Assessment of Ecological Effects - Herpetofauna

December 2017

Ecology New Zealand Limited

Technical Report 7d

NZ TRANSPORT AGENCY WAKA KOTAHI
Mt Messenger Bypass
New Zealand Government

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Glossary

Term	Meaning
ACO	Artificial Cover Object
AEE	Assessment of Effects on the Environment Report
AWA	Additional works area
CCFC	Closed Cell Foam Covers
DOC	Department of Conservation
Eastern Ngāti Tama forest block	The area of land largely owned by Ngāti Tama located east of existing SH3, including the Project footprint, approximately 3,098ha in size
EcIA guidelines	Ecological Impact Assessment guidelines
EIANZ	Environment Institute of Australia and New Zealand
ELMP	Ecology and Landscape Management Plan
Herpetofauna	Reptiles and amphibians
North Taranaki Ecological District	Part of the Taranaki Ecological Region, encompasses approximately 259,750ha, including the Project footprint
Parininihi	The area spanning the Waipingao Stream catchment located to the west of existing SH3, approximately 1,332ha in size
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.
RMA	Resource Management Act 1991
SH3	State Highway 3
Transport Agency	New Zealand Transport Agency
TRC	Taranaki Regional Council
VES	Visual Encounter Survey

Term	Meaning
Wider Project area	An area approximately 4,430ha in size which encompasses Parininihi and the Ngāti Tama Eastern forest block, and includes the Project footprint.

Executive Summary

The NZ Transport Agency is proposing to develop a new section of SH3, north of New Plymouth, to bypass the existing steep, narrow and winding section of highway at Mt Messenger. The Project comprises a new section of two lane highway, some 6km in length, located to the east of the existing SH3 alignment.

The overarching ecological aim for the Project is to ensure no net loss of biodiversity values, or to achieve a net benefit of biodiversity values, in the medium term.

To assess the ecological effects of the Project on herpetofauna, this report:

a Identifies and describes herpetofauna values in the Project footprint and wider Project area;

b Describes the potential effects of the Project on herpetofauna arising from construction, operation and maintenance; and

c Recommends measures to avoid, remedy or mitigate potential adverse effects.

This report broadly follows Ecological Impact Assessment (EcIA) guidelines developed by the Environment Institute of Australia and New Zealand (EIANZ, 2015). Professional judgement and expertise have also been applied in the assessment process to reflect good practice. Herpetofauna characteristics and values within the wider Project area were assessed by reviewing existing information and data, and by undertaking field surveys within the wider Project area.

Herpetofauna surveys have not yet been carried out within the Project footprint. Desktop investigations indicate that several herpetofauna species, including At Risk and Threatened species, could be present. However, herpetofauna surveys carried out to date within the wider Project area have not confirmed the presence of any herpetofauna species.

For the purposes of the EcIA assessment it has been assumed that up to 13 relevant species (including the 'Threatened' Archey's frog (*Leiopelma archeyi*) and a number of 'At Risk' species) may be present within the Project footprint. This report includes a more detailed analysis of the likelihood that each species would in fact be present.

Applying the EcIA framework, adapted to include expert judgment in light of the specific circumstances of the Project:

a the overall ecological value of herpetofauna in the Project footprint has been assessed as 'Moderate-High';

b the overall magnitude of the unmitigated effects of the Project on herpetofauna has been assessed as 'Low-Moderate'; and

c the overall level of unmitigated effects of the Project on herpetofauna has been assessed as 'Moderate'.

This report also includes a species-by-species assessment of effects.

The most significant potential adverse effects identified are habitat loss and direct herpetofauna injury/mortality during vegetation removal and earthworks.

Recommended measures to mitigate potential adverse effects on herpetofauna, and otherwise to improve the habitat value for herpetofauna in the wider area, include:

a the inclusion within the Ecology and Landscape Management Plan (ELMP) of appropriate herpetofauna management to be implemented prior to, and during, vegetation removal to avoid or minimise the likelihood of herpetofauna injuries or deaths;

b restoration planting and habitat enhancement, including to mitigate habitat loss described in the Mitigation and Offset Report (Technical Report 7h, Volume 3 of the AEE); and

c a predator management programme to mitigate residual effects, as also described in the Mitigation and Offset Report.

Overall, taking into account these measures, it is considered that any effects of the Project on herpetofauna are likely to be negligible, and possibly positive, in the medium to long-term.

1 Introduction

1.1 Purpose and scope of this report

This report forms part of a suite of technical reports prepared for the NZ Transport Agency's Mt Messenger Bypass project (the Project). Its purpose is to inform the Assessment of Effects on the Environment Report (AEE) and to support the resource consent applications and Notice of Requirement to alter the existing State Highway designation, which are required to enable the Project to proceed.

This report assesses the ecological effects on herpetofauna of the Project as shown on the Project Drawings (AEE Volume 2: Drawing Set).

To assess the ecological effects of the Project on herpetofauna this report will:

a Identify and describe herpetofauna activity and habitat values in the Project footprint (which is defined for the purposes of this assessment of effects on herpetofauna in Section 2.3.2 below) and the wider Project area (Section 3);

b Describe the potential effects of the Project on herpetofauna arising from construction, operation and maintenance (Section 4); and

c Recommend measures to avoid, remedy or mitigate potential adverse effects.

1.2 Project description

The Project involves the construction and ongoing operation of a new section of State Highway 3 (SH3), generally between Uruti and Ahititi to the north of New Plymouth (Figure 1.1). This new section of SH3 will bypass the existing steep, narrow and winding section of highway at Mt Messenger. The Project comprises a new section of two lane highway, approximately 6 km in length, located to the east of the existing SH3 alignment (Figure 1.1 and Figure 1.2).

The primary objectives of the Project are to enhance the safety, resilience and journey time reliability of travel on SH3 and contribute to enhanced local and regional economic growth and productivity for people and freight.

A full description of the Project including its design, construction and operation is provided in the AEE (Volume 1) and accompanying Drawing Set (Volume 2).

Figure 1.1 – Location of the Project in the Taranaki Region

1.3 Ecological aim for the Project

The overarching ecological aim for the Project is to ensure no net loss of biodiversity values, or to achieve a net benefit of biodiversity values, in the medium term. The ecologists engaged to provide advice and assessments in respect of the Project have been closely involved in recommending measures, including route selection and design features, to achieve this aim.

The ecological aim for the Project will ultimately be achieved through a range of measures to avoid, remedy or mitigate effects on ecological values, including in particular:

- A robust and transparent understanding of effects through detailed desktop and field assessments, as well as inputs from key stakeholders including Ngāti Tama, the Department of Conservation and New Plymouth District Council.

- Demonstrable efforts to avoid, remedy or mitigate potential adverse effects, through:
    - The selection of a route option that avoids the generally higher ecological value land to the west of the existing SH3. The Project ecologists played an important role in the route selection process;
    - The use of structures (i.e. a tunnel and bridge) to minimise habitat loss and severance;
    - Within the Project footprint, alignment optimisations through changes to design and construction methodologies that produce the best ecological outcomes (e.g. avoidance of wetlands);
    - Intensive monitoring programmes that minimise the potential for vulnerable species being harmed during road construction (e.g. radio-tracking of kiwi);
    - Salvaging and relocation of important biodiversity values (e.g. lizards); and
    - The establishment and operation of a long-term pest mammal control programme to mitigate for residual adverse effects on indigenous biodiversity values.

These measures as they relate to herpetofauna are discussed in more detail in Section 5 of this report.

1.4 Background to the ecological assessment of the Project

In 2016, through the earlier stages of the Project, consideration of options for the Project focused on land to the west of SH3 known as Parininihi (Figure 1.2 below). As a consequence, much of the initial fieldwork (until mid-2017) was focused on assessing ecological values to the west of SH3 along the previously proposed 'MC23' alignment (Figure 1.1).

Nonetheless, much of the information gained from the initial surveys is relevant to this assessment because both routes pass through broadly similar ecosystem types, and the distance between the two routes is relatively small (i.e. <5km).

