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Draft Pest Mammal Management Plan for the Point Solar Farm at Twizel, Canterbury

Contract Report No. 6621h-iv

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Draft Pest Mammal Management Plan for the Point Solar Farm at Twizel, Canterbury

Contract Report No. 6621h-iv

March 2026

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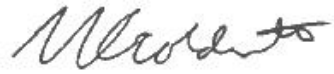

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05/03/2026

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1.0 Introduction

Far North Solar Farms Ltd (**FNSF**) are applying for a resource consent to develop a solar farm in Twizel near Ōhau C power station, known as The Point (also referred to as **the proposed development**). The Point will be built upon approximately 687 hectares of flat land that is currently a farm (also referred to as **the site**). The site is flat, with farmland to the north and rivers on the eastern (Pūkaki and Tekapo rivers) and western (Twizel River) boundaries. The site is approximately 10 kilometres to the southeast of Twizel township. FNSF intend to install 720,048 solar panels across the site (Figure 1), with a 3.8 metre gap between each panel. Wildland Consultants (Wildlands) have recently undertaken ecological surveys at the site, including a pest mammal assessment which identified the need for a Pest Mammal Management Plan (**PMMP**).

As part of effects management for The Point, FNSF intend to carry out site-wide pest mammal control to help manage impacts of the proposed development on flora and fauna, particularly with respect to habitat modification. Plans include a 13.8-hectare predator-proof-fenced enclosure, primarily for indigenous grasshoppers (also referred to as **The Point Grasshopper Reserve**).

Far North Solar Farms have commissioned Wildlands to prepare a PMMP for The Point reserve.

2.0 Existing Ecological Values

2.1 Overview

The Mackenzie Basin, including land surrounding the site, is important habitat for indigenous plants and wildlife. The site of the proposed development is in Pukaki Ecological District, which provides a unique inland environment with semi-arid alluvial terraces and outwash plains crisscrossed by braided rivers (McEwen 1987). As a result, its flora and fauna assemblages are unlike any others in Aotearoa New Zealand, and many species are endemic to the Mackenzie (Wakelin *et al.* 2023). Heavy modification of the local environment due to farming and hydrological power schemes has resulted in the decline of many species and habitats. Introduced weeds and pest mammals, such as rabbits (*Oryctolagus cuniculus cuniculus*), hares (*Lepus europaeus*), brushtail possums (possum, *Trichosurus vulpecula*), mustelids (*Mustela* spp.), hedgehogs (*Erinaceus europaeus*), rodents (*Rattus* spp. and *Mus musculus*), and feral cats (*Felis cattus*), thrive in the Mackenzie and pose various threats to its ecological values.

2.2 Site-specific context

The site is located between the lowest reaches of the Twizel and Pūkaki Rivers. The Tekapo River discharges into the head of Lake Benmore, a human-made hydro lake, immediately adjacent (east) of where the Ōhau River also discharges into the lake. The Twizel River flows into the Ōhau River about one kilometre upstream from the lake. A centre-pivot irrigator (diameter 1.5 kilometres) is present northwest of the site.

The site is largely flat land, *c.*400 metres above sea level, comprising the low interfluve between the Tekapo and Twizel Rivers. As such, the site is underlain by alluvial gravels. The lower reaches of the Tekapo and Twizel Rivers are both braided systems, with a line of low eroded cliffs on the edges of the river channels.

Most of the site is currently grazed farmland, and most of it is cultivated and cropped seasonally. A large portion of the eastern side of the site (also referred to as the 'eastern field') was last cultivated in 2018 and is largely left fallow.

2.3 Indigenous flora and fauna

The site of the proposed development is known to hold important ecological values, including Threatened and Endangered species, concentrated near the western and eastern edges. The interior of the site holds value for avifauna as a potential location for feeding and breeding for braided river birds. Two common lizard species (McCanns skink/*Oligosoma mccanni* and southern grass skink/*Oligosoma* aff. *polychroma*) are found in the interior of the site. Otago short-horned grasshopper (*Phaulacridium otagoense*) are clustered around habitat patches primarily in the eastern field, and New Zealand blue butterfly (*Zizina oxleyi*) are spread throughout the site.

Near the edges of the site are Southern Alps gecko (*Woodworthia* "Southern Alps") and higher quality habitat for Otago short-horned grasshopper, which may also support minute grasshopper (*Sigaus minutus*), robust grasshopper (*Sigaus robustus*), and Tekapo ground wētā (*Hemiandrus fabella*).

3.0 Implementation of the plan

The previous Assessment of Ecological Effects (**AEE**) for the site undertaken by Wildlands includes the following reports:

- Wildland Consultants. 2023. *Ecological Assessment for Two Solar Farm Sites in the Mackenzie District, South Canterbury*. Wildland Consultants Contract Report No. 6621. Prepared for Far North Solar Farms Ltd. 45pp.

- Wildland Consultants. 2025a. *Assessment of Ecological Effects for the Proposed Solar Farm Between the Lower Reaches of the Tekapo and Twizel Rivers, Mackenzie District.* Wildland Consultants Contract Report No. 6621c. Prepared for Far North Solar Farms Ltd. 57pp.

The PMMP intended to be implemented in conjunction with the following management plans:

- Wildland Consultants. 2026a. *Draft Lizard Management Plan for The Point Solar Farm, Twizel.* Wildland Consultants Contract Report No. 6621h-v. Prepared for Far North Solar Farms Ltd. 48pp.

- Wildland Consultants. 2026b. *Draft Terrestrial Invertebrate Management Plan for The Point Solar Farm, Twizel.* Wildland Consultants Contract Report No. 6621h-ii. Prepared for Far North Solar Farms Ltd. 31pp.

- Wildland Consultants. 2026c. *Draft Vegetation Management Plan for The Point Solar Farm, Twizel.* Wildland Consultants Contract Report No. 6621h-iii. Prepared for Far North Solar Farms Ltd. XXpp.

- Wildland Consultants. 2026d. *Draft Avifauna Management Plan for The Point Solar Farm, Twizel.* Wildland Consultants Contract Report No. 6621h-i. Prepared for Far North Solar Farms Ltd. 29pp.

4.0 Methods

4.1 Walkthrough survey

During the flora and fauna surveys carried out by Wildlands (2026), rabbit and hare sign was noted, and feral cats and hedgehogs were observed. An additional walkthrough survey was carried out in February 2026, which involved scanning the ground for any sign of pest mammals, and looking for live animals. Two people spent approximately 15 hours each on site looking for pest mammals. Important

habitat for indigenous flora and fauna near the edges of the site was prioritised by the survey, but some parts of the interior were also walked (Figure 2).

4.2 Chew cards

Six sets of 10 chew cards were placed on site, targeting areas where pest mammals were suspected to use the site, and areas of important habitat for flora and fauna. Chew cards were constructed as approximately 200 × 50 millimetre rectangles cut from white corflute, pasted with peanut butter on diagonally opposite edges for half the length of the rectangle each side, and folded over to form two 100 × 50 millimetre flaps, with peanut butter pasted down opposite edges. Each chew card was then nailed to a wooden stake, tree or fence post, near the ground to attract rodents as well as possums (Plate 1). Chew cards were placed at least 20 metres apart, strategically where pest animals were expected to be using the landscape, such as at the edge of the gully where possums were expected to pass through before and after feeding at night. The ground was scuffed at each chew card location and any tree branches obscuring the card were removed. No flour or other lure was used. Chew cards were left out for three fine nights and one rainy night.

