or importance to a site or area of vegetation/habitat/community.	
Matters	Attributes to be considered
Representativeness	Attributes for representative vegetation and aquatic habitats: • Typical structure and composition • Indigenous species dominate • Expected species and tiers are present Attributes for representative species and species assemblages: • Species assemblages that are typical of the habitat • Indigenous species that occur in most of the guilds expected for the habitat type
Rarity/ distinctiveness	Attributes for rare/distinctive vegetation and habitats: • Naturally uncommon, or induced scarcity • Amount of habitat or vegetation remaining • Distinctive ecological features • National priority for protection Attributes for rare/distinctive species or species assemblages: • Habitat supporting nationally 'Threatened' or 'At Risk' species, or locally uncommon species • Regional or national distribution limits of species or community • Unusual species or assemblages • Endemism
Diversity and pattern	• Level of natural diversity, abundance and distribution • Biodiversity reflecting underlying diversity • Biogeographical considerations – pattern, complexity • Temporal considerations, considerations of lifecycles, daily or seasonal cycles of habitat availability and utilisation
Ecological context	• Site history, and local environmental conditions which have influenced the development of habitats and communities • The essential characteristics that determine an ecosystem's integrity, form, functioning, and resilience (from "intrinsic value" as defined in RMA) • Size, shape and buffering • Condition and sensitivity to change • Contribution of the site to ecological networks, linkages, pathways and the protection and exchange of genetic material • Species role in ecosystem functioning – high level, key species identification, habitat as proxy

Table B.3: Criteria for describing magnitude of effect (EIANZ, 2018)

Magnitude	Description
Very high	Total loss of, or very major alteration to, key elements/features/ of the existing baseline[1] conditions, such that the post-development character, composition and/or attributes will be fundamentally changed and may be lost from the site altogether; AND/OR Loss of a very high proportion of the known population or range of the element/feature
High	Major loss or major alteration to key elements/features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed; AND/OR Loss of a high proportion of the known population or range of the element/feature
Moderate	Loss or alteration to one or more key elements/features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be partially changed; AND/OR Loss of a moderate proportion of the known population or range of the element/feature
Low	Minor shift away from existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances or patterns; AND/OR Having a minor effect on the known population or range of the element/feature
Negligible	Very slight change from the existing baseline condition. Change barely distinguishable, approximating the 'no change' situation; AND/OR Having negligible effect on the known population or range of the element/feature

[1]Baseline conditions are defined as 'the conditions that would pertain in the absence of a proposed action' (EIANZ, 2018).

Table B.4: Criteria for describing level of effects (EIANZ, 2018)

Magnitude of effect	Ecological Value				
	Very high	**High**	**Moderate**	**Low**	**Negligible**
Very high	Very High	Very High	High	Moderate	Low
High	Very High	Very High	Moderate	Low	Very Low
Moderate	High	High	Moderate	Low	Very Low
Low	Moderate	Moderate*	Low	Very Low	Very Low
Negligible	Low	Very Low	Very Low	Very Low	Very Low
Positive[86]	Net gain	Net gain	Net gain	Net gain	Net gain

[86] The EIANZ category of Net Gain has subsequently been defined in the NPSIB in relation to biodiversity outcomes for residual effects management. Accordingly, we have assigned a category of 'Positive' where a positive level of effect is expected following effects avoidance, minimisation and remediation measures, based on professional opinion.

*In contrast to Table 6 of the EcIAG, this assessment considers a 'High' value x 'Low' Magnitude of effect to constitute a 'Moderate' rather than 'Low' Level of Effect.

Appendix 3: Biodiversity Offset Report RMA Ecology

Memo

To:	Cheryl Low, Santana Minerals	Job No:	2352
From:	Graham Ussher, RMA Ecology Ltd	Date:	22 October 2025
cc:	Matt Baber, Alliance Ecology Ltd		
Subject:	Bendigo-Ophir Mine: biodiversity offset modelling for terrestrial ecology values		

Dear Cheryl,

The design process for the proposed Bendigo-Ophir mine has assessed potential adverse effects on terrestrial[1] ecology values through an iterative process to avoid, minimise, and mitigate impacts.

Some impacts on vulnerable or irreplaceable species or communities cannot be effectively offset, or fall within the limits to offsetting. These are addressed in the Ecological Effects Assessment report prepared by Alliance Ecology. Some other ecological values do not have a contemporary like-for-like replacement or enhancement that can be offered up, and an ecological compensation package is also being prepared by Alliance Ecology to address those effects.

Offsetting is applied in the first instance, however where there are limits to offsetting – which identifies values where offsetting should not be applied - ecological compensation has been proposed as a response where offsetting is inadequate or unavailable to address adverse effects.

Biodiversity offsetting is an approach to address unavoidable, residual, negative effects of development on indigenous biodiversity. The approach emphasises accounting for losses and gains in biodiversity, and securing long-term benefits with the goal to achieve at least a no net loss of biodiversity. Legislation and national guidance in New Zealand codifies biodiversity offsetting by providing principles for its application, and, in some cases, requiring that offsets provide redress for loss of extent, as well as values (condition) of biodiversity.

A well-designed offset provides assurance of the degree to which offset site(s) can provide replacement biodiversity values that are equivalent, appropriate, assured, and timely. Good offset design also allows consideration of potential risks where offsets are undertaken in different places, deliver benefits in the future, and where there is some uncertainty about their success.

Offsetting applies a repeatable and evidence-based modelling approach that focuses the response on the values affected, rather than societal considerations as the primary focus.

1 Biodiversity offsetting at the Bendigo-Ophir mine project

Of the potential adverse effects of the project that cannot be avoided or mitigated, there are six (6) ecological values on the site for which offsetting is an appropriate approach. Most other values cannot be addressed through an offsetting pathway primarily because insufficient knowledge exists regarding the distribution of the species across the site, or insufficient knowledge exists on how to salvage, relocate, restore, conserve or manage that ecological feature. This is especially true of many plants and terrestrial invertebrates of conservation importance found on the site.

All parts of the terrestrial and wetland systems present on the DDF are included in various parts of the models. Only direct effects (plus the buffer around the direct effect area) are included in the models. Where indirect effects by

[1] Birds, invertebrates, bats, vegetation communities, rare and threatened plants, lizards and wetlands.

dewatering of wetlands are possible,, that indirect effect is included in these models as a total loss of wetland values and extent within the potential Dewatering Drawdown Zone (DDZ). Because augmentation flow is proposed to some wetlands affected by dewatering, only those wetlands where augmentation is not proposed are included as an unmitigated impact within the offset model, i.e. it is assumed that flow augmentation will be successful where applied.

Ecosystems are dynamic, especially in modified environments such as this site. Parts of the site support exotic plant communities which, although they contain some indigenous values, hold more value as places where conversion to primarily indigenous communities is preferred. For large parts of Ardgour Station and the mine rehabilitation and regeneration areas, the objective of restoring a more advanced woody vegetation cover is the agreed objective, and is accepted as the natural state of the historic ecosystem for this site. Setting that as a target favours actions that benefit some species over others; for example, the progressive loss of open or exotic dominated communities. That is accepted as an ecological consequence of restoring more natural communities in this landscape. This is explained in greater depth in Appendices A- C to this report.

