REVIEW OF ECOLOGICAL ASPECTS OF THE PROPOSED REROUTING OF SH3 AT MT MESSENGER, TARANAKI

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REVIEW OF ECOLOGICAL ASPECTS OF THE PROPOSED REROUTING OF SH3 AT MT MESSENGER, NORTH TARANAKI

Valley to east of SH3, Mount Messenger

Contract Report No. 4402a

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1. INTRODUCTION

New Plymouth District Council commissioned Wildland Consultants Ltd to provide an independent audit of the ecological components of a resource consent application to reroute SH3 at Mount Messenger, Taranaki. The New Zealand Transport Agency has selected a preferred route that passes to the east of the existing SH3 at Mount Messenger. The regulatory processes are being navigated by an Alliance led by Tonkin & Taylor, and the following ecologists are in the Alliance:

- Opus International: John Turner, Roger MacGibbon.
- Tonkin and Taylor: Brett Ogilvie, Matt Baber.
- Ecology NZ: Simon Chapman (bats and herpetofauna).
- Independents: Nick Singers (vegetation), Keith Hamill (aquatic), John McLennan (birds), Corinne Watts (Landcare Research; invertebrates).

A site meeting with New Plymouth District Council, Taranaki Regional Council, New Zealand Transport Agency, the Alliance, and Wildlands was held on 5 September 2017. Following this, specialist reports covering vegetation, marine ecology, herpetofauna, bats, aquatic habitats, and terrestrial invertebrates, were supplied, prior to lodgement, to Wildlands in October 2017.

This report provides an initial assessment of the Alliance specialist ecology reports, to assist New Plymouth District Council with processing of the consent applications.

2. METHODS

- A literature search was undertaken to identify relevant ecological information pertaining to the site, which was then collated and reviewed.
- An on-site meeting was undertaken with the client, New Zealand Transport Agency, Taranaki Regional Council, and Alliance representatives on 5 September 2017.
- Vegetation and habitat types, within the proposed footprint and the wider area, were viewed from several roadside vantage points. At two locations, forested areas were briefly explored on foot: one site in the Parininihi Forest, to the east of the proposed alignment, and one site in the lower valley at the southern end of the proposed alignment, where the road will pass through tawa-dominant forest.
- Samples of obvious insect damage to indigenous plants were collected for later identification and analysis, together with samples of forest litter.
- Representative photographs were taken in the field and these are provided in Appendix 1.
- Specialist ecology reports for the assessment of ecological effects were received from the Alliance on 4 October 2017 (for bats, aquatic habitats, marine ecology, and terrestrial invertebrates), 6 October 2017 for herpetofauna and avifauna), and 16 October 2017 (vegetation and mitigation). The staggered release delayed the overall review as many of the reports are inter-related and the last two released are fundamentally important to various other specialist areas.

- The Alliance reports were assessed by relevant specialists, mostly using a consistent review structure:
  - Methods.
  - Assessment of effects.
  - Information gaps.
- Separate assessments were made of the proposed ecological mitigation and the offsetting approach used.
- Inconsistencies between reports were identified.
- A summary of key issues was produced, followed by a succinct conclusion.

3. ECOLOGICAL CONTEXT

3.1 Overview

Mount Messenger is located within the North Taranaki Ecological District (254,876 hectares), on the west coast of the Taranaki Ecological Region. The Ecological District is primarily composed of steep, finely dissected hill country most of which is below 300 metres in elevation. North Taranaki Ecological District is bounded by the Herangi, Waitomo, Taumaranui, Matemateaonga, and Egmont Ecological Districts to the north, east, and south, while the western boundary abuts the Tasman Sea.

3.2 Vegetation

In pre-human times, North Taranaki was almost entirely forested, apart from very small areas of scrub and herbaceous plants on the coast, on river cliffs, and in the relatively small areas of wetlands. In present times, broadleaved coastal tree species dominate indigenous forest remnants up to one kilometre inland. Kohekohe (*Dysoxylum spectabile*), karaka (*Corynocarpus laevigatus*), pūriri (*Vitex lucens*), and pukatea (*Laurelia novae-zelandiae*) are typical species, with tawa (*Beilschmiedia tawa*) in sheltered places.

Further inland, hill country is dominated by tawa, with hīnau (*Elaeocarpus dentatus* var. *dentatus*), rewarewa (*Knightia excelsa*), northern rata (*Metrosideros robusta*), and other broad-leaved species. Podocarps, especially rimu (*Dacrydium cupressinum*), become common. Steeper slopes and poorer soils may be dominated by kamahi (*Weinmannia racemosa*), and ridge crests are commonly dominated by hard beech (*Fuscospora truncata*), Hall's totara (*Podocarpus laetus*), tānekaha (*Phyllocladus trichomanoides*), and miro (*Prumnopitys ferruginea*).

Valley floors have remnants of podocarp forest. The fertile and sometimes poorly drained flats are where kahikatea (*Dacrycarpus dacrydioides*) is usually dominant, with pukatea, black maire (*Nestegis cunninghamii*), narrow-leaved maire (*N. lanceolata*) and, more locally, maire tawake (swamp maire, *Syzygium maire*), matai (*Prumnopitys taxifolia*) and totara (*Podocarpus totara*) also present. Swamp forest adjoins estuarine shrublands and reeds in the lower Mokau River, a sequence which is rarely seen in New Zealand today.

Large areas of shrubland are regenerating after historical forest clearance. Mānuka (*Leptospermum scoparium* agg.) is usually the dominant species, and successions develop quite quickly to forest. More stable shrub communities occur on the coast, on inland cliffs, and in wetlands. Estuaries such as the Mokau have saltmarsh ribbonwood (*Plagianthus divaricatus*) which, in less saline zones, grades into long-lived mānuka with harakeke (*Phormium tenax*) and sedges, then swamp forest.

Scrub on coastal cliffs is usually a narrow band between herbfields or rushes on the seaward side and low stature forest inland. Shrub species include taupata (*Coprosma repens*), karo, mingimingi (*Leucopogon fasciculatus*), hangehange (*Geniostoma ligustrifolium*), and kawakawa (*Piper excelsum*), mixed with harakeke, sedges, and toetoe (*Austroderia fulvida*). Invasion of coastal cliff communities by pampas (*Cortaderia* spp.) has become a major threat since the mid-1990s. Vegetation cover on inland cliffs varies according to aspect, slope, moisture and geology. Common shrubs include indigenous 'heaths' such as *Gaultheria* spp. and *Dracophyllum strictum*, tutu (*Coriaria arborea*), koromiko (*Veronica stricta*), and shrub daisies *Olearia townsonii* and, locally, *Brachyglottis turneri*.

3.3 Rivers

North Taranaki Ecological District has several notable waterways, including the Awakino, Mokau, Tongaporutu, Waitara, and Mohakatino Rivers. Most rivers flow east to west, although the upper Waitara River, a large catchment that occupies much of the southern half of the Ecological District, flows southwest then northwest. The larger rivers are characterised by meandering courses and deep, slow-moving water, with estuaries at the coast. The Awakino River rises in the rugged bush country of the Herangi Ranges, west of Te Kuiti, and flows south via the settlement of Mahoenui from where it runs alongside State Highway 3 to the Tasman Sea at Awakino.

3.4 Topography, geology, and climate

North Taranaki Ecological District mainly comprises dissected steep and broken sandstone and mudstone hill country. Old, elevated surfaces remain as the Waitaanga and Mt Damper plateaus. On broken hill country, mass movement and surface erosion are very common. Hill country generally slopes from east to west, with the highest point being 602 metres above sea level. Most of the land is under 300 metres a.s.l., while over 80% of the slopes are steeper than 20 degrees.

The primary underlying rock types of the North Taranaki Ecological District are Miocene sandstone and mudstone, although a narrow band of uplifted marine terraces occurs along the coastline, with cliffs 30-60 metres high. River mouths feature sandy estuaries, spits and sand flats. There are coal seams in the Mokau coalfield in the north of the ecological district. The hill country soils are shallow and have low fertility, but gentler land has volcanic ash deposits which produce deep well-drained soils. The climate is characterised by warm humid summers, and mild winters.

3.5 Land cover and threatened land environments

The New Zealand Land Cover Database Version 4.1 (Landcare 2015) was used to provide a current assessment of the land cover of the North Taranaki Ecological District. It shows that *c.*37.3 percent of the Ecological District has been developed (including 34 percent in farming and agriculture and *c.*3 percent with an exotic forest cover, mostly plantation), *c.*55 percent is in indigenous forest, *c.*6 percent is in indigenous scrub and fernland, <0.1 percent is in exotic scrub, <0.1 percent remains in herbaceous freshwater wetland or flaxland, and <0.1 percent in saline vegetation. This highlights the importance of any remaining freshwater wetlands in North Taranaki Ecological District.

Around ten percent of North Taranaki Ecological District contains land environments classified as 'Acutely Threatened' (< 10% indigenous cover left); less than one percent is classified as 'Chronically Threatened' (<20 percent indigenous vegetation remaining), while approximately 26 percent is classified as 'At Risk' (<30 percent indigenous cover remaining) (as per Walker *et al.* 2006). Most land within the Ecological District is classified as 'Less Reduced and Better Protected' (>30% remaining and >20% protected).

4. VEGETATION REVIEW

4.1 Methods

There are a number of shortcomings in the vegetation report, some of which are fundamental to how relevant vegetation types are assessed for ecological significance.

It is noted in Section 1.4 that initial ecological field work was undertaken in the Parininihi catchment (west of SH3), and investigations have been made of areas along the current road alignment (east of SH3) only in January and June 2017. This represents a very late change of focus in the investigation, which is likely to have resulted in information gaps. For example the project footprint within the northern part of Mangapekepeke Valley has not been surveyed as access permission was not granted.