Plate 1 – A chew card placed at the site.

4.3 Tracking tunnels

Three sets of 10 standard tracking tunnels were placed approximately 50 metres apart along fence lines, targeting areas of high ecological values and the interior of the site (Figure 2). The tunnels were baited with peanut butter on ink cards, which attracts rodents, hedgehogs, and mustelids (though it is not a standard bait for mustelids). Tracking tunnels were left for three fine nights and one rainy night.

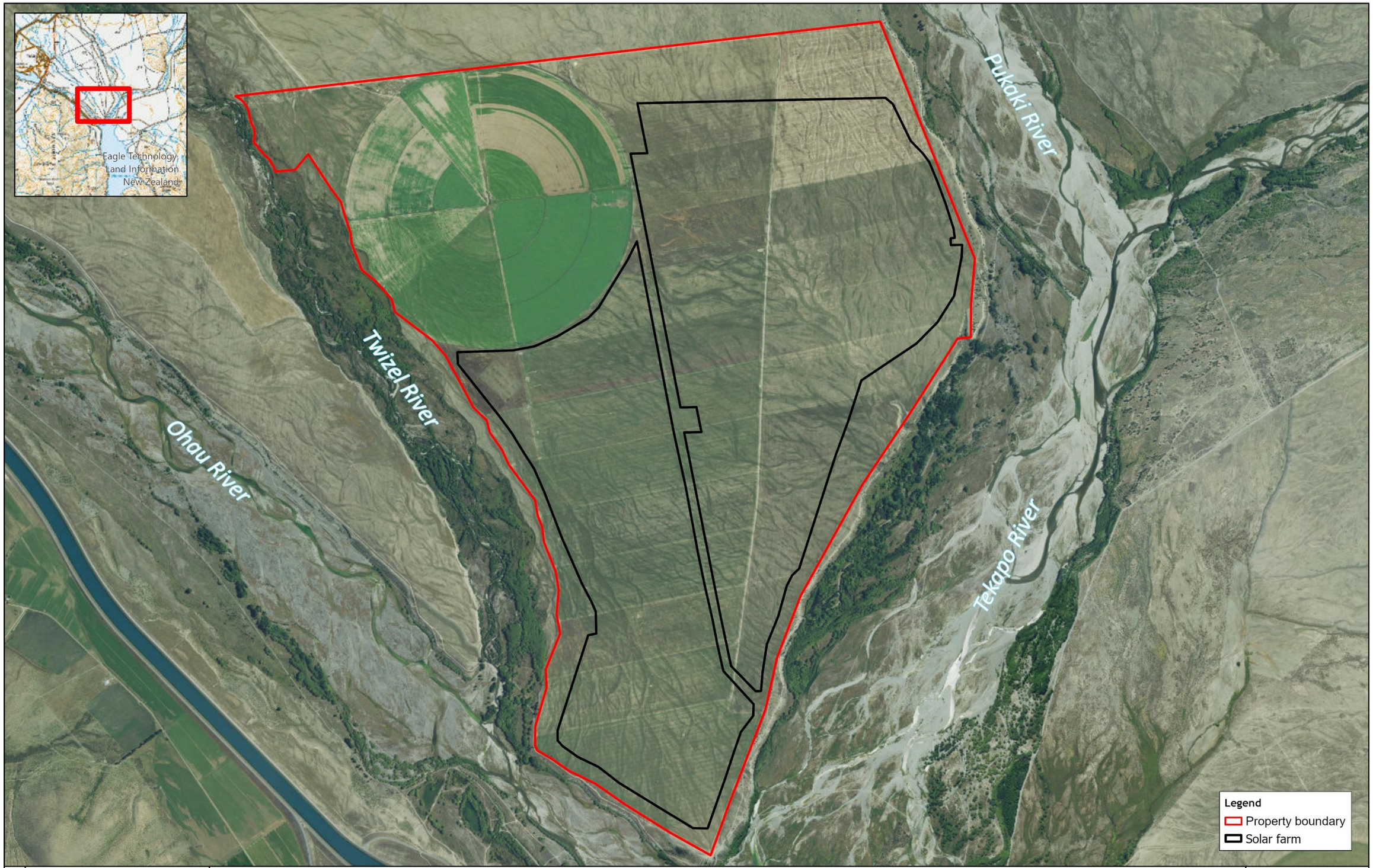

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Figure 1. Location of the proposed Point Solar Farm, MacKenzie Basin

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5.0 Results

Results are shown in Figure 2 and Table 1.

Rabbits and their sign were plentiful on the eastern and western edges of the property, where short vegetation and dry silty soil are ideal for burrowing. Their burrows were in minute and Otago short-horned grasshopper habitat both on site and in the Department of Conservation reserve adjacent to the site, which may be harmful to grasshopper populations. Hares were seen running through the interior of the site, and hare feeding sign was seen on an indigenous broom plant (*Carmichaelia* sp.). Hares are likely to cause harm to indigenous shrubs by cropping them.

Table 1 – Pest mammals present or potentially present at the site.

Common Name	Scientific Name	Ecological Impacts	Likelihood of Presence at the Site
Norway rat	*Rattus norvegicus*	Prey on birds, eggs, and chicks, and also eat seeds, lizards, and invertebrates.	Rat presence on site is confirmed, but the species of rat is unknown. Both species are likely on site.
Ship rat	*Rattus rattus*	Excellent climbers, so can prey upon roosting birds and tree nests. Like Norway rats, they also eat eggs, chicks, seeds, invertebrates, and lizards.	
Mouse	*Mus musculus*	Mice eat eggs, seeds, invertebrates, and lizards.	Confirmed.
Brushtail possum	*Trichosurus vulpecula*	Possums destroy and consume indigenous vegetation and opportunistically eat indigenous fauna including bird eggs and chicks.	Confirmed.
Weasel	*Mustela nivalis vulgaris*	Weasels primarily eat mice, but will often take birds, eggs, invertebrates, and lizards.	Likely.
Ferret	*Mustela furo*	Primarily eat rabbits, but will often take birds, eggs, and lizards. A food source for feral cats.	Almost certain.
Stoat	*Mustela erminea*	Prey on birds, eggs, chicks, lizards, and invertebrates, and will take prey much larger than themselves.	Almost certain.
Feral cat	*Felis cattus*	Prey on birds, eggs, chicks, lizards, and invertebrates.	Confirmed.
European rabbit	*Oryctolagus cuniculus*	Consume indigenous vegetation. Provides food for other introduced predators.	Confirmed.
Brown hare	*Lepus europaeus*	Consume and damage indigenous vegetation and limit the growth of woody vegetation.	Confirmed.

6.0 Predator Control Goals

The purpose of this PMMP is to describe methods for:

- Monitoring activity of rodents, rabbits, hares, mustelids, possums, hedgehogs, and feral cats throughout the site.
- Reducing introduced pest mammal numbers to alleviate pressure on indigenous flora and fauna.
- Eradication of pest mammals within The Point Grasshopper Reserve.
- Adaptive management, so that control is adjusted as needed in response to monitoring. If any of the performance standards for biodiversity or pest mammal control are not met (Section 13) once control is initiated, pest mammal control should be adjusted according to Section 14.

This plan prescribes a standard level of pest mammal control, based on best practice but tailored to the size of the site and the likely distribution of pest mammals and their impacts, intended to benefit indigenous plants and fauna. After control has begun, it should be increased or adapted as necessary in response to monitoring.