The implications for the offset model applied for the restoration of native dominant scrubland is that exotic pasture, mixed shrubland (in some cases) and tussock areas will most probably decline over time under the proposed restoration activities. This is accounted for and communicated in the assumptions underlying the model and within the statistics for expected change in the model. The one exception to this is for mixed depleted herbfield (cushionfield), where management of the offset areas and the models ensure no loss of extent or values, given the very diverse range of plants and animals of conservation importance (especially threatened plants) within that particular community.

The six ecological values that are the subject of this offset assessment are listed below. These have been selected as they are only vegetation/ environment types, and animal indicators for which enough is known about enhancement and uplift benefits for which offsetting can be applied at this site.

1. Tussock grassland plant community (native dominant tussockland);
2. Taramea plant community (native herbfield and shrubland);
3. Kawerau gecko;
4. McCanns skink;
5. Native dominant scrubland plant community; and
6. Wetlands

For the above ecological values, we have collected measures and counts from the DDF and the surrounding immediate landscape (the ESA), and have identified sites where enhancement of these features can be undertaken to address loss within the DDF footprint. For each there also exists knowledge and techniques in published literature or through personal experience for the enhancement or creation of these ecological values at offset sites.

The ecological values included in the offset assessment are either subject to more than minor residual adverse effects, are communities that support species of conservation value (tussock grassland), are functionally important in the landscape (wetlands), or represent many intermediate vegetation types towards a conservation ideal of a restored, stable, indigenous vegetation community (native scrubland).

2 Methods

The terrestrial biodiversity offset model that is most widely used in New Zealand is that developed by the Department of Conservation in conjunction with ecological practitioners over 10 years ago.

The Biodiversity Offset Accounting Model (BOAM[2]) provides a numerical basis for accounting for losses and gains, and incorporates the essential elements of risk, uncertainty and time lags into timescales between impact and replacement.

[2] As developed by the Department of Conservation: Maseyk F, Maron M, Seaton R, and Dutson, G. 2014. A biodiversity offsets accounting model for New Zealand: User Manual. Prepared for the Department of Conservation, Wellington. 77 pp.

As a wholly numeric model, the BOAM is well suited to this project and the extensive numerical data on the state of the ecological environment that has been obtained through site investigations.

The BOAM:

- Is based around an Excel spreadsheet accounting system.
- Requires measures and counts to be entered that describe existing values.
- The current state of the environment is used as the baseline, as is normally applied. In doing so, this most likely overestimates the impact on biodiversity where biodiversity is under pressure from anthropogenic or exotic species leading to an assumed background decline in biodiversity values (as is the case with the site), and underestimates the level of absolute biodiversity uplift over time at restoration management sites, where those sites are assumed to have a background rate of decline over time (as is the case with this site). Therefore, the offset modelling is conservative/ pre-cautionary even without the addition of the standard multipliers for risk, time lag and uncertainty that these models apply as part of the calculation process.
- Requires predictions of the amount of biodiversity loss that will result from the development.
- Requires predictions of biodiversity gain (uplift) resulting from the application of management actions at offset sites where ecological gains can be assured through creation, enhancement and restoration.
- Recognises that a fundamental principle integral to the accounting model is the explicit recognition that management actions at the impact site are usually more certain, and usually occur ahead of the delivery of offset gains. Degrees of confidence in offset outcomes are signalled in the model by the application of multipliers which serve to increase the amount of biodiversity offset required depending upon confidence.
- Assumes that the loss of biodiversity to society from a development has ecological meaning when replacement of extent or values occurs after an impact. For most developments, the time gap can be substantial (many years). Discounting of future values as an opportunity cost is the approach most commonly used to address time lags[3]. In the BOAM, the time lag multiplier is set at 3 %/ annum accruing annually as a discount on future values.

The development of a BOAM model is an iterative process. In this case, RMA Ecology (Dr Graham Ussher) took the lead on developing each model, and sought input from the ecological values assessments (various experts), the mine design plans to determine quanta of loss, and lead discussions with experts on mine site rehabilitation (Robyn Simcock), pest control (Keith Barber), effects management (Dr Matt Baber), and ecosystem trajectories, management and restoration (Professor David Norton).

The offset models presented here do not address research that is included as part of the mine project, as its inherent uncertainty (for cushionfields and invertebrates) does not align with an offsetting approach. The research programem on cushionfield that is proposed by the Applicant effectively constitutes enhancement of baseline values knowledge, and from there will likely inform mitigation and offsetting subject to the results.

In addition, the offset models used here assume that the CIT pit will proceed, although we understand that this may not occur if research into cushionfields does not provide confidence regarding cushionfield restoration and threatened cushionfield plant species conservation. Therefore, estimates of biodiversity loss, and the necessary quantum of corresponding gain, are based on the full mine design, not a partial design that may result if research objectives are not met.

[3] For example, Covec 2012, which considers an appropriate discount for an offset to be one that provides an equivalent value of consumption (taking timing differences into account) to the biodiversity that is displaced by the development project. See Covec, January 2012. Discounting for biodiversity offsets. Report produced by Tim Denne and Steven Bond-Smith, Covec, for the Department of Conservation. Unpublished.

Measures for describing biodiversity features included in the models use data collected from across the DDF and ESA. The data collection methods used were standard techniques and allow duplication at offset sites so that baseline and trajectory information can be collected in a consistent manner across time.

The offset sites that are included in the models are those proposed in the Assessment of Ecological Effects report and include the restoration of large parts of the adjoining Ardgour Station, as well as the development of two pest-free sanctuaries, rehabilitation planting across the finished postmining landforms, management of a buffer (the Mine Regeneration Zone) around the mine for ecological restoration purposes, and restoration of wetlands across parts of the post-mining landforms and nearby.

The management required to generate enhancements of biodiversity in those locations are described in the technical reports and management plans that address mine site rehabilitation, Ardgour Station restoration, animal and pest control, and the development and management of the pest-free sanctuaries.

Measures used to describe key functional, structural or compositional components of the biodiversity feature used in the model are termed 'attributes' in the BOAM. For some biodiversity features, only single attributes are used (for example, relative abundance for lizards, or canopy cover for tussock grassland), while for native scrubland five attributes are used to describe the community, including cover, species diversity, natural regeneration, bird abundance, and lizards (Table 1).

Table 1. Attributes used as indicators for the achievement of ecological condition for the various ecological features for which offsetting has been applied.

