

## Nelson Wildlife Halo: Operational Plan



Photo credit Sarah Allsopp

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## 1. INTRODUCTION

This Operational plan has been drafted for the Nelson City Council (NCC) to guide the establishment of native species recovery protocols and infrastructure as part of the management of Nelson Halo. There are a number of community groups and individuals in Nelson/Whakatū who are controlling introduced mammalian predators in Parks and backyards with the goal of enhancing wildlife populations. Independent of this, native bird populations in Nelson/Whakatū are likely to increase as birds disperse from the predator-free Brook Waimarama Sanctuary. There is the potential to further enhance native bird populations around the city by providing strategic guidance, technical advice and support for existing and new community predator control and habitat enhancement initiatives. This area of coordinated predator control and habitat enhancement is termed “the Nelson Halo” and is a key project of NCC’s Nelson Nature programme (<http://www.nelson.govt.nz/assets/Environment/Nelson-Nature/Nelson-Nature-Strategy-2017-2020-Final-June18.pdf>).

This plan provides a background to the current situation within the Nelson City environs with regard to native species, particularly birds, and suggests practical and sustainable tasks required to establish and enhance actions to encourage and increase native species populations within the Nelson Halo. This document should be read in concert with the Nelson Halo Discussion Document (Harper 2017), which sets out the rationale, goals and wider issues around establishing the Halo.

Note that at this stage pest management is based on trapping as a control tool for mammalian predators. There are advantages and disadvantages with this approach, but as a general rule trapping requires more effort and cost to attain the same results as control using toxins. Moreover, toxins can often be used to curtail an increases in the abundance of trap-shy animals that can develop during long-term trapping operations. Consideration of toxins has been discussed in the Nelson Halo Discussion Document (Harper 2017) and it is likely that this debate will need to be addressed at some stage by both the NCC and the wider public if the goals of the Halo are to be achieved and maintained.

As the plan principally relies on trapping for pest control, the corollary is that attaining the desired outcomes when largely relying on volunteers with a limited budget will not be straightforward.

As the plan is a dynamic document it will require further updates and reviewed as further sites are included within the Halo, additional data comes to hand, and new techniques and/or revised approaches to mammalian predator control and native species restoration are developed. It will be particularly influenced by the development of adjacent pest control projects in Marlborough and Tasman Districts. These changes should be incorporated as updated information becomes available.

This document provides information to:

1. Provide a rationale for a coordinated mammalian predator control effort in Nelson.
2. Support, enhance and establish sites within the Halo for native species restoration.

3. Undertaking monitoring of both introduced pests and native bird species to inform suitable responses, planning and reporting of progress within the Halo.
4. Outline further expansion of the Halo as funding and resources allow.

This document should be referred to while planning and carrying out all Halo planning, infrastructure and management work.

## 2. GOALS AND OBJECTIVES

### 2.1 Goal

To increase the long-term abundance and diversity of native birds and improve ecological integrity<sup>1</sup> (Lee et al. 2005) within the Nelson City boundaries

### 2.2 Objectives

1. Statistically significant increase in the overall abundance of most native bird species within the built area of Nelson by 2025 (with the understanding that some native bird species abundance may decline due to increased competition (Miskelly 2018) and species such as lizards and invertebrates are likely to also benefit from mammalian pest control).
2. Increase the area within the Halo that has habitat enhancement and mammalian predator control being undertaken for native birds by 25% by 2025.
3. Expand the area of mammalian pest control to include areas between and linking initial treatment sites.
4. Attain stated reductions in abundance of invasive mammalian predator numbers at treatment sites within the Halo to a level by 2025.
5. Follow best practice in the use of pest control tools to ensure the humane treatment of target animals and to avoid non-target by-catch.
6. Increase habitat suitable for native birds to breed and forage within the Halo, through:
  - a. Weed control to protect existing native vegetation and enable natural regeneration
  - b. Restoration planting of native vegetation
  - c. Additional planting of non-invasive exotic trees and shrubs sought by native birds.
7. Develop and use technology to encourage native birds to use and breeding in native forest, exotic forest and suburban back yards in the Halo (e.g. predator proof nest boxes)
8. Empower, energise and support community trapping groups (CTG) to undertake habitat enhancement and mammalian predator control for native birds within the Halo.
9. Engage and encourage cooperation between the public, CTG and interested parties to progress the goal of the Halo.

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<sup>1</sup> Ecological integrity refers to ecological processes being shaped primarily by indigenous species that naturally occur across a site in concert with regional environmental gradients derived from climate, soils and geology.

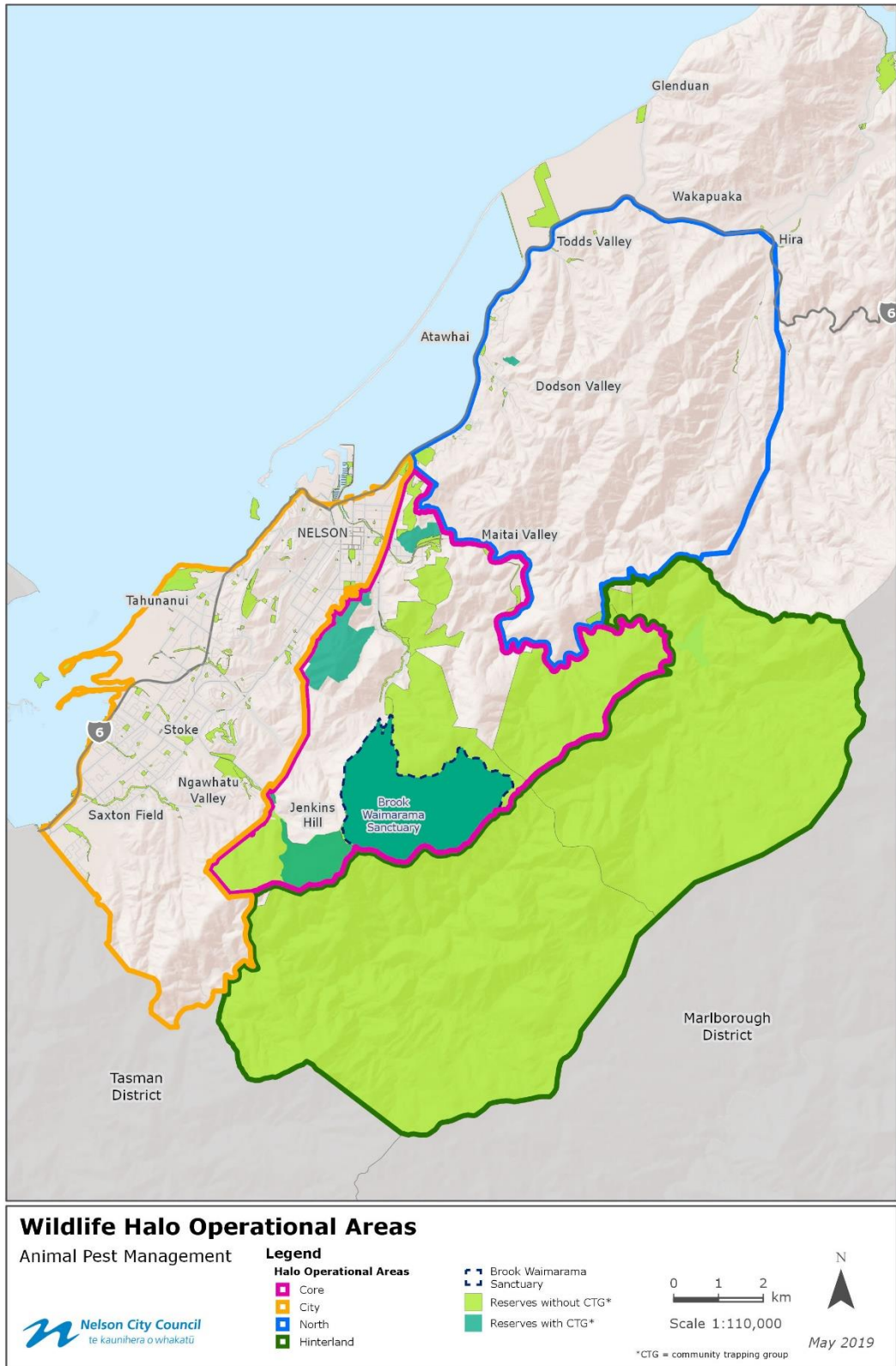
10. Encourage and support landowners to establish or restore native forest and habitat for native birds and undertake mammalian predator control for native birds on their land, including within urban and suburban areas.
11. Monitor changes in bird abundance and forest health within the Halo to inform stakeholders and direction of planning.

### 3. OPERATIONAL AREA

The Nelson City boundaries encompass the southern border with the Tasman District Council, north to the western Marlborough Sounds and east to western Richmond Range (Fig. 1). Within this area predator control conducted by Community Trapping Groups (CTG), with the aim of protecting native birds, is in place at several sites, with one site, the Brook Waimarama Sanctuary (BWS), being a fenced sanctuary which is now essentially free of all introduced mammalian pests. It is expected that as the native species numbers increase within the BWS due to the lack of mammalian predation, that additional individuals will disperse to breed outside the Sanctuary. The purpose of the Halo is to provide sites near the BWS where predator numbers are low and the native vegetation is of sufficient area and quality to enable birds to successfully breed and forage, hence the ‘halo’.

The Halo naturally divides into several areas using factors such as distance from the BWS, current predator control activity by CTG, size of treated areas, forest quantity and quality, NCC reserves, and their proximity to each other. These blocks are listed below with indicative group names (Fig. 1).

1. ‘Core’: Sites between the BWS and city; Marsden Valley, Grampians, Sugarloaf, Botanical Hill, Tantragee, Atmore, Fringed Hill.
2. ‘City’: Western Nelson to southern NCC boundary at Stoke; including Pipers, Highview and Bolwell reserves.
3. ‘Hinterland’: South Eastern Nelson; Maitai & Roding catchments
4. ‘North’: Northern Nelson; Titoki and Pukatea Reserves, to Todds Valley & Hira, and including large areas of production pine forest.



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Figure 1. Suggested Halo Operational Areas.

#### 4. CURRENT AND FUTURE WILDLIFE VALUES

Within Nelson City, the higher quality wildlife values for native birds are to be found in larger tracts of mature native forest, and mostly above 600m in altitude, which is related to lower rat numbers found above this altitude (Harper 2017, McArthur & Ray 2018). This strongly suggests that in lower altitude sites without predators the goal of the Halo will be constrained by the amount of mature forest. Of the 524 ha presently under some form of pest control by CTGs only a cumulative 143ha is mature native forest (Table 1), and the small size of these individual sites will not generally support significant populations of less common native species. Successional forest is important and will hold a number of native bird species, particularly more common ones, but is unlikely to support high diversity. At the outset, forest recovery in concert with effective pest control in existing mature native forest, and to a lesser extent, successional forest, will be a key component for the long-term success of the programme. Within older production pine forest, mainly in the North Block, there are some wildlife values for species such as robins and falcon (P. Gaze, pers. comm.).

At present most of the sites being treated by CTG hold most of the more common native birds to be found in Nelson (McArthur & Ray 2018, Table 1). Marsden Valley has a few species not found at other CTG sites (robin, kakariki) probably due to the presence of mature forest in, and immediately adjacent to, the site. As a general rule sites further from large areas of native forest, and with smaller blocks of mature forest, will hold a lower diversity of native birds (Harper 2017, Table 1).

Table 1. Native bird species recorded in NCC five minute bird counts (McArthur & Ray 2018) at sites within the Nelson Halo operational area, anecdotal reports by CTG and BWS.

Site (Block)	BWS (Core)	Maitai/Roding Water Reserves (hinterland)	Marsden Valley (Core)	Grampians (Core)	Botanical Hill (Core)	Titoki (North)
Mature native forest Native bird species	~600ha	~4000ha	90ha	38ha	10ha	5ha
Kaka	X	?				
Rifleman	X	X				
Kakariki	X	X	X			
Robin	X	X	X			
Brown creeper	X	X	X			
Pied tit	X	X	X	X		
Falcon	X	X	X	X	X	
Kereru	X	X	X	X	X	X
Ruru/ Morepork	X	X	X	X	X	X
Weka	X	X	X	X	X	X



Bellbird	X	X	X	X	X	X
Tui	X	X	X	X	X	X
Grey warbler	X	X	X	X	X	X
Silvereye	X	X	X	X	X	X
Fantail	X	X	X	X	X	X

All of the species listed as present in the BWS (Table 1) are able to disperse unaided out of the sanctuary, except weka. With the eradication of mammalian predators from the BWS in 2017 it is likely these bird species will increase in number and begin dispersing within the next five years, particularly the five species at the bottom of Table 1. Kaka, falcon, kakariki, robin, rifleman and brown creeper are largely missing from sites within the Core of the Halo and are of particular interest due to their comparative overall rarity. Each of these species is vulnerable to a differing mix of predators depending mainly on nesting and foraging behaviour. Some, like the kaka and kakariki, also require large areas of mature forest to forage in.

Of the missing native species likely to be re-introduced in the BWS, mohua, tieke, kokako, and other parakeet species will probably disperse once they have established large breeding populations, mainly into mature forest immediately adjacent to the BWS. This would include Fringed Hill, the upper Marsden Valley and the Roding/Maitai catchments.

Who are likely to be released within the entire halo across an entire suite of rivers, or within the BWS so they can disperse only once adequate stoat control is in place.

Of these rarer species that would disperse, kaka, kakariki, falcon and possibly brown creeper could be seen at almost all the sites within in the Core of the Halo within 10 years, with kaka the most likely to be seen across the entire Halo more often as their abundance increases. Robin can be found in localised pockets (e.g. pine forest) within the Halo, so establishment in native forest elsewhere could be a goal.

However, establishment of breeding populations of these rarer species will depend on the quality of predator control in addition to increasing the area of suitable habitat, which generally means tall successional native shrubland and mature native forest. Obviously the latter goal will take some considerable time to achieve in most of the current CTG sites and is likely to be a limiting factor in significant increases in native bird abundance within the CTG sites for the foreseeable future. Within areas with large areas of mature forest in the Halo, such as the Roding/Maitai and Fringed Hill, large-scale effective mammalian predator control is likely to result in improvements in native bird abundance relatively quickly (<5 years). Hence, control of mustelids and possums should begin as soon as possible and be planned for initiation by about 2022.