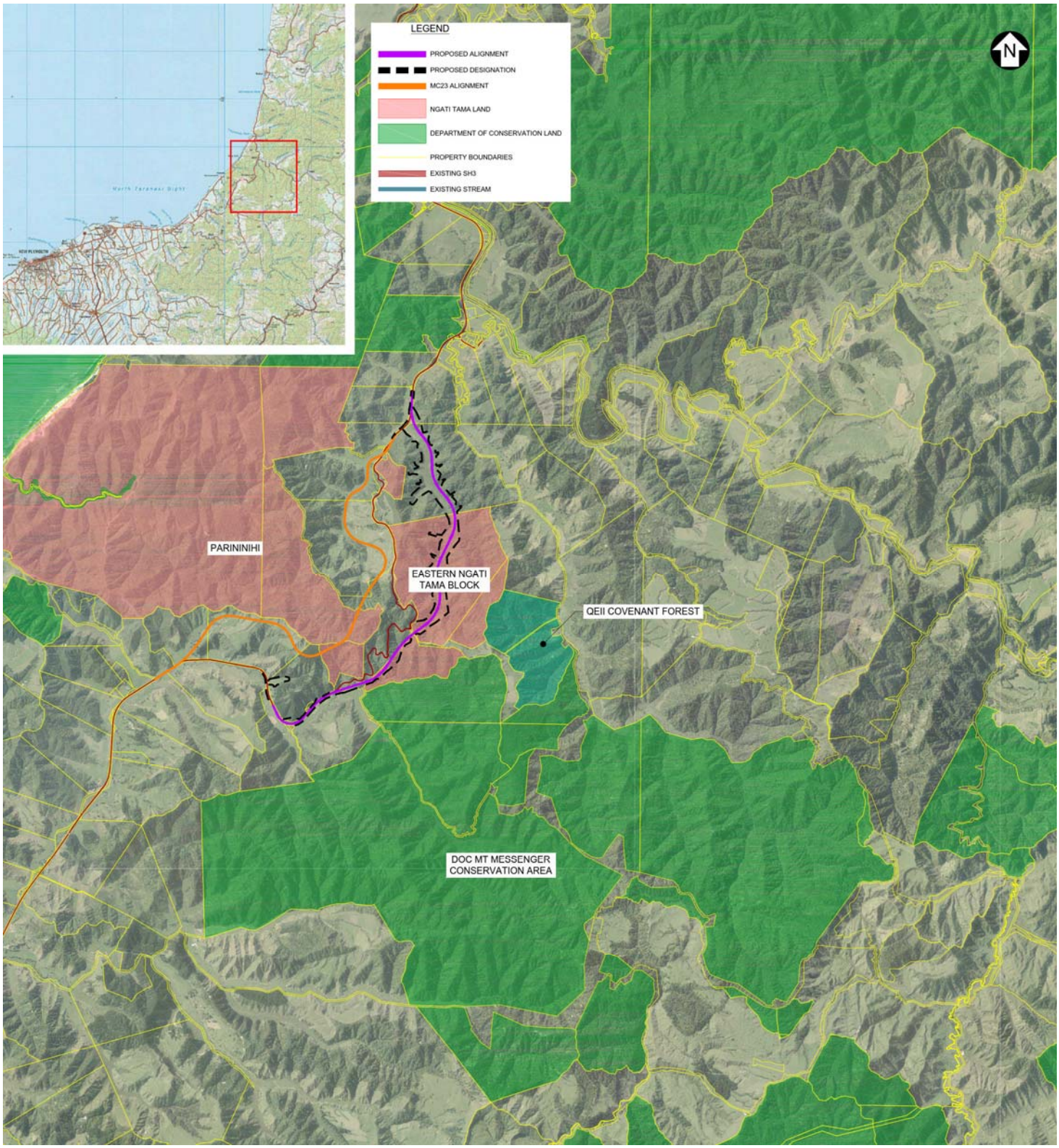

Figure 1.2 – The wider Project area, showing Parininihi and the previous MC23 alignment to the west of the existing SH3, and the Project footprint, Eastern Ngati Tama Block to the east, with the Mimi River to the south and Mangapepeke Stream towards the north

Given seasonal survey constraints, opportunistic survey effort has been undertaken along the Project footprint during the 2017 winter periods to augment this earlier survey information obtained to the west, and to inform the assessment of the likely nature and scale of effects of the Project. Importantly, the detailed vegetation mapping that has been undertaken for the wider Project area (Assessment of Ecological Effects – Vegetation (Technical Report 7a, Volume 3 of the AEE) provides a robust baseline habitat assessment for predicting the fauna species that are potentially present.

While the land to the west of SH3 has had the benefit of some 20 years of intensive pest management, this has not occurred to the east of SH3. In addition, large parts of the Project footprint have been used for pastoral farming or have otherwise been subject to browsing and pugging impacts attributed to both unfenced stock, and feral goats (*Capra hircus*) and pigs (*Sus scrofa*). Accordingly, the biodiversity values associated with Parininihi are recognised as generally being higher than those of the Project footprint.

In the absence of detailed baseline fauna surveys undertaken during the optimal season within the Project footprint, it has been conservatively assumed that any species recorded west of SH3 would also be present in similar habitats to the east of SH3. Further herpetofauna survey work is planned for the 4th quarter of 2017 to fully refine mitigation options, and to provide baseline data on herpetofauna populations within the Project footprint. However, the data obtained to date are sufficient for assessing the potential effects of the Project on herpetofauna; noting that a conservative approach has been taken to account for the lack of certainty about populations within the Project footprint.

1.5 The wider Project area

The wider Project area (i.e. the area in Figure 1.1 above) is situated in the North Taranaki Ecological District[1] (shown in Figure 1.3). The Ecological District includes a moderately diverse range of habitats, from stream flats and surrounding high productivity farmland to less developed steep hill country, through to high-diversity indigenous forest on hill country. The forest often occupies steep hillslopes with sparsely vegetated bluffs as well as a series of densely vegetated interconnected ridge systems. Warm, humid summers and mild, wet winters create conditions suitable for dense broadleaved dominant forest with an abundance of lianes and epiphytic plants over mostly hill country land, and kahikatea (*Dacrycarpus dacrydioides*), pukatea (*Laurelia novae-zelandiae*) and swamp maire (*Syzygium maire*) forest and associated wetlands in valley floor areas.

[1] http://www.doc.govt.nz/Documents/science-and-technical/Ecoregions1.pdf

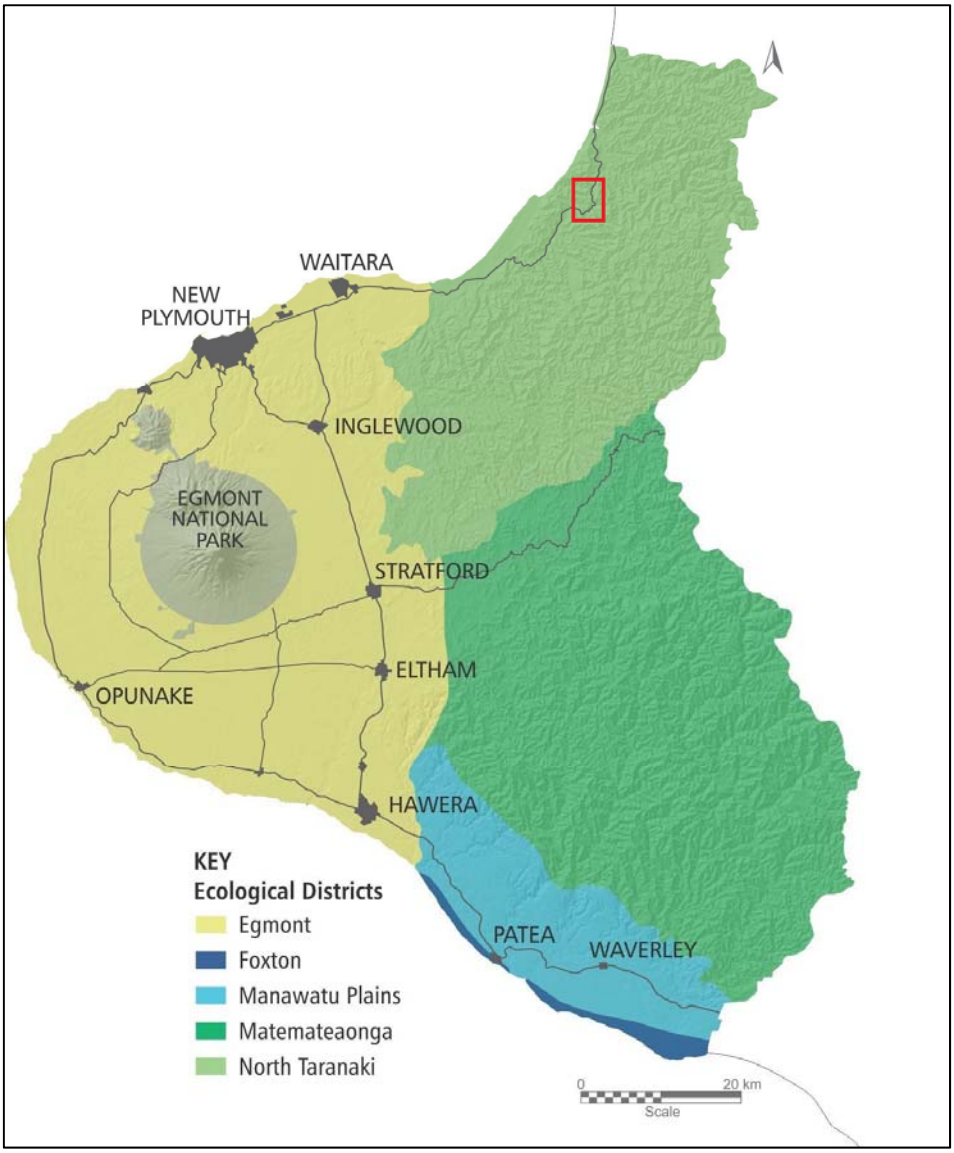

Figure 1.3 – Map showing the North Taranaki Ecological District (Taranaki Regional Council, 2017)

The wider Project area (refer Figure 1.2), within which the Project footprint is located, includes approximately 4430ha of predominantly indigenous forest habitat. The indigenous forest includes:

- a contiguous area of 1332ha of indigenous forest owned by Ngāti Tama that is located to the immediate west of Mt Messenger known as Parininihi (see Section 1.5.1); and
- a contiguous forest (approximately 3098ha in size) immediately adjacent to Mt Messenger and to the east of SH3 (see Section 1.5.2). This area is referred to as the Eastern Ngāti Tama forest block (but also includes land owned by the Department of Conservation and private landowners).

