Ecology supplementary report – Ecological Mitigation and Offset

February 2018

Mt Messenger Alliance

NZ TRANSPORT AGENCY WAKA KOTAHI

Mt Messenger Bypass

New Zealand Government

Quality Assurance Statement			
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Contents

Glossary

Term	Meaning
AEE	Assessment of Effects on the Environment Report
CPUE	Catch per unit effort, a measure used to compare relative goat abundance pre- and post-control, and as a measure of goat management effectiveness.
DOC	Department of Conservation
ELMP	Ecology and Landscape Management Plan
Parininihi	The area spanning the Waipingao Stream catchment located to the west of existing SH3, approximately 1,332ha in size
Pest Management Area	Area of land proposed to be actively managed for pests, across a number of parcels of land
Project	The Mt Messenger Bypass project
Project footprint	The Project footprint includes the road footprint (i.e. the road and its anticipated batters and cuts, spoil disposal sites, haul roads and stormwater ponds), and includes the Additional Works Area (AWA) and 5m edge effects parcel.
SH3	State Highway 3
Transport Agency	New Zealand Transport Agency
TRC	Taranaki Regional Council

1 Introdcution

The NZ Transport Agency (Transport Agency) is proposing to construct and operate a new section of State Highway 3 (SH3), generally between Uruti and Ahititi to the north of New Plymouth. The Transport Agency lodged applications for resource consents and a Notice of Requirement on 15 December 2017 to alter the existing SH3 designation, to enable the Mt Messenger Bypass project (the Project) to proceed.

This application included assessments of ecological effects attached as Technical Reports 7a – 7h, in Volume 3 of the Assessment of Effects on the Environment (AEE) report. The Ecological Mitigation and Offset Assessment, dated December 2017, was completed as part of this package. The purpose of the Ecological Mitigation and Offset Assessment was to propose a mitigation and offset package for the Project that would result in no net loss of biodiversity by year 10 and net gain by year 15.

These field investigations have now mostly concluded, including baseline pest monitoring of the area proposed for pest management. The information from these investigations has informed this supplementary report. The purpose of this report is to assess the results of those investigations and how they might change the nature and extent of the mitigation and offset package proposed.

Additional pest monitoring information will be collected through until the end of March 2018 to strengthen the data and set a solid baseline against which pest management effectiveness can be assessed.

2 Additional information of relevance to the Project Mitigation and Offset Package

2.1 Introduction

New ecological information has been generated as a result of additional field investigations undertaken over the 2017 – 18 summer period. From the additional data gathered, two areas (vegetation and freshwater ecology) have generated information that requires an update of the size and nature of the Mitigation and Offset Package, and one (pest monitoring) adds new information that supports the mitigation emphasis on pest management.

Additional data about terrestrial invertebrates was also collected, resulting in the need for an additional appendix in the Ecological and Landscape Management Plan (ELMP) for the management of peripatus.

2.1.1 Additional vegetation information - Significant trees

The Supplementary Vegetation Report (Singers 2018) has identified two extra significant trees in the Project footprint that may have to be removed compared to the count made in the original assessment in December 2017. The count of significant trees has increased from 15 to 17.

As noted in the original Ecological Mitigation and Offset Report (2017) it is proposed that 200 seedlings of the same species are planted for each significant tree felled. Consequently, 3400 seedlings will be planted in appropriate locations near to the Project footprint, in addition to the other mitigation planting to be undertaken.

2.1.2 Refined calculation of vegetation community areas lost

The Supplementary Vegetation Report has refined the areas of each vegetation type that will be lost as a result of the Project following additional summer field work. The most significant change has been a sizeable reduction in the amount and condition of swamp forest (especially kahikatea) that will be affected by the Project. The area changes have been fed into the biodiversity offset calculation model with the result that there are changes in the amount of offset planting required and a very small reduction (1ha) in the size of the proposed pest management area (refer to the Supplementary Biodiversity Offset Calculations Report (Singers 2018b) for details).

All significant forest areas that will be lost can now be offset by applying pest management to existing forest in the proposed Pest Management Area. No swamp forest planting is required to offset the amount of swamp forest lost. The previous report determined that 6 ha of swamp forest planting was needed in addition to pest management to offset the loss of swamp forest, but the reduction in swamp forest affected by the Project now means that no swamp forest planting is needed.

Table 2.1 shows the updated information including the area of each vegetation type that will be affected by the Project, the calculated offset area to replace the area lost, and the nature of the offset. Note that the less significant vegetation types that were not put through the offset calculator have also been included in the table below. These areas will be mitigated for by one-for-one replacement planting.