7.0 Grazing

Short-stature vegetation present at the site must be maintained as habitat for indigenous fauna, such as minute grasshoppers. Removing herbivores such as rabbits, hares, and possums will reduce grazing pressure on the plants, and may allow exotic vegetation to become taller and out-compete short-stature vegetation. If overgrowth of exotic grasses threatens short-stature herbfield habitat, light grazing by sheep should be implemented in spring and summer if necessary at a stock unit level that is appropriate to maintain short vegetation. Too much grazing by sheep could also have detrimental effects.

8.0 Pest Mammal Monitoring

8.1 Overview

Monitoring is necessary on an ongoing basis to understand pest mammal activity on site, assess the efficacy of control, and inform adaptive management. Monitoring methods are different for each pest mammal species. Figure 3 shows the pest mammal monitoring layout. Monitoring methods should be reviewed every five years to assess efficacy and update or adjust monitoring if needed. When eradication has been achieved within The Point Grasshopper Reserve, monitoring can be reduced to surveillance only (Section 8.7).

8.2 Tracking tunnels for mustelids and rodents

Tracking tunnels use a tunnel, ink, and card setup, with bait to encourage animals to run through the tunnel and leave ink footprints on the card. They are effective for monitoring rodent and mustelid activity, though not abundance, in time and space. For the full protocol, see Gillies and Williams (2013).

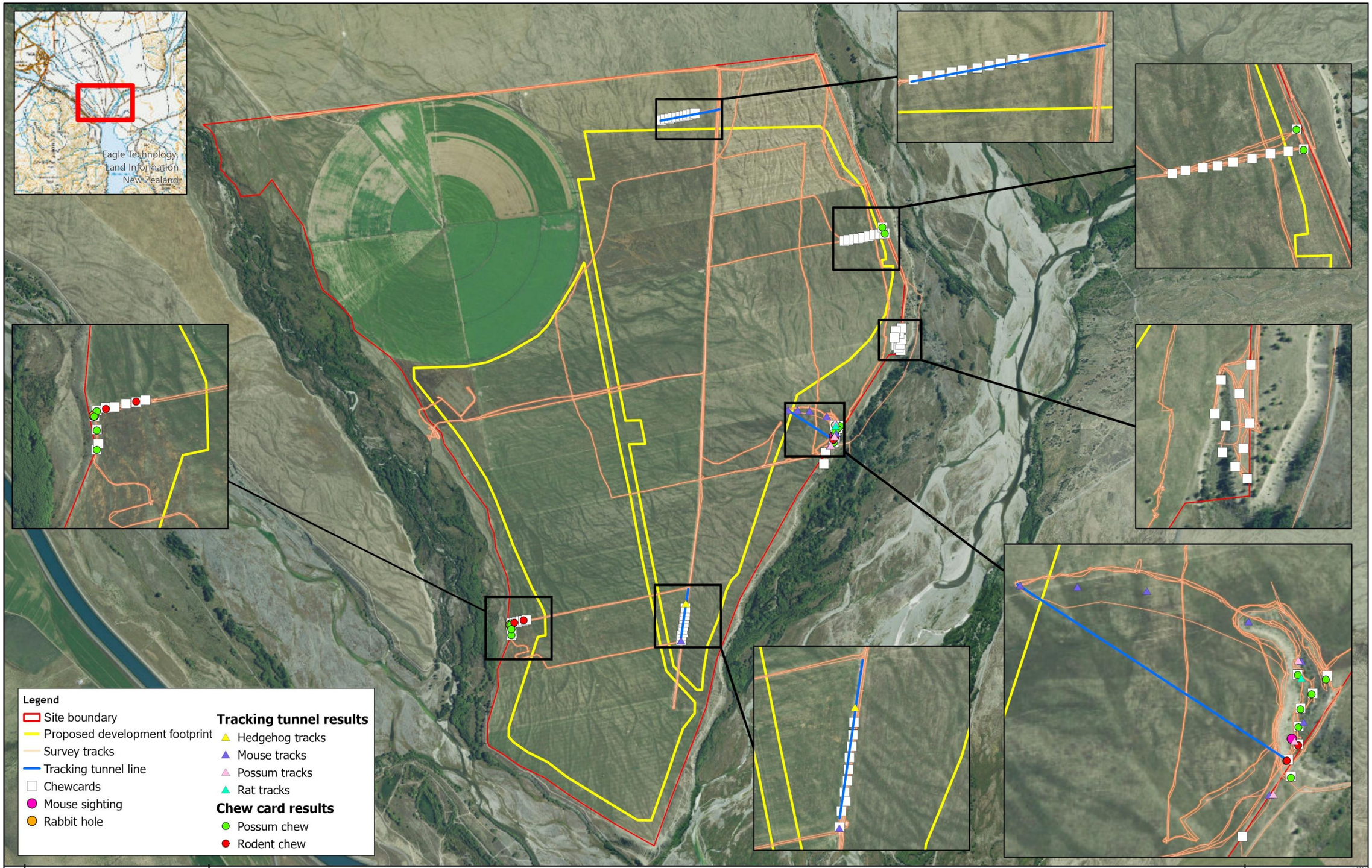

Figure 2. Map of pest mammal survey device locations and visual pest mammal survey at The Point, Twizel

Nine permanent lines of 10 tracking tunnels each (Figure 3; a total of 90 tunnels) should be established, baited with peanut butter, and left for rodent monitoring over one fine night. Then, five tunnels (every second tunnel) on four of the lines (indicated in Figure 3 as rodent and mustelid lines) should be baited with fresh rabbit (which could be shot on site) and left for mustelid monitoring over three fine nights. The difference in methodology between rodents and mustelids is designed to account for differences in their behaviour (Gillies & Williams, 2013).

A Tracking Tunnel Index (TTI) should be calculated to allow comparison of rodent and mustelid activity between years, and to inform adaptive management (Gillies and Williams 2013).

Following successful mustelid control (i.e. a downward trend in activity is detected, or performance targets in Section 13 are met), the frequency of tracking tunnel use for mustelid monitoring can be reduced so that tracking tunnel surveys are only carried out in February and November. This can be reviewed every five years in conjunction with other monitoring and control methods.

8.3 Night counts for feral cats, rabbits, and hares

Night counts for feral cats, rabbits, and hares provide useful information on relative abundance and distribution. Despite there being no best practice protocol for counting feral cats at night, the same methods should be used as for rabbits and hares, as all three species can be counted concurrently.

In spring and autumn, feral cats, rabbits, and hares should be counted along transects (Latham, 2014; National Pest Control Agencies, 2015c). Five one-kilometre transects should be plotted on site. They can be navigated either on foot or by motorbike as long as the same method is used, moving quietly and at a constant pace, sweeping the area with a strong/spotlight torch to count the number of feral cats, rabbits, and hares. Feral cats have green eyeshine (National Pest Control Agencies, 2018) while rabbits and hares have red-pink eyeshine. Weather conditions and other factors such as vegetation should be taken into account when planning a night count. Weather should preferably be consistent between counts, warm, and fine or slightly drizzly. For more comprehensive instructions, see the best practice standard. Where possible, use the same personnel consistently.

Night count data can be used to calculate the mean numbers of feral cats per kilometre, rabbits per kilometre, and hares per kilometre, for each transect and the entire site. Trends in abundance will become apparent over time, and can be used to track the efficacy of rabbit and hare control.