Page 14 of the report outlines the consultation that was undertaken with various experts and agencies. It appears that consultation with NPDC was not undertaken nor was there any reference to the Significant Natural Areas (SNA) project that Wildlands is undertaking for NPDC. This particular project may be highly relevant to the Mt Messenger assessments, for example by providing useful context information.

In general, however, the desktop approach to determine important plant species is consistent with good practice, and the description of vegetation and habitats is meaningful. It is not clear why unbounded recce plots were established as these have relatively low utility for provision of quantitative information, and other more robust methods, such as measurement of tree stem diameters in fixed size vegetation plots, would have provided good quality data for the biodiversity offsetting model. Future baseline monitoring, as alluded to in Section 5.6 of the report, should preferentially use such quantitative methods, and use the information generated to provide inputs to a revised biodiversity offsetting model.

In Section 2.2.1.1 the criteria for identification of significant trees (i.e. large old emergent trees, which have important flowering or fruiting resources, or cavities for bat roosts) are not consistent with rejection of tawa, rewarewa, or kamahi, which are not included as significant trees, irrespective of size. No justification is provided for the rejection of these species as significant. The exclusion of these three species is not consistent with Table 3.1 on page 30 where tawa-rewarewa-kamahi forest is assessed as having 'High' to 'Very High' value. As the significant tree layer has been important for project design, this shortcoming will have generated potentially significant adverse effects on these three tree species that have not been accounted for, and therefore will not be mitigated for by plantings.

It is noted in Section 2.3 that the author used Davis *et al.* (2016) as a source of significance criteria, not the New Plymouth District Plan criteria. It is possible that this could result in significant differences in assessments. For example the 'naturalness' criterion of Davis *et al*. (2016) is not widely accepted in recent TLA significance criteria sets.

4.2 Assessment of effects

The EIANZ framework has been used to classify values and effects, but this framework is not universally accepted and the rankings in the tables used require subjective assessments in any case.

In Section 2.3.2 a five metre edge effects parcel is described in relation to the 'Project footprint'. Actual edge effects are likely to be much larger; it is standard to consider edge effects as encroaching 50-100 metres into an area of vegetation. Although the references cited illustrate the extent of typical edge effects, they are not used in the report. This gives the impression of reducing the affected area so as to minimise predicted adverse effects. The author considers five metres 'appropriate' but gives no evidence in support of this assertion.

The vegetation mapping in Figure 3.3 is reasonably coarse and it is therefore likely that some units contain several different vegetation types.

Mānuka communities, as mapped in Figure 3.3, were not fully surveyed, but from viewpoints were reported to contain pole kahikatea and rimu, and some larger trees. The report has ranked this vegetation type as 'low' in Table 3.1. This requires better justification following site visits, and better description of values, including its value as habitat for other species. Mānuka-dominant vegetation is often important habitat for herpetofauna and in the applicant's herpetofauna report (Section 3.1.3), mānuka scrub is noted as habitat for three 'At Risk' gecko species (elegant gecko, forest gecko, Pacific gecko), and in total, scrub is noted as of high or moderate habitat value for nine lizard species (Herpetofauna report, Table 3.3). Areas of pole kahikatea or rimu should be mapped and assessed separately from the mānuka communities in which they occur as Nicholls (1956) noted the relative scarcity of regeneration of rimu, kahikatea, and matai in Taranaki hill country forest.

In Table 3.1, kahikatea-swamp maire forest is only ranked as 'High'. Given its rarity and representativeness, this vegetation type should be one of the highest value forest types. It is also noted that dry cliff is ranked as 'Moderate' but could be habitat for uncommon species, and thus may warrant a higher ranking.

On Page 31 of the report it states that the project has been designed to avoid the largest example of swamp forest and wetlands. However, smaller examples, which will be significant, will still be affected, as described on page 32.

On Page 32, a very good example of an indirect effect of roading is described, where the road formation will change hydrology by acting as a barrier to the movement of water. There may be other places where this will also occur along the route, and these should be assessed carefully.

Descriptions of 'pole kahikatea forest' on Page 33 repeatedly emphasise the adverse effects of grazing animals and weeds. However, these fragments would easily recover if fencing was constructed to exclude stock. In addition, the trees in the photographs are larger and older than the text descriptions of 'poles' suggests.

In Section 3.4.2 the kahikatea/*Carex* spp. treeland would be better classed as a *Carex* sedgeland with emergent kahikatea, thus reflecting its wetland status.

The whekī-ramarama vegetation type described as potentially affected in Section 3.4.4 appears to be an ecologically interesting and important habitat, but is not included in Table 3.1.

All alluvial forest, whether secondary or primary, should have been assigned 'Very High' ranking, due to the significantly reduced extent of this forest type locally, regionally, and nationally. All herbaceous freshwater wetlands dominated by indigenous species should also be ranked as "Very High' or "High', as less than 0.1 percent of this vegetation type remains in North Taranaki Ecological District. It should also be recognised that these areas of alluvial forest often form intact sequences with hillslope forest, and these ecological sequences are also significantly reduced at a national scale.

The miro-rewarewa-kamahi forest' described in Section 3.5.3 appears to be a distinctive and diverse ridge forest community, which also provides habitat for the regionally distinctive species *Astelia trinervia*. Its high rating in Table 3.1 is therefore appropriate.

Table 3.2 contains no large rewarewa, tawa, or kamahi, due to the non-justified exclusion of these species from the 'significant tree' definition. As described above, this means that adverse effects on significant trees will have significantly under-estimated the actual number of large trees that will be cleared.

Section 3.9 (Rare and threatened plants) does not address adverse effects on *Astelia trinervia*, which was listed in the vegetation description for miro-rewarewa-kamahi forest and was identified in Section 2.1.1 as regionally distinctive. This section also notes the presence of the epiphytes kohurangi and *Pittosporum cornifolium* on large podocarps, emphasising the importance of large trees as habitat, which is not easily replaceable.

In Section 4.1, only two New Plymouth District Plan criteria are referred to, and they are not the criteria defined in Schedule 21.1 of the Operative Plan, nor those in Policy IB-P1 of the draft New Plymouth District Plan. The assessment of significance needs to be re-assessed based on the full set of operative significance criteria.

In Table 4.1, different vegetation units have been grouped into broad ecosystem categories. This means that the significance of particular units (e.g. kahikatea-swamp maire forest) has been downgraded because of the inclusion of other vegetation types of lower value within the same ecosystem type. Also, the tawa, kohekohe, rewarewa, hīnau, podocarp forest (WF13) at the southern end of the route is described in the report as being in “a high ecological condition” (Section 4.2.3), with a highly representative diversity of palatable trees, and contains several significant trees. By lumping this unit with the more modified northern area, it is only given ‘Moderate-High’ importance. In Table 3.1 two examples of this forest type are ranked ‘High-Very High’, which is a more appropriate rating.

The significance of each vegetation unit needs to be evaluated and other biodiversity values, such as habitats and populations of indigenous fauna, also need to be included and addressed in the ecological significance assessment.

On Page 58 of the report, it is concluded that roadside batters will be suitable for cliff specialist species and that this will address the loss of 0.4 hectares of mapped cliff habitat, and thus the project should have a positive effect on cliff communities in the long-term. This assertion is not based on sufficient evidence.

On Page 62 the effects of loss of large trees is discussed, and it is considered that pest animal control can mitigate some of the loss. Effects of pest animal control on the health of large trees have not been quantified, so the extent to which pest animal control could mitigate the effects of loss of large trees is uncertain. In general, it is very difficult to mitigate the adverse effects of loss of large trees which may be over 500 years old. They are not able to be replaced, except in extremely low timeframes, as the report notes.

The discussion on Page 63 illustrates why an additional five metres of habitat loss along edges may not adequately deal with edge effects. The applicant notes that forests within 50-100 metres of edges will experience changes in environmental conditions, and also notes the potential increase of windthrow for large trees retained on forest edges. The relationship between newly-cut forest edges and additional subsequent tree loss, post clearance is well established for New Zealand forests (Martin and Ogden 2006).

The applicant only includes an additional five metres for calculation of edge effects, and the use of a five metre buffer is not backed up by any evidence. Additionally, the assessment of loss for significant trees (Table 3.2, Figures 3.19 and 3.20) appears to regard significant trees as retained if they are beyond the project footprint, regardless of distance from the edge of clearance. The applicant should acknowledge that some significant trees will be lost in the future, due to ongoing windthrow and other edge effects, as discussed above, and include these in the calculations for mitigation plantings. Plantings should compensate for all significant trees within project footprint, and those within at least 50 metres of the maximum extent of clearance.

Discussion of numbers of important plant species on Page 64 states that swamp maire was the most abundant regionally distinctive plant. Whilst this is likely to be the case where the footprint includes swamp forest, *Pittosporum cornifolium* is likely to the be most widespread regionally significant plant throughout the route. The regionally distinctive *Astelia trinervia* is also omitted from the discussion of effects on regionally distinctive plant species.

On Page 66, the overall unmitigated magnitude of effects on vegetation is assessed as only 'High' despite the two most affected types being associated with 'Very High' effects. The overall effect of vegetation clearance is actually 'Very High'.

In Section 5.2.2 (Avoidance of effects through optimisation of the Project footprint), measures such as incorporating a tunnel and bridge into the design are noted, but may partly have been due to the need to maintain smooth gradients rather than purely for avoidance of adverse effects on ecological values.