## 5. KEY SITES

Site	Area (ha)	Total number of traps	Vegetation	Access	Land tenure
Brook Waimarama Sanctuary	700	-	Mature native forest & shrubland	Roadend & tracks	NCC
Marsden Valley	359	600	Mature native forest & shrubland	Roadend & tracks	DOC/NCC? & private
Fringed Hill	~400	-	Mature native forest	4WD & tracks	NCC
Grampians Reserve	131	346	Mature native forest & shrubland & exotic forest	Road & tracks	NCC
Sugarloaf	130	-	Native and exotic shrubland	Roadends	Private
Tanragee Reserve	102	-	Exotic forest & mixed shrubland	4WD	NCC
Atmore Reserve	63	-	Exotic forest & mixed shrubland	4WD	NCC
Botanical Hill	29	78	Exotic forest	Tracks	NCC
Roding/Maitai	4000	-	Mature native forest	Roadends & tracks	NCC
Titoki	5	59	Mature native forest & shrubland	Roadend & tracks	NCC

### 5.1 Marsden Valley (359ha)

Marsden Valley has the largest area of mature native forest (90ha) of all the current core sites and is important due to its location adjacent to BWS and the mature native forest of the Roding Valley (Figure 2). It has an altitudinal range of 200-789m above mean sea level (AMSL). The mature forest exists above 600m whereas most of the remaining vegetation is largely in tall successional native forest. There are some older exotic pine plantations on the northeast boundary. The land tenure is approximately half in NCC Park and Reserve and private land.

Marsden Valley holds the greatest diversity of native bird species of all the CTG sites, with some relatively rare species, particularly in the high altitude forest (McArthur & Ray 2018). The current trapping programme was established by the Marsden Valley Trapping Group and

has been in place, with regular additions, since 2007. This programme, run by about 30 volunteers, currently comprises 813 traps targeting rats, stoats and possums.

There is road access at the bottom of the sites and 4WD access at the top, with numerous walking and trap-line tracks throughout.

The site has important values for the Halo due to the relatively diverse native bird fauna including some locally rare species, a relatively large mature native forest, a large area of successional native forest, and its location adjacent to BWS and Roding Catchment.

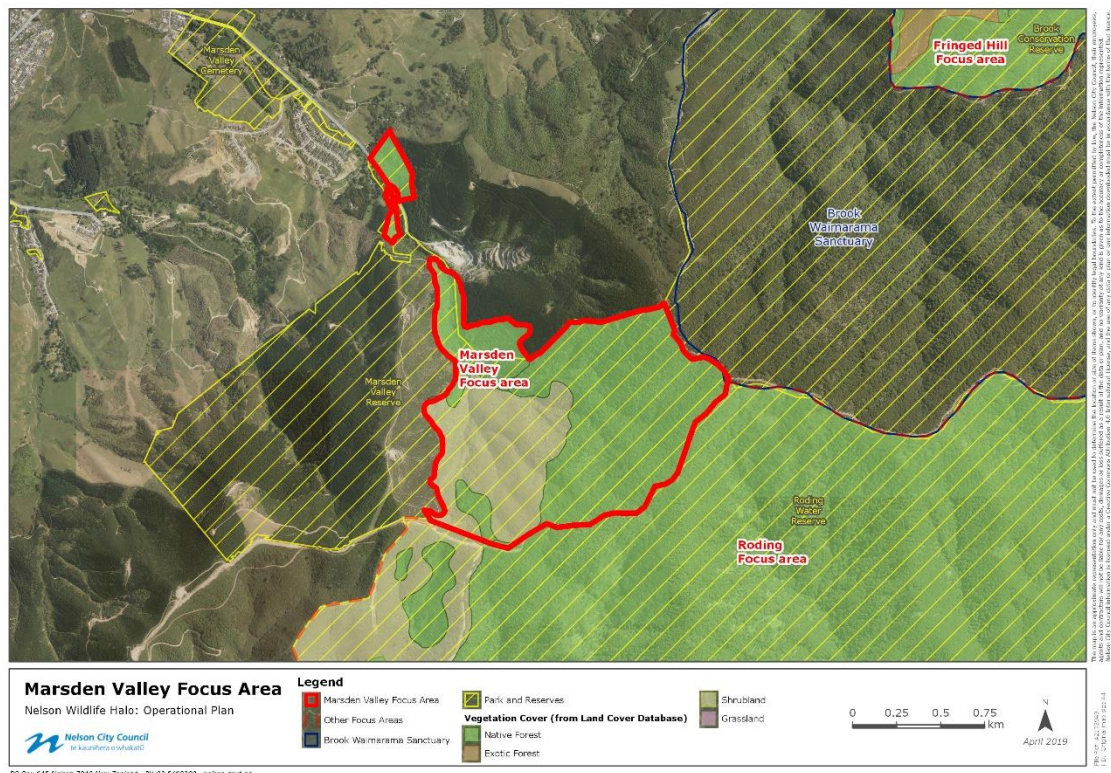


Figure 2. The Marsden Valley, showing mix of mature and successional native forest and location of Parks and Reserve land.

### 5.2 Grampians (130ha)

The Grampians is the largest of the sites immediately adjacent to the suburbs of Nelson City with an altitudinal range from 100-390m AMSL (Figure 3). It comprises a mix of mature native lowland forest with some very large kahikatea (38ha) on the southern boundary, areas of successional native forest of various ages, exotic tree plantings, and grazed rough pasture. The land is a NCC reserve.

Within the Grampians the southern block of mature native forest has a relatively high diversity of native birds when compared with other CTG sites (McArthur & Ray 2018). A trapping programme was established by Birdlife on Grampians CTG in 2009. It has about 20 volunteers who currently service 300 rodent traps, 32 possum traps, and 12 Fenn traps in boxes across the entire site.

There is good vehicular access into the centre of the site, with numerous walking, mountain-biking and trap-line tracks throughout.

The site has important values for the Halo due to the relatively high native bird diversity in the southern forest, a small area of mature native lowland forest, large areas of successional native forest, and its central proximity to both the BWS, Sugarloaf and the Nelson CBD.

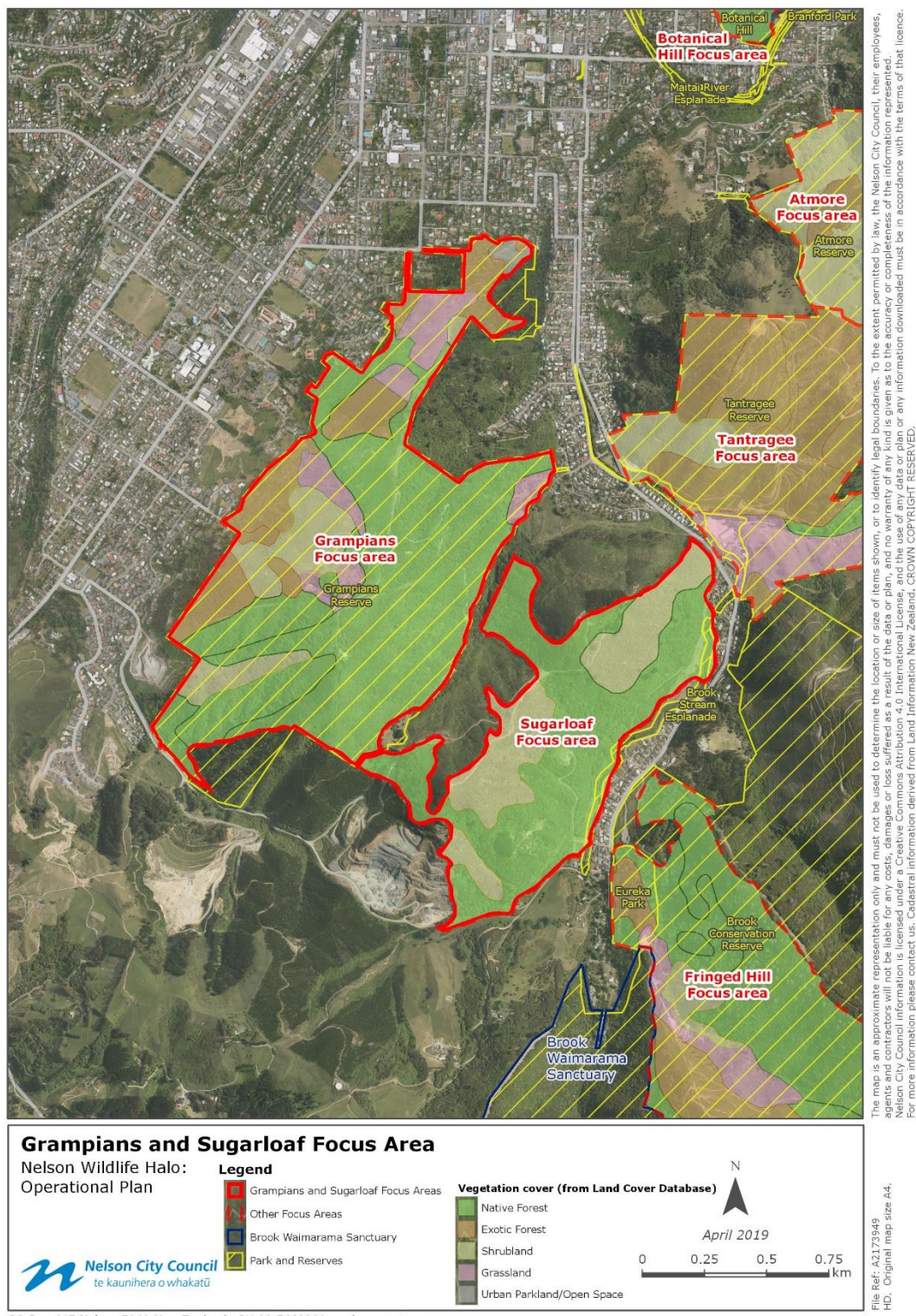
### 5.3 Sugarloaf (130ha)

Sugarloaf borders the Grampians and is close to the BWS with an altitudinal range from 80-308m AMSL (Figure 3). The site has tall successional native forest (~45ha) on the eastern slopes, along with areas of mixed exotic weed species and rank grass on northern slopes, due to be replanted in exotic forest. There is a large area of mature exotic forest on the summit. The land is entirely privately owned. It borders suburban settlement along the Brook Valley.

The newly formed Brook Valley Trapping Group (BVTG) is establishing a trapping programme in the Sugarloaf area. As of August 2018, there were 23 adjacent households running traps in their backyards, with plans for deploying traps on Sugarloaf once tracks have been cut. In future the BVTG is looking to expand into the Camping ground adjacent to the BWS and to include additional landowners between this site and Sugarloaf in the pest control operation (Christa van Loon pers. comm.)

There is vehicular access at several points, right around the base of the site.

The site is important for the Halo due to the relatively large area of successional native forest, and its proximity to both the Grampians and BWS.



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Figure 3. Map of the Grampians and Sugarloaf (Brook Valley) showing location of the mature native forest, successional native forest, exotic forest, pasture and Parks and Reserves boundary.

### 5.4 Botanical Hill (29ha)

Botanical Hill is close to the Nelson CBD and nearby suburbs with an altitudinal range of 20-147m AMSL (Figure 4). It is largely forested, but mainly comprised of exotic trees with a native understory. The land is a NCC reserve.

Birdlife Central have established 76 traps over the past 6 years, mainly for rodents, which are serviced by about 6-8 volunteers.

There is vehicular access to several points around the sites and several tracks throughout.

The site is important within the Halo for its native understory shrubland and as exotic food source for some native birds such as kereru and bellbird, along with its close proximity to Nelson CBD.

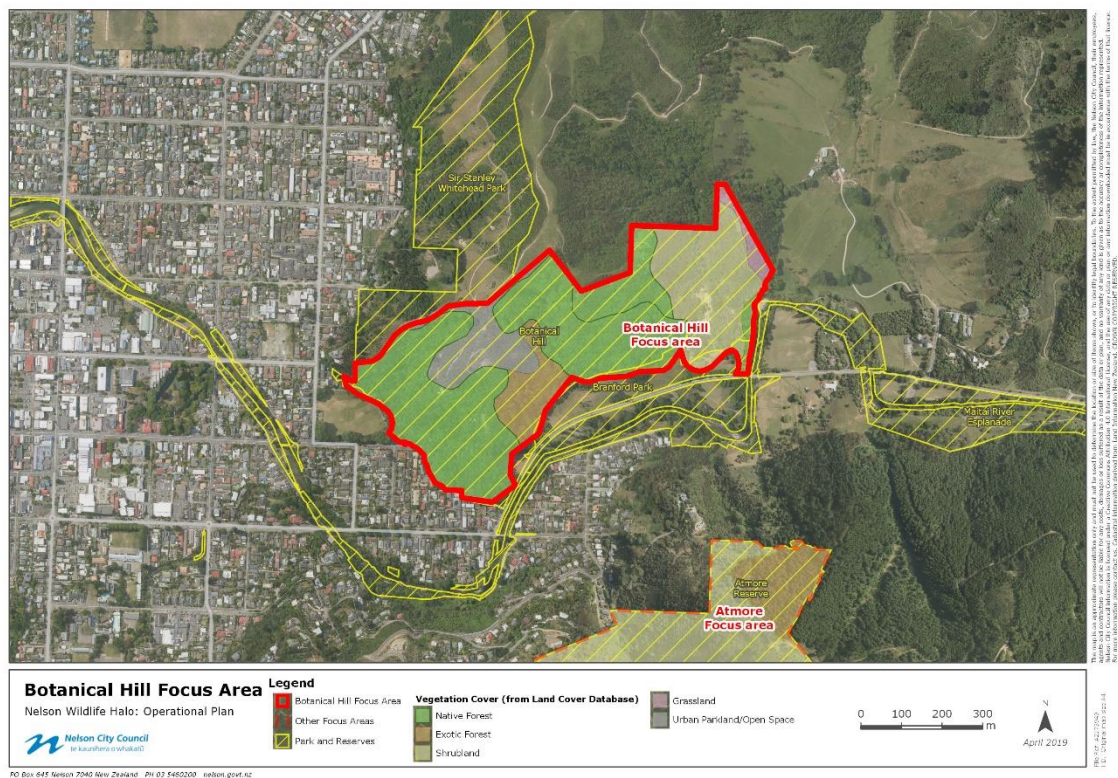


Figure 4: Map of Botanical Hill, showing vegetation cover within area currently under predator control.

### 5.5 Fringed Hill (~400ha)

Fringed Hill borders both the northern BWS and western Matai catchment and includes a portion of the Brook Conservation Reserve, with an altitudinal range of about 300-793m AMSL (Fig. 5). It contains a large area of mature montane native forest particularly at higher altitudes, large areas of successional native forest of various ages and some blocks of exotic plantation forest. Many wilding pines established in native forest have been killed by poisoning. The land is largely in NCC ownership.

There is no predator control in place at present, although there is apparently some interest in establishing a trapping group for the site.

Although there are walking and mountain-biking tracks across the site vehicular access is limited to a 4WD road on the southern boundary.

The site has important values for the Halo due the large area of mature native forest, having existing populations of some rarer native species, particularly as it adjoins the northern BWS boundary.

