Mt Cass Wind Farm
Environmental Management Plan

Revision 13 – 26 April 2023

This Management Plan has been prepared for Mt Cass Wind Farm Limited by:

- David Norton (overall plan preparation plus restoration ecology, Threatened plants and weeds)
- Jim Jolly (avifauna)
- Graham Ussher (herpetofauna and general review for Revision 6 and above)
- Tony Payne (weed management, planting, Threatened plants)

Version	Status	Issue Date
Rev 13	Operative version	26 April 2023
Rev 12	HDC Final Review for Issue following completion of Bird Collision Monitoring Plan	25 November 2022
Rev 11	HDC Final Review for Issue following Removal of Bat Management Section	28 April 2021
Rev 10	HDC Final Review for Issue inclusive of Bat Management Section	18 March 2021
Rev 9	Revision for HDC Final Review following CLG Review & HDC Independent Reviewer FMP Review	21 December 2020
Rev 8	Revision for CLG Review (including Draft FMP)	3 December 2020
Rev 7	Revision following DOC Consultation	29 July 2020
Rev 6	2020 update, consultation issue	25 November 2019
Rev 5	Final Draft	17 August 2013
Rev 4	Draft for Consultation	12 July 2012

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Cross-Reference Table to Conditions of Consent

The following table is provided as a means of cross-referencing the conditions of consent from the EMP sections.

EMP No.	Management Action	Pre Comm	Year 1-5	Condition No.
Covenant				
A5.1	Establish an appropriate covenant over the Mt Cass Conservation Management Area	Yes		80
A5.2	Securely deer fence the boundary of the CMA	Yes		86
A5.3	Internal fencing adequate for sheep grazing trials	Yes		91
A5.4	Regular inspection of fences		Yes	91
Livestock Management				
A5.5	Sheep grazing trials		Yes	89
Animal Pest Management				
A5.6	Eradicate deer from CMA		Yes	89
A5.7	Eradicate rabbits and hares (as best possible)		Yes	89
A5.8	Possum control in CMA and wider site		Yes	89
A5.9	Mustelid and rodent control in CMA and wider site		Yes	89
A5.10	Specific mouse control if necessary		Yes	89
A5.11	Liaison with ECan and landowners		Yes	
Weed Management				
A5.12	Baseline weed inventory	Yes		84a
A5.13	Prepare field guide to ecologically important weed species	Yes		
A5.14	Remove all priority invasive weeds	Yes		91d
A5.15	Annual nassella tussock control	Yes		91e
A5.16	Construction vehicles cleaned prior to entry	Yes		84b
A5.17	Use weed-free aggregate	Yes		84b
A5.18	Annual survey of disturbed sites with weed control as required	Yes		84b
A5.19	Annual surveillance of invasive weeds		Yes	91c
A5.20	Pasture grass and herb control for restoration plantings		Yes	91f
A5.21	Annual nassella tussock control		Yes	91e
A5.22	Annual survey of disturbed sites with weed control as required		Yes	84b
Active Restoration				

EMP No.	Management Action	Pre Comm	Year 1-5	Condition No.
A5.23	Map restoration planting areas	Yes		
A5.24	Let plant propagation contract	Yes		91f
A5.25	Use locally sourced plant stock		Yes	91n
A5.26	Rehabilitate disturbed areas	Yes		61
A5.27	Prepare sites before planting		Yes	91f
A5.28	Plant 1 hectare		Yes	91g
A5.29	Manage plantings (weed control)		Yes	91f
Avifauna Management				
A5.30	Contingency for falcon nesting	Yes		73c
A5.31	Protocol for handling injured or dead birds		Yes	76a
A5.32	Protocol for additional Rare or Threatened avifauna		Yes	76a
Herpetofauna Management				
A5.33	Detailed lizard survey within wind farm footprint	Yes		79f
A5.34	Micro-siting to avoid conflict if possible	Yes		10
A5.35	Capture and relocate affected lizards	Yes		79b
A5.36	Mouse Control if required		Yes	79e
A5.37	Protocol for novel lizard species	Yes	Yes	79c
Threatened and At-Risk Plant Management				
A5.38	Systematic search of construction sites, and relocation of specimens	Yes		60, 90
A5.39	Collect data on Threatened and At-Risk species in the construction footprint	Yes		
A5.40	Survey existing Limestone Wheatgrass sites	Yes		90
A5.41	Transplant directly affected plants	Yes		31n
A5.42	Prepare a field guide to Threatened and At-Risk plants at the site	Yes		
A5.43	Monitoring of three sub-populations of Limestone Wheatgrass		Yes	90
A5.44	Monitoring programme for three subpopulations of McCaskill's hebe		Yes	90
Fire Management				
A5.45	Recommendations of Fire Risk Management Plan implemented	Yes	Yes	121
Silver Tussock Grassland Management				
A5.46	Tussock areas surveyed prior to construction and plants relocated	Yes		93
A5.47	Monitor any rehabilitated tussock grasslands		Yes	93
Photo-Monitoring				
A6.1	Establish photo-points across the Mt Cass Conservation Management Area	Yes		89c

EMP No.	Management Action	Pre Comm	Year 1-5	Condition No.
A6.2	Repeat photo's annually		Yes	89c
Forest and Shrubland Monitoring				
A6.3	Vegetation monitoring established and remeasured after three years		Yes	89c
A6.4	Biodiversity model recalculated using data from monitoring sites		Yes	
Grazing Trial Monitoring				
A6.5	Monitoring established and remeasured annually		Yes	89b
Animal Pest Monitoring				
A6.6	Monitoring established and remeasured annually		Yes	89a
A6.7	*Tupeia antarctica* monitoring programme established.		Yes	85c
Weed Monitoring				
A6.8	Weed surveillance monitoring		Yes	84b, 91c
Restoration Monitoring				
A6.9	Monitoring established and remeasured annually to compare with performance targets		Yes	91h
Avifauna Monitoring				
A6.10	Baseline population monitoring for 2 years prior to construction	Yes		69, 70
A6.11	Repeat for 2 years post commissioning		Yes	71a
A6.12	Breeding season falcon monitoring during construction	Yes		73a
A6.13	Repeat breeding season falcon monitoring two years after commissioning		Yes	73a
A6.14	Migratory shore-bird monitoring	Yes		70d
A6.15	Mortality monitoring Years 1 & 2		Yes	71b
A6.16	Incidental behavioural observations	Yes	Yes	76a
Herpetofauna Monitoring				
A6.17	Establish lizard monitoring and run for two seasons before pest control	Yes		89e
A6.18	Repeat lizard monitoring		Yes	89e
Threatened Plant Monitoring				
A6.19	Monitoring established and remeasured on 2 year cycle		Yes	89g
A6.20	Provide an updated methodology in accordance with the latest best practice.		Yes	
Project Management				
A7.1	Establish GIS database	Yes		91m
A7.2	Establish Mt Cass Statutory Liaison Group	Yes		156

EMP No.	Management Action	Pre Comm	Year 1-5	Condition No.
A7.3	Prepare an annual work plan	Yes	Yes	
A7.4	Establish web site		Yes	
A7.5	Update GIS data as new information becomes available		Yes	91m
A7.6	Establish Bond		Yes	165

1 Introduction

The Mt Cass Conservation Management Area is part of an area of significant indigenous vegetation and significant habitat of indigenous fauna in terms of Section 6 of the Resource Management Act, and the limestone-associated vegetation types and habitats present are regarded as regionally rare and underrepresented within the current protected area network in Canterbury. As part of the mitigation for its Mt Cass wind farm, Mt Cass Wind Farm Ltd (MCWF) is required by conditions of its land use consent (dated 3 February 2012) to undertake a programme of conservation protection and restoration that within 50 years will result in an increase in the overall biodiversity values of the Mt Cass wind farm site and will protect and enhance *ca.* 127 ha of limestone forest, shrubland and escarpment/boulderfield within the Mt Cass Conservation Management Area[1] (Figure 1).

This plan describes the vision and outcomes proposed for the management of this site as required by the conditions of MCWF's land use consent, and the methods that will be used to achieve compliance with these conditions. Condition 80 specifies that the Consent Holder (MCWF) registers a legally binding covenant in a form approved by the Manager Environmental Services of the Hurunui District Council (HDC) no later than 3 months after commissioning of the wind farm providing legal protection in perpetuity to the area identified as the Mt Cass Conservation Management Area on Golder Associates plan CG221, as indicated in (Figure 1). The Mt Cass Conservation Management Area is then to be managed in accordance with the conditions of consent (Condition 81). Accordingly (Condition 66), this Environmental Management Plan (EMP) sets out the practices and procedures to be adopted to ensure compliance with consent conditions relating to:

a. Avifauna management (Conditions 68–76);
b. Herpetofauna management (Conditions 77–79);
c. Weed control (Conditions 82–84);
d. Habitat enhancement and pest control (Conditions 85–91);
e. Fire management (Conditions 119–121).

In addition, this EMP also covers tussock grassland management as required under Conditions 92 and 93.

[1] Subject to final survey.

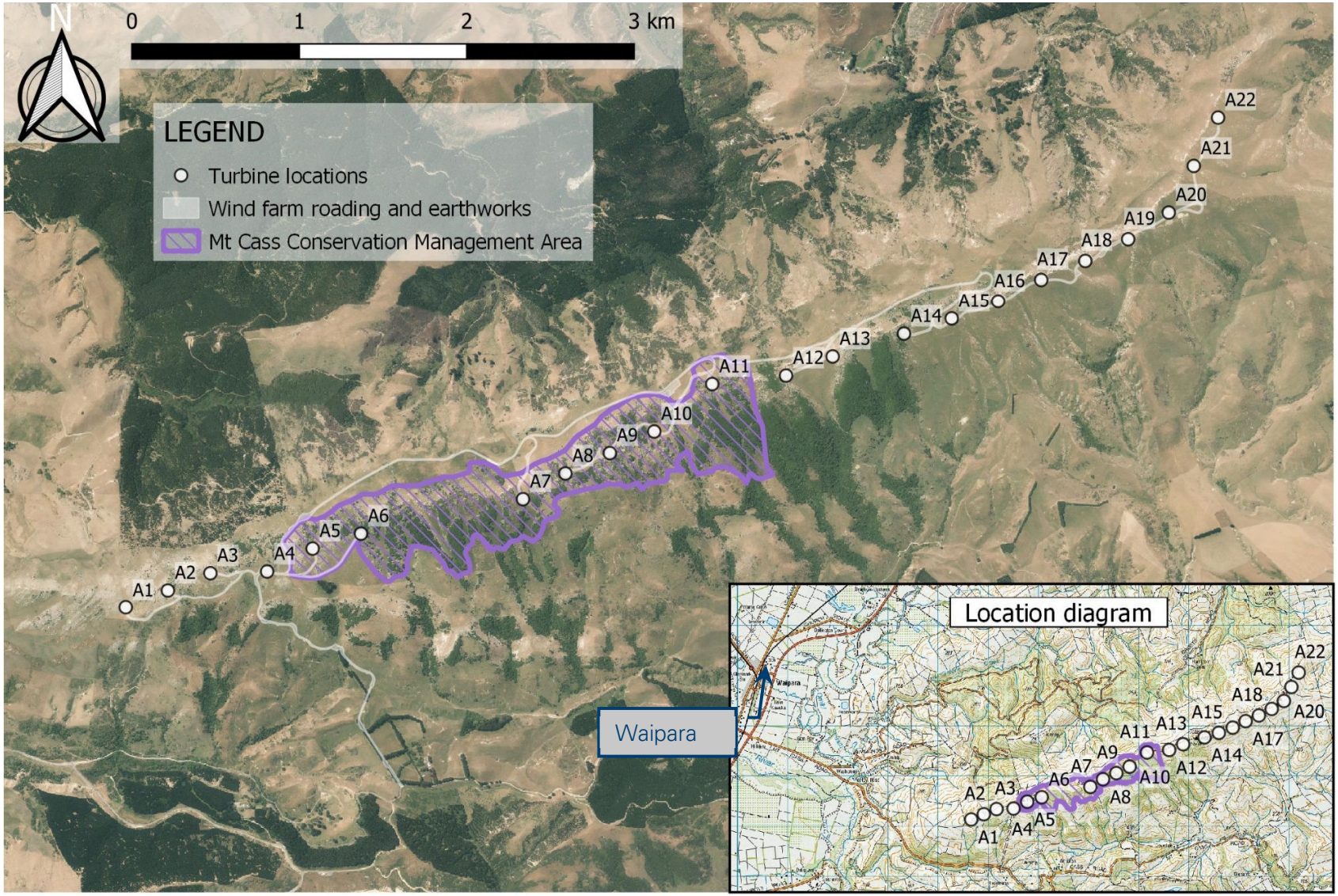

Figure 1: Mt Cass Wind Farm Infrastructure Footprint and Mt Cass Conservation Management Area

This EMP is the guiding document for environmental management of the Mt Cass site. It provides the overview of the approach that will be taken to meet the conditions of the land use consent, but is not prescriptive as it is not always possible to predict in advance changing circumstances that might occur as management proceeds – annual work plans will provide the detail on the specific actions that will be undertaken to implement this plan each year (these will be included in the annual reports required under Condition 67 of the resource consent). MCWF is required to provide an annual report to HDC (Condition 67) that:

a. Details all environmental monitoring and studies undertaken as part of the exercise of this consent;
b. Outlines any changes to the monitoring programme that may be required to allow compliance to be determined;
c. Reports on the extent to which activities are meeting the objectives of the EMP and are achieving or maintaining the performance indicators set out in Condition 91. Where the report identifies that the performance indicators have not been achieved or maintained, the report shall include:
    i. The reasons why the performance indicators have not yet been achieved and/or are not being appropriately maintained; and
    ii. Advice as to specific measures the Consent Holder has either already implemented or intends to implement to address the failure to achieve or appropriately maintain the performance indicators.
d. Reports on consistency of activities with the EMP procedures and methods, and whether there should be amendments made to those methods and procedures that would better assist the Consent Holder in meeting the objectives of the Plan.

The EMP will be reviewed every three years for the first nine years of the project to ensure that the outcomes envisaged are being achieved, and thereafter on a five-year cycle (Condition 27). However, under Condition 88, this first EMP is required to cover the first five years of the project, which therefore forms the time frame for this plan, although the first review will occur after three years. For clarity, Year One of this management plan commences on the date at which the wind farm is commissioned, and the work described in this plan is referred to as either 'pre-commissioning' or as 'Years 1-5' management actions.

MCWF is also required to prepare this EMP and undertake reviews of it in consultation with the Department of Conservation (DOC; Conditions 75, 78, 83 and 87, 89, 91k, 156-158) before it is provided to HDC for approval. Following the initial draft of this EMP (July 2012) it was also decided to include HDC's ecology peer reviewer in the consultation process.

Management of the Mt Cass site in general and the Mt Cass Conservation Management Area specifically will involve several components including control of domestic stock and feral animals, facilitated natural regeneration resulting from stock removal and animal pest control, management of native fauna and flora, weed control, fire management, active restoration of native vegetation, and monitoring of the outcomes of this management programme. Some of the management activities will be restricted to the Mt Cass Conservation Management Area while other activities will occur more widely across the Mt Cass site as dictated by the resource consent conditions. MCWF acknowledges the value of proactive conservation

management across the wider Mt Cass site and will, where appropriate, work with other individuals and organisations to promote this.

This EMP is structured as follows:

a. A brief description of the Mt Cass site, including an overview of the physical and ecological aspects of the site together with land use and tenure.
b. Outline of the vision and goals for environmental management at Mt Cass.
c. Outline of the opportunities and constraints presented by the Mt Cass site that will affect the ability to achieve the visions and goals, and the management responses to these constraints.
d. Overview of management methods including:
    i. Land tenure
    ii. Fencing
    iii. Livestock management
    iv. Animal pest management
    v. Plant pest management;
    vi. Active restoration;
    vii. Avifauna management;
    viii. Herpetofauna management;
    ix. Threatened and At Risk plant management;
    x. Fire management; and
    xi. Tussock grassland management
e. Overview of monitoring that will be undertaken to ensure that the project is achieving the desired goals.
f. Description of the manner in which this management plan will be implemented.

This version of the EMP has been edited and revised and includes a number of minor changes reflecting (1) the final decision on turbine type and location and (2) refinements in ecological management methods in light of more recent information. This version has also incorporated feedback from both the HDC independent reviewer and from DOC. The consent conditions require that the final version of the EMP should be provided to HDC at least three months prior to MCWF undertaking any activities authorised by this consent.

2 Management Plan Context

This section outlines the context within which the Mt Cass conservation and restoration project is located in terms of the ecology of the site and the tenure and land uses of both the Mt Cass site and adjacent sites. The legal requirements for conservation management are described in the resource consent conditions.

2.1 Ecological Context

The Mt Cass ridge, which rises to 557 m, is notable for its limestone geomorphology. The limestone pavement and escarpment topography present today has formed from limestone rocks laid down during the Oligocene (37-24 mya) and subsequently uplifted, tilted, and exposed from the late Pleistocene (*ca.* 250,000 before present) onwards. While two limestone types are present, Weka Pass and Amuri, it is the weathering of the Weka Pass Limestone that has produced the eroded limestone landforms (e.g. grikes, clints) evident today along the broad undulating ridgeline.

The Mt Cass ridge is of high ecological significance and represents the best remaining example in the eastern South Island of limestone pavement ecosystem. Some limestone ecosystems are Nationally Rare (Williams et. al. 2007) and Threatened (Holdaway et al. 2012), and the Mt Cass ridge is notable for its striking limestone geology and landscape, and its indigenous vegetation remnants.

The unusual geomorphology has resulted in both a relatively unique floristic assemblage, and retention of forest and shrubland vegetation cover within grazed areas, due to the inaccessibility of many of the limestone outcrops to farm stock.

Climate data from meteorological masts on the Mt Cass ridgeline (2006-2019) together with climate data from adjacent sites provides some indication of conditions at Mt Cass. The Mt Cass ridgeline is exposed to strong and persistent winds, especially from the northwest with ≈50% of all wind readings coming from this direction, including the strongest wind gusts (Figure).

There is no long-term rainfall data from Mt Cass but annual rainfall at Kate Valley to the south is 890 mm (1986-2011[2] average) while at Waipara to the northwest it is 626 mm (1986-2011 average). Rainfall along the Mt Cass ridgeline is likely to be higher because of its elevated location and occurrence of cloudy conditions. However, as with the rest of Canterbury, there is considerable variation both within years and especially between years. A rain gauge was installed on the Mt Cass ridge on 19 April 2012, with average annual rainfall[3] since then of 850 mm compared with 630 mm at Waipara for the same time period.

[2] Data missing in years 2001 to 2004
[3] Based on 69 months of valid data out of 96 months total (gauge was decommissioned from April 2017 to June 2019)

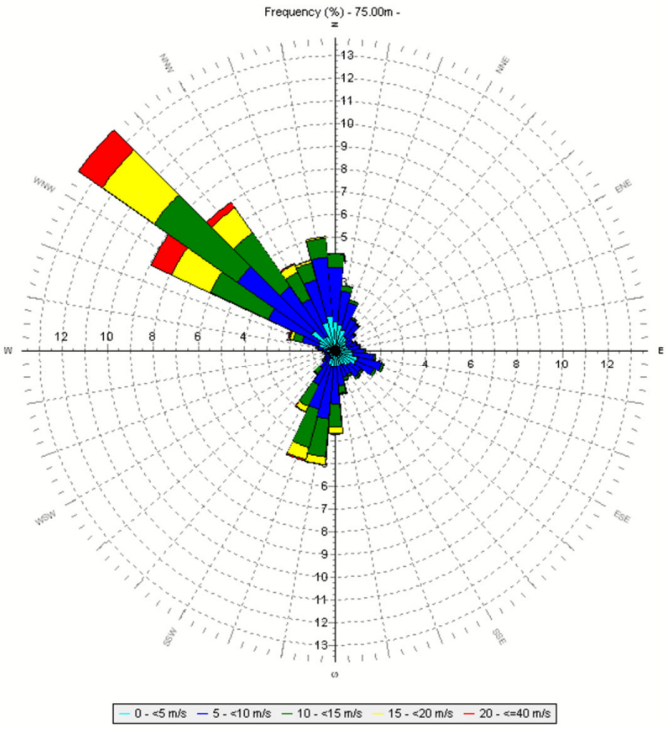

Figure 2: Mt Cass Wind Rose - highlighting the predominance of wind from the northwest

The Mt Cass ridgeline typically experiences warm, dry, summers and cool, wet, winters. Mean annual temperature[4] is 10.4 °C along the ridgeline, with a mean February maximum of 21.3 °C and a mean July minimum of 3.7 °C. Snow occasionally lies on the ridgeline in winter, and frost occurs in sheltered valleys.

In pre-human times the ridgeline, excluding the escarpment itself and other areas of outcropping limestone, would have most likely comprised mixed conifer-angiosperm forest (Molloy 1994) similar in composition to the present forest remnants especially on Dovedale, while lower forest and especially shrubland would have occurred on the most exposed sites or sites with very thin soils. Fossil charcoals from adjacent lowland areas (Moar 1971), believed to have dated from early Māori or natural fires, support the presence of this forest type. More recently, fire and subsequent grazing and associated management have converted much of the native woody communities to exotic pasture where not protected by exposed limestone outcrops. On exposed limestone, natural recovery of woody communities has occurred in some areas.

The vegetation of the Mt Cass ridgeline today comprises a complex mosaic of variously sized and moderately interconnected mixed conifer-angiosperm forest remnants, regenerating divaricating (grey) shrubland communities and grasslands (Table 1). The unusual geomorphology, micro-environment variability, biogeography, and local environmental conditions of the ridgeline have also resulted in a distinctive floristic assemblage (Appendix 1).

[4] Records from meteorological masts on site from April 2006 to June 2020

Community	Vegetation Type
1	Pasture
1(a)	Tussock grassland (>10% *Poa cita*)
2	Mingimingi – pasture grass shrubland
3	Broadleaf – (mingimingi) – (five-finger) – (kōhūhū) scrub
4	Kōwhai – (broadleaf)/(ongaonga) forest
5	Māhoe – (houhi)/Raukaua – ongaonga – climbing fuchsia forest
6	Broadleaf – five-finger – (māhoe)/(ongaonga) forest
7	(Matai)/māhoe – broadleaf – (tarata) forest
8	(Mānatu)/māhoe – kaikōmako/ongaonga forest
9	Tōtara/five finger – māhoe/(pasture) forest
10	Tōtara – (matai)/kōwhai – māhoe/kawakawa forest

Table 1 Vegetation Types present at the Mt Cass Site

The native flora comprises both wide-ranging species, as well as some species restricted to limestone and other base rich substrates (so-called basicoles *sensu* Molloy 1994). These include (with the most recent national Threatened species classification status; de Lange et al. 2018):

- Nationally Endangered
  - *Heliohebe maccaskillii*
  - *Australopyrum calcis* subsp. *optatum*
- Nationally Vulnerable
  - *Carmichaelia kirkii*
  - *Craspedia* (ii) (CHR 489432; Mt Cass)
  - *Kunzea robusta*
  - *Raoulia monroi*
- Declining
  - *Aciphylla subflabellata*
  - *Coprosma virescens*
  - *Discaria toumatou*
  - *Korthalsella clavata*
  - *Linum monogynum var. monogynum*
  - *Mentha cunninghamii*
  - *Tupeia antarctica*
- Naturally Uncommon
  - *Aciphylla aff. ferox* (CHR 617083; Mt Cass)
  - *Chenopodium allanii*
  - *Geranium microphyllum*
  - *Pseudopanax ferox*
  - *Senecio glaucophyllus subsp. basinudus*
  - *Senecio glaucophyllus subsp. toa*
  - *Senecio aff. dunedinensis* (?CHR 550250; Leatham)

Both of the Nationally Endangered species are also Canterbury endemics.

The mosaic of vegetation types along the Mt Cass ridge provides diverse habitat for native fauna, with data available for birds, reptiles and invertebrates (Golder Associates 2008 supplemented by monitoring results for 2012-2013 (Jolly & EcoGecko)). Seventeen native bird species and 14 naturalised species have been recorded. Of these species, three are listed as Threatened or At Risk (following Robertson et al. 2021):

- At Risk - Declining
  - South Island pied oystercatcher (*Haematopus finschi*)
  - New Zealand pipit (*Anthus novaeseelandiae novaeseelandiae*)
- Nationally Vulnerable
  - Eastern falcon (*Falco novaeseelandiae novaeseelandiae*)

The South Island pied oystercatcher is migratory. Other species have been identified that have potential to use or pass through the site, these include: wrybill, banded dotterel, eastern bar-tailed godwit, red knot, pied stilt and the Nationally Critical Australasian bittern.

Two reptile species (Waitaha gecko (*Woodworthia cf. brunnea;* formerly Canterbury gecko) and southern grass skink (*Oligosoma aff. polychroma Clade 5;* formerly common skink) have also been recorded and other reptile species may be present. Based on the latest assessment of the conservation status of New Zealand reptiles (Hitchmough et al. 2021), Waitaha gecko and southern grass skink are classified as At Risk - Declining. A number of common invertebrate species have also been recorded from the site.

Bat Surveys were undertaken in December 2020 and March 2021. Based on the reports submitted (Lloyd 2020 & 2021), both DoC and HDC have agreed that it is most unlikely that there are bats present on the Mt Cass Wind Farm site.

2.2 Land Tenure and Use

The Mt Cass wind farm site is located on a mix of land tenures including land owned by Organic Farm Holdings Ltd (who own Mt Cass Station), MainPower land (within which the Mt Cass Conservation Management Area lies), Dovedale Farm Ltd and Hamilton Glens Ltd (Figure 3). The site is also bordered to the northwest by Omihi Forest (owned by Corisol New Zealand Ltd) and to the southwest by Tiromoana Scenic Reserve. Part of the wind farm site (at the western end) has a Reserves Act conservation covenant on it that limits the grazing in this area to sheep only with a maximum stocking rate of 160 stock units per annum across the 26 ha of the covenant. All of the land that the wind farm is located on or lies adjacent to has a long history of sheep and cattle grazing, which, apart from Omihi Forest and Tiromoana Scenic Reserve, continues to the present day.

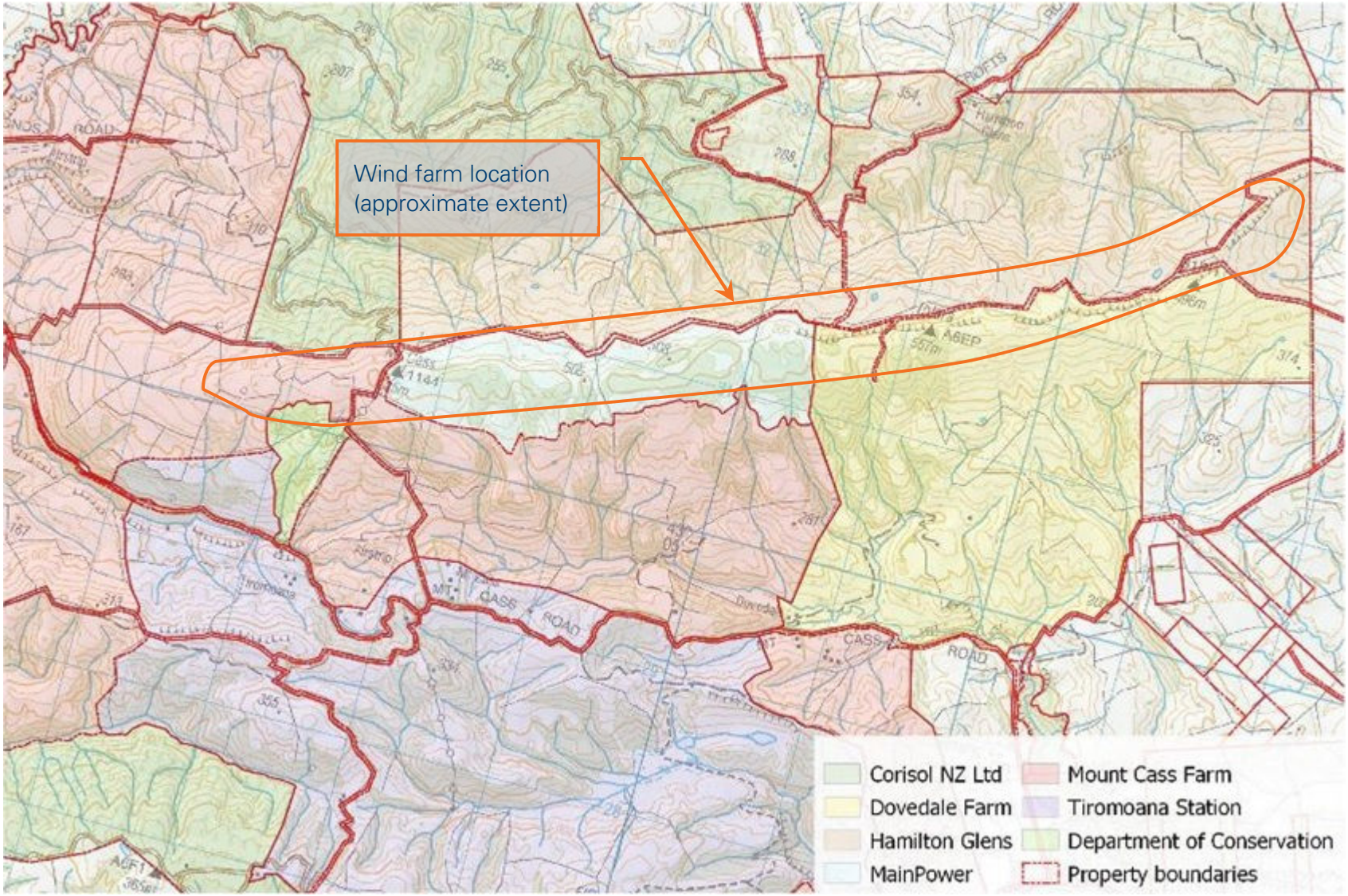

Figure 3: Land Tenure at the Mt Cass Site

3 Vision and Goals

Successful conservation management is dependent on having clearly defined goals, with specific measurable performance indicators. Such goals and their associated performance indicators are important as they enable the success of a project to be quantified as well as allowing the project manager to critically evaluate the effectiveness of the methods that are being used. It is useful to set goals within a broader vision of what the site might be like at some stage in the future. However, it is not possible to use such a vision to assess the success of management because of the long-time frames involved and because of the uncertainties over future conditions (e.g. as a result of climate change). For the Mt Cass Conservation Management Area, an overall vision of what the site might be like in the future has been developed to guide the project, with specific five-year goals identified to assess management success against.

3.1 Vision

This vision sees the Mt Cass Conservation Management Area achieving a healthy naturally functioning ecosystem maintained in perpetuity, including a diverse mixture of vegetation types historically appropriate to their location (mixed conifer-angiosperm forest, angiosperm forests and shrublands, and open escarpment communities) and where currently threatened and uncommon plant and animal species are flourishing.

The vision is specific to the Mt Cass Conservation Management Area as this area is subject to the specific management actions set out in this Management Plan. However, MCWF acknowledges the mutual benefits that arise from any similar conservation activities undertaken in the surrounding area in contributing to a better overall outcome for biodiversity conservation. Examples include vector control for TB, restoration management at Tiromoana Bush, the conservation management work being undertaken by the Hurunui Biodiversity Trust and the Waipara Environmental Trapping Association (WETA), and work on Rare or Threatened plants beyond the work undertaken by MCWF.

The vision is different to the benchmark used in the biodiversity offset calculation. The 'benchmark condition' is defined as the condition that occurs in least-modified ecosystems on the site today and can be considered as the result of benign neglect management. Application of the benchmark condition in the biodiversity offset calculation that formed part of the resource consent application assumed that both the flora and fauna had been impacted by 100+ years of invasive species (especially predators and herbivores) and as such the benchmark condition is the current or status quo condition of the site that will be improved on through the management work described in this plan.

The resource consent conditions outline the specific purposes or objectives of environmental management. With regard to the habitat enhancement and pest control programme (Condition 85) these are to:

- "Encourage and/or facilitate the natural recovery of and to increase the area of native woody vegetation present and to increase connectivity between remnant patches of woody vegetation within the Mt Cass Conservation Management Area;
- Reduce predation pressure on avifauna, invertebrate and lizard populations;
- Reduce browsing damage to existing and regenerating indigenous vegetation;
- Manage pest levels in accordance with specific targets, as measured by residual trap catches, or other pest density indices;
- Protect and enhance populations of Threatened plant species."

The objectives of avifauna (Condition 68) and herpetofauna (Condition 77) management are:

- "To monitor for potential adverse effects of the wind farm on avifauna, and to manage those effects if necessary;
- To achieve a net gain in the relative abundance of indigenous [avifauna] species present at Mt Cass;
- Identify methods to avoid or minimise any adverse effects on lizards arising from the construction and operation of the wind farm;
- Maintain Waitaha gecko, southern grass skink and McCann's skink populations at the same or greater abundances than those present at the wind farm site prior to development of the wind farm; and
- Maintain habitats of Waitaha gecko, southern grass skink, and McCann's skink populations at the wind farm site in the same or better condition than that present prior to the development of the wind farm."

The objective of weed monitoring (Condition 82) is to: "reduce the invasion of exotic weeds and ensure that any which do invade are controlled to acceptable levels".

The objective of fire management (Condition 119) is to establish "procedures for the management of the risk of fire and for fire suppression".

3.2 50-year Outcomes

As described in the Environment Court decision (no. 2011/384, dated 12 December 2011), four outcomes (goals) are sought for the Mt Cass Conservation Management Area over the next 50 years in order to achieve the vision:

- Vigorous regeneration of forest and scrub;
- Indigenous animal populations increasing in abundance and distribution;
- Restoration plantings facilitating succession in pasture; and
- Existing populations of Threatened plant and animal species are secure.

Should these conditions be met after 50 years, then it is highly likely that the situation described in the vision statement will be met over a longer time period.

3.3 Five-year Goals

In order to meet the vision and 50-year outcomes for the Mt Cass Conservation Management Area, a series of five-year management goals have been developed. These goals can be regarded as "stepping-stones" towards achieving the 50-year outcomes. While the resource consent conditions require a review of the management plan after three years (Condition 27), Condition 88 requires that the Habitat Enhancement and Pest Control section of the Environmental Management Plan sets out a management programme for five years. For this reason, goal setting has been set at five-years, but recognising that progress towards achieving these goals will be reviewed after three years. In revising the management plan after three or five years, the reasons why management outcomes as defined by the performance indicators for each goal (see below) might not have been achieved needs to be evaluated and measures put in place to address these (as emphasised in Condition 28).

For each five-year goal, one or more performance indicators are provided that enable the success of management actions in achieving the goal to be assessed. Performance indicators are measurable in order to provide transparency in accounting for management outcomes, and, where appropriate, are aligned with the projected biodiversity outcomes from the biodiversity offset model. The following five-year goals have been grouped under operational goals and outcome goals, reflecting the two core components of the Mt Cass biodiversity mitigation work.

3.3.1 Operational Goals

The following goals and their performance indicators relate to the implementation and running of the conservation management work at Mt Cass as required by the resource consent conditions, but do not relate specifically to biodiversity outcomes which are covered by the second set of goals.

Goal 1: Establishment of a Statutory Liaison Protocol with DOC that enables MCWF to meet with DOC at least annually to review the annual reports and work plans that arise from the Mt Cass EMP (Conditions 91k, 156-158).

Explanation: It is proposed that this goal is implemented by forming a small group with representatives from MCWF, DOC and the HDC peer reviewer (Statutory Liaison Group), with the following terms of reference:

- To review and comment on the work undertaken in implementing the Mt Cass EMP over the preceding year, including the results of monitoring.
- To review and comment on the work plan for the following year.
- Where disagreements arise between DOC and MCWF over implementation of the EMP the HDC Manager Environmental Services shall be asked to mediate, in order to resolve the dispute. In the first instance it is expected that this responsibility will be delegated to the HDC Peer Reviewer.
- To refer both the report (and monitoring results) and the next years work plan to the HDC.

Condition 67 of the resource consent states that annual reporting to HDC should be undertaken by the anniversary of the commencement of the resource consent (7 February). It is proposed here that 31 August is used for this reporting so that the results of management

work over the preceding growing season can be reported on in full. The Statutory Liaison Group will therefore need to meet prior to this date each year, most likely at the end of July.

Performance Indicators:

(P1.1) The Statutory Liaison Group meets at least once each year to review and comment on the conservation management achievements and proposed work as per its terms of reference.

Goal 2: A GIS system coupled with appropriate databases is used to manage all information relating to implementation of the Mt Cass Environmental Management Plan.

Explanation: Accurate geo-referenced information is essential to the successful management of native biodiversity at Mt Cass. Such information can be used to ensure that all management actions are carefully tracked (e.g. monitoring sites or weed eradication locations), and that the results of management interventions can be reliably reported.

Performance indicators:

(P2.1) A GIS with associated databases has been established with appropriate documentation and is updated on a regular basis to assist management and enable annual reporting.

Goal 3: The ecological integrity of the Mt Cass Conservation Management Area has been secured.

Explanation: At present the area is heavily grazed by cattle and sheep, which are having a significant adverse impact on ecosystem condition especially through hindering forest regeneration. Recent observation of the effects of livestock grazing includes breaking of branches; removal of regenerating seedlings; reduced vegetation cover at forest edges, and; consequential incursion of pasture grasses.

However, not all domestic grazing is necessarily 'bad' as stock, especially sheep may also be reducing grass competition with some Threatened and Uncommon plant species (e.g. limestone wheatgrass). Removal of cattle and controlled grazing of sheep is a requirement of the resource consent (Condition 86a).

Any new fencing constructed within the nominated "Exclusion Zones" will be constructed in a manner that accords with Condition 14b and any fences constructed along the northern escarpment will comply with Condition 103.

Performance indicators:

(P3.1) All fencing around and within the Mt Cass Conservation Management Area has been constructed or maintained to a standard that enables effective control of domestic and feral animals within the area including:

- *The boundary of the Mt Cass Conservation Management Area has been securely deer and rabbit fenced.*
- *Internal fences are maintained to a standard that permits effective control of sheep within the area as required for management purposes.*

- *Fence construction has met the requirements of Conditions 14b and 103 and all new fence alignments have been walked by the fencer and a suitably qualified representative of MCWF, prior to construction, with the aim of minimising any negative effects on limestone features and native vegetation.*

(P3.2) Cattle have been removed from the entire Mt Cass Conservation Management Area and if they do enter the area, they have been quickly and efficiently removed and the reasons for their ingress (e.g. damaged fence) have been remedied (Condition 91aiii).

(P3.3) A research programme, with appropriate management targets and monitoring, has been developed by MCWF, in consultation with DOC, that assesses the effect of different levels of domestic stock grazing on forest regeneration, forest edge ecotones, the survival of limestone wheatgrass and exposed rock microhabitats (e.g. solution basins and turf communities), and has been implemented (Condition 89b).

Goal 4: An animal pest control programme is established.

Explanation: Animal pests represent a major threat to native biodiversity at Mt Cass. Herbivores can significantly affect the growth of natural regeneration and restoration plantings while predators have devastating impacts on native fauna (birds, lizards and invertebrates). Deer, goats, pigs, rabbits and hares will be eliminated from within the deer/rabbit fence and possums, mustelids, rats, hedgehogs, cats and mice will be controlled to levels that are considered not to have an adverse effect on native biodiversity (refer to Section 6.4 Animal pest abundances for pest target levels).

Performance indicators:

(P4.1) An animal pest control programme, with appropriate biodiversity outcome monitoring, has been implemented.

Goal 5: A plant pest control programme is established.

Explanation: Plant pests threaten the viability of existing forest, shrubland and open communities, especially through competition. The Mt Cass site is currently largely free of plant pests apart from pasture species.

Performance indicators:

(P5.1) A plant pest control programme, with regular surveillance surveys for new records, has been implemented.

(P5.2) A nassella tussock control programme is undertaken each year through the Mt Cass Conservation Management Area.

(P5.3) A buffer zone around the wind farm site has been identified and landowners within the zone have been approached to encourage control of ecologically important weed species on the land they manage.

Goal 6: A restoration planting programme has been successfully established.

Explanation: The primary objective of restoration in the Mt Cass Conservation Management Area is to enhance connectivity between existing native forest and shrubland remnants and to enhance locally uncommon species through the restoration of at least 1 ha of land that

currently supports pasture, supplemented with up to 6 ha of further restoration, depending on natural forest expansion (regeneration) rates. Regeneration rates will be assessed at three-yearly intervals. Refer to Section Active Restoration for further information.

Performance indicators:

(P6.1) Areas considered appropriate for potential restoration planting have been identified and mapped with an accompanying approved species list. These areas will be predominantly pasture areas that avoid impacting on existing ecological values.

(P6.2) A plant restoration programme, using eco-sourced plants[5], has commenced including propagation, site preparation, planting, appropriate post-planting maintenance, and with outcome monitoring.

(P6.3) Plant propagation procedures include appropriate controls on pest animals, plants and diseases to avoid importing any new threats to the site.

Goal 7: A biodiversity monitoring programme has been established that enables the success of the management programme to be quantified.

Explanation: Monitoring is an integral part of conservation management as it allows the success of the methods used to be assessed, and modified as appropriate, and it provides a means to report on this success to the various groups with an interest in the project. Monitoring, however, needs to be carefully targeted to ensure that it can supply meaningful information that informs management without being an unreasonable cost.

Performance indicators:

(P7.1) A monitoring programme, focusing on both degrading factors (animal pests) and native biodiversity, has been established and all base line monitoring completed and re-measurements undertaken as appropriate.

(P7.2) The monitoring programme includes assessment of the condition of the eight biodiversity attributes used in the biodiversity offset model (canopy cover, understorey cover, ground cover, falcon abundance, kereru and bellbird abundance, small bird abundance, Waitaha gecko abundance, limestone wheatgrass abundance).

(P7.3) Monitoring results, including raw data, are reported to the Mt Cass Statutory Liaison Group in time for the annual environmental report to the HDC each year.

3.3.2 Outcome Goals

This second set of goals and their performance indicators focus on the expected outcomes of the conservation management work being undertaken both across the Mt Cass wind farm site generally and within the Mt Cass Conservation Management Area specifically. Some of these goals relate directly to the expected biodiversity outcomes that have been built into the biodiversity offset calculator used to establish the quantum of the Mt Cass mitigation package.

[5] Eco-sourced plants are plants that have been sourced from the Mt Cass site or from adjacent sites (e.g. Dovedale Farm or Tiromoana Bush).

Goal 8: High priority animal pests are controlled to levels that do not threaten native biodiversity values of the Mt Cass Conservation Management Area.

Explanation: Animal pests are widely regarded as the key factor limiting the abundance and distribution of a wide range of native plant and animal species, including many of those considered of biodiversity significance at Mt Cass. It is proposed that the animal pest control performance indicators are regularly reviewed.

Performance indicators:

(P8.1) High priority animal pests identified in this management plan have been controlled to levels that do not threaten native biodiversity as defined in Section 6.4 of this EMP.

Goal 9: The Mt Cass Conservation Management Area is kept free of key weeds by following the requirements of Section 5.5. Weed Management Strategy.

Explanation: Woody weeds and some herbaceous weeds potentially threaten biodiversity outcomes for the site either through altering successional trajectories or through establishing into open sites, such as the escarpment, displacing light-demanding native species.

Performance indicators:

(P9.1) No plants of Himalayan honeysuckle, hawthorn, cherry plum, box thorn, European broom, gorse, wilding conifers, wild thyme, barberry, elderberry, wild rose (or any other woody species deemed to threaten biodiversity values) are known to be alive within the Mt Cass Conservation Management Area, with any plants found eliminated within 3 months of their first record.

(P9.2) No plants of old man's beard, (or any other climbing species deemed to threaten biodiversity values) are known to be alive within the Mt Cass Conservation Management Area, with any plants found eliminated within 3 months of their first record.

(P9.3) Plants of herbaceous weeds such as spur valerian, burdock, wallflower, stonecrop or pigs ear (or any other herbaceous species deemed to threaten biodiversity values) are controlled to levels that no longer threaten those values.

Goal 10: Restoration of native plants covering an area of at least 1 ha are growing vigorously.

Explanation: This goal sees the area restored amounting to at least 1 ha allowing for a two-year lag for seed collection and plant propagation. A degree of mortality is normal in restoration plantings and can occur for a range of reasons. This goal aims to specify a minimum survivorship rate for restoration plantings, with replanting used should survival drop below this.

Performance indicators:

(P10.1) A minimum of 1 ha has been planted by the end of three years.

(P10.2) Plant survival is >75% after two years, with replanting being undertaken where survival is <75% after two years.

Goal 11: Reptile populations are maintained at the same or greater abundance than those present prior to wind farm development.

Explanation: Two reptile species are known to be present at Mt Cass, Waitaha gecko, and southern grass skink, and introduced mammals threaten their abundance. Reptiles have been identified as a key biodiversity attribute in the resource consent (Conditions 77-79) and this goal specifically seeks to ensure their ongoing survival at the site.

Performance indicators:

(P11.1) The abundance of Waitaha gecko and southern grass skink is the same or greater than that prior to wind farm development.

Goal 12: Biodiversity attributes identified in the biodiversity offset package have not deteriorated in condition relative to their baseline condition as a result of the management actions described in this plan[6].

Explanation: The ultimate measure of management success is an improvement in the condition of the biodiversity attributes identified in the biodiversity offset proposal. These attributes are:

- Canopy cover
- Understorey cover
- Ground cover
- Falcon
- Kereru and bellbird
- Fantail, greywarbler, brown creepers
- Waitaha gecko
- Limestone wheatgrass

The offset proposal outlines likely trajectories for the improvement in these attributes over a 50-year time-period. However, the course of improvement in attribute condition is unlikely to be linear and will most likely vary between different attributes. Furthermore, it may take 2-5 years for the benefits of initial animal pest control to have flow-on effects for native biodiversity. For these reasons no specific biodiversity targets have been identified for the first five-year management period. Details on the methods that will be used to assess these targets are provided in the monitoring section.