A number of other measures are proposed to avoid and minimise adverse effects. These include the propagation and relocation of threatened plants, although such activities are always associated with significant uncertainty and thus best included as mitigation, not minimisation. A key focus for avoidance should be the kahikatea remnants on alluvial flats in the Mangapepeke Valley, and other alluvial forest vegetation.

On Page 70 of the report it is noted that greater than estimated loss could occur, for example if landslides result from earthworks that are greater than the area of loss estimated.

On Page 73, the report states that the areas of highest ecological value in the project footprint are 1.231 hectares of kahikatea forest (refer to Table 4.4) and areas of hill-country forest. It is notable that the applicant does not state the type or extent of hill-country forest to be lost, and this comprises 19.852 hectares of tawa, kohekohe, rewarewa, hinau, podocarp forest. The applicant notes that this forest type is a "national uncommon ecosystem type (Table 4.4).

What is certain is that the road project will have a very significant adverse effect on the forest vegetation through which the road traverses, both from the predictable direct clearance required to clear the way for road construction, indirect and ongoing edge effects such as climatic alteration, windthrow of trees, and altered hydrology, and from unpredictable direct effects such as increases in erosion, landslides, and sedimentation effects.

The control of introduced pest animals is "the major focus of mitigation" and the applicant recognises that "most gains would quickly be lost within 10-20 years if management stopped" (Section 5.1). The applicant describes the pest management programme as "long-term" (Section 5.4). To act as the major component of the mitigation package, the habitat loss associated with road construction needs to countered by pest control in perpetuity.

4.3 Information gaps

- Incomplete field assessment of indigenous vegetation in the north of the project area (Mangapekepeke Valley).
- The assessment of significance needs to be undertaken with respect to the full criteria set in the operative New Plymouth District Plan.
- Justification needs to be provided for the failure to account for significant, large, tawa, rewarewa, and kamahi trees. Alternatively, adverse effects on these trees need to be assessed and avoidance and mitigation proposals developed to address these effects.
- Edge effects need to be more accurately estimated and avoided, remedied, or mitigated, including allowance for additional loss of significant trees on newly-exposed forest edges.
- More comprehensive evaluation is required of potential adverse effects on *Pittosporum cornifolium*.
- Failure to account for adverse effects on the regionally distinctive *Astelia trinervia* needs to be rectified.
- Further work is required on the mitigation package.

5. BAT REVIEW

5.1 Methods

The desktop review largely focused on the following reports:

- Opus (2017a). Mount Messenger Bypass Investigation. Bat Baseline Survey and Preliminary Assessment of Effects, April 2017. New Zealand Transport Agency
- Opus (2017b). Mount Messenger Bypass: Option MC23 - Bat Survey Addendum, Memo dated 25 July 2017.

However, at the time of writing, these reports had not been provided by the applicant with the report for review.

Data used to assess the bat fauna within the proposed project area is of limited use as the surveys occurred only within the winter and autumn periods when bats are less likely to be active. It has been acknowledged by the authors that surveys took place at sub-optimal times of year (Section 1.4 Background to the ecological assessment of the Project):

> "*In the absence of detailed baseline fauna surveys undertaken during the optimal season within the Project footprint, it has been conservatively*

assumed that species recorded west of SH3 are also present in similar habitats to the east of SH3".

In Section 2.2.2.2 ABM deployments on Page 16 it states:

> "*Winter is not the ideal time for bat surveys in New Zealand as both native species utilise torpor (periods of substantially reduced activity best described as short-term hibernation) to conserve energy during periods of cold weather"*.

It was therefore assumed by the applicant that species present to the west of SH3 are also present in similar habitats to the east of SH3.

In addition to records from the west of the project footprint, the Department of Conservation bat database (received 24 July 2017) includes records of both long-tailed bats and central lesser short-tailed bats approximately seven kilometres to the east of the project footprint in 1994 and 1995, as well as more recent records of central lesser short-tailed bats from Mt Damper, approximately 20 kilometres east of the project footprint in April 2016. The older records are closer than the 15 kilometres quoted in the report, and indicate that both species should be considered highly likely to be present within the project footprint. Despite this being the case, the authors suggest that it is "*unlikely that they [short-tailed bats] are present within the Project footprint*" (Executive Summary Page 3).

5.2 Assessment of effects

The assessment of bat ecological values within the Project footprint have been assessed as "Very High" for long-tailed bats and "High" for central lesser short-tailed bats. This is reasonable, given the relatively high threat classification ranking of both species. However, the threat classifications of both species considered present in the footprint area require updating. A recent review of bat threat classifications found that long-tailed bats are now considered "Threatened-Nationally Critical" - that is, more threatened than previously described, whilst central lesser short-tailed bats ranking remains "At Risk-Declining" (O'Donnell *et al.* in press).

The five metre wide edge effects strip proposed by the applicant is too small given that the effects of roads on bats can extend over far greater distances. Berthinussen and Altringham's (2012) research into the effects of roads on British bat species showed that activity and diversity were affected as far as 1.6 kilometres from major roads. Recent research funded by the New Zealand Transport Agency (Borkin *et al.* 2016 as discussed in the bat report which presented information from Smith *et al.* 2017a) shows that roads affect long-tailed bat activity. Along roads, Borkin *et al.* (2016) and Smith *et al.* (2017a) found long-tailed bat activity was reduced compared to edges 200 metres or more distant from roads used at night. This is contrary to the suggestion by the applicant that long-tailed bats may benefit from the increased edges due to the road's construction. In addition, in Section 4.3.3 Edge Effects, the applicant's vegetation report acknowledges that effects on forest structure may occur along newly-created edges due to changes in "*diurnal fluctuations in light, temperature and humidity*" for distances 50-100 metres from the forest edge. Edges are:

"*typically drier and hotter than forest interiors, with elevated tree mortality." "Large roads can also alter wind patterns within a forest, and combined with a loss of vegetation shelter, branch damage and or windthrow (especially of tall trees) adjoining the new road, adverse effects are likely to occur, potentially for several decades after construction. Predicting the scale of these effects is speculative because windthrow could also have occurred even if the forest remained intact. It is reasonable however to expect that edge effects will occur from the road construction and will result in impacts to adjoining vegetation. Tall trees are likely to bear the greatest impact of this effect, especially those which suffer root damage during construction and/or exposure to increased windiness"*.

The oldest and tallest trees in indigenous forest are those most likely to be selected by bats as roosts (Alexander 2001; Sedgeley and O'Donnell 1999). Consequently, the effects of new edge creation, as required by this project, may be substantially greater than the five metres suggested by both the bat report and the vegetation report, affect bat roosts, and remain long-term.

The report states in Section 4.2.3 Habitat Fragmentation:

"The Project also shifts this potential fragmenting feature [the road] *in the environment to the east away from the more contiguous and highly valued forested areas of Parininihi. Compared to the existing road, the Project design is likely to present less of a barrier for bat movements as it incorporates a tunnel and a bridge. In addition, the Project may provide long-tailed bats an opportunity to utilise the bush margins of the existing road edge for foraging"*.

In contrast to the assessment by the applicant, it is possible that the specific placement of the proposed road footprint along numerous watercourses including an "*ecologically significant wetland area*" may result in increased effects on long-tailed bats because this species are detected foraging along waterways at higher rates than in other locations (Borkin and Parsons 2009). The project does not "*shift this potential fragmenting feature*"; it adds an additional potentially fragmenting feature - another road. The cumulative effect of two roads placed relatively close to each other, both with their corresponding edge and potential barrier effects for long-tailed bats and short-tailed bats, is not addressed in the bat report.

The authors acknowledge in Section 4.2 Potential adverse effects on bats that:

"new roads have the potential to adversely impact bats, both during construction (e.g. as a result of direct physical disturbance) and on an ongoing basis from road operation and maintenance".

At least one key potential impact has been omitted from the assessment. Lighting during road operation, from both road and tunnel lighting, and from vehicle headlights, may affect bat activity. These effects have not been addressed in the proposed avoidance, mitigation, offset, and monitoring outlined in the Opus (2017) mitigation-focussed report.

The authors acknowledge that effects on the local bat population will be higher than their overall assessment ("negligible") if an occupied roost is felled. However, Section 4.4 Overall level of unmitigated effects assessment states that

> "*The loss of any occupied roost tree(s) would constitute an adverse effect of 'Very High' magnitude for both bat species"*.

It is unclear how the likelihood of this occurring is to be reduced given that vegetation removal protocols remain untested and their efficacy is unknown.

It is likely that residual effects will be greater than suggested in the bat report because the extent of pest management that is proposed as the main mitigation offset (562 hectares) is small in comparison to that required to protect long-tailed bat populations at roosts. O'Donnell (2014) identified that predator control to benefit bats should occur over a minimum area of 1000 hectares. Additionally, a recent study by O'Donnell *et al.* (2017) found no measurable benefits to bats when rats were controlled using bait stations over 650 hectares, and positive population growth rates were found when the area of control exceeded 3,000 hectares. It should be noted that possums also prey on long-tailed bats (O'Donnell 2000a).

The Opus (2017) mitigation-focussed report also suggests that region-wide benefits will occur for bats because:

> "*When the carrying capacity of each species is met "surplus" juveniles of mobile species (birds and bats) will move out into the wider Project area and increase populations in those areas. This is sometimes referred to as the "halo effect*" (Opus 2017: Section 4.4.4 Likely outcomes from intensive long-term pest management Page 38).

It is unknown whether the "*halo effect*", i.e. dispersal of juveniles to an area wider than their natal area (the area that they were born in) may occur for bats. This is because research into long-tailed bats shows that bats return to their natal social group to breed (O'Donnell 2000b). Social groups occupy traditional areas long-term, and individual bats rarely switch or leave their social groups rarely, although rates may increase as density increases (O'Donnell 2000b). During winter it appears that long-tailed bats remain in their summer areas and do not disperse to other areas (Griffiths 1996).