Table 2.1 - Summary of the area of affected vegetation communities and how they will be offset or mitigated. [This table replaces Table 5.1 in the December 2017 Ecological Mitigation and Offset report]

Potential Ecosystem Type	Vegetation community	Project footprint total (ha)	Offset required (ha)	Mitigation/offset treatment
WF8: Kahikatea pukatea forest	Kahikatea swamp maire forest & kahikatea forest	0.684	15	Offset: Intensive pest management
	Kahikatea treeland	0.641	3	Offset: Intensive pest management
	Pukatea treefern treeland	0.722	3	Offset: Intensive pest management
	Manuka scrub	0.582	1	Offset: Intensive pest management
	Kahikatea trees	1.325	6	Offset: Swamp forest/kahikatea restoration planting
	Exotic rushland	5.826	2.913*	Mitigation: replacement planting
WF13: Tawa kohekohe, rewarewa, hinau, podocarp forest	Tawa rewarewa kamahi forest	6.457	95	Offset: Intensive pest management
	Tawa nikau treefern forest	8.507	61	Offset: Intensive pest management
	Miro rewarewa kamahi forest	0.536	8	Offset: Intensive pest management
	Pukatea nikau forest	1.347	11	Offset: Intensive pest management
	Secondary mixed broadleaved forest	2.231	15	Offset: Intensive pest management
	Manuka treefern scrub	0.146	0.146	Mitigation: replacement planting
	Manuka succession	0.514	0.514	Mitigation: replacement planting
	Hard beech forest and tawa, kamahi, rewarewa forest	0.813	7	Offset: Intensive pest management

Potential Ecosystem Type	Vegetation community	Project footprint total (ha)	Offset required (ha)	Mitigation/offset treatment
WF14: Kamahi, tawa, podocarp, hard beech forest	Manuka treefern rewarewa forest	3.291	11	Offset: Intensive pest management
	Manuka treefern scrub	3.164	3.164	Mitigation: replacement planting
	Treefern scrub	0.080	0.080	Mitigation: replacement planting
	Manuka scrub	1.560	1.560	Mitigation: replacement planting
CL6: *Hebe*, flax rockland	Dry cliff	0.399		Treat to enhance natural regeneration
Total hectares		37.498		

* – The exotic rushland vegetation has a replacement planting ratio of 1:0.5. This is because the vegetation is not indigenous; however, it is recognised that this area of exotic rushland has some habitat value for indigenous fauna and therefore should be mitigated for by replacement planting with native rushland species at a rate of 50% of the area lost.

Table 2.2 shows the revised offset and mitigation areas proposed for the loss of vegetation along the Project footprint. The proposed core area for pest management has increased from 222ha to 230ha and the total area of offset and mitigation planting required is 14.38 ha (excluding the riparian offset which is discussed in a section below), a reduction of 0.62ha.

In response to the increase in core Pest Management Area of 8ha, the total Pest Management Area, including the buffer, has been increased to 585ha. This increased total area will ensure an effective buffer can be established around the enlarged core.

6ha of swamp forest / kahikatea planting is proposed as offset for the loss of kahikatea trees along the Project footprint, and 8.38ha of mitigation planting is proposed for the younger and lesser value indigenous dominant vegetation that will be lost.

The mitigation planting priority will be to complement the swamp forest / kahikatea restoration planting where required. The upper Mangapepeke valley (and other wet valleys in the area) is a mosaic of permanently very wet, permanently wet/damp, seasonally wet, and mostly dry soil conditions. To fully plant out an area, dryland and wet margin species will need to be planted in addition to the wetland – swamp species. Once established and supported by pest management these areas will complement the remnant swamp forest vegetation that exists in these valleys now.

Table 2.2 – Revised summary of the proposed areas of offset treatment as generated by the Biodiversity Accounting Model, and additional mitigation planting. [This table replaces Table 5.2 in the December 2017 Ecological Mitigation and Offset report]

Mitigation / offset treatment	Total treatment area (ha)
Intensive pest management (core area*) – offset	230
Swamp forest/kahikatea restoration planting – offset	6
Mitigation replacement planting – mitigation	8.38

* – In addition to the core Pest Management Area, a buffer pest management area will be established around the core. The total Pest Management Area will be approximately 590ha.

2.2 Additional freshwater Stream Ecological Valuation information

The Stream Ecological Valuation (SEV) scores have been altered in a minor way in the Supplementary Freshwater Ecology report.

While the overall length of stream impacted has increased (from 3470m to 3822m), the offset requirement has reduced from 8724m^2 to 8157m^2 of stream surface area (or from 8932 to 8627m of stream length) (Table 2.3). This reduction has occurred because of the replacement of a culvert with a stream diversion at one site and a revised assessment of impact on another section of stream.

Table 2.3 – Amended area of stream affected by the Project and the area of offset to achieve 'no net loss' (calculated by the SEV method). Taken from the Freshwater Ecology Supplementary Report. [This table replaces Table 4.2 in the December 2017 Ecological Mitigation and Offset report]

	Impact		Offset	
Catchment	Length (m)	area (m^2)	Length (m)	area (m^2)
Mangapepeke	2799		2678	
Mimi	1023		683	
Total	3822		3361	

2.3 Additional terrestrial invertebrates information

Surveys were carried out for terrestrial invertebrates in the Project footprint, and are reported in the Supplementary Terrestrial Invertebrates Report (Watts 2018). The key aspect of this Report, relevant to this mitigation report, was the finding of two species of peripatus:

- *Peripatus suteri;* and
- *Peripatus novaezealandiae.*

The Supplementary Terrestrial Invertebrates Report concludes (at Section 2.4) that a Peripatus Management Plan is needed to manage the potential adverse effects on these species. This will be developed as a chapter of the ELMP.