Performance indicators:

(P12.1) The condition of the eight biodiversity attributes used in the biodiversity offset model have not deteriorated at the end of five-years[7] within the Mt Cass Conservation Management Area relative to the condition of these attributes at comparable sites that are not subject to the management actions being implemented through this plan.

[6] Note that this goal incorporates the objectives from avifauna management (Condition 68b).
[7] Note that this is a longer time frame than the three-year period required for the first review of this management plan.

4 Opportunities and Constraints

This section outlines both the opportunities that the Mt Cass site presents for conservation management, and the factors that are likely to limit the success in achieving the management goals, and ultimately the long-term vision for the site. A clear recognition of both the opportunities and constraints is important to ensure that management is appropriately focused for the conditions that occur at this site.

4.1 Opportunities

The first set of opportunities for conservation management provided by Mt Cass relate to the physical environment.

- The location of Mt Cass on a high ridge close to the east coast ensures that it receives higher rainfall (due to moist SE-NE airflows) than adjacent sites in the Waipara Basin, while its relatively high elevation (300-500 m) ensures that evapotranspiration demands are not as great as at lower altitudes.
- The relatively remote location of the site, especially from public roads, means that the probability of deliberate fire is low. Fire is a major threat to native vegetation, especially regenerating vegetation, in dry eastern areas of New Zealand, and the potential for fire is likely to increase with climate change.
- The presence of extensive remnants of native forest along the Mt Cass ridgeline means that the probability of forest species colonising grassland and restoration sites is high.

The second set of opportunities relate to the socio-economic environment in which Mt Cass is located.

- The establishment of the wind farm provides the economic certainty (an ongoing income stream) for native biodiversity conservation at a site where this is unlikely to otherwise occur.
- Mt Cass's location close to Christchurch (approximately one hour's drive) means that it is possible to implement an effective conservation management programme with the opportunity for input from individual researchers from a range of institutions (universities, Crown Research Institutes, local and central government).
- The presence of the wind farm will enable easy access through the site because of the creation of an all-weather road, thus facilitating conservation management work in what is otherwise a difficult site to access (especially in winter).
- The inclusion of conservation management within the resource consent for the Mt Cass wind farm provides a guarantee that the management work outlined in this plan will be implemented.

4.2 Constraints

Notwithstanding these opportunities, a number of factors could potentially constrain the ability to achieve the management goals for the Mt Cass site.

Constraint 1: Climate is likely to limit natural regeneration and restoration through low summer soil moisture availability, frost and high wind speeds. Soil moisture deficits are common during summer in North Canterbury and in some years can lead to dieback in native vegetation. Restoration plantings and natural regeneration into grassland are particularly vulnerable to soil moisture deficits, especially during the initial stages of establishment. Soil moisture levels are strongly affected by the present vegetation. In particular, soils under grass swards are very dry because the dense grass root mat quickly takes up any water that reaches the ground. However, the higher altitude location of this site coupled with the common occurrence of a cloud cap with associated 'fog drip' may reduce the impacts of summer soil moisture deficits. Strong winds and winter frost may also limit the success of both restoration plantings and natural regeneration.

Response: While the impact of climate on natural regeneration cannot be mitigated, impacts on restoration plantings can. In this case, the primary response to dealing with soil moisture deficits, strong winds and frost is to use plant species adapted to local conditions in plantings, including sourcing all plant material locally. In addition, combi-guards and mulch can be used to reduce soil moisture loss.

Constraint 2: Because adjacent land uses include pastoral farming and forestry, weed spraying in adjacent areas has the potential to damage natural regeneration and restoration plantings if drift occurs[8]. A major population of the Nationally Endangered McCaskill's hebe near Weka Pass, a species that is also present at Mt Cass, was inadvertently killed during a routine weed control operation there.

Response: Liaising with adjacent landowners and Environment Canterbury about the threat of spray-drift to existing forest and shrubland remnants, escarpment communities and restoration areas.

Constraint 3: Fire is an ever-present threat to any native vegetation in the eastern South Island because of the occurrence of rank grass swards and warm dry summer conditions. At the Mt Cass site this risk is heightened to some degree by the proposed presence of a public walking track and the possibility of fire being generated by wind farm infrastructure (e.g. wind turbines, substation, power lines). Fire can also spread from any burn-offs occurring on adjacent land. Climate change modelling suggests that the number of fire weather days is likely to increase by up to one third over the next couple of decades.

Response: The threat of fire is addressed through the inclusion of fire management strategies in this plan including the presence of a 30,000-litre water source and a vehicle capable of carrying at least 200 litres of water on site, and through liaison with adjacent landowners.

[8] Mt Cass Station which surrounds the western half of the wind farm is a certified organic operation and does not use herbicides.

Constraint 4: Grazing by domestic stock (sheep and cattle) is presently a major limitation to natural regeneration, with most areas of remnant forest and shrubland having severely grazed understoreys. Stock damage to forest edges may have contributed to the decline in the Nationally Endangered limestone wheatgrass numbers, reported from the 2019 survey. In addition, domestic stock can quickly destroy young restoration plantings if they gain access to these. However, some sheep grazing might be required to sustain the limestone wheatgrass in order to reduce competition from exotic pasture grasses and associated weeds.

Response: Cattle will be removed from the Mt Cass Conservation Management Area when this area is covenanted[9] and a deer fence erected to ensure they do not gain entry in the future. A controlled sheep grazing experiment will be established to assess their impact on both forest/shrubland regeneration and the viability of the limestone wheatgrass population. Should sheep be found in restoration planting areas they will be quickly removed.

Constraint 5: One of the major factors likely to limit conservation management in New Zealand ecosystems is browsing and predation by introduced animals, especially possums, ungulates (deer and goats), lagomorphs (rabbits and hares), mustelids (stoats, ferrets and weasels), hedgehogs, cats and rodents (rats and mice). Pigs are also present in the wider area and can have a substantial impact on ecological values. Browsing reduces viability and growth rates of plants, especially young ones, while the impact of predation on invertebrate, reptile and bird species influences restoration success as these species play key roles in ecosystem processes such as pollination, seed dispersal and nutrient cycling. The escarpment community, while largely unaffected by domestic stock, is particularly vulnerable to goats.

Response: A sustained, ongoing, animal pest control programme will be undertaken within the Mt Cass Conservation Management Area, including the use of a deer/rabbit fence to exclude ungulates, pigs, goats, rabbits and hares.

Constraint 6: Introduced plant species also have the potential to limit the success of conservation management. Invasive woody species already present, or present in adjacent areas (e.g. hawthorn, cherry plum, box thorn, European broom, gorse, wilding conifers, wild thyme, Himalayan honeysuckle and old man's beard), have the potential to invade substantial areas of the Mt Cass Conservation Management Area, as do a number of herbaceous weeds (e.g. spur valerian, burdock and pigs ear). In addition, herbaceous plants such as grasses, clover and thistles can impact on restoration plantings.

Response: Regular surveys and control operations will be undertaken for identified problem woody weeds with the aim of eradicating those species identified as a management priority, while weed control will be an integral part of restoration plantings.

Constraint 7: Several studies have commented on the importance of using planting stock of local genetic origin in restoration projects because of concerns about local adaptation and maintenance of genetic integrity of existing plant populations. Planting of non-local material may result in loss of local adaptations (e.g. to particular environmental conditions) and

[9] Condition 80 requires that the legally binding covenant is approved no later than 3-months after the wind farm is commissioned.

eventually could lead to a loss of overall genetic variation within particular species. It is therefore prudent to use plant material of local origin as local plants will be better adapted to local conditions than non-local plants (e.g. resistance to cold temperatures) and as a safe-guard for maintaining local genetic diversity, but making sure that planting includes a diverse genetic base.

Response: To ensure that plants are adapted to local environmental conditions and to minimise the loss of genetic variability, locally sourced planting material will be used for the restoration plantings (sourced from Mt Cass or adjacent sites only).

Constraint 8: The presence of the operational wind farm has the potential to result in mortality of birds through turbine strike, including Threatened and At Risk species, especially as bird numbers increase as a result of the biodiversity enhancement work that this plan describes.

Response: The resource consent conditions (especially Conditions 72, 74 and 76) describe the approach that will be taken should this situation occur, including provision of additional mitigation if such mortality results in a net negative impact on local populations.

Constraint 9: The success of the Mt Cass Conservation Management Area project will not be realised for many years and there is therefore potential uncertainty over the long-term security of the site beyond the time frame of this management plan.

Response: The Mt Cass Conservation Management Area will be covenanted (Condition 80) to ensure that the tenure of the site as a conservation area is secured in perpetuity, while a bond will be established to guarantee long-term funding of conservation management work (Condition 184).

Constraint 10: As a high profile site because of the presence of the wind farm, it is likely that the wider public will have a strong interest in the management of the Mt Cass Conservation Management Area. This interest can be positive through people supporting the management values outlined in this plan, but can also be a constraint when people desire different outcomes for the site.

Response: MCWF will be proactive in how it lets the public know about the management work that is being undertaken on the property and in involving the local community in this management. In addition, appropriate public access will be provided.

5 Management Activities

This section outlines the management actions that will be undertaken at Mt Cass in order to achieve the goals for the Mt Cass project. Monitoring is covered separately in Section 6. The management actions described in this plan occur over two time intervals: those that will occur prior to the commissioning of the wind farm (i.e., before and during construction) and those that will occur once the wind farm has been commissioned. Both sets of management actions are described here.

5.1 Land Tenure

Ensuring the long-term security of the Mt Cass Conservation Management Area is essential to the success of this project and is a requirement of the resource consent. Without a guarantee of long-term site security there is no assurance to stakeholders that the management actions that will be undertaken under this plan will contribute to regional conservation objectives; a change in site ownership could quickly lead to a reversal of the positive management actions implemented here. While tenure provides no guarantee that appropriate management will occur, ensuring that the Mt Cass Conservation Management Area does enjoy an appropriate protective tenure in perpetuity is an important component of its long-term management.

A covenant in a form approved by HDC will be registered against the title of the Mt Cass Conservation Management Area on land that is owned by MainPower NZ Ltd. The final boundaries of this covenant have yet to be surveyed but will comprise approximately 127 ha of land and will be defined by the deer fence referred to in the next section (Figure 4). Condition 80 requires that this covenant be registered no later than three months after the wind farm is commissioned, although the preparatory work required to establish this covenant will need to be undertaken prior to this. Covenanting is therefore included as a pre-commissioning action.

5.1.1 Management Actions Pre-Commissioning

A5.1 Establish an appropriate covenant (e.g. under the Reserves Act 1977) over the Mt Cass Conservation Management Area in a form approved by Hurunui District Council (this needs to be completed within 3 months of commissioning).

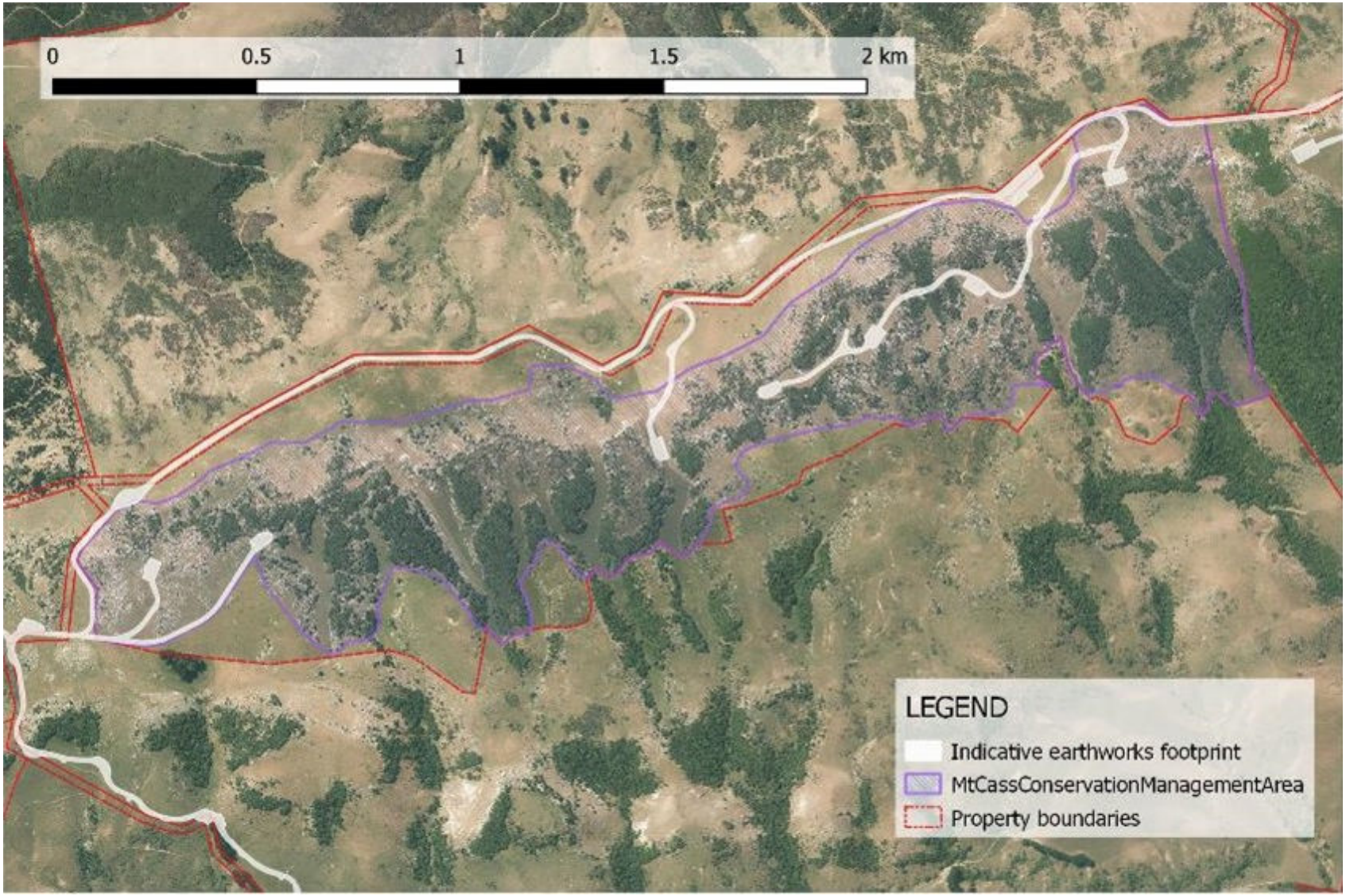

Figure 4: Proposed Mt Cass Conservation Management Area covenant with Wind Farm Infrastructure Footprint

5.2 Fencing

Fencing is essential to both secure the Mt Cass Conservation Management Area and to allow for implementation of the controlled sheep grazing trials (described below). The resource consent requires deer fencing of the boundary; the final location of this fence will need to be based on practical considerations (i.e. ease of fencing and practicality of alignment with regard to wind farm layout) and will need to avoid damage to indigenous vegetation (hand cutting is required within Exclusion Zones under Condition 14b). All new fence alignments are to be walked by the fencer and a suitably qualified representative of MCWF, prior to construction, to ensure effects are minimised while constructability and functionality are maintained.

The minimum area within the fence must be no less than 127 ha. This fence needs to be established before the covenant is registered, as several other management actions are dependent on it.

5.2.1 Management Actions Pre-Commissioning

A5.2 Securely deer fence the boundary of the Mt Cass Conservation Management Area (including rabbit netting), making sure that access gates (e.g. where turbines are located within the conservation management area and for stock management purposes) are designed to minimise the chances that unwanted animals could gain access.

A5.3 Ensure that all internal fences are of a standard that allows containment of sheep and erect additional internal fencing if required for the controlled sheep grazing trials.

5.2.2 Management Actions Years 1-5

A5.4 Undertake regular inspections of the boundary fence and internal fences to ensure that they are intact and providing the degree of security from livestock and feral animals, as intended.

5.3 Livestock management

Once the conservation management area boundary fence has been completed, all cattle will be removed and, should they re-enter the area, they will be quickly removed and the reasons for their entry (e.g. damaged fence) immediately fixed. A sheep grazing trial will then be implemented to assess the effect of different sheep grazing intensities on forest understorey vegetation, limestone wheatgrass, the abundance of shrub and ground layer species on open limestone pavement, and natural regeneration processes in shrubland and open limestone habitats (Condition 89b) as a basis for making decisions on the long-term role of sheep grazing in this system. The reason for this trial is that Molloy (1994) has strongly implicated grazing animals as having a role in limiting aggressive naturalized grasses from smothering limestone wheatgrass.

It is proposed to establish three grazing levels (100% grazing, 50% grazing, no-grazing), utilizing existing and new fencing allowing for two blocks each of the 100% and 50% grazing treatments, while exclosures will be used to implement the no-grazing treatment. The 100% grazing level will be defined by either the current stocking rate that the lessee is using over the area proposed for inclusion within the Mt Cass Conservation Management Area (including both

cattle and sheep stock units) or the maximum stocking rate as defined by the Conservation Covenant at the western end of the Mt Cass Ridge (which is 6.2 stock units per ha per year). The actual value used will be determined after discussions with the lessee and DOC.

Within each block, replicate monitoring points will be established to measure:

- Forest understorey vegetation (seedling and ground vegetation cover abundance);
- Limestone wheatgrass (plant/clump densities and height);
- Abundance of shrub and ground layer species on open limestone pavement (cover abundance); and
- Natural regeneration processes in shrubland and open limestone habitats (shrub cover abundance).
- Cover abundance within eco-tones

A full experimental design will be developed, prior to implementing the trial, for approval by the HDC peer-reviewer and DOC (as per Condition 89). The response of the vegetation will then be assessed annually; with a review of the monitoring frequency after five years. Further details on measurements are given in Section 6 of this plan.

5.3.1 Management Actions Years 1-5

A5.5 Undertake base line monitoring, implement sheep grazing trial and undertake annual response monitoring.

5.4 Animal Pest Management

A number of introduced animal pests including deer, goats, pigs, brushtail possums, stoats, ferrets, weasels, rats, mice, rabbits, hares, cats and hedgehogs are likely to be present or border upon the Mt Cass site and potentially or actually threaten native biodiversity. This section outlines the objectives for animal pest management and the programme that will be used to achieve these objectives. The objectives for animal pest management are to:

- Eliminate large mammalian herbivores as well as rabbits and hares from within Mt Cass Conservation Management Area;
- Reduce the impact of possums on the regeneration of the existing remnant forest and shrubland areas as well as on restoration plantings; and
- Reduce the impact of predators (mustelids, rodents, hedgehogs, cats) on recruitment of native fauna (primarily lizards and birds), and in the case of rodents, also on seedling establishment.

The approach to animal pest management is based on a mixture of exclusion and ongoing control. The boundary deer fence with rabbit netting around the Mt Cass Conservation Management Area will exclude deer, goats, pigs, rabbits and hares. An ongoing intensive animal pest control programme will focus on reducing the densities of possums, mustelids, rodents, hedgehogs and cats to levels that do not threaten the recovery of native flora and fauna.

The specific management approach used for eradication or intensive animal pest control (trap/bait station type, trap/bait station density, frequency of servicing etc) will be developed in consultation with the contractor being used to undertake this work but will follow accepted best practice standards (e.g. as defined by DOCs Natural Heritage Management System's Pest Management Tool Box) and the methods used will be kept under regular review through an adaptive management approach. Before animal pest control is implemented, the independent

peer-reviewer will review the proposed methods. All animal pest control work will meet the legislative conditions and requirements set by the relevant Acts and Regulations of Parliament. All pest control operators will be required to have appropriate pesticide licences where required.

The current lessees of the MainPower land that will form the Conservation Management Area have organic certification, which limits the ability to use toxins for animal pest control. However, some organic certifying agencies now list some anti-coagulant rodenticides as "Restricted inputs" which means their use can be applied for by an organic-registered farm on an annual basis. Decisions on the use of toxins (and the type of toxin) will be made at the time that animal pest control commences in consultation with appropriate parties (e.g. the lessee and DOC) and will be adjusted through time depending on biodiversity outcomes through the adaptive management approach.

The following notes outline the approach to be taken to the control of animal pest species as far as can be determined at this stage.

Deer, goats and pigs: Once the deer fence has been installed and all gates secured, the Mt Cass Conservation Management Area will be thoroughly hunted by an appropriately qualified hunter[10] to ensure that no deer or goats are present within the area. Pigs are not presently known at the site.

Rabbits and hares: It appears that rabbit numbers are low within the Mt Cass Conservation Management Area, although hares are more abundant. Exclusion of these species from the Mt Cass Conservation Management Area will initially involve an intensive ground shooting programme once the deer/rabbit fence has been installed and all gates secured. This will be followed by regular (monthly) ground hunting for the first year, and thereafter as required, to remove any residual hares and rabbits from the site. Should this control fail to eliminate rabbits, then the use of a poison such as Pindone, if appropriate, will be investigated. Ground hunting and, where necessary, toxin bait stations will also be used to control rabbits and hares around rehabilitation areas associated with the wind farm throughout the Mt Cass site (outside the Mt Cass CMA).

Brushtail possums: Brushtail possums are present throughout the Mt Cass area and are a direct threat to biodiversity values and also to neighbouring landholders in terms of damage to young pine trees and spread of bovine Tb. Because of previous records of bovine Tb in cattle in the Mt Cass area, possum control has been undertaken in the past which significantly reduced possum numbers, although numbers appear to be increasing again now that this control has ceased. It is intended to control possums for the foreseeable future. This control will involve a mixture of poisoning and trapping as circumstances dictate based on a comprehensive system of toxin bait stations (e.g. using Feratox, if appropriate) and kill traps located across the area. The effectiveness of possum control will be monitored through assessing biodiversity response, although the target for possum numbers is to have <5%[11] RTC within the Mt Cass Conservation Management Area. Should biodiversity monitoring (e.g.

[10] An "appropriately qualified hunter" will have hunting experience and an understanding of the wind farm and working farm environments. Hunters will need to work in accordance with the requirements of the MCWF Operational Health and Safety Plan.

[11] RTC and tracking tunnel index measures have been adopted from discussions at the time of the resource consent hearing in 2011. If subsequent research or technological advances suggest it is appropriate then, alternative detection methods and indices may be used for monitoring pest occupancy rates and relative abundances, and as part of that, the relationship between detection and occupancy will be demonstrated and targets will be scaled for equivalence".

of *Tupeia antarctica* and other possum sensitive plants) indicate that the level of possum control is insufficient to sustain biodiversity values then the possum control operation will be reviewed.

Mustelids and rodents: Mustelids and rats are likely to be present at the Mt Cass site and to be having adverse impacts on native fauna and in the case of rats, on seed germination as well. An intensive control programme involving trapping and poisoning will be undertaken within the Mt Cass Conservation Management Area, which will need to be sustained indefinitely. Control will be based on a systematic layout of kill traps and, if necessary toxin bait stations (e.g. Diphacinone anti-coagulant for rodents, if appropriate), across the site at a density appropriate for the control of these pests and utilising features such as access roads and forest edges. The effectiveness of mustelid and rat control will be monitored through assessing biodiversity response. Should biodiversity monitoring (as undertaken for the biodiversity offset model) indicate that the level of control is insufficient to sustain biodiversity values then the mustelid and rodent control operation will be reviewed. The target is to have <5% tracking tunnel index within the Mt Cass Conservation Management Area for mustelids and <15% for rats. Rats and mustelids will also be controlled more widely at the Mt Cass site through the location of bait stations and/or traps along the roads servicing the wind turbines following best practice in terms of bait station/trap densities.

Mice control is more difficult and the target density has been set at <15% tracking tunnel index in Condition 89a. It is anticipated that the underlying rat control programme will reduce mice numbers, although it is proposed that additional mice control is undertaken within the Mt Cass Conservation Management Area in areas with known high densities of Waitaha gecko.

Other animal pests: Cats and hedgehogs will be controlled using appropriate traps (control targets to be determined) within the Mt Cass Conservation Management Area based on current best management practice for these species.

The approach to animal pest control will be independently reviewed prior to control work starting, and the ongoing efficacy and level of control required to achieve the conditions to the resource consent will be regularly reviewed by an independent reviewer (see under monitoring section).

5.4.1 Management Actions Years 1-5

A5.6 Eradicate any deer and goats from within the Mt Cass Conservation Management Area.
A5.7 Eradicate as best possible all rabbits and hares from within the Mt Cass Conservation Management Area and undertake ongoing control as required.
A5.8 Establish a possum control operation both within the Mt Cass Conservation Management Area and more generally through the Mt Cass wind farm site.
A5.9 Implement active control of mustelids and rodents both within the Mt Cass Conservation Management Area and within specific locations through the Mt Cass wind farm site.
A5.10 Undertake mice-specific control around sites with high Waitaha gecko populations within the Mt Cass Conservation Management Area if and when mouse numbers increase to levels that threaten the lizards.
A5.11 Liaise with adjacent landowners and DOC over animal pest control.

5.5 Weed Management Strategy

Plant pest (weed) species are plants that are growing in places where they are not wanted and can out-compete and displace native species resulting in loss of biodiversity values. However, not all weeds pose the same level of threat, while the practicality of controlling weeds also differs between species. The objective of plant pest management is therefore to maintain the Mt Cass Conservation Management Area and more generally, the Mt Cass wind farm site[12] free of those weed species that pose the highest threats and are amenable to eradication, while managing other weed species to levels that are acceptable in terms of the goals of this management plan.

The goal of this strategy is that there will be no (i.e. eradication) mature (defined as fruiting or seeding) ecologically important weeds, or weeds listed in the RPMP, within the CMA or sites disturbed by MCWF. This is a five-year goal (refer Goal 9).

Three groups of weed species potentially threaten the success of the Mt Cass conservation and restoration project; (i) invasive weeds that establish into and out-compete native vegetation, (ii) pasture grasses and herbs (e.g. thistles and clover) which compete with Threatened herbaceous plants and naturally regenerating woody vegetation, and (iii) nassella tussock which threatens agricultural values on adjacent land.

This weed strategy has been developed to meet Consent Condition 84, detailed as follows:

84. The weed monitoring and control section of the Environmental Management Plan shall include, but not be limited to:

a. The details of a weed control strategy which shall include as a minimum:

i. An inventory of the baseline of weed infestations at the Mt Cass wind farm site including assessment of exotic grasses and herbs that are adversely affecting indigenous ground layer plants; and

ii. Assessment of weeds of ecological importance at the Mt Cass site; and

iii. Detail of methods to be used for weed removal and/or control; and contingency plans for high level infestations resulting from the construction operation.

5.5.1 Baseline Inventory of Weeds

Several weed surveys have been undertaken as part of surveillance surveys by Wai-Ora Landscapes in 2013, 2014, 2015, 2018, 2020, 2021 and 2022. Surveillance surveys included a variety of habitat types, including open grassland, closed canopy forest and shrubland.

In addition, further detailed botanical inventories have been undertaken as part of ecological investigations associated with the consenting process, including assessments from Sarah Flynn; Golder Associates Ltd (Statement of Evidence, 2009 Appendix 4a), and a 2019 rare plant survey undertaken by Alice Shanks; Plants Count Ltd and Ed Wilson; Wai-Ora Landscapes (Shanks 2019a) and the Canterbury Limestone Wheatgrass survey undertaken by Alice Shanks (Shanks 2019b).

[12] The extent of the 'site' in terms of weed monitoring is described in Condition 82 as the Conservation Management Area and other areas subject to physical disturbance by the wind farm.

Those reports include details of plant species, abundance, locations, and threats to native species through competition. General site observations from Tony Payne; RMA Ecology Ltd, during 2019 & 2021 micro-siting and lizard monitoring across the consented site footprint, have also been included.

This baseline information has been compiled to inform the strategies for weed control at the Mt Cass Wind Farm.

A compilation of Wai-ora Landscape weed survey tracks is provided in Figure 5 below.

Weed species and relative abundance, summarised across observers and surveys, is provided in Table 2.

Species	Common Name	Relative Abundance (ACFOR)	Information source
Arctium minus	Burdock	Frequent	Wai-Ora (multiple records). Shanks 2019a. Payne 2019
Berberus glaucocarpa	Barberry	Rare	Wai-ora 2021
Bromus diandrus	Ripgut brome	Common	Payne 2019
Bromus hordeaceus	Soft brome	Common	Payne 2019
Cerastium fontanum	Mouse-ear chickweed	Occasional	Flynn 2009
Clematis vitalba	Old man's beard	Rare	
Crataegus monogyna	Hawthorn	Rare	Wai-Ora (multiple records). Payne 2019
Critesion spp	Barley grass	Frequent	Payne 2019
Cytisus scoparius	Broom	Rare	Wai-Ora (multiple records)
Dactylis glomerata	Cocksfoot	Abundant	Shanks 2019b. Payne 2019
Dryopteris fili-mas	Male fern	Rare	Shanks 2019a
Euonymus japonicus	Spindleberry	Rare	Wai-ora 2021
Festuca rubra var. rubra	Red fescue	Abundant	Shanks 2019a. Payne 2019
Geranium robertianum	Herb robert	Occasional	Flynn 2009. Payne 2019
Holcus lanatus	Yorkshirefog	Common	Shanks 2019b. Payne 2019
Hypochaeris radicata	Cat's ear	Common	Flynn 2009. Payne 2019
Jacobaea vulgaris	Ragwort	Rare	Wai-Ora 2015
Lolium perenne	Perennial ryegrass	Common	Flynn 2009. Payne 2019
Medicago lupulina	Black medic	Unknown	Shanks 2019b
Mycelis muralis	Wall lettuce	Frequent	Flynn 2009
Nassella trichotoma	Nassella tussock	Rare	landowner
Orobanche minor	Broom rape	Occasional	Flynn 2009

Species	Common Name	Relative Abundance (ACFOR)	Information source
Pilosella officinarum	Mouse-ear hawkweed	Common	Flynn 2009. Payne 2019
Pinus spp.	Wilding Pine	Rare	Wai-Ora (multiple records)
Plantago lanceolata	Narrow-leaved plantain	Common	Flynn 2009. Payne 2019
Prunus sp.	Wild cherry	Rare	Shanks 2019a
Rosa rubiginosa	Sweet briar	Rare	Wai-Ora (multiple records)
Rytidosperma penicillatum	Wallaby grass	Unknown	Shanks 2019b
Sambucus nigra	Elderberry	Rare	Wai-Ora (multiple records). Payne 2019.
Sedum acre	Stonecrop	Rare	Payne 2019
Sherardia arvensis	Field madder	Unknown	Shanks 2019b
Solanum nigra	Black nightshade	Rare	Shanks 2019a
Tragopogon porrifolius	Salsify	Rare	Wai-Ora 2015
Trifolium repens	White clover	Common	Flynn 2009
Ulex europaeus	Gorse	Rare	Wai-Ora (multiple records)
Verbascum thapsus	Woolly mullein	Occasional	Flynn 2009. Payne 2019, Wai-ora 2022
Vicia sativa	Vetch	Occasional	Flynn 2009. Payne 2019

Table 2 Mt Cass baseline inventory of weed species; species present and relative abundance (ACFOR[13] index).

[13] ACFOR; Abundant, Common, Frequent, Occasional, Rare

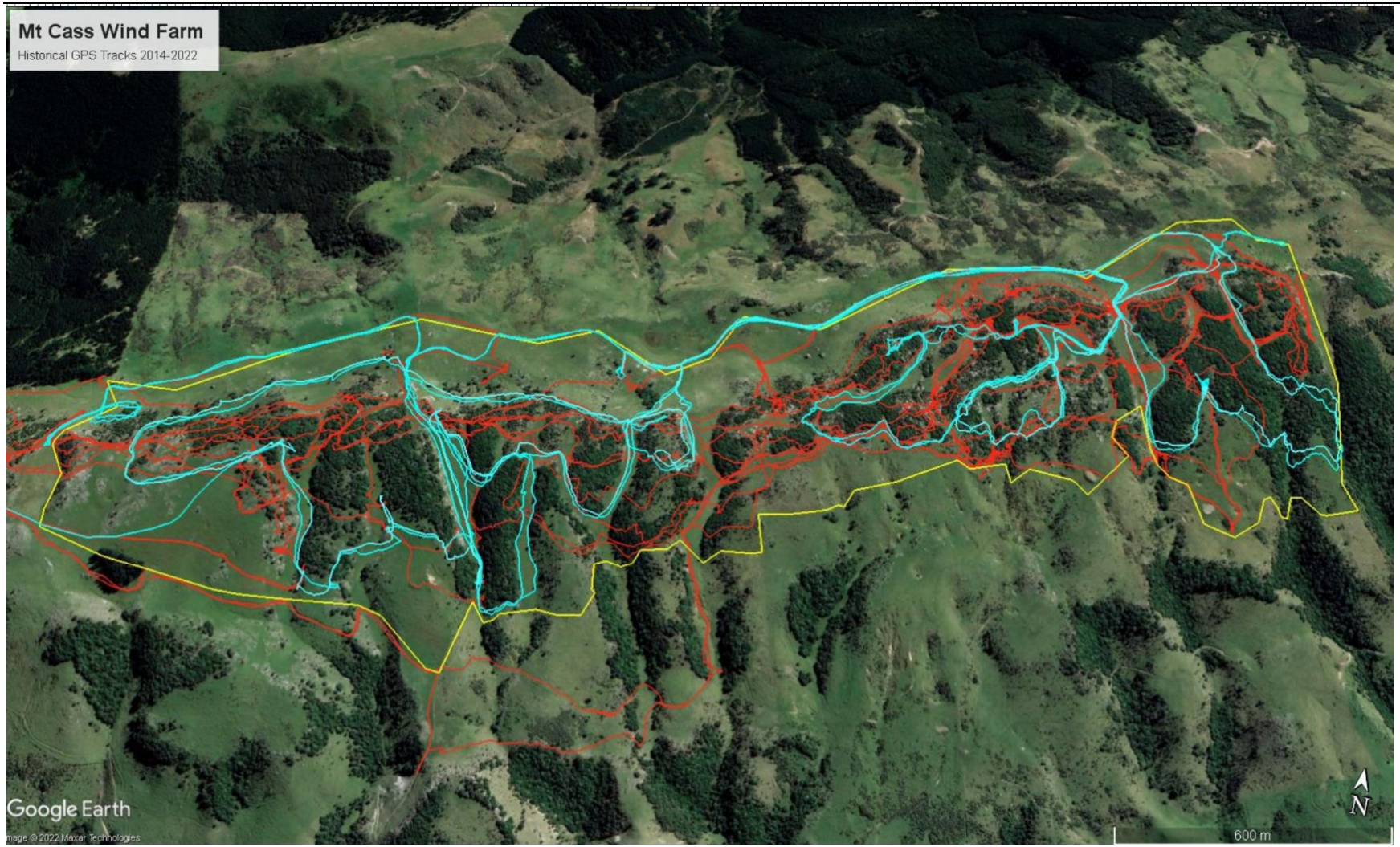

Figure 5: Weed observations compiled from annual Wai-Ora weed surveys (red tracks 2014-2021, blue tracks 2022, yellow line MainPower boundary)

Ecologically important weeds (Condition 84.a.ii): These are weed species that are known to cause problems in similar environments and therefore pose a threat to biodiversity values at this site. Ecologically important invasive weed species known to be present at the Mt Cass site or occurring in the general vicinity include wilding conifers, European broom, gorse, hawthorn, barberry, wild rose, elderberry, cherry plum, nasella tussock and old-man's beard (Condition 91d).

In addition, a number of other species not necessarily present on the site or even in the general area also have the potential to threaten biodiversity values at the Mt Cass site and include box thorn, wild thyme, Himalayan honeysuckle, spur valerian, burdock, stonecrop, wallflower and pigs ear. There are also a number of climbing weeds that are declared pests in the Environment Canterbury Regional Pest Management Plan (2018-2038) (RPMP) which could be introduced to the site including banana passionfruit, moth plant and cathedral bells.

Wind farm development and ongoing management represents a real risk for weed spread as seeds are readily dispersed on the vehicles entering the site, or by wind and birds, and can establish and grow quickly on disturbed sites associated with wind farm development (e.g. road cuts).

5.5.2 Weed Control Methods

All plant pest control will meet regional and national legislative requirements, especially any obligations imposed through the Environment Canterbury RPMP.

Contractors will be required to have appropriate certification for handling any chemicals involved. The following notes summarise the broad approach that will be taken to the management of weed species. Details of the specific methods to be used for plant pest control will be developed with the contractors undertaking the work and will be based on current best practice guidelines and will be appropriate for the scale of infestation.

At a minimum, surveillance and weed control will be undertaken biannually in spring and autumn within the CMA, focussing on forest edges, shrubland areas, sites close to wind farm infrastructure and sites from which weeds have previously been recorded, with less frequent surveillance of any areas that are continually found to be weed-free. For the wider Mt Cass site, weeds will be assessed once each year by traversing all of the wind farm roads and turbine sites and searching for any ecologically important weeds that might be present adjacent to these.

Limestone cliff areas that are within the CMA or adjoining sites disturbed by wind farm construction will be surveyed for ecologically important weeds or weeds listed in the RPMP as part of (bi)annual monitoring.

Any vine weeds will be controlled using the most appropriate method for controlling the infestation, typically by cutting and stump pasting, and minimising the use of herbicide sprays.

Pasture grasses and herbs: The growth of pasture and ruderal weeds will be kept in check across the Mt Cass site through the managed grazing regime, but where these might be perceived as a threat to biodiversity values (e.g. in disturbed areas), more intensive control might be undertaken.

Hand weeding of herbs and grasses that threaten two identified limestone wheat grass areas (Figure 6), which will be undertaken annually for a minimum of five years, after which the efficacy of the hand weeding will be assessed, and decision will be made whether to continue with hand weeding in these areas. Hand weeding will be undertaken in the months of January or February when flower heads are present, and only by personnel proficient in identifying limestone wheat grass.

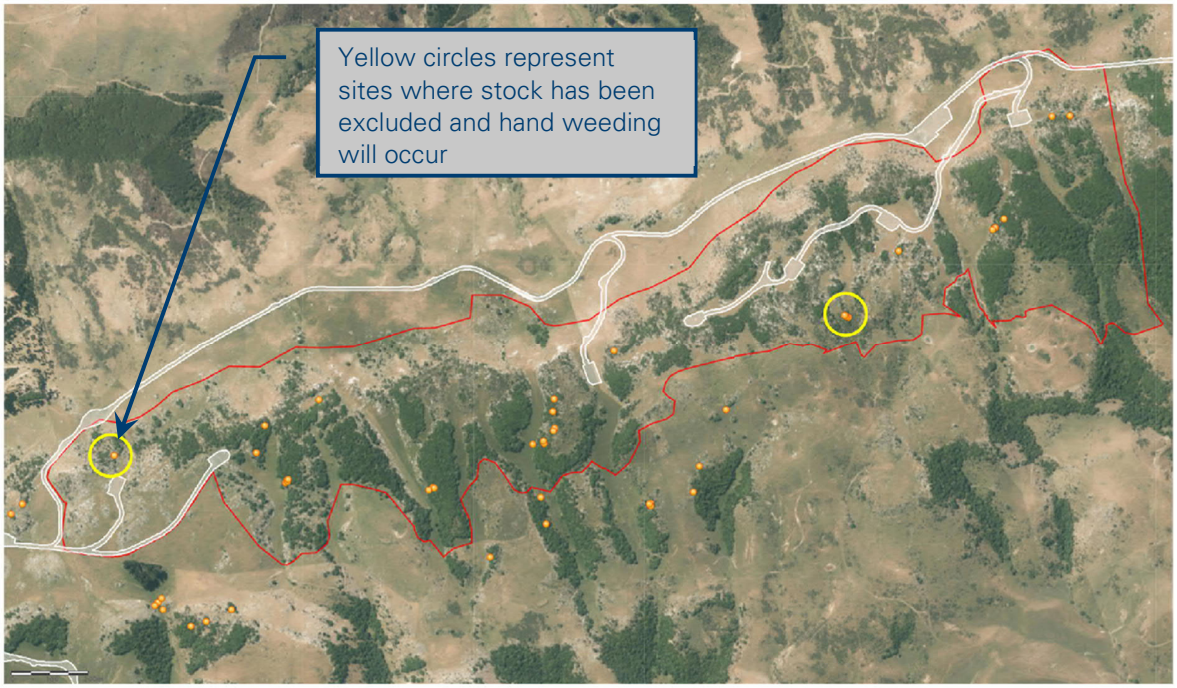

Figure 6: Canterbury Limestone Wheatgrass confirmed locations (orange dots; from Shanks 2019)

Nassella tussock

A nassella tussock control programme using experienced contractors will be undertaken annually to remove (by grubbing) nassella tussock plants within the Mt Cass Conservation Management Area and on any other land owned by MCWF. Where the wind farm is located on other land, the owners of these properties undertake nassella tussock control on their land. The Mt Cass Conservation Management Area will also be checked for Chilean needle grass (*Nassella neesiana*), which has been recorded from North Canterbury hill country, although not at Mt Cass, and is regarded as a serious threat to farming. If Chilean needle grass is found, the nassella tussock control programme will be extended to include this species.

Mt Cass Station

Mt Cass Station (including the CMA) operates as a certified organic farm, meaning that many common herbicides will not be used on this farm. Any herbicides used on this farm will be 'Certified Organic' for use in organic horticulture or farming. Alternative methods for control will be manual removal of weeds, such as grubbing, and disposing of material appropriately.

5.5.3 Reducing Weed Invasion due to Wind Farm Construction and Operation

Establishment and operation of the wind farm has the potential to result in the dispersal and establishment of weed species on site, including species that are currently not present.

A number of management actions will be implemented to address this including:

- All construction vehicles, machinery and equipment will be properly cleaned of any adhering soil prior to first entering the site (and on any subsequent entries);
- All construction and operational personnel will be briefed on the biodiversity status of the site, the objectives of this EMP and the importance of weed hygiene in maintaining the quality of the site;
- Weed-free sources of aggregate will be used;
- All sites disturbed during wind farm construction will be rehabilitated with vegetation appropriate to the sites location[14] within 12 months of the sites being no longer required for construction (and preferably more rapidly if seasonal conditions permit) in order to establish a vigorous plant growth that will reduce opportunities for weed species to establish;
- Annual monitoring of all areas disturbed by the wind farm will be undertaken to detect and remove any ecologically important weed species that might establish, refer to Section 6.5 for additional information on weed monitoring;
- Removal of any ecologically important weeds will be by hand weeding or spraying (using an appropriate herbicide), but with spraying not being undertaken within 10 m of any Threatened or At Risk plant species which has been identified, unless part of a specific management initiative;
- A suitably experienced ecologist will check all sites where herbicide application is required to ensure that no Threatened or At Risk plant species occur within 10 m of the site;
- Ongoing liaison with adjacent landowners (including DOC) to encourage control of ecologically important weed species on the land they manage.

Contingency Plans

The civil constructor will be responsible for control of any high level weed infestation that may arise as a result of wind farm construction. This will have the benefit of having greater resources to bring to the issue and will motivate the constructor to maintain good weed hygiene. Any weed control for high levels of infestation will still be subject to the same ecological controls as are required for routine weed surveillance.

[14] Refer to section 5.6 "Restoration Planting" for information on appropriate sources for revegetation stock and on ongoing management of planting sites

During the operations phase of the wind farm a 'high level infestation' will be any weed cluster that cannot be controlled by the team undertaking surveillance on the day that it is found. Such sites will be recorded and a follow up visit programmed within three months (if seasonally appropriate) with sufficient resources to control the infestation.

Reporting
All weed surveillance and control work will be reported to MCWF within one month of the work taking place. Reports will include:

- weed locations, species and numbers (with GPS records);
- control methods and comments on efficacy;
- labour inputs.

An annual summary will be prepared with analysis of any increases or decreases of weeds, any new weeds and changes in labour inputs and methods used, and any remedial actions required.

5.5.4 Management Actions Pre-Commissioning

A5.12 Undertake a base-line inventory of weeds across the Mt Cass site, with a focus on weeds of ecological importance (including GPS records of weed sites).
A5.13 Produce a field guide to ecologically important weed species present (Done).
A5.14 Remove all ecologically important invasive weeds from the site.
A5.15 Undertake annual nassella tussock control.
A5.16 Ensure all construction vehicles, equipment and machinery entering the site have been cleaned prior to entry.
A5.17 Use weed-free aggregate sources.
A5.18 Undertake annual weed surveys of disturbed sites and implement weed control as required.

5.5.5 Management Actions Years 1-5

A5.19 Undertake annual surveillance of ecologically important invasive weeds to identify and eliminate any new individuals that establish.
A5.20 Undertake pasture grass and herb control as required.
A5.21 Undertake annual nassella tussock control.
A5.22 Undertake annual weed surveys of disturbed sites and implement weed control as required.

5.6 Active Restoration

Active restoration in the Mt Cass Conservation Management Area will involve restoration plantings aimed at enhancing the area of native woody habitat present and increasing connectivity between the remnant patches involving a minimum of 1 ha within 3 years, with up to 7 ha planted if natural regeneration is limited (Conditions 86c and 91g). Issues covered in this section include the approach to collection and propagation of planting material, site preparation, planting and seeding, and post-planting maintenance.

In addition, several conditions (32i, 57, 60-62) relate to rehabilitation of sites disturbed during construction, although in these cases rehabilitation may well involve pasture grasses or silver tussock rather than native woody species, depending on the site's location. Nevertheless, several of the points made below will also be applicable and generally these rehabilitation plantings will follow best restoration practice appropriate to the target vegetation cover.

5.6.1 Planting Approach

There will be four major uses of restoration plantings:

- As a general tool to increase the area of native woody vegetation, especially enhancing connectivity between existing remnants, through planting a range of relatively fast growing early successional forest species (e.g. kōhūhū, tarata, manatu, houhi, māhoe, ngaio, five finger, broadleaf) appropriate to local site conditions.
- To reintroduce currently locally uncommon species including but not restricted to *Carmichaelia kirkii,* fierce lancewood*, Aciphylla subflabellata*, kahikatea, tōtara, matai and tītoki, if appropriate sites are available.
- To re-establish the escarpment shrubland communities in areas where they have been lost involving planting of a range of shrub and small tree species including *Hebe*, *Coprosma*, *Raukaua*, *Brachyglottis* and *Olearia* should appropriate sites be available.
- Establishing ecologically appropriate plantings around wind farm infrastructure appropriate to site locations (e.g. shrubland on road batters and silver tussock grassland around wind turbine towers). These rehabilitation plantings are discussed further in the Construction Management Plan, although the general approach described below will also be applied.