Consequently, the assessment of effects on bat fauna as "negligible" is not supported.

5.3 Information gaps

As no full survey of the project area has taken place during warmer months, when bats are more likely to be active and therefore detected (Smith *et al.* 2017b), it is premature to report definitively on the distribution of bat fauna within the project footprint. This is particularly the case for lesser short-tailed bats, which are notoriously difficult to detect even in areas where their presence is known or highly likely, because their echolocation calls attenuate over relatively short distances (Borkin and Parsons 2010). In addition, bat surveys are generally considered to only determine presence and not absence of bats, as suggested by this report, due to difficulties in detection. Furthermore, there is limited information provided about the placement of monitoring equipment (Automated Bat Monitoring units: ABMs), but what is provided raises doubt about the design of the early monitoring programme, and its likelihood of detection of short-tailed bats. For at least the initial surveys (of an alternative route's footprint, Section 2.2.2.2 ABM Deployment) these appear to have been placed largely at sites that would have been more likely to detect long-tailed bats than short-tailed bats (i.e. ridge line tracks and forest edges adjacent to farmland). This is because long-tailed bats are more likely to be detected along edges in comparison to short-tailed bats, which are more likely to be detected in forest interiors (O'Donnell *et al.* 2006).

No surveys for either bat species have taken place in the northern part of the project footprint.

The authors recommend that bat monitoring does not take place post-construction of the new road. Post-construction monitoring is recommended by the recently published NZTA Framework document (Smith *et al.* 2017c) in order to determine the effectiveness of mitigation measures. This also contradicts the Opus (2017) mitigation-focused report which suggests that monitoring will take place:

> *"to determine if the target outcomes [*of predator control*] are being achieved (Section 4.4.2 Page 36)".*

The authors instead suggest that effects will be such that this is not considered necessary because:

> "*the Project footprint represents only a relatively small proportion of the available habitat for bats in the wider Project area, and the benefits of large-scale long-term predator management for bats have been confirmed by a published study (O'Donnell et al. 2017)* (Section 5.4.3 Monitoring)".

Information provided about the proposed long-term predator management suggests that its extent will be too small to adequately protect roosting areas of long-tailed bats, and expected benefits to bat populations are therefore unlikely to occur. In the Eglinton Valley (Fiordland), long-tailed bat populations were not protected adequately when predator control took place over only 650 hectares, and only appeared sufficient to protect populations, or social groups, when the control took place over greater than 3,000 hectares (O'Donnell *et al.* 2017). The proposed "*intensive long term integrated pest management*" will apparently take place "*over a core area of 222 hectares plus an additional 340 hectares buffer area, for a total area to be managed for pests of approximately 560 hectares* (Section 3.3.2.2 Offset of residual effects (as derived from the Biodiversity Offset Calculation Report - see Appendix A; Opus 2017)." However, the buffer that is suggested will only be maintained "*where it is practicable to maintain such a buffer* (Opus 2017: Section 4.4.2 Proposed pest management strategy, Page 37)", and possibly not to the same level as the core management area:

> "*This buffer area, if managed to the same intensity as the core area, is expected to be sufficient to reduce to low levels the number of pests that reach*

the core management area." Opus 2017: Section 4.4.3 Pest Management Area Page 39).

Consequently, doubt remains about the extent of the proposed mitigation and its ability to mitigate or offset residual impacts.

In the report focusing on mitigation, Opus (2017) reported that radio-tracking of bats will take place prior to the commencement of construction to identify the location of bat roosts. It should be acknowledged that whilst this approach may identify bat roosts, if bats are able to be captured and their roosts found, it is unlikely to identify all bat roosts in the vicinity or within the project footprint.

The report refers to the vegetation report to support this technical report on effects on bat species. The bat report appears to rely heavily on the baseline habitat assessments included in the vegetation report to predict which fauna would be present in the project area. Both the vegetation report and the bat report did not survey the area in the northern Mangapepeke Valley, and this is a significant information gap.

The area of pest management that is proposed in the Opus (2017) report is 560 hectares (Executive Summary). Whilst it is acknowledged by this reviewer that predator control is the most effective tool in the tool box to improve survival of long-tailed bats, this is only the case if predator control takes place over large areas (O'Donnell 2014; O'Donnell *et al*. 2017). O'Donnell (2014) suggests that predator control designed to protect long-tailed bats at their roosts should take place over areas of at least 1000 hectares, and preferably over several thousand hectares. The proposed pest management area is far smaller than this.

There is no supporting evidence provided for the assessment of areas of vegetation communities and their suitability for indigenous bat roosting (Table 3.1). Indeed, there is evidence that long-tailed bats do use tree ferns as roosts (Borkin and Parsons 2011) but this vegetation type (mānuka-treefern scrub) has not been considered suitable for roosting in the bat report. The information supporting habitat suitability assessments in Table 3.1 is a significant information gap.

Areas considered important to bats have not yet been identified. Work beginning to aid an understanding of the relative importance of areas to bats is planned to take place over summer 2017-2018. This is a significant information gap.

In conclusion, the authors of the bat report acknowledge that surveys for bats are not complete. As such, significant information gaps remain:

- The lack of a full, and robustly-designed, survey of the project area over the warmer months of the year, followed by analysis and subsequent significance assessment.
- Supporting evidence for habitat suitability assessment for bat roosting as outlined in Table 3.1 in the bat report.
- Information about, and identification of, areas considered important to bats within the project footprint.

- Information regarding the presence and distribution of bat species in the proposed long-term predator management area.

6. AVIFAUNA REVIEW

6.1 Methods

Forest and farmland bird surveys were undertaken using five-minute bird counts along the original 'MC23' alignment to the west of the current highway. This presents some limitations for the assessment of avifauna presence within the project footprint, given that no surveys have been undertaken (or at least, no data is presented) within this area, which is to the east of SH3. This may not be a major issue for forest birds (see below), but presents a significant information gap for wetland birds, as no wetland habitat was present in the original alignment.

The authors state that potential avifauna values of the eastern block are likely to be similar, or lower than, the Parininihi block to the west where avifauna monitoring was carried out. The justification for this is that the forest type may be considered equivalent between Parininihi and the project footprint, but forest quality is considered to be lower, and there is a history of pest control at Parininihi. For forest birds, the assertion that avifauna values are equivalent or lower in the eastern block compared with Parininihi is likely correct, although for species that may be present in low numbers this cannot be confirmed without surveying both areas.

However, this is not the case for wetland bird species. No wetland habitat is present within the avifauna study area along the original 'MC23' alignment. In contrast, within the project footprint, the authors identify the area of "greatest ecological significance" to be the "hydrologically intact swamp forest and non-forest wetland area in the valley floor of the northern Mimi River catchment … which offers potential habitat for various threatened wetland birds" (Section 1.5.2). Section 3.1.3 states that matuku (Australasian bittern; *Botaurus poiciloptilus*, Threatened-Nationally Critical; Robertson *et al*. 2017) "may be present in some of the raupo dominated wetlands in the Mimi River catchment", although it is not made clear how close to the Project footprint this is. Further, Section 3.1.4.2 states "fernbird and spotless crake have been detected in close proximity to the Project footprint (as noted in the Assessment of Ecological Effects - Vegetation (Technical Report 7a, Volume 3 of the AEE))"; but it is not made clear what distance "close proximity" refers to, and review of the cited volume found no reference to either mātātā (fernbird; *Bowdleria punctata vealeae*) or pūweto (spotless crake; *Porzana tabuensis tabuensis*). The lack of information about wetland species presence in the project footprint is a major information gap.

There are also some gaps and inconsistencies within the methodology and results sections. For example, in Section 1.4, it is mentioned that "data have been gathered along the project footprint during the 2017 autumn and winter periods to augment this earlier survey information obtained to the west"; however, no mention of this data is found subsequently in either the methods or results, with only the spring/summer surveys to the west presented.

In Section 3 there is a mention of koekoeā (long-tailed cuckoo) being noted in "audio recordings made from February to March"; however, no previous mention of audio recordings is made in any other part of the report.

All North Island brown kiwi (*Apteryx mantelli*; At Risk-Declining) call count sites were located within Parininihi, with the exception of one count site that was located in the eastern Ngāti Tama block. However, in Section 3, it is stated that kiwi are widespread "both within Parininihi and the Eastern Ngāti Tama block", but it is not clear how it is known kiwi are widespread in the latter.

Counts were carried out for two to three hours per night, by one to two observers, at suboptimal times of year (c.f. Robertson and Colbourne 2017). As acknowledged by the authors, the survey methods used are considered to be appropriate simply for the detection of initial presence/absence at the locations surveyed, but the methodology would require some improvements were it intended to use this data as a baseline for counts in subsequent years with the purpose of detecting population trends.

Despite these shortcomings in methodology, the authors appear to have taken a conservative approach and assumed a relatively high density of kiwi within the project footprint, which is appropriate given the lack of surveys within the eastern area, and the 'At Risk' status of the species.

6.2 Assessment of effects

The authors expect the project "to have a 'Low' magnitude of unmitigated effect on wetland bird species", although they assume matuku (bittern) to be present (Section 4.3.4, in contrast to statement in Section 3.1.1, "bittern … may be present"). The authors reach this conclusion as they consider wetland habitat within the footprint to be degraded. However, higher value habitat is only *c.*300 metres from the project footprint. The effect on wetland bird species and populations cannot be determined without undertaking robust surveys for 'Threatened' and 'At Risk' wetland bird species, using correct methodologies at appropriate times of year. This has not occurred within the project footprint.