8.4 Wax tags for possums

Plain wax tags are useful for monitoring possums. They have an advantage over chew cards in that they are unlikely to attract the same possum twice due to the lack of palatable bait (National Pest Control Agencies, 2015d); possums are instead attracted due to their natural curiosity. Wax tags have the added benefit of being convenient to use in conjunction with tracking tunnels as they can be run adjacent to tracking tunnel lines (Figure 3) and at the same time as tracking tunnel surveys.

Ten wax tags should be placed 20 metres apart along each of the tracking tunnel lines illustrated in Figure 1 (90 wax tags). They should be fixed to shrubs, fence posts, or other upright surfaces where possible, or alternatively, a wooden stake can be used (National Pest Control Agencies, 2015d). They should be left out for seven fine nights, preferably avoiding Te Rakanui (full moon). Wax tag surveys should be run at the same time as rodent and mustelid surveys.

Monitoring possums using wax tags could be reduced in frequency if numbers are low, with monitoring only happening when a build-up of possum sign is evident.

8.5 Trap catch rates

All animal captures should be recorded, even if they are bycatch or non-target species, so that trapping protocols can be adjusted if necessary (for example if a non-target indigenous species is caught, the trap type may need to be modified with an exclusion device to prevent traps from capturing indigenous non-target species). If the trap is sprung but empty, that should also be recorded as if it happens twice over consecutive checks it may indicate the need for repairs.

For ease of data collection and analysis, all trap-catch data for pest mammal species being trapped should be in the form of captures per 100 trap nights (C/100TN; one trap night = one trap set for one night).

To calculate trap catch per 100 trap nights, first calculate the number of trap nights:

> Trap nights = number of traps × number of nights they have been set minus half a night for every night they were recorded as sprung.
>
> Then divide the number of captures by the number of trap nights, and multiply the result by 100.
>
> $$C/100TN = (captures/trap\ nights) \times 100$$

This calculation can be performed per trap line to pinpoint where more control may be needed (Section 13), but for monitoring general predator populations at the site it should be calculated for the whole site. Separate calculations should be made for each species.

8.6 Bait take

In the intensive control zones (Figure 4; Section 9.1), rodent activity can be monitored by the amount of bait that they have taken. Bait take can also be used to determine if the target pest mammal species are becoming bait shy, at which point the toxin being used should be changed.

8.7 Surveillance within The Point Grasshopper Reserve

When a pest mammal species is no longer detected within The Point Grasshopper Reserve for at least one year, it may be considered to have been eradicated. Monitoring protocols for eradicated species within the reserve can be switched to surveillance-only for that reserve (Table 3). During site visits (for example, to check tracking tunnels), personnel should observe whether pests or their sign are seen within the reserve. If any pests that were eradicated, or their sign, are seen within the reserve, targeted control should be undertaken until that species is no longer detected.

8.8 Summary of monitoring methods

Table 3 provides a summary of methods and timing for monitoring each pest mammal species at the site.

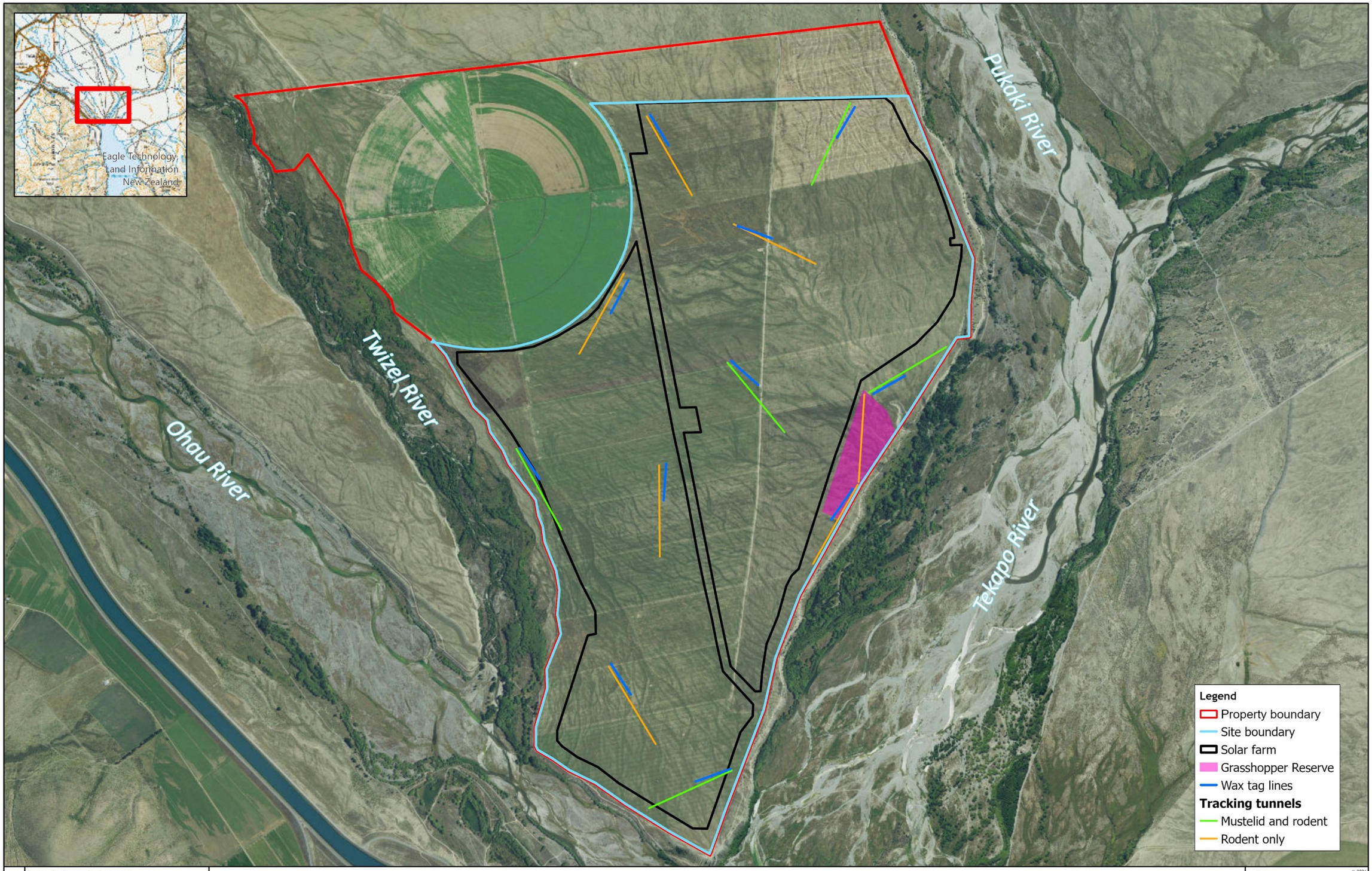

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Figure 3. Pest mammal monitoring lines at The Point Solar Farm, Twizel

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Date: 5/03/2026
Cartographer: HM
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Table 3 – Monitoring methods for pest mammals potentially present at the site.

Monitoring Method	Timing	Timing (surveillance-only)	Pest Species
Tracking tunnels	Feb, May, Aug, Nov. Run for one fine night.	May, Nov. Run for one fine night.	Norway rat, ship rat, mouse (baited with peanut butter).
	Feb, May, Aug, Nov. Run for three fine nights.	May, Nov. Run for three fine nights.	Weasel, stoat, ferret (baited with rabbit).
Trap catch	Continuous.	No trapping.	Norway rat[1], ship rat[2], weasel, stoat, ferret, hedgehog, feral cat, possum.
Bait take (intensive control zones only)	During poisoning pulses.	No poison baiting.	Rodent[2].
Spotlight counts	Spring and autumn.	No counts required; control resumed if rabbits or their sign are seen during site visits.	Rabbit, hare, feral cat.
Wax tags	Feb, May, Aug, Nov. Run for seven fine nights.	May, Nov.	Possum.