1.5.1 Parininihi

Parininihi, previously known as "Whitecliffs Conservation Area" is 1332ha of mainly primary forest centred on the Waipingao Stream catchment (shown to the west of SH3 in Figure 1.2 above). This area is classified as "Rimu (*Dacrydium cupressinum*) tawa (*Beilschmiedia tawa*) forest" within the New Zealand Forest Service class map (NZFSMS6). The area encompasses a rare continuous forest sequence through coastal, semi-coastal and lowland bioclimatic zones. As such, the area is regarded as being ecologically significant, and has been described as "the best example of primary coastal hardwood-podocarp forest on the west coast of the North Island" by eminent forest ecologist John Nicholls (Bayfield et al. 1991).

Ecological management of Parininihi was started in the early 1990s by the Department of Conservation, and involved possum and goat pest management activities. Since the return of this land to Ngāti Tama in 2003, management of these pests has continued, and control of rodents, mustelids and feral cats (*Felis catus*) has also occurred. Consequently, the health and ecological integrity of the area is now improving, with browse-sensitive plants regenerating and various predation-sensitive birds increasing in abundance.

Parininihi (and all land to the west of the existing SH3) is being avoided by the Project footprint, following the route selection process carried out in 2017.

1.5.2 Eastern Ngāti Tama forest block

The dominant forest to the east of the existing SH3 corridor is 3098ha in area (refer Figure 1.2) and would have originally been very similar forest type to the western part of Parininihi; however, it has not had consistent pest management. Consequently, the ecological condition of this area is poorer, with fewer palatable canopy trees remaining, such as thin-barked totara (*Podocarpus laetus*) and northern rata (*Metrosideros robusta*). Within the Mangapepeke Stream catchment to the east of existing SH3 (shown in Figure 1.2 adjacent to and within the northern end of the Project footprint), vegetation communities are more modified and have been affected by stock grazing, fire and logging.

Of greatest ecological significance in this area is the hydrologically intact swamp forest and non-forest wetland areas in the valley floor of the northern Mimi River catchment (shown in Figure 1.2 towards the southern end of the Project footprint), potential habitats of various threatened wetland birds. The valley floor sequence within the northern tributary of the Mimi River represents a full range of swamp forest, scrub and non-forest wetland communities.

2 Assessment methods

Herpetofauna distribution, activity patterns, and habitat values within the wider Project area were assessed by reviewing existing information and data, and by undertaking field assessment in the wider Project area.

The assessment in this report broadly follows Ecological Impact Assessment (EcIA) guidelines developed by the Environment Institute of Australia and New Zealand (EIANZ 2015). As described in Section 2.3, professional ecological judgement and expertise have also been applied in the assessment process to reflect good practice.

2.1 Desktop review

A desktop assessment was undertaken to review available information and data relating to the ecology of the wider Project area. This included:

- A review of key documents, reports and data including:
  - Identifying areas within and surrounding the Project footprint that are listed as having significant ecological values;
  - Department of Conservation's BioWeb Herpetofauna database from the last 10 years within a 50km radius of the Project site;
  - Department of Conservation's Atlas of amphibians and reptiles of New Zealand; and
  - Herpetofauna distribution maps.
- Discussion with:
  - Department of Conservation (Lynn Adams);
  - Landowners; and
  - Ngāti Tama (Conrad O'Carroll, Ngāti Tama Trust).

2.2 Field Assessment Methods

Survey methods were determined using the decision tree and comparative tables for terrestrial and arboreal lizards contained within the Department of Conservation Inventory and Monitoring Toolbox: Herpetofauna (Lettink & Monks, 2012). Artificial retreats (Artificial Cover Objects (ACOs) and Closed Cell Foam Covers (CCFCs)) and Visual Encounter Surveys (VES) were determined acceptable field methods for distribution and inventory baseline surveys.

The use of VES is categorised as 'good' for inventory surveys for native frogs and terrestrial and arboreal lizards. VES have low-medium equipment and personal costs, and the high degree of skill required was met by the project team ecologists. The use of artificial retreats is categorised as 'medium' for terrestrial and arboreal lizards. Artificial retreats have low equipment and personal costs, and the high degree of skill required was met by project team ecologists.

2.2.1 Survey sequencing and seasonality

As noted in Section 1.4, previous investigations during summer and autumn 2017 were focused on the MC23 alignment, with only limited vegetation survey work carried out to the east of the existing SH3. As it became apparent that the appointment of the Mount Messenger Alliance was likely to result in the options selection process being revisited, additional ecological surveys of a wider survey area, including areas to the east of the existing SH3, were undertaken.

With regard to herpetofauna, surveying in winter has greater limitations than spring and summer surveys as herpetofauna become less active as a result of lower temperatures.

Assessments of habitat quality within the Project footprint were undertaken during June 2017 to determine which species are likely to be present. Aside from opportunistic manual habitat searches carried out during the deployment of bat detectors during winter and early spring, no formal surveys of herpetofauna have been undertaken to date along the proposed Project footprint.

However, the habitat in many areas of the Project footprint is of lower quality compared with habitat encountered elsewhere within the wider Project area during the herpetofauna surveys carried out during summer and autumn 2017. As such, the data from those surveys are considered to be sufficient for the purposes of making this assessment.

2.2.2 Habitat Assessment

Prior to conducting field surveys in the wider Project area during the first half of 2017, a habitat assessment was conducted remotely using high resolution aerial maps to identify habitat types that may be utilised by native herpetofauna. Vegetation was categorised as mature/late regenerating forest, early successional/scrub, exotic forest, and rank pasture grass. Structural habitat was categorised as leaf litter, rock piles/debris, and logs/woody debris.

The potential locations for the deployment of artificial retreats and suitable areas for VES, were selected based on desktop habitat assessments, with field survey locations refined and finalised on the basis of validated in-field conditions determined during a site walkover. Further detailed habitat assessments of the Project footprint were undertaken during a site walkover in June 2017, where structural habitat types and vegetation were documented.

2.2.3 Artificial retreats

Artificial retreats were installed within the wider Project area in the first half of 2017 as a passive means to detect lizard species. ACOs were established within selected pasture/bush margin areas, and CCFCs in the main Waipingao Valley interior (Appendix A). Artificial retreats were installed within these targeted habitats by means of transects as they provide greater coverage of an area where species' presence and distribution is unknown (Lettink & Monks, 2012).

Six ACO transect lines were established in the pasture/bush margin areas south of the main forest, and four lines north of the main forest. These 10 transect lines comprised of 96

individual ACOs in total. Each ACO was deployed along transect lines at approximately 10-20m intervals, with transects spaced at least 100 m apart. These transects covered a range of representative terrestrial habitat types existing in the wider Project area (e.g. rank grass, kanuka (*Kunzea spp.*)/manuka (*Leptospermum scoparium*) scrub, and mature indigenous forest) (Appendix A).

Single layer Onduline ACOs were considered to be appropriate for the lizard fauna likely to be present across the wider Project area. Onduline is a lightweight corrugated roofing and cladding material constructed in layers (400 x 280mm). ACOs were deployed in late January 2017, and left to settle in the environment for 12 weeks before they were checked.

Based on their accessibility and diversity of habitat, two transect lines were established with a total of 47 CCFCs within the main forest area on pest control tracks along ridges. CCFCs were installed during late January 2017 and aimed to detect arboreal lizard species (Appendix A). CCFCs require a settling period in the environment much longer than Onduline ACOs. Covers were therefore left undisturbed for a minimum three-month period after initial deployment. Covers have been left in the environment over winter 2017. Future checks may be done at a time when the covers have been deployed for at least 8-9 months.

All herpetology work was carried out under Wildlife Act 1953 (Wildlife Act) permit number 53708-FAU. For any herpetofauna species found during implementation of any of the survey methods, the following information was to be recorded for each individual:

- Species;
- Reproductive status;
- Snout-vent length (SVL) from the tip of the snout to the vent at the base of the tail;
- Vent-tail length (VTL), including separate measurements for regenerating tails;
- Weight;
- Sex and life stage (if possible);
- Habitat description;
- GPS coordinates of location; and
- Specimen photos.