The general approach to planting involves five steps:

- Plant locally sourced species that are ecologically appropriate to the particular site.
- Plant in late winter/early spring to avoid winter frosts but provide the longest possible time for root systems to develop before summer droughts occur, using combi-guards.
- Before planting, use an appropriate herbicide to kill grass to lessen the competition for water while the seedling establishes. Spot spraying is likely to be adequate for this purpose.
- Undertake release weeding to clear encroaching grass/herbs after planting if required. Once root systems have developed (over the first two to three growing seasons) plants should readily survive grass and herb competition.
- Aftercare maintenance for ecologically important weeds will be undertaken biannually in all planted areas for the first 5 years following planting, or until canopy closure is achieved.

More detail on planting and maintenance is provided in the Ecological Restoration Planting Plan (approved version of 28 June 2021 or subsequent updates). Details of planting, monitoring, maintenance and reporting for locally uncommon plant species, such as *Aciphylla subflabellata* and *Carmichaelia kirkii*, that are not already included in the Ecological Restoration Planting Plan will be included in the Construction Management Plan.

5.6.2 Collection and Propagation of Planting Material

Selection of species for restoration will be based on the current ecological patterns in the forest and shrubland remnants in the Mt Cass Conservation Management Area including the initial restoration trials established in 2009. Species choice will focus on those species that are adapted to local conditions and that will grow rapidly and provide suitable conditions for subsequent native regeneration (Table 3).

Overall species choice represents a balance between those species that will grow best under the prevailing environmental conditions, are likely to contribute most to meeting the management goals, and be most attractive to seed dispersing birds. At a local site level, species choice needs to consider the main limitations to plant growth (moisture, frost, exposure, infertility and competition) associated with particular microsites. This can be guided by the success of restoration plantings as they are established as well as the general ecology of species in remnant forest in the Mt Cass Conservation Management Area. However, species choice needs to be regularly reviewed based on the performance of plantings, especially during dry years, and the availability of propagated material.

Sources of plant stock for propagation to be grown in the Mt Cass Conservation Management Area are seeds from wild plants growing in the same area, including from as many plants of each species as possible to insure wide genetic diversity in plantings (Norton et al. 2018). In some cases, plant material may be sourced from other sites in the general area (e.g. Tiromoana Bush or on Dovedale Station). The contracted plant propagator will collect all material for propagation.

Species	Common Name	Southern slopes	Exposed ridge crest	Infrastructure
Aciphylla aff. *ferox*	Speargrass			low
Brachyglottis monroi	Monro's Daisy		low	low
Griselinia littoralis	Broadleaf	moderate		
Coprosma crassifolia			low	moderate
Coprosma propinqua	Mingimingi		high	low
Coprosma virescens	Mikimiki	low	moderate	moderate
Corokia cotoneaster	Korokio		low	low
Pseudopanax ferox	Fierce lancewood		low	low
Pseudopanax arboreus	Five-finger	moderate		
Aciphylla subflabellata	Grassland spaniard			low
Coprosma robusta	Karamū	moderate		
Pittosporum tenuifolium	Kōhūhū	moderate	moderate	moderate
Veronica salicifolia	Koromiko	low	low	low
Sophora microphylla	Kōwhai	moderate		
Olearia avicennifolia	Akeake	moderate	moderate	moderate
Pittosporum eugenoides	Tarata	moderate		
Plagianthus regius	Mānatu	moderate		
Podocarpu totara	Totara	moderate		
Melicytus ramiflorus	Māhoe	moderate		
Hoheria angustifolia	Houhi	moderate		
Myoporum laetum	Ngaio	moderate		

Dodonaea viscosa	Akeake	low	low	
Phormium cookianum subsp. *cookianum*	Whaririki		low	low
Sophora microphylla	kōwhai	moderate	low	
Sophora prostrata	Prostrate kōwhai		low	low
Raukaua anomalus			moderate	low
Poa cita	Silver tussock			high

Table 3: List of (potential) species for restoration plantings and indicative abundances in plantings.

5.6.2.1 Management Actions Pre-Commissioning

A5.23 Identify and map on GIS the areas that will be used for restoration plantings over the life of this management plan (Included in the Ecological Restoration Planting Plan, 2021)

A5.24 Let contract to undertake plant propagation.

5.6.2.2 Management Actions Years 1-5

A5.25 Ensure that all plant material used for restoration is locally sourced.

5.6.3 Site Preparation and Planting

Pasture grasses (browntop, chewings fescue, cocksfoot etc) and herbs such as thistles and clovers are efficient competitors for water, as well as nutrients and light, and can restrict the growth of new plantings through physical smothering. Control of these species will focus on removing them prior to the establishment of restoration plantings (through spraying) and restricting their re-establishment and growth after planting, until plantings are tall enough to suppress them, through ongoing spraying. Planting methods will follow the standard restoration approach in Canterbury, which involves plantings spaced at 1.2m for smaller species and 1.5 m for larger species intervals with fertiliser and water-retention crystals (or similar) added prior to planting.

The underlying approach to restoration taken here is through appropriate site preparation and use of good quality plants, post planting management should be kept to a minimum except for follow-up weed control during the first 2-3 years after planting. The intention is that, once established, the restored areas should require minimal direct human intervention unless something unexpected occurs (e.g. an extreme weather event). The timing of restoration activities during the year is largely dictated by climatic conditions and the plant growth patterns. The annual work cycle is focussed on late winter/spring planting with the aim of gaining full benefit from the period when soil moisture is likely to be at a peak. However, plants must also be suitably hardened off prior to planting in order to withstand conditions at the time of planting. Sites protected from severe frost may be planted in late July, but in more frost-sensitive sites planting should be delayed until August or September.

5.6.3.1 Management Actions Pre-Commissioning

A5.26 Rehabilitate all areas disturbed during construction using techniques appropriate to the desired vegetation cover for the site and where using native species, involving the guidelines discussed above.

5.6.3.2 Management Actions Years 1-5

A5.27 All sites will be appropriately prepared prior to planting/seeding.
A5.28 At least 1 ha of planting will be undertaken once sufficient material is available (will possibly require a 2-3 year lead-in time from project commencement for material to be ready for planting).
A5.29 Appropriate management of restoration plantings will be implemented (post-planting weed control) once plants are in the ground.

5.7 Avifauna Management

The main focus of avifauna management is in establishing and implementing an avifauna monitoring programme, which is discussed in the monitoring section of this EMP. In addition, improvement in avifauna condition will occur as a result of animal pest control, which has already been described. The following section describes other management actions arising from the resource consent conditions that relate to avifauna.

5.7.1 Falcon Nest Discovery

If during wind farm construction or during the first two years of operation a falcon nest is identified at the Mt Cass site, a range of monitoring and mitigation actions will be implemented (Condition 73). Monitoring of breeding-season falcon is described in the monitoring section. The location of any such nest will initially be recorded using GPS and the site will be clearly marked on the ground to avoid any risk of interference. A 200 m setback of construction activities will be implemented if this can be achieved without adding significant delay or costs to the construction programme. The nest will be monitored, which will include methods suitable to assess the breeding success of each nesting attempt and the collision risk of each adult and chick fledged from the nest using radio-transmitters. Should an adverse effect be identified associated with the nest, then mitigation measures will be implemented which may include increased predator control around the nest, or an offsite release programme or other action suitable to support the conservation of this species (e.g. insulation of local power lines and transformers). The monitoring of nest success will be increased to intensive nest minding should the nest be located within 200 m of construction activity, where construction activity is unable to be deferred. Intensive nest minding will occur daily throughout the incubation phase and every other day for the first 14 days after hatching and will include intensive observational notes on behaviour. If the nest is more than 200 m away from construction activity, observations to determine productivity will be reduced to once a week but will also be mindful that in some situations construction activity may adversely affect breeding behaviour.

5.7.2 General Bird Injury and Mortality Protocols

A protocol for dealing with bird carcasses and injured birds including, but not limited to, kereru, falcon and pipit is required by Conditions 72 and 76a. Actions to be taken are defined in the Post-Construction Bird Collision Monitoring Plan (BCMP) (ref Appendix 4), Sections 2.7.4 and 2.7.5. It is important that the location of any discovered bird or carcass is recorded and a photograph taken of the bird at the location and an incident mortality data sheet must be filled out (Table C.7 of the BCMP).

Handling of wildlife (whether dead or injured) is only permitted with a 'Wildlife Act Authorisation' (WAA) obtained from the Department of Conservation. A 'WAA' is required for the Bird Collision Monitoring Programme and any conditions of the 'WAA' must be followed for incidental finds as well. Protocols for collecting bird carcasses are provided in Section 2.6.2.

For any carcasses located at the Mt Cass site either from the formal carcass searches (see Section 6) or from incidental collection, the data described for the mortality monitoring programme will be recorded and included in an annual report alongside the results of the mortality monitoring.

Should any evidence be found of injury and/or mortality of kereru, New Zealand falcon or New Zealand pipit through interaction with wind farm infrastructure, then a "Novel, Threatened or At Risk species" report will be prepared for Hurunui District Council as soon as is practicable (Condition 72). This report will detail a suitable monitoring and management regime that will be implemented to address any net negative impact at the local population level on these three species.

5.7.3 Additional Threatened or At Risk Species

Further assessments of risk associated with the wind farm will be undertaken should any additional Threatened or At Risk species of avifauna[15] be recorded on site (Condition 76b). The type of assessment will be dependent on the species recorded and on what the level of risk is perceived to be. As a result, at this stage, it is not possible to develop specific management actions that will be undertaken other than to note that any Threatened or At Risk species found will be reported to DOC and HDC as soon as possible. This report will include what action is required to assess the threat to this species and what potential mitigation measures might be employed to mitigate any potentially adverse effects (refer BCMP Section 2.7.5).

5.7.4 Additional Mitigation Measures

If unanticipated adverse effects of the wind farm on avifauna are identified, then additional avifauna mitigation will be considered (Condition 76c). The suitability of mitigation options will most likely be species specific and will be dependent on the level of adverse effect recorded (Condition 76b specifies that additional mitigation is only required if there is a net negative

[15] As defined in Robertson et al (2021) or in subsequent avifauna threat status evaluations.

impact due to the wind farm on the population within the Motunau Ecological District). As such it is important that mitigation is developed once the effect is recorded and matched accordingly. There are a variety of options available to mitigate the effects of wind farms on avifauna at Mt Cass including:

i. Bird corridor enhancement;
ii. Off-site habitat protection or enhancement;
iii. On or off-site breeding programmes;
iv. Nest protection; or
v. Changes in the operation of the wind farm to reduce impacts.

Which of these will be suitable to employ will be dependent on the particular effect recorded. Section 5 of the BCMP provides more detail on additional mitigation or compensation.

5.7.4.1 Management Actions Pre-Commissioning

A5.30 If evidence of falcon nesting is detected on the site, implement appropriate management as described above.

5.7.4.2 Management Actions Years 1-5

A5.31 Once the wind farm is commissioned implement the protocol described above for handling injured and dead birds.

A5.32 Should additional Threatened and Rare avifauna be discovered at the Mt Cass site, then implement appropriate management actions, including possible additional mitigation.

5.8 Herpetofauna Management

The overall objectives of herpetofauna management include:

a. avoiding or minimising impacts on lizards associated with construction of the wind farm; and
b. maintaining lizard habitat and populations at the same or in better condition than that present prior to wind farm development (Condition 77).

The first of these objectives will be addressed through detailed on-ground searches for lizards, and turbine micro-siting to minimise the effect on lizard habitat as far as practicable, together with relocation of lizards away from the wind farm footprint. The second objective will be addressed through pest management aimed at reducing predation pressure on lizards. In addition, there is a requirement in the Resource Consent conditions to develop protocols that need to be followed in the event that Novel Threatened lizard species are found on site.

These management actions are now described.

Lizard management will follow an 'adaptive-management' approach (Condition 79e) in that the specific management of lizards will be modified in accordance with the latest results of the monitoring programme, with specific reference to the effectiveness of pest control, including, if necessary, the control of mice irruptions, as measured by the response of the lizard populations. Should lizard numbers decline relative to the targets given in this management plan (see Monitoring Section), then more intensive lizard management may be required, including more intensive mice trapping and/or the erection of a mice-proof fence around key lizard populations.

5.8.1 Avoiding and Minimising Impact of Wind Farm Construction

This will primarily involve pre-construction surveys by an experienced herpetologist immediately prior to development to identify locations of lizard populations as a basis for providing advice on micro-siting of wind farm elements and for implementing a programme of lizard relocation where avoidance is not possible. Prior record location data of lizards collected by various ecologists and herpetologists during the Assessment of Environmental Effects stage of the wind farm have been retained and will be utilised for this. The following section provides detail on the methods that will be used for lizard relocation where micro-siting does not avoid an impact on lizards.

All geckos and skinks that are detected and captured will be removed from the development corridor and relocated immediately to a pre-determined release site. The capture for relocation programme will comprise intensive daily surveys using multiple techniques over five consecutive days per site (less if the site is deemed to be substantially cleared of lizards; and more than 5 consecutive days if the project Herpetologist is of the opinion that lizards may still be present or if lizard habitat remains to be cleared), as follows:

- Experienced herpetologists will be utilized in the rescue and relocation of all lizards within the development footprint.
- Onduline Artificial Cover Objects (ACOs) every 5 m in a grid pattern will be laid in the period October to February. There will be a minimum 3-month period for all ACOs to

settle in before the salvage commences at sites identified as potentially having lizards. ACOs will remain in place and will be checked as part of the manual salvage process outlined below that will be undertaken, during the period of salvage immediately prior to habitat clearance being undertaken.

- On confirmation of the actual layout of the wind farm, rescue and relocation efforts of lizards in affected areas will take part over the warmer months of the year (mid-September to March) and will run concurrent to construction activity on Mt Cass over that summer, finishing as each area is required for construction.
- Capture and relocation will only take place during periods of fine, warm (12° – 20°C) weather.
- Any ACOs remaining outside of the construction area will be removed and resident lizards released at the same location.
- All loose rock, slabs and vegetation cover will be removed from affected areas, and vegetation cover reduced (e.g. by grazing sheep, or careful mowing/ line trimming).
- Up to 5 days of intensive searching (involving 70 person hours during suitable weather (12 – 20degrees C and no rain); and more than 5 consecutive days if the project Herpetologist is of the opinion that lizards may still be present or if lizard habitat remains to be cleared) in two 'blocks', where each block represents one half of the Mt Cass construction corridor, in which all sites of high conflict within this half will be visited repeatedly during the week. A minimum of 3 days searching will be undertaken at each lizard site. The capture methods used will involve visual day searching to check artificial refugia and natural crevices, plus a 5 m buffer zone, and lizards extracted using nooses from crevices. Limestone slabs will be turned over (and removed), and any lizards hand captured. Gee's-minnow trapping will occur throughout the habitat feature spaced as a 5 m x 5 m grid to be checked daily (if there is more than one instance of a rodent being caught in a Gee's-minnow trap on any given salvage site, Gee's-minnow trapping will be discontinued at that specific salvage site. Gee's-minnow trapping will be discontinued if there are three instances of rodents being caught in Gee's-minnow traps, collectively, across the entire site for the entire period of the salvage. If Gee's-minnow trapping is not undertaken, additional effort will be expended on ACO checks and hand searching of lizard habitat).
- Three days of night spotlighting will occur to capture active geckos. A final day survey (visual) will be undertaken immediately prior to development to check for and remove lizards which may have subsequently recolonised the site.
- After the minimum 3 day search effort per site, if lizards have not been sighted in 4 consecutive hours in ideal conditions (12-20 degrees C, not raining), and suitable habitat, then searching can cease.
- There must be an experienced herpetologist on site during the salvage at all times. Only the experienced herpetologist can determine whether all possible lizards have been salvaged from each site, and whether earthworks at the site can proceed.
- Physical works at each site at which lizard salvage is undertaken, will be completed within one week of the lizard salvage taking place, in order to prevent the recolonization of any remaining habitat by lizards. An experienced herpetologist will be at each site during these physical works.

Suitable lizard release sites have been selected by the project herpetologist (See Figure 7 and Plates 1-5) and detailed in the Wildlife Act Authority (98153-FAU) 2022-11-29. Four sites have been identified and stock fenced with predator control put in place prior to the first release of salvaged lizards. Three sites are expected to be sufficient to accommodate all relocated lizards

with the fourth site available as a contingency if required. The release sites are in areas of limestone habitat with crevices and boulder areas with a naturally established mingimingi/pasture grassland/shrubland vegetation cover (Golder Associates Vegetation Type 2) and are more than 100 m from any of the proposed lizard capture sites.

Each release site has been assessed for suitable habitat for geckos and skinks, and it has been confirmed that there appears to be capacity (no sign, sloughs or presence), indicating that the sites are likely to be currently below carrying capacity.

Each site has been fenced to exclude stock and has a programme of stock exclusion, and mustelid, possum rat, and, where necessary, mouse control prior to the first release of salvaged lizards. Habitat at each site will be augmented by constructing 20 cairns per site (rock stacks comprising at least 20 large rocks able to be carried by one person in each stack). With stock removal, predator control (in accordance with Animal Pest Control Programme in Section 5.4 above) and habitat augmentation, it is estimated that up to 200 geckos and 50 skinks could be released at each site without exceeding available habitat resources.

Lizard salvage undertaken in March/April 2021 resulted in 101 Waitaha geckos and 15 southern grass skinks released into three of the pre-prepared release sites (59 Waitaha geckos and 5 southern grass skinks were relocated into Release Site RB (Release Site 1); 2 Waitaha geckos were relocated into Release Site RA (Release Site 2), and 40 Waitaha geckos and 10 southern grass skinks were relocated into Release Site 3).

Further salvage of lizards is planned for March/ April 2023 for:

- Confirmed spoil and laydown areas
- Final walkover of previous salvaged tracks and turbine platforms
- Tussock areas within the footprint

5.8.2 Animal Pest Control Programme within Release Sites

An animal pest control programme has been developed for the release sites by a suitably experienced pest animal control contractor, with the objective of reducing numbers of possum, mustelids, rabbits, rats and, where necessary, mice to very low levels within each release area, with intensive control commencing at least two months prior to the release of lizards (refer to Section 5.4 Pest Management).

Control of animal pests will be sustained until the release areas are incorporated into the wider CMA fenced area, which will also have an intensive pest animal control programme in place.

5.8.3 Pre-Release Monitoring of Lizards within Release Sites

Pre-release monitoring of lizards has been undertaken within Release Sites 1 & 2 according to the following design:

- Sites: Set up monitoring in Sites 1 & 2
- Method: triple stacked ACOs (Onduline, same dimensions as for the 6 x long-term monitoring sites)
- Layout: For each release site: 15 nodes; each node comprising 5 x tripled-stacked ACOs with 5 m between ACOs.
- For node placement: Deliberately place amongst boulder habitat/ long grass edges. Do not place in boulderfield (embedded rocks) or short grass. Ensure at least 20 m between nodes, scattered across release site
- Pre-release monitoring:
  - 1st monitor = early March 2020 (2 x checks of ACO grid on consecutive days)
  - 2nd monitor = November 2020 (2 x checks of ACO grid on consecutive days)
  - Summary report to DOC following the second monitor and prior to salvage

5.8.4 Post-Release Monitoring of Lizards within Release Sites

Post-release monitoring has been initiated to ascertain that relocated lizards establish at their new location.

Where practically feasible, lizards found in close proximity to one another (i.e. potential family groups) during salvage have been released into the same release site.

For post-release monitoring, the same pre-release site ACO monitoring grid in Release Sites 1 & 2 is being used.

- Post-release monitoring:
  - Post-release monitoring #1 = April 2021 (2 weeks following releases of salvaged animals)
  - Post-release monitoring #2 = November 2021 (2 x checks of ACO grid on consecutive days)
  - Post-release monitoring #3 = November 2022 (2 x checks of ACO grid on consecutive days)
  - Post-release monitoring #4 = Spring 2023 (2 x checks of ACO grid on consecutive days)
  - Summary report to DOC

Individual geckos have been marked (temporary marks) with a non-toxic marker pen on the ventral surface to provide an individually unique identifier. Monitoring work over 2013-2015 found that such marks on gecko persisted over time and were a reliable means of identifying geckos at the site over time. Marking of geckos is being undertaken in accordance with the existing lizard monitoring permit for the Mt Cass site.

Post-release monitoring of lizards at sites RB and RA has resulted in few of the March/April 2021 salvage release lizards being re-caught, with declining or similar catch rates in the two

post-release monitoring periods. Overall monitoring of lizards at each release site since March 2020 shows a considerable increase in the occupancy of ACOs monitoring clusters over time (see below summary table for Waitaha geckos).

Success of the relocation will be defined as:

1. For geckos, at least 20 % of salvaged geckos are recaptured in the 3 years following release (excluding the initial monitoring period 2 weeks after the release); and
2. For skinks, no decline is detected from the baseline monitoring (2 weeks after release) to the final monitoring period (3 years after release).

Data collected from individual geckos and skinks includes:

- ACO identifier
- Sex (by examination of the cloacal area of geckos and eversion of the hemipenes in skinks);
- Snout-vent length;
- Tail length (full tail length, and break to tip length, if the tail is regenerated);
- Gravidity of female animals;
- Photograph of dorsal surface; and
- Weight.

5.8.4.1 Management Actions Pre-Commissioning

A5.33 Undertake a detailed survey of all sites within the wind farm footprint to determine if any lizards are present, recording this information using GPS.

A5.34 Liaise with wind farm development team and other ecologists to see if any identified lizard populations can be avoided through micro-siting of wind farm elements.

A5.35 For those lizards that cannot be avoided, undertake a capture and relocation programme to a suitable site within the Mt Cass Conservation Management Area, with an appropriate post-release monitoring programme, if required.

5.8.5 Maintenance of Lizard Habitat and Populations

This will primarily be undertaken through the animal pest control programme described previously and will be assessed through the lizard monitoring programme described in Management Actions A6.17 and A6.18. In addition, a localized and seasonal (January-July) mice-specific control programme (in addition to the general rodent control programme) will be undertaken at sites within the Mt Cass Conservation Management Area where Waitaha geckos are abundant, including the lizard relocation site should this involve Waitaha gecko, if monitoring suggests that this is required. An assessment of the need for mouse control will be made by HDC, DoC and the project ecologist based on field data of lizard monitoring at these sites as well as the results of pest animal monitoring, and the evaluation of risk posed to lizards by monitored pest numbers.

5.8.5.1 Management Actions Years 1-5

A5.36 Undertake mice-specific control around sites with high Waitaha gecko populations if and when mouse numbers increase to levels that threaten the lizards.

5.8.6 Procedures to Deal with Discovery of Novel Threatened Herpetofauna

Should additional lizard species be subsequently discovered at any stage in the lifetime of the wind farm, MCWF will immediately incorporate these species within this EMP. Possible novel lizard species may include Naultinus geckos or large skink species (such as the Threatened Central Canterbury spotted skink *Oligosoma spp.*), which have hitherto not been recorded at this location.

5.8.6.1 Management Actions Pre-Commissioning & Years 1-5

A5.37 Should any novel lizard species be recorded, MCWF will engage an experienced herpetologist to review the record which is to be submitted to the DOC Amphibian and Reptile Distribution Scheme (ARDS), undertake a follow up survey and survey report with management recommendations (if any), and review relevant aspects of this EMP in light of this new development.

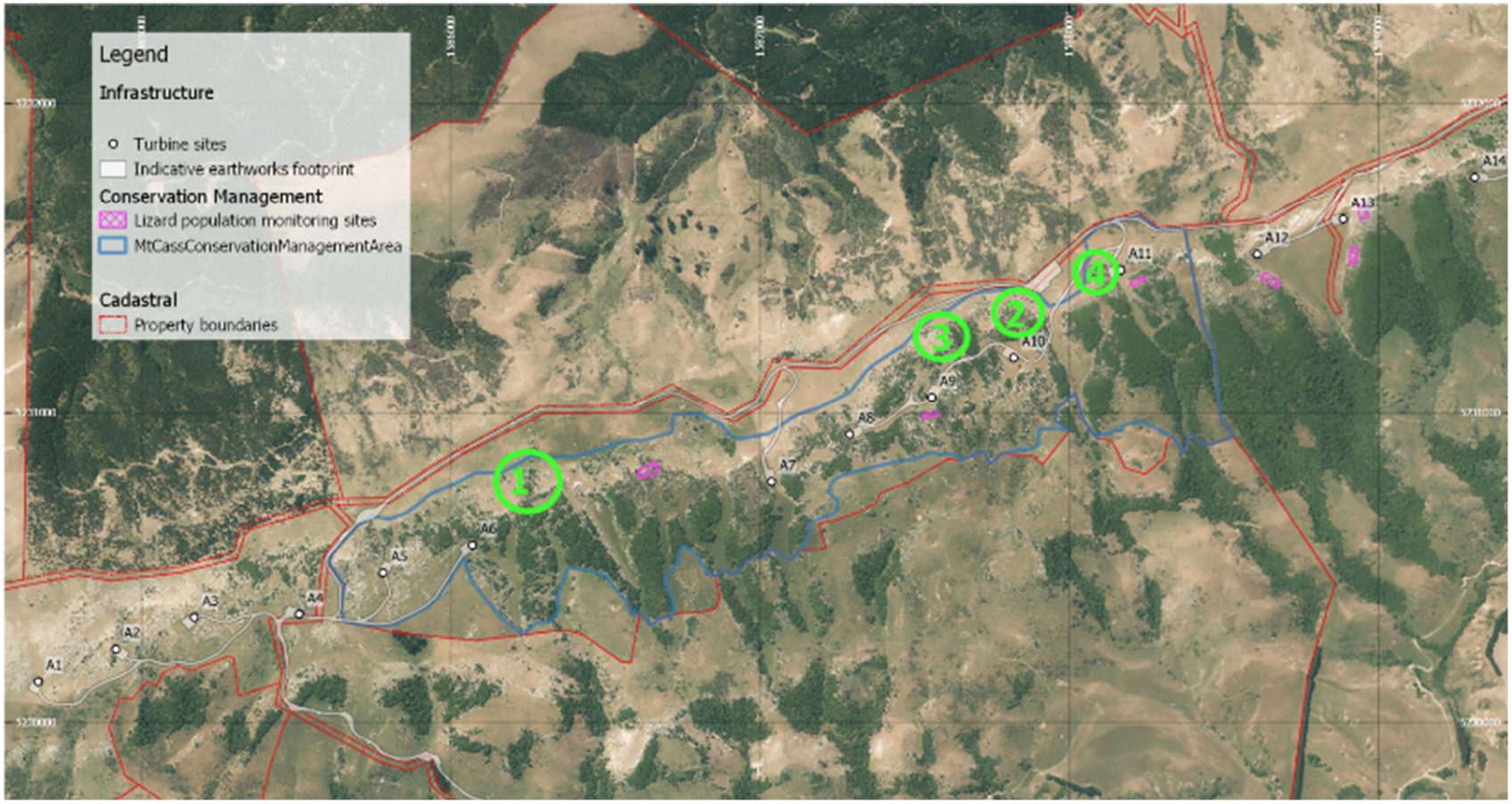

Figure 7: Location of sites into which salvaged lizards will be released. Sites are approximately each 1 ha in area, are within the CMA area and at least 100 m from any of the lizard salvage sites. All sites are north-facing and support a range of habitat options for geckos and skinks. Visual inspection of release sites confirms that available habitat is currently under-utilised and that each site is capable of supporting a larger population than is currently present. The fencing is complete and pest management control is underway with stock excluded. This is expected to improve the habitat greatly.

Plates 1 & 2: Representative view of release site 1. Red line shows indicative boundary of release area.

Plates 3 & 4: Representative view of release site 2. Red line shows indicative boundary of release area.

Plate 5 Representative view of release site 3. Boundaries are out of picture on all sides.

5.9 Threatened and At Risk Plant Management

A number of Threatened and At Risk plant species are present at the Mt Cass site with the resource consent conditions identifying a number of management actions both during construction and subsequently once the wind farm has been commissioned.

5.9.1 Identification and Relocation of Threatened and At Risk Species

All construction sites will be searched by a qualified botanist prior to construction for any Threatened or At Risk plant species[16]. This search will involve the systematic coverage of the planned construction areas, once they have been marked out on the ground, for all known Threatened and At Risk species, being mindful of the fact that previously unidentified Threatened or At Risk species may also be present. All occurrences will be recorded using GPS. For some species such as limestone wheatgrass, searches will need to be undertaken at the time of year when these species are most conspicuous (e.g. when seed heads are present).

All Threatened flora (as defined by de Lange et al 2009[17]) and where practicable any other Threatened or At Risk flora will be relocated prior to construction works occurring. Relocation may involve complete removal of the plant and replanting in the Mt Cass Conservation Management Area or growing-on in a nursery, or the collection of cuttings or seed for propagation where it is not possible to remove the whole plant, before planting out in the Mt Cass Conservation Management Area. Advice will be sought from appropriately experienced nursery people on the most appropriate methods at the time any such relocations are required.

5.9.1.1 Management Actions Pre-Commissioning

A5.38 Appropriately qualified botanist(s) undertake systematic searches of all construction sites prior to construction and relocate any Threatened plant species and, where practicable, any At Risk plant species.

5.9.2 Limestone Wheatgrass (Threatened - Nationally Endangered)

This small slender, creeping, perennial grass up to 60 cm tall is found sparsely under rock overhangs on the south-facing dip slope, primarily between Mt Cass and Totara Peak. The Mt Cass site is the second largest population known for this species (after the Flock Hill area).

At the time of the resource consent the Mt Cass population was estimated at 653 plants spread over 164 sites with records based on 2002-2004 DOC and Golder Associates surveys 2007-2009. A thorough census was carried out in January 2019 and reported (Shanks, 2019) in the Annual Environmental Report (year viii, 2018-2019) as comprising 266 plants over 89 sites with only 31 of the original sites still active but with 58 new sites discovered. This indicates a significant decline in the population.

[16] As defined by de Lange et al. (2018) or any subsequent threat assessment published prior to construction
[17] de Lange et al 2009 is the version of the species list identified in the resource consent conditions

Both access road and turbine construction associated with wind farm development may result in the loss of some limestone wheatgrass although all surveys to date suggest that limestone wheatgrass plants are not directly threatened as they are on sites that are not part of the development. Nonetheless, it is proposed that once the road and other construction areas have been surveyed on the ground, detailed surveys for limestone wheatgrass will be undertaken and any affected plants transplanted to sites not affected by the wind farm. It is further proposed, should any limestone wheatgrass plants be impacted by wind farm construction, that an equivalent number of additional plants will be propagated from seeds collected on site and planted into the wild. Monitoring will be undertaken of both undisturbed wild populations and of planted populations (if any) of this species.

As a basis for undertaking these plantings a detailed survey of the microsites where limestone wheatgrass occurs will be undertaken, focusing particularly on light levels, substrate and associated species. The results from this survey will be used to inform the decision on planting sites. In addition, a management experiment will be undertaken to assess the influence of sheep grazing on the persistence of limestone wheatgrass, and hence to determine if any ongoing grazing is required for conservation purposes and is described in Section 5.3 above which describes the experiment, with Section 6.3 describing the monitoring procedures.

5.9.3 McCaskill's Hebe (Threatened - Nationally Endangered)

This spreading, semi-divaricating shrub 50-300 mm tall is common at nine locations along the limestone escarpment where it occurs on ledges and in crevices on the limestone bluffs, and less often in open mixed herb-shrub communities in limestone boulder field adjacent to the escarpment. The total population is estimated as *ca.* 600 plants. The Mt Cass site is possibly the largest remaining population of this species and is also the only site where this species is known to be sympatric with the related *Heliohebe raoulii*.

The populations of McCaskill's hebe are not directly threatened by the wind farm development as they are on sites that are not part of the development. Nonetheless, it is proposed to establish a comprehensive monitoring programme for at least three McCaskill's hebe subpopulations as a basis for assessing long-term trends in population structure and abundance as a basis for any future management interventions.

5.9.3.1 Management Actions Pre-Commissioning

A5.39 Data is collected on all Threatened and At Risk species located within the construction footprint, including information on species lost, species translocated and the success of translocations.

A5.40 A survey of existing limestone wheatgrass sites will be undertaken to better determine planting sites.

A5.41 All limestone wheatgrass plants directly affected by the wind farm will be transplanted within 100 m of their collection site. Where seed is available from these translocated plants, additional plants will be propagated and grown-on in the nursery with the objective of also planting these plants back into the wild. Translocation and planting success will be monitored.

A5.42 A field guide to nationally Threatened and At Risk plant species present at the Mt Cass site will be produced and will be updated at the same time as the EMP review process, or more frequently, to reflect any taxonomic changes or updates to threat classifications for New Zealand plants (has been completed).

5.9.3.2 Management Actions Years 1-5

A5.43 A monitoring programme for at least three subpopulations of limestone wheatgrass will be established (this is in addition to the monitoring associated with the grazing trial).

A5.44 A monitoring programme for at least three subpopulations of McCaskill's hebe will be established and remeasured at least biannually.

5.10 Fire Management

A Fire Risk Management Plan for the Mt Cass wind farm is included as Appendix 2 of this Environmental Management Plan.

5.10.1 Management Actions Years 1-5

A5.45 The recommendations and actions in the Fire Risk Management Plan will be implemented as outlined in the plan and the plan will be updated as required.

5.11 Tussock Grassland Management

Where silver tussock grassland is disturbed during construction, there is a requirement in the resource consent (Conditions 92) for any sites not required for long-term wind farm operations to be rehabilitated to a standard similar to that present pre-construction. Where areas with a median silver tussock cover of >10% are permanently removed (Condition 93), an equivalent area will be established using direct vegetation transfer or other suitable techniques.

It is proposed that the following steps will meet these conditions:

- All proposed construction sites, including areas that will be temporarily disturbed during construction, will be surveyed and the density and cover of silver tussocks recorded.
- Should areas meet the criteria identified in Conditions 92 and 93, then areas for rehabilitation will be identified preferably within the Mt Cass Conservation Management Area.
- Appropriate techniques will then be used to salvage silver tussock plants during construction, and these will either be directly transferred to rehabilitation sites, or seed collected from these plants propagated and the resultant plants planted out in the rehabilitation sites.
- Site preparation for silver tussock rehabilitation will follow best-practice procedures for grassland restoration.
- Rehabilitated silver tussock grasslands will be monitored to ensure that silver tussock plants survive and meet the cover targets described above.

5.11.1 Management Actions Pre-Commissioning

A5.46 Silver tussock grasslands within proposed construction areas will be identified and surveyed prior to construction and any silver tussock plants present relocated to appropriate rehabilitation sites, if practicable, or equivalent areas to be established by propagation and planting.

5.11.2 Management Actions Years 1-5

A5.47 Monitor any rehabilitated silver tussock grasslands using photopoints and permanent sampling plots and if required take any appropriate remedial action to meet conditions 92 and 93.

6 Monitoring

A comprehensive monitoring programme will be established to assess the success of the management work described in this plan. Monitoring will focus on the recovery of forest and shrubland remnants, on the success of the restoration plantings (e.g. plant survival), and on the population dynamics of Threatened plant and animal species. There will also be some monitoring of animal pest abundances, although this is not the major focus of the monitoring at the Mt Cass site. This section provides an overview of the approach that will be taken to monitoring. Statistical analysis of monitoring data will follow best scientific practice for such analyses including consideration of spatial and temporal autocorrelation. Details on statistical analysis techniques will be included in annual monitoring reports and are not included here.

The results of monitoring will be reported annually as part of the reporting requirements under the resource consent (Conditions 158 and 161) and will be subject to independent review every three years. This process is discussed further in the next section.

The overall goal of the management being undertaken in the Mt Cass Conservation Management Area is to enhance the biodiversity values present sufficiently to offset the values lost during wind farm development. However, in the conditions of the resource consent it is recognised that this enhancement will take some years to achieve. Under Condition 91i there is a requirement that the eight biodiversity attributes[18] used in the biodiversity offset model have not deteriorated at the end of 5 years from the commencement of activities authorised by the consent relative to the condition of these attributes at comparable sites that are not subject to the management actions being implemented through this management plan. Thus, the goal of monitoring for these eight biodiversity attributes is to show no net deterioration, or reduction over the five years of this first management plan relative to control sites.

[18] Composed of: Vegetation structure and composition (canopy cover; understorey cover; ground cover) and species abundance (falcon; kereru and bellbird; small birds (fantail, grey warbler, brown creeper); Waitaha gecko; limestone wheatgrass).

This Management Plan does not provide for periodic general inventory and monitoring surveys, however, MCWF will allow and provide logistical support to external researchers who may wish to carry out such surveys, provided the researchers comply with all safety requirements of MCWF; are approved by DOC, and; all results and raw data (including GPS locational data) are made available on request by MCWF.

6.1 Photopoints

Permanent photopoints will be located throughout the Mt Cass Conservation Management Area as a means to document the change that occurs as a result of management work. Landscape photopoints will be established in locations that provide a panoramic view of the area (including possibly using drones). Photopoints will also be established at each permanent monitoring plot location (see below). In order for successive photos to be taken at the same location, all photopoints will be permanently marked with stakes and located using GPS. Photos will be taken in early summer (December) each year.

6.1.1 Management Actions Pre-Commissioning

A6.1 Establish photopoints across the Mt Cass Conservation Management Area.

6.1.2 Management Actions Years 1-5

A6.2 Repeat photograph the photopoints annually and report on the results of these photos as part of annual reporting.

6.2 Forest and shrubland monitoring

A biodiversity offset model was developed to assist the Environment Court's evaluation of the Mt Cass wind farm proposal. This model made some specific predictions on the likely future state of biodiversity in the Mt Cass Conservation Management Area as a result of the management actions being implemented under this plan. In that model, eight biodiversity attributes were included namely:

- Canopy cover
- Understorey cover
- Ground cover
- Falcon abundance
- Kereru & bellbird abundance
- Small bird (fantail, greywarbler, brown creeper) abundance
- Waitaha gecko abundance
- Limestone wheatgrass abundance

The specific value assigned to each attribute for each benchmark ecosystem type was based on a mixture of data sources (Table 3). For the three vegetation attributes, average percentage cover abundance data collected from forest (communities 4 – 7, Table 1) and scrub (community 3) plots was used to derive these values (Golder Associates 2008). For the species attributes, abundances are expressed as proportions of the optimal abundance under current conditions

(i.e. 'benign neglect' management). The optimal abundance was assigned a value of 100 for what is regarded as the 'best' current habitat for that species based on expert opinion.

Attribute	Type	Scrub karst[19]	Scrub no-karst	Forest karst	Forest no-karst
Canopy cover	Cover	55	55	84	84
Understorey cover	Cover	25	25	25	25
ground cover	Cover	71	71	60	60
Waitaha gecko	relative abundance	100	10	50	25
falcon	relative abundance	100	90	100	90
kereru & bellbird	relative abundance	25	25	100	100
Small birds	relative abundance	50	50	100	100
Wheat grass	relative abundance	75	5	100	5

Table 3 Benchmark attribute scores for the four benchmark ecosystem types.

The current (pre-wind farm) condition for each attribute for each of the current vegetation types currently present at Mt Cass across the four benchmark ecosystem types was then determined based on a mixture of existing data (for vegetation attributes) and expert opinion. The scores for canopy cover, understorey cover and ground cover (Table 4) were derived from percentage cover abundance data collected from recce plots established in different vegetation types, taking into account differences in surface geology (distinguishing between plots on karst and those not on karst; Golder Associates 2008). The condition scores for the species attributes Table 5) were based on expert assessments that reflect what is known about the current distribution and abundance of these species based on the results of the various surveys that have been undertaken along the Mt Cass ridge by Golder Associates and others.

Attribute/presence of karst	Current vegetation			
	Pasture	Grey shrub	Scrub	Forest
Canopy cover				
With karst	0	50	50	84
Without karst	0	50	50	84
Understorey cover				
With karst	0	0	25	20
Without karst	0	0	25	40
Ground cover				
With karst	0	5	25	20
Without karst	0	5	25	20

Table 4: Pre-project condition scores for vegetation attributes for current vegetation types.

For each of these attributes the expected improvement in their condition as a result of the conservation management work that is being implemented under this plan was then modelled forward for 50 years. However, under the resource consent (Condition 91i) no improvement in condition of these attributes is expected in the first five years, with the performance target being that condition for these eight attributes has not deteriorated.

[19] In this context the terms "karst" and "no-karst" are used to denote the presence or otherwise of exposed surface limestone as identified on the geomorphology mapping by MWH (2011)

In order to assess the performance of the three vegetation attributes described in the biodiversity offset model, permanent 10 x 10 m plots will be established in a representative selection of forest and shrubland areas. The design across vegetation types and grazing regimes will be included in a vegetation monitoring design plan to be prepared by MCWF. The design will include replicated plots within the CMA area. Further plots will be established on the adjacent Dovedale property following the same methods and will be stratified across the same vegetation types in order to provide a non-treatment control.

Plot establishment will estimate the cover abundance of vegetation (by species) in the canopy, understorey and ground layers.

The species attributes are being assessed through the other monitoring described in this section.

Attribute/presence of karst	Current vegetation			
	Pasture	Grey shrub	Scrub	Forest
Waitaha gecko				
With karst	50	75	100	50
Without karst	0	1	10	25
Wheatgrass				
With karst	10	75	75	100
Without karst	0	1	5	5
Falcon				
With karst	50	100	100	100
Without karst	45	90	90	90
Kereru & bellbird				
With karst	0	5	25	100
Without karst	0	5	25	100
Small birds				
With karst	5	30	50	100
Without karst	5	30	50	100

Table 5: Pre-project condition scores for species attributes for current vegetation types.

Once the baseline monitoring plots (and species monitoring for birds and reptiles) has been undertaken, the biodiversity offset model will be recalculated so the expected improvement in biodiversity attributes is appropriate for the monitoring sites used here. As explained earlier, the requirement of Condition 91i is that the eight biodiversity attributes discussed here have not deteriorated at the end of 5 years from the commencement of activities authorised by the consent relative to the condition of these attributes at comparable sites that are not subject to the management actions being implemented through this management plan.

6.2.1 Management Actions Years 1-5

A6.3 The forest and shrubland vegetation monitoring plots have been established and remeasured after three years.

A6.4 The biodiversity offset model has been recalculated using data from the monitoring sites.

6.3 Grazing Trial

In Section 5 under 'Livestock Grazing', a grazing trial is outlined that aims to assess the effects of different grazing levels on four aspects of native biodiversity in the Mt Cass Conservation Management Area. Three grazing levels will be established and the response of the four biodiversity attributes to these assessed, with two grazing blocks for the 100% and 50% grazing treatments used. The effect of no grazing will be assessed using exclosures, with each biodiversity attribute measured in two no-grazing exclosures, which will be distributed within the four grazing blocks[20]. From an experimental perspective, this gives two replicates of each treatment (Table 6).

The final details of monitoring methods for this trial will be subject to independent review prior to the trial being implemented, but the following provides an indication of the methods that are likely to be used.

Attribute	Plot size	Variable measured	Plots per treatment	Number of treatment replicates	Plot total
Forest understorey vegetation	10 x 10 m	Number & cover	3	6	18
Limestone wheatgrass	variable	Plant attributes	5	6	30
Shrub vegetation & ground layer vegetation	5 x 5 m & 1 x 1 m	Cover	3	6	18
Ground layer vegetation	1 x 1 m	Cover	3	6	18
Natural regeneration	5 x 5 m	Height & number	3	6	18

Table 6: Plot details for grazing trial (numbers of plots to be confirmed by the final monitoring design).

Forest understorey vegetation: The cover of seedlings and cover of forest understorey plants will be assessed using the same sample plots as described in the next section, with plots located in each grazing treatment replicate.

Limestone wheatgrass: Discrete areas of limestone wheatgrass in each of the grazing treatment replicates will be identified and the location of individual plants/clumps in each of these permanently marked. Plant height, number of inflorescences and extent of clumps will be measured.

Abundance of shrub and ground layer species on open limestone pavement: 5 x 5 m plots will be permanently marked out in areas of open limestone pavement and the cover abundance of shrubs assessed within these. In addition, one smaller plot (1 x 1 m) will be permanently

[20] There may be more exclosures than this in order to accommodate all the biodiversity attributes, especially for limestone wheatgrass. In this case, small cages may need to be erected around individual clumps if plants do not fall within the no-grazing exclosures used for the other attributes.

marked within each 5 x 5 m plot and the cover abundance of all ground layer species assessed. Again, plots will be located in each grazing treatment replicate.

Natural regeneration processes in shrubland and open limestone habitats: A further set of 5 x 5 m plots will be established in shrubland/open limestone habitats adjacent to the limestone pavement areas and shrub cover and the height and number of individual shrub plants recorded in these. Shrub plants will be individually tagged.

6.3.1 Management Actions Years 1-5

A6.5 Grazing trial monitoring has been established prior to implementing the trial and has been remeasured annually[21].

6.4 Animal Pest Abundances

Monitoring of animal pests will involve use of the relative trap catch index for possums and tracking tunnel indexes for mustelids and rodents. The application of these methods will be based on the current best management practice for each method and will be undertaken annually at the same time of year across the Mt Cass Conservation Management Area. The following performance targets for animal pest monitoring have been achieved by the end of year five (Table 7). These will be regularly reviewed in light of the results of biodiversity monitoring (see below).

In addition, specific monitoring of the mistletoe *Tupeia antarctica* and if there are insufficient plants, other possum sensitive species, will be established. *Tupeia antarctica* is known to be vulnerable to possum browse (Sweetapple et al. 2002) and therefore acts as an additional indicator of possum impacts.

6.4.1 Management Actions Years 1-5

A6.6 Animal pest monitoring has been established and remeasured annually, and is achieving the performance targets in Table 7 below by year 5.

A6.7 A monitoring programme for *Tupeia antarctica* has been established.