Biodiversity feature	Attribute and units of measure
Tussock grassland plant community (native dominant tussockland)	Percentage cover (bird's eye view) across 5 m x 5 m quadrats, or by remote sensing (census)
Taramea plant community (native herbfield and shrubland)	Percentage cover (bird's eye view) across 5 m x 5 m quadrats, or by remote sensing (census)
Kawerau gecko	Relative abundance (ACO occupancy rates across fixed stations as transects or clusters)
McCann's skink	Relative abundance (ACO occupancy rates across fixed stations as transects or clusters)
Native dominant scrubland plant community	Cover of native woody species (percentage cover across plots or by remote sensing). Species richness of native tree, shrub and liana species per permanent plot of transect line. Abundance of seed dispersing native birds (average number per 5-minute bird count at fixed count stations). Average abundance of Kawerau geckos per ACO. Presence of naturally dispersed native woody vegetation species excluding matagouri, tree daisy and mingimingi (percentage frequency across multiple plots)
Wetlands	Native plant over (% cover) from 2 x 2 m plots. Native plant diversity (average species number) from 2 x 2 m plots

Including multiple attributes, where feasible, ensures that representative parts of the community are included in the model to provide a balanced picture of how an offset site may or may not provide equivalence when component parts are considered separately.

Settings in common across each of the models developed for this project are described below. A list of the assumptions for each of the offset features in terms of site management is provided in Table 3.

1. The discount rate used for impacted sites is nil (0%) as the impact is considered to be instantaneous. This is precautionary because not all biodiversity from the DFF will be removed at once, rather it will be progressively removed over several years as the mine and associated infrastructure are developed. Predicting annual loss areas is fraught and subject to commercial and operational vagaries; it is more robust and less complex to simply model loss at Year 1.

2. The discount rate used for uplift sites is 3.0 % per annum, in accordance with usual use in New Zealand and globally for biodiversity offsetting.

3. The benchmark used is tailored to each biodiversity feature and represents the maximum reasonable state of that feature under ideal management conditions. 'Ideal management conditions' includes the absence of introduced animal pests, weeds and invertebrates, and best practice management of habitat for that environmental setting to provide capacity for population growth and community condition. A benchmark cannot usually be sourced elsewhere as almost all of New Zealand (including most offshore islands) support habitat and populations that are affected in some way by human-induced change or un-natural conditions; hence a benchmark is almost always theoretical.

   Because the same benchmark is applied to the impact and offset sites, the absolute value is unimportant – it just needs to be ecologically sensible and reasonable. It is advisable to set a benchmark greater than the maximum level of attainment under offset management for a feature, as uplift beyond the benchmark is truncated and is not counted.

4. The baseline (starting) state for a biodiversity feature is informed completely by the data collected from the site during the ecology investigations. In the case of this project, the data collection has been extensive and intensive and provides an excellent dataset from which to obtain measures of extent, catch rates, relative abundance counts, and measures of cover and diversity. This greatly benefits these models as including counts for the predictions of biodiversity change over time allows for the development of a robust construction and postconstruction monitoring programme to assess how well the trajectories for biodiversity track over time compared to model predictions.

5. The currency used for the BOAM is Net Present Biodiversity Value (NPBV) which communicates the change in state of a biodiversity feature over time compared to the benchmark and taking into account risk, uncertainty and time lags. NPBV for a feature is derived from the average of the individual attributes that describe that feature. Where one feature describes an attribute, the average score is that individual score. Where more than one attribute describes a feature, the average is the unweighted average of those scores, i.e. there is no weighting system applied that places one attribute as more important above others – they are treated equally.

   This approach follows current convention and avoids debate over judgements of 'differential worth' of biodiversity that comprises a community. Where NPBV is calculated for different sites or sub-sites (for example within different vegetation communities or within multiple different offset sites) the individual scores are added to provide a total loss, total gain (uplift) and total net change over time. The BOAM model provides summary statistics for individual (disaggregated) NPBV for attributes, and averaged scores across line entries in the attribute tables, allowing the most relevant statistic to be selected that supports the query that is being modelled.

6. Equivalence (like-for-like) is a core tenant of biodiversity offsetting and sets it apart from ecological compensation, which deals mostly with like-for-unlike trades. Equivalence has been maintained through the offset trades for this project by:

a. For species, incorporating how habitat quality changes across the site, which for this site is best represented by vegetation community types that are separated by provenance and complexity (see the vegetation values assessment report by RMA ecology); and

b. For communities, determining the continuum that exists on the site from purely exotic through to native dominant. The restoration objective is native dominant communities – whether that is tussockland, wetland or native scrubland. Communities that are degraded examples of native communities, or which are on a trajectory towards a native dominated community, are treated as subordinate stages along a succession trajectory. For tussock communities, mixed tussock shrubland is treated as an undesirable degraded stage of native dominant tussockland, and so the focus is on restoring or creating native dominant tussockland.

   Likewise for wetlands where the objective is to create or restore native dominant wetlands. For woody shrubland offsetting, exotic pasture and mixed exotic shrubland are treated as communities that can be modified (e.g. planting, weed control) in favour of creating, restoring and preserving native dominant scrubland.

The areas occupied by each community or species, and how the extent changes within the mine's development and is incorporated into the BOAM models is summarised in Table 2. Table 2 also provides a summary of the degree to which the spatial extent of habitat occupied by a biodiversity feature will be replaced following mining.

Table 2. Pre-development areas of occupation by biodiversity features included in the offset models.

Biodiversity feature	Area occupied		Notes
	Prior to mine development	After mine development	
Tussock grassland			
• DDF & mine rehab	25 ha native dominant 187 ha mixed tussock	222 ha native dominant Nil mixed tussock	222 ha native dominant planted by Year 10, then 25 years to establish & grow.
• Ardgour Station	207.6 ha native dominant 348.1 ha mixed tussock	186.8 ha native dominant 297 mixed tussock	Some loss over 35 years due to natural spread of woody vegetation
• Bendigo Sanctuary	nil native dominant 8.2 ha mixed tussock	4 ha native dominant 2.8 mixed tussock	Some loss over 35 years due to natural spread, and planting of woody vegetation (4 ha).
• Ardgour Sanctuary	nil native dominant 3.1 ha mixed tussock	12.9 ha native dominant 0.3 mixed tussock	Some loss over 35 years due to natural spread, and planting of woody vegetation (12.9 ha).
• MRZ	133 ha native dominant 304 ha mixed tussock	119.7 ha native dominant 273.6 mixed tussock	Some loss over 35 years due to natural spread of woody vegetation.
	Total pre-mine 1,216 ha	Total post-mine 1,119.1 ha	