As required by Wildlife Act permits for herpetofauna surveys, all records of individuals found were submitted to the Department of Conservation's national data repository for herpetofauna records (BioWeb Herpetofauna database).

2.2.4 Visual encounter surveys

Opportunistic daytime VES were undertaken in mild and still weather conditions, in areas identified as possible lizard and terrestrial frog habitat during artificial retreat deployment. Daytime searches are carried out to detect diurnal species, either terrestrial or arboreal, but also have the advantage of revealing inactive nocturnal species sheltering under objects or within refugia. Terrestrial herpetofauna VES effort involved scanning vegetation and inspecting areas of understorey with particular focus on light wells.

Manual hand searching for terrestrial lizards and frogs was undertaken in conjunction with daytime visual searches. Hand searching was done through sedges, grasses, ferns and other forest groundcover vegetation, lifting ground cover objects, and searching crevices in dead wood or debris piles near artificial cover transects. Manual hand search effort for semi-aquatic frogs included searches along damp stream banks and lifting and inspecting under potential instream refuge habitat items. As recommended in the DOC Inventory and Monitoring Toolbox Herpetofauna: Systematic searches guidelines (Hare, 2012), care was taken to minimise potential for crushing when lifting objects and the lifter was always able to hold the object up long enough to catch any herpetofauna.

Nocturnal spotlighting searches for frogs and arboreal geckos were not carried out in steep areas of the wider Project area due to health and safety concerns. However, the lower sections with bush/farmland margins were suitable for night spotlighting which targeted arboreal lizards (Appendix A). Night searches were carried out using powerful torches mounted on binoculars for scanning habitat from a distance, or hand-held torches alone for close-range spotlighting. A total search effort of 18 person-hours of spotlighting was undertaken during late January (north side) and mid-April (south side). Night searches were undertaken by a team of experienced ecologists under the supervision of an experienced herpetologist.

2.3 Assessment of effects methodology

The assessment of ecological effects broadly follows the EcIA guidelines (EIANZ, 2015), with some adaptation, including to allow for the expert opinion of herpetofauna specialists to be applied within the context of the EIANZ framework[2].

The guidelines are useful in that they enable effects to be assessed in a systematic and transparent way.

2.3.1 Assessment of Ecological Values (Step 1)

Ecological values were assigned a level on a scale of ‘Low’, ‘Moderate’, ‘Moderate-High’, ‘High’ or ‘Very High’ based on assessing the values of species, communities, and habitats identified against criteria set out in the EcIA guidelines (Table 2.1). For this herpetofauna assessment, each individual species is assigned an ‘Ecological Value’ based on criteria set out in Table 2.1in the column entitled ‘Species Value Requirements’.

[2] In terms of the EIANZ process steps, Step 4, which provides for the overall level of effects to be translated to an "RMA effect" has been omitted. The rationale for this includes that it is considered more appropriate / straightforward for ecological effects to be expressed in the high / moderate / low terms used in the other EIANZ steps.

Table 2.1 - Assignment of values within the footprint to species (adapted from EIANZ, 2015)

Value	Species Value requirements
Very High	Important for Nationally Threatened species
High	Important for Nationally At Risk species and may provide less suitable habitat for Nationally Threatened species
Moderate-high	May provide less suitable habitat for Nationally At Risk species
Moderate	No Nationally Threatened or At Risk species, but habitat for locally uncommon or rare species
Low	No Nationally Threatened, At Risk or locally uncommon or rare species

2.3.2 Magnitude of unmitigated Effect assessments (Step 2)

Step 2 of the EcIA guidelines requires an evaluation of the unmitigated magnitude of effects on ecological values based on footprint size, intensity and duration. The unmitigated 'Magnitude of Effect' that the Project is expected to have in the Project area is evaluated as being either 'No Effect', 'Negligible', 'Low', 'Moderate', 'High' or 'Very High', (see Table 2.2).

Table 2.2 - Summary of the criteria for describing the magnitude of unmitigated effect (based on EIANZ, 2015).

Magnitude of effect	Description
Very High	Total loss or major alteration of the existing baseline conditions; Loss of high proportion of the known population or range
High	Considerable loss or alteration of existing baseline conditions; Loss of high proportion of the known population or range
Moderate	Moderate loss or alteration to existing baseline conditions; Loss of a moderate proportion of the known population or range
Low	Minor shift away from existing baseline conditions; Minor effect on the known population or range
Negligible	Very slight change from the existing baseline conditions; Negligible effect on the known population or range
No Effect	No effect at all

The 'Magnitude of Effect' is a function of:

- The scale of unmitigated effect per se (i.e. the areal extent of the Project footprint);
- The proportion of habitat loss versus local availability (e.g. the proportion of habitat loss relative to the contiguous habitat that remains);
- The duration of effect (e.g. permanent versus temporary); and
- The intensity of the unmitigated effect (i.e. the extent to which habitat loss within the Project footprint was complete or partial).

The 'Project footprint' is the principal spatial zone, where the direct effects of the Project on ecology (including herpetofauna) are considered to occur. 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);
- an Additional Works Area (AWA), accounting for additional habitat loss for construction access, laydown areas and temporary stormwater drains (see detailed drawings in Volume 2: Drawing Set); and
- 5m edge effects parcel.

Note that the AWA is smaller in habitats with 'High' 'Ecological Values' because temporary work activities will be focused on the road footprint and immediately adjacent areas, and more precautions will be taken in managing construction effects, in order to mitigate potential adverse effects on the surrounding habitat. These measures will be set out in the Construction and Environmental Management Plan (Volume 5 of the AEE), which will include the Ecology and Landscape Management Plan.

The inclusion of the 5m edge effects parcel in the Project footprint accounts for the degradation of habitat suitability in close proximity to the direct effects footprint through edge effects. The creation of new edges where existing vegetation is removed is known to alter micro-climatic conditions (e.g. through increased exposure to temperature extremes, desiccation, and wind) with potential adverse effects on both habitat suitability and availability for a number of species (Young & Mitchell 1994; Davis-Colley *et al.* 2000).

Moreover, a variety of other factors, including invasion of weeds and occupancy of mammalian predators and browsers are generally considered to be higher in edge habitats (Murcia 1995; Lahti 2009) though evidence for higher predation rates is mixed (Ruffell *et al.* 2014). While edge effects do not result in the direct clearance of vegetation for the purposes of calculating offset, the 5m edge has been included in the calculation as though it were a direct total loss. The inclusion of a 5m edge parcel is considered appropriate for herpetofauna as some species may be adversely impacted by edge effects.

2.3.3 Level of effects assessment in the absence of mitigation (Step 3)

Step 3 of the EcIA guidelines requires the overall level of effect to be determined using a matrix that is based on the ecological values and the magnitude of effects on these values **in the absence of any efforts to avoid, remedy or mitigate for potential effects**. Level of effect categories adopted for the purposes of this assessment include 'No Ecological Effect', 'Very Low', 'Low', 'Moderate', 'Moderate/High', 'High' and 'Very High'. Table 2.3 shows the matrix

used to describe the overall level of ecological effects, adapted from EIANZ (2015) to allow for the consideration of likelihood of presence and uncertainty with regard to magnitude of potential effects.

After applying the EcIA guidelines and the table below for individual herpetofauna species, the authors have used their professional judgement to assess the overall level of effects on herpetofauna.

Table 2.3 – Criteria for describing overall levels of ecological effects (adapted from EIANZ, 2015).

Magnitude of effect	**Ecological Value**			
	Very High	High	Moderate or Moderate-High	Low
Very High	Very high	Very high	High	Moderate
High	Very high	Very high	Moderate–High	Low
Moderate	Very high	High	Low	Very low
Low	Moderate	Low	Low	Very low
Negligible	Low	Very low	Very low	Very low
No effect	No ecological effect	No ecological effect	No ecological effect	No ecological effect

3 Herpetofauna survey/assessment results

3.1 Herpetofauna desktop review results

3.1.1 Herpetofauna database

The following table provides a summary of known herpetofauna records obtained from the Department of Conservation's herpetofauna database within 50km of the wider Project area. The results of this database search (Table 3.1) provide insight into the diversity of herpetofauna potentially present within the wider Project area.

Table 3.1 - Historic herpetofauna records within 50km of the wider Project area.