Species	Performance target
Deer, goats and pigs	absent
Rabbits and hares	absent
Possums	<5% RTC index
Mustelids	<5% tracking tunnel index
Rats	<15% tracking tunnel index
Hedgehogs	<5% tracking tunnel index
Cats	<5% tracking tunnel index
Mice	<15% tracking tunnel index

Table 7: Performance targets within the CMA for animal pest densities after five-years control.

[21] Performance targets have not been set here as the outcome of the trial is unknown.

6.5 Weed Monitoring

Weed monitoring will involve annual surveillance of both the Mt Cass Conservation Management Area and the wider Mt Cass wind farm site. For the Mt Cass Conservation Management Area, one day will be devoted twice each year (in spring and autumn) to carefully traversing as much of the site as possible, focusing on forest edges, shrubland areas, sites close to wind farm infrastructure and sites from which weeds have previously been recorded. The locations of any ecologically important weeds encountered will be recorded and the plant(s) removed then if at all possible. For the wider Mt Cass site, weeds will be assessed once each year by traversing all of the wind farm roads and turbine sites and searching for any ecologically important weeds that might be present adjacent to these. Again, weed locations will be recorded and the plant(s) removed then if at all possible.

Limestone cliff areas that are within the CMA or adjoining sites disturbed by wind farm construction will be surveyed for ecologically important weeds or weeds listed in the RPMP as part of (bi)annual monitoring. The results of these surveys will be included as part of annual reporting. The performance target for weed monitoring is that ecologically important weeds are absent at the end of year five.

6.5.1 Management Actions Years 1-5

A6.8 Weed surveillance monitoring occurs twice a year within the Mt Cass Conservation Management Area and annually within the greater Mt Cass site.

6.6 Restoration Monitoring

Permanent 50 m long belt transects will be established within the restored areas to monitor their overall success. These transects will be used to assess both the survivorship and growth of the plantings and the establishment of ecosystem processes within the plantings. There is a specific requirement in Condition 91h that plant survival is >75% after 2 years, with replanting required where survival is <75%. This monitoring will provide this information. In addition, the information on the success of the initial restoration plantings will be important for informing decision making with regard to subsequent restoration plantings. Permanent transects will be measured annually during the first five years after planting.

It is proposed that four permanent 50 m x 10 m belt transects are established for each 1 ha planted. Each transect corner will be permanently marked with a peg and location recorded using GPS and include recording the following attributes:

- The total of each plant species;
- The height of each plant (in centimetres); and
- The total number of mortalities, and species (where identifiable).

Note that plants which are on the very edge of the transect boundaries must be identified as within the transect to avoid errors in repeat survival assessments.

In addition to overall cover, the following the information will be collected to monitor the condition of the plants:

- Pest plants – The total number of each species and maturity based on flowering/ seeding;
- Herbivory/Animal sign – The total number and species of plants browsed as well as general observations of animal sign (e.g. scat);
- Disease (discolouration, markings) - The total number and species of plants with signs of disease; and
- Plant form (e.g. hardened) - The total number and species of plants with poor form (e.g. small stature, frost damage, wind damage).

Photomonitoring points will be established at each transect corner, and include four photographs per transect photographing the direction of the 50 m length of the transect. Each photopoint will be given a unique identifier (e.g. 1A, 1B).

6.6.1 Management Actions Years 1-5

A6.9 Restoration planting monitoring has been established and remeasured annually, and achieving the above performance targets two years after planting.

6.7 Avifauna Monitoring

Avifauna monitoring comprises several elements, which are described separately here.

6.7.1 Avifauna Population Monitoring

In order to identify displacement or any effects of habitat loss or collision mortality occurring as a result of the wind farm, as well as for quantifying the benefits that occur from animal pest control, it is necessary to measure bird species abundance pre-construction of the wind farm. In order to do this five-minute bird counts have been carried out using the standard protocols outlined by Dawson and Bull (1975) and included measures of flight activity in order to put the mortality monitoring data in the context of the activity present in the local area.

Traditional bird monitoring is time consuming and there has been considerable interest in recent years around the use of machine learning approaches to analysing data from automated acoustic recorders (Stowell et al. 2019). As this technology develops, the potential of using it in this project should be critically evaluated but a statistically valid cross-reference period will be required if it is to replace 5-minute bird counts. Reference work undertaken in 2021 concluded the use of ARU's was not appropriate at this time to replace 5-minute bird counts at Mt Cass Wind Farm.

Monitoring will be carried out seasonally, during the months of October, January, March and June (Condition 70 & 71). Each bird count station will be visited five times during each of these months in order to obtain appropriate measures of seasonal variation. Monitoring will occur during the same period that carcass searches are taking place and where practicable, should be repeated in the same week every year. Data analysis will follow current 'best-practice' for this

type of count data as advised by DOC at the time the analyses are undertaken.

The key elements of this monitoring are as follows:

- Thirty-nine bird count stations in total have been established to measure bird abundances; 19 in the general area where turbines will be located ('turbine' stations) and 20 located 200 m down the dip-slope from these (control stations) (see Figure 8);
- Approximately half of the 'turbine' bird count stations and half of the 'control' stations are located in grassland and half in bush/scrub habitat
- 5-minute bird counts will be undertaken using best practice techniques as outlined in Dawson and Bull (1975);
- Each station will be visited five times in as short a time period as possible at the same time as the carcass searches (during October, January, March and June);
- Pre-construction data has been collected for two years (2012/2013) prior to construction of the wind farm in addition to data already collected as part of the resource consent application;
- The same monitoring will be undertaken for two years as soon as the wind farm is commissioned and then again once the wind farm has been in operation for five years and repeated every five years after that to allow assessment of the avifaunal attributes used in the biodiversity offset model against the offset targets (see Section 6.2 above).

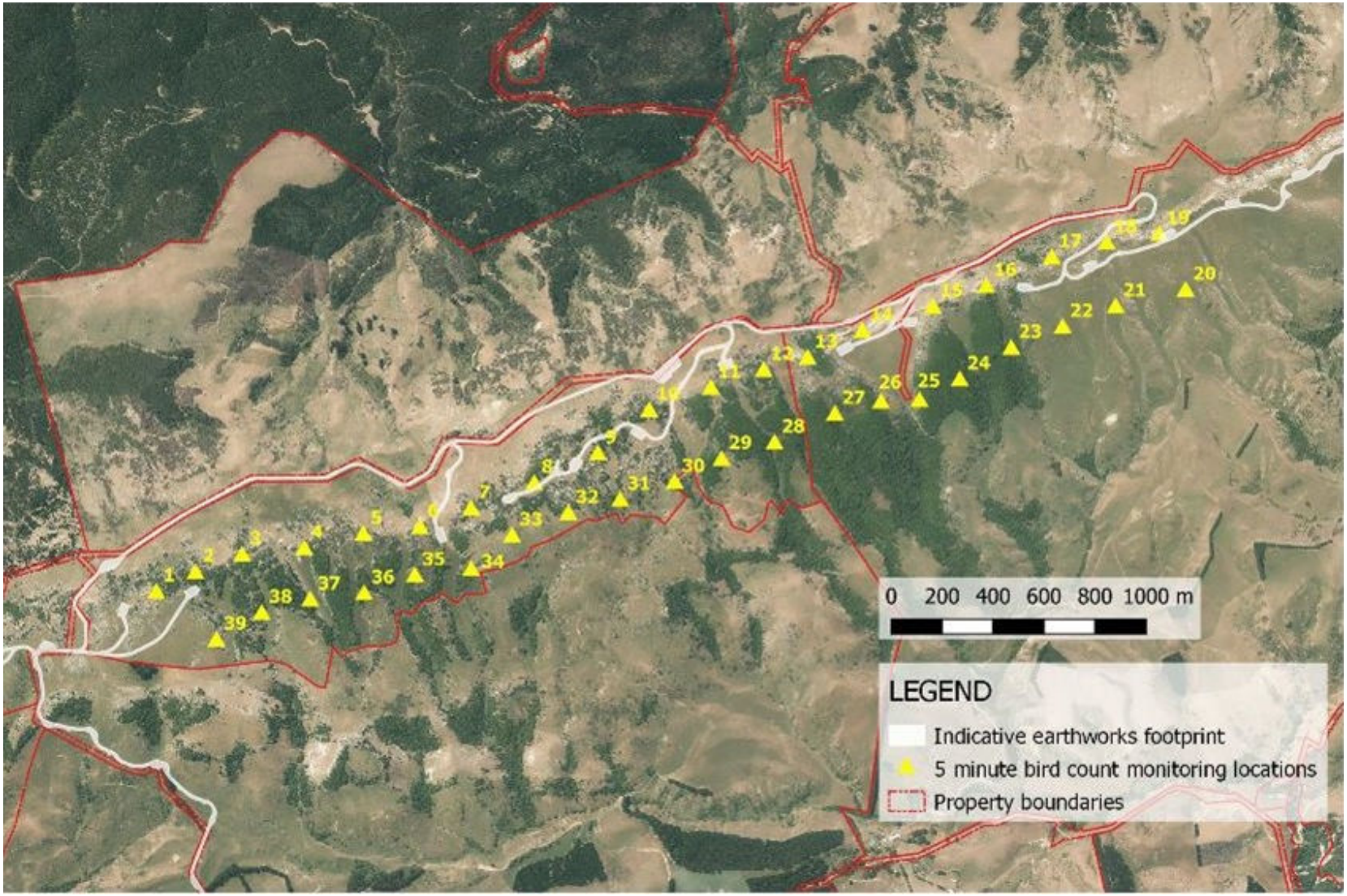

Figure 8: Location of the Avifauna Monitoring Sites

The adjacent Dovedale property will be used as a control (non-treatment) site for birds, but it is recognised that spill-over effects from predator control in the Mt Cass Conservation Management Area will have a positive effect on bird abundances at Dovedale too. However, no other suitable control site is available at Mt Cass. Interpretation of bird monitoring will take this effect into account, and reference to other bird monitoring programmes in the wider Canterbury region will also be used for comparative purposes. Advice on appropriate data sets for these analyses will be sought from relevant experts in DOC and elsewhere at the time.

6.7.1.1 Management Actions Pre-Commissioning (Complete)

A6.10 Establish avifauna monitoring and undertake for two years prior to construction of the wind farm.

6.7.1.2 Management Actions Years 1-5

A6.11 Repeat avifauna monitoring for two years after wind farm commissioning and then on a five-year cycle.

6.7.2 Breeding Season Falcon Monitoring

In addition to the avifaunal population monitoring described in the previous section, a specific survey focusing on falcon will be undertaken during the known falcon breeding-season (Aug to May) each year throughout the construction period and for two years post commissioning (Condition 73a). This survey will involve a person experienced with falcon, traversing the full extent of the wind farm site, focusing on sites within 200 m of construction work, including those parts that might not yet have been constructed, and recording any evidence of falcons including their breeding status. Should a falcon nest or nests be found, then management actions under Section 5.7.1 are to be undertaken.

6.7.2.1 Management Actions Pre-Commissioning

A6.12 Establish breeding-season falcon monitoring and undertake during wind farm construction period.

6.7.2.2 Management Actions Years 1-5

A6.13 Repeat breeding-season falcon monitoring for two years after wind farm commissioning.

6.7.3 Migratory Shorebird Monitoring

Within New Zealand there are several shorebird species that migrate every year from their breeding grounds in the South Island to spend the winter in the North Island (most notably in the harbours around Auckland and the Firth of Thames). Additionally, there are several species that spend the Northern Hemisphere winter in New Zealand and migrate every year to breed in the Northern Hemisphere summer (e.g. in Alaska). Although the risk of a significant effect of the Mt Cass wind farm on migratory shorebirds appears to be low (as most shorebirds seem likely to fly up the east coast of the South Island rather than over land), because of a general lack of quantitative evidence on the routes that shorebird species take during migration it is difficult to make a definitive statement on the risk to these species. As a result, monitoring of migratory shorebird movements in the vicinity of the Mt Cass ridgeline was carried out in order to allow the risk to these species to be fully assessed.

Monitoring covered the peak period of South Island/New Zealand pied oystercatcher (SIPO) migration as they are the most conspicuous of these species and can be broadly assumed to be a proxy for the movements of other internally migratory shorebird species that are more difficult to detect (Fuller et al. 2009). Peak migration of SIPO occurs in January on their north-bound migration and in August on their south-bound migration (Fuller et al. 2009).

The consent condition (70d) for this monitoring required observations on the Mt Cass Ridge in summer (January-February) and winter (July-mid August). Experience from five-minute bird counts in June indicate that this technique is inadvisable in winter on this very exposed site with difficult vehicle access both in terms of the likely effect on the quality of the information gained and the safety of observers. An alternative method was used, including observers for the summer migration period and a bio-acoustic survey for both winter and summer. The bio-acoustic recorders can distinguish the calls of different species of birds, particularly SIPO that call frequently in flight.

The results of migratory shorebird monitoring were published in the final avifauna monitoring report for 2012 – 2013 (Jolly Consulting & Kessells Associates), provided with the Annual Environmental Report year iii, 2013-2014. The report concluded that "*SIPO used airspace about Mt. Cass infrequently, with between 0.2 and 0.6% of the estimated migrating population in summer and between 0.2 and 0.5% in winter.*"

Condition 70d requires further monitoring and investigation *"if significant numbers of migratory shorebirds are recorded to cross the proposed wind farm"*. Given the low usage of the site by these species no further monitoring is proposed. However, if mortality monitoring or other observations detect shorebirds then this decision will be revisited.

6.7.3.1 Management Actions Pre-Commissioning (Complete)

A6.14 Undertake one winter and one summer round of migratory shore bird monitoring.

6.7.4 Mortality Monitoring Programme

A mortality monitoring programme to estimate the rate of wind-turbine induced bird mortality will be undertaken for two years immediately after the turbines become operational and again for two years after the turbines have been operating for five years. The programme is described in the Post-Construction Bird Collision Monitoring Plan (BCMP) included as Appendix 4 to this document (version dated 26 April 2023 or subsequent updates). Mortality rate estimates for the wind farm will be calculated from raw carcass counts adjusted for carcass detection and persistence rates and search coverage.

A summary of the survey techniques is provided in Section 2.5 of the BCMP and replicated in Table 8 below. Further details of records to be kept, how to deal with carcasses and general statistical approaches are provided in the BCMP.

Number of monitored turbines:	All 22 turbines will be monitored annually at some time during the year.
Search area (distance from turbine):	120 m search radius in the first year. The search area will be assessed at the end of the 1st year to determine if a smaller search area would be appropriate.
Search area for the standardised mortality searches and the Carcass persistence rates trials.	Linear transects every 10 m. A 5 m buffer around each transect being the effective search area.
Standardised mortality searches (refer to Section 2.2 of BCMP)	Dog search team - 32 monthly search sessions per year at weekly intervals. One month for each season (nominally Jan, March, July, October) made over 8 randomly selected turbines per season. Searches per search session will occur every 7 days from day 0 to 21.
	OR (if dogs are not available): Human only team – 96 monthly search sessions at fortnightly intervals. Three consecutive months each season made over 8 randomly selected turbines per season.
Carcass persistence rates trials (refer to Section 2.3)	A total of 24 trial sessions will be conducted over the period of a year.
	Eight small (13 – 35 g), 8 large (205 -1700 g) carcasses and 8 feather spots per year.
	Infrared cameras will record removal activity.
Carcass detection rates trial (refer to Section 2.4)	12 carcasses (6 small [13-35 g] and 6 large [205-1700 g]) and 4 feather spots – annually
	Annually, 4 carcasses up trees (2 small and 2 large), 8 carcasses (4 small and 4 large) on the ground, 4 feather spots on the ground.
	Random predetermined allocation and timing determined prior to the start of the standardised mortality searches.
	At maximum only two carcasses/feather spots will be randomly allocated to each trial turbine search areas at a time.

Table 8: Key elements of Bird Collision Monitoring Plan

6.7.4.1 Management Actions Years 1-5

A6.15 Undertake mortality monitoring in January, March, June and October in Years 1 and 2, with a repeat survey undertaken after five years (Year 6 of the plan).
A6.20 Provide an updated methodology in accordance with the latest best practice.

6.7.5 Incidental Behavioural Observations

Incidental observations of avifauna within the Mt Cass wind farm footprint will be recorded during the time that any personnel are on site undertaking avifauna work (including prior to commissioning). Observations will include a list of the species observed within the wind farm envelope on each visit, the location of any Novel, Threatened or At Risk species (and kereru), the distance from the turbines they were observed and any behavioural interactions with the turbines (e.g. flew at rotor height towards the rotors, but once the bird was within 50 m of the turbine changed flight path to avoid the turbine and flew over the turbine; flew over the ridgeline beneath the turbine – no sign of behavioural change as a result of the turbine).

6.7.5.1 Management Actions Pre-Commissioning and Years 1-5

A6.16 Undertake incidental behavioural observations as opportunities allow

6.8 Herpetofauna Monitoring

Long-term monitoring of (non-relocated) resident gecko and skink populations will be undertaken to measure responses to pest control and compared with a reference site using a BACI (Before-After/Control-Impact) design. Three sites within the escarpment of the Mt Cass Conservation Management Area and three reference sites within similar habitat on Dovedale Farm have been selected for long-term monitoring using the BACI framework. Monitoring has been undertaken for two seasons prior to implementation of animal pest control (2014/ 2015), and then will be undertaken annually for the first five years and then every five years after that, up to Year 21.

Monitoring is based on 400 x 500 mm Onduline ACOs arranged in grids of 30 ACOs typically in a 6 x 5 (25 x 30 m) formation. However, the shape of the grid may need to be modified to ensure all areas cover suitable gecko habitat. Sites are at least 100 m apart to ensure their independence. The sites will be established in early summer (e.g. December) of the start of the monitoring programme and checked during a period of forecasted fine weather in March or early April of each relevant year to avoid the main birthing periods of McCann's skinks in January-March (Jewell 2008), southern grass skinks in January (Barwick 1959, Lettink et al. 2011), and Waitaha geckos in Feb-March (McIvor 1972, Hitchmough 1997). The ambient temperatures, while cooler in March and April, should still be suitable for the detection of southern grass skinks (best detection is achieved between 12-18 °C ambient temperature, Hoare et al. 2009) and Waitaha geckos.

Monitoring sessions will be undertaken over consistent weather conditions, and when weather is 12-18° C with no rain.

All ACOs will be checked twice on each monitoring visit on Days 1 and 3 to report on relative abundance trends and demographic changes. Each lizard caught will be marked on the lateral side with a unique marking using a Xylene-free paint pen to identify lizards and to minimise

handling time of lizards by providing a quick means to identify recaptures over that particular monitoring period (tests of marking during pilot 2014/2015 years found that marks generally do not persist between years).
Data collected from individual geckos and skinks will include:

- Sex (by examination of the cloacal area of geckos and eversion of the hemipenes in skinks);
- Snout-vent length;
- Tail length (full tail length, and break to tip length, if the tail is regenerated);
- Gravidity of female animals;
- Photograph of dorsal surface; and
- Weight.

ACO catches will be reported as:

1. Total, gender, and age group catches per monitoring check, per site;
2. Catch rates (species/ ACO) per monitoring day (+/- standard error), with results compared between sites and treatments, and with baseline abundance indices.
3. Relative change in catch rates for each species between years and sites, reported as change relative to the baseline catch rate for that site. Non-overlap of standard error bars will provide a coarse indication of statistical significance.
4. That will provide estimates of change in relative abundance of lizards. The information regarding geckos can be used to re-run the offset model and assess change in net-value of geckos due to the wind farm (the offset model approved by the Environment Court includes only Waitaha geckos as an indicator of lizard community health, not skinks).

Information on weather for each grid check will also be collected (ambient temperature 1m from the ground, relative humidity, rainfall in the past 24 hours, wind (Beaufort scale) and cloud cover in eighths), as weather conditions are known to affect lizard detection. If trend monitoring shows a decline in lizard abundance, or if pest numbers are shown not to be effectively controlled, a re-evaluation of the pest control programme will be undertaken with the objective of increasing control effectiveness.

6.8.1 Management Actions Pre-Commissioning (Complete)

A6.17 Establish lizard monitoring and run for two summer seasons prior to implementation of animal pest control. This has been completed.

6.8.2 Management Actions Years 1-5

A6.18 Repeat lizard monitoring annually.

6.9 Threatened Plant Monitoring

A monitoring programme will be established for at least three representative subpopulations of both McCaskill's hebe and limestone wheatgrass. The monitored areas will be searched carefully, and all plants present will be tagged and their dimensions recorded. Monitoring will be repeated on a regular basis (at least every two years) as a basis for assessing long-term trends in population structure and abundance. The following performance targets for Threatened plant monitoring have been achieved after five years (Table 9).

Species	Performance Target
McCaskill's hebe	Abundance is the same or has increased
limestone wheatgrass	Abundance is the same or has increased

[Table 9] Performance target for Threatened plants at the Mt Cass site after five-years.

6.9.1 Management Actions Years 1-5

A6.19 Threatened plant monitoring has been established and remeasured on a two-year cycle, and the above performance targets have been met after five years.

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7 Project Management

7.1 Introduction

Having a clear plan for project management is essential if this project is to be successful. Furthermore, a clearly outlined approach to project management is essential for providing certainty to stakeholders with an interest in the outcomes of the management work. This section outlines the manner in which the Mt Cass EMP will be implemented and the way in which its success will be assessed.

7.2 Statutory Liaison

The Mt Cass Statutory Liaison Protocol will establish oversight of the implementation of the Mt Cass EMP providing for regular meetings between MCWF, DOC and HDC peer reviewers (at least once each year). The specific terms of reference of the Statutory Liaison Group are:

- To review and comment on this management plan prior to certification by HDC.
- To review and comment on the work undertaken in implementing the Mt Cass EMP over the preceding year.
- To review and comment on the work plan for the following year.
- To provide advice to the managers of the Mt Cass Conservation Management Area as deemed necessary by DOC or as requested by management staff.

7.3 Annual Work Plan

This EMP is the guiding document for the management of the Mt Cass Conservation Management Area and of biodiversity values more generally at the Mt Cass site. It provides the overview of the approach that will be taken in management but is not a prescriptive document as it is difficult to predict in advance changing circumstances that might result as management proceeds or changing biotic and abiotic factors that might influence the site. Annual work plans will provide these prescriptive details. This management plan provides the general overview of the project while the annual work plans will provide the detail on the specific actions that will be taken to implement the management plan. The annual work plan must be reviewed by the Mt Cass Statutory Liaison Group prior to being certified by HDC.

7.4 Timing of Activities

Timing of most activities is dependent on actual construction of the wind farm except the draft EMP which was provided within six months of the granting of the resource consent (Condition 22[a]). The draft EMP is to be finalised when wind farm design is complete and at least three months prior to construction commencing (Condition 23). It will govern environmental management activities during construction of the wind farm but more importantly for the operating life of the wind farm, accordingly Year 1 of the EMP corresponds to Year 1 of wind farm operations, which is currently expected to be 2024. The timeline presented in Figure 9 is indicative of the range of dates over which key activities could occur but is not a comprehensive timeline for the project.

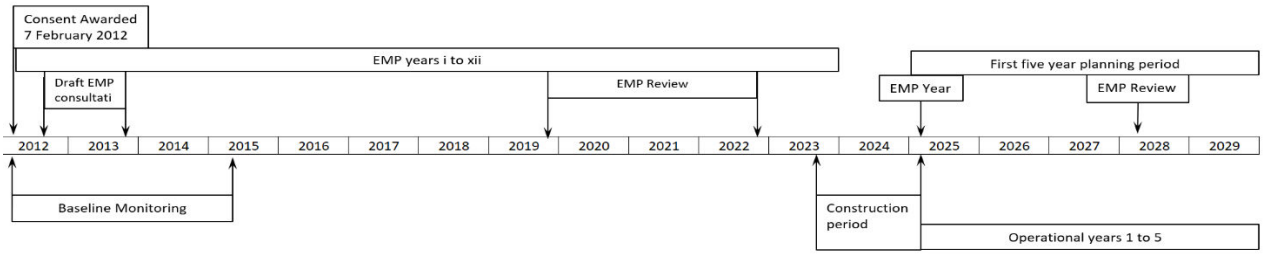

Figure 9: Time-line for Environmental Management Plan Development and Implementation

7.5 GIS

Accurate and geo-referenced information is essential to the successful management of native biodiversity at Mt Cass. Such information can be used to ensure that all management actions are carefully tracked (e.g. monitoring sites or weed eradication locations), and that the results of management interventions can be reliably reported. A GIS database will be set up at the start of the Mt Cass restoration project and will include information on the following amongst other things:

- Underlying land resource data (aerial photos, vegetation map, limestone features map etc).
- Boundary and fence line information.
- Location of all permanent monitoring points.
- Location of Threatened species (especially plants and lizards).
- Weed observations.
- Location of animal pest control points.

7.6 Performance Bond

MCWF is required by conditions to establish a performance bond to ensure that there is sufficient capital available to guarantee the long-term management of the Mt Cass Conservation Management Area and will establish a financial instrument to provide for the ongoing management in perpetuity.

7.7 Public Relations

MCWF is committed to making this conservation management project and the results that arise from it widely known. This is important for several reasons; because it enables ownership of the project by local communities, it permits transparency in terms of project management, and it allows sharing of the results that arise from the project with other similar projects. It is proposed that information about the project will be disseminated through a range of tools including information signs along any public walking tracks located through the area, newsletters and/or brochures, and via the web. A web page will be established that provides regularly updated information on the project including copies of all plans and reports relating to the project.

7.7.1 Management Actions Pre-Commissioning

A7.1 Establish GIS database.
A7.2 Establish the Mt Cass Statutory Liaison Group (Done).

7.7.2 Management Actions Years 1-5

A7.3 Prepare an annual work plan that describes the management actions for each year.
A7.4 Establish a web site that described the Mt Cass restoration and conservation project and makes all results from the project publicly available.
A7.5 Update GIS database as new information becomes available.
A7.6 Establish a bond to guarantee the long-term funding of the Mt Cass conservation management work.

8 Management Time-Line

This section will summarise management actions by the year they need to be undertaken covering both pre-commissioning and years 1-5 post-commissioning once a construction start date has been confirmed.

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Appendix 1: Mt Cass Wind Farm Site Recorded Indigenous Vascular Plants

Species	Life Form	Threat Status (2017)
Acaena anserinifolia	ED herb	
Acaena novae-zelandiae	ED herb	
Aciphylla aff. ferox	ED herb	Naturally Uncommon
Aciphylla subflabellata	ED herb	Declining
Adiantum cunninghamii	Fern	
Alectryon excelsus	Tree	
Anaphalioides bellidoides	ED herb	
Anthosachne solandri	Grass	
Aristotelia fruticosa	Shrub	
Aristotelia serrata	Tree	
Arthropodium candidum	M herb	
Asplenium flabellifolium	Fern	
Asplenium flaccidum	Fern	
Asplenium gracillimum	Fern	
Asplenium lyallii	Fern	
Astelia fragrans	M herb	
Australina pusilla	ED herb	
Australopyrum calcis subsp. optatum	Grass	Nationally Endangered
Blechnum chambersii	Fern	
Blechnum fluviatile	Fern	
Blechnum penna-marina	Fern	
Brachyglottis monroi	Shrub	
Brachyscome sinclairii	ED herb	
Calystegia tuguriorum	Liane	
Cardamine debilis agg.	ED herb	
Cardamine sp. "glossy leaf"	ED herb	
Carex flagellifera	Sedge	
Carex secta	Sedge	
Carmichaelia australis	Shrub	
Carmichaelia kirkii	Liane	Nationally Vulnerable
Carpodetus serratus	Tree	
Celmisia gracilenta	ED herb	
Chaerophyllum novae-zelandiae	ED herb	
Chaerophyllum ramosum	ED herb	
Chenopodium allanii	ED herb	Naturally Uncommon
Chiloglottis cornuta	M herb	
Clematis afoliata	Liane	
Clematis foetida	Liane	
Clematis foresteri	Liane	
Clematis marata	Liane	
Clematis paniculata	Liane	
Colobanthus acicularis	ED herb	
Colobanthus apetalus	ED herb	
Colobanthus muelleri	ED herb	
Convolvulus waitaha	ED herb	

Species	Life Form	Threat Status (2017)
Coprosma crassifolia	Shrub	
Coprosma linariifolia	Shrub	
Coprosma lucida	Shrub	
Coprosma propinqua	Shrub	
Coprosma rhamnoides	Shrub	
Coprosma robusta	Shrub	
Coprosma rotundifolia	Shrub	
Coprosma rubra	Shrub	
Coprosma tayloriae	Shrub	
Coprosma virescens	Shrub	Declining
Cordyline australis	Tree	
Corokia cotoneaster	Shrub	
Corybas sp.	M herb	
Craspedia (ii) CHR 489432 Mt Cass	ED herb	Nationally Vulnerable
Craspedia sp.	ED herb	
Dacrycarpus dacrydioides	Tree	
Dichelachne crinita	Grass	
Dichondra repens	ED herb	
Discaria toumatou	Shrub	Declining
Echinopogon ovatus	Grass	
Epilobium nummulariifolium	ED herb	
Epilobium rotundifolium	ED herb	
Festuca multinodis	Grass	
Festuca novae-zelandiae	Grass	
Fuchsia excorticata	Tree	
Fuchsia perscandens	Liane	
Galium propinquum	ED herb	
Galium trilobum	ED herb	
Geranium brevicaule	ED herb	
Geranium microphyllum	ED herb	Naturally Uncommon
Gingidia montana	ED herb	
Griselinia littoralis	Tree	
Haloragis erecta	ED herb	
Hebe salicifolia	Shrub	
Helichrysum filicaule	ED herb	
Heliohebe maccaskillii	Shrub	Nationally Endangered
Heliohebe raoulii	Shrub	
Hierochloe redolens	Grass	
Hoheria angustifolia	Tree	
Hydrocotyle heteromeria	ED herb	
Hydrocotyle moschata	ED herb	
Hydrocotyle novae-zeelandiae	ED herb	
Ileostylus micranthus	Parasite	
Korthalsella clavata	Parasite	Declining
Kunzea robusta	Tree	Nationally Vulnerable
Lachnagrotis lyallii	Grass	
Lagenifera pumila	ED herb	
Leptinella pusilla	ED herb	
Leptinella squalida	ED herb	
Libertia ixioides	M herb	

Species	Life Form	Threat Status (2017)
Linum monogynum var. monogynum	ED herb	Declining
Melicope simplex	Shrub	
Melicytus ramiflorus	Tree	
Melicytus sp. aff. alpinus	Shrub	
Mentha cunninghamii	ED herb	Declining
Microsorum pustulatum	Fern	
Microtis sp.	M herb	
Muehlenbeckia australis	Liane	
Muehlenbeckia complexa	Liane	
Myoporum laetum	Tree	
Myrsine australis	Tree	
Myrsine divaricata	Tree	
Nematoceras macranthum	M herb	
Olearia avicenniifolia	Shrub	
Olearia bullata	Shrub	
Oxalis exilis	ED herb	
Parietaria debilis	ED herb	
Parsonsia capsularis	Liane	
Parsonsia heterophylla	Liane	
Passiflora tetrandra	Liane	
Pellaea rotundifolia	Fern	
Pennantia corymbosa	Tree	
Phormium cookianum	M herb	
Phormium tenax	M herb	
Pimelea sp.	Shrub	
Piper excelsum	Shrub	
Pittosporum eugenioides	Tree	
Pittosporum tenuifolium	Tree	
Plagianthus regius	Tree	
Plantago spathulata	ED herb	
Pneumatopteris pennigera	Fern	
Poa cita	Grass	
Poa colensoi	Grass	
Poa imbecilla	Grass	
Podocarpus totara	Tree	
Polystichum richardii	Fern	
Polystichum vestitum	Fern	
Prumnopitys taxifolia	Tree	
Pseudopanax arboreus	Tree	
Pseudopanax crassifolius	Tree	
Pseudopanax ferox	Tree	Naturally Uncommon
Pteridium esculentum	Fern	
Pterostylis areolata	M herb	
Pterostylis banksii	M herb	
Ranunculus multiscapus	ED herb	
Ranunculus reflexus	ED herb	
Raoulia monroi	ED herb	Nationally Vulnerable
Raukaua anomalus	Shrub	
Ripogonum scandens	Liane	
Rubus schmidelioides	Liane	

Species	Life Form	Threat Status (2017)
Rubus squarrosus	Liane	
Rytidosperma clavatum	Grass	
Rytidosperma racemosum	Grass	
Scandia geniculata	Liane	
Schefflera digitata	Tree	
Schizeilema trifoliolatum	ED herb	
Senecio glaucophyllus subsp. basinudus	ED herb	Naturally Uncommon
Senecio glaucophyllus subsp. toa	ED herb	Naturally Uncommon
Senecio quadridentatus	ED herb	
Senecio sp. aff. dunedinensis	ED herb	Naturally Uncommon
Solanum laciniatum	Shrub	
Sophora microphylla	Tree	
Sophora prostrata	Shrub	
Stellaria gracilenta	ED herb	
Stellaria parviflora	ED herb	
Stenostachys gracilis	Grass	
Streblus heterophyllus	Shrub	
Tetragonia implexicoma	ED herb	
Trisetum lepidum	Grass	
Tupeia antarctica	Parasite	Declining
Uncinia sp.	M herb	
Urtica ferox	Shrub	
Urtica incisa	ED herb	
Viola cunninghamii	ED herb	
Vittadinia australis	ED herb	
Wahlenbergia albomarginata	ED herb	

Appendix 2: Cross Referencing Table to Technical Reports

The following table is provided as a means of cross-referencing the various technical reports that are required by or support this plan. Reports are organised by subject area.

EMP Ref	Report Title	By	Date (from Consultant)	Date to Authority	Annual Report Issued (Year)
5.4	**Animal Pest Management**				
	2022-04-30 MCWF-Lizard Release Sites Pest Monitoring Results (April 2022)	Pest Control Solutions	30/04/2022		Year xi
	2021-12-16 MCWF-Lizard Release Sites Pest Monitoring Results (Nov 2021)	Pest Control Solutions	16/12/2021		Year xi
	2021-05-18 MCWF-Lizard Release Sites Pest Monitoring Results (May 2021)	Pest Control Solutions	18/05/2021		Year x
	2021-03-22 Mt Cass Wind Farm-Lizard Release Sites-Pest Control Monitoring (Mar20-Apr21)	Pest Control Solutions	22/03/2021		
	2020-11-30 Mt Cass Wind Farm-Lizard Release Sites-Pest Control Monitoring (Mar20-Nov20)	Pest Control Solutions	30/11/2020		
	2020-08-03 Mt Cass Wind Farm-Lizard Release Sites-Pest Control Monitoring (Mar20-Jul20)	Pest Control Solutions	03/08/2020		Year ix
	2020-05-05 Mt Cass Wind Farm-Lizard Release Sites-Pest Control Monitoring (Mar20-Apr20)	Pest Control Solutions	05/05/2020		
	2019-12 Mt Cass Ridge Lizard Release Sites – Animal Pest Monitoring & Control Plan – December 2019	Pest Control Solutions	12/2019		
5.5	**Weed Management**				
	2022-05-31 Mt Cass Wind Farm-Weed Management Report	Wai-ora Forest Landscapes	31/05/2022		Year xi
	2021-12-07 Mt Cass Wind Farm-Weed Management Report	Wai-ora Forest Landscapes	07/12/2021		Year xi
	2021-04-30 Mt Cass Wind Farm-Weed Management Report	Wai-ora Forest Landscapes	30/04/2021		Year x
	2020-12-04 Mt Cass Wind Farm-Weed Management Report (Dec 2020)	Wai-ora Forest Landscapes	04/12/2020		
	2018-11-06 Mt Cass Wind Farm-Weed Management Report-2018	Wai-ora Forest Landscapes	06/11/2018		Year xiii
	2015-05-20 Mt Cass Wind Farm-Weed Surveillance and Control-2016	Wai-ora Forest Landscapes	20/05/2015		Year v
	2015-03-04 Mt Cass Wind Farm-Weed Management Report-2015	Wai-ora Forest Landscapes	04/03/2015		Year iv
	2014-06-09 Mt Cass Wind Farm-Weed Management Report-2014	Wai-ora Forest Landscapes	09/06/2014		Year iii
5.6	**Active Restoration**				
	Mt Cass Wind Farm-Ecological Restoration Planting Plan (Rev4-Final)	RMA Ecology Ltd	01/07/2021		Year x

EMP Ref	Report Title	By	Date (from Consultant)	Date to Authority	Annual Report Issued (Year)
5.7	Avifauna Management				
	2022-09-15 MCWF Post-Construction Bird Collision Monitoring Plan (Rev10-Final)	Bluewattle Ecology	15/09/2022		
	2014-07-07 Mt Cass Wind Farm-Pre-Construction Avifauna Monitoring (2012-2013)	Jolly Consulting Ltd	07/07/2014		Year iii
	2013-01 Mt Cass Wind Farm-Summer 2013 Acoustic Avifauna Survey	Jolly Consulting Ltd	01/2013		Year ii
	2012-08 Mt Cass Wind Farm-Winter 2012 Acoustic Avifauna Survey	Jolly Consulting Ltd	08/2012		Year i
5.8	Bat Management				
	2021-04-01 Mt Cass Wind Farm-Bat Acoustic Monitoring Survey Addendum (2021)	Lloyds Ecological Consulting	0/04/2021	07/04/2021	Year x
	2020-12-14 Mt Cass Wind Farm-Bat Acoustic Monitoring Survey (2020)	Lloyds Ecological Consulting	14/12/2020	17/12/2020	Year x
5.9	Herpetofauna Management				
	2022-08-30 MCWF-Long Term Lizard Monitoring-May 2022 (RMA Ecology)	RMA Ecology Ltd	30/08/2022		Year xi
	2022-02-15 MCWF-Lizard Release Site Postmonitoring-Nov 2021	RMA Ecology Ltd	15/02/2022		Year xi
	2021-06-16 Mt Cass Wind Farm-Lizard Release Site Monitoring-April 2021	RMA Ecology Ltd	16/06/2021		Year x
	2021-05-31 Mt Cass Wind Farm-Long Term Lizard Monitoring Report	RMA Ecology Ltd	31/05/2021		Year x
	2021-05-27 Mt Cass Wind Farm-Lizard Salvage Report	RMA Ecology Ltd	27/05/2021		Year x
	2020-12-01 Mt Cass Wind Farm-Lizard Release Premonitory Report (Nov 2020)	RMA Ecology Ltd	01/12/2020		Year x
	2020-04-17 Mt Cass Wind Farm-Lizard Release Sites-Pre-Release Monitoring Report	RMA Ecology Ltd	17/04/2020		Year ix
	2015-07 Mt Cass Wind Farm-Lizard Population Monitoring Report-2015 Season	Ecogecko Consultants	01/07/2015		Year iv
	2014-08 Mt Cass Wind Farm-Lizard Population Monitoring Report-2014 Season	EcoGecko	01/08/2014		Year iii
	2013-08 Mt Cass wind Farm-Lizard Population Monitoring Report-2013 Season	EcoGecko	01/08/2013		Year ii
5.10	Threatened and At-risk Plant Management				
	2022-07-13 MCWF-Limestone Wheatgrass Monitoring Report	RMA Ecology Ltd	13/07/2022		Year xi
	2021-11-16 Mt Cass Wind Farm-Vegetation Micrositing Report Addendum	AECOM	16/11/2021		Year x
	2021-10-13 Mt Cass Wind Farm-Vegetation Micrositing Report	RMA Ecology Ltd	13/10/2021		Year x
	2021-03-10 Mt Cass Wind Farm-Vegetation Micrositing Report	RMA Ecology Ltd	10/03/2021		
	2021-03-09 Mt Cass Wind Farm-Limestone Wheatgrass Survey Memo	RMA Ecology Ltd	09/03/2021		Year x

EMP Ref	Report Title	By	Date (from Consultant)	Date to Authority	Annual Report Issued (Year)
	2019-12-14 Mt Cass Wind Farm-Restoration Planting Trial	David Norton	14/12/2019		Year ix
	2019-08-30 Mt Cass Wind Farm-Wheatgrass Census Report	Alice Shanks, Plants Count	30/08/2019		Year ix
	2010 Mt Cass Wind Farm-Mt Cass Ridge Nationally Threatened & Rare Plant Species	David Norton	2010		
	Limestone Rehabilitation Trials				
	2014-06-10 Mt Cass Wind Farm-Limestone Excavation Treatment Trial	Chris Glasson Landscape Architects	2014-06-10		Year iii
	2012-08-13 Mt Cass Wind Farm-Limestone Rehabilitation Trials	Chris Freear, Energy Matters	13/08/2012		Year i
	Ground Water Monitoring				
	2020-07-22 Mt Cass Wind Farm-Spring Steams Pre-construction Ecological Surveys	Pattle Delamore	22/07/2020		Year ix
	2016-10 Mt Cass Wind Farm-Microinvertebrate Survey	Golder Associates	2016-10		Year iv
	2016-10 Mt Cass Wind Farm-Groundwater Biomonitoring	Golder Associates	2016-10		Year v
	2015-02-24 Mt Cass Wind Farm-Water Quality Monitoring	Golder Associates	2015-02		Year v
	2014-15 Mt Cass Wind Farm-Groundwater Water Quality Monitoring	Golder Associates	2015-01		Year v
	2014-15 Mt Cass Wind Farm-Groundwater Biomonitoring	Golder Associates	2016-10		Year v
	2014-05 Mt Cass Wind Farm-Microinvertebrate Survey	Golder Associates	2014-05		Year iii
	2013-03 Mt Cass Wind Farm-Macroinvertebrate Survey	Golder Associates	2013-03		Year ii
	2012-08-13 Mt Cass Wind Farm-Spring Monitoring	Chris Freear, Energy Matters	13/08/2012		Year i
	Micro-siting Assessment				
	2020-08-04 Mt Cass Wind Farm-Micro-siting Preliminary Results-Memo	RMA Ecology Ltd	04/08/2020		Year ix
	2020-01-30 Mt Cass Wind Farm-Turbine Micro-Siting Geotechnical Assessment	Aurecon NZ Ltd	30/01/2020		Year ix
	2020-01-30 Mt Cass Wind Farm-Geophysical Investigation-Ground Conductivity Surveys	Aurecon NZ Ltd	30/01/2020		Year ix
	Walking Track				
	2020-06-17 Mt Cass Wind Farm-Certification of Outline Plan for Walking Track	Hurunui District Council	17/06/2020		Year ix
	Fire Management Plan				
	2020-12-17 Mt Cass wind Farm-Fire Management Plan (Rev8)	Mt Cass Wind Farm	17/12/2020		

Appendix 3: Fire Management Plan

Mt Cass Wind Farm
Fire Management Plan

Revision 10 – 11 January 2023

This document has been prepared for the benefit of Mt Cass Wind Farm Ltd (MCWF). No liability is accepted by this company or any employee or sub-consultant of this company with respect to its use by any other person. This disclaimer shall apply notwithstanding that the report may be made available to other persons of an application for permission or approval to fulfil a legal requirement.

Revision History

Version	Description	Date	Prepared by	Approved By
Rev 4	For Inclusion in EMP	28 Sep 2020	Henry Willis	-
Rev 5	Comments from MCWF	22 Oct 2020	Henry Willis	-
Rev 6	Updated following Review	3 Nov 2020	Henry Willis	-
Rev 7	Updated following FENZ Review	19 Nov 2020	Henry Willis	-
Rev 8	Updated following CLG Review & HDC Independent Reviewer Review	17 Dec 2020	Henry Willis	Scott Bennett
Rev 9	Updated following cBoP Contractor Review	7 Dec 2022	Henry Willis	Scott Bennett
Rev 10	Incorporates Stantec Review	11 Jan 2023	Henry Willis	Scott Bennett

TABLE OF CONTENTS

1. Introduction

1.1 Purpose

The purpose of this Fire Management Plan (FMP) is to inform people involved in the Mt Cass Wind Farm how to control and reduce the possibility of fire on the site and to specify what equipment may be used in case of a fire.

The plan covers all phases of wind farm development including detailed design, construction and operation. Fire Management is an integral part of environmental management at the site and this plan is accordingly part of the Environmental Management Plan. However, given that aspects of construction and operations are potential fire sources it is also seen as integral to Construction Management and Operations Management.

Although the main aim of fire control is preservation of life, it is also the case that Mt Cass is a valuable site for native biodiversity which could be severely damaged by fire. Appropriate management of the fire risk is therefore crucial in maintaining the biodiversity.

The plan is also required to meet the requirements of the resource consent conditions, specifically Condition 121 which requires the plan to include:

a) The names and contact details of the Ashley Rural Fire Authority (Now FENZ)[1]
b) Other relevant contact details (of the organisations set out in appendix G of the Ashley Rural Fire District Plan 2009-2011) (Now FENZ)
c) A description of the sources of water to be used in fire fighting
d) A requirement for the provision on site of a water point of at least 30,000 litres of water
e) Requirement for at least one vehicle with a minimum capacity of 200 litres onsite during periods of extreme fire risk
f) Ensuring adequate protection is in place prior to undertaking any activities authorised by the consent, including any preliminary geotechnical investigations.

1.2 Site Fire Management Overview

Fire Management is the primary responsibility of the MCWF Construction Manager and begins with hazard awareness and risk minimisation.

This plan is an over-arching Management Plan and will be expanded upon as required for specific activities on site.

The plan sets out Fire Risks and associated Management Processes to mitigate the identified Project Risks.

[1]The New Zealand Fire Service, the National Rural Fire Authority, and the rural fire districts and territorial authorities including Ashley Rural Fire Authority amalgamated to form Fire and Emergency New Zealand (FENZ) in 2017.

Resource Consent Condition 120 requires that the Department of Conservation be consulted in the development of the Fire Management Plan.

In addition, Resource Consent Condition 120 requires the Ashley Rural Fire Authority and the Principal Rural Fire Officer of the Hurunui District Council, or such authority as may replace any one of these authorities, as parties responsible for the management of rural fires within and on land adjoining the footprint, shall be consulted during the development of the Fire Management Plan. These authorities have amalgamated to become Fire and Emergency NZ (FENZ) and FENZ will be the authority that is consulted on the development of this plan going forward.