Taramea herbfield			
• DDF & mine rehab	2 ha	2 ha	Plant 2 ha
• MRZ	76 ha	83.6 ha	Stock removal and pig control gives 10 % increase in extent over 35 years
	Total pre-mine 78 ha	Total post-mine 85.6 ha	
Lizards (Kawerau gecko and McCanns skink)			
• DDF & mine rehab	607 ha habitat	480 ha habitat	Loss of habitat due to roads, pit lakes and non-rehab areas
• Ardgour Station	1,224.3 ha habitat	1,224.3 ha habitat	Area remains the same; quality of habitat improves
• Bendigo Sanctuary	27.6 ha habitat	27.6 ha habitat	Area remains the same; quality of habitat improves
• Ardgour Sanctuary	37.3 ha habitat	37.3 ha habitat	Area remains the same; quality of habitat improves
• MRZ	889 ha habitat	889 ha habitat	Area remains the same; quality of habitat improves
	Total pre-mine 2,785 ha	Total post-mine 2,630.6 ha	
Woody scrubland			
• DDF & mine rehab	124 ha mixed scrubland 86 ha native scrubland	nil mixed scrubland 230 ha native scrubland	Plant 230 ha by Year 10, no stock over 20 years.
• Ardgour Station	102.4 ha mixed scrubland 105 ha native scrubland	225.6 ha mixed scrubland 177.9 ha native scrubland	No or low stock, assumes increase over 35 years
• Bendigo Sanctuary	0.02 ha mixed scrubland nil native scrubland	0.02 ha mixed scrubland 6.7 ha native scrubland	Plant 6.7 ha, and natural increase over 35 years
• Ardgour Sanctuary	nil mixed scrubland 2.8 ha native scrubland	nil mixed scrubland 8.8 ha native scrubland	Plant 6 ha, and natural increase over 35 years
• MRZ	38.2 ha mixed scrubland 125.4 ha native scrubland	42.0 ha mixed scrubland 137.9 ha native scrubland	No stock, assumes 10% natural increase over 35 years
	Total native scrubland pre-mine 319.2 ha	Total native scrubland post-mine 561.3 ha	
Wetlands			
DDF, DDZ & mine rehab	Swamp/ Marsh 2.51 ha[a] Seep 0.19 ha Fen 0.85 ha	Swamp/ Marsh 6 ha	Creation of 6 ha of planted wetland (and 0.5 ha open water) on the TSF at completion

MRZ – Shepherds Creek	nil	Swamp/ Marsh 1.5 ha	Creation of 3 x 0.5 ha wetlands along lower Shepherds Creek.
	Total pre-mine 3.55 ha	Total post-mine 7.5 ha	

[a] Wetlands mapped within the Dewatering Drawdown Zone (DDZ) include 607 m^2 of seep, 3,713 m^2 of fen and 19,416 m^2 of swamp/marsh. A small area of the DDZ was not surveyed for wetlands and lies to the far west of the proposed CIT pit. Only seep and fen within the DDZ have been added to the totals in this table for offsetting, as it is assumed that the proposed flow augmentation for swamp/marsh within the DDZ proposed by Santana will be successful at mitigating adverse effects on those wetlands.

Table 3. Prescriptions for rehabilitation/ regeneration and offset sites where biodiversity features are predicted to improve under changes to existing management. The assumptions listed here summarise the management proposed in the various management plans for mine rehabilitation, the Mine Regeneration Zone, Ardgour Station Restoration Area, and the Bendigo and Ardgour sanctuaries.

Biodiversity feature	Assumptions for assessing uplift potential
Tussockland	Ardgour Station – remove all cattle. LMUs 1-4: natural tussock cover increases by 3 x over 35 years with no grazing at all. LMUs 5-7: natural tussock cover increases by 1.5 x over 35 years with sheep grazing maintained. Tussock extent decreases by 10 % over 35 years as woody vegetation increases and outcompetes tussocks.
	Bendigo and Ardgour Sanctuaries – No stock grazing. Some loss of extent as woody planting occurs in areas preferred for woody vegetation restoration. Planted tussock areas received 6,000 plants /hectare to provide starting cover at maturity of 15 % (assumes each tussock covers 0.25 m^2 when mature). Tussock cover increases 3 x over 35 years.
	Mine rehabilitation – No stock or only periodic light sheep grazing to control exotic grass growth. Planted tussock areas received 6,000 plants /hectare to provide starting cover at maturity of 15 % (assumes each tussock covers 0.25 m^2 when mature). Tussock cover increases 2 x over 20 years.
	Mine Regeneration Zone (MRZ) - No stock or only periodic light sheep grazing to control exotic grass growth. Planted tussock areas received 6,000 plants /hectare to provide starting cover at maturity of 15 % (assumes each tussock covers 0.25 m^2 when mature), by Year 15. Tussock cover increases 2 x over following 20 years.
Taramea	Mine rehabilitation – Periodic light sheep grazing to control exotic grass growth. Control pigs. Planted areas received 2,000 taramea /hectare to provide starting cover at maturity of 20 % (assumes each taramea covers 1 m^2 when mature), by Year 15. Taramea cover increases 2 x over following 20 years.
	Mine Regeneration Zone (MRZ) - No stock grazing. Control pigs. No planting. Natural taramea cover increases by 3 x over 35 years. Taramea extent increases by 10 % over 35 years.
Lizards (Kawerau gecko and McCanns skink)	Ardgour Station – No stock or only periodic light sheep grazing to control exotic grass growth. Control of large mammalian predators to low levels. No rat or mouse control. Results in 1.5 x increase from current relative abundance after 35 years.
	Bendigo and Ardgour Sanctuaries – No stock grazing. Complete removal of all introduced mammalian predators of lizards leads to 3 x current relative abundance rates after 35 years (for context Mokomoko Dryland Sanctuary in nearby Alexandra has achieved 2-3 x increase in relative abundance for geckos and skinks 6 years after pest eradication).
	Mine rehabilitation – No stock or only periodic light sheep grazing to control exotic grass growth. Vegetated areas are planted and have rock/ habitat added at Year 15 and take several years to mature. Lizards naturally recolonise to reach pre-development abundance by Year 35.
	Mine Regeneration Zone (MRZ) - No stock or only periodic light sheep grazing to control exotic grass growth. Control of large mammalian predators to low levels. No rat or mouse control. Results in 1.5 x increase from current relative abundance after 35 years.
Woody scrubland	Ardgour Station – No stock or only periodic light sheep grazing to control exotic grass growth. No planting. Mixed shrubland increases extent by 50 % over 35 years, and condition by 1.5 – 3 times depending on attribute, except for plant species richness of naturally established species that indicate

	functional and structural complexity, which increases form an extremely low level now, to a much greater level after 35 years. Native dominant scrubland increases extent by 10 % over 35 years, and condition by 1.5 – 3 times depending on attribute. Extent increases based on measured increases to woody vegetation in nearby Dry Creek Reserve over 20 years of stock exclusion.
	Bendigo and Ardgour Sanctuaries – No stock grazing. Increase to woody vegetation extent through planting. Increase to vegetation condition over 35 years in terms of indicators of cover, diversity, birds, natural regeneration. Planted areas planted at 5,000 stems/ ha.
	Mine rehabilitation – No stock or only periodic light sheep grazing to control exotic grass growth. Planted areas planted at Year 10 and received 5,000 plants /hectare to provide complete coverage of planting areas. Woody vegetation cover increases to 80 % by Year 35 (i.e. 20 years of establishment and growth).
	Mine Regeneration Zone (MRZ) - No stock or only periodic light sheep grazing to control exotic grass growth. No planting. Mixed shrubland increases extent by 50 % over 35 years, and condition by 1.5 – 3 times depending on attribute, except for naturally plant species richness of naturally established species that indicate functional and structural complexity, which increases form an extremely low level now, to a much greater level after 35 years. Native dominant scrubland increases extent by 10 % over 35 years, and condition by 1.5 – 3 times depending on attribute. Extent increases based on measured increases to woody vegetation in nearby Dry Creek Reserve over 20 years of stock exclusion.
Wetlands (see the Mine Rehabilitation Plan)	TSF wetland– Create 6 ha of marsh wetland by Year 15. No stock or only periodic light sheep grazing to control exotic grass growth. Planted wetland areas received 7,500 plants /hectare to provide complete plant coverage at Year 15. Wetland plant cover increases to 90 % cover by Year 25 and is maintained through to Year 35 (i.e. 20 years of growth).
	Mine Regeneration Zone (MRZ) – three x 0.5 ha wetlands (total 1.5 ha) formed along Shepherd's Creek. All fenced to exclude stock grazing. • Ardgour Terrace (0.5 ha) – Created wetland alongside Shepherd's Creek at Year 1. Vegetated using existing wetland sods from DDF to provide 66 % cover following transplantation. Cover of 80 % by Year 5. Full wetland establishment (90 % cover) by Year 15. No planting required. • Lower Shepherds wetland (0.5 ha) - Created wetland alongside Shepherd's Creek at Year 1. Vegetated using existing wetland sods from DDF to provide 66 % cover following transplantation. Cover of 80 % by Year 5. Will be used as sod source at Year 15 for TSF inoculation for wetland planting. Full wetland establishment (90 % cover) by Year 25. No planting required. • Process Plant wetland (0.5 ha) – Created wetland alongside Shepherd's Creek following removal of the process plant at Year 15, with planting at 10,000 plants /hectare to provide complete planting coverage (90 % cover) by Year 25.