Name	Scientific Name	Threat Status	Years of Record
Goldstripe gecko	*Woodworthia chrysosiretica*	At Risk - Relict	2014, 2013, 2012, 2011, 2009, 2008
Striped skink	*Oligosoma striatum*	At Risk - Declining	2010, 2008
Hochstetter's frog	*Leiopelma hochstetteri*	At Risk - Declining	2009, 2008
Copper skink	*Oligosoma aeneum*	Not Threatened	2010
Forest gecko	*Mokopirirakau granulatus*	At Risk - Declining	2009
Ornate Skink	*Oligosoma ornatum*	At Risk - Declining	2001
Common gecko	*Woodworthia maculata*	Not Threatened	2002
Northern Grass skink	*Oligosoma polychroma*	Not Threatened	2001
Archey's frog	*Leiopelma archeyi*	Threatened - Nationally Vulnerable	2000
Pacific gecko	*Dactylocnemis pacificus*	At Risk - Relict	2000
Duvaucel's gecko	*Hoplodactylus duvaucelii*	At Risk - Relict	1984

3.1.2 Atlas of Amphibians and Reptiles of New Zealand

A review of herpetofauna distribution within the Taranaki Region under the Department of Conservation's *Atlas of Amphibians and Reptiles of New Zealand* details the potential for a further two lizard species within the wider Project area. These include both skink and gecko species (Table 3.2).

Table 3.2 - Additional herpetofauna distributed within the Taranaki region

Name	Scientific Name	Threat Status
Elegant gecko	*Naultinus elegans*	At Risk - Declining
Brown skink	*Oligosoma zelandicum*	At Risk - Declining

3.1.3 Habitat assessment

A habitat assessment was conducted remotely, using high resolution aerial maps to identify habitat types that may be utilised by native herpetofauna. The assessment indicated that the Project footprint encompasses several habitat types, ranging from wetlands to mature remnant forest. To varying degrees, these habitat types fulfil the niche requirements for the diversity of herpetofauna identified in Section 3.1.1 and 3.1.2 of this report. A breakdown of these habitats and the species which may occupy them is described below, with a summary provided in Table 3.3.

3.1.3.1 Mature Forest

Mature or late successional forest is found within the Project footprint. This is a complex habitat that contains multiple features for a diversity of herpetofauna species to utilise. Old emergent trees such as rimu (*Dacrydium cupressinum*) and totara (*Podocarpus totara*) contain a large number of epiphyte plants, most commonly *Astelia* spp. This epiphyte microhabitat provides favourable habitat for arboreal and semi-arboreal species including goldstripe gecko, elegant gecko, forest gecko, Pacific gecko, and striped skink.

Mature tree trunks with deep crevices and loose bark could be used by the above-mentioned species, with addition to, duvaucel's gecko and common gecko for refuge. Forest geckos are often found on trunks and larger branches of trees in mature forest.

Where present, groundcover plants such as young tree ferns, ground ferns, fallen epiphytes, flax, and sedges (e.g. *Gahnia* and *Astelia*) provide habitat for species such as striped skink, Pacific gecko, Duvaucel's gecko, goldstripe gecko and Archey's frog.

Woody debris and deep leaf litter on the forest floor provide ideal refugia and feeding areas for copper and ornate skink. All these habitat types are located throughout the forested area of the Project footprint and it is possible the above species are present within these areas (Table 3.3).

Small upper reaches of the Mangapepeke Stream and the Mimi River are dominated by mature forest cover and are located within the wider Project area. These reaches are characterised by a naturally steep incised gully, with rocks and logs as the substrate. Superficially, these areas appear to provide potential habitat for Hochstetter's frog.

3.1.3.2 Scrub

Scattered areas of scrub and bush margin habitat is located throughout the wider Project area, including the Project footprint. These areas are predominantly comprised of manuka and kanuka. The canopy of manuka and kanuka is a known foraging habitat for arboreal

geckos such as elegant, forest, and Pacific gecko. Rock areas and small clay banks within these areas may provide habitat for terrestrial gecko species. Scrub areas generally provide an abundance of woody debris, grasses, sedges and areas of deep leaf litter that provide suitable habitat for all skink species listed in Table 3.1and Table 3.2 that may be present within the wider Project area.

3.1.3.3 Rank Grass

Rank grass and pasture are found in several areas along the Project footprint. These areas were found around the periphery of wetland areas and adjacent to bush margins. This habitat matrix provides potential habitat for several of the skink species expected to occur within the wider Project area. The dense vegetation cover and moist ground-level conditions provided by rank grass environs are more suitable for these skink species when coupled with forest edges and scattered refugia provided by habitat items including woody debris that was found in these areas.

3.1.3.4 Wetland

The two major lowland wetland areas within the Project footprint provide overall marginal habitat for lizard species. Gecko species may be able to utilise the denser vegetation within these areas, while the Northern grass skink may be present within drier parts of wetlands (e.g. wetland edges).

Table 3.3 - Habitat types preferred by herpetofauna species most likely to be present within the Project footprint. Habitat suitability: √√√ High; √√ Moderate; √ Marginal.

Name	Mature Forest	Scrub	Rank Grass	Wetland
Archey's frog	√√√			
Brown skink	√√	√√√	√√	
Common gecko	√√√	√		
Copper skink	√√√	√√√	√√	
Duvaucel's gecko	√√√	√√		√
Elegant gecko	√√	√√√		√
Forest gecko	√√√	√√√		√
Goldstripe gecko	√√√	√√		√
Hochstetter's frog	√√√			
Northern Grass skink		√√√	√√√	√√
Ornate skink	√√√	√√	√	
Pacific gecko	√√√	√√		√

Name	Mature Forest	Scrub	Rank Grass	Wetland
Striped skink	√√√	√	√	

3.2 Field surveys

Field surveys principally targeted areas in Parininihi with high quality habitat that had received long-term pest control. Though in-field investigations have currently been limited to opportunistic searches along the Project footprint, robust baseline field surveys within the wider Project area (which has been subject to long-term pest control) provide a strong degree of insight into the species and densities of resident herpetofauna within the Project footprint. However, it is important to note that the habitat within the Project footprint is generally of a lower quality than in Parininihi due to lack of long-term pest management.

3.2.1 Artificial Cover Objects

A total of 96 ACOs deployed in late January 2017 were checked in mid-April, mid-May, and late May 2017 (12, 16 and 18 weeks after initial deployment). ACOs were checked throughout the course of the day during cool, overcast days by two team members. No lizard species were detected during any of the 288 ACO checks. This result was somewhat unexpected given the level of effort employed. It would have been expected that at least low levels of common lizard species would have been detected during these checks.

3.2.2 Closed Cell Foam Covers

A total of 47 CCFC deployed in late January 2017, were checked in late April and late May 2017, during cool, overcast days with low to moderate wind by two team members. No lizard species were detected during any of the 94 CCFC checks. Though CCFCs are useful for detecting the presence of arboreal lizard species, these results were not unexpected. These covers require a significant part of the year settling within their environment, and are generally subject to relatively low herpetofauna occupancy rates, even in areas where lizards are in high abundance.

Though long-term pest control had been undertaken in Parininihi, legacy impacts from pests and relatively slow reproduction rates of New Zealand herpetofauna, result in slow population bounce backs. The current level of pest control undertaken within the area may require review as approximately 13% (6/47) of the deployed CCFCs exhibited damage from pest mammals (e.g. scratch marks and bites) during the first round of checks. Despite this, a diverse range of potential invertebrate food sources were detected under these covers which included weta, millipedes, cockroaches and spiders.

3.2.3 Nocturnal visual encounter surveys

Nocturnal VES (i.e. spotlighting) for arboreal geckos were undertaken during late January 2017 (northern end of MC23) and mid-April (southern end of MC23) (see Figure 1.1 for MC23 location). No arboreal gecko species were detected during a total search effort of 18 person hours. The presence of multiple moth species, katydids and flightless arboreal stick

insects detected during these searches demonstrated plentiful food sources for arboreal geckos.

3.2.4 Daytime visual searches

No lizard or frog species were detected during daytime visual searches and manual habitat searches within terrestrial and aquatic environments. These opportunistic searches targeting the most likely habitat features encountered were undertaken in conjunction with artificial retreat checks as well as the installation of bat detectors across the wider Project area. While the Project footprint includes apparently suitable habitat for Hochstetter's frog, the geology of the area is such that the rocks along the valley floors and streambeds are soft and highly erodible. Consequently, many of the microhabitats preferred by Hochstetter's frog are in fact clogged with sediment.

3.2.5 Conclusions and discussion

Baseline survey efforts did not detect any herpetofauna species within the wider Project area or Project footprint.

However, the presence of herpetofauna cannot be discounted. The challenge of detecting species that are extremely cryptic in terms of camouflage and behaviour, is increased when they are in low population densities. Given the results of the habitat assessment and relevant database searches, it is possible (on a very conservative basis) that up to 11 species of lizard and two species of frog may be present within the wider Project area but may be at levels below detectability. This covers all 13 species discussed in section 3.1 above.

For these reasons, a very conservative approach would assume that these species within the relevant habitat types are likely to be present along the Project footprint. It is noted that the lack of ongoing pest management in the vicinity of the Project footprint reduces the quality of the habitat, so lower abundance of herpetofauna would be expected within the Project footprint compared with other parts of the wider Project area, such as Parininihi.