In addition, FENZ will be provided with detailed information on site access and track locations. This information will be updated throughout the life of the project. The location of water storage ponds and water tanks that can supply water for firefighting purposes will be clearly identified.

During construction, the MCWF Construction Manager will be responsible for ensuring that this Fire Management Plan is correctly implemented by the relevant Contractor(s) and will review all documentation relating to fire risk before it is finalised and issued.

Site induction for all personnel must include a briefing on fire safety including the main content of this plan and any SOP's relevant to the task being performed.

In the event of a fire, details of the emergency response will be covered in the Emergency Response Plan.

1.3 The Site

The Mt Cass ridge is a prominent ridge defining the seaward side of the Waipara Basin. Mt Cass is approximately 5 km south east of Waipara town and the ridge trends east-north-east and runs parallel to State Highway 1 ending near Omihi. The wind farm (refer to Figure 1) consists of 22 wind turbines configured as a single row stretching the length of the Mt Cass ridge. The wind farm shares the ridge with four dry pastoral farming operations interspersed with areas of native bush. Formal access to the site is via Mt Cass Road with the wind farm entrance located 2.5 km beyond the turn off to the Kate Valley landfill. Prior to construction (and in emergency situations) there is also access to the ridge via Simmonds Road and farm tracks across Mt Cass Station.

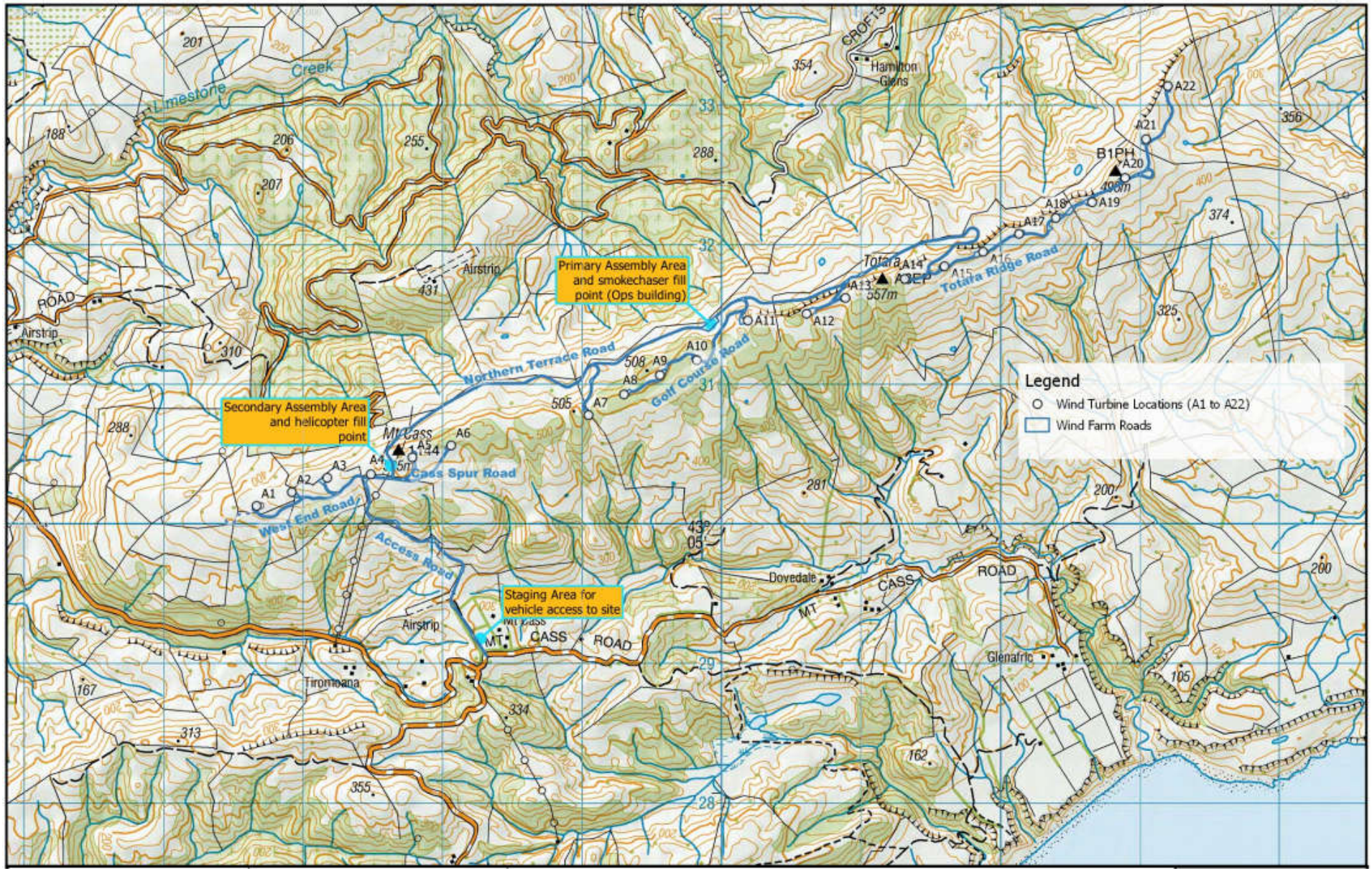


Figure 1 - Site Layout

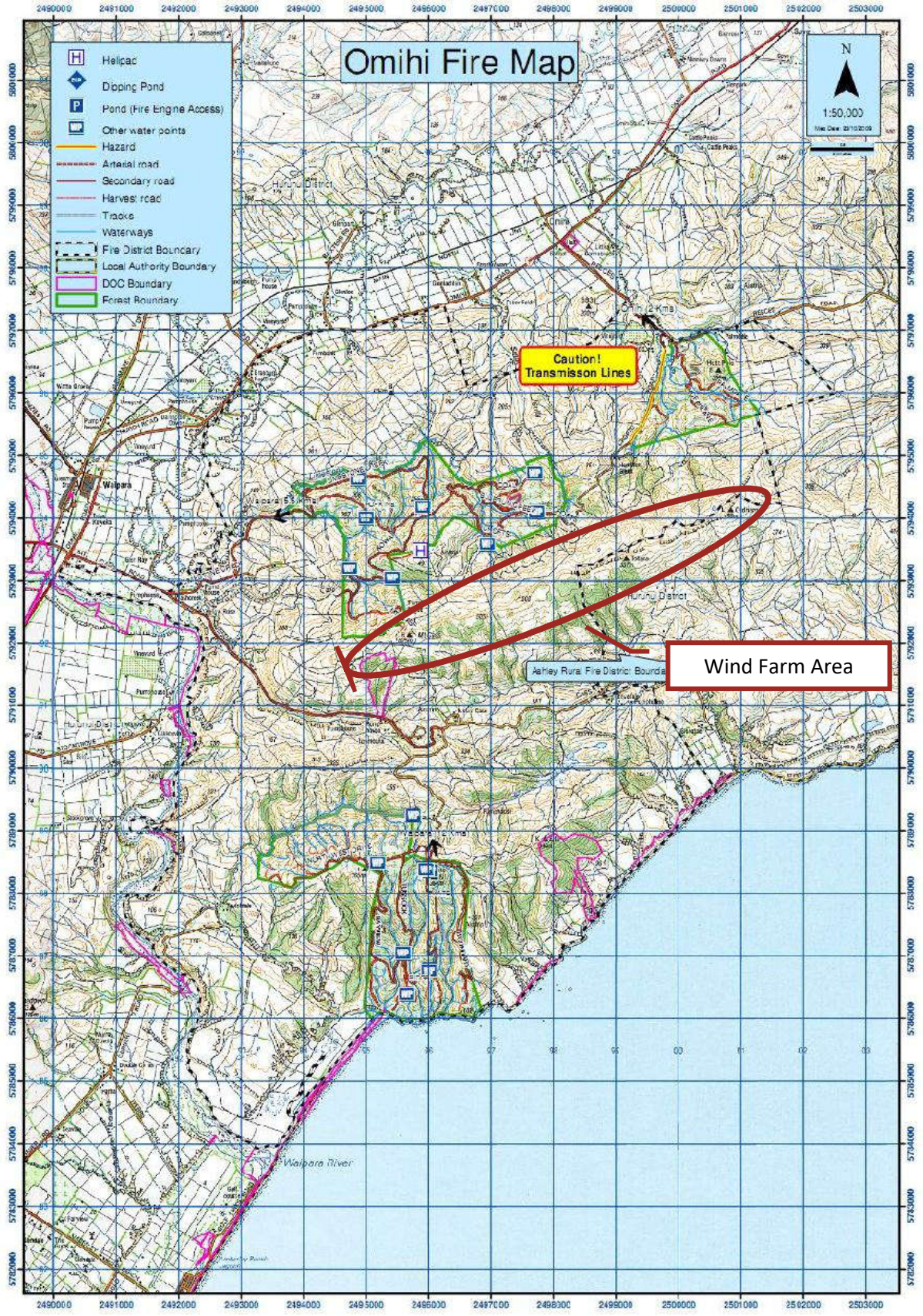
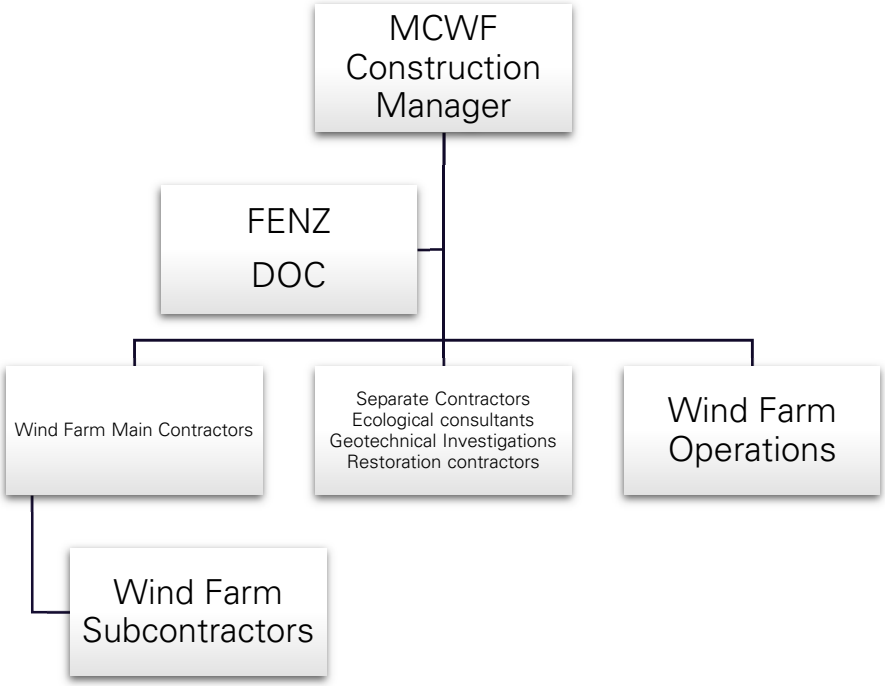


Figure 2 - Larger Site Map showing Fire Services and Water Sources.

2. Fire Management Roles and Responsibilities

The project Fire Management Organisation Chart is shown below



The following responsibilities are specific to Fire.

2.1 MCWF PM Responsibilities

- Has overall responsibility for the Fire Management Plan.
- Ensure that the Fire Management Plan is up to date, reviewed and approved, and available to all personnel on site.
- Issues any revisions of the plan to FENZ.
- Updates the Environmental Management Plan with the latest FMP revision.
- Ensure all consent conditions pertaining to the Fire Management Plan have been achieved.
- Ensures all contractor and subcontractor staff are adequately inducted and trained in site fire control procedures including emergency procedures.
- Undertakes Reviews and Audits of Contractor's related Standard Operating Procedures (SOP's).
- Reports non compliances and arranges appropriate corrective actions.

2.2 FENZ Responsibilities

- Lead agency in the event of a wild fire, will run a Fire outbreak event as an Incident under the Coordinated Management System once notified of a Fire via the 111 system.
- Can support MCWF in other emergency events such as: Structure Fire, Hazardous Spill or Motor Vehicle Accident.
- Coordinates with other agencies in the event of an emergency such as: NZ Police – Fatality or Evacuation, Hurunui District Council – Civil Defence response, DoC – Historic or Biodiversity advice/actions, Land Owners – Operations on site.

- Reviews MCWF Fire Management Plan and associated Emergency Response Plan
- Ensures that local fire response teams have been provided the access and water storage information from site.
- Ensure local response teams are familiar with Mt Cass site.
- Issue Fire Permits as requested.

2.3 Wind Farm Main Contractor Responsibilities

- Develops related SOP's for contract operations and submits for review and approval.
- Ensure they follow all requirements of their FMP and SOP's.

2.4 Wind Farm Sub Contractor Responsibilities

- Develops related SOP's for contract operations and submits for review and approval.
- Ensure they follow all requirements of their FMP and SOP's.

2.5 Separate Contractors Responsibilities

- Develops related SOP's for contract operations and submits for review and approval.
- Ensure they follow all requirements of their FMP and SOP's.

2.6 Operations Contractor Manager Responsibilities

- Ensure they follow all requirements of their FMP and SOP's.

3. Risk Identification

A fire on the wind farm is of significant risk due the potential for high levels of fuel from dry grass, high value vegetation in the area, and risk to personnel and property that a fire in the area would pose. Other fuel sources of significance on site include diesel storage for civil construction and oil storage for transformers.

Potential Ignition sources for a fire include the following:

- Faulty equipment, causing sparks, arcing or open flame
- Hot Works, (Gas Cutting, Angle Grinding, Welding)
- Combustion Engine Equipment (hot exhausts)
- Cigarettes and open cooking flames / BBQ's
- Members of the Public
- Lightning strike

4. Minimisation Procedures General

Due to the nature of works and site, it is impossible to remove all fuel sources, and all potential ignition sources. Key aspects which will minimise the risk of fire include removing as much fuel from the site as possible and separating the works from any remaining fuel as much as practical.

The following plan provides risk mitigation measures for fire, including work processes and emergency readiness.

The Emergency Response Plan will be developed and will be ready for implementation during the Construction Phase in case of fire.

Key site rules include:

- No fires are to be lit or stoves are to be used on site, smoking is not acceptable unless a specific area has been nominated for smoking under a fire safety plan. The construction site will be designated a no-smoking site however vape & e-cigarettes will be permitted in designated areas.
- All vehicles are to be equipped with a fire extinguisher. Spark arrestors will be required for any vehicle (apart from turbo-diesel) which is to go off a formed road.
- Hot works permits are required for all hot works on site.

5. Fire Danger Assessment

The Site Manager will review the Fire Danger information as provided by FENZ and/or Department of Conservation as well as any local information including site specific conditions and assessments by the wind farm landowners or Kate Valley Landfill operators.

Fire Danger assessment for the site can been viewed on the fireweather.niwa.co.nz website for the Salt Water Creek Weather Station of North Canterbury. The fire rating is shown for General, Forestry, Powerline, and Hotworks. Fire seasons can also be viewed on the FENZ website.

Current and forecasted windy weather will be monitored and assessed during all operations involving high likelihood ignition source to fire – works. Works, where practicable will be managed with regard to lowering these risks.

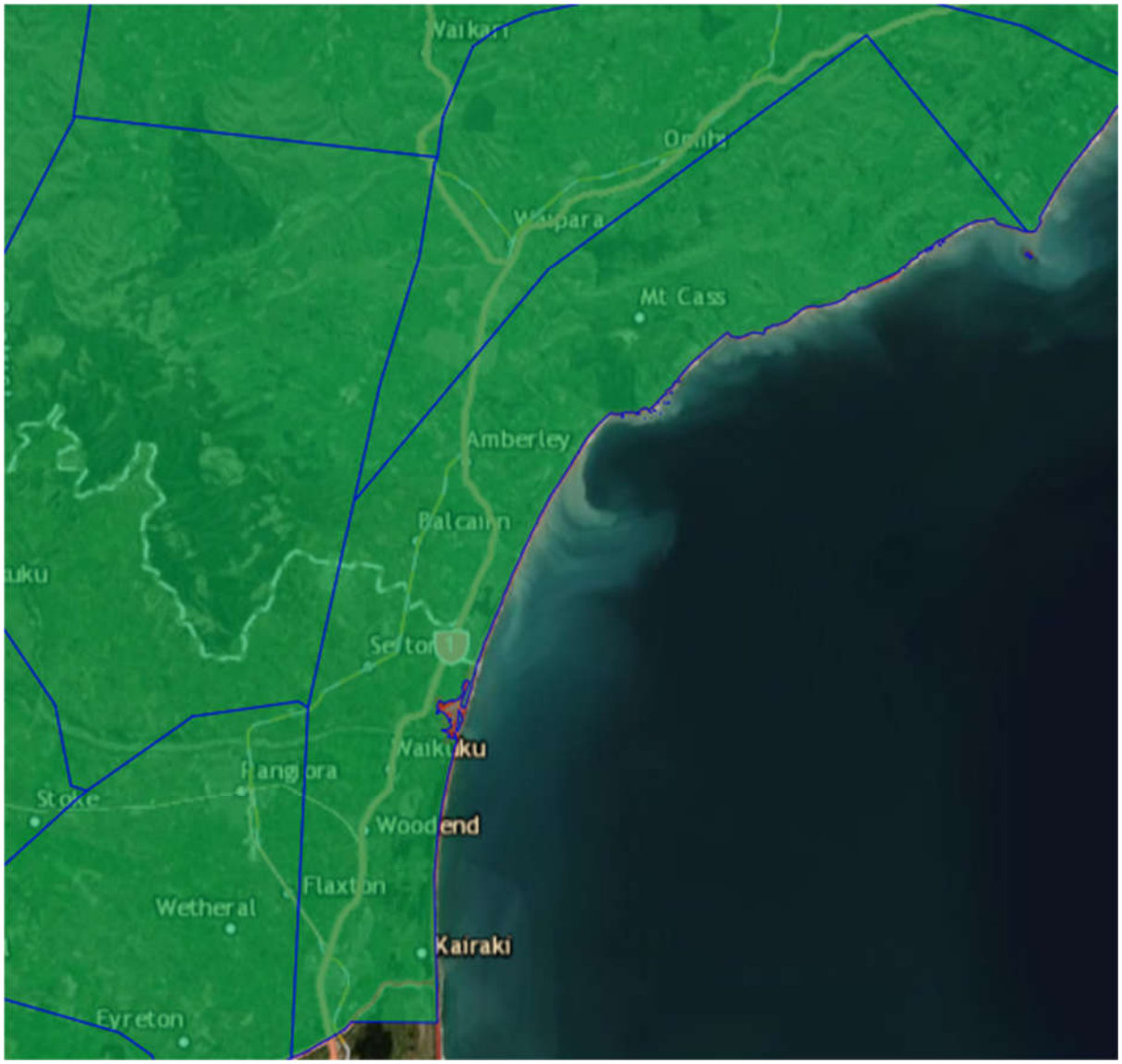


Figure 3 - NZ fire danger class for Salt Water Creek, North Canterbury (Example)

From the status level (as shown in the figure 3 example), and the fire season, the appropriate controls can be put in place as per the controls for each fire level defined in Appendix C.

6. Risk Minimisation Procedures - Detailed Design

6.1 Design Phase Risks

During detailed design of the wind farm there will be limited activity on site and therefore less risk of a fire occurring. However, there will also be less facilities in place, including access roads, so the consequences of a fire may be greater.

6.2 Mitigation

Any design phase activities involving machinery (e.g. geotechnical drilling) should be assessed on a case by case basis and fire safety operating procedures be submitted as part

of the contractor's method statement. All contracts are to include provisions for adherence to the latest version of this Fire Management Plan and any relevant SOP's.

There is a requirement under the resource consent to ensure adequate protection is in place prior to undertaking any activities authorised by the consent, including any preliminary geotechnical investigations. Hence any preliminary works will require a SOP, which specifically addresses fire management, approved by the project manager.

The wind farm design, including Turbine selection included consideration of the ability to mitigate fire risk including, track record, transformer type and any active or passive fire detection or suppression systems. A design review for fire risk was undertaken by the design team.

7. Risk Minimisation Procedures - Construction

7.1 Construction Risks

The objective of the construction works will be to complete access routes, platforms, substation and foundations as soon as possible to allow the connecting infrastructure and turbines to be erected and the turbines progressively connected to the network. The likely construction sequence for the site is as follows:

- Site mobilisation, including establishment of temporary site offices, workshops, stores and other facilities;
- Installation of erosion and sedimentation control measures;
- Preparation of initial haulage routes to provide access for construction plant. Haulage routes will follow as close as possible to the proposed alignment of the proposed access roads or may use the existing farm tracks;
- Access road excavation and formation, with cut material transported, placed, and compacted as fill or at disposal sites. Installation of culverts, where appropriate;
- Preparation of laydown areas and the substation platform;
- Installation of internal electrical reticulation along the road;
- Construction of the concrete batching plant site platform and establishment of the batching plant including aggregate stockpile areas, water storage, etc;
- Delivery of concrete aggregates – progressive as concrete demand dictates;
- Construction of substation;
- Construction of overhead transmission line;
- Construction of the turbine access roads and working platforms for turbine foundations and crane set up;
- Excavation for and construction of reinforced concrete turbine foundations (as working platforms are created);
- Cut slope and disposal site rehabilitation progressively behind earthworks;
- Installation of remainder of internal transmission network;
- Delivery and erection of towers, nacelles and rotors;
- Progressive commissioning of turbines; and
- Removal of temporary services and site offices, laydown area rehabilitation and general site reinstatement.

7.2 Mitigation

The following mitigation will take place to minimise the possibility of a fire:

Hot Works

- Hot Works Permit required for all hot works – refer Appendix C for controls to be implemented for hot works.
- Where, and only if possible – Hot Works involving direct spark or flame tasks will be done early morning/late in date, or during foggy days/high humidity. Do not undertake hot work outdoors during prohibited fire seasons unless you have a special permit.
- Hot Works Permits for all high fire risk work with fire permits obtained from FENZ as necessary.
- Wet down the area you are working in and have firefighting equipment handy if the conditions are dry.
- Carry appropriate fire extinguishers, shovels, or knapsack sprayers.
- 30 minutes after you have finished the hot work, do a final check for any hot spots that might cause a fire.

General

- Stop using welders, chainsaws, slashers, and some tractor operations, on extreme fire danger days.
- No Smoking except in locations authorised by the Project Manager.
- No gas cookers on site except in locations authorised by the Project Manager.
- Fire extinguishers in all vehicles and site buildings.
- Vehicle use restricted to formed roads when fire risk exceeds 'High' unless vehicles are equipped to eliminate spark hazard.
- Vehicles that are determined to be suitable for off-road use (i.e. have appropriate spark suppression) are to be recorded in a register and marked with a windscreen sticker.
- Review FENZ information at least daily with records kept for verification if necessary.
- Store petrol, diesel fuels and chemicals in clearly labelled approved containers and in single-purpose locations away from other buildings.

7.3 Maintaining Machinery

- Fire extinguishers in all vehicles
- Check all machinery is free of mechanical defects that could start a fire and has approved exhaust systems and spark arresters.
- Pay special attention to checking your machinery's bearings and moving parts.
- Clean all machinery regularly to ensure belly pans and spaces around motors are free of oil, dust, grease, birds' nests, grass and straw.

7.4 Equipment and Preparation Prior to Works

The following fire equipment is to be onsite for the duration of the construction operation:

- A primary water filling point located just west of Mt Cass peak. This will have 30,000 litres of storage, in addition to that necessary for farm or construction operations. This area will be equipped as a fill point for helicopters.

- A second water point comprising a water tank of at least 10,000 litres will be located at the substation site. This fill point will be suitable for refilling of the 'smoke chaser' units but may not be suitable for helicopters.
- "Smoke chaser" unit (typically a 4WD flatbed truck/ute) equipped with up to 400 litres of water storage a pump and micro-droplet delivery system. The smoke chaser unit will be the primary tool for grass and debris fire suppression should such events occur.
- High Volume filling pump complete with hoses.
- Hand tools including shovels, mattocks and knapsack sprayers.
- Vehicle/machinery fire extinguishers (Mandatory on all site equipment).
- Personal Protective Equipment (PPE)
- Weather recording equipment

For tanker filling requirements the nearest hard-drafting location is in Omihi Stream or the Waipara River (accessed from Mt Cass Road adjacent to the Omihi Stream Bridge). For extended helicopter operations several water points exist in the Omihi Forest block to the north of the ridge.

7.5 Training – On-site Personnel

The following training of on-site personnel will be undertaken prior to the start of fire season:

- Review of all fire prevention / control measures.
- Fire equipment familiarization and operation.
- Emergency Response Plan review and training – refer the emergency response plan.

Fire extinguisher training will be undertaken by plant operators. Other training requirements will be included in emergency response plan.

8. Risk Minimisation Procedures - Operation

Once fully commissioned the wind farm site will change from Construction to its Operational phase. At this point the Site Manager will be the head of Operations and Maintenance. This will include the responsibilities for Fire Management and Incident Control when necessary.

8.1 Fire Suppression Practices and Tools

Grass fires are the most likely fire type to be encountered on the site. Grass fires can move at great speed and are even faster when fanned by the high winds typical across the wind farm. Primary control of grass fires is by ensuring 'fuel loads' are kept to a minimum during Fire Danger periods of "High" or above. This is commonly achieved by maintaining appropriate levels of grazing across the site. Special consideration will need to be given to areas where grazing has been reduced to encourage establishment of woody vegetation, however, these areas are mostly away from the wind farm infrastructure.

Turbine nacelle fires are very rare but may result from brake or electrical failure and could occur during high winds. For fires of this nature, the principal aim is to prevent the fire from spreading (because of burning debris) until it has burnt itself out.

The turbines will be installed with a specific fire detection system where the primary function is to detect and send a response signal to the SCADA system operators & employer in case of fire in the turbines nacelle and down tower assembly (detected using smoke sensors). This system does not provide fire suppression.

Remote monitoring of the turbines should detect a nacelle fire very early and the Emergency Services shall be notified on 111 if fire is detected.

Regular maintenance of the turbines including lubrication and cleaning of accumulated debris will assist in mitigating the risk of nacelle fire.

8.2 Training – On-site Personnel

Site personnel will be trained in the Fire Management Plan. The Operations Emergency Response Plan will also outline any other training requirements.

9. Emergency Response

The Emergency Response plan will outline the process for all responses in the case of emergencies. The below is the outline of the fire emergency response.

9.1 Standard Immediate Actions

When an emergency occurs, standard immediate actions are used to:

- Raise the alarm
- Ensure the safety of all workers and public nearby as the first priority,
- Assess the situation and decide on a response to the situation

The following is the Standard Immediate Actions in the order that they should be carried out:

- Check your own safety
- Raise the alarm
- Make the area of the emergency safe if possible – put out the fire if possible, never put yourself in harm's way
- Senior person at the scene takes control until someone more qualified turns up on site and takes control.
    - Senior worker accounts for all workers using sign in book and records that this has been done
    - Assesses the situation and decides on course of action, based on Emergency Response Plan including contacting emergency services as required
    - Inform Project Manager
    - Secures the site to ensure that public/media are unable to enter the site area using a physical barrier that is controlled – Site access controller to monitor the cordon and record access/egress
    - Designate a guide for emergency services

9.2 Evacuation Procedures - Immediate site evacuation to muster point

When an alarm is raised, people on the Mt Cass Wind Farm are to assemble in the Primary Assembly Area. If it is unsafe to do so they are to assemble at the Secondary Assembly Area which is shown on the emergency response layout drawing. Once there, a roll call will be carried out by the senior site worker and all workers accounted for.

All resources and expertise available on site are to be made available to FENZ. Personnel on site will comply with directions given by FENZ.

No one will leave site until they have been given direction by FENZ or the Project Manager

No one will re-enter site until FENZ or the Project Manager has approved that it is safe to do so.

10. Plan, Review and Distribution

This plan is an integral part of the Environmental Management Plan (EMP) for the site and the Construction Management Plan for the wind farm. As part of the EMP it is to be publicly available via the MCWF web site and at the Amberley and Christchurch City libraries. All personnel working on the Mt Cass wind farm site will attend a site-specific induction prior to work commencement. At the induction, the fire plan and emergency response plan will be discussed with copies of the evacuation plan distributed.

As detailed in Resource Consent Condition 120, the Fire Management Plan is to be available for viewing by the Consent Authority on request in writing.

Drivers on short term delivery assignments and site visitors will receive a short form induction. During this induction they will be made aware of the fire hazards on site and will be issued with a copy of the evacuation plan. All subcontractor employees and visitors will receive the contractor's briefing on the fire risks at the site. This briefing is to be recorded in an induction checklist.

Members of the public using the walkway to access the site will be made aware of the potential fire danger via noticeboards. When the fire risk is high the walkway will be closed, and the public notified of this via the wind farm web site.

Any reviews to the management plan shall be approved by the Project Manager and distributed to all parties as required.

11. Appendices

Appendix	Description
A	Agencies Available for Assistance
B	Training Matrix
C	NZ Fire Danger Classes & Codes and Recommended Risk Mitigation Measures
D	Hot Works Permit (Sample Only)
E	Fire Suppression Water Storage and Access Road Plan

Appendix A: Agencies Available for Assistance

Fire and Emergency New Zealand	
Direct Contact	Bruce Janes
Role	FENZ PRFO
Email	bruce.janes@fireandemergency.nz
Contact Details	027 278 5052

Department of Conservation	
Direct Contact	Abby Lawrence
Role	Senior Ranger Community
Email	alawrence@doc.govt.nz
Contact Details	027 280 5359

Emergency Contact Details	
Police	111
Fire	111
Ambulance	111
Amberley Volunteer Fire Brigade	http://maps.google.com./?q=21 Markham Street, Amberley, New Zealand03 314 8600 21 Markham Street, Amberley
Waipara Volunteer Fire Brigade	03 314 6707 94 Glenmark Drive

Appendix B: Training Matrix

	MCWF Construction Manager	*Site Manager*	*Hot Works Spotter*	*General site staff*
All personnel and visitors onto the site will be required to attend an induction when they first arrive on site. Part of this induction will include aspects of the Fire Management Plan. Inductions will also address the smoking policy on site, Hot Work Permits, emergency phone numbers, and aspects of the Emergency Response Plan and the muster area.	✓	✓	✓	✓
Hot works Permit Process and Authorisation	✓	✓	✓	
Safe Operation Training for Water Cart			✓	

Appendix C: NZ Fire Danger Classes, Codes & Recommended Risk Mitigation Measures

Code (Fire Danger Class)	Green (Low) You can still carry out the work, but you need to be ready with a fire extinguisher, water, a shovel and a radio or working phone to call it in if there is a fire.	Blue (Medium) You can still carry out the work, but you need to be ready with a fire extinguisher, water, a shovel and a radio or working phone to call it in if there is a fire.	Yellow (High) You can still carry out the work, but you need to be ready with a fire extinguisher, water, a shovel and a radio or working phone to call it in if there is a fire.	Orange (Very High) Schedule your jobs before 10:00am or after 6:00pm	Red (Extreme) Only essential work should be carried out and only before 10:00am or after 6:00pm
Activity	Mitigation Measures	Mitigation Measures	Mitigation Measures	Mitigation Measures	Mitigation Measures
Welding/gas cutting/abrasive wheel cutting	• Work only on bare earth • Have a fire extinguisher/minimum of 20 litres of water, along with an appropriate method of applying that water, within 5 metres of the work area • Patrol for 30 minutes after completion	• Work only on bare earth • Have a fire extinguisher/minimum of 20 litres of water, along with an appropriate method of applying that water, within 5 metres of the work area • Patrol for 30 minutes after completion	• No Hot Work unless on a 20 metre radius of bare ground • Have a fire extinguisher/minimum of 20 litres of water, along with an appropriate method of applying that water, within 5 metres of the work area • Patrol for 30 minutes after completion	• No Hot Work unless on a 20 metre radius of bare ground • Have a fire extinguisher/minimum of 20 litres of water, along with an appropriate method of applying that water, within 5 metres of the work area • Patrol for 30 minutes after completion	• Consider stopping all Hot Works for a defined period unless a smoke chaser plus crew can be located nearby, OR • Work before 1000 hours and after 1600 hours; OR wet the area before and after the Hot Works; maintain 1000 litres of water plus pump on site for two hours following the final wet-down • Maintain observation presence for two hours afterwards
Inspections & maintenance requirements		• Check machinery for debris build up near hot working parts such as belly pans and radiators • Check engine bay hydraulic hoses for leaks	• Check machinery for debris build up near hot working parts such as belly pans and radiators • Check engine bay hydraulic hoses for leaks	• Daily - Assess daily weather at 1300 hours by forest to determine need for elevation of readiness level • Weekly - Inspection of all fire equipment (including extinguishers) - Regular cleaning for all machinery	• Daily - Assess daily weather at 1300 hours by forest to determine need for elevation of readiness level • Weekly • Inspection of all fire equipment (including extinguishers) • Regular cleaning for all machinery
Fire starts		Notify 111 of any fire start regardless of size	Notify 111 of any fire start regardless of size	Notify 111 of any fire start regardless of size	Notify 111 of any fire start regardless of size
Emergency planning		• Notify FENZ of any road closures or weekend work • Inform the workforce about Code Blue requirements and preparation for future elevation to Code Yellow at, for example, tailgate meetings	• Notify FENZ of any road closures or weekend work • Inform the workforce at tailgate meetings about Code Yellow requirements. • Escape plans: Consider covering in tailgate meetings	• Inform the workforce about Code Orange requirements and preparation for future elevation to Code Red at tailgate meetings • Consider covering in tailgate meetings: Escape plans, initial response actions • Identify suitable water points (for ground and helicopter) around work areas	• Inform the workforce about Code Red requirements at tailgate meetings • Consider covering in tailgate meetings: Escape plans, initial response actions • Identify suitable water points (for ground and helicopter) around work areas and maintain as appropriate • Patrol sites for at least one hour after machine shutdown • Consider having a 3-person quick response crew with smoke chaser based at a central location. • Liaise with FENZ to determine FENZ initial response plans in case of fire
Machines				• Vehicle use restricted to formed roads when fire risk exceeds ‘High’ unless vehicles are equipped to eliminate spark hazard	• Vehicle use restricted to formed roads when fire risk exceeds ‘High’ unless vehicles are equipped to eliminate spark hazard

Appendix D: Hot Works Permit (SAMPLE ONLY)

1	**Project Name:**					**Date:** ...../...../.....
2	**Fire Hazard Level**	**Green** (Low)	**Blue** (Medium)	**Yellow** (High)	**Orange** (Very High)	**Red** (Extreme)

3 SCOPE OF HOT WORK: (define as clearly as possible).....

.....

.....

.....

.....

.....

NO HOT WORK OUTSIDE THIS SCOPE MAY BE PERFORMED UNDER THIS PERMIT

4 POTENTIAL IGNITION SOURCES: (Tick as required)

☐ Thermal Cutting ☐ Grinding ☐ Abrasive Blasting ☐ Welding ☐ Electric Arc Of Any Type

☐ Electric Tools ☐ Drilling ☐ Radiography ☐ Impact Tools ☐ Combustion Engine

☐ Non Intrinsically Safe Equipment ☐ Other

.....

5 POTENTIAL FUEL SOURCES: (Tick as required)

☐ Fuel Oil (liquid) ☐ Lubricating Oil (liquid) ☐ Timber ☐ Vegetation / Grass ☐ Plastics

☐ Fuel Oil (vapour) ☐ Lubricating Oil (vapour) ☐ Paper ☐ Chemicals ☐ Electrical Cables

☐ Gas ☐ Nil ☐

Other.....

6 HOT WORK CHECKLIST: (Tick as required the precautions taken, refer NZ Fire Danger Classes & Codes and Recommended Risk Mitigation Measures)

☐ No Hot Work unless on a 20 metre radius of bare ground

☐ Have a fire extinguisher/minimum of 20 litres of water, along with an appropriate method of applying that water, within 5 metres of the work area

☐ Work area swept and wetted down ☐ Water hose rolled out and left running

☐ Appropriate fire extinguisher ready for use

☐ Means of escape identified and available ☐ Isolations on Associated Permit adequate

☐ Patrol for 30 minutes after completion

7 SPECIFIC PRECAUTIONS TO BE TAKEN DURING THIS HOT WORK: (Tick as required)

☐ Ventilation ☐ Fire Watch Required ☐ Barricades/Signage ☐ Sparks To Be Contained

☐ Extraction ☐ Respiratory Protection ☐ Inert Gas Purge To Be Maintained

OTHER PRECAUTIONS: (include any special PPE).....

.....

.....

8	**PERMIT ISSUE**: All precautions in section 5 have been made to ensure the safety of those working under this permit. All the conditions on this permit have been discussed with the permit acceptor & I authorise work to proceed. **All hot work permits are Valid for 1 Day.**

Authorised Issuer:…… Signature: .....

9	**PERMIT ACCEPTANCE**: All Work Crew members involved in the hot work confirms & accepts that conditions stated in this work permit & any associated procedures will be strictly adhered to & all persons are aware of all conditions relating to the scope of the hot work.

Name: ..... Signature: ..... Name: ..... Signature: .....

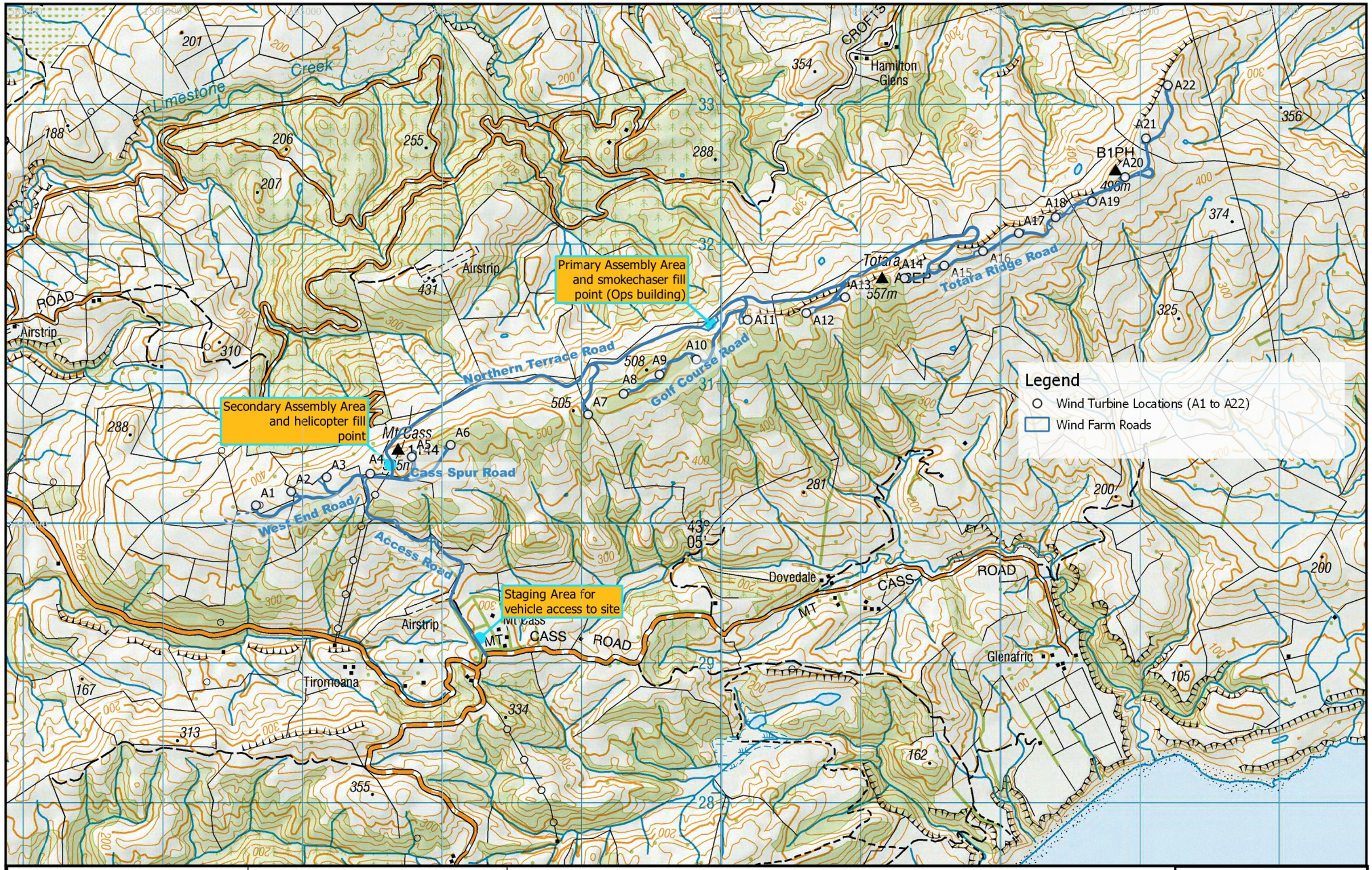
Name: ..... Signature: ..... Name: ..... Signature: .....

Name: ..... Signature: ..... Name: ..... Signature: .....

10	PERMIT CLOSURE: Accepts and confirms completion as above and verifies permit has been returned and signed off by Acceptor. Precautions recorded in section 5 have been removed and the area has been inspected and left in a safe condition. Site has been Patrol for 30 minutes after completion

Authorised Issuer:…… Signature: .....

Appendix E: Fire Suppression Water Storage & Access Road Plan



Mt Cass Wind Farm

Background map: NZ Topo50
Sourced from the LINZ Data Service and licensed for re-use under the Creative Commons Attribution 4.0 International License.

MT CASS WIND FARM
Features for Fire Management

Drawn: AJH 27 Oct 2020
Scale (at A3) 1:25,000
Drg 4768 - Sheet 1 of 1

Appendix 4: Post-Construction Bird Collision Monitoring Plan

Mt Cass Wind Farm
Post-Construction Bird Collision Monitoring Plan

Revision 11 – 26 April 2023

This Post-Construction Bird Collision Monitoring Plan has been prepared for Mt Cass Wind Farm Limited by:

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Version	Status	Issue Date
Rev 11	Operative version	26 Apr 2023
Rev 10	Final Report submitted for Approval by HDC (Boffa Miskell) & DoC	15 Sep 2022
Rev 9	Draft Review for Approval & Issue	15 Aug 2022
Rev 8	Second draft following internal joint review	01 Aug 2022
Rev 7	First draft following teleconference with HDC (Boffa Miskell) & DoC on 9 June 2022	15 May 2022
Rev 6	Draft submitted for review by HDC (Boffa Miskell) & DoC	28 Mar 2022

Table of Contents

Prepared by: Ingrid Stirnemann, Derek Christie & Gerry Kessels

Reviewed by: David Riddell

Version: 11: 26 April 2023

PWF Ref: MPN.00652

1 Introduction

1.1 Scope

Mt Cass Wind Farm Limited has obtained Hurunui District Council (HDC) Land Use Resource Consent (RC070250) to construct, operate and maintain Mt Cass Wind Farm in North Canterbury. The consent conditions require the preparation of a Post-construction Bird Collision Monitoring Plan (PCMP) with the objective of estimating bird fatality from wind turbines and associated infrastructure at Mt Cass Wind Farm (the relevant consent conditions are contained within Appendix A).

The aim of the monitoring programme is to:

- Identify whether mortalities are occurring;
- Identify mortality rates, including the effect of carcass detection and carcass persistence on the mortality rate estimate;
- Determine what species/species groups are involved;
- Determine where mortalities are occurring and how they relate to project operations;
- Identify environmental factors that may have increased the potential of wildlife interaction with the renewable energy infrastructure (i.e., changes in weather, fog etc.); and
- Determine if operational mitigation is required.

The post-construction bird fatality monitoring programme was required to estimate the level of avian mortalities occurring at the wind farm, particularly regarding the key species of interest (resource consent condition 72) that are resident at Mt Cass: New Zealand falcon (*Falco novaeseelandiae*), New Zealand pipit (*Anthus novaeseelandiae*) and New Zealand pigeon/kererū (*Hemiphaga novaeseelandiae*), and develop an appropriate adaptive management approach and/or mitigation if required.

Resource consent condition 74 requires that the monitoring programme be designed in consultation with the Department of Conservation (DOC), and the results of all monitoring shall be provided to the HDC and the DOC annually.

1.2 Site Context and Area Description

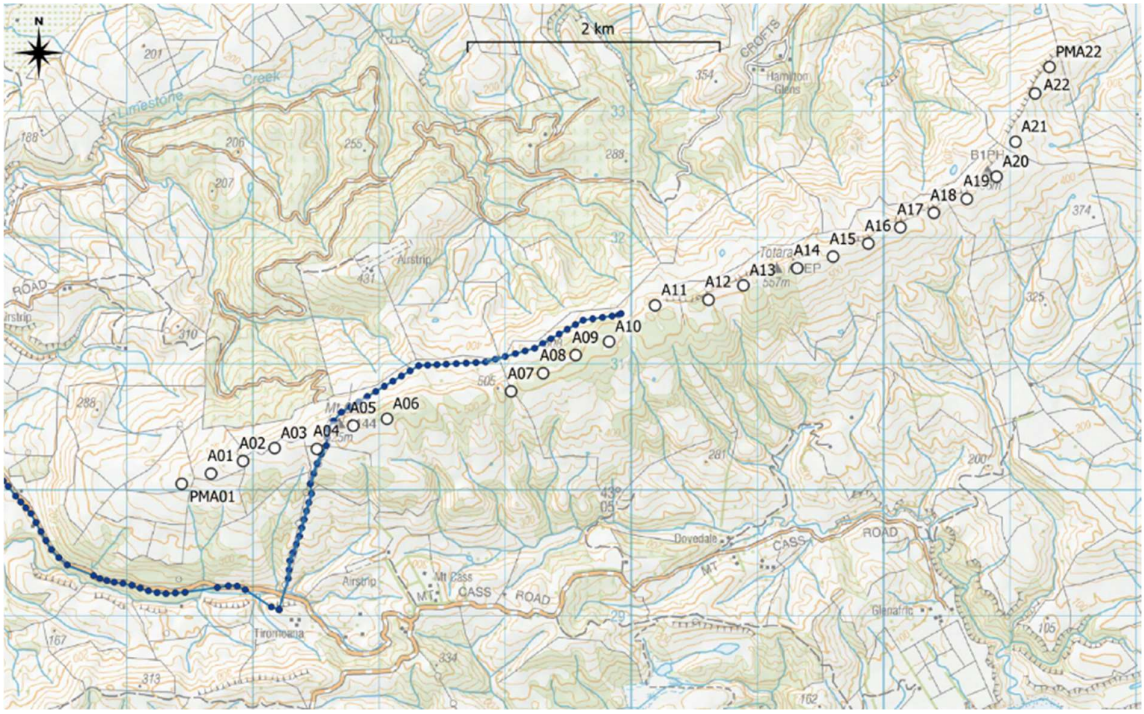
The Mt Cass Wind Farm project area (the wind farm envelope) is located in North Canterbury, approximately 53 km north of Christchurch and 10.7 km north-east of Amberley at an altitude of approximately 500 m asl. It is located approximately 4 km from the east coast of the South Island.