The statement "if any eggs or young are present during habitat loss activities, only a few birds (if any) are likely to be present" does not consider the potential population-level effects of such habitat loss. If only a few individuals of a particular species are present, the effects of loss of nests or young would be of 'High' magnitude, and could drive the species to local extinction. For 'Threatened' and 'At Risk' species, and regionally threatened species, such local extinctions may be significant and require consideration.

Sedimentation controls are proposed, and if effective, should avoid adverse effects on high quality wetland habitat outside and downstream of the project footprint. However, in a worse-case scenario in which sedimentation controls failed, potential effects on wetland birds may be 'High'. This is not addressed in the report, other than stating it has not been assessed given sedimentation controls have been developed.

Species such as matuku, pūweto, and mātātā are thought (by the applicant) to be present in the vicinity of the project footprint. The status of these species within the footprint is unknown. They are all classified as 'Threatened' or 'At Risk': matuku is 'Threatened-Nationally Critical', and pūweto and mātātā are both 'At Risk-Declining' (Robertson *et al.* 2017). Consequently, their status within the footprint needs to be assessed.

The authors acknowledge there is a possibility that kōkako (*Callaeas wilsoni*; At Risk-Recovering) will disperse into the project footprint, and acknowledge the uncertainty around the potential for construction activity to affect kōkako. They state that if this occurs, a 'Low' magnitude of effect is expected. There is a low probability of dispersal, but suggest that there is some uncertainty around this assessment that will only be resolved with time (i.e. ongoing releases and monitoring of post-release dispersal of kokako). However, if any released kōkako do disperse and settle within the project footprint, the magnitude of effect would be 'Moderate' to 'High', as habitat clearance would disrupt breeding activity during the critical early years of the reintroduction attempt. Section 3.1.4.1 states that the Translocation Proposal noted that kōkako dispersing beyond Parininihi could be caught and moved back. We consider that this is highly unlikely to be successful, should it be attempted, because it is an unproven method, and there a high probability birds that would simply return to the site.

The authors state that "the road is likely to sever, fragment and isolate an area of North Island brown kiwi habitat", and "conservatively speaking, could potentially bisect or encroach on the territories of up to 15 pairs of kiwi". As above, this conservative approach is supported, as kiwi densities in the project footprint are unknown.

Page 71 of the vegetation report refers to the deployment of felled logs to benefit forest and wetland birds but it is not clear which birds are expected to benefit, and what the magnitude of these benefits might be.

6.3 Information gaps

The major information gaps in the avifauna report are:

- No survey of forest or farmland birds (with the exception of one kiwi call count site) have been undertaken within the project footprint, although surveys to the west of the footprint may be adequate for this purpose for these species. If baseline monitoring is required to enable comparisons with future counts, this will need to be undertaken within the Project footprint prior to the start of construction.

- No survey of wetland birds has been undertaken within the project footprint, hence it is not possible to accurately assess possible effects on wetland species.

7. HERPETOFAUNA REVIEW

7.1 Desktop methods

An appropriate desktop review was undertaken by the author to identify herpetofauna records over a period of 10 years and within a 50 kilometre radius, and thus guide the identification of likely lizard and frog species within the area. Additional consultation with the Department of Conservation Lizard Technical Advisory Group, landowners, and local iwi were also appropriate, as anecdotal sightings lead to a more robust understanding of herpetofauna within an area.

Habitat assessments were undertaken using aerial maps to create categories by which likely herpetofauna presence may be gauged, and particular survey techniques prescribed. Habitats were described with sufficient detail, along with the correct identification of lizard and frog species that may be likely to inhabit them. These descriptions are supported by Table 3.3 which ranks the suitability of each vegetation type against each potentially present species. These assessments were then ground-truthed in the field to ensure the technique was appropriate. This type of desktop and in-field assessment is considered an appropriate way to identify species specific habitat types.

7.2 Field methods

Artificial Refuges - ACOs and Closed Cell Foam Covers

The use of a range of survey methods, which included Artificial Cover Objects (ACOs), Closed Cell Foam Covers (CCFCs), and Visual Encounter Surveys, but would have ideally also included live traps such as pitfall and funnel traps. ACOs and Artificial Refuges (ARs) rely upon inspection during the precise time that a lizard is taking refuge, which varies between species and weather conditions. Unless a lizard is present, or has left behind scat or a sloughed skin, ACOs and CCFCs provide little indication of the presence of lizards or densities in a location. Another tool which is equally passive and easy to deploy, that might have been used in conjunction with, or in lieu of active traps, include tracking tunnels, which only rely upon a single encounter with the tunnel and an adequate print to confirm its presence. Many lizard prints can be distinguished to species level, and it is often possible to determine how many lizards of a given species have passed through a tunnel by various print sizes of feet or belly, and tail drag.

ACOs consisting of a single layer of Onduline were set up in a total of ten transects (each approximately 100 metres apart), with each transect including nine or ten stations (total of 96 single layer ACOs) along pasture and scrub margins. The author states that single-layered refuges were deemed appropriate for the likely lizard fauna of the area, however further justification for this is not given. The New Zealand Lizards Conservation Toolkit describes the best practice use of ACOs as two or three layers (Anderson *et al*. 2015). It is more common for skinks to be found at the lower layer of a double layered ACO stack, and this is supported by findings of O'Donnell and Hoare (2012) that skink detection is proportional to retreat area, not the number of layers. However, terrestrial geckos such as the common gecko (*Woodworthia maculata)* are frequently found to utilise the upper layer as well.

No ACOs appear to have been installed within interior forest areas (i.e. along the same transects that CCFCs were installed along) to target terrestrial skink species. It would have been beneficial to have included provisions to sample for skinks (in addition to opportunistic visual searches) throughout these forested areas, given they were accessible and in use for arboreal CCFC refuges.

Two transects consisting of 47 CCFCs were installed along accessible, pest-controlled ridgelines and left undisturbed for three months. The author correctly notes that geckos can take quite some time to take up residence within CCFCs and consequently left these undisturbed for three months, along with ACOs, which is an appropriate length of time.

<u>Visual Encounter Surveys</u>

Opportunistic visual and hand searches for terrestrial lizards and semi-aquatic frogs were undertaken during appropriate weather conditions, and in an appropriate manner, by inspecting ground cover objects, trunk crevices, ground vegetation, piles of woody debris and potential in-stream refuge objects. The author makes note of being guided by the Inventory and Monitoring Toolbox: Herpetofauna, to ensure that all searches were undertaken in a careful manner.

Spotlighting for nocturnal species was restricted due to steep terrain, and associated safety concerns. This is acceptable, however, it means that significant knowledge gaps around gecko presence and density remain for the majority of the area surveyed. As such, it is risky to make any assumptions around gecko abundance in the project footprint, particularly when much of it will also be inaccessible when the time comes to survey it.

Overall, assessment of field survey methods are that the number of transects, survey devices and visual encounter surveys (VES) throughout the various vegetation and habitat types within the MC23 alignment were appropriate.

<u>Seasonality</u>

The time of year in which the surveys were undertaken (throughout summer and autumn 2017) were appropriate, however, these surveys were undertaken in the MC23 alignment, to the west of SH3, and not within the Project footprint. Consequently, preliminary opportunistic VES undertaken in the correct footprint were not undertaken until winter. The failure to detect lizards during winter is not indicative of the absence of lizards, as winter is not considered a suitable time of year for lizard surveys due to reduced lizard activity, and therefore reduced lizard detectability. This is acknowledged in the report.

7.3 Transferability of survey results

The author comments in Section 2.2.1 on the quality of habitat within the Project footprint as lower than the survey area, due to a lack of consistent pest control. This is used to justify the transferability of the survey results from the MC23 alignment, to the project area. This is a poor assumption as i) spatial distribution and dispersal behaviour of New Zealand lizards remain poorly understood, ii) indigenous lizards are anecdotally reported to commonly be found in degraded habitats, and iii) several indigenous lizard species, including Duvaucel's gecko (*Hoplodactylus duvaucelii)* and common gecko, have been found to exhibit spatially aggregative behaviours, with large populations holding residence in a small discrete areas, despite the abundance of suitable available refugia throughout the wider environment (Hare *et al.* 2016). In effect, surveys which do not incorporate all potential areas of habitat within a given area, along with a variety of survey techniques, may not detect spatially clustered lizard populations even if a significant search effort is undertaken.

7.4 Assessment of effects

Identification of Constraints, Limitations, and Assumptions

The author acknowledges the heavy reliance of the report's impact assessment upon expert opinion, in the absence of having formally surveyed the project footprint during the appropriate season. They state that the results of the MC23 alignment survey (no lizard detections), combined with expert opinion, are sufficient to make conservative impact assessments for herpetofauna populations within the project footprint, and then proceed to rank risk accordingly.

The author uses specialist opinion in Section 2.3 to adapt the EcIA guidelines (EIANZ 2015) and form assessments on i) ecological values, ii) magnitude of unmitigated effect, and iii) level of unmitigated effect, to form overall conclusions on the potential impact of the project on resident herpetofauna populations. However, the use of this framework is questionable, given its reliance in assessing magnitude based on information of a "known population or range" (see Table 2.2), which the report author acknowledges they do not have.

Species Value Assessment

The attempt to modify the EcIA species value assignment framework has resulted in a number of contradictions which make it unclear whether Table 2.1, entitled 'Assignment of values within the footprint to species' is ranking lizards or habitat, or a blend of both. Confusion arises in the description of a species (for which relative value is categorised as either 'Very High', 'High', Moderate-High', 'Moderate', or 'Low'), that is presented as if the value is being assigned to a habitat, rather than a species.