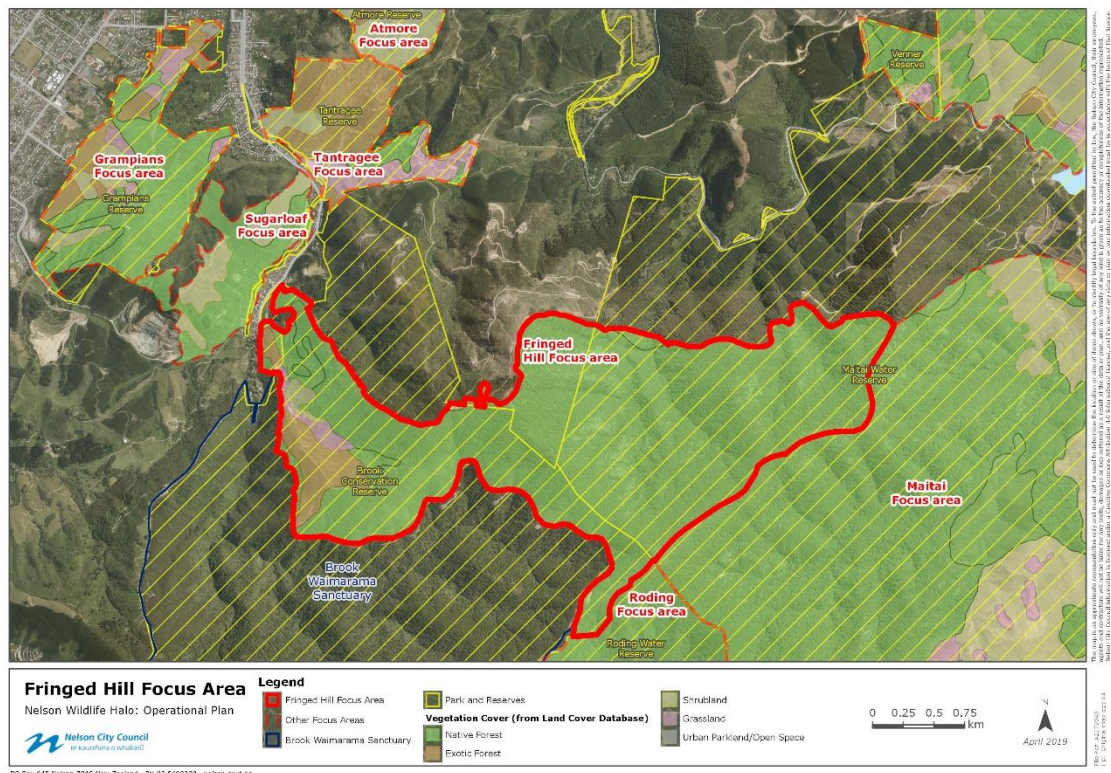


Figure 5. Fringed Hill, showing the location of the native forest and Parks and Reserve boundaries.

### 5.6 Atmore (63ha)

This site, along with Tantragee, is adjacent the Grampians, Sugarloaf and Botanical Hill, with an altitudinal range from 40-351m AMSL (Fig. 6). It is owned by the Nelson City Council. It contains a small area of mature native forest along with a predominance of mixed successional shrubland and exotic production pine forest. It borders suburban settlement along the lower Maitai River.

There is no mammalian predator control in place at present, with no CTG involvement.

There are a few roads providing access to the site. Little is known about its native bird species composition, but is likely to be similar to the Grampians and Botanical Hill

The site is important within the Halo for its proximity to Botanical Hill, Sugarloaf and the Grampians, and its small area of mature native forest.

### 5.7 Tantragee (102ha)

This site is on the southern boundary of Atmore, is close to the Grampians and Sugarloaf, with an altitudinal range from 40-351m AMSL (Fig. 6). It is owned by the Nelson City Council. It is dominated by exotic production pine forest, which is being replaced with native plantings. It also contains 26ha of mature native forest along with mixed successional shrubland, and a large area of old pasture in the valley floor.

There is no mammalian predator control in place at present, with no CTG involvement.

There are two to three roads providing access to the site, with numerous 4WD roads throughout. The Sharlands Hill delineates its northern boundary. Little is known about its native bird species composition, but is likely to be similar to the Grampians and Botanical Hill

The site is important within the Halo for its proximity to Botanical Hill, Atmore, Sugarloaf and the Grampians, and its small area of mature native forest. The large area of rank grass has significant scope for re-planting in native trees, as the native forest on lowland valley floors is rare this close to the Nelson City CBD, and would hold a suite of trees uncommon to the area and valuable to native birds, such as kahikatea for example.

### 5.8 Roding & Maitai catchments (~4000ha)

This site is in the Hinterland Block and is easily the largest area within the Nelson Halo, being almost entirely composed of mature native forest, shrubland and grassland, with an altitudinal range from about 150-1100m AMSL (Fig 7). It is owned by the Nelson City Council.

There is no consistent mammalian predator control in place, although some ungulate control in the form of goat and deer control has occurred and sustained control of ungulates is planned for the near future. Due to its size and terrain it is not likely to be suitable for large scale control by a CTG.

The access comprises some walking and mountain-biking tracks with road access limited to the bottom of each catchment.

The site is important for the Halo for its very large area of mature native forest, the existence of some populations of some rarer native bird species, and because it borders the BWS.



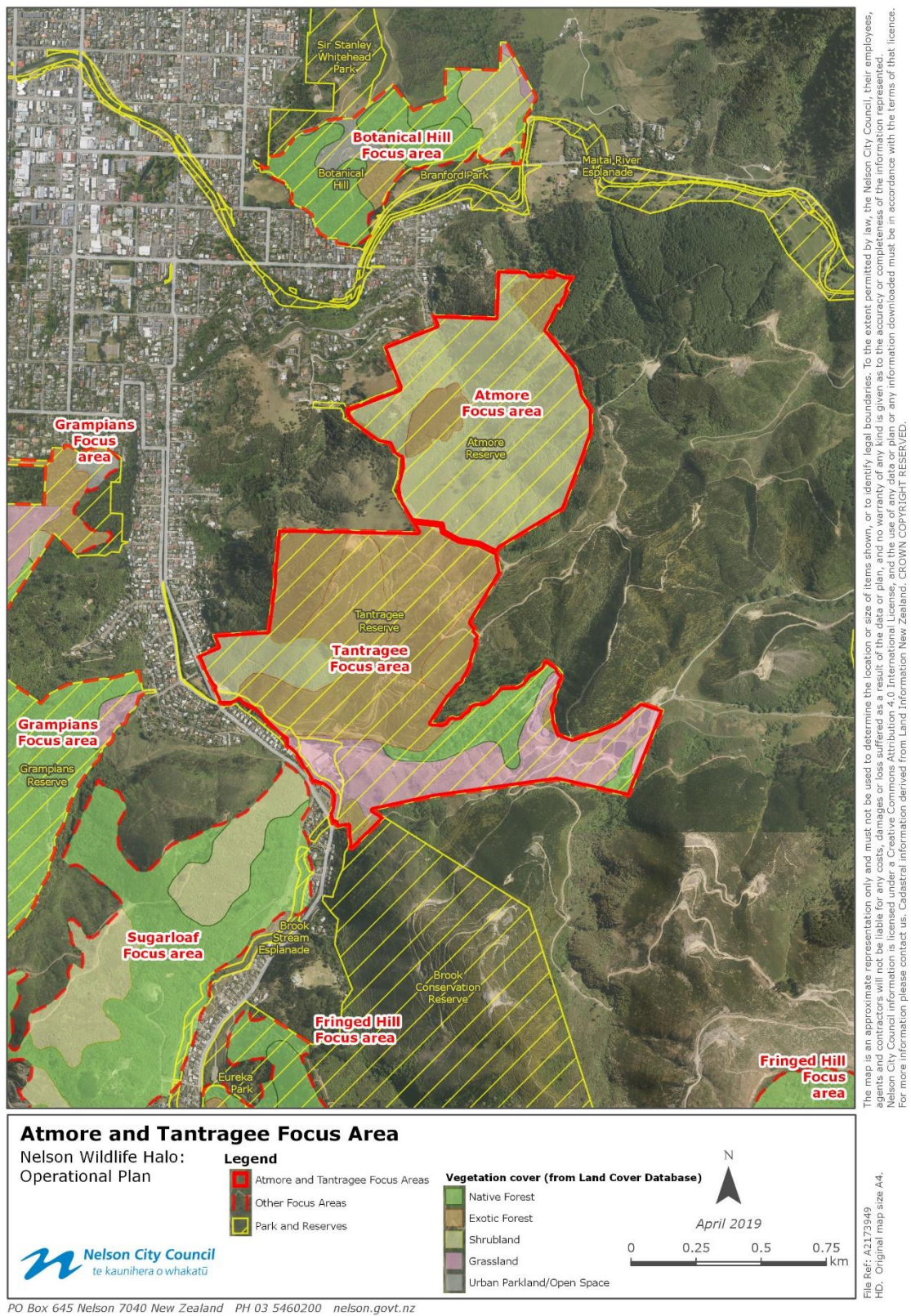


Figure 6. Map of Tantragee and Atmore showing approximate boundary of recommended focus area.

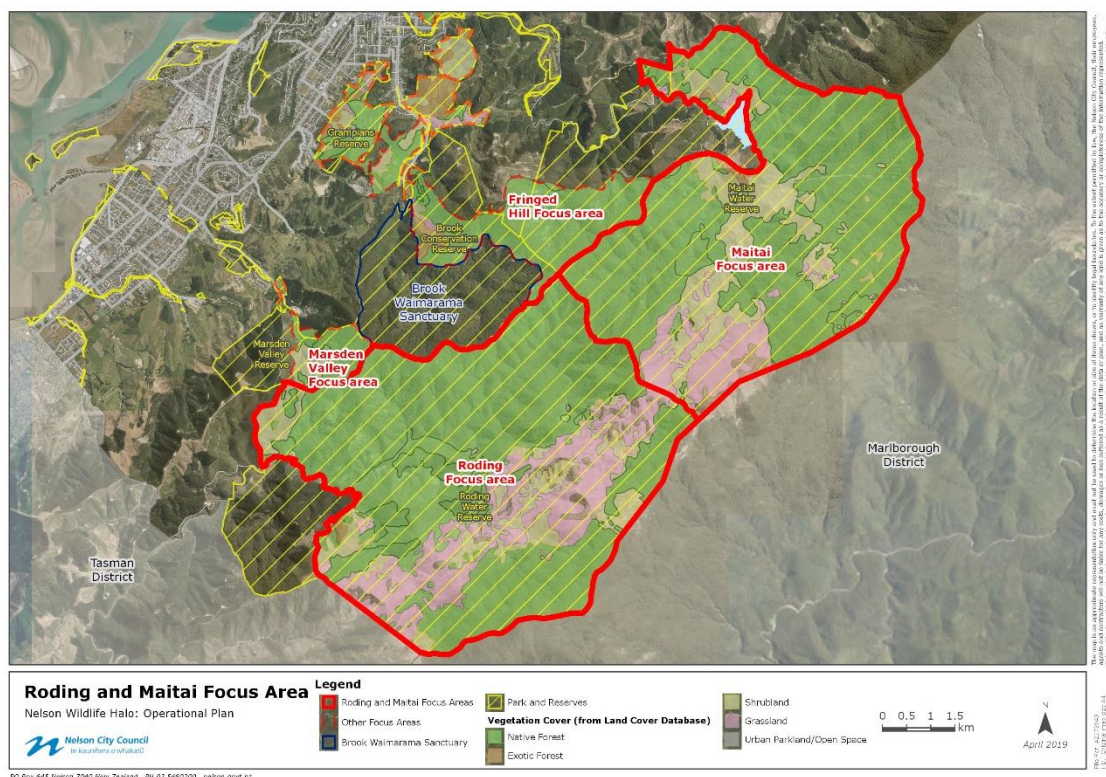


Figure 7. Map of the upper catchments of the Roding and Maitai valleys.

### 5.9 Titoki (5ha)

This is a site in the North Block, at the southern end of a large area within a mosaic of hill farmland, exotic and native forest with several significant natural areas (SNA) present. It is a small fragment and thus not entirely representative of bird values and larger potential. It retains an area of mature titoki, some older successional native forest and some new plantings of native species trees on the eastern side of the reserve (Fig. 8). It is owned by the Nelson City Council. The forest has apparently recovered well after it was fenced and goats were removed from the site. Recent fencing of the stream will allow riparian planting to go ahead in the near future. It has an altitudinal range from 60-100m AMSL.

The local CTG has a trapping programme in place comprising a mix of 59 traps targeting rats, possums and stoats.

Access is from a sealed road end in upper Atawhai and by a series of walking tracks.

It has important value for the Halo as a refuge for common native birds within the North Block and may be suitable for expansion.

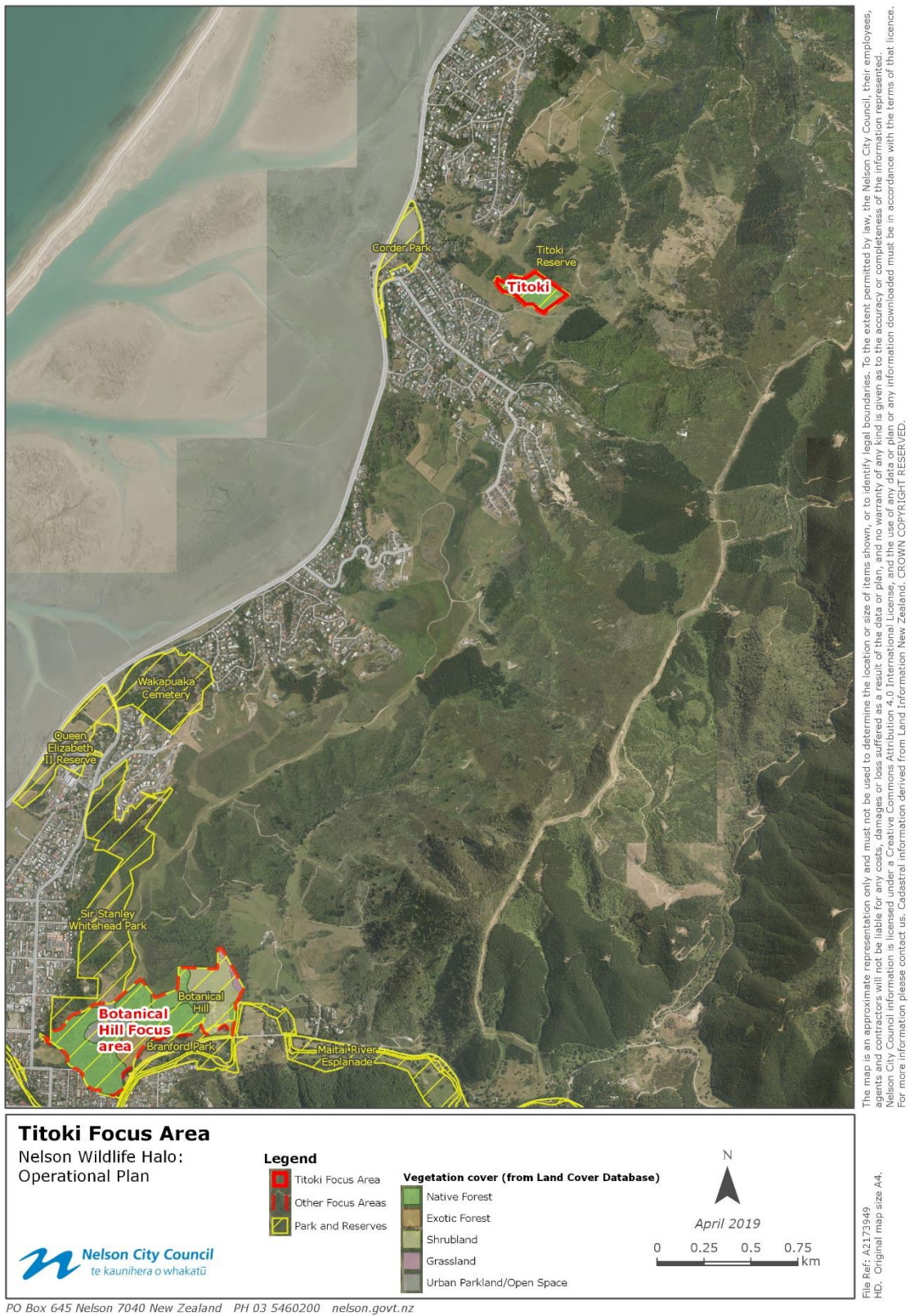


Figure 8. Map showing location and approximate boundary of the Titoki Reserve.