The inputs and outputs of each BOAM model are included in the Excel spreadsheet models attached electronically to this report (or are available upon request as electronic files).

3 Results

The summarised results of the BOAM models are provided in the Table 4 below. The results are divided into the net-balance status for replacement of extent of the ecological feature, and the replacement of condition (value) of the feature.

Overall, of the eight BOAM models developed to address the unavoidable loss of eight species or vegetation communities, three (3) predict redress for loss of extent of that feature, and four (4) predict redress for loss of values (condition) (Table 4) under the proposed programme of mine rehabilitation, Ardgour Station restoration, sanctuary development, mine regeneration zone management, planting, stock management and pest animal and weed control.

Table 4. The net balance for biodiversity features modelled under offsetting (like-for-like) conditions for extent and values (condition). For condition, the modelled loss of biodiversity with the development of the mine is shown (mine loss) compared to the net state with rehabilitation, restoration and enhancement actions over a 35-year duration from the commencement of the mine (post mine). Cells shaded green denote overall net-gain; cells shaded orange denote overall net-loss.

Feature	Will the proposed rehabilitation, regeneration, restoration, enhancement works result in a net-gain for biodiversity?	
	Extent	Values (condition)
Tussock	No (pre 1,216 ha; post 1,119.1 ha	Yes (mine loss -56.3 NPBV; post mine 113.5 NPBV) Net NPBV = 57.2
Taramea	Yes (pre 78 ha; post 85.6 ha)	Yes (mine loss -0.3 NPBV; post mine 5.8 NPBV) Net NPBV = 5.5
Woody shrubland	Yes (pre 319.2 ha; post 561.3.9 ha)	Yes mine loss -38.4 NPBV; post mine 86.1 NPBV) Net NPBV = 47.7
Lizard - Kawerau gecko	No (pre 2,785 ha; post 2,630 ha)	No (mine loss -75.3 NPBV; post mine 51.9 NPBV) Net NPBV = -23.3
Lizard - McCanns skink	No (pre 2,785 ha; post 2,630 ha)	No mine loss -132.6 NPBV; post mine 87.6 NPBV) Net NPBV = -45.1
Wetlands - Marsh/Swamp	Yes (pre 2.51 ha; post 7.5 ha)	Yes mine loss -0.51 NPBV; post mine 1.41 NPBV) Net NPBV = 0.90
Wetlands - Seeps	No (pre 0.19 ha; post nil ha)	No mine loss -0.04 NPBV; post mine 0.00 NPBV) Net NPBV = -0.04
Wetlands – Fens	No (pre 0.85 ha; post nil ha)	No mine loss -0.17 NPBV; post mine 0.00 NPBV) Net NPBV = -0.17

The areas of loss of plant communities or species habitat within the DDF, and the corresponding areas that are included in the offset models as ecological creation, enhancement or restoration sites, are laid out in Table 2.

Where a net-gain outcome is predicted, there is confidence that the unavoidable losses caused by the project can be addressed to provide an overall positive outcome.

Where a net loss is predicted, there is confidence that, despite the areas, types and management proposed to enhanced or create replacements, insufficient benefit will result to fully address the permanent residual impacts of the project. In most cases, ecological compensation has been offered to provide commensurate benefit.

See Appendix D for a more detailed summary of the losses and gains for the various line items in each model.

The areas of land that are proposed to be managed for biodiversity improvement and protection purposes are substantial (some 3,000 ha) and eclipse the scale and intensity of most ecological effects management programmes in New Zealand. The offset models presented here take, by their intended nature, a de-constructionist approach to ecology and cannot incorporate broader benefits relating to ecological clines, sequences, and landscape connectivity and resilience.

The broader benefits of this offset programme are communicated in the Ecological Effects Assessment report; however, it is worth reiterating here that the outputs of the biodiversity models listed in in Table 3 should be considered in the context of the protection, restoration and enhancement of:

- Altitudinal sequences across a large scale, which build both climate resilience and cater for life stages of species that shift on the landscape;
- Aquatic and terrestrial environments together such that hydrology at a sub-catchment and catchment level is incorporated, which will result in local landscape benefits for water and habitat quality; and
- Connectivity across a broad area of the northern faces of the Dunstan Mountains due to the proposed restoration areas linking existing public conservation land at Bendigo Scenic Reserve and Bendigo Historic Reserve to the west, with Bendigo Conservation Area and Ardgour Conservation Area to the south, and Neinei i kura Conservation Area and Dry Creek Conservation Areas to the north-east.

We do not comment on the relative worth of these non-valued components in terms of offsetting; however, we do encourage that these broader benefits be included in a weighing up of the relative merits of the overall project.

A compensation package proposed to address the residual loss of extent or values for biodiversity listed in Table 3 is described in the Ecological Effects Assessment report prepared by Alliance Ecology.

Graham Ussher

Principal Ecologist

22-Oct-25

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Appendix A - Vegetation uplift in the Ardgour Restoration Area

Background to proposed vegetation uplift in the Ardgour Restoration Area

Emeritus Professor David Norton

Biodiversity Solutions Ltd

Lake Hāwea

30 June 2025

Introduction

The following notes summarise the likely vegetation development (and associated changes in native seed dispersing birds) that might occur over 35 years as a result of the management that is proposed in the *Ardgour Restoration Area Management Plan*. It is, however, difficult to assess just how much change will occur for several reasons, perhaps the most important being that there is little information for other comparable sites.

The development of kānuka shrubland with grazing removal in Bendigo Scenic Reserve is of limited relevance as kānuka is not important at Ardgour. The following notes outline the information and assumptions that have guided the suggested changes in woody vegetation and associated avifauna at Ardgour.