9.0 Pest Control

9.1 Overview

The following pest mammal control plan is designed to be implemented adaptively in conjunction with the monitoring outlined in Section 8.

This pest mammal control plan uses traps, toxins, and shooting (for rabbits and hares) to knock pest mammal numbers down and maintain them at low levels (Figure 4; Table 4). Within The Point Grasshopper Reserve, targeted methods are used to eradicate (mop up) pest mammal species when low numbers have been achieved (targeted methods may also be employed when a species that was considered to have been eradicated is detected within a reserve). Control methods for each pest mammal species are given for control outside the intensive control zones, within the intensive control zones, and within The Point Grasshopper Reserve (including targeted methods).

Health and safety is a primary concern when finalising pest management protocols. At the site, stock and public safety must be safeguarded by preventing access to poison baits and traps by any humans or stock that could be harmed by them. Waterways, cattle and sheep grazing on the farm, and the public tracks that run along the outside of the site's boundaries, are the primary hazards. Local and national legislation and best practice must be followed when deploying poison baits and traps. A pest control operator, the trap or bait manufacturer, or the local Medical Officer of Health should be consulted if there is any concern for human or stock safety.

[1] DOC-series traps cannot effectively control rat populations but are useful for monitoring them.

[2] The rodent species taking the bait will not be able to be reliably determined, so bait take can be used as a general proxy for rodent abundance.

The plan is flexible and should be implemented with consideration for terrain, safety, animal welfare, and other important factors that may not have been apparent during the site visit.

Kills of all species, including non-target species, must be recorded so that any issues with repeated non-target kills can be addressed as soon as possible. All relevant regulations must be followed regarding health and safety of trapping and poisoning operations. For a summary of devices and methods proposed in this plan, see Figure 4 and Table 3.

Pest mammal control should be carried out continuously, but reviewed every five years (alongside the monitoring programme) in consultation with a suitably qualified ecologist. The review should cover whether performance targets (Section 13) are being met or if adaptive management is needed (Section 14). Pest mammal control should continue for the life of the solar farm, but may be adjusted as required over time, and as long as performance targets are being met or exceeded then control intensity may be reduced gradually. Within The Point Grasshopper Reserve, control can be ceased when target species are eradicated, but surveillance monitoring should continue.

10.0 Construction of The Point Grasshopper Reserve

One *c.*14-hectare reserve will be constructed on the eastern boundary of the site using XCluder fencing to form pest mammal-free enclosures, promoting population establishment (where necessary) and growth for robust, minute, and Otago short-horned grasshoppers. Benefits for other taxa such as indigenous vegetation are also likely to be realised.

Pest mammals are easier to eradicate from larger reserves than smaller reserves of the same shape, due to the smaller perimeter to area ratio, as the perimeter is where reinvasion can take place if the fence is breached. However, The Point Solar Farm is unusual for the following reasons:

- The area suitable for a reserve along the eastern edge of the site is long and relatively narrow.
- The edges of the site have the highest values.
- Grasshoppers, particularly robust grasshoppers, will benefit from maximised connectivity with the Pūkaki and Tekapo riverbeds.

The fencing used to exclude pest mammals will need to have a wide gate so that sheep can be mustered through for seasonal grazing (Section 7).

Birds are likely to prey upon grasshoppers within the reserve. They may be discouraged using bird-scaring techniques and devices, or wires along the top of the fence. Further advice from an avifauna ecologist or the Department of Conservation may need to be sought if birds are found preying upon grasshoppers within the reserve. Similar issues have been found with the robust grasshopper reserve at Paterson's Terrace (Warren Chinn, pers. comm.) and a solution does not yet appear to have been found.

Predation risk rises significantly in uniform terrain, so the creation of rock stacks and planting of low herbfield and shrub species (which provide horizontal complexity) will provide important refugia for grasshoppers and other invertebrates.

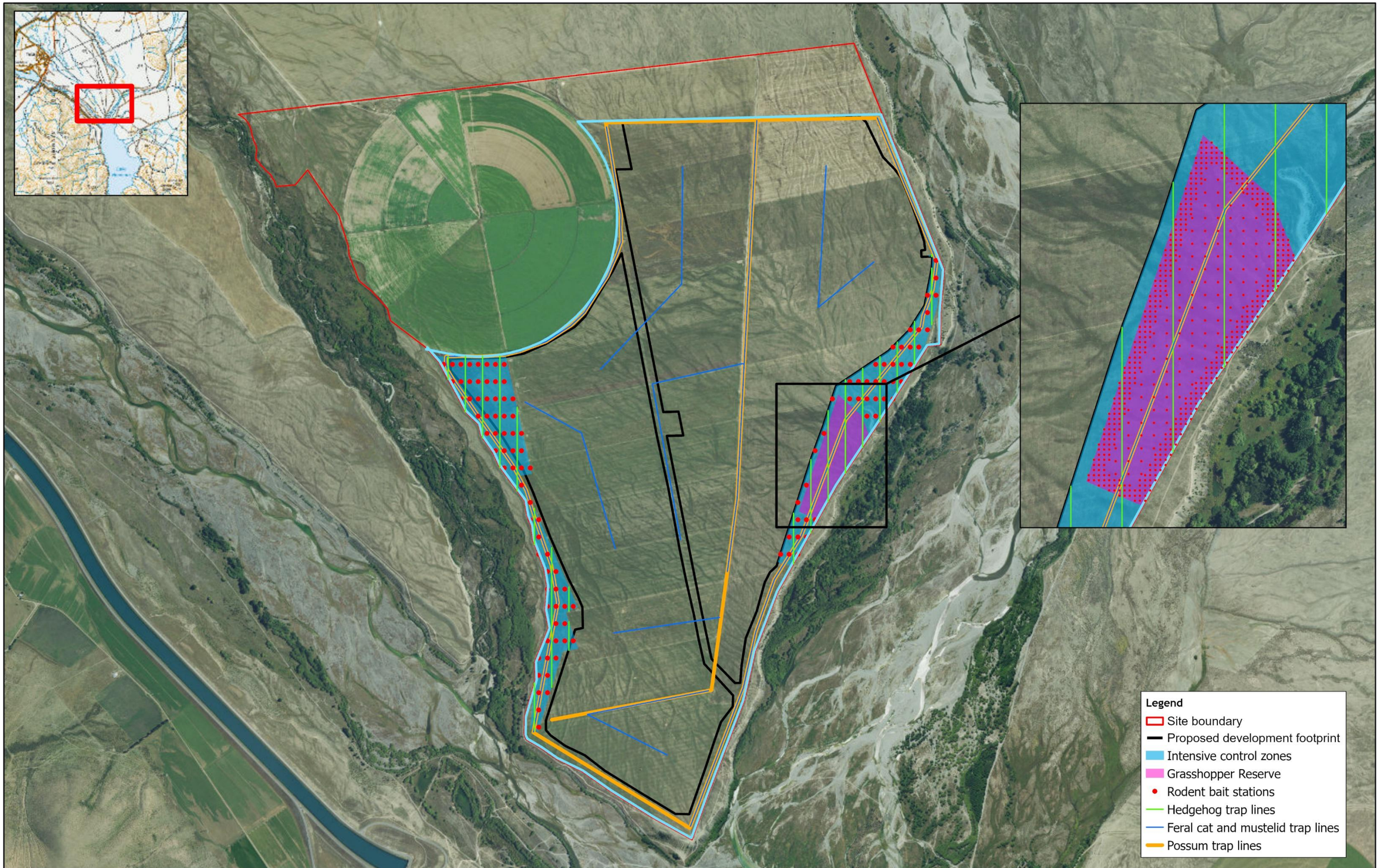

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Figure 4. Indicative pest mammal control lines and device placement at The Point Solar Farm, Twizel

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Table 4 – Summary of pest mammal control methods for The Point Solar Farm.