2.4 Pest animal monitoring

2.4.1 Introduction

A pest animal monitoring programme was initiated in the forested land in and adjacent to the Project footprint in November 2017 with the purpose of determining the relative abundance of key animal pest species, notably rats, possums and mustelids (ferrets, stoats and weasels). Pest monitoring will continue through until March 2018. The results from the monitoring programme will be used to substantiate (or otherwise) the ecological value of focusing the mitigation and offset effort for the Project on pest management. The resultswill also serve as a baseline against which the performance of pest management contractors and the achievement of residual pest density targets can be measured.

2.4.2 Methodology

2.4.2.1 Field assessment methods

Full details of the areas surveyed for pests, the methods used and the interim results to date can be found in a report in Appendix A.

Tracking tunnels (for rats, mustelids and possums) and chew cards (for rats and possums) have been used. These techniques are recommended by the Department of Conservation (DOC 2013; Gillies et al 2013) as the best way to monitor relative abundance of rats, possum and mustelids in forested areas. Best practice methodology for the use of these monitoring techniques has been adopted, as advocated by DOC and National Pest Control Agencies (NPCA) and documented in the NPCA “Best practice guidelines for controlling and monitoring vertebrate pests” (NPCA 2015). Repeated surveys along established survey transect lines improves the robustness of the data and for this reason the monitoring effort will continue until March.

The interim data in the report in Appendix A is from November and December 2017 surveys undertaken on Ngati Tama land within the proposed Pest Management Area. Repeat surveys on the Ngati Tama block have occurred in January and February and surveys along new transect lines on DOC land within the proposed Pest Management Area will be installed in February and March. The data obtained from all surveys will be reported in a final pest monitoring report in March.

Feral goat and pig surveys have not yet been undertaken. However live animals have been seen and heard, and the visual sign of the damage they cause have been reported by several members of the Project ecology team over the 2017-18 summer. It is proposed that the first goat and pig control effort will occur immediately preceding the commencement of road construction and this will serve as the baseline CPUE (catch per unit effort) measure of density against which subsequent control effectiveness will be measured.

2.4.3 Interim pest monitoring results

2.4.3.1 Rats and possums

The results of the initial pest monitoring surveys undertaken in November and December 2017 show possum and rat numbers to be moderately high for forested land, and representative of pest populations that are largely unmanaged.

The chew card data, a technique developed for possums but also useful for rats, shows a CCI (chew card index) of 25% for possums and 38.33% for rats when the cards were left out for three nights. This compares with an overall average of 6.2% for chew card monitoring of possums undertaken by DOC on all conservation lands (note that DOC leave chew cards out for one night only but we have adopted the NPCA recommendation of 3 days to increase the likelihood of pest animal engagement with each card – refer to the interim pest management report in Appendix A for explanation).

Preliminary results from the tracking tunnel survey undertaken in January 2018 yielded an index of 53% for rats and 30% for possums. This result for rats is very similar to the results found in the Whareorino (approximately 50km north of Mt Messenger) from surveys undertaken from 2011 until 2015. Whareorino is an area that was unmanaged for possums or rats during the survey period.

2.4.3.2 Mustelids

No mustelid tracking data is yet available. Tracking cards need to be left out for 21 days at a time for mustelids and it is intended that at least 2 repeat surveys will be undertaken in order to generate robust data. The results for mustelids will be reported in the final pest monitoring report at the end of March.

Stoats, in particular, are expected to be present in moderate to high numbers within the proposed Pest Management Area but it is possible that the effectiveness of tracking tunnels in measuring their abundance may be masked by high numbers of possums and rats also occupying the tunnels.

2.4.3.3 Goats, pigs and livestock

While no specific survey has yet been undertaken for goats or pigs visual observations of goats and pigs, and physical evidence of their sign (chew marks and faeces) were common throughout the proposed Pest Management Area and indicative of high numbers of both animals. Feral pigs are especially abundant in the lower Mangapepeke.

The impact of goats, pigs and farm livestock (cattle and horses) on the understorey vegetation within the proposed Pest Management Area has been documented in the

Supplementary Vegetation Report. The absence of palatable plant species over large areas of the Project footprint, and the complete absence of any understorey vegetation in some areas of the middle and lower Mangapepeke valley (Figure 2.1) is clear evidence of the impact of ungulates.

Figure 2.1 – Forest understorey in the mid Mangapepeke valley completed devoid of subcanopy and groundcover vegetation

2.4.4 Discussion and implications for mitigation

The interim rat and possum monitoring data and observed goat and pig presence and damage have confirmed the presence of moderately high to high pest numbers. Rat and possum monitoring indices to date are indicative of indigenous forest areas that have not been managed for pests.

The pest information obtained aligns with the observable damage to the forest understorey and canopy and is well documented in the original Vegetation Assessment (Singers 2017) and the Supplementary Vegetation Report. Pest animals and farm livestock, especially cattle, are having a significant impact on many aspects of the ecology of the Project footprint and the surrounding environment.

The pest monitoring data supports the Project's focus on intensive and enduring pest management as outlined in the Ecological Mitigation and Offset Report. The removal of farm livestock and control of pest densities to low levels within the proposed Pest Management Area can be expected to assist the reasonably rapid recovery of the forest understory and canopy and lead to an improvement in the quality and volume of habitat for many native species.