Changes in the extent of woody vegetation

The only really good information we have is from aerial photo analysis of shrubland expansion in the Dry Creek catchment over the last 20-odd years (see Appendix 1 below). This suggests that mixed matagouri-scented tree daisy shrubland expanded rapidly in extent in several parts of this catchment over this time period, with increases in shrubland area ranging from about 20% to over 50%, with the greatest increases at higher elevation.

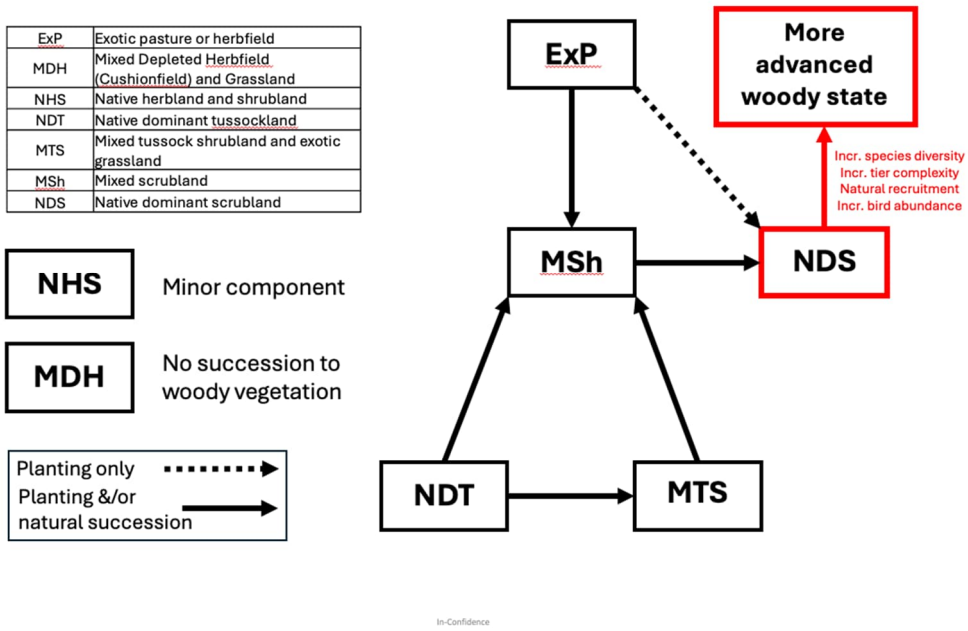
The reasons for this expansion are likely due to fertilizer application creating conditions conducive for woody species to become more dominant, especially when combined with cessation of woody vegetation control (spraying and burning) and removal of livestock grazing. While some of the areas analysed in Appendix 1 have had grazing removed as a result of tenure review, not all have, and cessation of woody vegetation control, coupled with high soil fertility, is likely the main driver of woody expansion.

These data suggest that expansion of woody vegetation is likely to occur with the cessation of woody vegetation control and removal of livestock grazing, especially on south facing aspects. The aerial photos also suggest that woody expansion does occur on other aspects, but that the rate is slower and sweet briar appears to be the dominant species, at least early on.

An assessment of the likely successional development of the extant vegetation types in the Ardgour Restoration Area is included in Appendix 2. This is summarized in the following diagram that highlights the pathways and management interventions over the next 35 years. All successional pathways assume that the management that is proposed in the *Ardgour Restoration Area Management Plan* is implemented including no fertilizer application, no woody vegetation control (by either fire and spraying) and no livestock grazing.

Potential vegetation development over 35 years

ExP	Exotic pasture or herbfield
MDH	Mixed Depleted Herbfield (Cushionfield) and Grassland
NHS	Native herbland and shrubland
NDT	Native dominant tussockland
MTS	Mixed tussock shrubland and exotic grassland
MSh	Mixed scrubland
NDS	Native dominant scrubland



Changes in woody vegetation composition and structure

It is more difficult to assess the likely development of woody vegetation into a more structurally complex and species diverse state. The biggest limitation for any natural increase in diversity and structure is a lack of seed sources for most later successional species. Restoration management aims to promote this through enrichment planting of currently absent species that will increase both species richness and structural diversity (e.g. trees). It is, however, difficult to predict how fast these species will grow.

Natural regeneration

Currently natural regeneration is almost entirely dependent on dispersal from propagule (seed and spore) sources often tens of kilometers distant as local sources are largely absent. Species with very light propagules such as ferns are likely to be better suited to this, as are species with wind dispersed seeds. However, a sizable portion of our native woody flora has bird dispersed seeds. There is therefore likely to be very little long-distance dispersal occurring. Further compounding this issue, is that upwind propagule sources may not be well suited for growth in the Ardgour Restoration Area as these are in higher rainfall environments around Lakes Wānaka and Hāwea.

Natural regeneration at Ardgour will therefore be dependent on planted species reaching a sufficient size to start producing seeds, having sufficient genetic diversity present within the plantings to ensure that these seeds are viable and having birds present to spread the seeds around the developing woody vegetation. It may also be necessary to introduce ferns from areas with a climate more similar to Ardgour to ensure that they can establish.

Native seed dispersing birds

Four native bird species play a key role on the dispersal of native plant species with fruit – kereru, tuī, korimako and tauhou. Some introduced bird species can also disperse native seeds. Kereru and tuī are currently absent, or very rare visitors, while korimako are only occasionally present and are unlikely to be currently resident within the area. Tauhou are present but in small numbers. The presence of these species may be limited by several factors including predation, lack of nesting and food resources, and lack of habitat connectivity. Through restoration management all of these factors will be addressed, and it is anticipated that numbers of these birds will increase and that that least korimako and tauhou will become resident within the Ardgour Restoration Area over the next 35 years.

Conclusions

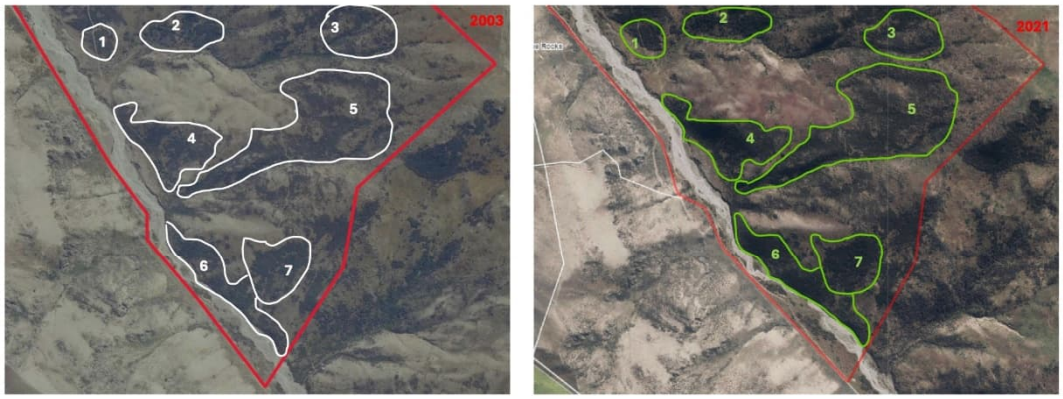
Based on the information in the above notes and the management actions that are outlined in the *Ardgour Restoration Area Management Plan*, I have made conservative estimates of the likely vegetation development and associated changes in native seed dispersing birds that might occur over 35 years. These are included in the attached Excel spreadsheets.