## 6. MANAGEMENT ACTIONS FOR NATIVE BIRD RECOVERY AND ESTABLISHMENT

The Operational Plan is based on a rationale of firstly securing and enhancing the highest quality areas for native birds, through predator control and removal of introduced browsers. From these 'seed' sites additional sites will then be added and improved through effective predator control and habitat enhancement as native bird abundance improves, and as they increasingly move into them.

As the most diverse native bird populations are found in the area surrounding the BWS, efforts should initially concentrate on the Upper Marsden Valley & Fringed Hill to allow existing remnant native bird populations to establish robust breeding populations and freely move between the three sites. These species include rifleman, kaka, robins, kakariki, brown creeper and pied tit as there are remnant populations already present in the area, which are likely to be supplemented from the BWS within 5 years. At this initial stage the Hinterland is logistically too difficult to establish predator control due to its size, coupled with the terrain.

Once species populations in this initial core area recover and predator control is shown to be effective there, the enhanced predator control and habitat restoration programme should be progressively applied at the other high value sites closer to Nelson City. This would initially include the southern Grampians, and the successional forest at Sugarloaf and lower Marsden Valley. Linking sites such as the Grampians and Sugarloaf will provide more secure pathways for native birds to traverse than open pasture. It is likely that robins, bellbird and possibly brown creeper and pied tit are likely to be able to establish there within 5 years as they disperse from BWS. Kaka and kakariki are likely to disperse to these sites from BWS over about 5-10 years as their populations expand there and in Fringed Hill and upper Marsden.

For smaller sites immediately within or adjacent to the Core block, habitat enhancement should be the immediate priority, particularly focussing on benefitting species with strong dispersal ability, such as kaka, tui, bellbird and kereru. Areas of the Grampians, Sugarloaf & Botanical Hill with tall successional forest or exotic forest are likely to see increases of species such as kereru, tui, bellbird and possibly pied tit, within about 5 years with habitat enhancement and the establishment of increasingly effective predator control regimes. Some of the smaller sites, which are still at an early stage of forest regeneration should concentrate on the more common birds that are likely to be found in early successional native forest or with a large component of exotic trees. These areas would be species would be Atmore/Tantragee, Botanical Hill and the city reserves with a focus on species such as kereru, tui, bellbird, grey warbler and fantail within the first five years.

If a significant number of rarer species (e.g. kaka, whio) are being detected in the upper Roding/Maitai then consideration of large scale control measures there will be needed. This will be a significant undertaking, as predator suppression to a level that will lead to meaningful increases in bird numbers requires a lot of effort and resources. For example, maintaining stoats below the 5% threshold has been shown to necessary for kaka populations to benefit (Greene

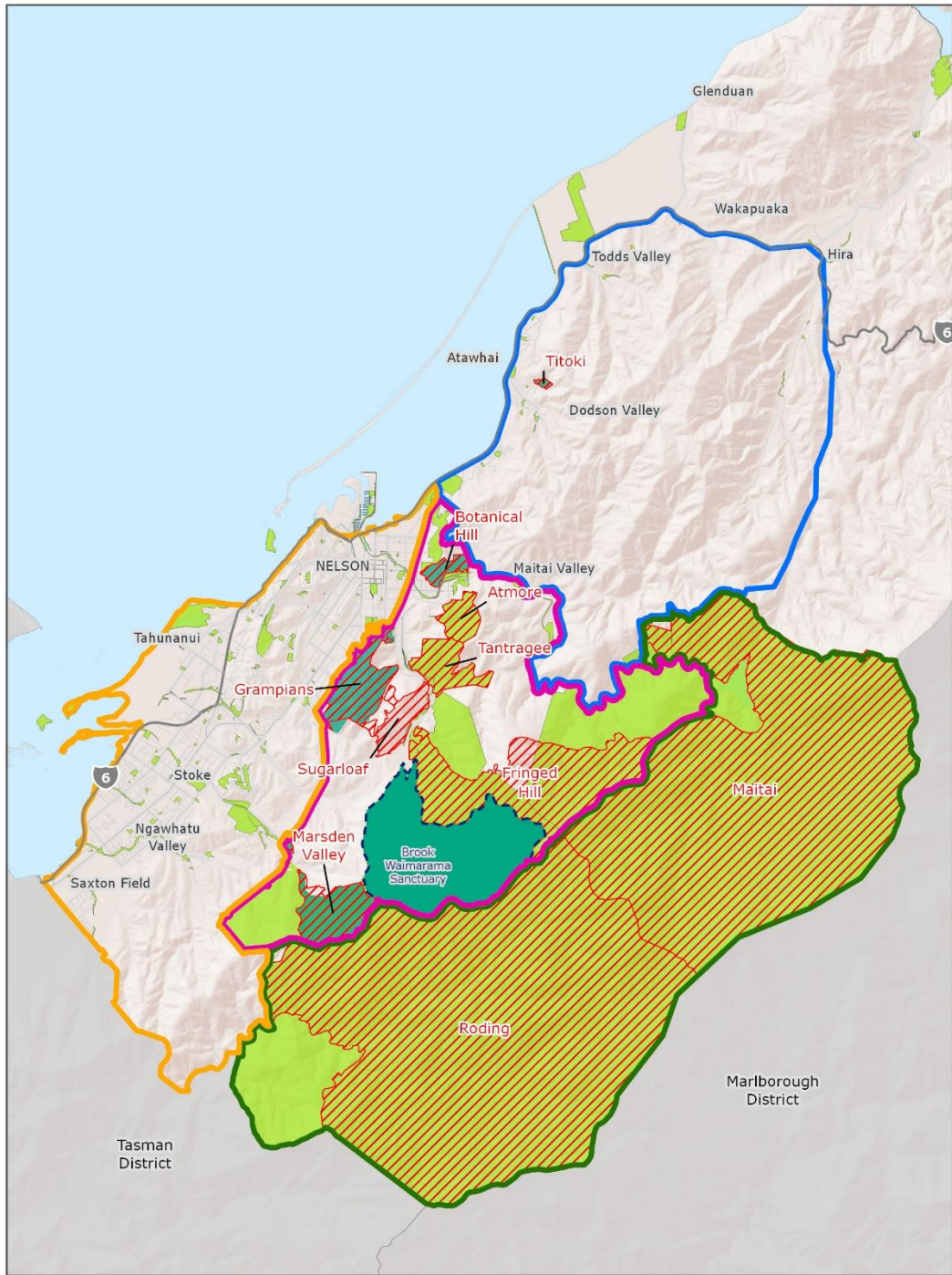
et al. 2004), but this translates to a higher density trap layout and higher checking frequency for stoats than is currently installed in some of the CTG sites. Moreover, the generally small size of the CTG sites makes mustelids monitoring problematic as reinvasion will be a significant complicating issue. The assumption is that increased predator control for rarer species in this block would lead to improved conditions for more common native species, with a concomitant increase in their abundance, and hence overall native bird diversity.

Furthermore, stoat control will generally result in increased rat abundance, with implications for the viability of populations of bird species susceptible to rat predation, above what they would normally face in mast-seed years. Any pest control planning requires careful consideration of its aims with regard to the desired result in terms of particular native bird populations.

Moreover, additional planning and effort leading up to mast-seed years may be required to maintain bird populations within CTGs, particularly in areas of mature native forest.

Sites in the North block, except Titoki can be added as landowners join the programme over a more extended timeline. Titoki is a promising site with good botanical values, but probably requires eventual expansion to become a more valuable addition to the Halo for native birds. This is the case for most of the small forest blocks and SNAs in the North block and the focus should be on their expansion or creating links between them in order to increase their value.

Along with toxin use, cat control is likely to be a contentious issue for the Halo, except at sites removed from settlement, such as Fringed Hill, upper Marsden and the Hinterland. Cats have a particular impact on native birds that spend time on the ground or in the lower understory such as robins, fantail, pied tit and occasionally kereru. However, cats are also generally regarded favourably by a significant portion of homeowners and wholesale removal of cats, especially in suburbs bordering Halo sites, is likely to provoke a strong adverse reaction. Therefore the cat issues needs to be approached with admission of the associated sensitivities and look to methods for ameliorating the impact of cats on native species within the Halo, whilst still achieving its goals. Wellington City Council has recently introduced a bylaw that all domestic cats must be microchipped which enables domestic cats and wild/stray cats to be differentiated. Following a similar approach in Nelson would increase ability to control wild and stray cats in suburban reserves.



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Figure 9. Map of recommended Halo Operational Areas with Focus Areas for predator control and habitat enhancement.

## 6.1 'Core' Block

Native bird species that are likely to respond to predator control and habitat enhancement at specific sites within the Core Block are:

- Upper Marsden & Fringed Hill – rifleman, kaka, robins, kakariki, brown creeper (remnant populations already present in the area, which are likely to be supplemented from the BWS within 5 years)
- Lower Marsden and Grampian tall forest - robins, brown creeper, bellbird (likely to be able to establish within 5 years as they disperse from BWS) kaka, and kakariki (likely to disperse from BWS over about 5-10 years as the population reaches carrying capacity there).
- Grampians, Sugarloaf & Botanical Hill - kereru, tui, bellbird (within 5 years)
- Atmore/Tantragee and city reserves - kereru, bellbird, tui, grey warbler, fantail

### A. Marsden Valley

In the Upper Marsden Valley (above 500m ASL)

i (a). *Targets for native birds*

Objective:

Statistically significant increase in abundance of rifleman, robins, kakariki and brown creeper within the Halo over 5 years. Increase in kaka sightings over 5 years.

Mohua & tieke detected within the treatment area within 5 years of their release into BWS.

ii (a). *Targets for predator control*

1. Within the treatment area, rat tracking rates should average <5% within 6 months of implementation of the Halo Plan and be maintained at this level throughout each spring (Sept. – Nov.).

2. Within the treatment area, possum residual trap catch (RTC) or similar detection method should be <5% within 1 year of implementation of the Halo Plan and be maintained at this level throughout the year.

3. Across the entire Marsden Valley, stoat tracking rates should aim for <10% within 6 months of implementation of the Halo Plan and be maintained at this level throughout the year.

4. Across the entire Marsden Valley, encounters should average < 0.5 pigs or goats detected per hunter day.

In the Lower Marsden Valley (below 500m ASL)

i (b). *Targets for native birds.*

Statistically significant increase in abundance of robins, brown creeper, bellbird within the Halo over 10 years.

ii (b). Targets for predator control

1. Within the treatment area, rat tracking rates should average <5% within 5 years and then maintained at this level unless pulsed trapping for protection of nesting birds is the goal, in which case, this should be attained only from August to December.

2. Within the treatment area, possum chew card index should be <5% within 1 year and be maintained at this level

3. Across the entire Marsden Valley, stoat tracking rates should average <10% within 6 months and be maintained at this level.

4. Declining annual capture rate for cats to zero over next 5 years.

5. Across the entire Marsden Valley, encounters should average < 0.5 pigs or goats detected per hunter day.

iii. *Predator control methods*

(a) Within the 90ha mature forest above 500m ASL.

Rats:

Victor snap-traps at 100x 50m spacing (360 traps), checked weekly AND/OR A24 traps in weka-proof boxes at 50 x 100m spacing, checked quarterly (180 traps).

Possums:

Sentinel possum traps at 200 x 200m spacing (23 traps), checked fortnightly. Traps moved to new adjacent locations every 4 months.

Stoats:

Double-set DOC 200 traps at a 150m spacing on all perimeter and major internal tracks, checked monthly.

Cats:

Leg-hold traps on raised sets at 400m spacing set 10m off all perimeter and major internal tracks, over 500m apart. Set and run every month for a week and checked each morning.

(b) Within the remaining successional native forest below 500m AMSL

Rats:



Victor snap-traps at 50 x 50m spacing, checked weekly AND/OR A24 traps in weka-proof boxes at 100 x 100m spacing, checked quarterly (180 traps).

Possums:

Sentinel possum traps at 200 x 200m spacing (23 traps), checked fortnightly.

Mustelids:

Double-set DOC 200 traps at a 150m spacing on all perimeter and major internal tracks, checked monthly.

Cats:

Leg-hold traps on raised sets at 400m spacing set 10m off all perimeter and major internal tracks, over 500m apart. Set and run every month for a week and checked each morning.

#### iv. *Habitat enhancement*

Objective:

Protect mature forest, and improve diversity and structure of successional forest

Methods:

Removal of ungulates (goats/deer) and pigs by hunting. Tie this in with control in the adjacent Roding Catchment. Control of goats in Roding Valley extended onto Upper Marsden Valley.

Block in-fill planting of tall native trees into successional forest in lower valley. These trees should comprise species that fruit or provide nest holes and may have limited seed dispersal, such as podocarps and red beech. Planting should initially take place on damp valley floors and south facing slopes to improve likelihood of successful establishment.

Undertake exotic weed control, particularly of smothering weeds such as banana passionfruit and introduced fruiting trees such as cotoneaster/holly which are favoured by birds.

#### v. *Outcome and results monitoring*

Birds: 5-minute bird counts in November

Rats: Permanent tracking tunnel or chew card transects comprising of 10 detection devices set at 50m intervals. Two sets of transects within upper Valley and four transects within lower valley. Locations should be stratified for broad forest types. Set for 1 fine night every 3 months.

Mustelids: Permanent Tracking tunnel transects of 5 detection devices set at 100m intervals as part of wider Halo mustelid monitoring. One line in upper Valley, and two lines in lower Valley. Can be the same as the rat detection line. Set quarterly for 21 nights.