The Mt Cass site lies on a high limestone escarpment ridgeline (Figure 1). The vegetation of the Mt Cass ridgeline comprises a complex mosaic of variously sized and moderately interconnected mixed conifer-angiosperm forest remnants, regenerating divaricating shrubland communities and grasslands. The mosaic of vegetation types along the Mt Cass ridge provides diverse habitat for native birds.

1.3 Mt Cass Wind Farm

Mt Cass Wind Farm Ltd proposes to install twenty-two Siemens Gamesa Renewable Energy (SGRE) 'DWT-DD120-4.3' wind turbine generators (WTG) which will have a total capacity of 94.6 MW. Each turbine is 4.3 MW with a 120 m Rotor Diameter and 76.5 m Hub Height. The DWT-DD120-4.3 has a blade length of 58.6 m, a rotor swept diameter of 120 m, and a rotor swept area (RSA) of 11,300 m^2. Given a hub height of 76.5 m, the rotor swept area (RSA) occurs 16.5 - 136.5 m above the base of the tower. The wind farm is planned to extend approximately 7.5 km along the Mt Cass ridgeline from south-west of Mt Cass to north-east of the Oldham spot height. The lowest turbine is located at an altitude of 415 m, and the highest at 537 m. The highest point on the ridge is 557 m.

Mt Cass Wind Farm will include two permanent meteorological masts within the wind farm footprint at either end of the ridge. Transmission lines are 66 kV, typically single pole mounted with wires in a delta configuration. The line starts at the substation on the northern terrace below turbine A10 and runs west along the terrace, crossing the ridge close to turbine A04 and then running down the southern slope to Mt Cass Road, in the valley.



[Figure 1] Mt Cass turbine locations (A01-A22), two permanent meteorological masts (PMA01 and PMA22) and transmission line (blue line and blue dots) lie on a high limestone escarpment ridgeline.

1.4 Bird species at Mt Cass

Pre-construction baseline point counts and bio-acoustic surveys at Mt Cass recorded 31 bird species, with 17 of these being native species and 14 introduced (Jolly 2015) – see Appendix B for the Mt Cass bird species list. Native birds of open country and farmland were recorded during the baseline surveys including Australasian harrier (*Circus approximans*), New Zealand pipit (*Anthus novaeseelandiae*), paradise shelduck (*Tadorna variegata*), spur-winged plover (*Vanellus miles*) and welcome swallow (*Hirundo tahitica*).

Native species of forest remnants and shrubland communities including silvereye (*Zosterops lateralis*), kererū, bellbird (*Anthornis melanura*), fantail (*Rhipidura fuliginosa*), and grey warbler (*Gerygone igata*) were also recorded during the baseline surveys (Jolly 2015).

Key species of concern (threatened/at-risk/migrant) that have been observed or recorded at Mt Cass include the "Threatened – Nationally Vulnerable" New Zealand eastern falcon (*Falco novaeseelandiae* "eastern"), and two New Zealand bird species that have been listed as "At Risk – Declining": the South Island pied oystercatcher (*Haematopus finschi*, aka SIPO), and NZ pipit (Robertson et al. 2021). Resident kererū are also of concern as their display flight can take them into the turbine blade strike zone, a behaviour that is also observed in NZ pipit (HANSAB 1990-2006). Movement of the "Threatened - Nationally Critical" Australasian bittern (*Botaurus poiciloptilus*) has been mapped moving from Te Waihora/Lake Ellesmere in Canterbury to Wairau Lagoon in Marlborough. This bird flew in both directions (northwards and southwards) through the Waipara Hills (GPS transmitter work being undertaken by DOC, Colin O'Donnell *pers comm*).

SIPO are the most abundant migratory species within New Zealand (HANZAB 1990-2006). Bio-acoustic recorders detected SIPO passing though the wind farm envelope on Mt Cass Ridge (Stewart *et al* 2014). Other internal migrant bird species (i.e. wrybill, *Anarhynchus frontalis*) and external migrant waders (e.g. Eastern bar-tailed godwit, *Limosa lapponica bauer*i) have been observed using similar flight paths to SIPO in other wind farm projects (I Stirnemann/ G Kessels pers obs). Other species that may use these flight paths include pied stilt (*Himantopus himantopus*) and banded dotterel (*Charadrius bicinctus*), as well as other migratory wader species such as red knot (*Calidris canutus*).

2 Field Methods

2.1 Overview

Globally, including within New Zealand, the most widespread method of monitoring onshore wind farm bird collisions involves the regular search for carcasses and remains, under operating wind turbines (e.g. Hull and Muir 2010, Hull et al 2013, Bull et al 2013). However, even if a site is checked daily, scheduled searches for carcasses on a wind farm site are likely to provide an under-estimate of the wind turbines' associated bird mortalities. Two key factors that influence accurate fatalities estimates include carcass removal by predators and imperfect detection of carcasses by searchers. Wind farm mortality rates are generally adjusted by these estimates of error (Huso 2011). Therefore, the three survey components of the PCMP include:

1. Carcass searches;
2. Carcass persistence trials; and
3. Carcass detection trials (See Table 1).

Further details on each of these components is provided in the following sections.

Method	Objective
Standardised mortality monitoring	Estimate of the mortality rates of birds within the windfarm with a focus on target species.
Carcass persistence rate trials	Estimate the length of time avian carcasses remain in the searcharea prior to being removed to account for bias in persistence rates.
Carcass detection rate trials	Estimate the percentage of avian carcasses found (detected) bysearchers to account for bias in carcass detection.

[Table 1] Three survey components required to estimate bird mortality within the wind farm envelope and to adjust for error

Carcass persistence and imperfect detection by searchers can be influenced by site- and carcass-specific characteristics (e.g. carcass size), season, type/density of vegetation cover and individual searchers' abilities (Morrison 2002; Labrosse 2008). Therefore, these factors have been incorporated into the Post-construction Bird Collision Monitoring Plan design at Mt Cass.

2.2 Standardised Mortality Monitoring

2.2.1 Search Effort

All twenty-two turbines will be searched in a systematic way for bird carcasses during the standardised mortality monitoring survey. Each turbine at Mt Cass is numbered (i.e. from A1 to A22, see Figure 1). Eight turbines will be randomly selected per season (hereby called the search session). The shape of the search area (a circle) is as suggested by Gauthreaux (1995). Four search sessions will be undertaken per year (i.e. annual turbines searched *N*=32) over a two-year period (see Section 2.2.2). The PCMP will then be repeated again in 5 years from the first standardised survey years (consent condition 71c). This design will ensure that the whole windfarm will be represented in the sampling and that inter-annual variation is recorded.

Each search year, random selection of turbines will be undertaken using a random number generator that is constrained to the number of turbines. All turbines will be monitored a minimum of once a year (i.e. once a turbine has been selected for monitoring it will be excluded from random number generator until all turbines have been selected). Some turbines will be randomly selected more than once within a year.

A Monte-Carlo simulation model based on ballistic theory (as use by Hull and Muir) was used to calculate the search radius for a turbine with a blade length of 56.9 m. This model is used to estimate the fall zone distribution of different sized bird carcasses after colliding with different sized wind turbines. This two-dimensional (2-D) ballistics model describes the carcass fall trajectory in the plane of the turbine rotor. The Hull and Muir model assumes that the carcasses are stationary in the rotor plane before being hit by the blade and calm conditions, resulting in no wind drift effects on the carcass' as they fall toward the ground. The output from the Hull and Muir model is a one-dimensional (1-D) fall distributions of carcasses from the tower, along the rotor plane.

Six key New Zealand bird species carcasses fall distances were modelled using the Hull and Muir model - NZ falcon, harrier, NZ pigeon, SIPO and paradise shelduck [medium to large birds > 38 g], and NZ pipit [small <35 g]. For each bird species a simulation run consisted of the trajectories of >110 000 carcass strikes and their resulting flight-paths. Certain parameters of the Mt Cass Wind Farm were all input as static parameters into each simulation, i.e. the height of the turbine hub (Hhub), the turbine rotor radius (Rmax), and the rotational frequency of the turbine (ω). Based on simulation the modelled fall zones was depicted from the base of the turbine for each species.

The model outputs predicted that the maximum distance travelled by a NZ pipit carcass for the wind turbine was 72.9 m from the turbine base (i.e. 99% of the simulations fell within this distance assuming a blade length of 56.9 m and 76.5 m hub height[1]). It was found that the maximum distance travelled by a NZ paradise shelduck carcass from the turbine base was 94.6 m (i.e. 99% of the simulations fell within this distance for a blade length of 56.9 m

[1] The modelling was carried out using a turbine with a 117 m rotor diameter. The difference in estimated fall radius for a turbine with a 120 m rotor diameter is expected to be captured by the extended search area.

and 76.5 m hub height). The model predicted that the other four species fall zones fell between these two species.

Smallwood (2007) suggested that an insufficient search radius could bias mortality data estimates. Given that the blade length of wind turbines to be used at the Mt Cass Wind Farm is slightly longer than that used in the ballistic model a search radius slightly greater than 95 m may be appropriate. To account for these estimate biases and potential biases in the modelling (e.g. no wind drift effects were accounted for in Hull and Muir 2010), searchers will use an extended search area, of 120 m radius, for the 1st year (See Figure 2). The 120 m search radius will be assessed, and recommendations made at the end of the 1st year by appropriate MCWF experts in consultation with DOC and HDC experts. Recommendations will use the data obtained in the 1st year to determine if a smaller search area then 120 m would be appropriate e.g. if 95% of carcasses are within the 95 m radius.

This component of the monitoring design will fulfil the Resource Consent Conditions (61b, iv) requiring extended searches of some turbines. Exclusion maps will be prepared prior to surveys commencing depicting exclusion areas where searches will not take place (because of safety, environmental, geographical or topographical constraints). These exclusion area maps are to be reviewed by DOC and HDC experts prior to the surveys commencing and once ground-truthed. Exclusion areas will also be taken into account in the statistical analysis to ensure that an adequate search effort is maintained throughout the survey term and area of the wind farm (see Section 3).

Each search plot will be divided into equally spaced belt transects (10 m apart). Equally spaced transects will ensure that the search effort will be evenly distributed across the search area, where feasible and safe for searchers. The direction the transects are orientated will differ depending on each site's constraints (e.g. some sites will be orientated along fence lines, some across the contour, and the orientation of other sites will take into account landscape features such as vegetation and rock formations). Careful consideration of the transect orientation at each site is needed to enable searchers to walk along the safest and most energy efficient routes that cover the greatest area (see Appendix F for the proposed transects; please note these still require ground-truthing).

A suitable GIS program will be used to create a spatial layer of transect locations within each of the 22 search plots, which will then be uploaded to a handheld GPS unit (an example layout is shown in Figure 2). The GPS will be used in the field to navigate along the transect lines during carcass searches. This search pattern will remain the same for the entire duration of the PCMP to maintain searcher consistency.

A draft layout of the survey transects at each wind turbine is shown in Appendix F. Principles and potential constraints adopted in developing these transects are:

- The standard search area for the 1st year is a 120 m radius – centred on the turbine and assessed for utility in the ongoing programme. The search radius will be assessed at the end of the 1st year to determine if a smaller search area would be appropriate (e.g. if 95% of carcasses are within the 95 m radius) and approved by DoC and HDC experts.
- A series of transects will be created that cover the search area as efficiently as possible, allowing for a 5 m buffer around each transect (being the effective search area using dogs).

- Logistical and safety constraints will be considered when siting the transects– including:
  - Aligning transects with main geological features (observation on site shows that this is often the path of least resistance through bush and limestone pavement areas.
  - Traversing of slopes is preferred as often offering path of least resistance.
  - Built features (e.g. fencelines and proposed roads).
- Vegetation constraints are also to be considered, including:
  - Penetrating certain vegetated areas with a dense under-storey, often consisting of onga-onga, is not practical and could be hazardous (especially to dogs).
  - Density of vegetation on rocky outcrops which cannot be penetrated or searched.
  - Locations of rare plants are to be treated with caution.
  - Dense canopy (especially with vines) may mean that carcasses don't make it to the ground.

2.2.2 Schedule of Search Sessions

Four seasons will be monitored annually. These seasons will cover key at-risk periods for resident bird species (e.g. NZ pigeon and NZ pipit, can fly through the turbine rotor sweep area (RSA), particularly during display dive rituals in the mating season), as well as key movement periods for migratory bird species (e.g. New Zealand internal and external migratory bird species). Due to the number of turbines being monitored, each search session will span over multiple consecutive days. During each season the study turbines will be searched in the same order to ensure the 0, 7, 14, and 21 day search periods are correct for each turbine. Each turbine search area will contain spaced transects every 10 m. The following schedule is recommended, based on the literature (grey and published scientific articles) and key behavioural observations that would result in resident birds being at higher risk of strike.

The schedule of search sessions are to be carried out in the following months (dog aided only, see Sections 2.2.3 and 2.2.4):

- January (migration period)
- March
- July (migration period)
- October (after lambing)

Four search sessions per season are to be conducted as follows (dog aided only, see Sections 2.2.3 and 2.2.4):

- 0 day (first day of search within a season)
- 7 days
- 14 days
- 21 days

Additional surveys may be required if substantial mortality is observed, particularly to evaluate any mitigation measures that that may have been introduced (see Section 5). The mortality monitoring programme shall be repeated after a period of 5 years of operation of the wind farm (consent condition 71c).

[Figure 2] Example mortality search plot and transect placement. The standardised mortality search plot is a 120 m radius search area centred on each turbine for the 1st year of surveys. The 95 m area is the area where 99% of carcasses have been modelled to fall after being struck for a turbine with a 117 m rotor diameter. Mt Cass Wind Farm Ltd proposes to install twenty-two turbines with a 120 m rotor diameter.

2.2.3 Dog Team Search Techniques

Turbine searches at Mt Cass will be undertaken with a trained dog and human handler. This technique has been shown to have substantially better detection rates leading to increased accuracy in carcass detection (Paula et al 2011, Smallwood et al 2020) and be more efficient (Mathews et al 2013). Carcasses found by the human handlers as part of a dog-human fatality detection team will also be recorded (see Section 2.6 for recording method).

During daylight hours searchers will undertake a grid search along set parallel transects within the search area. The handler will use a global positioning system (GPS) to track and record their location along the set tracks.

The handler will guide dogs along each transect. Dogs will be encouraged to select their paths within 5 m on either side of the transect, air-scenting for carcasses along the way. Although dogs could detect scent far beyond the transect, they will be discouraged from indicating a carcass location until a transect intersects with the carcass.

Site-specific conditions might prevent full searches of the plot around each turbine (i.e. difficult terrain and vegetation, as well as safety concerns). To account for this, tracking devices will be attached to the searchers (i.e. a GPS) recording the search pattern which will

be downloaded each day. The proportion of the area searched (and the inverse) will then be calculated and used to account for differences in search area between plots and to adjust mortality estimates.

To maximise consistency of reporting, a mortality monitoring datasheet will be provided in the form of an application and entered digitally on site (see Appendix C, Table C.1-2). This will be filled in by field staff to record all mortality searches undertaken. The spatial position of each carcass will be mapped using a GPS unit, carcasses identified to species and photographed as found prior to being collected and stored in a freezer to prevent double counting (see Section 2.6 for protocol and recording methodology). However, if a permit is not issued by DOC under the provisions of the Wildlife Act 1953 (WWA) all carcasses found will have to remain in situ but will be labelled with a tag and all flight feathers cut to prevent double counting by searchers.

2.2.4 Human Search Techniques

If dog search teams are unable to be utilised (i.e. only humans are available) approximately three times the search effort will be required to achieve an adequate level of detection. To achieve this, human searchers will perform six fortnightly searches of 8 randomly selected turbines during the search season (nominally. Jan, March, July, October). The selected turbines for searching will change on the same rotation as planned for dog assisted searches.

The transects, record keeping, and the usage of tracking devices will be implemented as per Section 2.6.

2.2.5 Search limitations

Carcass searches will only be conducted between one hour after sunrise and one hour before sunset for best light. As extreme weather conditions can have considerable effects on carcass detection and safety, carcass searches will not be conducted during heavy rainfall, or during high wind conditions that impede search ability due to reduced visibility.

2.3 Carcass Persistence Rate Trials

The key aspects of the carcass persistence rate trails are summarised as follows:

Method: Remote detection cameras (which use either motion or temperature change) will be placed adjacent to bird carcasses;

Sites: 16 selected "sites" within the wind farm which are representative of the turbine sites (e.g. in vegetation type and elevation). An equal number will be in the predator control zone (n=8) and the area with no predator control (n=8). Each site will have a 100 m buffer

Response variable: day carcass/feather spot is gone from base day (base day/0 = day carcasses/feather spots is set out)

Mortality estimates calculated based on turbine searches have been shown to be impacted by scavenging of bird carcasses (see Paula et al 2015). To account for this bias, trials will be undertaken to estimate the time a carcass remains in the environment (i.e. to measure carcass persistence rate). The rate of scavenging, decomposition or removal of carcasses

will be measured through the placement of bird carcasses within the Mt Cass wind farm envelope (but away from all turbines to prevent additional strike by raptors) and recorded using remote digital cameras (after Paula et al 2015). The rate of carcass persistence will be used to adjust calculations of mortality for carcass persistence bias. Response variable is defined as: day carcass is observed as gone from the 'base day' (base day/0 = day carcasses/feather spots set out). As rates of scavenging could be influenced by the size class of a carcass, scavenging rates will be estimated for both large and small birds (Table 2).

A total of 24 trial sessions will be conducted over the period of a year (8 small, 8 large carcasses and 8 feather spots per year) during each season. Trials will be conducted over a two-year period (N= 48). To avoid scavenger swamping[2], for each trial a maximum of two carcasses will be able to be randomly placed at a single site. Carcasses will be placed following the standardised mortality monitoring (give or take a couple of days for logistics). For instance, carcasses will be placed out once the standardised mortality monitoring has been completed, not prior to its completion. By undertaking the persistence trials outside of the time period for the standardised mortality monitoring the potential of the carcass persistence rate trails drawing predators to or away from study turbines will be avoided.

A randomly stratified study design will be used to select the placement location (e.g. GPS point) of each carcass at a site (see Table 3). Each carcass will be allocated a randomly selected location within 100 m of each site using suitable GIS software. Carcass placement will also be stratified to ensure representation of high (tussock/grassland) and low (scrub/forest) visibility classes/habitats while accounting for the proportion of habitat available in the landscape within the different turbine radii and the predator control zones (e.g. the area within Mt Cass Wind Farm which has predator control and no predator control).

Appendix D depicts the average proportion of the low and high visibility classes used in ArcGIS to calculate the proportion of visibility classes around the turbines across the wind farm. Additional randomised points will be allocated and utilised if the random location of a point of a carcass is too dangerous to be accessed by searchers and/or is too accessible to visitors (to avoid interference with the cameras).

Size Class	Weight Range	Examples Of Key Species
Small	13 – 35 g	NZ pipit, silver eye, fantail, tomtit, skylark and bellbird
Medium/large	205 -1700 g	NZ pied oystercatcher, NZ falcon, Kereru, Harrier and Paradise duck

[Table 2] Trials will include different bird sizes to represent two different key at-risk species size classes (see Appendix B for mass of birds at Mt Cass)

[2] Scavenger swamping is where the number of carcasses exceeds the capacity of vertebrate scavengers to process and remove all evidence of carcasses; see Smallwood 2007.

Carcasses will be sourced from wild birds found in situ, or domestic stock (e.g. small brown finches/ large brown ducks) if a Wildlife Act permit cannot be obtained. Carcasses will be frozen and thawed the day prior to the trial. Each carcass will be labelled with an identification number using a small label around the leg, wing primaries will be clipped, and their locations recorded on a GPS.

Remote detection cameras (which use either motion or temperature change) will be used in the carcass persistence trials. Each camera will be mounted on a stake 50 cm above the ground and approximately 2.5 m from the carcass. The camera will be tilted slightly downward to centre the carcass in the camera's field of view. Details on recording the data and photo storage are detailed in Section 2.7.3. The carcass persistence camera setup and persistence trial data sheets are provided in Appendix C (see Table C.2 and C.3). In the event of failure of any camera (within an initial twenty-one-day period, and before the carcass is gone) the trial will be repeated, ensuring that 16 trials are carried out each year.

The brand of remote trial camera used, camera specifications, and details on camera setup (e.g. cameras will be set up to take video) will be recorded in the annual monitoring report. The same brand of camera will be used throughout the trial. Feather spots will be checked every 7 days to obtain an average time that they remain in situ, as a camera alone may not record all factors affecting presence (e.g. changes in wind).

		Birds		
		Small	Medium/large	Feather spots
		0-90 m	0-115 m	0-115
Visibility class/ habitat	Grassland/ tussock	N=16 * proportion of grassland	N=16 * proportion of grassland	N=16 * proportion of grassland
	Scrub/forest	N=16 * proportion of bush/forest	N=16 * proportion of bush/forest	N=16 * proportion of bush/forest

[Table 3] Random stratification of carcasses across vegetation type per size class across the 2-year period. An equal amount of carcasses/feather spots will be placed in the predator control area and the non-predator control area.

2.4 Carcass Detection Rate Trials

The key aspects of the carcass detection rate trails are summarised as follows:

- **Method:** Search team detection of random placement of carcasses within turbine search areas
- **Response variable:** Number of carcasses found out of the total

Sixteen "detection" carcasses will be placed on the ground (8 from each of the two size classes, see Table 2), 8 carcasses up trees (4 from each of the two size classes) and 8 feather spots at randomly selected turbines over a two-year period (N=32). At maximum only two carcasses/feather spots will be randomly allocated to each trial turbine search areas at a time.

Carcasses will be placed out the morning preceding a search period commencing. As human search efficiency (dogs less so) can be influenced by size class of the target species (Domínguez del Valle, 2020), two different size classes of bird carcass will be used in the trial (see Table 2). The carcasses will be kept frozen and allowed time to defrost the day before use. Carcasses will be handled using either plastic bags, gloves, or tongs to avoid contamination with human scent, as this could influence the detectability of the carcass by dogs. Each carcass will be tied and pinned to the ground so that it could be identified as a 'detection' carcass and to prevent scavengers from removing it. Each carcass will be labelled with a small, numbered ID tag and the tips of flight feathers will also be clipped to prevent mistakes in detection in future trials and to ensure all carcasses are retrieved. All carcass detection rate trials will be blind (i.e., searchers will not be informed when these trials are to be undertaken, to avoid changes in search effort).

After each carcass has been placed within the search area (by somebody other than the searcher), the searcher will follow the same procedure used for mortality carcass searches. Carcass detection trials at a turbine are considered finished when the search plot is fully covered. Carcasses not found by the searcher will be removed following the completion of the standardised mortality search.

A randomly stratified block design will be used to select the placement location (i.e. GPS point) of each carcass using GIS software. The location of carcass will be within set radii from the turbine base depending on the size class of the carcass. Small carcasses will be placed within 0-73 m of each turbine and large carcasses and feather spots will be placed 0-120 m from the turbine (see Figure 2). These size difference reflect the distances different size categories of carcasses are predicted to fall from the wind turbine structure (see Section 2.2.1).

Carcass placement will also be stratified to ensure representation of different visibility classes/habitats (i.e. medium to high visibility – grassland/tussock/cleared vegetation, and low – shrub/forest vegetation) – see Appendix D1 a & b. The proportion of randomised points in each category will reflect the proportion of each vegetation type in the survey area. A few additional randomised points will be allocated in case the random location of a point of a carcass is too dangerous to access. An equal number of carcass detection rate trials will be carried out for each searcher team (if more than one) so observer bias can be accounted for in the analysis.

If dog teams are unavailable for a search session the carcass detection rate trail will be repeated for the human only search teams to account for differences in carcass detection rates.

2.5 Summary of the turbine specifications and the survey techniques

Turbine specifications:	Siemens Gamesa Renewable Energy (SGRE) 'DWT-DD120-4.3' wind turbines - 120 m Rotor Diameter and 76.5 m Hub Height
Number of turbines on site:	22
Number of monitored turbines:	All 22 turbines will be monitored annually at some time during the year.
Search area (distance from turbine):	120 m search radius in the first year. The search area will be assessed at the end of the 1st year to determine if a smaller search area would be appropriate.
Search area for the standardised mortality searches and the Carcass persistence rates trials.	Linear transects every 10 m. A 5 m buffer around each transect being the effective search area.
Standardised mortality searches (refer to Section 2.2)	Dog search team - 32 monthly search sessions per year at weekly intervals. One month for each season (nominally Jan, March, July, October) made over 8 randomly selected turbines per season. Searches per search session will occur every 7 days from day 0 to 21. OR
	Human only team – 96 monthly search sessions at fortnightly intervals. Three consecutive months each season made over 8 randomly selected turbines per season.

Carcass persistence rates trials (refer to Section 2.3)	A total of 24 trial sessions will be conducted over the period of a year.
	Eight small (13 – 35 g), 8 large (205 -1700 g) carcasses and 8 feather spots per year.
	Infrared cameras will record removal activity.
Carcass detection rates trial (refer to Section 2.4)	12 carcasses (6 small [13-35 g] and 6 large [205-1700 g]) and 4 feather spots - annually
	Annually, 4 carcasses up trees (2 small and 2 large), 8 carcasses (4 small and 4 large) on the ground, 4 feather spots on the ground.
	Random predetermined allocation and timing determined prior to the start of the standardised mortality searches. At maximum only two carcasses/feather spots will be randomly allocated to each trial turbine search areas at a time.

2.6 Additional Data Collection

2.6.1 Weather Data

Severe weather and fog can increase the risk of collision with wind farm structures, particularly for migrant birds (Drewitt and Langston 2006). For example, severe weather can impair visibility and causes migratory birds to fly at lower altitudes to follow topographical cues increasing the probability of collisions. Whereas fog can impair birds vision and result in a reduction of avoidance behaviour. Thus, if there is a high proportion of foggy days during a period of migration at a proposed wind farm site that is on a migration route, there is likely to be an increased risk of collision. Given this, weather conditions will be collected from the wind masts to use in the data analysis. Additional weather information not collected by the wind masts (e.g. data on fog, cloud cover) will be recorded on daily data sheets by an appointed member of the operations team.

2.6.2 Casualty Collection

To hold and deposit a dead wildlife specimen (i.e. any part of the wildlife) 'Wildlife Act Authorisation' permission must be obtained from DOC in accordance with the relevant provisions of the Wildlife Act 1953. This permit will need to be obtained from DOC prior to the surveys and trials commencing to allow for the collection and storage of native and exotic bird carcasses found within the Mt Cass Wind Farm envelope.

The following protocols shall be met in the collection of bird carcasses at the Mt Cass Wind Farm site:

- All carcasses found within the study turbine search area will be collected, photographed as found and a GPS co-ordinate recorded. A photograph will be taken of the carcass / feather spot as found.
- Rubber gloves will be used to handle all carcasses to eliminate possible transmission of diseases. Each carcass will be placed in a separate plastic bag and labelled with a waterproof marker prior to being sealed and placed in the freezer.
- Native species (e.g. kereru, falcon, SIPO, and NZ pipit) may be subject to necropsy and their carcasses supplied for research or taonga.
- Carcasses of non-native species may be used in the carcass detection and carcass persistence trials if there are sufficient numbers. Otherwise, domestic birds/fowl will be used instead.

Details of the persons to whom any carcasses should be supplied, either for research or as taonga are outlined below:

Department of Conservation Contact details to be inserted here prior to commencement of monitoring.

2.7 Data Recording

2.7.1 Records - Standardised Mortality Monitoring

A conservative approach will be taken whereby any sign of a possible mortality (e.g. feather spot, partial and entire carcasses) and any carcass within the study turbine search areas will be assumed to be a result of a turbine collision, as opposed to a natural mortality. All signs of mortality will be recorded within the turbine mortality datasheet (see Appendix C1 for an example data sheet which will be converted to an application and entered digitally on site). Turbines with no mortalities will also be recorded (see Appendix C2 for example). Additional incidental avifauna behaviour observations of interest will be recorded in the data sheet or noted in a notebook (along with the date and time of the observation).

Note that the study turbine mortality record data sheet will also be used to record mortalities and injured birds found during any monitoring within the survey plots, whereas mortalities and injured birds outside the search plots will be recorded in another Excel sheet (refer to Section 2.7.4).

Data will be entered directly into a digital collector app during the field season or the spreadsheet after each monitoring session. The column headings of the app and spreadsheets entered will mirror those parameters recorded in the respective data sheets (refer to Appendices C1-C2).

2.7.2 Records – Carcass Persistence Rate Trials

All carcass persistence rate trials will be recorded in either an app or two spreadsheets:

- Carcass persistence rate trials (setup and collection): camera/carcass setup; and
- Carcass persistence rate trials: camera collection.

All carcass persistence rate trials spreadsheet will be recorded and stored in two respective Excel files. The column headings of the ap and spreadsheets will mirror those parameters recorded in the respective data sheets (refer to Appendices C3-C4).

Each carcass will be given a unique ID (i.e. camera number setup date). Following the end of the trial (i.e. the carcass is no longer present) the camera data will be downloaded from each camera and saved in folders containing the unique ID. The unique ID will function as a unique ID for each carcass trial. This ID will be used to merge the Excel files into a single file for future analysis. All camera malfunctions will be recorded, and an additional trial undertaken in the next season, if required. If the carcass remains present after 21 days, the camera will be left on site and picked up during the following search session.

2.7.3 Records - Carcass Detection Rate Trials

All carcass detection rate trials will be recorded into two aps/spreadsheets:

- Carcass detection rate setup and collection; and
- Carcass detection by the search team.
- The column headings of the ap and spreadsheets will mirror those parameters recorded in the respective data sheets (refer to Appendices C5-C6).

2.7.4 Records - Incidental Mortalities/Injuries

In addition to mortalities found within the study turbine search area, there may be instances whereby incidental bird mortalities are observed on the site outside of the survey period, or outside of turbine search area (e.g. injured birds flying outside of the search area resulting in mortalities outside the search area, collisions with buildings, transmission lines etc). In such cases, carcasses will be photographed as found, a GPS co-ordinate recorded, and the carcass collected (as outlined in Section 2.6.2). An incidental mortality record data sheet will then be filled in by the observer (see Appendix C.7).

2.7.5 Protocol for injury or mortality of novel Threatened or At Risk species (& Kereru)

Novel birds are classified in this document as those species that have not been observed on site previously (e.g. are not recorded in Appendix B, Table B1 as being onsite) and listed as Threatened or At Risk species are as that described in Robertson et al (2021) or subsequent DOC threat list publications.

The following protocol will be followed if a bird is injured, or a carcass found:

i. Details on the incident will be recorded in either the mortality data sheets or incidental mortalities/injuries data sheet (see Appendix C).
ii. The carcass will be collected and labelled for autopsy (see Section 2.6.2);
iii. If any threatened (threatened/at-risk/migrant), and/or banded avifauna species are injured, or carcass found, HDC will be informed by email as soon as practicable, OR
iv. If any of the key species of concern (i.e New Zealand falcon, NZ pipit, New Zealand pigeon) are injured, or carcass found, HDC will be informed by email as soon as practicable.
v. If a Threatened or At-Risk species is found to be using the site (including injured or dead) that has not been previously recorded, DOC and HDC will be informed by email as soon as possible (consent condition 76 b).
vi. As per the resource consent condition (72), if evidence is found of injury and/or mortality of kereru, New Zealand falcon or New Zealand pipit through interaction with wind farm infrastructure then the proponent shall, as soon as practicable, provide a "Novel, Threatened or At Risk species" report to HDC detailing a suitable monitoring and management regime to be implemented to address any net negative impact at the local population level.

If an injured bird is found, please contact:

Contact details to be inserted here prior to commencement of monitoring.

3 General Statistical Approach

3.1 Bird Mortality Estimates

The general statistical approach to estimating turbine mortality is to search beneath the turbines at regular intervals. The number of birds found is then adjusted to allow for the fact that some corpses may be removed by scavengers or decay before the search takes place, and, of those that remain, some may not be detected by searchers. A trial experiment will allow estimation of the proportion of the birds killed since the last search which can be expected to still be on the ground when the next search is made (the carcass persistence rate – see Section 2.3). A second trial experiment will allow estimation of the proportion of carcasses on the ground which will be found during the next search (the carcass detection rate – see Section 2.4).

This adjusted number of birds can then be scaled by the number of turbines monitored and the number of years of monitoring to estimate the average mortality in birds/turbine/year. This process is repeated for both size classes, as the persistence and detection rates may well depend on the size of the bird.

3.2 Estimating the Carcass Persistence Rate

As part of the standardised mortality monitoring, randomly selected sites during each season will be searched every 7 days within the search period, with deaths assumed to be occurring randomly during that period. Some of the carcasses falling in those 7 days will have disappeared before the next search. The proportion of birds that remain to be found is the carcass persistence rate.

Over the course of the complete 2-year persistence experiment, a total of 16 corpses of each class (small, large, and feather spot) will be laid out at various places and times, and the number of days for each corpse to disappear recorded. The number of corpses of each class remaining after 1 day, 2 days, up to 7 days is found and the average number of corpses remaining over the 7 days is calculated. This number, expressed as a percentage of the original 16 birds of each size class, is the average persistence rate for that class. It gives the probability that at least a findable trace of a random bird killed by a turbine since the last search will still be present to be found during the next search of the turbine. This figure will be used in the mortality calculations below. Data will be collected with camera traps over longer periods and the findings used to improve the persistence estimate. Sections 2.3 and 2.6 provides details for collecting the data to estimate carcass persistence.

3.3 Estimating the Carcass Detection Rate

Section 2.4 (Carcass detection rate trials) details the protocol for estimating the detection rates for the two size classes. The percentage of detections for each class recorded will be used in the calculation for estimating bird mortality (see section 3.4).

3.4 Estimating Turbine Mortality

If **R** = the number of birds actually recovered over a period of monitoring, **P** = the carcass persistence rate, and **D** = the carcass detection rate, then our best estimate of the actual number of birds **B** killed by the monitored turbines during the monitoring period is given by:

Estimated Birds = Recoveries/Persistence/Detection, or B = R/P/D birds.

If M is the monitoring effort in turbine years taken to recover the R birds, then Estimated True mortality = Birds/Monitoring effort, or T = B/M birds/turbine/year.

Total mortality for the whole wind farm = T x **N** where N is the total number of turbines in the farm.

3.5 Monitoring Effort

The monitoring effort M is not always simply the number of turbines monitored x the number of years of monitoring. If 10 turbines are monitored for 2 years M = 10 x 2 = 20 turbine.years. If 8 turbines are monitored for 2 years for only 4 months per year then M = 8 x 4/12 x 2 = 5.33 turbine.years. Mt Cass has both resident and migratory species so while the data for both types will be collected at the same time, each type will have its own monitoring effort for mortality estimates and so both resident and migratory mortalities will need to be estimated separately.

Some turbine search areas cannot be fully searched for topographical or safety reasons. When the final mortalities and standard error have been calculated, they should be adjusted upwards by dividing by the average searchable area of all the turbines involved accounting for any turbine search areas which cannot be fully searched due to safety or topographical constraints

See Appendix E for an example of a mortality calculation.

3.6 Estimating Mortality Uncertainty

Mortality rates are most useful when they come with an indication of their uncertainty, either as a suitable confidence interval or as a standard error (SE). There are three main sources of uncertainty in the calculation of the mortality rate.

The persistence and detection rates, P and D, are the results of two trial experiments for each size class, and each trial proportion comes with its own uncertainty. There is a formula for the SE of a sample proportion. These two component uncertainties contribute to the uncertainty in the mortality estimate. Once the trials are complete the uncertainty arising from the trials remains the same no matter how many years the monitoring continues for and puts a lower limit on the SE of the mortality estimate.

Even when conditions are constant, carcasses are recovered at random, and this randomness produces a sampling uncertainty in the estimated mortality rate. There is also a formula for the SE for a count of events that happen at random. The effect of sampling uncertainty on mortality uncertainty drops off as more years are surveyed and more data is accumulated.

The mortality estimate involves the division B = R/P/D above. The SE of this calculation involves combining the relative SE or %SE (the SE divided by the estimate) of each of the uncertain components R, P and D. This combining of the individual %SEs can be done by a well-established formula (RSS or "root sum of squares") to give a reasonable approximation to the %SE of B, the number of birds actually killed during the monitoring. From these we can get a %SE for the mortality estimate and so the actual SE of the estimate. An approximate 95% confidence interval for the true mortality is the estimated mortality ±2xSE.

A more effective way of assessing these uncertainties is a Monte Carlo analysis. The selection of the approach should be made by the statistician undertaking the work (a suitable qualified statistical expert) and should take into account advances in statistical techniques.

Appendix E gives an example of the formulas for calculating the SE of an estimate, and an indication of how a Monte Carlo analysis works.

3.7 Limitations with the Approach

While sampling is adequate to detect collisions of common species, it is unlikely to detect rarer species collisions. Given that the sampling is unlikely to detect rare but significant events (e.g. rare events have a lower probability of being picked up during the survey period but given that a species that is endangered or threatened and may have low population numbers an important proportion of the population may be removed). One consequence of the proposed sampling protocol is that the use of search dogs and shorter search periods means that fewer turbines need to be monitored to determine mortality rates to any given accuracy.

Unfortunately, this reduction in the number of turbines makes it more likely that rare but significant events such as the recovery of carcasses of rare or endangered species may be missed at the unsearched turbines. This concern that fewer turbines may mean fewer rare events detected may be allayed to some extent because the much higher detection and persistence rates proposed mean that rare events that happen at the turbines that are searched are much less likely to be missed.

4 Reporting

4.1 Annual Report

Resource consent condition 73 outlines the requirements for the post-construction bird monitoring programme results to be provided to HDC and DOC annually. Whether any additional mitigation is required will be determined in consultation with HDC and DOC and shall consider whether the effect will result in a net negative impact at the local population level of any threatened or non-threatened species.

The annual monitoring report shall present, summarise, and analyse the data collected in the preceding year and report on the operation of the Mt Cass Wind Farm against the objectives of the BCMP.

To enable an adaptive response to the results of the monitoring, the annual reports will also detail the scope of the bird collision monitoring program for the next monitoring period (which will be provided to the Statutory Liaison Group for review).

The report shall address the following matters:

- Identify whether mortalities are occurring;
- Identify mortality rates, including the effects of carcass detection and carcass persistence on the mortality rate estimate;
- Determine what species/species groups are involved;
- Determine where mortalities are occurring and how they relate to project operations;
- Identify environmental factors that may have increased the potential of wildlife interaction with the renewable energy infrastructure (e.g. changes in weather, fog etc.);
- Determine if additional monitoring is required; and
- Determine whether any additional mitigation and/or compensation needs to be implemented.

A summary of the reporting requirements is shown as Table 4.

4.2 Year 5 - Second Bird Collison Monitoring Assessment

Consent condition 71c outlines the requirements for the proponent to commission a second Bird Collison Monitoring assessment. The second Bird Collison Monitoring assessment shall commence on the fifth anniversary of the first standardised survey.

Monitoring (BCMP Section)	Frequency	Notes
Standardised mortality searches (refer to Section 2.2)	Dog search team - 32 searches per year (Four seasons of search sessions per year, 8 turbines a season). Searches per search session will occur every 7 days from day 0 to 21. OR Human only team – 96 monthly search sessions at fortnightly intervals. Three consecutive months each season made over 8 randomly selected turbines per season.	Commence immediately following the date any wind turbine first generates electricity and continue for a period of 2 years.

Carcass persistence rates trials (refer to Section 2.3)	A total of 24 trial sessions will be conducted over the period of a year.	First year commences from the date when all turbines are operational and generating electricity.
Carcass detection rates trial (refer to Section 2.4)	12 carcasses (6 small [13-35 g] and 6 large [205-1700 g]) and 4 feather spots – annually. Random predetermined allocation and timing determined prior to the start of the standardised mortality searches. At maximum only two carcasses/feather spots will be randomly allocated to each trial turbine search areas at a time.	First year commences from the date when all turbines are operational and generating electricity.
Novel, Threatened or At Risk species report (refer to Section 2.7.5)	As required	If any Threatened or At-Risk species are injured or a carcass found the Hurunui District Council will be informed by email as soon as practicable. The Hurunui District Council will be provided with a report detailing a suitable monitoring and management regime to be implemented to address any net negative impact at the local population level.
Annual monitoring report (refer to Section 4.1)	Once per year over a two-year period following a full year's monitoring	Draft submitted to Council and DOC. Final report, submitted to the Hurunui District and the Department of Conservation.
Year 5 - Standardised mortality searches (refer to Section 2.2)	Repeated 5 years from commencement of the wind farm operation	The mortality monitoring programme shall be repeated on the fifth anniversary from the first standardise survey (consent condition 71c).
Additional research /mitigation and/or compensation (refer to Section 5)	As required	An annual report will provide evidence to DOC if the need for addition mitigation and/or compensation has been triggered. As per resource consent condition (74) whether any additional mitigation is required will be determined by the proponent in consultation with the Department of Conservation and shall consider whether the

		effect will result in a net negative impact at the local population level of any threatened or non-threatened species.

[Table 4] Summary of the bird collision monitoring requirements for Mt Cass Wind Farm.

5 Additional Mitigation or Compensation

Upon submission of the annual report, the information available will be reviewed to determine if adaptive management measures are necessary to address any unanticipated adverse effects of the wind farm on avifauna. It may be determined that further information is needed for decision making or that species-specific mitigation measures are needed.

Further investigation to identify those factors that may be contributing to high levels of mortality (e.g. weather conditions, time of year when bird density is particularly high) may include, but not be limited to:

- Increasing survey frequency for decision support;
- Increasing reporting frequency to speed decision-making; and
- Adding behavioural or movement surveys (depending on the species involved).
- Mitigation measures could include, but would not be limited to:
    - Bird corridor enhancement;
    - Off-site habitat protection or enhancement;
    - On or off-site breeding programmes; or
    - Nest protection.

Operational mitigation measures could include:

- Automated detection and deterrent systems designed to minimise the risk of birds colliding with wind turbines (e.g. DTBird system, IdentiFlight beta unit);
- Temporary shutdown during high-risk migratory period/ or for high-risk turbines at key periods.; or
- Smallwood & Thelander (2004) found that turbines at the ends of lines and edges of clusters killed disproportionately more birds. So hypothetically the wind monitoring masts at Mt Cass could be used for a scarecrow affect by adding visibility marker balls.

The suitability of any measures to avoid, remedy, mitigate and/or compensate will need to be determined on a case-by-case and take into account the scale of mortality, species affected and any relevant contributing factors (e.g. climatic conditions, spatial location etc).

As per resource consent condition 74 whether any additional mitigation is required will be determined in consultation with HDC and DOC experts and shall consider whether the effect will result in a net negative impact at the local population level of any threatened or non-threatened species.

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7 Appendix A: Relevant Consent Conditions

Avifauna Management

68. The Consent Holder shall undertake a programme of avifauna monitoring and management, the objectives of which are:
    a. To monitor for potential adverse effects of the wind farm on avifauna, and to manage those effects if necessary; and
    b. To achieve a net gain in the relative abundance of indigenous species present at Mt Cass.

Pre- Construction Monitoring

69. The Consent Holder shall engage a suitably qualified and experienced avian ecologist to undertake a pre-construction survey of avifauna populations and species abundance at the site[7] in order to assess potential avifauna displacement and future population trends. The monitoring shall include measures of species abundance across the wind farm site and within all habitat types present within the wind farm footprint. Monitoring methods shall be standardised between pre-construction and post-construction surveys.

70. The monitoring shall:
    a. be carried out seasonally, during the months of October (as soon as possible after lambing), January, March and June;
    b. include visiting each bird count station five times each season to give a measure of variation around the data;
    c. include two years' data to account for annual variation and provide robust baseline data;
    d. include a survey of internally migrant shorebird species using observers with suitable identification skills positioned along the Mt Cass ridgeline during at least one period of summer migration

[7] For the purpose of this condition, "the site" means the length of ridgeline over which any construction activity occurs, extending down the dip-slope to include all major tracts of bush and down the scarp to the bottom of the scarp.

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(January-February) and at least one period of winter migration (July and August). If significant numbers of migratory shorebirds are recorded to cross the proposed wind farm then a further more in depth monitoring program will need to be established to identify the risks posed to internal and internationally migrant shorebirds and how best to avoid, remedy or mitigate these.

Post Commissioning Monitoring

71. Following commissioning of the wind farm, the Consent Holder shall:
    a. Undertake an annual survey for a minimum of two years of avifauna populations, which includes measures of species abundance across the wind farm and within all habitat types present within the wind farm footprint, to assess potential avifauna displacement post commissioning.
    b. Undertake a mortality monitoring programme at least once a season, during the same months that the avifauna population surveys are carried out (consent condition **[68]**) for a minimum of two years that includes:
        i. Carcass searches
        ii. Searcher efficiency trials
        iii. Carcass decomposition and/or removal rates
        iv. Extended searches of some turbines (especially on forest pasture margin)
        v. Calculation of mortality rates adjusted by estimates of error from the above protocols.
    c. The mortality monitoring programme outlined in condition 71(b) shall be repeated after a period of 5 years of operation of the wind farm.

72. If evidence is found of injury and/or mortality of Kereru, New Zealand Falcon or New Zealand Pipit through interaction with wind farm infrastructure then the Consent Holder shall, as soon as practicable, provide a report to the Hurunui District Council detailing a suitable monitoring and management regime to be implemented to address any net negative impact at the local population level.