Appendix B. Assessment of shrubland development in the Dry Creek catchment undertaken by RMA Ecology 2025.

Dry Creek Conservation Area. Left = 2003, Right = 2021 (top half).

1. >20% increase in native scrub
2. >20% increase in native scrub
3. >30% increase in native scrub
4. Decrease/dieback in >80% of scrub.
5. >10% increase in native scrub
6. >20% increase in native scrub

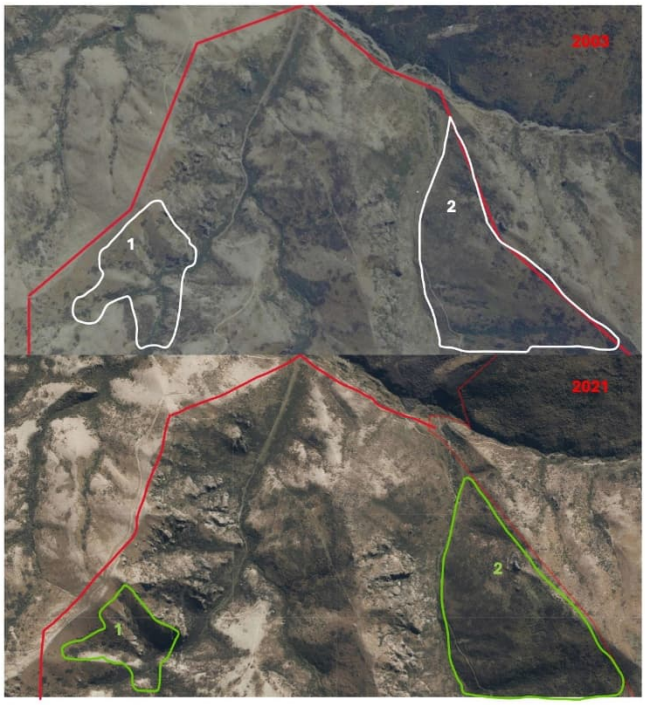
General increase over ~20 years (~10 as public conservation land) of around 20% in native scrub.



Dry Creek Conservation Area. Left = 2003, Right = 2021 (bottom half).

1. >30% increase in native scrub
2. >20% increase in native scrub
3. >20% increase in native scrub
4. >40% increase in native scrub
5. >30% increase in native scrub
6. >40% increase in native scrub
7. >50% increase in native scrub

General increase over ~20 years (~10 as public conservation land) of around 35% in native scrub.



Upper Dry Creek (Ardgour) (top half)

1. >40% increase in native scrub
2. >50% increase in native scrub

General increase over ~20 years of around 50% in native scrub.

Upper Dry Creek (Ardgour) (bottom half)

1. >40% increase in native scrub
2. >35% increase in native scrub
3. >60% increase in native scrub
4. >40% increase in native scrub.

Appendix C. Predicted vegetation changes from the RMA Ecology *Vegetation Values Assessment* report

The following notes are extracted verbatim from this report.

Exotic pasture or herbfield: If farm management inputs were removed (grazing, cultivation, fertiliser, etc.), this vegetation type would slowly develop onto a more woody state on south facing slopes, but likely with sweet brier (*Rosa rubiginosa*) dominant because of the high fertility and generally being more distant from areas of native woody vegetation.

Mixed depleted herbfield (cushionfield) and grassland: A reduction in grazing pressure (rabbits and sheep) and/or fertiliser application may favour more woody species and lead to a loss of this vegetation community in some places.

Mixed tussock shrubland and grassland: This is a less developed version of 'Exotic pasture' that has likely had an ongoing history of AOSTD and sheep and cattle grazing, but no cultivation and less recent woody vegetation control (herbicide application or burning), hence the higher woody component. Depending on management history, especially woody vegetation control and grazing pressure, scattered to small clumps of shrubs are also present with native tūmatakuru / matagouri (60 % freq.) and exotic sweet brier (81 % freq.) the most common, although shrubs are never dominant (19 % cover).

Mixed shrubland: With appropriate management (no fertilizer and modification of grazing patterns), 'Mixed scrubland' may transition into more diverse 'Native dominant scrubland'.

Native dominated tussockland: 'Native dominated tussockland' is an induced vegetation type in that historically it would have supported woody vegetation and because of its higher elevation and farming history, invasion of woody species is slower. With removal of grazing pressure and time, tussock and native woody cover may not increase without other intervention (Walker *et al*., 2003). Walker *et al*. (2003) observed a trend of decreasing native species richness in hard tussock/short tussock grassland regardless of management practices, i.e., grazed, ungrazed, ungrazed and fertilised, and ungrazed and irrigated.

Native herbfield and shrubland: Like 'Native dominated tussockland', this is an induced vegetation community in that historically it would have supported a woody canopy. With removal of grazing pressure and time, 'Native herbfield and shrubland' will develop into a woodier state with tūmatakuru / matagouri likely dominant, at least initially.

Native dominant scrubland: This vegetation community has expanded since large scale anthropogenic burning essentially ended within the ESA several decades ago. Aerial imagery shows an increase of 10-60 % in woody vegetation cover in suitable locations (i.e., some existing woody vegetation, and not north facing) over an 18-year period between 2003 and 2021 in grazed (Dry Creek Conservation Area) and ungrazed areas (Ardgour Station). In some locations, AOSTD has assisted woody regeneration.

Appendix D – summarised model outputs

(see the models for more detailed inputs and outputs)

Tussock

BOAM model outputs	units are net present biodiversity value (area x condition adjusted for risk and time lag)		
Tussock - site	**loss**	**gain**	**net**
DDF - NDT	-6.7	26.0	19.4
DDF - MTS	-27.4	0.0	-27.4
Ard - NDT LMU 1-4	-3.0	15.9	12.9
Ard - NDT LMU 5,6,7	-2.5	3.3	0.8
Ard - MTS LMU 1-4	-6.6	22.0	15.4
Ard - MTS LMU 5,6,7	-0.9	0.8	-0.1
Ben Sanct MTS	-0.8	0.2	-0.6
Ben Sanct planted	0.0	0.7	0.7
Ard Sanct MTS	-0.4	0.0	-0.4
Ard Sanct planted	0.0	2.3	2.3
MRZ- NDT	-3.6	18.7	15.2
MRZ - MTS	-4.5	23.5	19.1
total	**-56.3**	**113.5**	**57.2**

ExP	Exotic pasture or herbfield
MDH	Mixed Depleted Herbfield (Cushionfield) and Grassland
NHS	Native herbland and shrubland
NDT	Native dominant tussockland
MTS	Mixed tussock shrubland and exotic grassland
MSh	Mixed scrubland
NDS	Native dominant scrubland

Taramea

BOAM model outputs	units are net present biodiversity value (area x condition adjusted for risk and time lag)		
Taramea site	**loss**	**gain**	**net**
DDF	-0.3	0.3	0.0
MRZ		5.5	5.5
total	**-0.3**	**5.8**	**5.5**