Possoms: Waxtag transect of 5 detection devices at 100m intervals. One transect within upper Valley and two transects within lower valley. Can be set within 50m of rat transect line, but not closer than 30m. Moved to new locations and set quarterly.

Establish and maintain photo plots within the main vegetation types to record changes in structure and composition over time. Repeat every 5 years.

## **B. Fringed Hill**

### *i. Bird Management*

Objective:

A. Statistically significant increase in rifleman, robins, kakariki, brown creeper abundance in the Halo over next 5 years. Increases in kaka sightings over 5 years.

B. Mohua detected within 5 years of release into BWS.

### *ii. Targets for predator control*

Initial Treatment Area:

(Within ~250ha of mature forest above 600m AMSL or bordering the north side of the BWS [see Figure 5]).

1. Within the initial treatment area, rat tracking rates should average <5% within 6 months of treatment initiation and be maintained at this level. This should be expanded to include the entire Fringed Hill area after attaining Bird Result A, possibly in less than 5 years.

2. Within the initial treatment area, possum residual trap catch (RTC) OR chew card index should be <10% within 1 year of treatment initiation and be maintained at this level. This should be expanded to include the entire Fringed Hill area after attaining Bird Result A, possibly in less than 5 years.

3. Within the entire Fringed Hill area, stoat tracking rates should average <5% within 6 months of treatment initiation and be maintained at this level.

4. Declining annual capture rate for cats to zero over next 5 years.

### *iii. Predator control methods*

Rats:

Victor snap-traps at 50x 50m spacing, checked weekly AND/OR A24 traps in weka-proof boxes at 50 x 100m spacing, checked quarterly.

Possoms:

Sentinel possum traps at 200 x 200m spacing, set 10m off all perimeter and internal tracks, checked fortnightly. Traps moved to new adjacent locations every 4 months.

Mustelids:

Double-set DOC200 traps at 150m spacing, set 10m off all perimeter and major internal tracks, checked monthly.

Cats:

Leg-hold traps on raised sets at 400m spacing set 10m off all perimeter and major internal tracks, over 500m apart. Set and run every month for a week and checked each morning.

iv. *Habitat enhancement*

Objective: Improve understory condition

Removal of ungulates (goats/deer) and pigs by hunting. Control of goats extended onto Fringed Hill, concurrent with control in Roding/Maitai.

v. *Outcome and results monitoring*

Birds: 5-minute bird counts in November.

Rats: Permanent tracking tunnel or chew card transects of 10 detection devices at 50m intervals. Four within treatment site. Set transects in denser forest, not open ridgelines. Set quarterly for 1 fine night.

Mustelids: Permanent Tracking tunnel transects of 5 detection devices at 100m intervals. Two within treatment site. Can be the same as the rat detection line. Set quarterly for 21 nights.

Possoms: Permanent wax tag transect of 5 detection devices at 100m intervals. Two within treatment site. Can be set within 50m of rat transect line. Set quarterly.

Establish and maintain photo plots within the main vegetation types to record changes in structure and composition over time. Repeat every 5 years.

## C. Grampians

### i. *Bird Management*

Objective: Statistically significant increase in abundance kereru, tui, bellbird within the Halo over next five years. Statistically significant increase in detections of kaka, kakariki and robins within 10 years.

### ii. *Targets for predator control*

1. Rat tracking rates within mature native forest should average <5% within 6 months and be maintained at this level.
2. Within the treatment area, wax tag index should be <10% within 1 year and be maintained at this level within mature and successional native forest
3. Within the treatment area, stoat tracking rates should average <5% within 6 months and be maintained at this level for all of the Grampians.
4. Declining annual detection rate (cameras) for cats to zero over next 5 years.

### iii. *Predator control methods*

Rats:

Victor snap-traps at 50x 50m spacing, checked weekly AND/OR A24 traps at 50 x 100m spacing, checked quarterly. Initially within mature native forest in southern Grampians. Expanded to include successional native forest on northern and northeast Grampians as bird abundance increases. Backyard trapping on all boundaries. Rat traps set in back-yards adjacent to successional native forest.

Possums:

Sentinel possum traps at 200 x 200m spacing, set 10m off all perimeter and internal tracks, checked fortnightly. Traps moved to new adjacent locations every 4 months. Set within mature native forest in southern Grampians and in successional native forest, including pasture boundaries.

Stoats:

Double-set DOC 200 traps at 150m spacing, set 10m off all perimeter and major internal tracks, over 500m apart, checked monthly.

Cats:

There will be significant challenges to reduce cat impacts in Reserves near residential areas (refer p21). If there was support from the Nelson community for microchipping domestic cats, the following method could be used to reduce cat impacts:

Cage traps at 400m spacing set 10m off all perimeter and major internal tracks, over 500m apart. Set and run every month for a week and checked each morning. Domestic

cats micro-chipped and released. Education of neighbouring cat owners about impacts on native birds.

iv. *Habitat enhancement*

Objective: Improve condition of mature native forest and enhance structure and diversity of successional forest. Improve value of exotic forest for native honeyeaters over winter.

Mature native forest:

Block plant successional forest species on border of forest

Exotic weed control, particularly of smothering weeds such as banana passionfruit and fruiting trees such as cotoneaster.

Successional native forest:

Allow native successional forest to regenerate. Remove exotic weed tree/shrub species within successional forest. Block planting of tall native tree species (e.g. beech, podocarps) into open tall successional forest, to expedite natural regeneration. These trees should comprise species that fruit or provide nest holes and may have limited seed dispersal, such as podocarps and red beech. Planting should initially take place on damp valley floors to improve likelihood of successful establishment.

Exotic forest:

Planting non-invasive exotic trees into areas with exotic tree plantations, particularly non-invasive flowering exotic trees that native honeyeaters prefer, and especially winter flowering species for when food resources are scarce for tui and bellbird in particular (see Appendix 1).

v. *Outcome and results monitoring*

Birds: 5-minute bird counts in November.

Rats: Permanent tracking tunnel or chew card transects of 10 detection devices at 50m intervals. Two within mature native forest and four established within successional forest a year before establishment of rat trapping grids. Set transects in denser forest, not open ridgelines. Set quarterly for 1 fine night.

Possoms: Permanent wax tag transect of 5 detection devices at 100m intervals. One in mature native forest and two within successional forest. Can be set within 50m of rat transect line. Set quarterly.

Stoats: Permanent Tracking tunnel transects of 5 detection devices at 100m intervals. One in mature native forest, and two in successional forest. Can be the same as the rat detection line. Set quarterly for 21 nights.

Establish and maintain photo plots within the main vegetation types to record changes in structure and composition over time. Repeat every 5 years.

#### D. Botanical Hill

##### i. *Bird Management*

Objective: Statistically significant increase in abundance of bellbird, tui and kereru within the Halo over 5-10 years.

##### ii. *Targets for predator control*

1. Rat tracking rates should average <5% within 6 months and be maintained at this level.

2. Within the treatment area, wax tag index should be <10% within 1 year and be maintained at this level

3. Declining annual capture rate for cats to <1% (1/100 trap nights) over next 5 years.

##### iii. *Predator control methods*

Rats:

Victor snap-traps at 50x 50m spacing, checked weekly AND/OR A24 traps in weka-proof boxes at 50 x 100m spacing, checked quarterly.

Possums:

Sentinel possum traps at 200 x 200m spacing, set 10m off all tracks, checked fortnightly. Within mature native forest in southern Grampians and in successional native forest. Traps moved to new adjacent locations every 4 months.

Cats:

There will be significant challenges to reduce cat impacts in Reserves near residential areas (refer p20). If there was support from the Nelson community for microchipping domestic cats, the following method could be used to reduce cat impacts:

Cage traps at 400m spacing set 10m off all perimeter and major internal tracks, over 500m apart. Set and run every month for a week and checked each morning. Domestic cats micro-chipped and released. Education of neighbouring cat owners about impacts on native birds.

Cage traps at 400m spacing set 10m off all perimeter and major internal tracks, over 500m apart. Set and run every month for a week and checked each morning. Domestic cats micro-chipped and released. Education of neighbouring cat owners about impacts on native birds.

iv. *Habitat enhancement*

Objective: Improve value of site for honeyeaters and kereru, particularly over winter

As this site has only moderate value for native forest enhancement here could be improved through further plantings and replacement with non-invasive flowering exotic trees that native honeyeaters prefer, particularly winter flowering species when food resources are scarce (See Appendix 1). Plant native understory fruiting trees and shrubs under the exotic canopy.

Undertake exotic weed control, particularly of smothering weeds such as banana passionfruit and fruiting trees such as cotoneaster,

v. *Outcome and results monitoring*

Birds: 5-minute bird counts in November.

Rats: Permanent tracking tunnel or chew card transects of 10 detection devices at 50m intervals. Two within Botanical Hill. Set transects in denser forest, not open ridgelines. Set quarterly for 1 fine night.

Possoms: Permanent wax tag transect of 5 detection devices at 100m intervals. One in Botanical Hill. Can be set within 50m of one of the rat transect lines. Run quarterly

Establish and maintain photo plots within the main vegetation types to record changes in structure and composition over time. Repeat every five years.

## E. Sugarloaf

i. *Bird Management*

Objective: Statistically significant increase in abundance of bellbird, tui, and kereru within the Halo within 5 years. Increase in detections of robin and brown creeper within 10 years. As this site is largely composed of successional forest, the native bird species composition will be different to nearby sites with mature native forest.

ii. *Predator control targets*

1. Rat tracking rates should average <5% within 6 months of treatment initiation and be maintained at this level.

2. Possum wax tag index should be <10% within 1 year of treatment initiation and be maintained at this level

3. Within the treatment area, stoat tracking rates should average <5% within 6 months of treatment initiation and be maintained at this level.

4. Declining annual capture rate for cats to <1% (1/100 trap nights) over next 5 years.

iii. *Predator control methods*

Rats:

Victor snap-traps at 50x 50m spacing, checked weekly AND/OR A24 traps in weka-proof boxes at 50 x 100m spacing, checked quarterly. Within successional native forest on eastern slopes of Sugarloaf and on the northwest slopes adjacent to the Grampians.

Backyard trapping on boundary. Rat traps set in back-yards adjacent to all successional native forest.

Possums:

Sentinel possum traps at 200 x 200m spacing, set 10m off all perimeter and internal tracks, checked fortnightly. Traps moved to new adjacent locations every 4 months. Set within, and on pasture boundaries of, successional native forest. If possible establish possum control within mature exotic pine forest also.

Mustelids

Double-set DOC150 traps set every 150m in single trap-line within all of Sugarloaf boundary.

Cats:

There will be significant challenges to reduce cat impacts in Reserves near residential areas (refer p20). If there was support from the Nelson community for microchipping domestic cats, the following method could be used to reduce cat impacts:

Cage traps at 400m spacing set 10m off all perimeter and major internal tracks, over 500m apart. Set and run every month for a week and checked each morning. Domestic cats micro-chipped and released. Education of neighbouring cat owners about impacts on native birds.

iv. *Habitat enhancement*

Objective: Enhance diversity and structure of successional forest.

Allow native successional forest to regenerate. Block planting of tall native tree species into open tall successional forest. These trees should comprise species that fruit or provide nest holes and may have limited seed dispersal, such as podocarps and red beech. Planting should initially take place on south facing slopes initially to improve likelihood of successful establishment.

Remove exotic weed tree/shrub species within successional forest. Control invasive exotic weeds on northern rank grass slopes.



v. *Outcome and results monitoring*

Birds: 5-minute bird counts in early spring.

Rats: Permanent tracking tunnel or chew card transects of 10 detection devices at 50m intervals. Three within Sugarloaf. Set transects in denser forest, not open ridgelines. Set quarterly for 1 fine night.

Possoms: Permanent wax tag transect of 5 detection devices at 100m intervals. Two in Botanical Hill. Can be set within 50m of one of the rat transect lines. Run quarterly

Stoats: Permanent Tracking tunnel transects of 5 detection devices at 100m intervals. One line in Sugarloaf on eastern slope. Can be the same line as the rat detection line. Set quarterly for 21 nights.

Establish and maintain photo plots within the main vegetation types to record changes in structure and composition over time. Repeat every five years.

## F. Atmore/Tantragree

i. *Bird Management*

Objective: Statistically significant increase in abundance of kereru, bellbird, tui, grey warbler, fantail within the Halo within 5 years.

Focus on habitat restoration for this site for the initial ten years, rather than values for native birds. Hence rats and possums will be targeted to reduce seed, seedling and plant consumption. Pine forest and gorse shrubland tends to hold very low numbers of both rats and possums and so would not need significant control measures in place.

ii. *Predator control targets*

1. Rat tracking rates in mature and successional native forest blocks should average <5% within 6 months of treatment initiation and be maintained at this level.

2. Within the treatment area, wax tag index should be <10% within 1 year of treatment initiation and be maintained at this level.

iii. *Predator control methods*

Victor snap-traps at 50x 50m spacing, checked weekly OR A24 traps in weka-proof boxes at 50 x 100m spacing, checked quarterly. Within successional and mature native forest.

Backyard trapping on boundary. Rat traps set in back-yards adjacent to all successional native forest.

Possums:

Sentinel possum traps at 200 x 200m spacing, set 10m off all perimeter and internal tracks, checked fortnightly. Traps moved to new adjacent locations every 4 months. Set within, and on pasture boundaries of, successional native forest. If possible establish possum control within mature exotic pine forest also.

NOTE: These control methods will require some additional walking tracks to be established in some portions of the site

iv. *Habitat enhancement*

Objective: Increase the area and diversity of existing successional native shrubland.

Much of the site not in exotic pine forest is in low stature early successional native shrubland with a significant component of invasive weed species. Much of the shrubland can be left to continue to regenerate but will require an intensive effort for weed control. Where gorse predominates, this can be left to become a nurse crop for native trees over the next two decades. Where taller native shrubland exists, planting of taller native tree species into these areas can be undertaken, with lowland species such as podocarps, titoki, kohekohe, red beech etc.

The large area of rank grass in the valley floor would hold a significant valley floor forest if replanted with native forest with aim to include podocarps that are rare in the area, such as kahikatea, totara etc.

v. *Outcome and results monitoring*

Birds: 5-minute bird counts in November.

Rats: Permanent tracking tunnel or chew card transects of 10 detection devices at 50m intervals. Three within Atmore/Tantragree. Set transects in denser tall successional forest, not open ridgelines. Set quarterly for 1 fine night.

Possums: Permanent wax tag transect of 5 detection devices at 100m intervals. Two in Atmore/Tantragree. Can be set within 50m of one of the rat transect lines. Run quarterly.

Establish and maintain photo plots within the main vegetation types to record changes in structure and composition over time. Repeat every five years.

## 6.2. 'City' Block

### A. Pipers, Highview & Bolwell Reserves

i. *Bird Management*

Objective: Statistically significant increase in abundance of small native passerines (grey warbler, fantail, silvereye, bellbird & tui) within Halo over next 10 years.