2.4.4.1 Terrain constraints

The pest monitoring programme has highlighted the physical challenges associated with undertaking ground based activities in steep terrain. It was not possible to complete all randomly generated transect lines because some were on terrain that was too steep to walk safely. This is likely to place some limitations on the pest management grid that can be established for ground based pest management operations. In some locations it may not be possible to space bait station lines accurately at 100m spacings because of impassable bluffs. While it should be possible to cover the Pest Management Area with a bait station grid that averages 100m between lines (with some lines closer to make up for others further apart) – a requirement for effective rat control – it will not be physically possible to establish bait station lines at 50m or closer spacings which would be necessary if mouse control was specifically targeted. Mouse control is not proposed as part of the mitigation/offset package for reasons outlined in the December 2017 Ecological Mitigation and Offset Report.

2.4.4.2 Timing of pest management

While possums, rats and mustelids can be controlled by a mix of toxin application and trapping goats will need to be controlled by shooting. Pigs will be controlled by a mix of toxin application and hunting. Goats will need to be reduced to low numbers, and farm livestock completely removed, before any restoration planting activities can occur. Consequently, goat control will need to begin before construction commences.

3 Conclusions

The additional information and data derived from the 2017 -18 ecology field investigations has verified our understanding that pest densities in and adjacent to the Project footprint are moderately high and likely to be causing significant harm to indigenous plant and animal communities. This finding supports the emphasis on pest management as the primary offsetting effort.

Field data has also enabled the quantity of mitigation and offset to be refined, and informed the development of the Peripatus Management Plan. The result is a small increase in core pest management area (8ha more), the same amount of offset restoration planting, a small reduction in stream length requiring riparian fencing and planting, and a 0.62ha reduction in mitigation planting required. In summary, the amount of ecological mitigation and offsetting proposed is:

- 230ha of pest management (supported by a buffer pest management area for a total area of 560ha);
- 6ha of kahikatea/swamp forest restoration planting;
- 8.38ha of mitigation planting of indigenous species;
- The planting of 3400 native plant seedlings – 200 seedlings of the same species of each significant tree removed along the Project footprint;
- Fencing and riparian planting of 8.626km of stream length.

The additional pest information that will be obtained through until the conclusion of the pest monitoring programme at the end of March will be used to verify the results to date and provide greater certainty about the nature and extent of the offset package.

The offset and mitigation package proposed can be expected to generate no net loss in biodiversity 10 years following construction of the bypass and a net gain from year 15 onwards.

4 References

Department of Conservation. 2013. Animal pests: tracking tunnel indices of small mammal abundance. Version 1.0. DOCDM-322684

Gillies, C.A.; Williams, D. 2013. DOC tracking tunnel guide v2.5.2: using tracking tunnels to monitor rodents and mustelids. Department of Conservation, Science and Capability Group, Hamilton, New Zealand.

National Pest Control Agencies. 2015. Possum Population Monitoring Using the Trap-catch, Waxtag, and Chewcard Methods. http://www.npca.org.nz/images/stories/NPCA/PDF/a1_possum%20monitoring_2015-nov_lr.pdf

Appendices

Appendix A: Baseline monitoring for vertebrate pests – interim report

Baseline Monitoring for Vertebrate Pests – Interim Report

February 2018

Mt Messenger Alliance

NZ TRANSPORT AGENCY WAKA KOTAHI
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Contents

1 Introduction

The Mt Messenger Ecological Mitigation and Offset Report (December 2017) proposes long-term pest control be undertaken within a core 222ha[1] area (revised in February 2018 to 231ha) and a surrounding buffer zone, totaling approximately 560ha[1], in areas surrounding the proposed SH3 Mt Messenger bypass (the Project). A small mammal pest monitoring programme was designed by Opus International Ltd to provide baseline information on densities of mustelids (stoats, weasels and ferrets), rodents (rats and mice) and possums. The information derived from this programme will be used to assist in the design of the pest management component of the proposed biodiversity offset. Transect lines established will be used to monitor the success of the pest control effort on an ongoing basis.

The monitoring programme was undertaken in November and December 2017 on Ngāti Tama land east of the existing SH3 route. This block has been proposed as part of the main area for the pest management offset programme.

Rodents, possums and mustelids are the focus of this monitoring programme, however goat and pig densities will also be determined prior to the commencement of road construction and used to measure control success when the pest management programme is implemented.

[1] The Supplementary Ecological Mitigation and Offset Report (February 2018) has revised the core Pest Management Area up to 231ha and the total Pest Management Area including buffer to 590ha.

2 Methodology

Best practice monitoring methods were used, following DOC and National Pest Control Agencies (NPCA) protocols which provide an index of relative activity (NPCA 2015; DOC 2013). A series of monitoring transects were established along which tracking tunnels with ink tracking cards and chew cards were placed.

Transect lines for mustelids, rodents and possums were randomly located[2] within the proposed core pest management area on Ngāti Tama land in November 2017 (see Figure 2.1 below). Five mustelid and rodent lines and six possum lines were successfully established. This is one less each than that recommended by Gillies and Williams (2013), but this was a reflection of the steep terrain and constraints on the number of stoat transects that could be placed according to the protocol of lines spaced 1km apart from each other.