Pest Species	Control Method	Line Spacing (metres)	Device Spacing Along Lines (metres)	Timing of Control	Timing of Device Checks
Rodents	Poisoning inside The Point Grasshopper Reserve.	25	25	Continuous.	Once per week initially, then as needed to keep them at least half-full.
	Poisoning in intensive control zones, outside the reserve.	100	50	Four pulses per year (Table 3).	Three times per month during a pulse (Figure 3).
Least weasel	Trapping with DOC-150s and DOC-200s.	500	200	Year-round.	Twice per month September-March; once per month March-September.
Ferret	Trapping with DOC-250s.	500	200	Year-round.	Twice per month September-March; once per month March-September.
Stoat	Trapping with DOC-200s.	500	200	Year-round.	Twice per month September-March; once per month March-September.
Feral cat	Trapping with modified Timms traps.	500	400	Year-round.	Twice per month September-March; once per month March-September
Possum	Trapping with AT220s and Trapinators.	N/A	100	Year-round.	Once per month (AT220s); twice per month initially, then as needed (Trapinators).
	Poisoning (inside The Point Grasshopper Reserve).	20	20	After initial cyanide run, fill bait stations with cholecalciferol and pulse as for rodent baiting.	Three times per month during a pulse; cyanide checks not needed.
Hedgehog	Trapping with mustelid traps outside intensive control zone.	500	200	Continuous.	Coincides with mustelid trap checks.
	Trapping with DOC 250 traps inside intensive control zone.	100	100	Continuous.	Twice per month initially, then as needed.
Rabbit	Night shoot; fumigation.	N/A	N/A	Spring and autumn.	Twice yearly.
Hare	Night shoot.	N/A	N/A	Spring and autumn.	Twice yearly.

10.1 Feral cats

10.1.1 Control outside intensive control zones

Feral cats should be trapped using Steve Allan 2 Feral Cat Traps (SA2s) set inside wooden chimney boxes. Lines of feral cat traps have been marked on Figure 3 no more than 500 metres apart; traps should be spaced every 400 metres along each line. Where possible, lines should follow fences to avoid obstructing farm activities. They should be baited using fresh rabbit or hare meat, dragging the meat around near the trap and on top by to spread the scent. Prior to first setting the traps, they should be left unset but baited with fresh meat to encourage feral cats to interact with them. After three weeks of pre-feeding the traps should be baited and set. Feral cat traps should be checked every two weeks from September to March, and every four weeks from March to September.

10.1.2 Control inside intensive control zones

Feral cat control inside intensive control zones remains the same as outside intensive control zones.

10.1.3 Targeted control within The Point Grasshopper Reserve

When feral cats are suspected to have been eradicated, or are below a trap catch of 5%, a feral cat detection dog should be employed to search the reserve and indicate feral cat scat or presence. If a feral cat is found, it must be shot, or trapped using a live-capture trap baited with jelly meat and then shot within 12 hours of capture. For feral cats that are difficult to trap, a dog may be able to track the feral cat down and capture it; alternatively, a live-capture trap should be left unset but baited every day with jelly meat until the jelly meat is gone for two days in a row. A camera trap will confirm that the feral cat is eating the jelly meat or if other species such as hedgehogs which also eat jelly meat have not yet been eradicated. The trap should then be set.

10.2 Mustelids

10.2.1 Control outside intensive control zones

For weasels, ferrets, and stoats, DOC-series traps in wooden tunnels should be used (National Pest Control Agencies, 2015a, 2018). All DOC-series traps can potentially catch any of the mustelid species, but DOC 150s may be more suited to catching weasels and DOC 250s are more humane and effective for catching ferrets. DOC 200s can catch all three species but are most suitable for stoats. Therefore, all three models should be used, and alternated along trap lines for multi-species control.

Mustelids have large home ranges, so trap spacings on a line can be far apart (Smith & Jamieson, 2005). Mustelid traps should be spaced every 200 metres along the same lines used for feral cat traps (Figure 3). Some can be placed adjacent to feral cat traps for efficient checking. Mustelid trap sites should be grubbed up to remove plants, expose the soil, and provide a stable, flat surface for the trap. Weeds should be removed by hand around the trap to provide a clear entrance and allow for air flow over the bait. Traps should be baited using hen eggs or fresh rabbit, with some meat dragged around the entrance to spread the scent where practicable. Pre-feeding unset traps with fresh meat for three weeks before setting them may increase catch rate by encouraging mustelids to interact with the traps.

Mustelid traps should be checked every two weeks from September to March, and every four weeks from March to September.

10.2.2 Control inside intensive control zones

Mustelid control inside intensive control zones remains the same as outside intensive control zones.

10.2.3 Targeted control within The Point Grasshopper Reserve

When mustelids are suspected to have been eradicated, or are below a trap catch and TTI of 5%, a mustelid detection dog should be employed to search the reserve and indicate mustelid scat or presence. If a mustelid is found, it must be killed by the dog or a blow to the head, or trapped using a leg-hold trap baited with fresh rabbit and then killed by a blow to the head. For mustelids that are difficult to trap, a similar protocol can be followed as for feral cats.

10.3 Rats and mice

10.3.1 Control outside intensive control zones

Rodents will not be controlled outside intensive control zones. Their high numbers and fecundity make control across the wider site unfeasible, as the amount of poison baiting required would be prohibitively expensive and labour-intensive.

10.3.2 Control inside intensive control zones, outside The Point Grasshopper Reserve

Run-through bait stations should be used for mice and rats. They should be placed in 50 by 100-metre grids. Any rodent carcasses found within or adjacent to the rodent control zone should be buried or sent to landfill. Rodents can rapidly develop bait aversion, so using more than one bait type is advised. Bromadiolone and diphacinone are among the least environmentally harmful, most cost-effective, and most readily-available toxins that affect mice as well as rats. For the first year, bromadiolone should be used to knock rodent numbers down and keep them low. In subsequent years, diphacinone should be used. If diphacinone bait is no longer being taken, yet tracking tunnel results suggest that rodent numbers are high, then diphacinone bait should be removed and replaced with bromadiolone pulses for a year before switching back to diphacinone.

A pre-feed is recommended prior to the first bromadiolone pulse to maximise uptake of toxic bait. During a pulse, bait stations should be filled on Days 1, 5, and 14 of the pulse (Auckland Council n.d). All bait should be removed on day 30. For example, for a January-February bromadiolone pulse starting in the last week of January, bait stations should be filled on 24 and 28 January, and 7 February. All bait should be removed on 23 February. Removing bait prevents bait aversion from developing, as degraded bait is less palatable and may result in a sub-lethal dose.