Lizard – Kawerau gecko

BOAM model outputs	units are net present biodiversity value (area x condition adjusted for risk risk and time lag)			
lizards – Kawerau gecko	**loss**	**gain**	**net**	**confidence level in model**
Ard Exp	0.0	0	0.0	low
Ard MDH	0.0	5.3	5.3	low
Ard NHS	0.0	0.0	0.0	low
Ard NDT	0.0	2.6	2.6	low
Ard MTS	0.0	4.9	4.9	low
Ard MSH	0.0	2.2	2.2	low
Ard NDS	0.0	2.1	2.1	low
DDF Exp	0.0	0.0	0.0	confident
DDF MDH	-24.2	1.3	-22.9	confident
DDF NHS	0.0	0.0	0.0	confident
DDF NDT	-3.1	4.6	1.5	confident
DDF MTS	-28.1	0.0	-28.1	confident
DDF MSH	-10.9	0.0	-10.9	confident
DDF NDS	-9.0	9.9	0.8	confident
MRZ Exp	0.0	0.0	0.0	low
MRZ MDH	0.0	2.2	2.2	low
MRZ NHS	0.0	0.2	0.2	low
MRZ NDT	0.0	2.0	2.0	low
MRZ MTS	0.0	4.5	4.5	low
MRZ MSH	0.0	0.6	0.6	low
MRZ NDS	0.0	1.6	1.6	low
Ard sanct Exp	0.0	0.0	0.0	very confident
Ard sanct MDH	0.0	2.1	2.1	very confident
Ard sanct NHS	0.0	0.0	0.0	very confident
Ard sanct NDT	0.0	1.3	1.3	very confident
Ard sanct MTS	0.0	0.0	0.0	very confident
Ard sanct MSH	0.0	0.0	0.0	very confident
Ard sanct NDS	0.0	0.7	0.7	very confident
Ben sanct Exp	0.0	0.0	0.0	very confident
Ben sanct MDH	0.0	2.6	2.6	very confident
Ben sanct NHS	0.0	0.0	0.0	very confident
Ben sanct NDT	0.0	0.4	0.4	very confident
Ben sanct MTS	0.0	0.3	0.3	very confident
Ben sanct MSH	0.0	0.0	0.0	very confident
Ben sanct NDS	0.0	0.6	0.6	very confident
total	**-75.3**	**51.9**	**-23.3**	

ExP	Exotic pasture or herbfield
MDH	Mixed Depleted Herbfield (Cushionfield) and Grassland
NHS	Native herbland and shrubland
NDT	Native dominant tussockland
MTS	Mixed tussock shrubland and exotic grassland
MSh	Mixed scrubland
NDS	Native dominant scrubland

Lizard – McCanns skink

BOAM model outputs	units are net present biodiversity value (area x condition adjusted for risk and time lag)		
lizards - McCanns skink	**loss**	**gain**	**net**
Ard Exp	0.0	0	0.0
Ard MDH	0.0	5.1	5.1
Ard NHS	0.0	0.2	0.2
Ard NDT	0.0	5.1	5.1
Ard MTS	0.0	11.8	11.8
Ard MSH	0.0	4.6	4.6
Ard NDS	0.0	2.8	2.8
DDF Exp	0.0	0.0	0.0
DDF MDH	-23.1	1.2	-21.9
DDF NHS	-0.5	0.5	0.0
DDF NDT	-6.3	9.2	2.9
DDF MTS	-67.3	0.0	-67.3
DDF MSH	-22.9	0.0	-22.9
DDF NDS	-12.5	13.6	1.1
MRZ Exp	0.0	0.0	0.0
MRZ MDH	0.0	2.2	2.2
MRZ NHS	0.0	2.6	2.6
MRZ NDT	0.0	4.0	4.0
MRZ MTS	0.0	10.9	10.9
MRZ MSH	0.0	1.2	1.2
MRZ NDS	0.0	2.2	2.2
Ard sanct Exp	0.0	0.0	0.0
Ard sanct MDH	0.0	2.0	2.0
Ard sanct NHS	0.0	0.0	0.0
Ard sanct NDT	0.0	2.5	2.5
Ard sanct MTS	0.0	0.1	0.1
Ard sanct MSH	0.0	0.0	0.0
Ard sanct NDS	0.0	1.0	1.0
Ben sanct Exp	0.0	0.0	0.0
Ben sanct MDH	0.0	2.5	2.5
Ben sanct NHS	0.0	0.0	0.0
Ben sanct NDT	0.0	0.8	0.8
Ben sanct MTS	0.0	0.7	0.7
Ben sanct MSH	0.0	0.0	0.0
Ben sanct NDS	0.0	0.8	0.8
total	**-132.6**	**87.6**	**-45.1**

ExP	Exotic pasture or herbfield
MDH	Mixed Depleted Herbfield (Cushionfield) and Grassland
NHS	Native herbland and shrubland
NDT	Native dominant tussockland
MTS	Mixed tussock shrubland and exotic grassland
MSh	Mixed scrubland
NDS	Native dominant scrubland

Woody vegetation (native dominant scrubland)

BOAM model outputs	units are net present biodiversity value (area x condition adjusted for risk and time lag)			
woody vegetation		**loss**	**gain**	**net**
LMU	**veg type**			
LMU1	Mixed scrubland		0.9	0.9
LMU1	Native dominant scrubland		2.7	2.7
LMU2	Mixed scrubland		0.7	0.7
LMU2	Native dominant scrubland		15.2	15.2
LMU3	Mixed scrubland		5.1	5.1
LMU3	Native dominant scrubland		0.6	0.6
LMU4	Native dominant scrubland		0.6	0.6
LMU5	Mixed scrubland		2.5	2.5
LMU6	Mixed scrubland		2.7	2.7
LMU7	Mixed scrubland		2.2	2.2
DDF	Mixed scrubland	-18.9		-18.9
DDF	Native dominant scrubland	-19.6		-19.6
rehab	Mixed scrubland		0.0	0.0
rehab	Native dominant scrubland		33.5	33.5
MRZ	Mixed scrubland		2.9	2.9
MRZ	Native dominant scrubland		13.9	13.9
Ardgour Sanct	Native dominant scrubland		0.3	0.3
Ardgour Sanct	Native dominant scrubland - planting		1.0	1.0
Bendigo sanct	Mixed scrubland		0.0	0.0
Bendigo sanct	Native dominant scrubland - planting		1.2	1.2
total		**-38.4**	**86.1**	**47.7**

Wetland

BOAM model outputs	units are net present biodiversity value (area x condition adjusted for risk and time lag)			
wetland - marsh/ swamp		**loss**	**gain**	**net**
LMU	**vegetation type**			
DDF & TSF	marsh/swamp	-0.51	0.96	0.5
MRZ	marsh - Ardgour Terrace		0.17	0.17
MRZ	marsh - Lower Shepherd's Creek		0.13	0.13
MRZ	marsh - process plant		0.15	0.15
total		**-0.51**	**1.41**	**0.90**
wetland - seep				
DDF	seep	-0.04		-0.04
total		**-0.04**	**0.00**	**-0.04**
wetland - fen				
DDF	fen	-0.17		-0.17
total		**-0.17**	**0.00**	**-0.17**