It is proposed that the small mammal indexing will continue to occur throughout the construction period as well as post-construction.

2.1 Possum monitoring

- 200m long permanent transect lines were cut through understorey vegetation and permanently marked and were separate lines to those used for rodents/mustelids. All possum lines are at least 200m apart.
- A minimum of 10 lines is generally recommended for an area of 500ha or more, consequently six lines were established within the Ngāti Tama block and four more will be established later on the adjacent DOC land.
- Corflute chew cards (Connovation Ltd) were used to monitor possum activity. The first chew-card on each transect line was placed 20m from the transect start, and at 20m spacing's thereafter. 10 chew-cards were placed per line. Cards were set on a suitable tree at a height of 30cm from the ground. The date, tag and line number were written on the back of each card prior to fixing it to the tree.
- Chew-cards were set for three nights before being collected.[3]
- The same chew card lines were used on subsequent occasions.

2.2 Mustelid and rodent monitoring

- Five tracking tunnel transects were established, each of 10 tunnels spaced at 50m intervals. Therefore each transect line is 450m long with the first tunnel being placed at the line start (unlike the possum transects). Transects can be used for both rodent and mustelid monitoring but where a transect is used for mustelid monitoring, only every second tunnel is used and the tunnel is baited with a small chunk of salted rabbit meat in a tea strainer suspended in middle of the tunnel.

[2] Using random function within Excel and defining grid co-ordinates as 'random numbers' for selecting from. Any co-ordinates that fell on steep ground were discounted due to safety concerns.
[3] One night is used for DOC Tier I monitoring while three nights is recommended according to NPCA protocols.

- As per the DOC protocol (DOC 2013; Gillies et al 2013), rodent lines are set at least 200m apart from the nearest point of any other rodent line and 1000m apart from any mustelid lines.
- The start points and orientation of each line were randomly generated. Lines were established with consideration of the practicality of physically establishing and walking the lines safely because of the steep nature of the survey terrain. Where the start of the line was reached but the orientation was unsuitable the line was reorientated.
- As per the DOC protocol, tunnels were deployed three weeks prior to the first monitoring round.
- For rodent monitoring, the tunnels were baited with peanut butter and the ink cards deployed for one night only. Peanut butter was placed as a small blob directly within the centre of the ink pad[4].
- Ink tracking cards and salted rabbit meat are placed out for 21 nights for mustelids (due to low detection rates) and can follow on from or precede rodent monitoring (G. Elliot (DOC), *pers comm*, December 2017).
- The NPCA (NPCA 2015a) advises that several mustelid surveys may be necessary over spring and summer and that monitoring should be undertaken at least once per season. Initial monitoring was based on a three/six week cycle in order to gain adequate baseline information and to allow fine-tuning of methodology.
- Notes were made on tracking cards (or notebook) in the field for observations on e.g. 'card pulled from tunnel" or "rat pellets on card but no tracks". This information is factored in to overall index calculations i.e. a card with no tracks but pellets on the tunnel is counted as a 'presence'.
- Identification of tracks was undertaken in the office using footprint guides for the various animals. Identification of chew marks on chew cards was undertaken in the same way. Where a positive identification was not able to be confirmed the cards were sent to an experienced, qualified expert for determination.
- Data storage and analysis is described within the referenced documents. A relative abundance index was obtained from chew cards and transects for each period[5]. Stratification according to catchment will be undertaken once baseline information from the DOC block comes to hand, thereby allowing comparison of the Mimi and Mangapepeke catchments. Monitoring of the DOC land is expected to be completed by the end of March 2018.
- The methodology will be repeated and compared with the baseline monitoring data to obtain comparisons of trends over time and between pre and post-control.

[4] On the first survey round peanut butter was placed at either end of the tunnel under the lip of the tunnel ceiling but the low detection rates indicated this was not yielding a true reflection of the actual abundance and subsequent monitoring methods were modified.