Table 5 summarises baits for rodent control. Figure 5 summarises the timing of poison baiting depending on the poison to be used.

10.3.3 Control inside The Point Grasshopper Reserve

Inside The Point Grasshopper Reserve, rodent bait station spacings should be reduced to 10-metre grids within 30 metres of the reserve fence to more effectively manage any incursions (i.e. by a providing a protective buffer). Bait stations will be spaced at 25-metres throughgout the remainder of the reserve (total of *c*.600 bait stations inside the reserve). Bromadiolone should be the only bait used, and bait stations should be kept full until no more bait is taken. If rodents are still detected, then diphacinone should be used until no more bait is taken. Bait should continue to be switched and used until rodents are no longer detected within the reserve.

It is unrealistic that mice can be maintained at zero densities inside the reserve; however, it is feasible to suppress them at levels whereby invertebrates and lizards can thrive.

Bait should be removed from all stations prior to sheep being permitted to enter the reserve for the purpose of periodic grazing.

Figure 5 – Toxin application timeline for rodent control.

Table 5 – Toxins recommended for rodent control at the site.

Poison Type	Example Products	Advantages	Disadvantages	Usage Guidelines
Bromadiolone	Contrac	Highly effective at rat and mouse control.	Livestock must be removed before baiting. The treatment area cannot be restocked immediately after the bait has been removed[1]. Risk of secondary poisoning for wild and domestic animals. Residue remains in carcasses and the environment for months after use.	Initial treatment, and for use if rodent numbers remain high despite diphacinone baiting. Four pulses over one year in August, November, January-February, and March-April. The following August, switch back to diphacinone. A pre-feed is recommended before the first treatment with bromadiolone.
Diphacinone blocks	D-Block[2] Ditrac	Has resulted in mouse eradication (Shiels et al. 2018). Effective on both mice and rats. Little residue or risk of secondary poisoning. Bait aversion does not happen as quickly as with non-first-generation anticoagulants.	Variable effects on mice.	Four pulses per year in August, November, January-February, and April. Continue use until bait take decreases but tracking tunnels show rodent activity to be high. Then switch to bromadiolone.

[1] Before toxic baiting starts, check national and local legislation to confirm restocking rules after poison baiting.

[2] D-Block is more palatable to rodents than Ditrac but Ditrac lasts longer. Preferably D-Block should be used.

10.4 Rabbits

10.4.1 Control outside intensive control zones

Night shoots

Rabbit night shoots should take place following monitoring, if rabbits have been seen during night counts. Rabbit shooting protocols should follow best practice methods (National Pest Control Agencies, 2015c).

Rabbit meat can be used as bait for feral cat and mustelid traps, and for mustelid tracking tunnels.

Fumigation

If rabbit burrows are found on site, they should be fumigated using MagToxin, which releases toxic phosphine gas when it comes into contact with water. One to two Magtoxin pellets, plus a squirt of water from a bottle or a moist paper towel, should be placed deep inside one burrow entrance after all other entrances have been thoroughly blocked with earth and/or rocks. The last entrance should be blocked immediately upon placing the pellets.

Fumigation should not occur less than three months either side of a night shoot.

10.4.2 Control inside intensive control zones

Rabbit control inside intensive control zones remains the same as outside intensive control zones.

10.4.3 Targeted control within The Point Grasshopper Reserve

When rabbits are no longer detected during night counts within The Point Grasshopper Reserve, or only one or two rabbits are suspected to remain, if burrows are present they can be fumigated or ferreted[1]. If no burrows are present, thermal imagery and dogs should be used to detect and kill (by shooting, or by dogs) the remaining individuals.

If rabbits or their droppings are found within the reserve but are not in burrows and are too shy to be caught, they may be poisoned using pindone in bait stations.

10.5 Hares

Hares should also be shot during shooting nights. Hare shooting protocols are similar to rabbit shooting protocols (National Pest Control Agencies, 2015b).

Hares within The Point Grasshopper Reserve may be tracked down and killed using thermal imagery and/or dogs.

[1] Ferreting involves using ferrets to flush rabbits out of burrows. The rabbits are killed by guns or dogs and the ferrets are retrieved using radio collar tracking. Use of ferrets for rabbit control requires special training and permitting by the Department of Conservation. Contact the Department of Conservation for contact details of a ferret handler.

10.6 Brushtail possums

10.6.1 Control outside intensive control zones

Possums are likely to be living in the bush near the perimeter of the property and may come onto the property at dusk to feed. Possum movements may therefore be intercepted by placing traps along the perimeter fence. Fence posts and trees can be used to hang traps.

Near bush habitat and tracks, where most possums are likely to be caught, automatic traps (AT220s)[1] should be set along the perimeter (Figure 4). These traps require little maintenance, although a monthly check is recommended to ensure that they are functioning well. Lure will need to be replaced and batteries will need to be recharged approximately once every six months.

Trapinators should also be placed along the perimeter, interspersed with the AT220s, so that there is one of either type of trap per 100 metres of fence line. Trapinators should be baited with possum dough and lured with a possum flour blaze (four parts flour to one part icing sugar). They should be checked once every two weeks initially, then as needed to ensure that at least 50% of Trapinators are always set.

All traps should be placed high up out of the reach of any stock or dogs that may have access.

10.6.2 Control inside intensive control zones

Within intensive control zones, possums can be controlled using Timms traps in 100 by 100-metre grids. The traps should be baited with apple halves and lured using a possum flour blaze. Caution should be used with Timms traps around stock; they may need to be removed if stock are deemed at risk of injury.

10.6.3 Eradication within The Point Grasshopper Reserve

Feratox encapsulated cyanide, in a FeraFeed matrix, in BioBags should be used to poison possums within the reserve[2]. Baits should be stapled to trees and fence posts, or wooden stakes where necessary, to cover a 50 by 50-metre grid. Three days later, all remaining bait and carcasses should be removed and disposed of according to the cyanide manufacturer's guidelines.

If more than one possum is detected after the cyanide run, cholecalciferol paste should be placed in Philproof bait stations attached to fence posts, trees, or wooden stakes. This should be pulsed as for rodent baiting until no more bait is taken.

A possum detection dog should be used to detect and destroy any remaining possums within the reserve(s).

10.7 Hedgehogs

10.7.1 Control outside intensive control zones

There is currently no standard best practice methodology that exists for hedgehog control. Hedgehog home ranges vary widely depending on the sex of the hedgehog, food availability, and the time of year (Paterson, 2024). They are frequently caught in DOC-series traps baited with rabbit, which are

[1] ATT220 traps can also effectively control rats, feral cats, and stoats.

[2] Cyanide use requires a Controlled Substances Licence. It may not be used within 60 metres of a public road or any area where the public have access. The local Medical Officer of Health must be notified before cyanide is used on site. Where cyanide cannot be used, Timms traps or Trapinators at 50-metre spacings should be set and checked every three days.

proposed for mustelid control in Section 10.2. However, larger hedgehogs cannot fit through the smaller entrances of DOC 150 and DOC 200 traps, but widening their entrances can reduce the humane effectiveness of the traps for killing ferrets and small feral cats. To improve hedgehog capture rate, the entrances of DOC 200 tunnels should be widened to 800 mm and if any ferrets are caught, they should be rubbed around the entrances of DOC 200 and DOC 250 traps where practicabe (Jones *et al.* 2021). If hedgehog catch rate increases so that 50% or more of traps have caught hedgehogs when the DOC-series traps are checked, trap check frequency should be doubled until catch rate decreases so that at least 50% of traps are always open to catch mustelids and hedgehogs.