Excerpt from Table 2 of the Herpetofauna report:

Value	Species Value requirements
High	Important for Nationally At Risk species and may provide less suitable habitat for Nationally Threatened species.

If the intention of this modification to the framework is to assign value to both species and habitats, the title should be renamed to 'Assignment of value to habitats based on suitability to herpetofauna species'. However, if this is not the intention, which is likely, the report should have used the qualifiers as per Tables 1 and 10 of the EcIA guidelines that are specifically for assessing the value of a species for these purposes.

Furthermore, the lack of clarity around what is actually being 'valued' in Table 2.1 results in five 'At Risk-Declining' species being 'undervalued' in Table 4.1 of the report based on the misleading criteria (Table 1).

The EcIA guidelines are clear about the value of 'At Risk-Declining' species, and their value ranking as 'High'. The modified value assessment in Table 2.1 of the report downgrades the five 'At Risk-Declining' species from 'High' to 'Moderate-High', on the basis that there is i) a lack of certainty of their presence within the project footprint, and ii) the extent of their preferred habitat(s) within the project footprint (Section 4.1 of the report).

Table 1: Ecological values of herpetofauna within the project footprint based on threat status as per Hitchmough *et al.* (2016). (Adapted from Table 4.1 of Herpetofauna report). Species are highlighted if the applicant's value did not match the corresponding EcIA value.

Name	Threat Status	Applicant Value	EcIA Value
Archey's frog	Nationally Threatened	High	Very high
Brown skink	At Risk-Declining	Moderate-high	High
Common gecko	Not threatened	Low	Low
Copper skink	Not threatened	Low	Low
Duvaucel's gecko	At Risk-Relict	Moderate-high	Moderate-high
Elegant gecko	At Risk-Declining	Moderate-high	High
Forest gecko	At Risk-Declining	Moderate-high	High
Goldstripe gecko	At Risk-Relict	Moderate-high	Moderate-high
Hochstetter's frog	At Risk-Declining	Moderate-high	High
Northern grass skink	Not threatened	Low	Low
Ornate skink	At Risk-Declining	Moderate-high	High
Pacific gecko	At Risk-Relict	Moderate-high	Moderate-high
Striped skink	At Risk-Declining	Moderate-high	High
Overall score		**Moderate-high**	

This approach is inconsistent with their stated aim to be conservative (page 11 of the report). It is inappropriate to reduce the value of these 'At Risk' species because a survey has yet to be undertaken within the footprint, and due to the abundance of high value habitat present within the project footprint for each of these five species, as demonstrated in Table 3.3 of the report.

The overall result of 'Moderate-High' has been concluded for herpetofauna species, however, it could be considered as 'High' given the number of At Risk species that are potentially present, and the abundance of each of their preferred habitats throughout the project footprint.

<u>Magnitude of Unmitigated Effects</u>

Assessments of the magnitude of effects are used to describe the effects of the extent, intensity and duration of the works with respect to the availability of habitat in the area. The ranking system used in the report to identify the magnitude of unmitigated effects is consistent with the EcIA guidelines, which relies upon assessing magnitude against a "*known population or range"* of a species/ecosystem etc.

As the project footprint had not been thoroughly surveyed at the time of writing the report, and the report acknowledges this requirement, it is premature to make an assessment of magnitude of effects on an unknown population present and/or range of the thirteen herpetofauna species listed.

Habitat removal is appropriately identified as the most significant impact to herpetofauna populations, given the range and quality of vegetation and habitats within the project footprint. The potential for injury and mortality during the removal process is described, and the impact of this will be considered significant if a 'Nationally Threatened' (e.g. Archey's frog) or range-restricted species (e.g. Duvaucel's gecko) is encountered. The author correctly identifies the significant habitat value of mature forest, and that it cannot be recreated in the short to medium term.

Habitat fragmentation and resulting reduced gene flow is identified as having the next greatest impact on herpetofauna in areas of scrub and mature forest. The report states that the construction of a tunnel and bridge will provide two means of connectivity for populations between the east and west, however, this would only be for the proportion of lizards whose home ranges are within the immediate location of the tunnel and bridge. For all lizards that reside throughout the rest of the area, the hard barrier of the road will fragment the wider habitat that would otherwise be available to them. The applicant correctly identifies the fragmentation impacts of creating a second road, however then suggests that the impact of it will be minimised as road traffic will decrease along the old road. This is contradictory to the report's statement about roads acting as 'hard barriers that species or individuals within a populations would not be able to traverse', reduced traffic volume along the existing road is unlikely to have any positive effect on the fragmentation effects of creating a second road. The construction of the new road will result in the creation of an 'island' of habitat between the old and new roads, which will isolate resident lizard populations and render them vulnerable to edge effects (i.e. degraded quality of edge vegetation and habitat, and increased exposure to predation).

Taking the above impacts into consideration, the report states that the overall magnitude of unmitigated effects is 'Low-Moderate', and reflective "*of the fact that the herpetofauna population across the wider project area is unlikely to be affected in any meaningful way".* This seems to contradict the author's finding that the project effects upon an 'At Risk' or 'Threatened' species would be potentially <u>significant</u> if unmitigated. Given that ten of the thirteen species identified as potentially present within the footprint are classified as 'At Risk', there is a considerable likelihood that at least one or more 'At Risk' species will be encountered. Furthermore, the authors state in section 4.3.1 that:

> "*the unmitigated removal of over 40 hectares of habitat would nonetheless adversely impact a potentially significant herpetofauna community. It is possible that the project footprint contains critical habitat for one or more very rare species (e.g. striped skink)*."

In spite of this, the assessed magnitude of effects on seven of the species, four of which are classified as 'At Risk', is 'Low'. The author's justification for this is based upon a prediction of likelihood of a species being present, which is inconsistent with the habitats within the project footprint. As such, it is unclear how the magnitude of unmitigated effects for the removal of 34 hectares of complex and variable indigenous habitat has been assessed as 'Low' or 'Moderate' for unknown populations of thirteen herpetofauna species, with an overall effect of 'Low-Moderate'. This is inconsistent with the conservative assessment the applicant intended to make.

Overall Level of Unmitigated Effects

An overall assessment of unmitigated effects is gained by combining species values and the magnitude of unmitigated effects. The assessment relies on the ability to rank the magnitude of unmitigated effects, and currently there is no information regarding lizard and frog species within the project footprint. The overall assessment of 'moderate' made by the applicant would only be reliable if based on a robust spring or summer survey for herpetofauna within the Project footprint.

As this had not been done, results from a survey undertaken throughout the wider project area were used, and justified on account of pest control and differing habitat quality. The resulting overall assessment of effects, as described in Section 4.3, are that the unmitigated effects on resident herpetofauna, if their densities are comparable with those of area surveyed (i.e. below detectability thresholds), will likely be 'moderate'. Potential adverse effects are further broken down according to species, based on the threat status, with the exception of Archey's Frog, which is categorised as either 'low' or 'very low'. This conflicts with "the potential for the unmitigated impacts to be significant, pending the presence of 'At Risk' or 'Threatened' species". Whilst this assessment outcome may be consistent with the methods of the EcIA guidelines, it is the result of the incorrect assignment of values for At Risk species at the beginning of the assessment process.

The report states that "*it is likely that a number of herpetofauna species are present within the Project footprint, potentially including Archey's frog (which is Nationally Threatened) and/or other species that are Threatened*". However, it neglects to acknowledge that all herpetofauna species (irrespective of threat status), are absolutely protected under the Wildlife Act 1953. As such, the unmitigated impact of the project upon any species detected, should be considered as at least moderate, due to the removal of 34 hectares of good quality lizard habitat.

In conclusion, the herpetofauna report would have provided a more robust assessment of effects if it was prepared following a survey of the project footprint.

7.5 Proposed mitigation options

Key components of a lizard mitigation package include i) a robust lizard survey throughout the project footprint, ii) a detailed lizard management plan which describes capture and relocation methods, iii) pest control within the lizard release area, and iv) habitat enhancement within the lizard release area. These are appropriate measures to reduce the adverse effects of the project on resident herpetofauna populations.

A survey is planned to be undertaken during the fourth quarter of 2017, to better refine lizard management and reduce the risk of unexpected discoveries of significant herpetofauna populations within the project footprint. The report states that the findings of the survey will guide a lizard management component within a wider Ecological Management Plan, which is yet to be prepared.

The report briefly describes the likely survey techniques that will be used to capture lizards, but provides no detailed information on how these may vary with respect to different habitats and their respective assemblage of potential species. Additionally, it does not acknowledge the significant proportion of the development footprint that may not be surveyed due to lack of accessibility and safety concerns.

The mitigation report provides a higher level of detail on what will be included within lizard management plan, and states that it will include provisions for all of the usual, and expected activities for a project of this scale, including the provision for post-release monitoring. However on the same page of the report, in Section 3.6.3, it states that no post-construction herpetofauna monitoring is recommended, and that pest monitoring will serve as an indicator. Post-release monitoring should be a requirement, given the scale of the project, and the likelihood of At Risk and/or Threatened species being present.

Long-term pest control is proposed to mitigate adverse effects on lizard communities, however the control proposed does not include the management of mice, which are well documented predators of indigenous lizards (Newman 1984; Reardon *et al.* 2012).

7.6 Information gaps

Modifications to the EcIA guidelines have been applied in a way that is inconsistent, and as a result has under-valued ‘At Risk’ lizard species in order to achieve an overall unmitigated effect of ‘moderate’. The report concludes that once mitigation measures are applied, this will yield a net effect of ‘negligible’ or even a possible positive impact in the medium to long term.

This is an inappropriate conclusion to come to given a robust lizard survey has yet to be undertaken within the project footprint. Until these survey results are available and a specific lizard management plan has been prepared, there are major information gaps. The reporting will need to be revised and updated following the upcoming summer surveys.