3.3 Species potentially present within the Project footprint

Up to 13 species of herpetofauna including skinks, gecko and frogs have been identified within Table 3.1and Table 3.2 to be potentially present within the vicinity of the wider Project area. As noted above, a very conservative approach is to assume all 13 species are present within the Project footprint. In practice, though, it is unlikely that all of these species are present within the Project footprint given a range of factors including habitat suitability, known species ranges, distances of historical records and the expected abundance of pest species across the wider Project area.

Table 3.4 assesses the likelihood of each herpetofauna species being present within the wider Project area and Project footprint. This assessment is based on on-site conditions, available species information and expert opinion.

Table 3.4 - Likelihood of species presence within the Project footprint: √√√ High; √√ Moderate; √ Marginal.

Name	Wider Project Area	Project Footprint
Archey's frog	√	√
Brown skink	√	√
Common gecko	√	√
Copper skink	√√√	√√√
Duvaucel's gecko	√	√
Elegant gecko	√√√	√√
Forest gecko	√√√	√√√
Goldstripe gecko	√√	√
Hochstetter's frog	√	√
Northern Grass skink	√√	√
Ornate skink	√√	√√
Pacific gecko	√√√	√√
Striped skink	√√√	√√

3.3.1 Constraints, limitations and assumptions

The initial survey effort that was employed across the Wider Project area was targeted for a preliminary alignment, 'MC23', which bisected the interior of the Waipingao Valley to the west of the existing SH3. While subsequent investigations have been carried out in the vicinity of the Project footprint, a lack of survey information along the Project footprint results in the assessment of effects being heavily reliant on expert opinion on actual infield conditions. However, the lack of herpetofauna found through the surveys in Parininihi mean that large populations in the Project footprint, which has been without sustained pest management, is not considered likely.

The survey methodologies and efforts employed across the wider Project area and footprint were undertaken with overview from an expert herpetologist. A proportion of this field survey effort was undertaken by experienced generalist ecologists.

Daytime VES surveys undertaken for both frogs and lizards were carried out in an opportunistic manner. A lack of dedicated time which focused on this survey methodology

may have potentially biased the results of these efforts. Dedicated VES (specifically, manual habitat searches) are scheduled to be carried out along the Project footprint during late 2017.

4 Assessment of effects on herpetofauna values

This assessment is broadly based on the EcIA guidelines produced by EIANZ (2015), adapted based on expert opinion as described in Section 2.3 to determine the overall unmitigated 'level of effect' of the Project on herpetofauna communities.

Based on the EcIA guidelines, in the absence of efforts to avoid, remedy or mitigate adverse ecological effects, the overall level of adverse effects on herpetofauna associated with the Project on is expected to be 'Moderate'.

4.1 Herpetofauna values assessment

The ecological value of herpetofauna affected by the Project was determined using step 1 of the EcIA guidelines (Table 2.1). The ecological value of each of the 13 herpetofauna species potentially present within the wider Project area has been weighted with consideration to their current threat status (Table 3.1and Table 3.2) and the presence of their known habitat within the Project footprint (Table 3.3).

For example, the ecological value of Archey's frog was assessed as 'High' instead of 'Very High' because the Project footprint is approximately 50km further south than the southern limit of the species' known current and historic distribution.

Table 4.1below describes the value of the species potentially present within the Project footprint.

Table 4.1 - Ecological values of herpetofauna within the Project footprint

Name	Value
Archey's frog	High
Brown skink	High
Common gecko	Low
Copper skink	Low
Duvaucel's gecko	High
Elegant gecko	High
Forest gecko	High
Goldstripe gecko	High
Hochstetter's frog	High

Name	Value
Northern Grass skink	Low
Ornate skink	High
Pacific gecko	High
Striped skink	High
Overall score	**High**

As summarised in Table 4.1, Herpetofauna values within the Project footprint are likely to range from 'High' for Archey's Frog, which is a Nationally Vulnerable species, to 'Low' for more common species including copper skink and Northern grass skink. The overall ecological value for herpetofauna is considered 'Moderate-High'.

As noted in Table 3.4 above, the assessed likelihood of these species actually being present in the Project footprint varies; from 'marginal' (including for the high value Archey's frog), through to 'High'.

4.2 Magnitude of unmitigated effects assessment

The magnitude of unmitigated effects of the Project on herpetofauna was determined using the methodology set out in Section 2.3.2 (Step 2 of the EcIA guidelines). This requires an evaluation of the magnitude of effects on ecological values based on footprint size, intensity and duration and habitat availability within the Project area. An additional variable has been included into this evaluation which assumes the more realistic in-field conditions within the Project footprint by predicting the likelihood of a species being present (Table 3.4). As noted above in Section 3, the Project footprint is located in an area which has not been subject to ongoing pest management, therefore reducing the potential for many species to be present or abundant.

Table 4.2 - Magnitude of effect of the Project on herpetofauna species in the Project footprint

Name	Magnitude of effect
Archey's frog	Moderate
Brown skink	Low
Common gecko	Low
Copper skink	Low
Duvaucel's gecko	Moderate

Name	Magnitude of effect
Elegant gecko	Low
Forest gecko	Low
Goldstripe gecko	Moderate
Hochstetter's frog	Moderate
Northern Grass skink	Low
Ornate skink	Low
Pacific gecko	Low
Striped skink	Moderate
Overall score	**Low-Moderate**

Following this methodology and applying professional judgement, the overall magnitude of effects on herpetofauna species is considered to be 'Low-Moderate' (refer Table 4.2). This reflects the fact that the herpetofauna population across the wider Project area is unlikely to be affected in any meaningful way by the Project. The key effects on herpetofauna associated with the construction and operation of the Project are habitat loss and fragmentation. Vehicle strike is also a potential effect of the Project, although the removal of the existing SH3 reduces this effect. These effects are described in more detail in Sections 5.2.1-3.

4.2.1 Habitat removal

Habitat removal poses the most significant impact to resident herpetofauna populations during the construction phase of the Project, if they are located in the Project footprint. The habitats present within the Project footprint include scrub, wetlands, rank grassland and mature forest, which collectively provide a wide range of microhabitat conditions for the species identified in Table 3.3. Although the presence, abundance and distribution of these species has yet to be confirmed in surveys both in the wider Project area and within the Project footprint, it is highly likely that one or more will be present.

The most significant herpetofauna habitat loss is that of the removal of mature forest within the Project footprint. The localised loss of larger native trees from within the Project footprint would represent the loss of forest habitats which are relatively abundant within Parininihi, although some of this habitat is more degraded than in Parininihi due to browsing by pest animals and grazing by stock, which is significantly lower in Parininihi.

While the amount of forest that will be removed for the project represents a small proportion of the mature forest present within the wider Project area, the dynamic matrix of microhabitats provided by this forest environment could not be recreated through

mitigation planting in the short- to medium-term. For example, within a 10-year period, mitigation planting could not provide mature trees containing crevices, loose bark, and epiphytes which provide optimal conditions for arboreal skink and gecko species. However, the proposed habitat recycling of felled vegetation (e.g. epiphytes and woody debris) in addition to pest management as part of the offset for the Project (see Section 5) could supplement mitigation planting in the short term. While no published studies have confirmed that pest control which excludes mice, benefits native mainland forest dwelling herpetofauna populations, anecdotal reports and unpublished studies indicate that long-term pest management can improve habitat quality for herpetofauna.

Removing vegetation could lead to the injury or death of native herpetofauna during the construction phase of the Project. A current lack of knowledge of herpetofauna species, distribution and abundance within the Project footprint poses uncertainties on the actual level of ecological impact that the Project will have on these resident populations. Given the range and quality of available habitat, it is highly likely that one or more lizard species is present within the Project footprint, and possible – although less likely – that frog species may also be present. The impacts on herpetofauna will be most significant if a Nationally Threatened species such as Archey's frog or a currently range-restricted species such as Duvaucel's gecko is found and harmed during the construction phase.

4.2.2 Habitat fragmentation

Habitat fragmentation would likely have an adverse effect on native herpetofauna populations that are present, mostly within the scrub and main forest areas of the Project footprint. Herpetofauna's behavioural avoidance of roads is poorly documented, but it can be assumed that some degree of road avoidance may result due to noise, light and the open nature of the road itself (Andrews et al., 2008). The construction of a road would create a hard barrier that species or individuals within a population would not be able to traverse. However, the proposed 235m long tunnel and bridge will provide some level of connectivity for herpetofauna across the Project footprint.

Geneflow between metapopulations between the habitats to the east and west of the existing SH3 may further be reduced by the Project, which poses a secondary barrier within the environment (i.e. two roads to cross). However, the use of the existing SH3 (if it remains open at all) would be greatly decreased, and potentially limited to providing access for local property owners. As such, the 'barrier' effect of the existing SH3 road will be reduced somewhat. The Project will also create a forest fragment between the existing SH3 road and the Project footprint, although once the Project is complete, traffic volumes on the existing SH3 road will reduce to very low levels thereby reducing the barrier effect.