10.7.2 Control inside intensive control zones

Within intensive control zones, hedgehogs should be controlled using DOC 250 traps at 100-metre grid spacings (Paterson, 2024), baited with hen eggs or fresh rabbit.

10.7.3 Targeted control within The Point Grasshopper Reserve

Trapping should be sufficient to eradicate hedgehogs within the reserve. If remaining individuals are trap shy, they can be captured live using the same protocol as for feral cats, and killed with a blow to the head.

11.0 Limitations of Predator Control

The large size of the site, its shape, and easily-navigable terrain, are conducive to efficient predator control operations and effective suppression. However, bush and tree-lined waterways along the eastern and western edges of the site offer excellent predator habitat, leading to probable continuous reinvasion outside The Point Grasshopper Reserve. Reinvasion could be curtailed if neighbouring landowners could be encouraged to control pest mammals on their land and thereby provide a buffer. Some adjoining land is managed by the Department of Conservation (DOC), offering potential opportunity for integrated pest management and sharing of information and monitoring data.

Rabbits and hares are abundant and occur in substantial populations throughout the Mackenzie. Controlling them at the site may produce a sink effect, whereby rabbits and hares continuously move in from outside the property. This could result in rabbit and hare populations remaining the same or even increasing on the property despite control. Rabbit and hare control on neighbouring properties would help to minimise the risk of this happening. If monitoring shows that populations remain steady or increase despite control other options may have to be explored, such as pindone poisoning.

12.0 Record Keeping

Data collected from device checks is of fundamental importance for monitoring pest mammal populations at the site, and for assessment of the efficacy of the control methods for adaptive management (Section 14). The data may be useful for research into pest biology and control methods. Data must be collected and stored separately for every device check. Digital copies of data must be made and backed up securely to prevent data loss. Databases should be set up in Microsoft Excel, with different workbooks for monitoring and control, and different worksheets for each device type. Data recorded should include:

<u>Traps</u>

- Date of device check.
- Weather.
- Device identification number.

- Device type.
- Device status (AT220s: functioning, not functioning; traps: set, sprung but empty, or sprung with animal).
- Kill count (AT220s only).
- Species caught.
- Notes (e.g. trap broken needing maintenance; trap missing).

Bait stations

- Date of device check.
- Weather.
- Device identification number.
- Device type.
- Device status (full, partially full, empty).
- Any kills nearby.
- Comments (e.g. bait removed in preparation for toxin change).

Monitoring devices

- Date device set.
- Date device checked.
- Weather.
- Device identification number.
- Device type.
- Device status (animal detected, no detections).
- Species detected.
- Comments (e.g. tracks look like possum but may be hedgehog).

Uploading data onto Trap.nz is recommended to help manage the project and enable multiple device checkers to work together.

13.0 Performance Standards

13.1 Biodiversity performance standards

Performance standards should be biodiversity-based and adaptive, with baseline surveys of pest mammals and ecological values informing targets and regular auditing to ensure best practice.

Monitoring of flora and fauna should show negligible or no signs of predation by pest mammals being controlled under this programme on lizards, adult birds, chicks, or bird eggs. No predation of lizards or invertebrates should be apparent in the rodent control zone. Any decline in fauna populations on site should be investigated to attempt to determine the cause, and in particular to rule out pest mammal increases as a cause.

13.2 Pest mammal performance standards

Pest mammal monitoring should show general declines in pest mammal activity and abundance across the site, comparing between the same seasons across different years. Absolute targets in the form of percentage trap catch or TTI are unlikely to be helpful outside intensive control zones, as without research into the pest ecology specific to the site the thresholds at which indigenous flora and fauna will begin to recover after pest mammal control cannot be known. However, declines in pest mammal

abundance or activity should be compared with biodiversity outcome monitoring at the site to see if the abundance of Threatened or At Risk species is improving.

Within intensive control zones, but outside The Point Grasshopper Reserve, the following standards should be implemented:

- Less than 10% TTI for mice and rats.
- Feral cat residual trap catch below 5%.
- Hedgehog TTI below 5%.

If pest mammals remain above these densities and are not declining, adaptive management should be implemented (Section 14).

All pest mammal species should be eradicated inside The Point Grasshopper Reserve. However, mice have proven difficult to eradicate in other pest mammal-proof enclosures nationwide, so elimination is the goal, where mice may be present in small numbers but are not increasing in number, and are functionally eradicated in that they do not appear to be adversely affecting flora or fauna.

13.3 Auditing

An audit of pest mammal control and monitoring practices should be undertaken once every five years (before each control and monitoring review) to ensure that best practice is followed correctly. Records (Section 12) should be examined and a site visit conducted to assess the quality of pest mammal control. The audit also presents an opportunity to gather data and views from pest control operators for consideration during the review. Auditing should be carried out by an independent pest control specialist. Any changes in practice recommended as a result of each audit should be considered in the context of this plan, relevant research, and the views of the pest control operator before any decisions are made regarding changes of practice.

14.0 Adaptive Management

14.1 Overview

Pest mammal control measures should be guided by monitoring, and adjusted if necessary. Continuous increase in mammal activity and/or abundance is a sign that control may need to be intensified to bring mammal numbers down. Monitoring results will fluctuate seasonally and in response to food availability. To track trends in mammal activity which may be due to abundance, monitoring results should be compared between the same seasons across multiple years.

14.2 Pest overabundance

If pest mammal control does not appear to be decreasing pest mammal activity (i.e. tracking tunnel and/or wax tag indices are decreasing between years), but trap catches and bait take have not declined, then pest mammal control devices are killing pest mammals but there are not enough of them to control the high numbers present. If necessary, pest control intensity can be increased by reducing the distances between devices and adding more devices where pest mammal numbers are not declining.

14.3 Bait aversion by rodents

If bait take declines or remains low, but monitoring devices show no drop in rodent activity, rodents may have developed bait aversion, or poisoning methods may not have used best practice.

In the first instance, check that all bait stations are functioning fully, referring to the manufacturer's guidelines. If bait is not being taken, but rodent numbers are high near the rodent control area, check that the bait has not expired or gone mouldy in the bait stations.

Baiting methods need to be reviewed if aversion develops in pest mammal populations. All operators must be coordinated in their efforts and using best practice as described in Section 10 and in the best practice documents in the references list below. Common causes of bait aversion include:

- Use of expired or mouldy bait.
- Mixing of bait with a non-toxic substance to make it more palatable.
- Leaving bait in bait stations at the end of a pulse.
- Not filling bait stations at the correct time during the pulse.

Bait should be switched when aversion is detected. Initially, bait should be switched from diphacinone to bromadiolone (Section 10.4; Table 5). After a year of baiting with bromadiolone, diphacinone should be used again. All poison baiting should follow the pulsing protocol (Figure 3).

15.0 Conclusions

The proposed solar farm site is large with important values for indigenous plants and fauna. Ecological values on site can be protected using a suite of pest mammal control methods, guided by monitoring. The construction and implementation of pest mammal-free grasshopper reserve is likely to be beneficial to indigenous grasshoppers, including robust grasshopper, but will also benefit other flora and fauna such as lizards and indigenous plants. The main challenge to pest mammal control at the site is the likely high abundance of some species such as rabbits and rats. However, the intensive control areas and pest mammal-free reserve will provide refuge for sensitive flora and fauna from high numbers of pest mammals which cannot be sufficiently suppressed over the whole site.

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