Falcon monitoring

73. The Consent Holder shall undertake falcon monitoring as follows:
    a. Surveys for breeding falcons shall be carried out during the breeding season throughout the construction period and for two years post-commissioning. This shall include surveys of the Mt Cass ridgeline and all areas of suitable breeding habitat adjacent to the wind farm footprint.
    b. If at any time pre, during or post construction there is evidence of falcon breeding on or neighbouring the wind farm footprint, or there is evidence of falcon being adversely impacted by the wind farm, then a more intensive monitoring programme for falcon needs to be initiated and continued for at least two years post commissioning. The monitoring programme shall include breeding success, measures of habitat use and the survival of fledglings and adult falcons (through radio-tracking).
    c. If during construction, a falcon nest is identified on the site, the Consent Holder will ensure that, where practicable, a 200m setback of construction activity from the nest is maintained while it is still active.

74. The monitoring programmes required by conditions **[69]** to **[73]** shall be designed in consultation with the Department of Conservation, and the results of all monitoring shall be provided to the Hurunui District Council and the Department of Conservation annually. Whether any additional mitigation is required will be determined in consultation with the Department of Conservation and shall consider whether the effect will result in a net negative impact at the local population level of any threatened or non-threatened species.

Management Plan

75. The Consent Holder shall engage a suitably qualified and experienced avian ecologist to prepare an avifauna monitoring and management section of the Environmental Management Plan, in consultation with the Department of Conservation.

76. The avifauna section of the Environmental Management Plan shall include, but not be limited to:

a. The survey methodologies and reporting mechanisms for the surveys required by conditions **[69]** to **[73]**, and in particular the mechanisms in relation to:
   i. Incidental avifauna behaviour observations
   ii. Reporting incidental injury and mortality events (i.e. events that occur outside of the official survey)
   iii. How to manage avifauna and whom to contact should injured avifauna be found
   iv. Reporting of injury or mortality of threatened, at risk, regionally rare and/or banded avifauna. This shall also include details of the persons to whom any carcasses should be supplied, either for research or as taonga.

b. A protocol that outlines what steps to take if a Threatened or At Risk species is found to be using the site (including injured or dead) that has not been previously recorded. Additional mitigation is only required if there is a net negative impact, due to the wind farm, on the population within the Motunau Ecological District.

c. Identification of additional mitigation options that may need to be implemented if adverse effects occur (e.g. including but not limited to avifauna corridor enhancement, off-site habitat protection or enhancement (for species that use the site but do not breed there), on or off site breeding programmes, nest protection, captive breeding, or changes in the operation of the wind farm to reduce impacts).

Herpetofauna Management

77. The Consent Holder shall undertake a programme of lizard management, the objectives of which are to:
   a. Identify methods to avoid or minimise any adverse effects on lizards arising from the construction and operation of the wind farm;
   b. Maintain Canterbury gecko, common skink and McCann's skink populations at the same or greater abundances than those present at the wind farm site prior to development of the wind farm; and
   c. Maintain habitats of Canterbury gecko, common skink, and McCann's skink populations at the wind farm site in the same or better condition than that present prior to the development of the wind farm.

8 Appendix B: Bird Species List at Mt Cass

Common name (*LATIN*)	Māori name	NZ status	Source reference at Mt Cass	Mass (Source: HANZAB 1990-2006)
New Zealand bellbird (*Anthornis melanura*)	Makomako	Native	Jolly 2015	34 g (male), 25 g (female)
Black-backed gull (*Larus dominicanus*)	Tarāpuka	Native	Jolly 2015	1050 g (male), 830 g (female)
New Zealand eastern falcon (*Falco novaeseelandiae* "eastern")	Karearea	Native	Jolly 2015	205 - 340 g (male), 420 - 740 g (female)
New Zealand fantail (*Rhipidura fuliginosa*),	Pīwakawaka	Native	Jolly 2015	8 g
Grey warbler (*Gerygone igata*)	Riroriro	Native	Jolly 2015	5.5-6.5 g
Australasian harrier (*Circus approximans*)	Kāhu	Native	Jolly 2015	650 g (male), 850 g (female)
New Zealand pigeon (*Hemiphaga novaeseelandiae*)	kererū, kukupa	Native	Jolly 2015	700 g
Sacred kingfisher (*Todiramphus sanctus*)	kotare	Native	Jolly 2015	55 g
Paradise shelduck (*Tadorna variegata*),	Pūtangitangi	Native	Jolly 2015	1700 g (male); 1400 g (female)
New Zealand pipit (*Anthus novaeseelandiae*)	pihoihoi	Native	Jolly 2015	35 g
Shining cuckoo (*Chrysococcyx lucidus*)	Pīpīwharauroa	Native, Migratory	Jolly 2015	23 g
Tomtit *(Petroica macrocephala*)	piropiro, maui-potiki, ngirungiru, miromiro	Native	Jolly 2015	11 g
Welcome swallow (*Hirundo tahitica*)	Warou	Native	Jolly 2015	9 - 20 g
South Island pied oystercatcher (*Haematopus finschi*, SIPO)	Tōrea	Native, Migratory	Stewart et al 2014	550 g
Brown creeper (*Mohoua novaeseelandiae*)	Pīpipi	Native	*	13.5 g (male); 11 g (female)
Silvereye (*Zosterops lateralis*)	Tauhou	Native	Jolly 2015	13 g
Spur-winged plover (*Vanellus miles*)		Native	Jolly 2015	350 - 370 g
Eurasian blackbird (*Turdus merula*)		Introduced	Jolly 2015	90 g
California quail (*Callipepla californica*)		Introduced	Jolly 2015	145 - 210 g
Chaffinch (*Fringilla coelebs*)		Introduced	Jolly 2015	21 - 22 g
Dunnock (*Prunella modularis*)		Introduced	Jolly 2015	21 g
Goldfinch (*Carduelis carduelis*)		Introduced	Jolly 2015	11-18 g
European greenfinch (*Carduelis chloris*)		Introduced	Jolly 2015	28 g
House sparrow (*Passer domesticus*)		Introduced	Jolly 2015	28 g
Australian magpie *(Gymnorhina tibicen*)		Introduced	Jolly 2015	350 g
Redpoll (*Carduelis flammea*)		Introduced	Jolly 2015	12 g
Rock pigeon (*Columba livia*)		Introduced	Jolly 2015	295-320 g
Eurasian skylark (*Alauda arvensis*)		Introduced	Jolly 2015	38 g
Song thrush (*Turdus philomelos*)		Introduced	Jolly 2015	70 g
Starling (*Sturnus vulgaris*)		Introduced	Jolly 2015	85 g
Yellowhammer (*Emberiza citrinella*)		Introduced	Jolly 2015	18 - 30 g
Wrybill (*Anarhynchus frontalis*)*	ngutuparore, ngutu pare	Native	*	55 g
Banded dotterel (*Charadrius bicinctus*)*	tūturiwhatu, tuturiwhatu, pohowera	Native, Migratory	*	60 g

Common name (*LATIN*)	Māori name	NZ status	Source reference at Mt Cass	Mass (Source: HANZAB 1990-2006)
Eastern bar-tailed godwit (*Limosa lapponica baueri*)*	Kuaka	Native, Migratory	*	275-400 g (male); 325-600 g (female)
Red knot (*Calidris canutus*)*	Huahou	Native, Migratory	*	105 g
Pied stilt (*Himantopus himantopus*)*	Poaka	Native	*	190 g
Australasian bittern (*Botaurus poiciloptilus*) *	matuku-hūrepo, matuku-hurepo	Native	*	1400 g (male), 900 g (female)

[Table B1] Bird species list for Mt Cass (observed and potential).

*Species that have not been observed or recorded at Mt Cass but have the potential to migrate through the site. Migratory vagrants also may use the same flight pathway as SIPO.

9 Appendix C: Data Sheets

Table C.1 A mortality monitoring data sheet will be filled in by field staff to record all mortality searches undertaken. The spatial position of each carcass will be mapped using a GPS unit, identified carcasses to species and photographed as found prior to being collected and stored in a freezer (see Section 2.7.1 for protocol and recording methodology). Vegetation density definitions in Table C.8.

MORTALITY SEARCHES PER TURBINE Turbine number: Start time:____ – End time:_____ *(record 24 hr clock)* Found by searcher name & dog name:					DATE: _____ Cloud cover: 0, 0-25, 25-50, 50-75, 75-100% (circle) Fog: Y / N (circle)			Sheet ID: *e.g. SE_DATE_N* Team ID:			
Time found	Carcass GPS X	Y	Carcass species	Sex	Age	Condition carcass	Vegetation	Vege density	Grass height (cm)	Photo/ Bag ID	Notes:
10:00			*Paradise duck*	*F/M*	*Adult /juvenile/ unknown*	*injured, intact carcass, partial remains, scavenged, feathers only*	*Forest /scrub/ grassland*	*None, short or sparse vegetation, dense or long vegetation*	*4cm*	*N or photo ID: Date_teamID_number*	
13:00			*Unknown*	*NA*		*feathers*	*grassland*	*Short/sparse*	*2cm*	*N*	

Table C.2 A mortality monitoring data sheet will be filled in by field staff per turbine even if no carcasses are found. *The height of grass is the average height surrounding the carcass.*

MORTALITY SEARCHES PER TURBINE Turbine number: DATE: _____ Sheet ID: *e.g. SE_DATE_N* Start time:_____ End time:_____ *(record 24 hr clock)* Cloud cover: 0, 0-25, 25-50, 50-75, 75-100% (circle) Found by searcher name & dog name: Fog: Y / N (circle) Team ID:											
Time found	Carcass GPS X	Y	Carcass species	Sex	Age	Condition carcass	Vegetation	Vege density	Grass height (cm)	Photo/ Bag ID	Notes: (if NA – describe site vege)
NA	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*e.g. Grassland - sparse, dense near shrub area*

Table C.3 Carcass persistence data sheets will be filled in by field staff each day while setting up remote cameras on carcasses

Carcass persistence trials Placed by (name): FOR CARCASS/ CAMERA PLACEMENT Date: Sheet ID: Number of carcasses/cameras deployed on day: NB: cameras should only be picked up once there is no evidence of a carcass												
Turbine N:	Carcass ID	Camera ID	SIM ID	Set up Time	Carcass Location X	Y	Carcass species	Size category	Vegetation	Vege density	Grass height (cm)	Notes:
12A	*10*	*1*	*2*	*7:00am*				*large/small*	*Forest/scrub/ grassland*	*None, short or sparse vegetation, dense or long vegetation*	*4cm (grass height next to carcass)*	*lambing nearby, predators*

Table C.4 Carcass persistence data sheets will be filled in by field staff each day while collecting remote cameras on carcasses

Carcass persistence trails Collected by (name):			FOR CAMERA COLLECTION		Date: Number of cameras collected on day:			Sheet ID:	
Turbine N	Carcass ID	Camera ID	Carcass ID	Date camera collected	Sim downloaded	Data uploaded into folder			
					Y/N	*Y/N*			

Table C.5 Carcass detection data sheets will be filled in by field staff each day while placing carcasses around turbine

Carcass detection trials			FOR CARCASS PLACEMENT		Date:			Sheet ID:	*e.g. SECP_DATE_N*	
Placed by (name):					Number of carcasses deployed:					
Carcass ID	Date	Time	Turbine N:	GPS X	Y	Carcass species	Size category	Vegetation	Vege density	Grass height (cm)
1	*3/08/2025*	*7.00am*	*1A*			*finch*	*small*	*Forest/scrub/ grassland*	*None, short or sparse vegetation, dense or long vegetation*	*4cm (grass height next to carcass)*

Table C.6 Carcass detection data sheets will be filled in by searchers when they find a labelled carcass

Carcass detection trials			FOR SEARCHING		DATE:		Sheet ID:	*e.g. SE_DATE_N*	
Start time:	*15:00*	End time:	*17:00*		Cloud cover:	0 , 0-25, 25-50, 50-75, 75-100% (circle)			
Found by searcher name & dog name:			*Mary and Amber*		Fog:	Y / N (circle)			
Carcass ID	Time	Turbine N:	GPS X	Y	Carcass species	Size category	Vegetation	Vege density	Grass height (cm)
	7.00am	*1A*			*finch*	*small*	*Forest/scrub/ grassland*	*None, short or sparse vegetation, dense or long vegetation*	*4cm (grass height next to carcass)*

Table C.7 Incidental finds data sheets will be filled in when a carcass is found outside of mortality monitoring surveys (plot location and survey times)

INCIDENTIAL FINDS	*For any injured bird or incidental carcasses finds outside of mortality monitoring surveys (plot location and survey times)*	Sheet ID: *e.g. Incidental_Find_DATE FOUND* *e.g. Incidental_Find_12_6_2023*
Found by *(name)*:	Date found: Time found:	

Description of where found:
GPS location:
Turbine: *Y/N (circle)* Turbine number (if applicable):
Species found:
Condition: *injured, intact carcass, partial remains, scavenged, feathers only (circle one)*
Photo: *Y/N (circle)* Photo Number:

Vegetation within general vicinity of carcass – bare ground, short or sparse vegetation, dense or long vegetation
Found in: forest, scrub, grassland or other (circle)
Carcass identifier – who identified the species?
Fate of carcass – was it removed or left in place to be included in mortality surveys?
Was it frozen in the freezer? Y/N
Bag number if taken and frozen: *Bag ID* Number_____

Description of incident/notes:

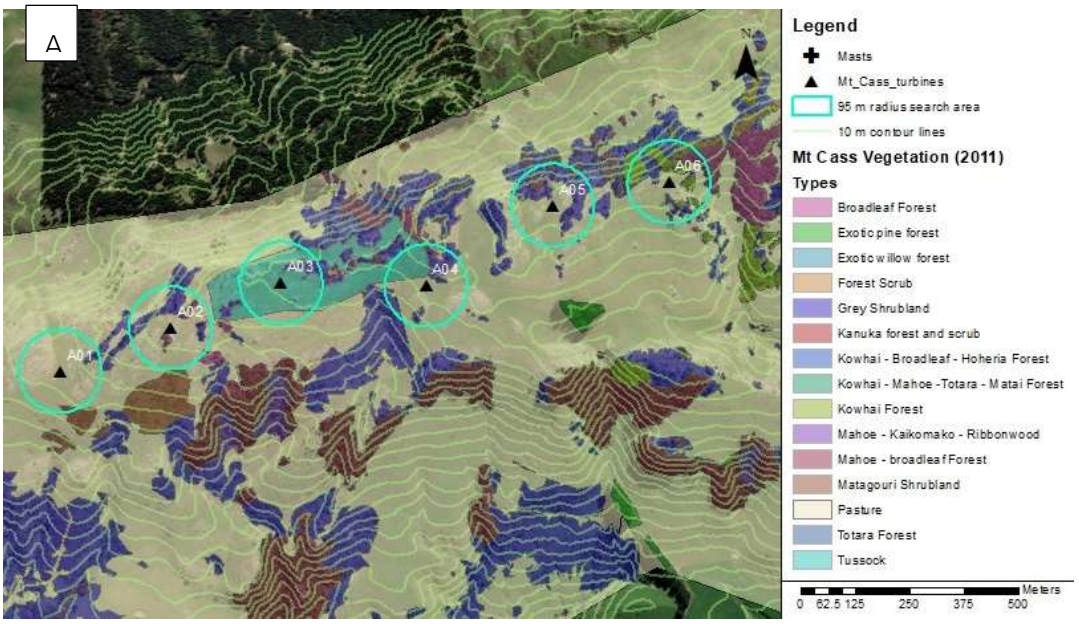
If this is a species of interest have the correct people been notified: Y/N *(circle one)*

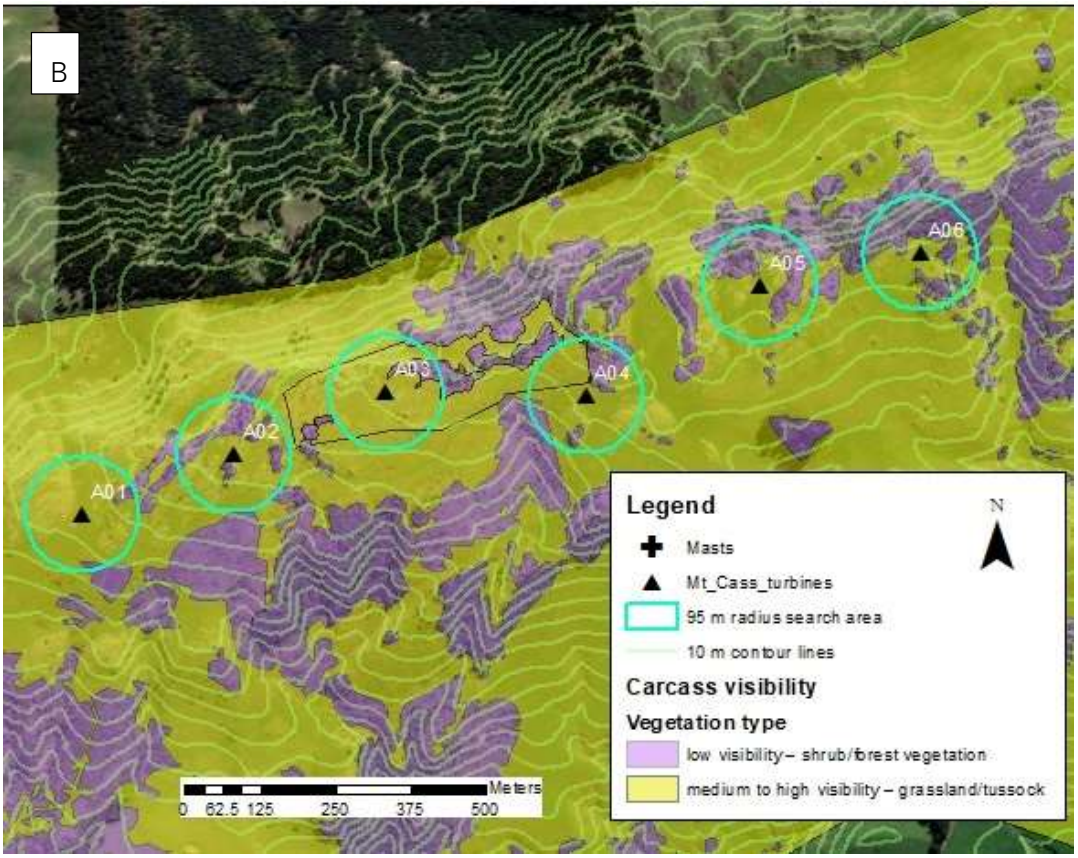
Table C8. Visibility Classes and Defining Characteristics to use for defining the vegetation density in the data sheets

Categories in the mortality sheet	% Vegetation Cover	Vegetation Height	Visibility Class
None	≥90% bare ground*	<15 cm tall	Class 1 (Easy)
short or sparse vegetation	≥25 to <90% bare ground	15 – 30 cm tall	Class 2 (Moderate)
Dense or long vegetation	<25% bare ground	>30 cm tall	Class 3 (Difficult)

NOTE: * Bare ground would include unvegetated areas such as roads, turbine pads, or areas of ground where less than 10% of the area is vegetated.

10 Appendix D: Stratification by Vegetation





[Figure D1 (A & B)] In the carcass detection trials, carcass placement will be stratified to ensure representation across different visibility classes/habitats. All vegetation types (A) will be put into one of two categories: (i.e. high to medium visibility – grassland/tussock, and

low visibility – shrub/forest vegetation) (B) and the average proportion of each class calculated across the Mt Cass Wind Farm in each size range.

11 Appendix E: Additional background on the proposed analysis

Below we demonstrate two potential methods for calculating annual mortality. Section A.1 is the standard method usually used to calculate mortality uncertainties and is a technique commonly used by analytical chemists and physicists (Taylor, 1997). It requires no specialist statistical knowledge and can be implemented as is, using the Excel formulas shown. These SE estimates are adequate. Section A.2 outlines the Monte Carlo method. It requires specialist knowledge and software, but it will give more realistic confidence intervals which in this situation are not symmetric about the mortality estimates. We suggest that the choice of method could well be left up to the statistician and should consider if any advances have occurred in the field since the writing of this methodology.

A.1 Estimating standard errors

This is a worked example from a fictional wind farm. After monitoring 10 turbines for 3 years, the carcasses of 47 small birds have been recovered. The persistence trial used 20 birds and estimated that 65% of birds killed remained to be found at the next search. The detection trial of 10 birds estimated that about 60% of small birds remaining on the ground were found.

The two screen shots below show the values and the formulas involved for the standard method. The estimated mortality is 4.0 birds/turbine per year with %SE of 34% or ±1.4 birds/turbine/year.

	A	B	C	D	E	F	G	H	I
1		Monitoring	Recoveries	Persistence		Detection		Birds	True Rate
2		Effort		n	p	n	p		Birds/Tur/Yr
3		M	R		P		D	B	T
4	Value	30	47	20	65%	10	60%	121	4.0
5	SE		6.86		0.11		0.15		1.4
6	%SE		15%		16%		26%		34%

	A	B	C	D	E	F	G	H	I
1		Monitoring	Recoveries	Persistence		Detection		Birds	True Rate
2		Effort		n	p	n	p		Birds/Tur/Yr
3		M	R		P		D	B	T
4	Value	=10*3	47	20	0.65	10	0.6	=C4/E4/G4	=H4/B4
5	SE		=SQRT(C4)		=SQRT(E4*(1-E4)/D4		=SQRT(G4*(1-G4)/F4)		=I4*I6
6	%SE		=C5/C4		=E5/E4		=G5/G4		=SQRT(C6^2+E6^2+G6^2)

The SE formulas are those for a Poisson count, and a Binomial proportion. The %SEs are combined by square rooting the sum of the squares of the component %SEs to give the %SE of T.

In practice, these calculations are done for each size class separately then the SEs combined at the end.

A.2 Monte Carlo method

The Monte Carlo method provides an alternative analysis. It gives more information than the standard method but the standard method provides a simple and adequate answer in this situation.

This method does not use SE formulas. Instead it randomly generates plausible scenarios for the true values of R, P and D, based on the collected data.

	A	B	C	D	E	F	G	H	I
1		Monitoring	Recoveries	Persistence		Detection		Birds	True Rate
2		Effort		n	p	n	p		Birds/Tur/Yr
3		M	R		P		D	B	T
4	Value	30	47	20	65%	10	60%	121	4.0
5									
6		M	R		P		D	B	T
7	Value	30	***41***	20	***71%***	10	***54%***	107	3.6

For the scenario shown, the true values for R, P and D are assumed to be 41, 71% and 54% giving a Monte Carlo estimate of 3.6 as one plausible mortality estimate. Several thousand of these scenarios are generated and, from the collated estimates, improved SE and confidence intervals can be calculated. It will be found that the 95% confidence intervals are not in fact symmetric as the standard analysis implies.

The formulas for generating the plausible scenarios are based on the inverse Poisson and Binomial likelihood distributions and are not shown here because they are not provided by standard Excel. You must either use an Excel Monte Carlo package or write special functions for the analysis.

12 Appendix F: Draft transects at each wind turbine site

Indicative turbine search areas maps are shown at a 1:2000 scale. 10 m contours are orange lines and rare plant locations are shown as pink dots.

Note: These draft transects have been prepared to assist in the development of the MCWF Post-Construction Bird Collision Monitoring Plan Principles adopted in developing these transects are:

- The standard search area is within a radius of 120 m, centred on the turbine, for the first year, and subject to the review outcomes after year 1, a 95 m search radius will be used in subsequent survey events.

- A series of transects will be created that cover the search area as efficiently as possible, allowing for a 5 m buffer around each transect (being the effective search are using dogs).

Terrain constraints will be considered during search events including:

- Aligning transects with main geological features (observation on site shows that this is often the path of least resistance through bush and limestone pavement areas)

- Traversing of slopes is preferred as often offering path of least resistance

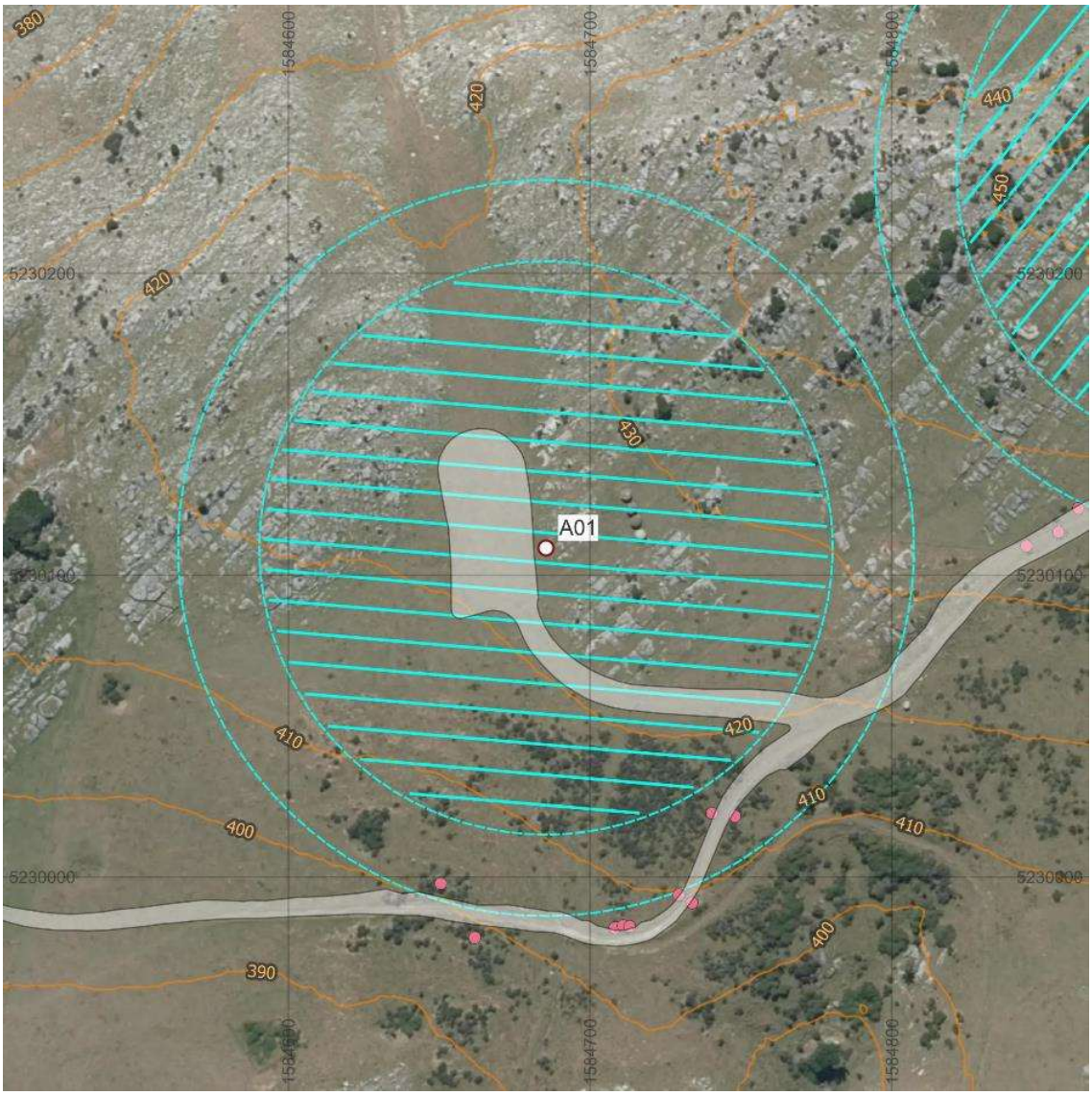
- Navigating built features (eg fencelines and proposed roads)

Vegetation constraints are also to be considered, including:

- Penetrating an under-storey of Onga-onga is not practical and could be hazardous (especially to dogs)