4.2.3 Vehicle strikes

The implications of vehicle strike on herpetofauna is poorly understood and documented within current literature, and does not appear to have been studied within the New Zealand context. Despite anecdotal observations of lizard roadkill, this potential impact on herpetofauna during the operation of the road is likely to be minor. While individual lizards may be killed, the Project is unlikely to pose a threat to lizards at the population level.

4.3 Overall level of unmitigated effects assessment

4.3.1 Effects assessment

The assessment of the level of effects of the Project on herpetofauna, in the absence of mitigation, is set out in Table 3.3. This was assessed by applying 'Step 3' of the EcIA guidelines, adapted as described in Section 2.3.3.

In summary, based on the overall 'Moderate-High' ecological value and a 'Low-Moderate' predicted unmitigated magnitude of effects for herpetofauna, the overall level of effects in the absence of any efforts to avoid, remedy or mitigate for potential effects is assessed as 'Low' (Table 4.3).

The level of effect varies by species, as per the EcIA framework. The level of effect on each of the 13 species potentially present in the Project area has been assessed as 'Low' or 'Very low', with the exception of Archey's Frog. As discussed in section 3, there is at best, a marginal likelihood of Archey's Frog being present in the Project footprint.

It is likely that a number of herpetofauna species are present within the Project footprint, potentially including Archey's Frog (which is Nationally At Risk) and / or other species that are Threatened. While the Project footprint represents only a small proportion the available habitat in the wider Project area, the unmitigated removal of over 40 hectares of habitat would nonetheless adversely impact a potentially significant herpetofauna community. It is also possible that the Project footprint contains critical habitat for one or more very rare species (e.g. striped skink).

To account for that uncertainty, and for community-level impacts, it is considered reasonable to adopt a conservative approach and assign an overall level of effect of 'Moderate'.

Table 4.3 - Overall level of effect of the Project on herpetofauna in the absence of mitigation

Name	Level of effect
Archey's frog	High
Brown skink	Low
Common gecko	Very low
Copper skink	Very low
Duvaucel's gecko	Low
Elegant gecko	Low
Forest gecko	Low
Goldstripe gecko	Low

Name	Level of effect
Hochstetter's frog	Low
Northern Grass skink	Very low
Ornate skink	Low
Pacific gecko	Low
Striped skink	Low
Overall level	**Moderate**

4.3.2 Assumptions and limitations

Due to seasonal and access constraints on the field-based herpetofauna investigations to date, only limited information is currently available about herpetofauna and their habitats in the Project footprint (as opposed to the wider Project area, particularly to the west of the current SH3 where surveys have been carried out). Consequently, the assessed values and effects are subject to a range of assumptions. This is reflected in the conservative nature of the effects assessment.

While sufficient information was available to reach the above tentative conclusions (including by extrapolating results from desktop review and surveys in the wider Project area), there is still a level of uncertainty around the value of herpetofauna and effects of the Project on herpetofauna. If any At Risk or Threatened herpetofauna species are present within the Project footprint, impacts would potentially be significant if unmitigated.

However, the programme of ecological investigations is continuing and will include spring and summer field surveys of herpetofauna and their habitats. Given the seasonal constraints on earlier surveys, this will provide the opportunity for much more data to be collected on any herpetofauna populations within the Project footprint.

As discussed in section 6 below, a range of mitigation measures will be implemented to manage potential adverse effects on herpetofauna. These measures are an additional and appropriate way of dealing with the current uncertainty and lack of information in respect of herpetofauna within the Project footprint.

5 Proposed measures for addressing potential adverse effects

5.1 Overview

Extensive and ongoing effort has been made to avoid, remedy or mitigate potential ecological effects of the Project on herpetofauna. The ecologists engaged to advise on the Project, and provide expert assessments of the potential effects of the Project on ecological values, have been closely involved in these efforts.

Through the process of selecting the alignment, the inclusion of structures (a tunnel and bridge), and design and construction methods for the Project, ecological effects on herpetofauna have been either avoided or reduced in magnitude. The Project footprint now avoids Parininihi, a large area of high quality forest which was considered to have high herpetofauna habitat values.

Further proposed surveys will aim to provide increasing evidence of the herpetofauna present within the Project footprint, and inform measures to avoid accidental discoveries during construction.

Herpetofauna-specific mitigation measures have also been proposed, and have been accepted by the Transport Agency, as discussed in this section.

Given that the Transport Agency is proposing a comprehensive mitigation and offset package to address other ecological effects, this section of the report also assesses the potential for those proposed measures (set out in the Mitigation and Offset Report (Technical Report 7h, Volume 3 of the AEE) to mitigate effects on herpetofauna.

5.2 Project measures to avoid or minimise effects

A number of adverse ecological effects on herpetofauna (and other ecological values) have been avoided through the selection of the Project footprint, which (unlike many other options considered) completely avoids the generally higher value land to the west of the existing SH3. These measures have been factored into the 'unmitigated' effects assessment detailed above.

5.2.1 Avoidance through the options assessment process

The options considered for the Project included alignments to the west of SH3 which traversed areas with significant biodiversity values, including the Waipingao catchment and Parininihi. Potential adverse effects identified for options west of SH3 are described in the options assessment reports (Volume 4 of the AEE). These effects include loss of significant habitats, severance of a nationally important vegetation sequence and effects on associated regionally and nationally significant flora. Moreover, a number of options excluded the use of structures (bridges and tunnels), which would have resulted in much more significant ecological effects; and would likely have resulted in more significant effects on herpetofauna than the Project as it is now proposed.

5.2.2 Avoidance or minimisation of effects through optimisation of the Project footprint

The Project footprint traverses areas of significant habitat and vegetation types to the east of Mt Messenger, as described in various specialist reports (Volume 3 of the AEE). All vegetation types and significant trees (Assessment of Ecological Effects – Vegetation (Technical Report 7a, Volume 3 of the AEE) have been mapped and delineated to identify the most ecologically significant areas and relict trees in the wider Project area. Project ecologists have worked closely with design and construction engineers to avoid or minimise ecological effects on these significant habitat types. Such efforts include:

- Inclusion of a 235m long tunnel through the ridge dividing the Mangapepeke and Mimi catchments. The tunnel has greatly reduced the size of the cut and fill area that would otherwise have been required and has preserved the important east-west connectivity of habitat (ridge to coast) and mobile animal movement.
- Incorporation of a 120m bridge across a tributary valley to the Mimi River on the south side of the route. This bridge sits very close to the ecologically significant wetland area and has substantially reduced the impact that a cut and fill approach would have had on the wetland and will preserve east-west ecological connectivity.
- Minor adjustments to the route to avoid the need to fell significant trees. The number of trees potentially needing to be felled has been considerably reduced by this means.
- Avoidance or minimisation of effects on significant ecological values (i.e. significant vegetation/habitat types and trees through):
    - Realignment of the corridor, including shifting part of the corridor further from the ecologically significant wetland area.
    - Use of retaining walls to avoid loss of significant trees where possible.
    - Undertaking vegetation/habitat clearance in accordance with the Construction Environmental Management Plan (CEMP) and the Ecology and Landscape Management Plan (ELMP) to further reduce effects on significant habitat. The CEMP is supported by a suite of sub-plans, which outline the management of specific construction effects such as construction-related ecological effects in more detail.
    - Having an ecologist on site to advise the construction teams when vegetation is being cleared near wetlands.

Taken together, these measures have likely reduced the potential effects of the Project on herpetofauna.

5.3 Specific measures to avoid or minimise effects on herpetofauna

As noted above, specific measures are proposed to avoid or minimise the assessed 'Moderate' level of unmitigated effects on herpetofauna.

5.3.1 Refined surveys and herpetofauna management

Further targeted surveys are scheduled to be undertaken within the Project footprint during the 4th quarter of 2017. These surveys will aim to detect the presence of herpetofauna species, and the habitats they occupy. This will inform the refinement of herpetofauna management and species-specific habitat enhancement measures to be included in the ELMP for the Project. Targeted herpetofauna management measures will reduce the risk of unexpected discoveries of significant herpetofauna species during construction.

The ELMP will include measures to manage effects on herpetofauna. These measures will be aimed at mitigating potential adverse effects on herpetofauna – especially the risk of injury or mortality to herpetofauna during construction of the Project. Herpetofauna-specific measures in the ELMP should include:

- Capture and relocation methods and timing;
- Release site selection based on habitat suitability and capability of supporting additional herpetofauna; and
- Habitat enhancement at the release site(s), including provision of refugia.

Suitable capture methods could include a combination of CCFCs, ACOs, live traps, spotlighting and destructive habitat searches prior to vegetation clearance. Construction supervision would be critical during vegetation clearance. Habitat most likely to be occupied by herpetofauna (e.g. vegetation, woody debris, leaf litter, rocks, etc.) would need to be searched by suitably qualified and experienced herpetologists who would then relocate any herpetofauna to alternative habitat before and during construction works. High risk trees with large epiphyte loads could be identified and climbed to search for arboreal herpetofauna species (e.g. striped skink).