Possum control is difficult within these sites as they are small and are highly accessible to the public. Virtually all effective possum control measures would be hazardous to small children or pets and would need very careful management to result in effective possum control. Possum trapping in backyards adjacent to these blocks is likely to be effective and a safer method for control as access can be controlled. Similarly, backyard rat-trapping will assist with reaching the control targets in these sites.

ii. *Predator control targets*

1. Rat tracking rates at each site should average <5% within 6 months of trap deployment and be maintained at this level.
2. Declining annual capture rate for cats to <1% (1/100 trap nights) over next 10 years.

iii. *Predator control methods*

Rats:

DOC200s at 50x 50m spacing, checked weekly (Rats are more likely to be Norway rats, rather than ship rats). Backyard trapping on boundary. Rat traps set in back-yards adjacent to all sites.

Cats:

There will be significant challenges to reduce cat impacts in Reserves near residential areas (refer p20). If there was support from the Nelson community for microchipping domestic cats, the following method could be used to reduce cat impacts:

Five cage traps, set 10m off internal tracks, spaced approximately equidistantly within each reserve. Set and run every month for a week and checked each morning. Domestic cats micro-chipped and released. Education of neighbouring cat owners about impacts on native birds.

iv. *Habitat enhancement*

Objective: Improve value of sites for native passerines through increasing the diversity and density of native tree and shrub species at each site.

Block plant additional native trees and shrubs into each site, particularly species favoured as food sources (Appendix xx).

Undertake exotic weed control, particularly of smothering weeds such as banana passionfruit and fruiting trees such as cotoneaster

v. *Outcome and results monitoring*

Birds: 5-minute bird counts in November.

Rats: Permanent tracking tunnel or chew card transects of 10 detection devices at 50m intervals. One at each site. Set transects in denser forest. Set quarterly for 1 fine night.

Cats: Cat captures declining to <1% over 10 years.

Establish photo plots within the main vegetation types to record changes in structure and composition over time. Repeat every 5 years.

### 6.3 'Hinterland' Block

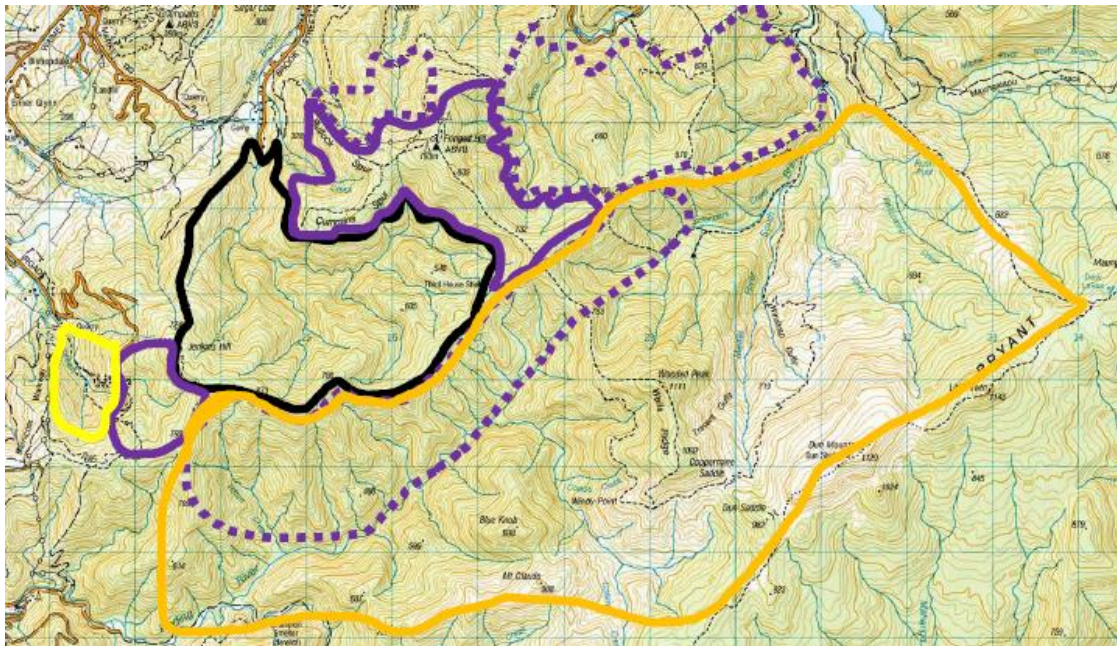


Figure 10. Schematic map of Hinterland Block, showing management units for native birds.

Black: Brook Waimarama Sanctuary

Purple solid: Marsden Valley, Fringed Hill (initial predator control areas).

Purple dashed: Roding/Maitai & Fringed Hill, Area for predator control (Year 5 onwards in discussion with BWS)

Orange: Roding/Maitai (Predator control from Year 5-10 onwards)

## A. Maitai/Roding catchments

### i. *Bird Management*

Objective: Statistically significant increase in abundance of rifleman, brown creeper, kaka, kakariki in Halo over next 10 years. Increase in abundance of whio, tieke and mohua within 10 years.

Note: Increases in the kaka abundance could be used as a trigger point for establishing mammalian pest control within the Maitai/Roding catchments, although Orange-fronted parakeet numbers may provide a better measure and requires further discussion. Initially the kaka population will increase due to dispersal from BWS. Predator control should be initiated three years after the start of this programme in order to reduce mustelid and possum abundance prior to the likely release of whio and kaka. Pest control will protect kaka, whio, orange-fronted parakeet and other birds that are then likely to establish a breeding population outside the BWS.

### ii. *Predator control targets*

1. Within the treatment area rat tracking rates should average <5% within 1 month of treatment initiation and be maintained at this level during the breeding season.
2. Within the treatment area, wax tag index should be <10% within 1 year of treatment initiation and be maintained at this level.
3. Within the treatment area, stoat tracking rates should average <5% within 6 months of treatment initiation and be maintained at this level.
4. Across the entire Maitai /Roding, encounters with pigs or ungulates should average < 0.5 of each species detected per hunter day.

### iii. *Predator control methods*

#### A. Initial treatment site (western Maitai/Roding)

Initiated once the kaka trigger point is reached.

Mustelids: Double-set DOC 200 traps at 100m spacing, set on internal tracks, at ~800m apart, checked monthly.

Possums: Sentinel possum traps at 200m spacing, set on internal tracks at 200m apart, checked fortnightly. Traps moved to new adjacent locations every 4 months.

#### B. Entire treatment site.

Predator and browser control across this site will probably be the most expensive and possibly contentious portion of the Halo. As such it will need careful planning, attention to public concerns and rigorous cost-benefit analysis before a final decision on possible implementation is made. The recovery of native bird populations is

unlikely to be significant within a 5-year period, even with some dispersal from the BWS, and so any restoration actions are likely to be toward the end of next decade.

Rat control: Large-scale multi-annual aerial poisoning. This is the only viable control tool for rats in this site, due to its terrain and size. This technique will also be required for the initial knock-down of possums and periodic reduction in stoat numbers across the entire area.

iv. *Habitat enhancement*

Objective: Improve structure and diversity of forest understory.

Ungulate, pig and possum control will be required to improve the health of the understory and allow canopy tree seedlings to reach maturity.

Possum and stoat control across the entire site is possible, and is being done at this scale at other sites within the Tasman District. Note that it is more labour intensive, and therefore expensive, than using toxins. It is clear, however, that significant reduction in stoat abundance will result in an overall increase in rodent numbers (G. Elliot, pers. comm.), so will only favour bird species that are less vulnerable to rats.

v. *Outcome and results monitoring*

**This monitoring should be established as soon as possible, as it will provide an initial baseline of bird and predator numbers well-prior to treatment**

Birds: 5-minute bird counts in November

Rats: Permanent tracking tunnel or chew card transects of 10 detection devices at 50m intervals. Three within the initial treatment site or six within the whole site. Set in denser forest, not open ridgelines. Set quarterly for 1 fine night.

Stoats: Permanent Tracking tunnel transects of 5 detection devices at 100m intervals. Five within the initial treatment site or eight within the whole site. Can be the same as the rat detection line. Set quarterly for 21 nights.

Possums: Permanent wax tag transect of 5 detection devices at 100m intervals. Three within the initial treatment site or six within the whole site. Can be set within 50m of rat transect line. Run quarterly.

Establish and maintain photo plots within the main vegetation types to record changes in structure and composition over time. Repeat every five years.

## 6.4 'North' Block

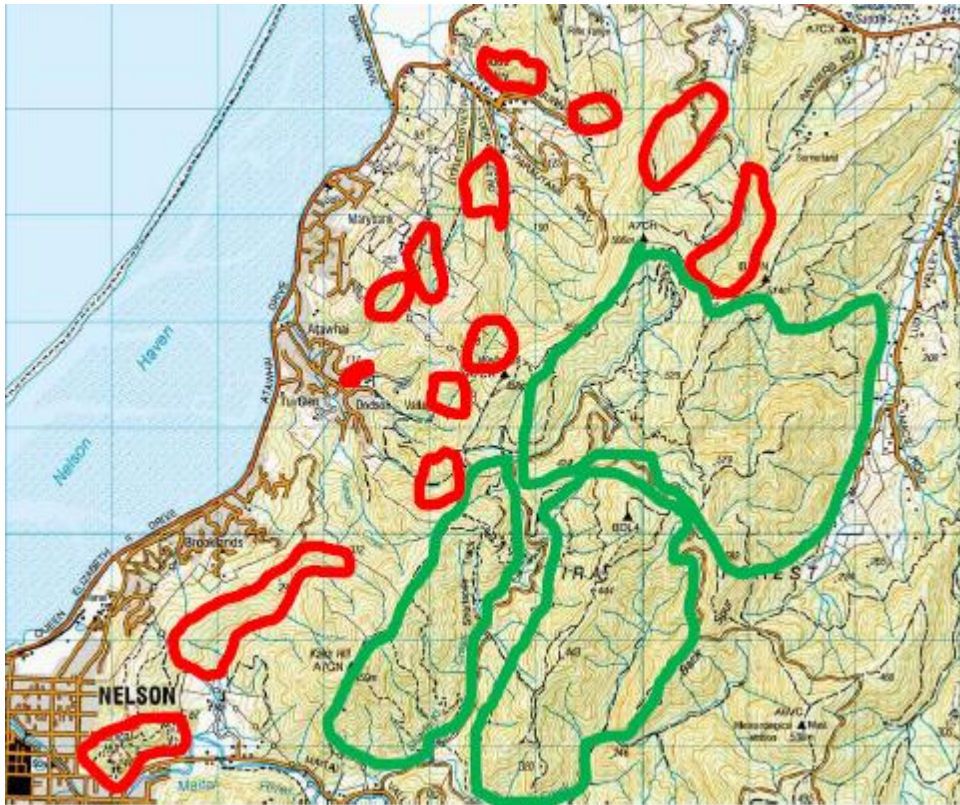


Figure 11. Map of North Block, showing management units for native birds.

Red: Titoki (& Botanical Hill and significant patches of native vegetation) plus possible additional sites: Kereru, bellbird, tui, grey warbler, fantail

Green: Exotic pine production forest: Robins, brown creeper and falcon

### A. Titoki

#### i. *Bird Management*

Objective: Statistically significant increase in abundance of kereru, bellbird, tui, grey warbler, fantail within the Halo within 5 years.

This is a small site and the current predator control for larger species such as stoats or cats is probably being swamped by continuous re-invasion from outside. Until this site is large enough or linked with adjacent sites such that large predators have to traverse a significant area of traps, their monitoring will be unlikely to reveal any reduction in their abundance at this site.

#### ii. *Predator control targets*

1. Rat tracking rates should average <5% within 6 months and be maintained at this level.

2. Possum wax tag index should be <5% within 1 year and be maintained at this level.

iii. *Predator control methods*

Victor snap-traps at 50x 50m spacing, checked weekly AND/OR A24 traps set in weka-proof boxes at 50 x 100m spacing, checked quarterly.

Sentinel possum traps at 200 x 200m spacing, set 5m off all perimeter and internal tracks, checked fortnightly. Within, and on pasture boundaries of, successional native forest. Traps moved to new adjacent locations every 4 months.

iv. *Habitat enhancement*

Objective: Improve and increase amount of native vegetation

Additional planting of native trees into open areas and the understory, particularly species favoured as food sources (Appendix 1).

Plant the riparian boundary in wet-tolerant species.

Discuss possible extension of the forested area with adjacent landowners to gauge their views.

v. *Outcome and results monitoring*

Note: It is not worth running mustelid monitoring in such a small site as it will be swamped by individuals from outside the reserve.

Birds: 5-minute bird counts in November.

Rats: Permanent tracking tunnel or chew card transects of 10 detection devices at 50m intervals. One required. Set transects in mature forest, not planted sites. Set quarterly for 1 fine night.

Possums: Permanent wax-tag transect of 5 detection devices at 100m intervals. One required. Set transects in mature forest, not planted sites. Can be set within 50m of one of the rat transect lines. Run quarterly.

Establish and maintain photo plots within the main vegetation types to record changes in structure and composition over time. Repeat every 5 years.

## **B. Other areas of native forest**

i. *Bird Management*

Objective: Statistically significant increase in abundance of kereru, bellbird, tui, grey warbler, fantail within the Halo within 5 years of beginning control.



ii. *Predator control targets*

1. Within each treatment area rat tracking rates should average <5% within 6 months of initiation of rat control and be maintained at this level.
2. Across the entire treatment area possum residual trap catch (RTC) OR chew card index should be <5% within 6 months of treatment initiation and be maintained at this level.
3. Across the entire treatment area, including Titoki, stoat tracking rates should average <5% within 6 months of treatment initiation and be maintained at this level.

iii. *Predator control methods*

Rats:

Victor snap-traps at 50x 50m spacing, checked weekly AND/OR A24 traps at 50 x 100m spacing, checked quarterly. Backyard trapping on boundary where applicable. Rat traps set in back-yards adjacent to successional native forest.

Possums:

Sentinel possum traps at 200 x 200m spacing, set 10m off all perimeter and internal tracks, checked fortnightly. Set within mature native forest or and in successional native forest, including pasture boundaries.

Stoats:

Double-set DOC 200 traps at 100m spacing, set 10m off all perimeter and major internal tracks, over 500m apart, checked monthly.

iv. *Habitat enhancement*

Objective: Improve and increase amount of native forest

Encourage landowners to retire and fence successional forest blocks with potential for restoration. Possibly advanced through use of QEII covenants.

Encourage landowners and local CTG to collaborate on forest and bird restoration projects in additional valleys (e.g. Todds, Wakapuaka, Lud)

In fill planting of large native trees into successional forest, particularly species that provide fruit or nest holes and have limited seed dispersal or not well represented at each site, such as podocarps and red beech for example. Plant on damp valley floors or south facing slopes initially.

v. *Outcome and results monitoring*

Birds: 5-minute bird counts in November.