- Locations of rare plants are to be treated with caution

- Dense canopy (especially with vines) may mean that carcasses don't make it to the ground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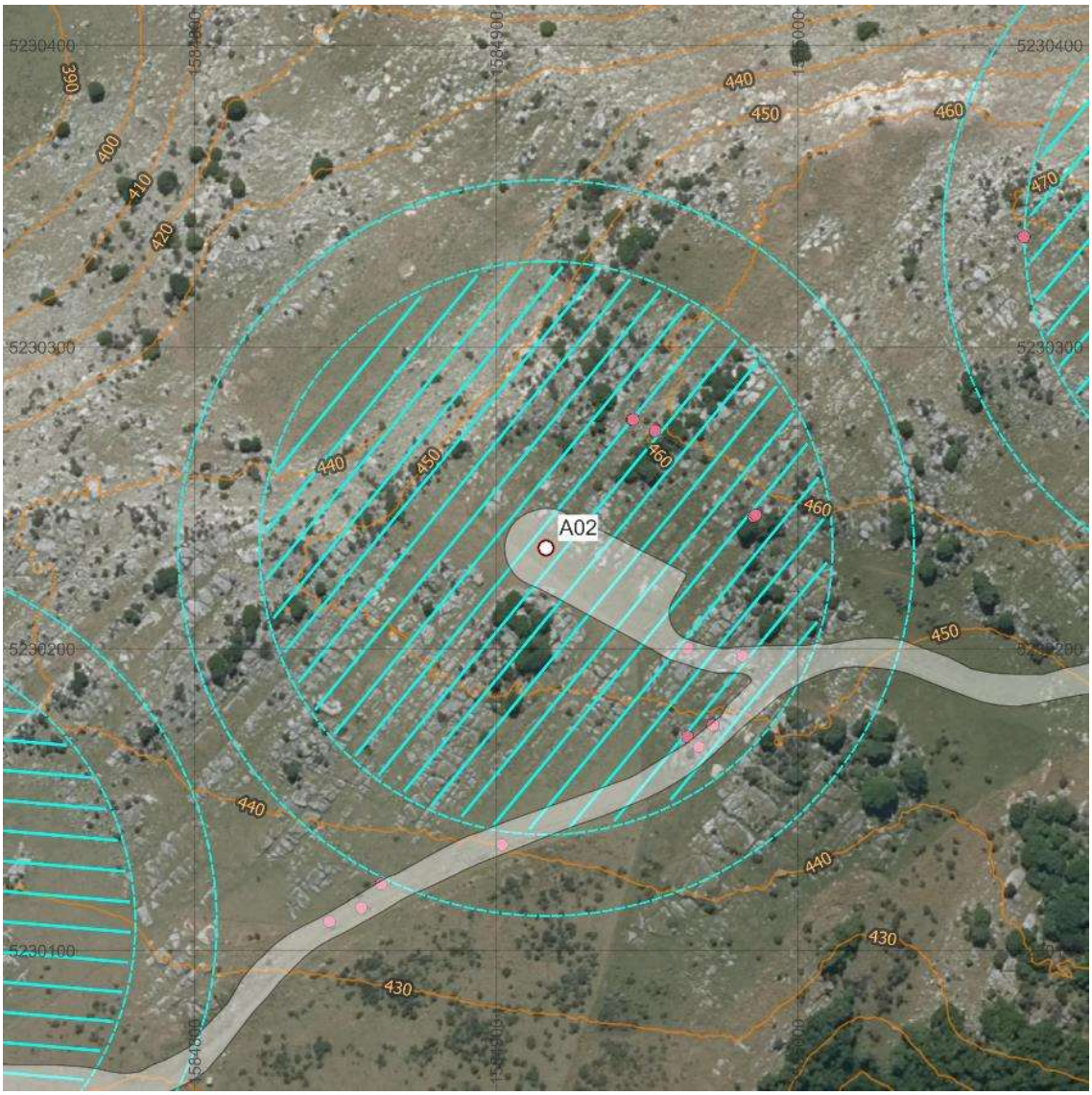
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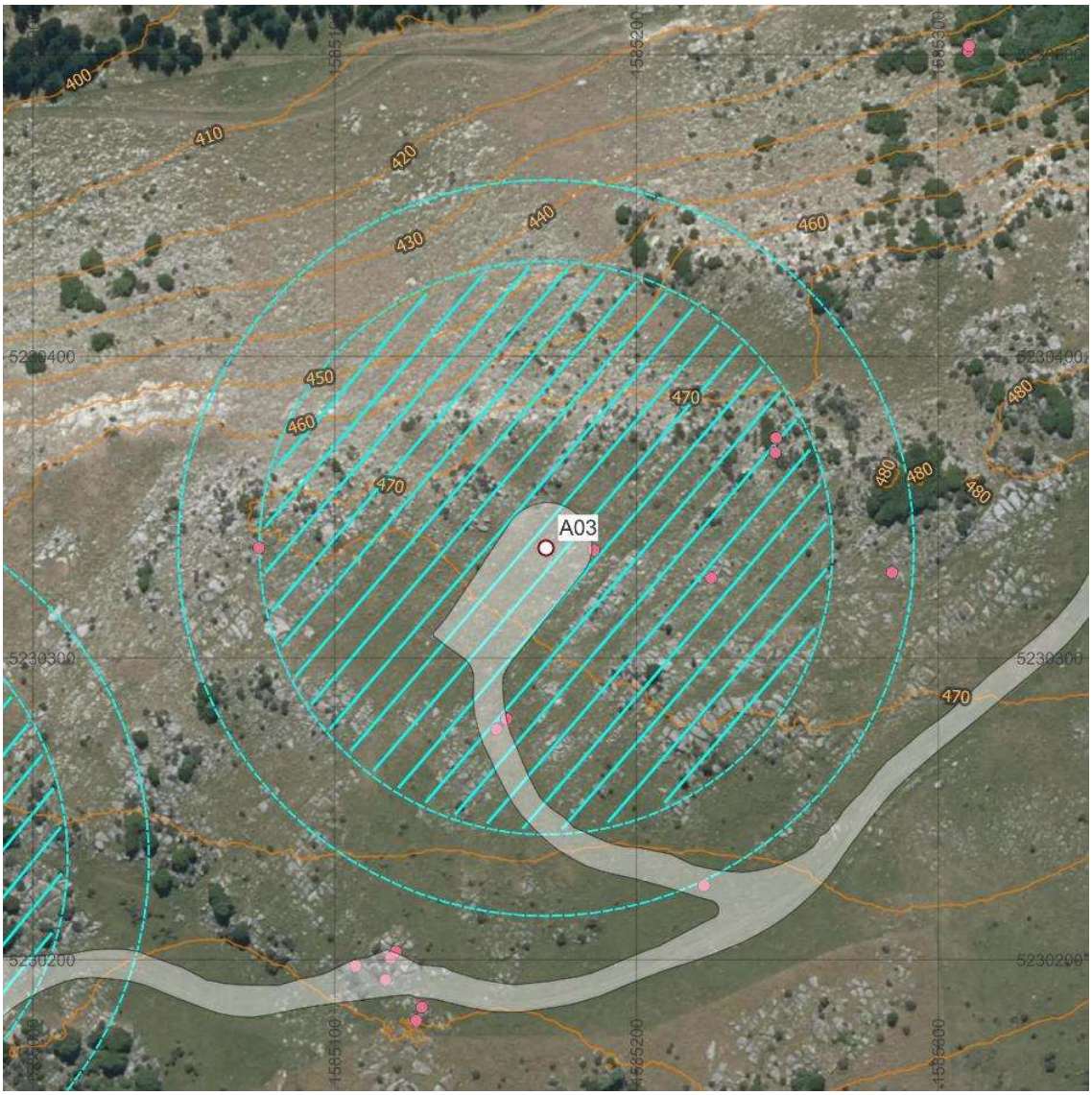
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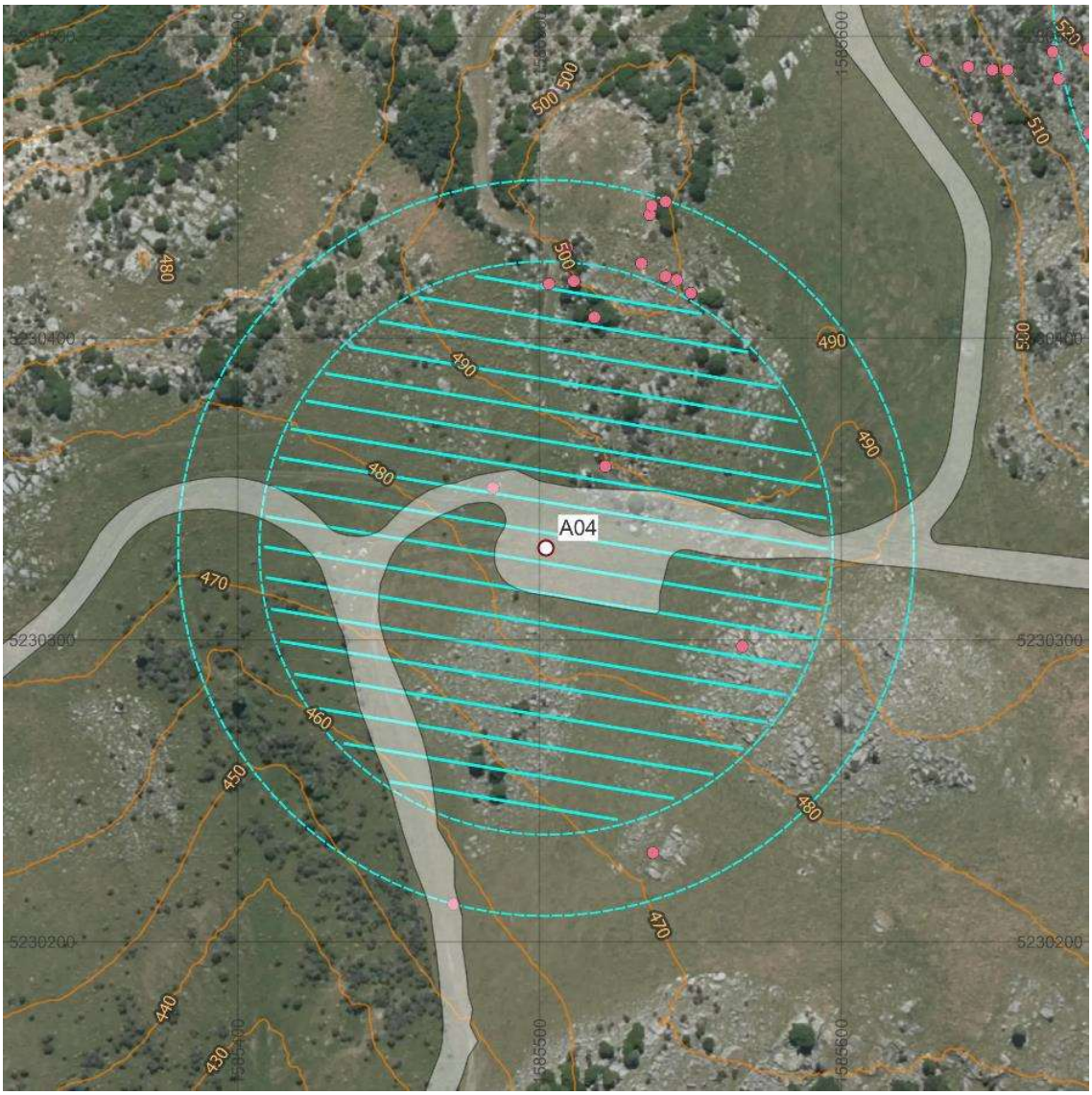
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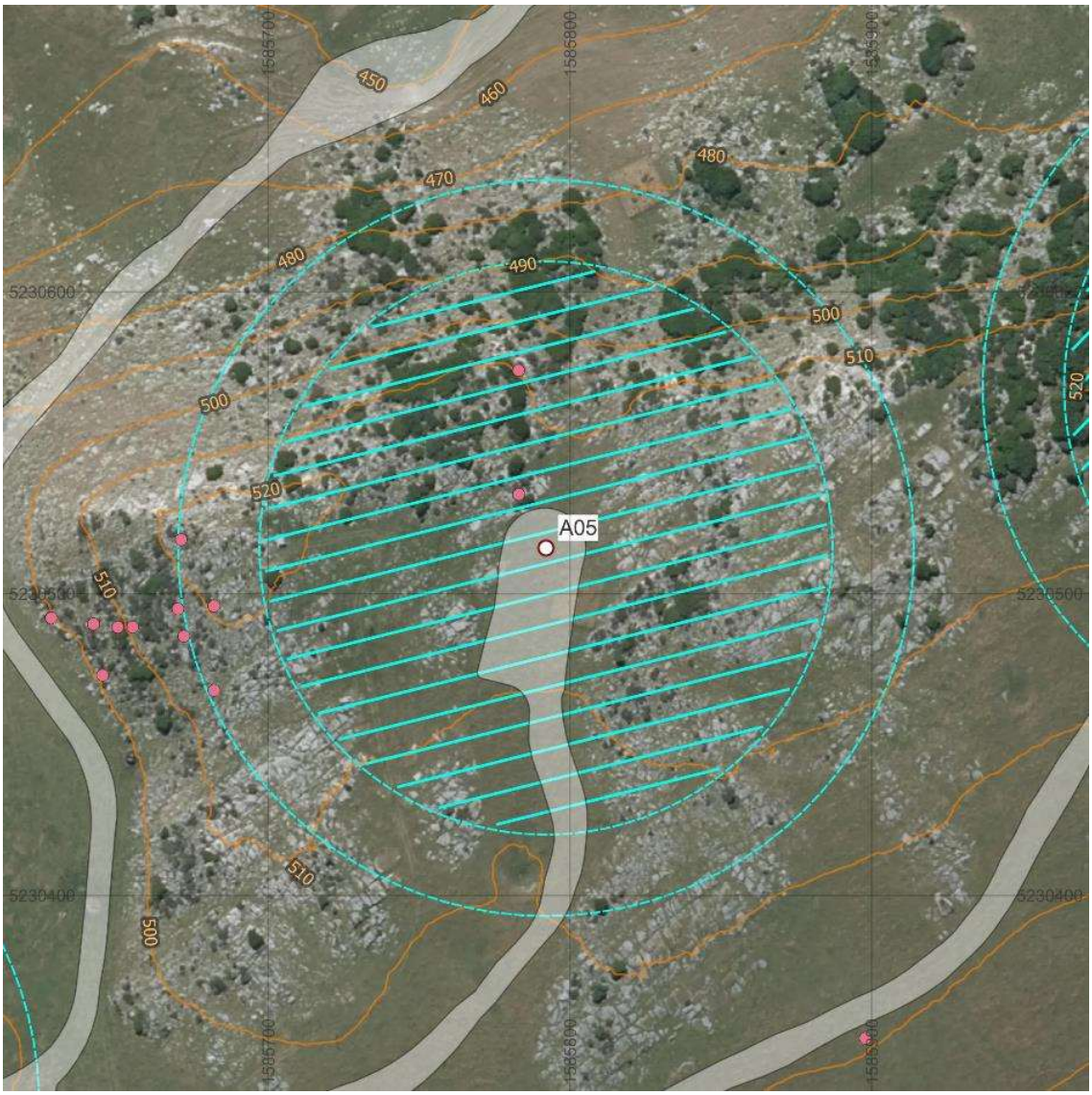
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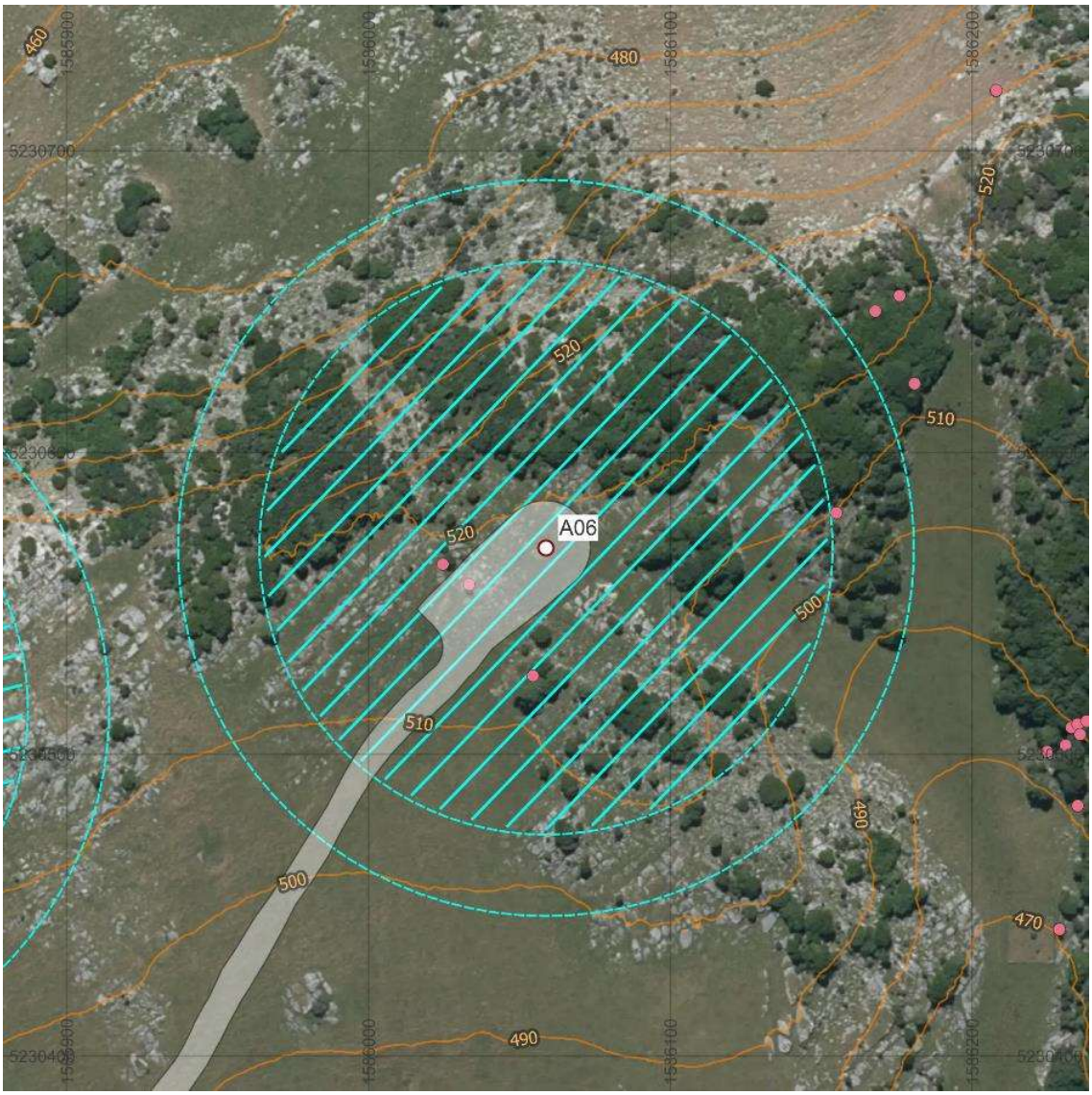
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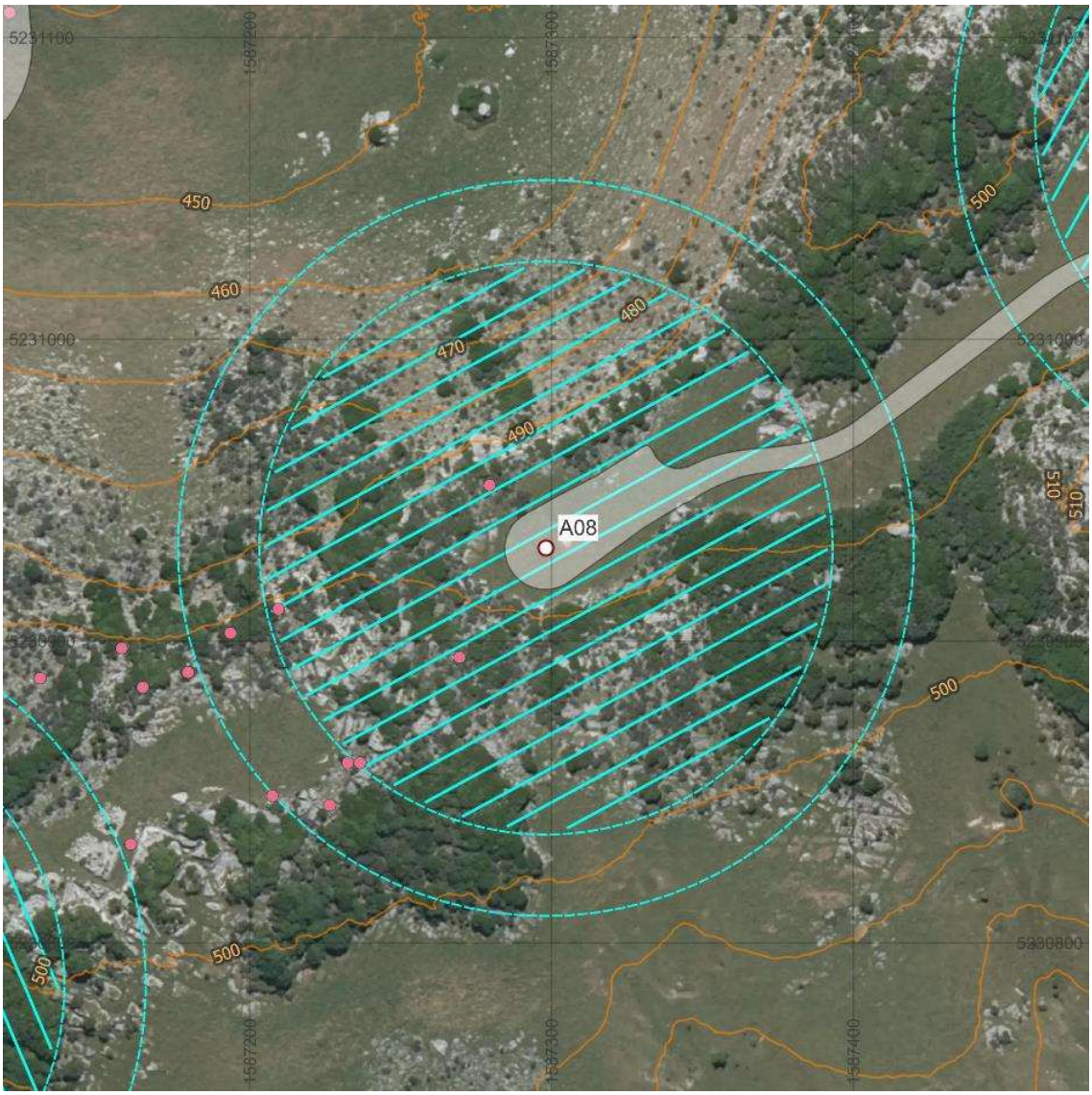
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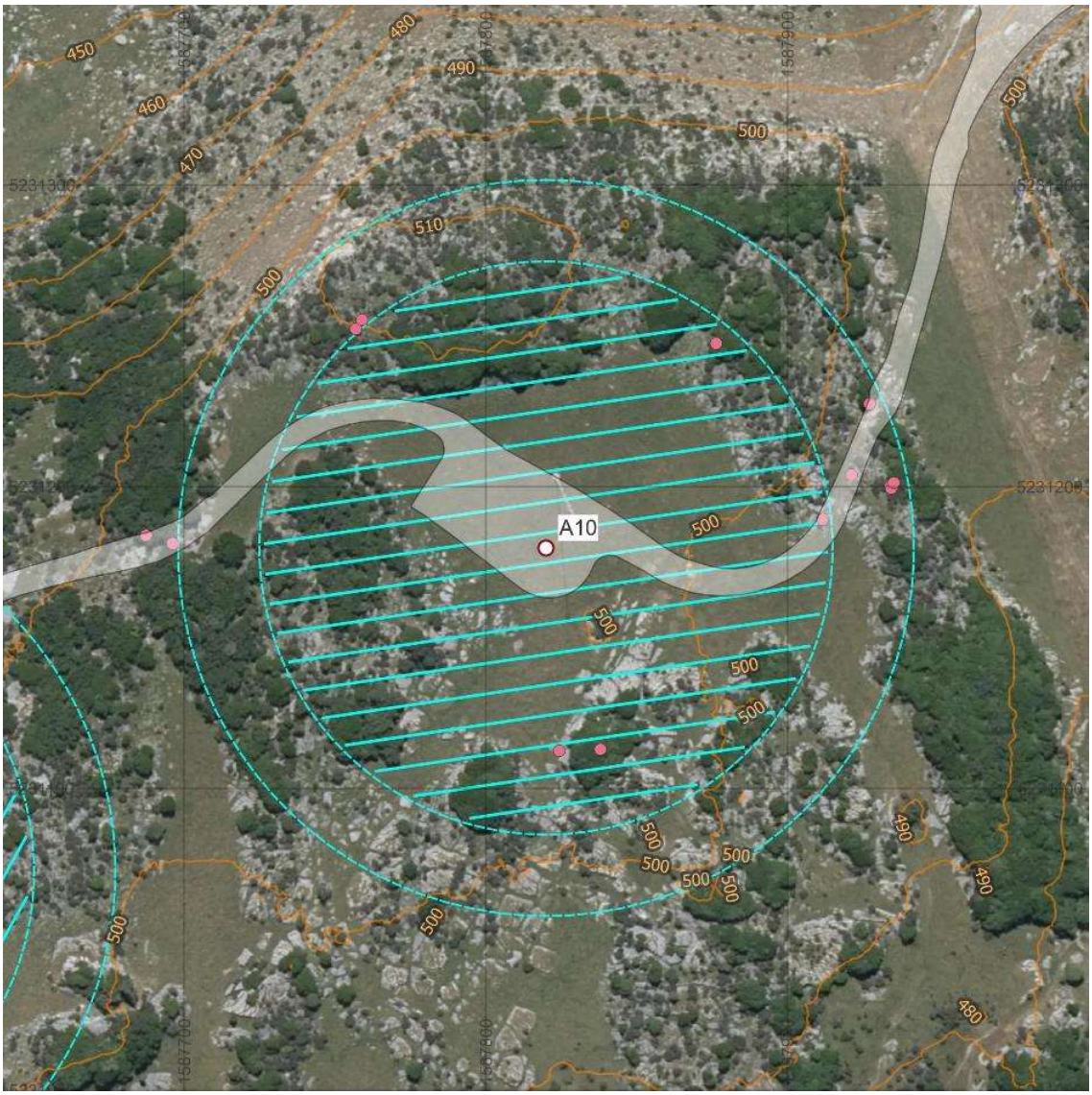
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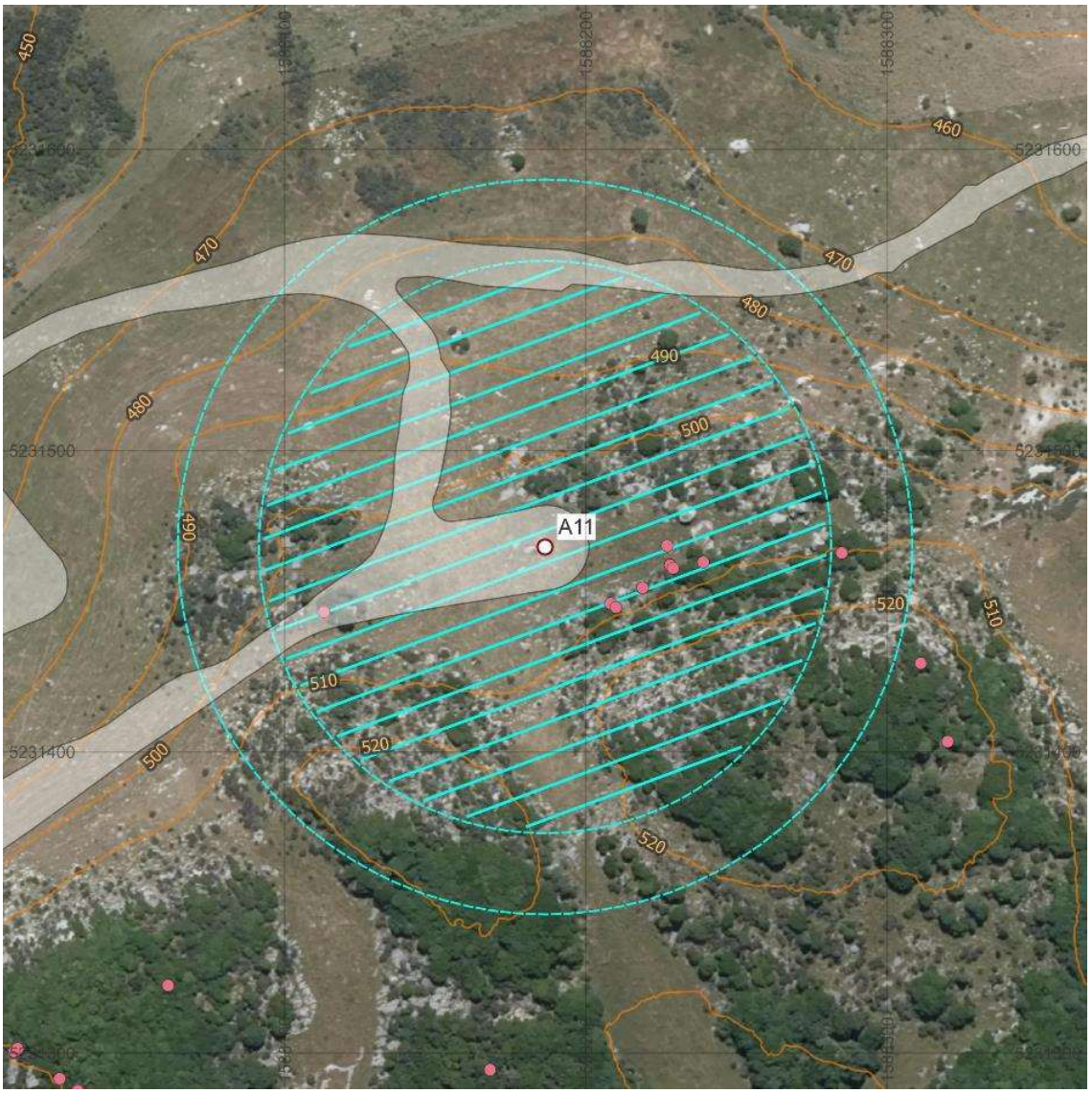
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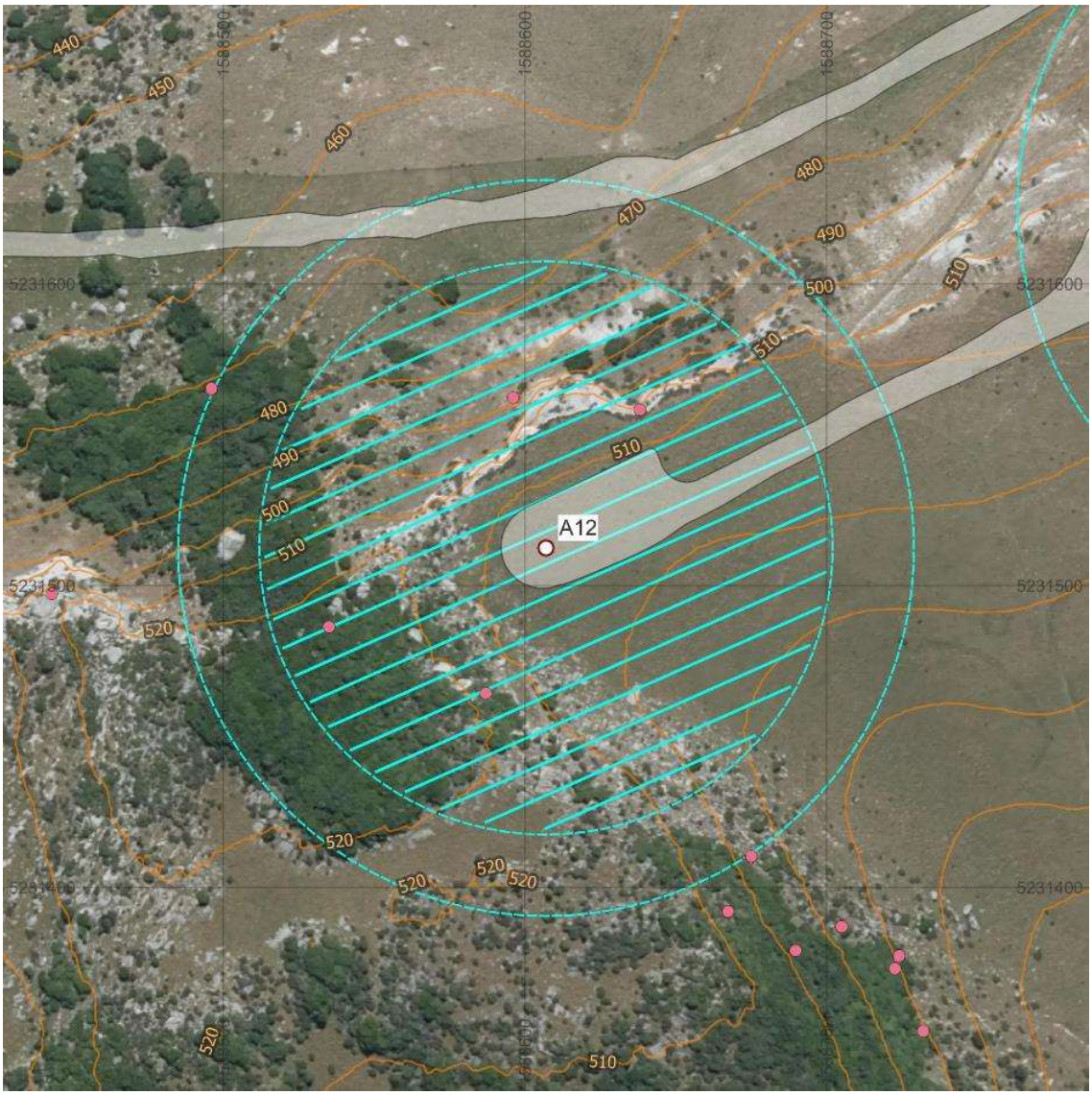
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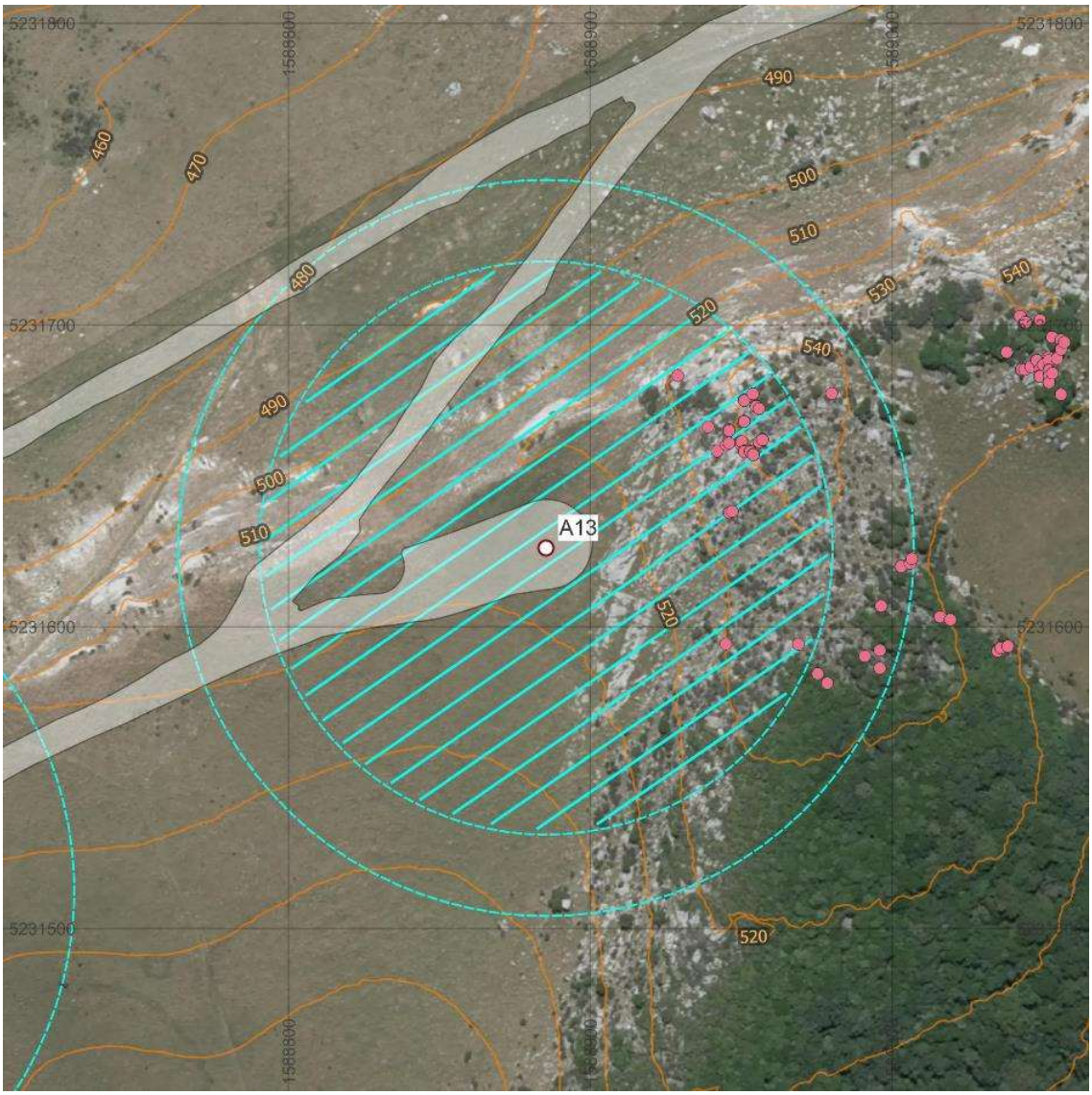
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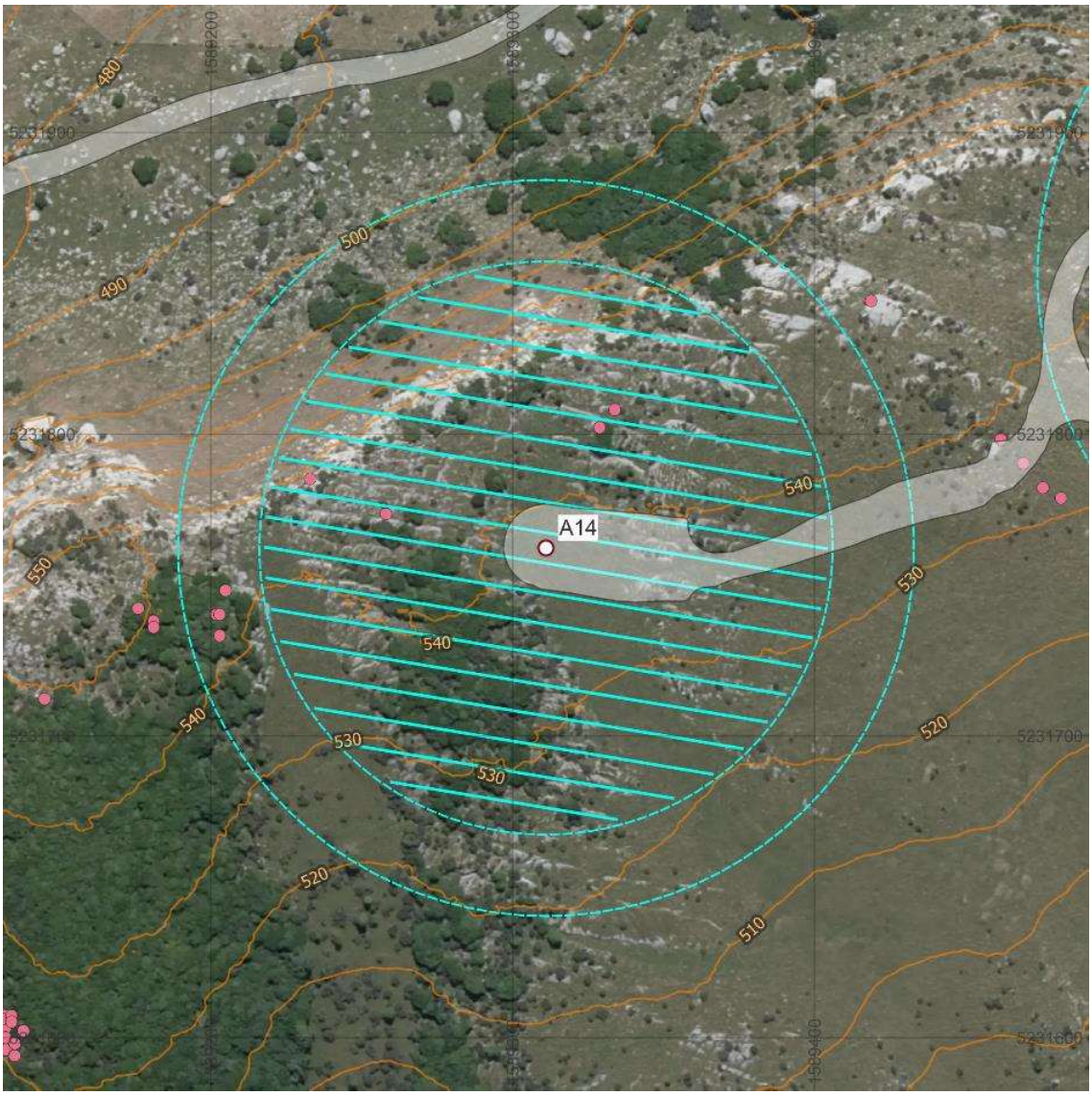
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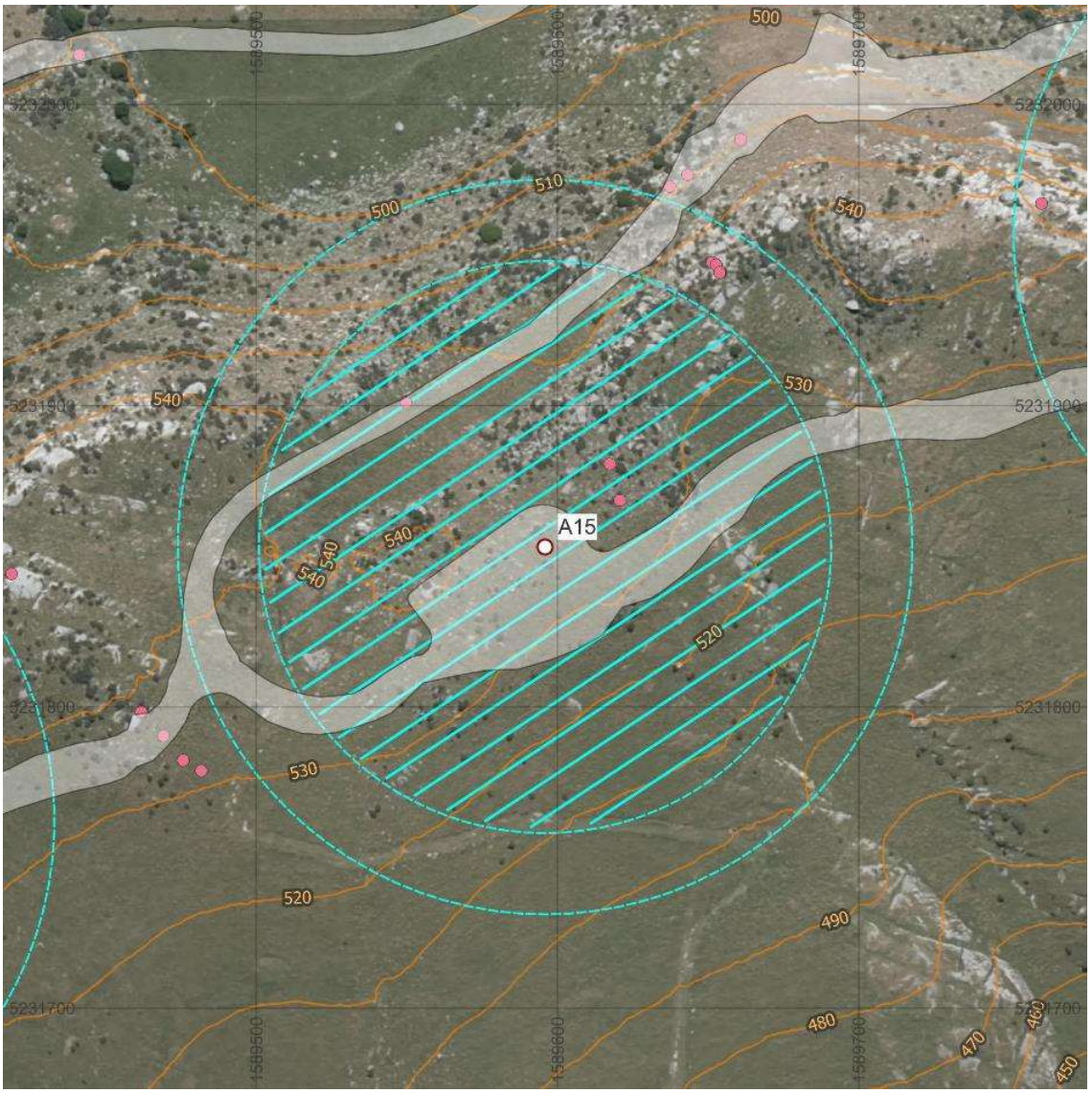
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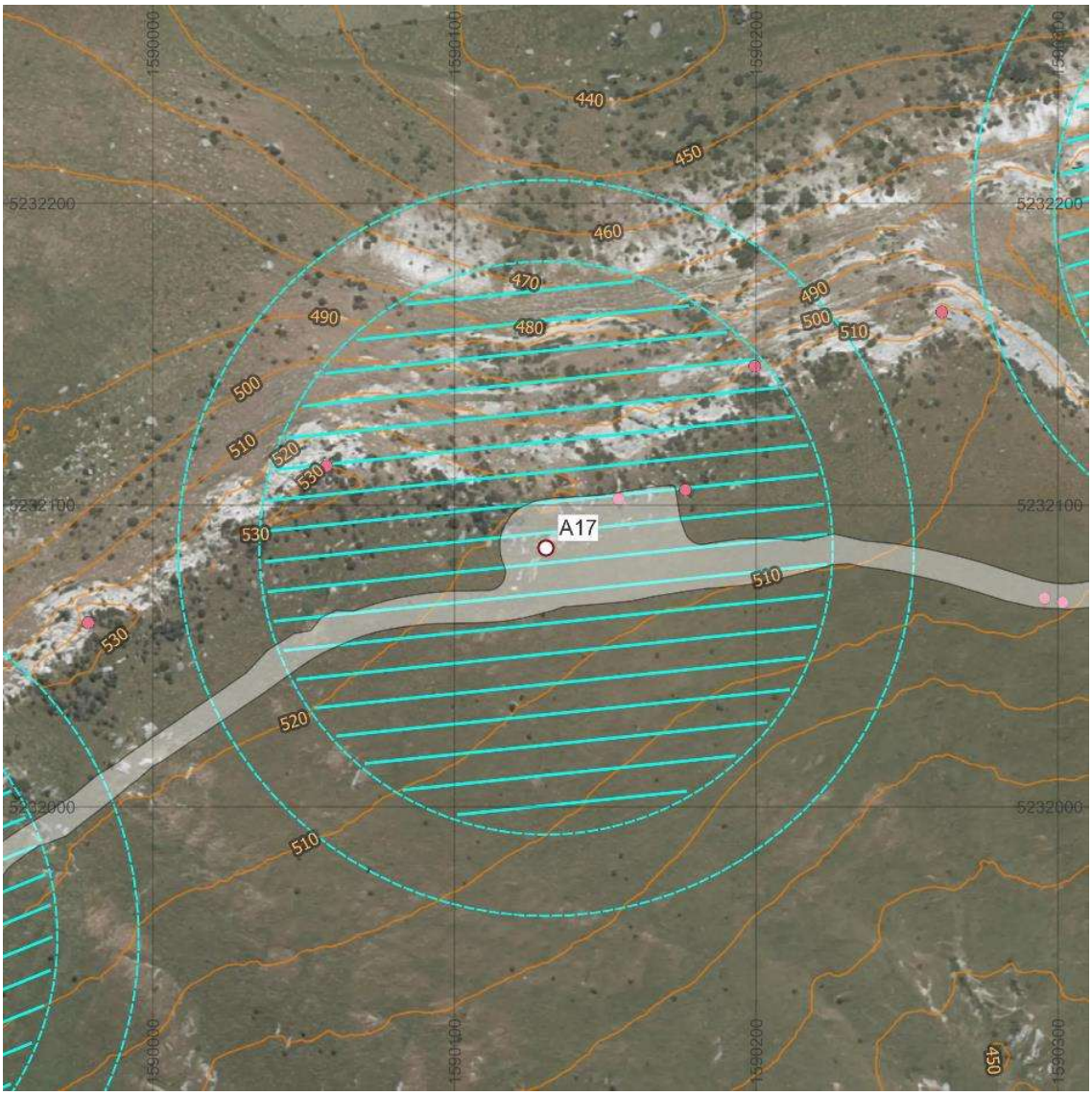
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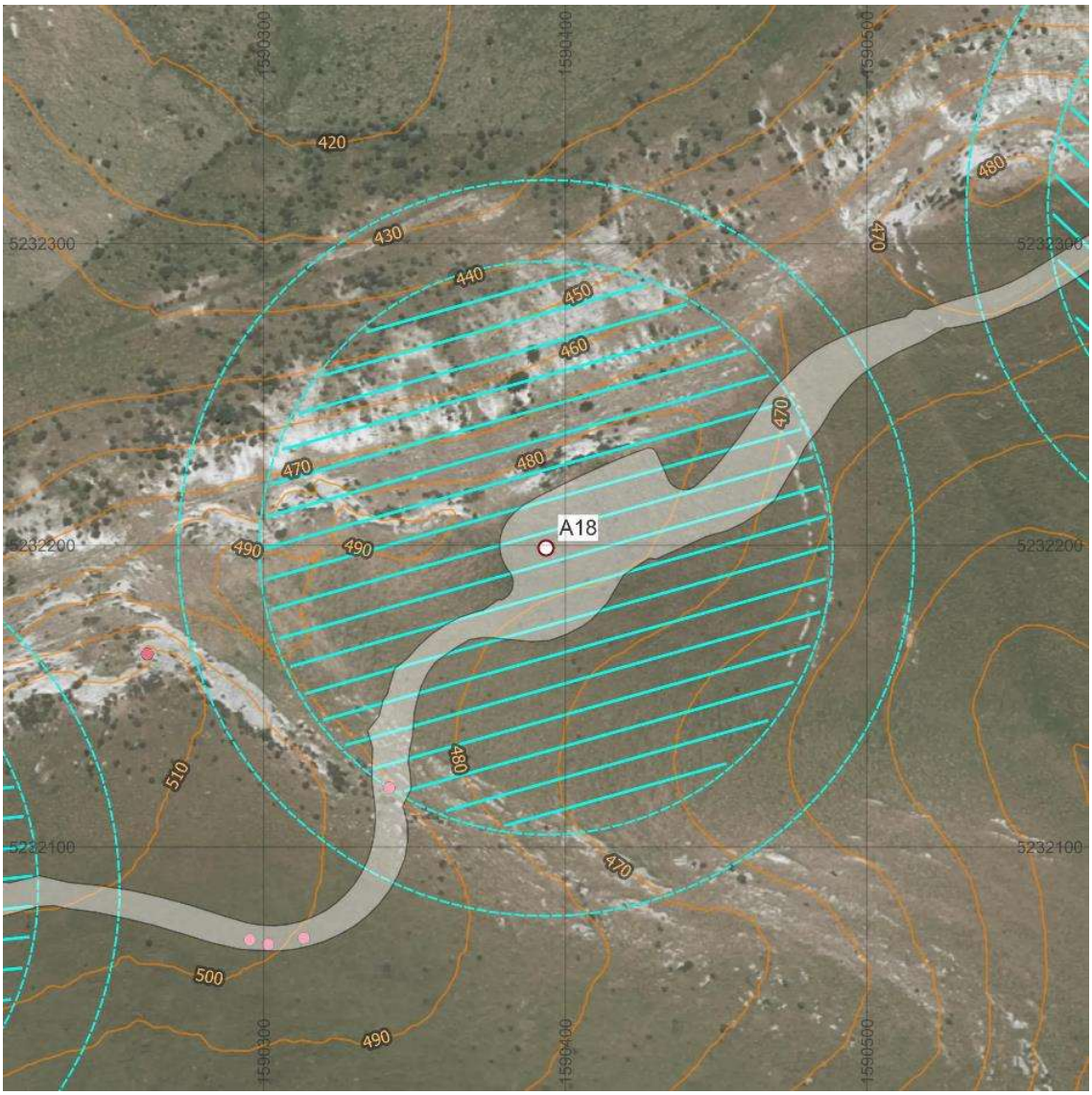
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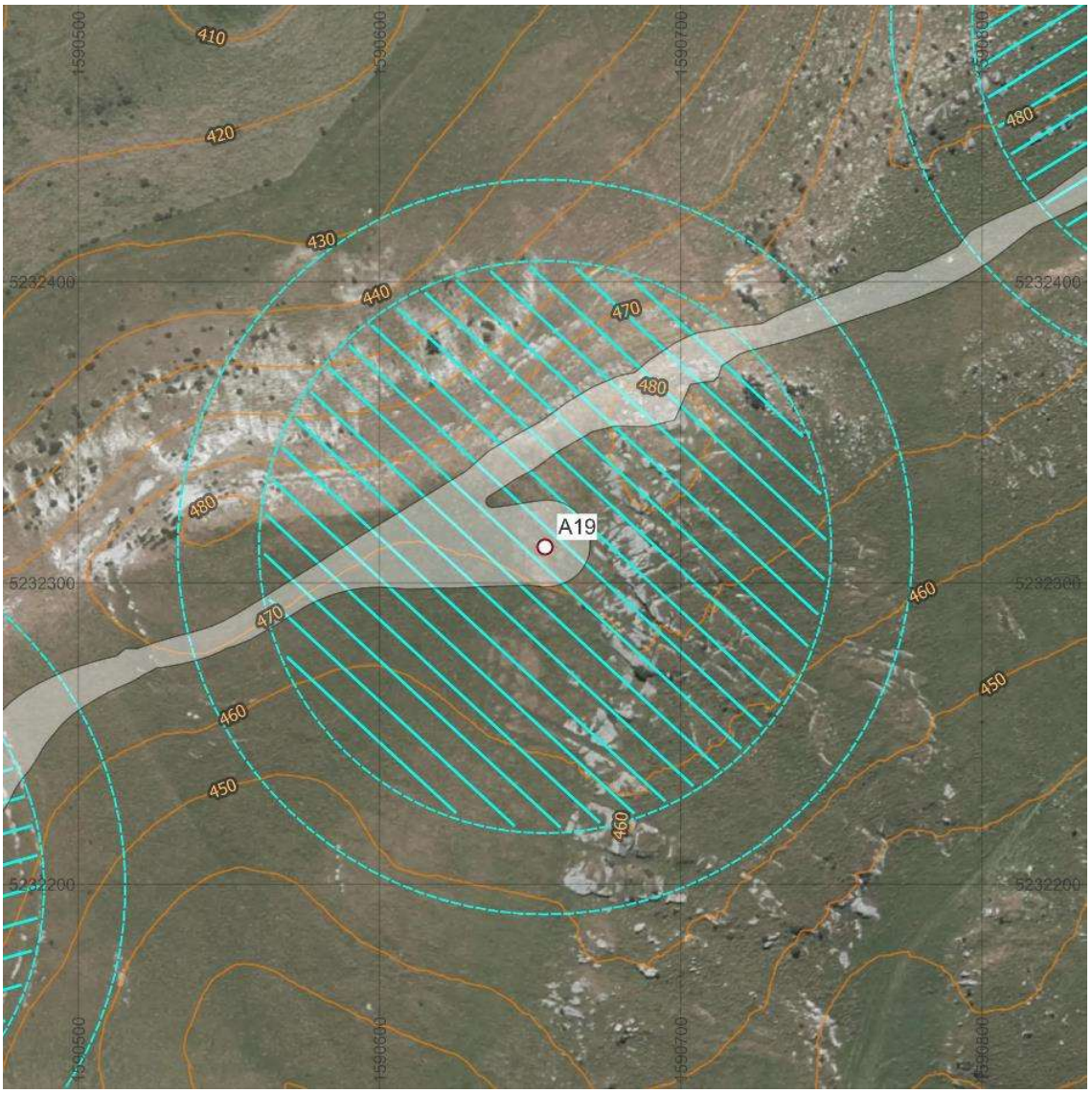
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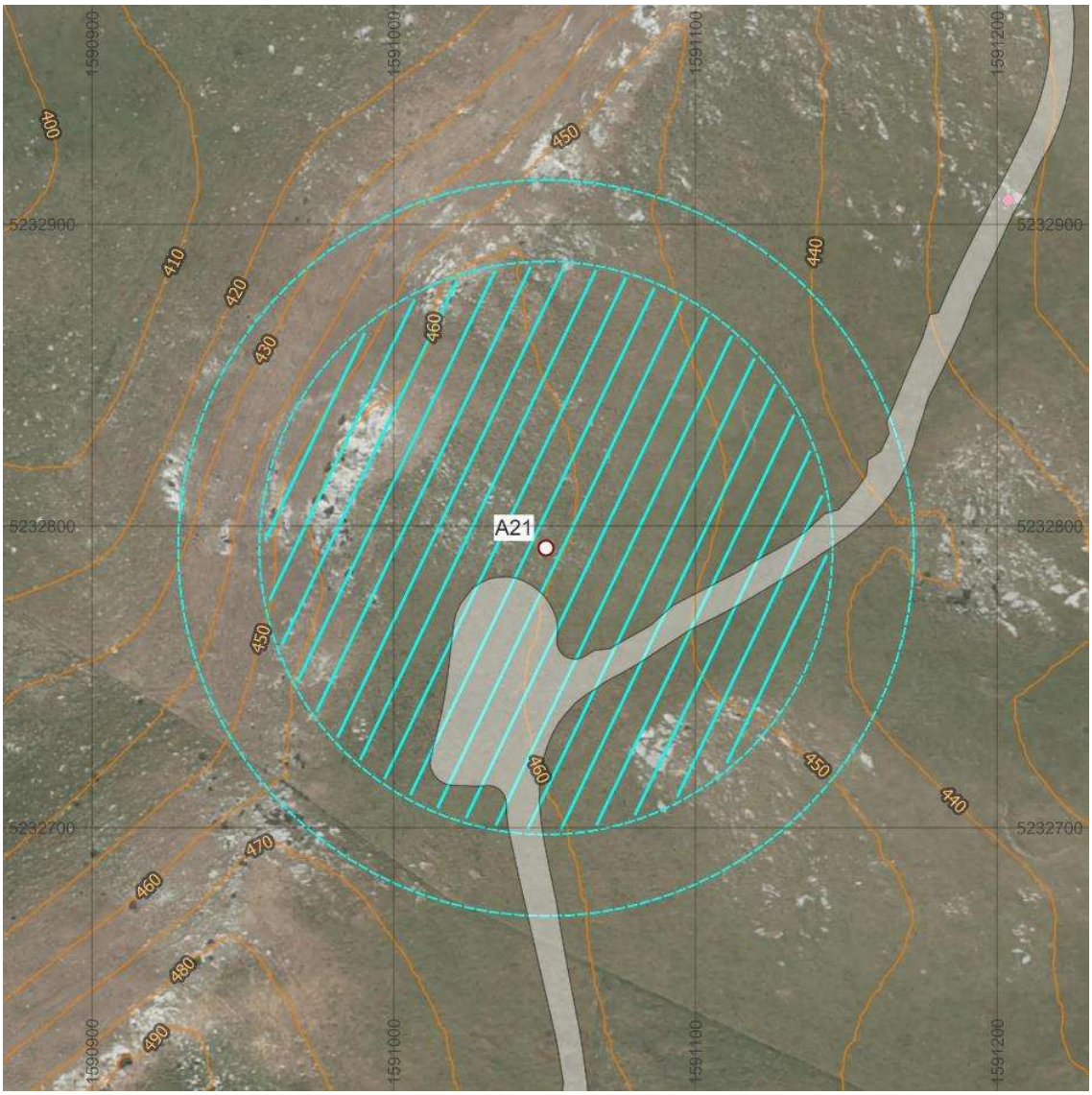
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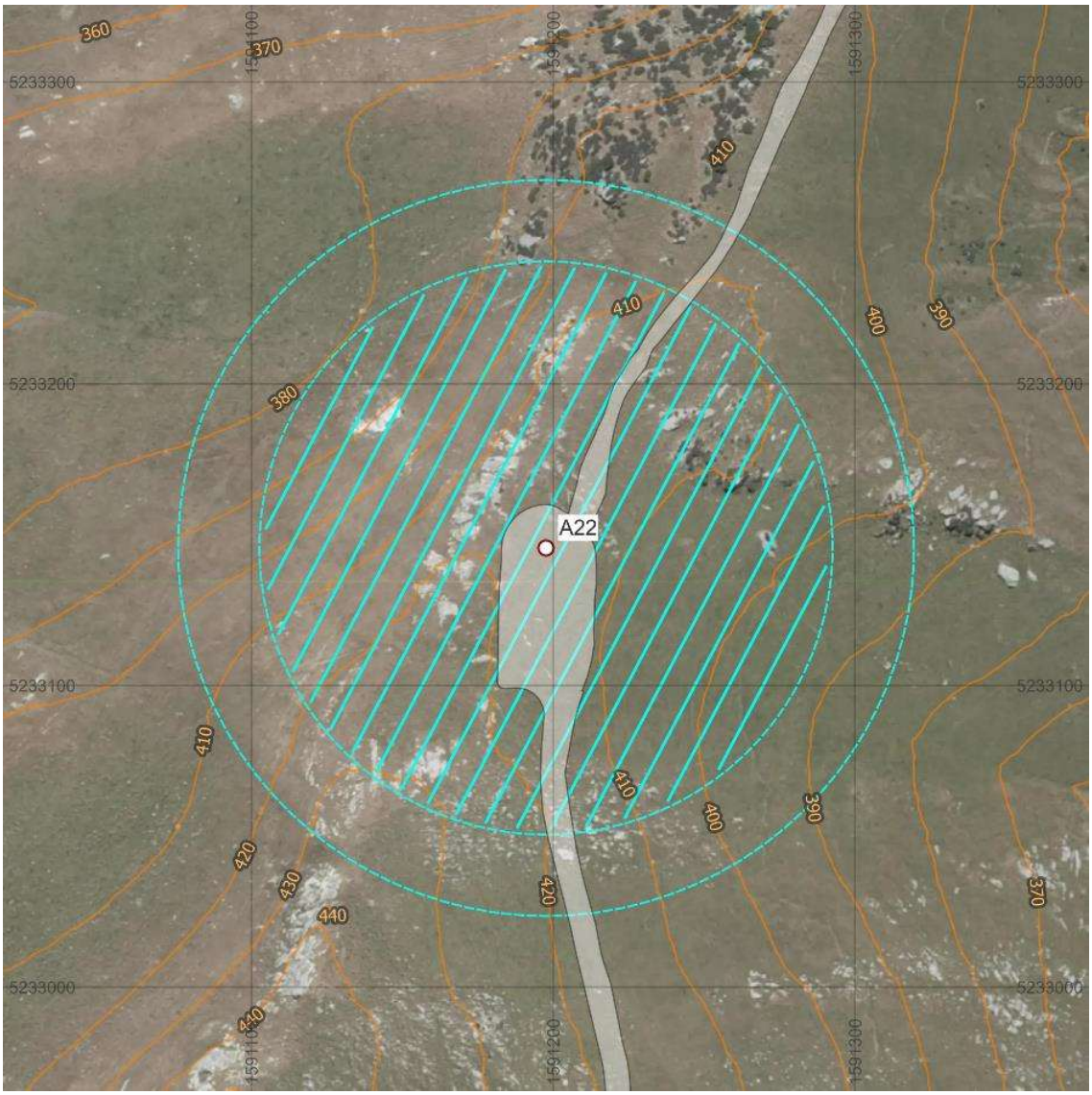
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