5.4 Impact on herpetofauna of proposed offset programme

A comprehensive offset programme is proposed for the Project and described in the Ecological Effects Assessment – Ecological Mitigation and Offset Report (Technical Report 7h, Volume 3 of the AEE). That programme will benefit herpetofauna in the area, as discussed below.

5.4.1 Pest management

A long-term form of mitigation likely to contribute towards offsetting the Project's potential residual impacts on herpetofauna is to undertake a large-scale pest management programme as described in the Mitigation and Offset Report (Technical Report 7h, Volume 3 of the AEE). In contrast to offshore islands where eradication of some or all mammalian predators has been achieved, there is currently a paucity of published evidence that native

herpetofauna populations in mainland forest habitats benefit from large-scale pest management programmes.

However, the lack of published evidence should not necessarily be interpreted as evidence that such programmes do not benefit herpetofauna. Rather, it most likely reflects the challenges in monitoring forest-dwelling herpetofauna populations. Unpublished and anecdotal evidence from some mainland areas where long-term management of mammalian predators has been carried out (eg Ark in the Park and Shakespear Regional Park) indicates that forest dwelling herpetofauna such as arboreal geckos do in fact benefit from long-term pest management.

For the purpose of this report it is considered reasonable to assume that the proposed long-term pest management programme will contribute to mitigating residual effects on herpetofauna. The details of the pest management programme are provided in the Mitigation and Offset Report (Technical Report 7h, Volume 3 of the AEE).

5.4.2 Restoration Planting and Habitat Enhancement

Overall, the proposed restoration planting and habitat enhancement programme summarised below and detailed in the Assessment of Ecological Effects - Ecological Mitigation and Offset (Technical Report 7h, Volume 3 of the AEE) will have beneficial and positive effects on herpetofauna. Restoration planting and habitat enhancement will either occur within the wider Project area or nearby, and will consist of both mitigation and offset measures, as follows.

Mitigation:

- Planted riparian margins of 10m each side of the channel will be created;
- Restoration planting of all secondary scrub areas along the footprint plus temporary access tracks and storage areas that retain soil, hydrology and growing conditions suitable for reinstatement (up to 9ha); and
- Deployment of felled logs within mitigation sites to improve biodiversity values for a number of plants and animals.

Offsets:

- Restoration planting of up to 8ha of swamp forest;
- Planting of 200 seedlings of the same species for every significant tree that has to be felled;
- Protection (fencing) and riparian planting of approximately 9km of existing stream; and
- 560ha of long-term pest management.

In time, restoration planting and habitat enhancement will create habitat, improve ecological connectivity and reduce edge effects on existing vegetation, all of which are likely to benefit the herpetofauna community affected by the Project.

The recreation of mature forest and the microhabitats it provides is not possible in the short- to medium-term, due to the timescales required for vegetation communities to

mature. Appropriate secondary successional canopy species will be included in the mitigation planting (or follow-up enrichment planting) to increase habitat complexity in the long term. Ground cover plants will also be included in revegetation or follow up enrichment planting to provide habitat for terrestrial herpetofauna that utilise this habitat type.

Site preparation for revegetation will aim for heterogeneity as opposed to a homogenised flat surface prior to planting. Habitat complexity will be incorporated with artificially created mounds and slump as well as the incorporation of habitat recycling which could include the importation of epiphytes and woody debris from tree felling. Stripped topsoil during the construction phase will be recycled and used across revegetation areas, given that the diversity of soil organisms (symbiotic Mycorrhizae, invertebrates, fungi etc) within the mature forest environment may not be able to be recreated artificially. The presence of a seed bank within this topsoil will also facilitate revegetation and provide a greater species diversity more reflective of the one lost.

6 Conclusions

While baseline surveys are ongoing, this assessment provides a strong indication that the Project's potential adverse effects on native herpetofauna can be appropriately addressed and managed. The most significant potential effects identified are habitat loss and direct injuries and mortalities during vegetation removal.

Recommended ecological management to mitigate potential adverse effects on herpetofauna include:

a the inclusion within the ELMP of appropriate herpetofauna management to be implemented prior to, and during, vegetation removal to avoid or minimise the likelihood of herpetofauna injuries or deaths, and

b a long-term pest management programme to mitigate residual effects as described in the Ecological Effects Assessment – Ecological Mitigation and Offset Report (Technical Report 7h, Volume 3 of the AEE).

Overall, taking into account these measures, it is considered that any effects of the Project on herpetofauna are likely to be negligible, and possibly positive in the medium- to long-term.

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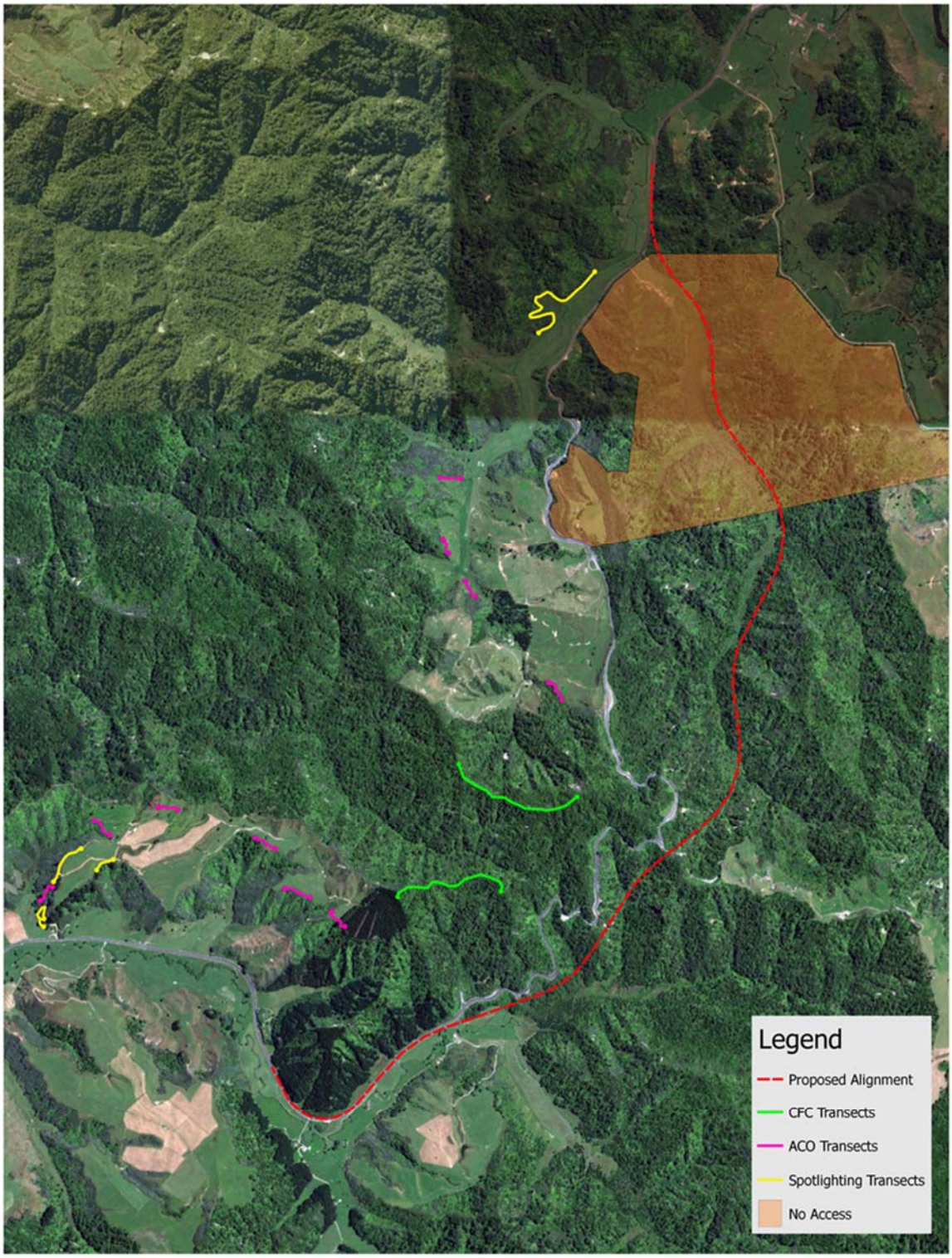
Appendices

Appendix A: Field Survey Effort



ECOLOGY NEW ZEALAND

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0 250 500 750 1000 m

1:20,000 @ A3

Projection: WGS 84 / Pseudo Mercator

Sources: Map data ©2015 Google, Alignment shapefile provided by Tonkin and Taylor

Mt Messenger

Lizard Survey Effort

Date: 10 October 2017 | Revision: 2

Plan prepared for the Mt Messenger Alliance by Ecology New Zealand Limited

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