Rats: Permanent tracking tunnel or chew card transects of 10 detection devices at 50m intervals. Established within native forest a year before establishment of rat trapping grids to determine progress of programme. Number of lines will be dictated by the size of the treatment area. Set transects in denser forest, not open ridgelines. Set for 1 fine night.

Possums: Permanent Chew card transect of 5 detection devices at 100m intervals. Number of lines will be dictated by the size of the treatment area. Can be set within 50m of rat transect line.

Stoats: Permanent Tracking tunnel transects of 5 detection devices at 100m intervals. Number of lines will be dictated by the size of the treatment area. Can be the same line as the rat detection line. Set for 21 nights.

Establish and maintain photo plots within the main vegetation types to record changes in structure and composition over time. Repeat every 5 years.

### C. Exotic production forest

NOTE: This part of the programme will depend on discussion and agreement with landowners and forestry managers.

i. *Bird Management*

Objective: Statistically significant increase in abundance of robins, brown creeper and falcon.

ii. *Predator control targets*

1. Within each treatment area, rat tracking rates should average <5% within 6 months of initiation of rat control and be maintained at this level.

2. Across the entire treatment area, possum residual trap catch (RTC) OR chew card index should be <5% within 6 months of treatment initiation and be maintained at this level.

3. Across the entire treatment area, stoat tracking rates should average <5% within 6 months of initiation and be maintained at this level.

iii. *Predator control methods*

Rats:

Victor snap-traps at 50 x 50m spacing, checked weekly OR A24 traps at 50 x 100m spacing, checked quarterly. Consider 1<sup>st</sup> generation poison in bait stations for effective rat control.

Possums:

Sentinel possum traps at 200 x 200m spacing, set 10m off all perimeter and internal tracks, checked fortnightly.

Stoats:

Double-set DOC200 traps at 100m spacing, set 10m off all perimeter and major internal tracks, checked monthly.

iv. *Habitat enhancement*

Objective: Improve health of native understory.

Note that blocks of mature pines will be harvested within time-frame of this document, largely destroying the native understory. However as forest is removed in rotation, some mature forest is always present.

Allow sites within production forest that are not viable for plantation forestry to regenerate – e.g. very steep slopes, wet or rocky sites. Note that wetland in pine forest can be suitable for fernbirds. Sustained rat and stoat control is necessary to maintain populations of fernbirds.

v. *Outcome and results monitoring*

Birds: 5-minute bird counts in November.

Rats: Permanent tracking tunnel or chew card transects of 10 detection devices at 50m intervals. Number to be established dependent on size of area under treatment. Set in denser understory, not open ridgelines. Set quarterly for 1 fine night.

Stoats: Permanent tracking tunnel transects of 5 detection devices at 100m intervals. Number to be established dependent on size of area under treatment. Can be the same as the rat detection line. Set quarterly for 21 nights.

Possums: Permanent Chew card transect of 5 detection devices at 100m intervals. Number to be established dependent on size of area under treatment. Can be set within 50m of rat transect line. Run quarterly.

## 7. REVIEW OF EXISTING PREDATOR & WEED CONTROL

### 7.1 Predators

At present the overall density of traps for pest control within the larger CTG sites is less than required for effective pest control in order to allow native bird populations to increase through enhanced breeding success. However, the distribution of traps within the higher value areas in all sites is unknown (Table 2). For example, are there more than 2.5 rat traps/ha in the southern mature native forest in the Grampians, where it would be most effective for native bird recovery? At this stage, without mapping all the traps locations, recording the trap type and the forest types they are in, we cannot conclude whether the current trap distribution and density is likely to result in effective suppression of mammalian predators. Good mapping of the available pest control resources and the forest types present in each site is an essential prerequisite for effective trapping programmes.

Site	Area (ha)	Rat traps	Possum traps	Mustelid/ cat traps	Ungulate/ Pig control
Brook Waimarama Sanctuary	700	Fenced to exclude mammalian pests – no significant numbers of mammalian pests present. Some traps outside the fence.			
Marsden Valley	359	649 (1.81/ha)	76 (0.21/ha)	88 (0.25/ha)	
Fringed Hill	~400	No mammalian pest control in place			
Grampians Reserve	131	300 (2.29/ha)	32 (0.24/ha)	12 (0.09/ha)	N/A
Sugarloaf	130	Currently being established			
Tantragee Reserve	102	No mammalian pest control in place			
Atmore Reserve	63	No mammalian pest control in place			
Botanical Hill	29	76 (2.62/ha)	0 (0/ha)	2 (0.07/ha)	
Titoki Reserve	5	51 (10/ha)	5 (1/ha)	3 (0.6/ha)	
Total area (minus BWS & current non-treatment sites)	524	1076	113	105	
Overall traps/ha		2.05	0.22	0.2	
Density of traps (traps/ha) required to improve breeding success by native birds		2.4	0.2	0.25	

Table 2: Pest control tools available in current and proposed areas for predator control in Nelson City. Required trap density derived from: <https://www.doc.govt.nz/nature/pests-and->

[threats/predator-free-2050/toolkit-predator-free-2050/trapping-and-poisoning/where-to-put-trap-and-bait-lines/](https://www.doc.govt.nz/resources/100000182/threats/predator-free-2050/toolkit-predator-free-2050/trapping-and-poisoning/where-to-put-trap-and-bait-lines/)

At present there is no objective measure of predator abundance, bird abundance or forest health at any of the current CTG sites. This data is essential to measure the effectiveness of the programmes. In all cases the principal reason cited for running the predator control at the sites was to increase native bird numbers, but there is no independent data to support any perceived improvement. Data will be required if future progress of the Halo is to be assessed and any programme adjustments put in place.

Many trappers expressed the reason they trapped was to kill pests, and this was reinforced for them by finding dead predators in traps and was cited as one reason for some resistance to self-resetting traps such as the A24. Although this pest removal ethos is commendable, a shift towards using motivators such as improved bird abundance and forest health, alongside fewer trap captures, will be needed in future. This is particularly pertinent if the pest control is effective, as trapping success should decrease over time.

## 7.2 Weeds

Weed control needs to be run on a site-led basis in order to reduce the predominant weed species within each site. Current CTG members are largely not interested in weed control, but it is obvious that weeds are a significant problem in most, if not all, of the sites. Weed control can be difficult, time consuming and requires good mapping, so it is understandable that this aspect of ecosystem restoration is not favoured. However, weeds smother and compete with native plants and their control will be required to ensure the health of native forest and prevent further spread of weed seeds as bird abundance increases. It is likely that because CTG time is limited and focussed on predator removal it will fall to the NCC to take the lead on weed control at each site.

There are a few weed species that are beneficial as cover crops for native plants, with gorse being the principal exception in Nelson. As undisturbed gorse ages it develops a thick leaf litter and an open structure, which is ideal for native seeds to establish. Gorse is not shade tolerant, and will not survive once nascent native forest over-tops it and canopy closure occurs. The Atmore/Tantragee site may be the best site where this management action is put in place, but should be a deliberate decision as part of the Halo objectives (See 6.1F.)

## 8. SITES OUTSIDE THE HALO

The sites discussed below are within NCC boundaries but not part of the Halo Operational Plan at present. It is possible they could be incorporated in future, and certainly some Significant Natural Areas may be within the timeframe of this document. They should be kept in consideration for eventual inclusion, and as such, decisions about their management need to have regard to the Goals and Objectives of this Operational Plan.

### A. Significant Natural Areas

There are a large number of SNA within in the NCC boundaries, particularly in the North Block. There is a need to invite discussion with landowners with SNAs and suitable adjacent

forested sites in regard to including them in larger areas of regenerating native forest. Merging forest blocks and SNAs will improve their resilience, attractiveness to native birds, and ecological diversity.

#### **B. Oxidation ponds, Delaware Inlet, Kokorua**

The Oxidation ponds, Delaware Inlet, and Kokorua are small areas of wetlands on the northern Nelson City boundaries, with several species of wetland birds present in the latter two sites, including banded rail and fernbird. There is scope for further protection work here, including more intensive pest control and native tree planting within and on the boundaries of these sites, such as is being carried out at Delaware Inlet by Forest & Bird.

#### **C. Cable Bay & Horoirangi/Drumduan**

This is a large hill area in the northwest Nelson City. It has large areas of regenerating native forest and shrubland present and is separated from the nearby forested ranges by the surrounding farmland and State Highway 6. This lends itself to a ‘mainland island’ approach to pest control, whereby pest numbers are suppressed to very low abundance and maintained by intensive trapping in the ‘moat’ of farmland surrounding it.

#### **D. Northern ranges (Blue Hill/Bryant Range)**

These comprise the largest blocks of contiguous mature native forest within the Nelson City boundaries and are mainly Public Conservation Estate. Cooperation with the Department of Conservation would be required to establish large scale pest control operations here, in a similar manner to the Maitai/Roding sites. Reducing pest numbers in this area would provide a significant boost to species such as kaka, kereru and small less common species such as rifleman and kakariki.

All these sites could eventually be bought into the Halo in future and in some cases may occur naturally as motivated locals initiate their own programmes, particularly in area of Cable Bay/Delaware Inlet. In these cases, publicity surrounding the Nelson Halo, discussion with possibly interested parties and/or some seed money may be sufficient to get local restoration projects underway.

## **9. RECOMMENDATIONS**

### **9.1 Suggested Work Programme**

A suggested work programme, including timing and monitoring/review required, is set out below. The programme is based on the priorities set out in the opening paragraphs of Section 6, such that sites currently with higher biodiversity values need to be protected and enhanced initially in order to secure them, before significant restoration work is carried out in lower value sites. Monitoring will be required at all sites from the beginning of the programme in order to track restoration recovery for the entire Halo and assess improvements in biodiversity values at each site. The proposed work programme is tabulated in Appendix 3.

### **A. QUANTIFY**

#### ***Year 1. Determine what is present***

1. What control devices are present?

Locate, identify, map and number/name all traps and tracks on CTG sites. This will require assistance from members of CTGs.

2. How are the control devices being used?

Establish a system to record servicing and capture data for traps on CTGs. It will need to be simple and accessible online in order for trappers to input the information.

3. What is pest abundance at CORE sites and the North Block?

Establish predator detection transects within all CORE sites, as specified, and activate them once they have been in place for 4-6 weeks. Run quarterly. This will provide baseline pest numbers and enable analysis of future trend data.

4. What vegetation have we got?

Use GIS and ground-truthing to confirm the type and area of the main vegetation types within the CORE sites. Determine the areas of focus sites of uncertain size that are likely to be part of the Halo, e.g. Tantragree/Atmore.

Establish photo plots within the main vegetation types in each CORE sites to record changes in structure and composition over time. Use GIS methodology to quantify current areas of forest types within CTGs. To be used as baseline for measuring increases in native forest through planting or regeneration.

5. What is native bird abundance at CORE sites?

Establish stratified 5-minute bird count stations within all CORE sites so it places the counts in the various broad vegetation types - montane native forest, lowland native forest, tall successional native forest, short successional native forest, mixed native and exotic shrubland production pine forest and exotic hardwood forest. Suggested timing for counts is once a year in early spring (September).

6. Discuss management of Fringed Hill with interested parties and support establishment of pest control infrastructure there.

7. Establish native plant raising programme for eventual planting (Year 3 onwards).

8. Publicise and engage the public about the goals and actions in the Halo.

- Construct a website for publicity, information and for data downloads from CTGs.
- Set up a social media site for the Halo to allow the public and CTG volunteers to record their work and successes with each other.
- Secure a portion of the local newspaper(s) for each month to provide information on the Halo.

## **B. PROTECT**

### ***Year 2. Establish effective predator control where rarer native bird species are present***

1. At Marsden Valley and the Grampians intensify the pest control in mature native forest sites.
2. Initiate pest control operations within Fringed Hill.
3. Increase weed control operations in the Marsden Valley and the Grampians focussing on mature native forest initially, then moving into native successional forest.
4. Assess the predator control programmes within Sugarloaf, Botanical Hill and Titoki, based on 18 months of predator abundance data. Revise predator control regimes if required.
5. Assess the suitable areas within Atmore/Tantragee for pest control operations, focussing on mature native forest initially, with a view to eventual expansion. Approach possible CTG for inclusion in their programme.

## **C. EXPAND**

### ***Year 3. Include additional sites within the predator control programme***

1. Within the sites with existing pest control (Marsden Valley, Grampians, Fringed Hill) increase the areas with effective pest control into adjacent montane beech forest and/or tall successional forest.
2. Where required, based on predator abundance results, enhance the predator control effectiveness at Sugarloaf, Botanical Hill and Titoki through additional traps, advice or consolidation of current effort.
3. Assess small reserves in the CITY block for targeted planting programmes with native food plants and rodent control. Where possible, expand back-yard rat control to eventually link rat control between CITY block sites.

## **D. ENHANCE**

### ***Year 3-6. Initiate planting programmes***

1. Initiate dialogue with landowners in the NORTH block regarding inclusion of their land in the Nelson Halo. Focus particularly on sites with significant natural values present.
2. Begin planting native fruiting shrubs and trees as they become available, using native plants grown over past 3+ years. Plant into existing early successional native shrubland and planted native forest at CORE sites of Grampians, Sugarloaf, and the CITY reserves. Link the planting programmes to Work Programme A4 above.
3. Begin planting plantations of native and exotic nurse shrubs at selected sites in the Grampians, Atmore/Tantragee.



4. Begin planting additional exotic flowering trees into and adjacent to existing exotic forest on the Grampians and Botanical Hill (See Appendix 1).
5. Approach targeted landowners of native and exotic forest in the NORTH block to gauge support for initial native bird abundance monitoring and forest diversity and structure assessments within their respective sites. Use initial assessments of bird abundance and forest health to guide which sites are likely to be the best for establishing predator control operations.

## **E. REVIEW AND INCREASE**

### ***Year 5. Add the hinterland sites into the programme***

1. Increase initial trapping effort in the Roding and Maitai as kaka and whio abundance increases and dispersal occurs from the BWS.
2. Analyse and report on trends in abundance of native birds to enhanced predator control programmes in all CORE sites over the previous five years
3. Analyse and report on trends in abundance of mammalian predators and browsers to enhanced predator control programmes in all CORE sites over the previous five years
4. Analyse and report on trends in native forest health as a result of browser and weed control programmes in all CORE sites over the previous five years. Uses data from photopoints.
5. Based on the results and recommendations of the analysis of native bird, predator abundance and forest health trends, undertake an independent review of the first five years of the Halo programme with recommendations for future work.

## **E. ADD AND EVALUATE**

### ***Year 6-10. Bring in exotic forest plantations and additional successional native forest into the Halo.***

1. Where possible increase trap density at all sites but focus on mature forest and tall successional forest.
2. Continue for weed control, with focus on sites not under treatment until now.
3. In Year 10 assess and analyse trends in abundance of native birds to enhanced predator control programmes in all CORE sites over the past ten years
4. In Year 10 assess and analyse trends in abundance of mammalian predators to enhanced predator control programmes in all CORE sites over the past ten years
5. Analyse and report on trends in native forest health to browser and weed control programmes in all CORE sites over the previous ten years
6. Based on the results and recommendations of the forest health, native bird and predator abundance trend analyses, undertake an independent review of the first ten years of the Halo programme with recommendations for future work.