[5] Awaiting latest January results

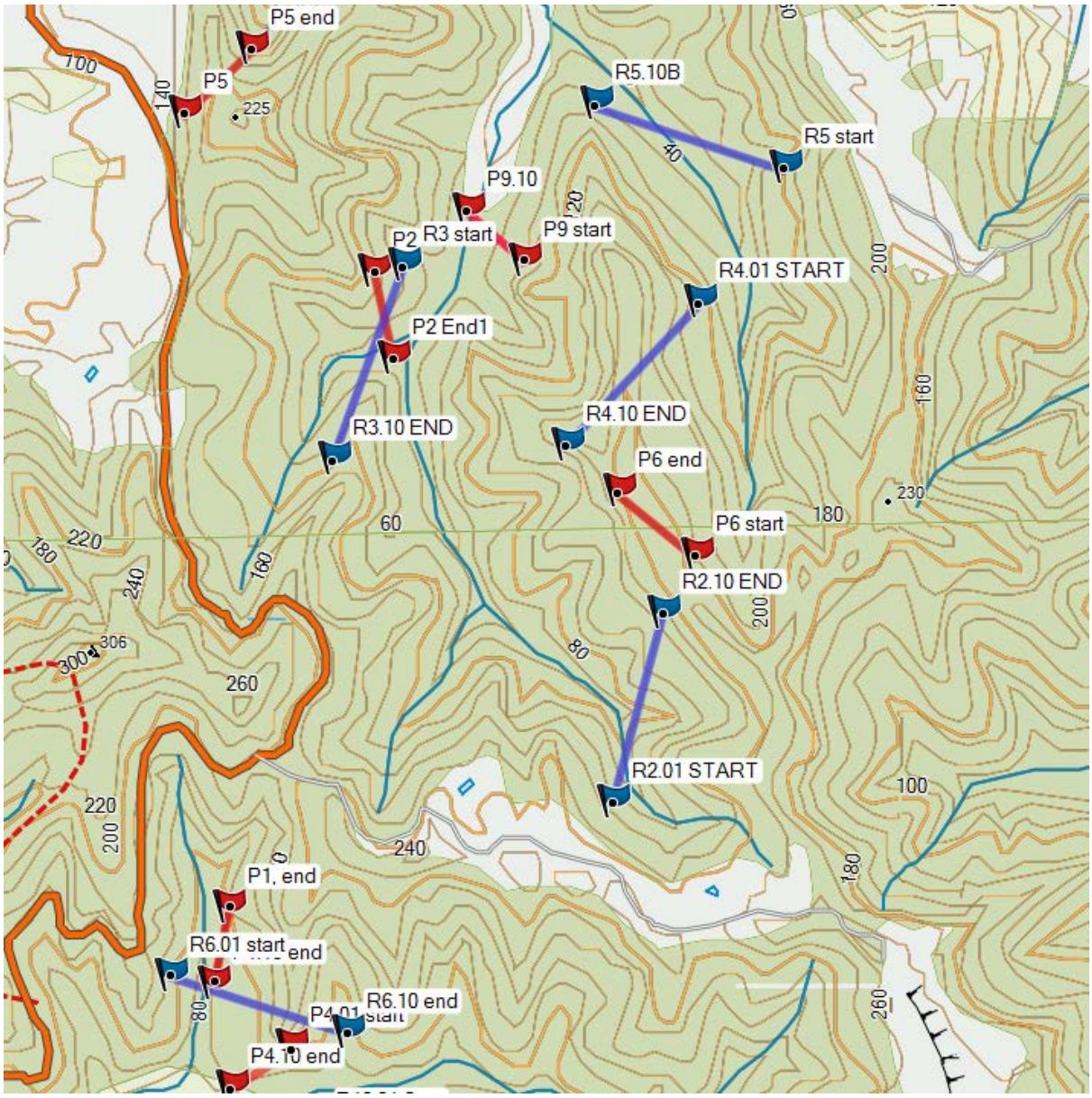

Figure 2.1 – Possum chew card (red) and rodent/mustelid (blue) transects within Ngāti Tama block. All tunnel locations are shown as well as start and end of transect lines.

In February 2018 an additional four rodent transects will be established on the Mt Messenger Conservation Area in the Mimi catchment (two of these may be utilised as mustelid transects) (Figure 2.2).