8. TERRESTRIAL INVERTEBRATES REVIEW

8.1 Methods

Desktop methods used to assess the invertebrate fauna of the proposed project area were generally appropriate, with considerable effort put into obtaining available information from the collections of museums and CRIs, electronic databases, and published literature. Additionally, the author consulted with ten invertebrate taxonomists, covering a diverse array of invertebrate groups, to locate additional records from the project area.

A full field survey of the project area's invertebrates has not been undertaken as this needs to be implemented over the warmer months to match the emergence of adults of most species. A walkover of the project footprint was undertaken on 26 July 2017 to "assess habitat quality for invertebrates". This is reasonable and appropriate for that time of year. The report notes that one of the proposed routes, west of the current SH3, was visited in February 2017 and invertebrates were collected, identified, and stored.

8.2 Assessment of effects

Terrestrial community values within the project footprint have been assessed as "High" in the report. This is reasonable given that it is not based on a survey of invertebrates present within the project footprint, rather on a precautionary approach that extrapolates data from a proposed route to the west of SH3, combined with habitat observations from a short walkover of the proposed eastern route undertaken in July 2017.

To assess the terrestrial invertebrate values of the project footprint, a full survey is needed by appropriately trained and experienced personnel at the appropriate time of year over the project footprint. This assessment then needs to be put into a regional context.

New Zealand is renowned for its high biodiversity of invertebrates, high endemism, and the disharmonic nature of its invertebrate species (that is we are out of harmony with the rest of the world in having many global groups missing), and a high diversity of what is present. This high biodiversity is a function of having many species naturally occupying, relatively small areas. Therefore, it is extremely difficult to extrapolate from area to area even if they are geographically close. This means that a full survey of invertebrates must be carried out in the project footprint to see what is there. Groups that appear to be missing at present, such as peripatus and giant land snails, may be present in comparatively small natural habitats, and threatened species such as the forest ringlet butterfly may also be present.

Page 30 of the invertebrate report incorrectly states that the forest ringlet butterfly was once widespread throughout New Zealand. Both Patrick and Patrick (2012) and Wheatley (2017) state that the forest ringlet has (or had) a distribution south to Greymouth in the South Island, although it is relevant that two records of this species are known relatively close to the project area. As one of New Zealand's rarest butterflies with a conservation status of 'At Risk-Relict', a careful search of the project area and route should be undertaken by someone with knowledge of the ecology of this butterfly species to look for adults or larvae on the host plants in the genera *Gahnia* and *Chionochloa*, or larval damage on these species. As the invertebrate report states, two *Gahnia* species are recorded from the project footprint.

8.3 Information gaps

As no full invertebrate survey of the project area has been carried out it is premature to assess the invertebrate fauna of the project footprint, and its significance.

Therefore, the major information gap of this report is a full survey of indigenous invertebrates of the project area over the warmer months of the year, followed by identification, analysis, and a significance assessment.

To the author's credit, because of the late change to the proposed route, they were only able to carry out an invertebrate habitat assessment, rather than a full survey of invertebrates as had been done for the proposed route to the west of the current highway. Additionally, based on vegetation mapping associated with the new proposed route, and the data from the invertebrate survey of the former route, they predicted the invertebrate fauna likely to be present in the new project footprint. This has significant limitations despite only a five kilometre distance between the two proposed routes.

The author's recommendations under Section 5.5 of the report are to carry out sampling in late spring 2017-early summer 2018 and report on the results to provide "a robust sampling strategy will provide a clearer snapshot of the invertebrate fauna present along the project footprint".

To illustrate the diversity of invertebrates along the new proposed route, Appendix 2 lists the invertebrates collected by Wildland Consultants in September 2017 during a brief site visit. It is mainly based on obvious insect damage to foliage that was forwarded to the author (BP) for identification.

The literature search that was done appears to be adequate as a background to this invertebrate survey. This literature search clearly showed that no thorough or targeted invertebrate survey had previously carried out for the project footprint, once again highlighting the need for one, as recommended. A full invertebrate survey at the appropriate time of year covering a full range of invertebrate groups is clearly required to provide an assessment of the entomology of the proposed route, its ecological context and significance.

The proposed entomological survey of the newly proposed route to the east of State Highway 3 will focus on beetles, based on the statement on page 40:

> *"Due to the lack of taxonomic knowledge of a number of invertebrate groups in New Zealand, the research will focus on identifying beetle species, and their abundance, collected in pitfall and malaise traps".*

While beetles (Order Coleoptera) are the most speciose insect order in New Zealand, it is important that a number of other invertebrate groups of high conservation interest are included, as follows:

- Order Orthoptera (weta, grasshoppers, katydid and crickets) - several weta groups are of high conservation interest
- Class Mollusca, specifically giant land snails as these are of high conservation interest
- Phylum Onychophora (peripatus) - many species are of high conservation interest
- Order Lepidoptera (moths and butterflies) - a speciose and well-documented insect group with many species of conservation interest

9. AQUATIC HABITATS REVIEW

9.1 Methods

The desktop methods used to assess the freshwater ecology of the proposed project area are appropriate and comprehensive. Discussions with both the Department of Conservation and Taranaki Regional Council were undertaken in order to gain a better understanding of the site.

Sampling locations in relation to the proposed route are clearly marked on the accompanying maps. Field methods are well described in the report and are largely appropriate for the type of work undertaken, including surveys for fish and the sampling and analysis of aquatic macroinvertebrates. A broad range of habitat types were included in the study, and the results are clearly presented in the report.

Fish surveys were undertaken 6-9 June 2017 and 31 July-1 August 2017, which is not ideal timing given that generally fish are less active and less susceptible to capture when temperatures are low. To ensure that most migratory species are present in streams and can thus be captured in surveys, surveys for SOE type monitoring should generally not take place between 1 May and 30 November (Joy *et al.* 2013). In saying that, at least six fish species, two crustacean species, and one bivalve species were recorded during the surveys, and these are supplemented by records from the New Zealand Freshwater Fish Database (NIWA). It is also acknowledged that the author was working within a narrow timeframe.

The author provided a detailed and well-thought out approach to calculating the Environmental Compensation Ratios (ECRs). The assumptions the author made are largely justified with respect to determining potential SEV scores.

Two areas require clarification:

- It is not clear how the stream widths listed in Tables AC.2 and AC.3 were determined. Given that these widths form a critical part of the offsetting calculations, further clarity is required (note that this information has been requested from Tonkin and Taylor).

- In Section 2.7.1.2 the author states that the 'potential' SEV score for sites was based on applying hypothetical scenarios within the SEV calculator using expert judgement. It would be useful if these hypothetical scenarios, including predicted scores for each variable, could be provided in the same format as Table AC.1 (Results of SEV calculations sites along the route, Mt Messenger).

9.2 Assessment of effects

Unlike the other specialist reports, which focused on habitats to the west of SH3, the aquatic assessment was undertaken along the confirmed route to the east of SH3, which means that assumptions about freshwater values and potential effects on those values are well-informed and did not have to be extrapolated from other sites.

However, given that there is some uncertainty about the final design, the author acknowledges that stream offsetting may change with modifications in the designs.

Ecological values are listed against various habitat types in Tables 4.2 and 4.3 but it would be useful, however, to include a section in the report that summarises the overall ecological values for each sampling location.

The report identifies a range of potential short term and long-term ecological effects, which are summarised in Table 4.1. Each potential effect is described in detail together with the relevant measures for mitigation. Sedimentation is rightly identified as one of the key potential effects of the proposed works, particularly given the underlying geology of the area and the relatively high rainfall, which typically exceeds 1,900 millimetres per year. In particular, it highlights the risk of a catastrophic failure of erosion and sediment control measures on the kahikatea swamp forest. If such as failure does occur, the report states that *"further biodiversity offsets should be provided in addition to what is described in the report".* Some examples of these offsets would be useful given that such a failure is likely to cause long-term and possibly irreversible damage to the kahikatea swamp forest.

As part of the overall mitigation package the report states that Fish Recovery Protocols will need to be prepared together with Vegetation Clearance Management Plan, and a Stream Restoration Plan. These reports will require peer review in order fully assess the potential effects. For instance, it is not clear how diverted streams will be rehabilitated following the works.

Page 58 of the report states that:

> *"The Mangapepeke Stream and Mimi River upstream of the current SH3 have high potential for successfully improving stream values through riparian planting and restoration, subject to obtaining the necessary access rights. This is because the restoration can be contiguous with the forested headwaters, which helps ensure good water quality, a source of plant seed and wood, and more rapid colonisation by invertebrates and fish".*

It is advantageous that offset riparian planting is contiguous with existing forest, however, there needs to be a high level of confidence that the nominated offset reaches will clearly benefit from restoration planting. For instance, the riparian margins near E4 (one of the potential restoration sites) should recover if ungulates - including stock - are removed, thus negating the need for planting. Active restoration could then take place where the valley widens and the stream reaches are largely bounded by pasture (and unlikely to regenerate into indigenous vegetation in the absence of intervention).

Timing works to avoid peak migration of most fish species is outlined as a key mitigation measure for the short term loss of fish passage (Table 4.1); however, it is not included the summary of mitigation (Section 4.4.1).

With regards to stream restoration, the report clearly states that the sites identified in the upper Mimi River and Mangapepeke Stream may not be available for offset purposes. In this case, new sites will need to be identified and additional SEV surveys will need to be undertaken to recalculate offset requirements.

It should be acknowledged that any stream restoration works will only succeed if goats are effectively controlled throughout the proposed route and environs.