## 10. KEY PERFORMANCE INDICATORS

KPIs are required to provide data to show if progress is being made, and possibly indicate where changes in operational planning need to be undertaken. They need to be relatively simple to record and readily repeatable. In this way at least some of the data can be recorded by the CTG volunteers. Some data, such as 5MBC and forest health, are likely to require additional specialist skills and are probably best served by contractors. KPIs that would likely provide the most useful information are listed below.

1. Trap nights: Number of nights, per trap type, per hectare, per year – is the trapping being maintained or increased?
2. Volunteer effort: Total number of Hours of effort AND the number of volunteers per year – is effort being maintained or increased?
3. Native Bird abundance measures: As per 5MBC over 5 years periods – are native bird numbers increasing or decreasing at each site and within the entire Halo?
4. Native Bird diversity measures: As per 5MBC over 5 year periods – are more species of native birds being recorded at each site.
5. Native Forest health measures: Forest Photopoints every 5 years - Is forest structure and diversity improving? Established in mature and tall successional forest.
6. Amount of native forest: Aerial/Satellite photos taken every 5 years. – is the amount of native forest increasing? Established in short successional native forest, exotic shrubland, rank grass.
7. Publicity: Hits on Halo website per year: Is interest in the Halo increasing over time?
8. Public interest and support: Has outside funding increased each year? Are more traps for backyard trapping being sold each year? Increase in citizen science bird observations. Increase in number of residents undertaking backyard trapping. Recorded and reported annually.
9. Weed measures: Number and species of weeds located per unit effort each year – are weeds becoming less of a problem?

## 11. ROLES & RESPONSIBILITIES

At present there are two principal parties in the Halo – the Council and the CTGs. The main role for the NCC should be support and oversight for the CTGs, and to provide an overall picture of how the Halo is progressing and how their efforts are making a difference. An ancillary role will be publicity for the Halo.

Support from NCC would be in the form of coordination of monitoring, data support and analysis, mapping support, seed funding for predator control initiatives, assistance with

sourcing and securing additional funding, information dissemination about the Halo, new pest control techniques, and provision of concise annual, and larger five-yearly reports for the CTG, NCC, funders, supporters, and the public.

NCC will need to organise and schedule annual meetings with stakeholders, CTGs, funders and the public to discuss and implement further work in the Halo Operational Plan. This should incorporate a social event so participants can mingle in a more relaxed manner.

NCC will provide the impetus behind further expansion of the Halo, through publicity in print, social media and a website, along with approaching land owners with suitable forested land for addition to the Halo.

Weed control will be required, with organisation by the NCC. Additional training for new CTG volunteers could be done through current training courses at NMIT and/or assistance from DOC Staff.

The CTGs could be responsible for management of their site, most of the funding procurement process, deployment and maintenance of traps and trap-lines and encouraging and sourcing new volunteers. They will need to manage Health and Safety aspects of their work. CTGs will run their own website if they desire, preferably with links to the Halo website. They can source 'in kind' support for their work in the form of bait, timber, traps etc.

DOC could provide additional support via assistance with sourcing funding, technical expertise, and direct support from DOC staff (e.g Regional Predator Free Ranger).

There is also a need for the NCC to engage with research organisations such as the Cawthron Institute, Universities, and Landcare Research for mutual benefit. They could get sites for research into predator control techniques, ecosystem restoration, and community engagement while the Halo will obtain additional publicity, technical expertise and possible assistance with funds.

Other interested parties, including iwi (cultural and ecosystem health), Forest and Bird (tree-planting, monitoring), Ornithological Society (Bird counts), Brook Sanctuary (volunteers for Fringed Hill pest control, technical support), Nelson Tasman Botanical Society (Plant monitoring), could be approached and brought into the programme.

## 12. RESOURCING

Although NCC has and will provide some funding for the Halo, it is certainly not sufficient to support the entire programme as laid out in this document. Similarly, CTG seek support themselves through finding additional funding or by 'in-kind' donations from interested parties. In order to progress the Halo further funding will be required, some sourced locally and others nationally, through philanthropy, government grants, and community grants. The vehicle for seeking funding needs to be discussed and agreed between the CTGs and NCC, but a collaborative effort for the entire Halo is likely to be looked on favourably by funders. So at this stage the NCC support is more to provide the framework, planning and initial seed funding to get the Halo off the ground.

Although volunteers do a significant amount of work, the effort as laid out in this Plan will require additional support in terms of funding and staffing. An additional staff member will be required to work with the CTG and nurture new groups. This role is likely to have a data management and basic analysis component (Appendix 2). At the outset, obtaining essential baseline information (Section 9.1A) will need additional resources. This is probably best served by a new staff member, possibly with contractor support, as they will need to establish and obtain initial data from monitoring lines, bird count points, forest health plots, in addition to mapping and recording current trap layouts. In some cases, such as important sites like Fringed Hill, contractors may have to establish and run the predator control as it is a more remote site with difficult access.

### 13. ACKNOWLEDGEMENTS

Particular thanks to Leigh Marshall who has undertaken a huge amount of work to shepherd the Halo project along from its diffuse, incipient days. A special thanks to members of the Community Trapping Groups at the Marsden Valley, Grampians, Sugarloaf, Botanical Hill and Titoki Reserve for discussions and assistance with information. Dave Butler, Neil Fitzgerald, Pete Gaze, Chris Golding, Leigh Marshall, Tristan Rawlence and Wendy Sullivan provided valuable comments on the draft document. Staff at Nelson City Council provided assistance with information and mapping.

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## 15. APPENDIX 1.

Suggested small trees & shrubs as native bird food sources for Nelson Halo sites

<b>Native shrubs/trees</b>	<b>Species name</b>	<b>Food</b>	<b>Notes</b>
Five-finger	<i>Pseudopanax arboreus</i>	Fruit, nectar	
Tree fuchsia	<i>Fuchsia excorticata</i>	Fruit, nectar	
Pate	<i>Schefflera digitata</i>	Seeds	
Hangehange	<i>Geniostoma ligustrifolium</i>	Fruit	
Karamu	<i>Comprosmia robusta</i>	Fruit	
Flax/Hakeke	<i>Phormium tenax</i>	Nectar	Damp or wet sites
Kohekohe	<i>Dysoxylum spectabile</i>	Fruits	Winter food source
Titoki	<i>Alectryon excelsus</i>	Nectar, fruit	Winter food source
Rewarewa	<i>Knightia excelsa</i>	Nectar	Early spring food source
Mapou	<i>Myrsine australis</i>	Fruit	Winter food source
Karo	<i>Pittosporum crassifolium</i>	Seeds	
Kowhai	<i>Sophora</i> species	Nectar, leaves	
Wineberry	<i>Aristotelia serrata</i>	Fruit	Fast growing, nurse tree
Mahoe	<i>Melicytus ramiflorus</i>	Fruit	Fast growing, nurse tree
Broadleaf	<i>Griselinia littoralis</i>	Fruit	
Putaputaweta	<i>Carpodetus serratus</i>	Nectar	
Hebe	<i>Hebe</i> species	Nectar	
<b>Introduced species</b>	<b>Species name</b>	<b>Food</b>	<b>Notes</b>
Eucalyptus	<i>Eucalyptus leucoxydon</i> <i>Rosea</i>	Nectar	Winter food source
Tree lucerne	<i>Chamaecytisus palmensis</i>	Leaves, nectar	Kereru eat leaves, excellent nurse tree for native trees, hardy, fast growing
Protea	<i>Protea</i> species	Nectar	
Banksia	<i>Banksia</i> species	Nectar	

## **16. APPENDIX 2.**

### **Example role description for a Halo coordinator**

**Hours of work:** 20-24 hours per week

#### **The Nelson Nature Halo coordinator responsibility:**

- Coordinating community predator control efforts to enhance wildlife outcomes as part of the Nelson Halo project
- Providing technical advice on predator control and predator monitoring to the community
- Providing support to maintain or establish sustainable trapping groups and networks of backyard trappers
- Managing contractors and/or volunteers to deliver regional predator control and predator monitoring programmes
- Encouraging and enhancing community involvement with predator control programmes
- Seeking opportunities for enhancing predator control programmes in Nelson

#### **The position requires:**

- Excellent community engagement and relationship skills
- Excellent understanding of conservation ecology
- Practical experience in predator control and monitoring
- Good writing and record keeping skills
- Good contractor management skills

### 17. APPENDIX 3.

#### Suggested 5-year work programme (Section 9.1)

Area	Site	Species Target	Predator target	Year 1 <i>Quantify</i>	Year 2 <i>Protect</i>	Year 3 <i>Expand</i>	Year 4 <i>Enhance</i>	Year 5 <i>Review</i>
Core	Marsden - Upper	(< 5 years) Rifleman, robin, brown creeper. (5+ yrs) Kaka, whio, mohua, tieke.	Mustelids, Possum, Ship rat, Cat Browsers	Map control devices. Monitor pest/ bird abundance. Map vegetation.	Intensify predator control.	Maintain control and monitoring.	Maintain control and monitoring.	Analyse and report on bird, predator, browser & vegetation assessments. Review programme.
Core	Marsden - Lower	(< 5 years) Brown creeper, robin, bellbird.	Mustelids, Possum, Ship rat, Cat Browsers	Map control devices. Monitor pest/ bird abundance. Map vegetation.	Intensify predator control. Increase weed control.	Maintain control and monitoring.	Maintain control and monitoring.	Analyse and report on bird, predator, browser & vegetation assessments. Review programme.
Core	Fringed Hill	(< 5 years) Rifleman, robin, brown creeper. (5+ years ) Kaka, mohua.	Mustelids, Possum, Ship rat, Cat Browsers	Monitor pest/ bird abundance. Map vegetation.	Begin predator control.	Maintain control and monitoring.	Maintain control and monitoring.	Analyse and report on bird, predator, browser & vegetation assessments. Review programme.



<b>Core</b>	Grampian tall forest	(< 5 years) Kereru, tui, bellbird. (5+ years) Kaka, kakariki, robin.	Mustelids, Possum, Ship rat, Cat	Map control devices. Monitor pest/ bird abundance. Map vegetation.	Intensify predator control. Increase weed control.	Maintain control and monitoring.	Maintain control and monitoring.	Analyse and report on bird, predator, browser & vegetation assessments. Review programme.
<b>Core</b>	Grampians (successional native forest and exotic forest)	(< 5 years) Kereru, tui, bellbird.	Mustelids, Possum, Ship rat, Cat	Map control devices. Monitor pest/ bird abundance. Map vegetation.	Maintain predator control.	Begin additional native and exotic tree planting. Maintain control and monitoring.	Maintain additional native and exotic tree planting. Maintain control and monitoring.	Analyse and report on bird, predator, browser & vegetation assessments. Review programme.
<b>Core</b>	Sugarloaf	(< 5 years) Kereru, tui, bellbird. (5+ years) Robin, brown creeper.	Mustelids, Possum, Ship rat, Cat	Map control devices. Monitor pest/ bird abundance. Map vegetation.	Review predator control.	Begin additional native tree planting. Maintain control and monitoring.	Maintain additional native tree planting. Maintain control and monitoring.	Analyse and report on bird, predator, browser & vegetation assessments. Review programme.
<b>Core</b>	Botanical Hill	(5-10 yrs) Kereru, tui, bellbird.	Possum, Ship rat, Cat	Map control devices. Monitor pest/ bird abundance. Map vegetation.	Review predator control.	Begin additional exotic tree planting. Maintain control and monitoring.	Maintain additional exotic tree planting. Maintain control and monitoring.	Analyse and report on bird, predator, browser & vegetation assessments. Review programme.

<b>Core</b>	Atmore/Tantregee	(< 5 years) Kereru, tui, bellbird, grey warbler, fantail.	Possum, Ship rat	Monitor pest/ bird abundance. Map vegetation.	Start pest control in native forest.	Begin additional native tree planting. Maintain control and monitoring.	Maintain additional native tree planting. Maintain control and monitoring.	Analyse and report on bird, predator, browser & vegetation assessments. Review programme.
<b>Core, City, North</b>	Backyard trapping	(5-10 years) Kereru, tui, bellbird, grey warbler, fantail.	Possum, Norway rat Ship rat	Monitor pest/ bird abundance. Map vegetation.		Expand rat control between city reserves. Maintain control and monitoring.	Maintain control and monitoring.	Analyse and report on bird, predator, browser & vegetation assessments. Review programme.
<b>Core, City, North</b>	Possum control between CTGs	Kaka, Kereru, tui, bellbird.	Possum		Negotiate with landowners	Begin possum trapping on private land.	Maintain control and monitoring.	Analyse and report on bird, predator, browser & vegetation assessments. Review programme.
<b>Core, City, North</b>	Mustelid control between CTGs	Kaka, Kereru, tui.	Mustelids		Negotiate with landowners	Begin mustelid trapping on private land.	Maintain control and monitoring.	Analyse and report on bird, predator, browser & vegetation assessments. Review programme.

<b>City</b>	Pipers, Highview, Bolwell	Silvereve, tui, bellbird, grey warbler, fantail.	Norway rat Ship rat, Mustelids Cat	Map control devices. Monitor pest/ bird abundance. Map vegetation.		Begin additional native tree planting. Add other reserves to control regime.	Maintain additional native tree planting. Maintain control and monitoring.	Review programme.
<b>Hinterland</b>	Roding and Maitai	(5 – 10 years) Rifleman, robin, brown creeper, kaka, kakariki. (10+ years) Whio, tieke, mohua.	Mustelids, Possum, Ship rat, Cat Browsers	Monitor pest/ bird abundance. Map vegetation.		Mustelid & possum control initiated. Maintain control and monitoring. Extensive rat control in mast-seed years.	Extensive rat control in mast-seed years. Maintain control and monitoring.	Review programme.
<b>North</b>	Titoki	(< 5 years) Kereru, tui, bellbird, grey warbler, fantail.	Possum, Ship rat	Map control devices. Monitor pest/ bird abundance. Map vegetation.	Review predator control.	Maintain control and monitoring.	Maintain control and monitoring.	Review programme.
<b>North</b>	Other native bush sites/SNAs	(< 5 years of control beginning) Kereru, tui, bellbird, grey warbler, fantail.	Mustelids, Possum, Ship rat			Approach land owners about inclusion in Halo assessments.	Undertake bird, predator, vegetation assessments if desired.	Review programme.

<b>North</b>	Exotic production forest	(< 5 years of control beginning) Robin, brown creeper, falcon, fernbird.	Mustelids, Possum, Ship rat			Approach land owners about inclusion in Halo assessments.	Undertake bird, predator, vegetation assessments if desired.	Review programme.
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