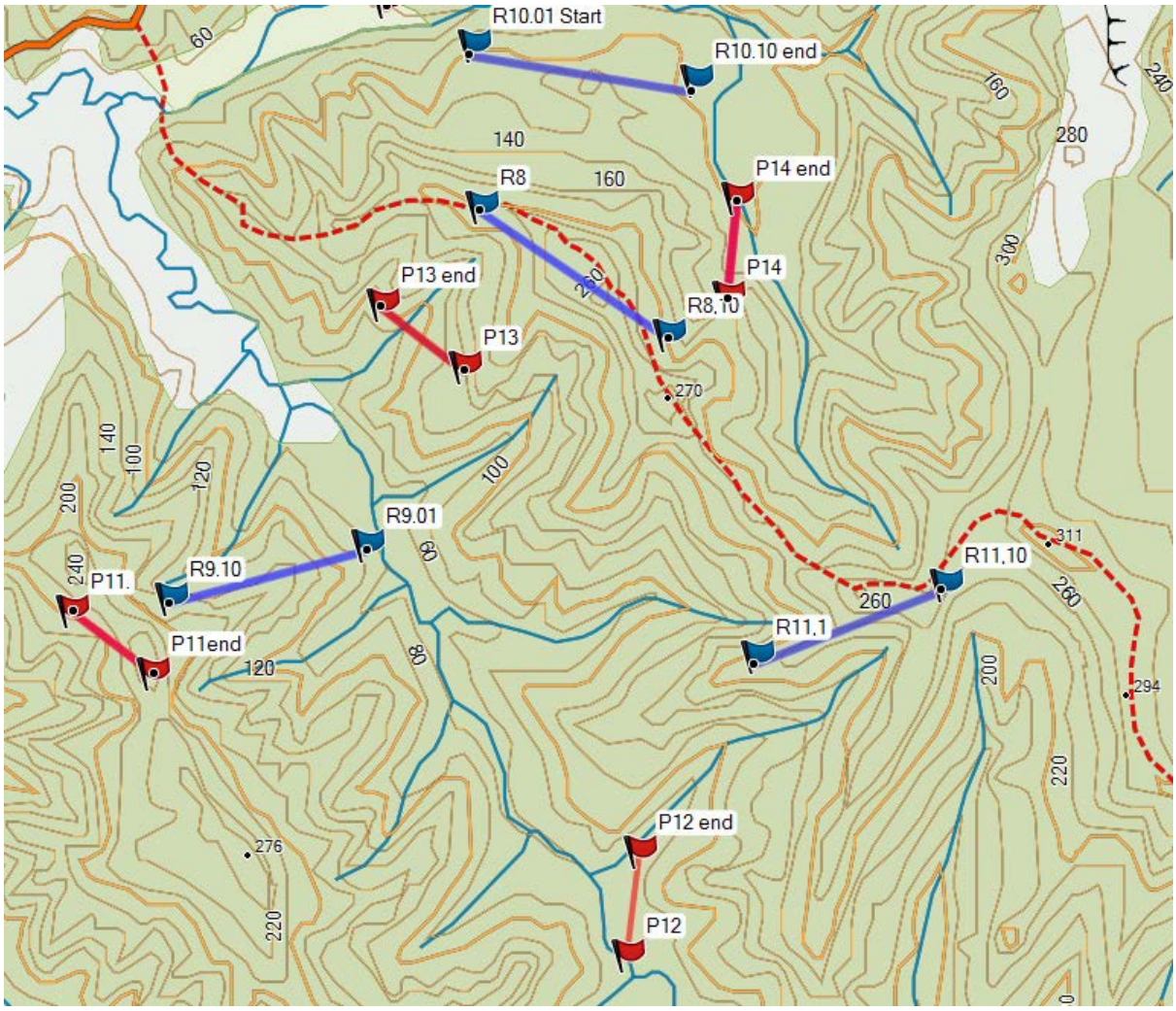

Figure 2.2 – Proposed mustelid/rodent transects and possum chew card lines (red) within the Mt Messenger Conservation Area (blue), to be established February and March 2018.

2.3 Goat monitoring and management

Goat monitoring has not yet occurred. It is recommended that goat densities be measured through a combination of total annual kills within a defined management area, kill locations recorded on GPS, catch per unit effort (CPUE) measured as kills per hunter day and potentially pre and or post-ground hunter contractor auditing using thermal imaging (Trap & Trigger). Combined, these metrics will enable an accurate assessment of distribution patterns, initial population size, percent reductions in the knock-down phase as well as on-going assessment of goats remaining.

Kill maps provide a useful resource for new operators as goats typically favour certain sites and habitat types. This data will be especially important in the maintenance phase to ensure the target density (<1 goat/ hunter day) has been achieved within the core offset Pest Management Area where conservation outcomes will be measured. Thermal imaging assessments prior to maintenance operations will be trialed for goat surveillance (and potentially control) in order to focus ground hunter effort to areas where goats have been detected.

The CPUE approach recommended has the advantage of utilising personnel hours in the field while also reducing the number of goats in the area. Recent goat kills within Parininihi yielded returns of around 1 goat/hunter day while the abundance on the eastern Ngāti Tama block (the Pest Management Area) is expected to be around 20 goats per hunter day.[6] Conrad O'Carroll (Ngāti Tama) has also confirmed the presence of two Judas goats in the vicinity of Mt Messenger.

To date, no particular resource has been directed towards goat hunting in either the Ngāti Tama land or the Mt Messenger Conservation Area. It is proposed that the first goat control effort will occur immediately preceding the commencement of road construction.

2.4 Feral pig monitoring

No well-established and nationally consistent monitoring techniques are recognised for measuring the actual or relative abundance of feral pigs (NPCA 2015). Field inspections (for pig sign or soil disturbance), faecal counts and catch per unit effort (CPUE) are monitoring methods most commonly used. Though untested at Mt Messenger thermal imaging may also be suitable for measuring pig abundance and this method can be used to assess both goats and pigs simultaneously. Initially, CPUE is recommended as the preferred monitoring method because it can be incorporated into the pest control programme and is consistent with the approach to feral goat monitoring.

It is proposed that the first pig monitoring effort will occur immediately preceding, or soon after, the commencement of road construction.

Table 2.1 - Baseline Pest Monitoring Programme, actual to date.

Programme schedule	Work completed or proposed	Transects established
Trip 1. Week commencing Monday 27th November	Six rodent transects established within Ngāti Tama block[7]. Three of these able to be utilised as mustelid lines[8]. Established 6 possum chew card lines within Ngāti Tama block and monitored over a single night.	**Rodent transects:** R2, R3, R4, R6, R5, R7 (this last later withdrawn from service). **Mustelid transects** are R2, R5, R6. **Possum transects:** P1, P2, P4, P5, P6, P9
Trip 2. Week commencing Monday 18th December 2017	Possum chew cards put out for three nights. Five rodent lines monitored overnight. Mustelid lines set for 21nights of monitoring	Possum: P1, P2, P4, P5, P6, P9 Rodents: R2, R3, R4, R6, R5 Mustelid: R2, R5, R6

[6] Paul Prip, Taranaki Regional Council (*pers. comm*, 9 November 2017)

[7] One of these later discontinued due to safety concerns

[8] Mustelid lines are to be 1km apart from each other.

Programme schedule	Work completed or proposed	Transects established
Trip 3. Week commencing Monday 8th January 2018	Picked up mustelid papers (15) from three lines. Set rodent papers.	Mustelid: R2, R5, R6 Rodent: R2, R3, R4, R6, R5
Trip 4. Week commencing Monday 29th January 2018	Pick up mustelid papers day 1	Mustelid (pick up): R2, R5, R6

3 Results to date

- Preliminary results suggest moderate possum abundance when monitoring was undertaken in November 2017 and in January 2018.

Table 3.1 - Results of possum chew card monitoring November 2017, from one night of monitoring

	Possum	Rat
CCI[9]	8.3	18.3
SD	0.098319	0.240139
SE	0.04013	0.098016

Table 3.2 - Results of possum chew card monitoring December 2017, from three nights of monitoring

	Possum	Rat
CCI[10]	25.00	38.33
SD	0.250998	0.365605
SE	0.102448	0.149226

- Preliminary results of tracking for rodents from January 2018, yielded an index of 53% for rats and 30% for possums, a result that is higher but in a similar ratio to results from chew cards for December. Full results with confidence limits will be reported at the end of the monitoring programme. Tracking for mustelids has yet to be finalized.
- Site conditions were extremely dry pre-Christmas and this may have resulted in lower possum and rat indices than was actually the case. The very poor quality understorey and the dry forest floor conditions may have resulted in arboreal pests spending a disproportionately high percentage of their time in the canopy thereby reducing contact with tracking tunnels and chew cards.
- Within Ngāti Tama land high pest numbers are responsible for causing a number of monitoring challenges. These range from pigs kicking or squashing the tunnels to possums masking the effects of rats in tracking tunnels.
- The square 'Gotcha' tunnels allow possums to squeeze into the tunnels and not only steal the peanut butter lure but may also break open the tunnel assemblage. A high

[9] CCI refers to the chew card index, a percentage measure of the proportion of cards showing sign of pest presence

[10] CCI refers to the chew card index, a percentage measure of the proportion of cards showing sign of pest presence

proportion of tracking tunnel cards have indications of possum presence. This was not anticipated. The Corflute triangular tunnels used by DOC are more robust and don't allow possums to squeeze in.

- Tracking cards must be secured in the tunnel or they will frequently be dragged out. Modified paper clips or ties can be used to pierce the card and then fed through the two holes at the end of the tunnel. This must be done at least at one end of the tunnel.
- Leaving the tunnels out for 21 nights with rabbit lure in the tunnel is a long time (formerly it was three nights). This results in a considerable period during which tunnel interference may occur. Tunnel placement is therefore important and they should be placed alongside a root or log, or backed by other vegetation rather than placed on open, flat ground.

4 Discussion

Baseline monitoring within the Ngati Tama portion of the proposed 590ha Pest Management Area, has been undertaken. This area is indigenous forest where no coordinated pest control occurs and indices measured are indicative of unmanaged possum and rat populations.

Initially, possum chew cards were placed out for only one night, since it was not clear whether saturation of cards with bite marks would make a three night monitoring period unsuitable. While one night of monitoring is the method used by DOC for its Tier 1 monitoring programme, the short monitoring duration is more due to resourcing and practicality. Three nights of monitoring (or even seven nights), is the duration recommended for rodent monitoring by the NPCA, and three nights was adopted for subsequent monitoring.

Possum chew card indices from sites around the country are available on the DOC website: http://www.doc.govt.nz/2017-annual-report-factsheets/?report=NationalPossumFactsheetWeb

It must be noted that these indices are, as mentioned, from a single night of monitoring. In the past possum abundance has been derived from trap-catch and then wax tag monitoring methods. Currently the chew card method is the one preferred. Chew card indices (CCI) from several sites in the vicinity of Mt Messenger are some of the highest in the country. For example, Mt Messenger Conservation Area yielded 39.2%, and Mokau Scenic Reserve 22.5%. This compares with an overall average of 6.2% on conservation lands on which monitoring undertaken.

Rat tracking indices for January of 53% may be compared with results from forested land at Whareorino (approximately 50km north of Mt Messenger). Here, tracking indices were consistently above 55%, for the period November 2011 to June 2015[11]. Elevation above sea level of areas of interest is a factor, with low elevation forest such as at Mt Messenger tending to be "continuously ratty" (i.e. areas with the highest median rat numbers and warm forest generally (S. Walker[12] *pers. comm*. February 2018). In contrast, population irruptions tend to occur within sites at higher elevation, and especially as a result of beech mast events. Rat populations also increase greatly following mast tawa seeding events, which are more likely to occur once possum abundance is reduced to low levels.

[11] Three tracking transects at between 500-600m, within which no possum or rodent control undertaken, data for period November 2011 to June 2015 (unpublished data provided by Josh Kemp, Department of Conservation Nelson).

[12] Susan Walker, Landcare Research Dunedin is currently preparing a paper linking habitat type with rodent population dynamics and densities.

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