9.3 Information gaps

There are no critical gaps in the report, which in part can be attributed to the fact the author was able to obtain access to the confirmed route.

Although the report provides general descriptions of the sampling sites - and the photographs are also helpful - individual descriptions of each sampling site would be useful. The descriptions should include stream morphology, substrate, average width and depth, in-stream habitat, riparian vegetation, overall ecological values, and existing pressures.

It is acknowledged that a full assessment on aquatic values cannot take place until additional reports and management plans have been prepared and peer reviewed. These include the following:

- Stream Restoration Plan
- Fish Recovery Protocols
- Construction Water Management Plan
- Vegetation Clearance Management Plan

10. MARINE ECOLOGY REVIEW

10.1 Methods

Marine ecology has been addressed in Technical Report 7g, h, Opus International Consultants Ltd, dated October 2017. No authors are noted.

The assessment was undertaken as a desktop review exercise, with discussions with five named parties.

10.2 Assessment of effects

The following key marine ecological values were identified:

- Estuarine habitat
- Intertidal habitat
- Subtidal reef habitat in Parininihi Marine Reserve
- Subtidal soft sediment habitat
- Marine mammals, including the Threatened Maui's and Hector's dolphins
- Fishery resources, including commercial fisheries, and protected great white shark
- Kaimoana
- Seabirds, including At Risk wading species and blue penguins.

The key conclusions are:

> *"In the absence of efforts to avoid, remedy or mitigate adverse ecological effects, the potential effects on marine ecological values would come from indirect, short-term effects during construction relating to sedimentation. Erosion and sedimentation after vegetation clearance and earthworks in the upper reaches of streams could potentially result in suspended sediment travelling down freshwater streams and rivers to the marine coastal environment. Any such sedimentation would only be a relatively very small addition to the sediment that already reaches the marine environment via the streams.*
>
> *The degree to which the marine ecological values might be adversely affected is dependent upon how much, and how far, suspended sediment would travel from the Project. The Project is a significant distance from the coastal marine area (i.e. 9.2 kilometres and 21.5 kilometres stream distance from the Tongaporutu and Mimi estuaries respectively)."*

If best practice sediment control measures are implemented, and in the absence of a major catastrophic storm(s) or tectonic events during the construction phase, adverse effects on the marine environment are unlikely.

Overall, given the distances upstream from the coast, the desktop approach used for this element of the project evaluation and reporting is appropriate.

10.3 Information gaps

No information gaps were identified in this review.

11. ECOLOGICAL MITIGATION REVIEW

11.1 Overview

Throughout the mitigation report in particular, there is a pattern of assertions made that are not backed up by supporting evidence from the site. These assertions are simply declared to be correct, and adversely affect the professionalism and credibility of the reporting. For example, in the executive summary, it is stated that:

- *"All aspects of the indigenous flora and fauna present in the project area will benefit from the management of pest animals to permanently low densities"*

  Benefits to all flora and fauna will not occur. For example, if there is increased growth of palatable plant species, these will exert a competitive effect on unpalatable species. Studies of invertebrate responses to pest control in particular do not always result in positive trends. For example, large beetle abundance unexpectedly declined for six years after pest eradication in the Zealandia ecosanctuary in Wellington (Watts *et al.* 2014), and control of rodents at the Moehau Sanctuary did not benefit invertebrates (Rate 2009). Furthermore, New

Zealand forest vegetation has not always recovered after control of herbivores such as deer (Coomes *et al.* 2003; Tanentzap *et al.* 2009). Kohekohe, which was a former canopy dominant but now only presents as scattered saplings, is an example of a palatable species that may not recover quickly.

- *"All aspects of the indigenous flora and fauna present in the project area will benefit from ..... the establishment of substantial new areas of swamp forest, shrubland, and riparian habitat"*.

  The total area of swamp forest and shrubland to be established is less than the area of forest and shrubland to be lost.

- In the executive summary it also states that *"The project will result in the removal or modification of 34 hectares of predominantly indigenous vegetation and habitat"*.

  In Section 3.3.1 of the mitigation report it states that 33.3 hectares of indigenous dominant vegetation is subject to *"removal"*, with an additional 1.37 hectares of sedgeland wetland that is of "significant value". This equates to *"34.7 hectares of removal"*. If the amount of habitat subject to *modification* is also added to this extent, the extent of *"removal or modification"* is much greater than 34 hectares, primarily due to the extent of edge effects. Edge effects have been estimated by the applicant to extend five metres from the edge of clearance, but 50-100 metres is better supported by literature. If 50 metres was conservatively used as the extent of edge effects, the extent of indigenous vegetation subject to removal or modification could increase by a further 54 hectares (six kilometres of road multiplied by the additional 45 metres multiplied by two for both sides of the road). This would place the total extent of removal or modification, including edge effects, at approximately 87 hectares.

- Another assertion in the executive summary is that the proposed mitigation will greatly improve the connectedness of the forested areas. As the forest through which the road passes is largely continuous and intact, and the project will result in a permanent new major road barrier through this forest, it is very difficult to see how any connectivity benefits will occur. When considering connectivity, it is always important to determine which specific biota would benefit from improved connectivity. For example, forest birds are unlikely to have any connectivity limitations in the project area, whereas herpetofauna and flightless invertebrates are likely to experience nearly complete severance of populations due to road construction.

11.2 Vegetation

Section 3.3.2.1 of the mitigation report describes actions undertaken to mitigate the adverse effects of vegetation clearance. These include the planting of nine hectares of secondary scrub vegetation, mostly along the floor of the Mangapekepeke Valley. This cleared vegetation comprises mānuka scrub and mānuka-tree fern communities, and it is proposed to replace these on a 1:1 basis. This is certain to result in a net loss, as the affected mānuka forest associations in the Mangapekepeke Valley are from 25-50 years old and some include pole-sized trees of rewarewa, kahikatea, and rimu

(Section 3.6.2 of the vegetation report). Furthermore, these secondary scrub replacement plantings constrain the amount of higher value alluvial forest that could be planted in the Mangapekepeke Valley, as shown in Figure 4-5 of the mitigation report. It would provide much more benefit to restore more important indigenous forest types on these alluvial flats; either kahikatea-swamp maire forest in very wet sites or matai-kahikatea-tōtara forest on better drained alluvial sites.

The applicant proposes to plant 200 trees as compensation for each significant tree felled (including in the project area). Unfortunately, planting of 200 seedlings will not compensate for the loss of a single significant large tree. This is because large trees are likely to be centuries old, have large canopies that support epiphytes, provide habitat for indigenous lizards, and provide significant sources or fruit and or nectar. None of these resources are available in seedlings or young trees. It is almost impossible to offset the loss of large trees through planting due to the very long period of time required for planted trees to grow large enough to provide similar habitat and resources. No details are provided regarding where the plantings to compensate for significant tree loss will occur.

Monitoring proposals on Page 21 are very vague and do not include any detail on methods. They are therefore unverifiable and little weight can be given to them.

11.3 Lizards

Proposals to survey, detect, monitor, capture and relocate lizards become less practical when epiphytes in large trees are prime habitat for some arboreal lizard species (page 11 of the mitigation report). Benefits of pest control proposed for these lizards are also very questionable, and it cannot be assumed that these benefits will occur, as the mitigation report simply declares (Section 3.6.2.2) without any supporting evidence.

11.4 Invertebrates

Similarly for arboreal lizards, the mitigation report simply assumes that invertebrates will benefit from pest control and thus does not consider that any monitoring is necessary. As noted above, there is evidence that invertebrates do not benefit from pest control, so the unsupported contrary assertions in the mitigation report carry no weight.

11.5 Avifauna

The proposed predator control area will need to be an extension of existing predator control in order to be an effective mitigation technique for avifauna. A stand-alone area with a core of 250 hectares of intensive rodent and mustelid control is considered highly unlikely to be of sufficient size to have significant positive effects on most forest bird species (Ruffell *et al.* 2017), including kiwi (which require areas >10,000 hectares; Basse and McLennan 2003) and kōkako (need at least 1,000 hectares under pest control; Collen *et al.* 2016). The vast majority of papers cited in Table 7 of the avifauna report were studies where predator control was undertaken over considerably larger areas, or was undertaken in a smaller area with low connectivity to uncontrolled areas. Protecting forest bird species in larger, contiguous forest requires areas of predator control larger than 250-580 hectares.

However, if the proposed predator control is adjacent to Parininihi (as suggested in Technical Report 7h), this will essentially increase the biodiversity value of the Parininihi area under control by providing additional safe habitat for species such as kōkako and kiwi to disperse into.

Potential benefits of pest control to wetland bird species cannot be assessed without information on species presence, population status, and spatial distribution of 'Threatened' and 'At Risk' species within the proposed pest control area.

11.6 Bats

In the bat report (Section 5.4.2) and herpetofauna report (Section 5.3.2), the applicant correctly recognises that planting is needed, with the aim to reflect the vegetation communities to be removed - but that loss of mature forest cannot be recreated in the short to medium term. This time lag is normally addressed by the use of a compensation ratio that factors in this time delay, e.g. a ratio of 1:5 or more for area lost to area planted. No basis is provided for the *c*.15 hectares of plantings (swamp forest) proposed in the light of total potential loss (34 hectares), excluding edge effects which are additional to that? The most extensive forest type being lost is tawa-dominated (tawa-rewarewa-kamahi forest (6.5 hectares) and tawa nīkau treefern forest (8.7 hectares)). If the planting proposed is 15 hectares of swamp forest, this will result in a net loss of forest extent for the site of *c*.19 hectares (excluding edge effects), and the revegetation plantings are not like-for-like (swamp-forest focused when this comprises <1.3 hectares of forest loss within the footprint (0.186 hectares + 1.045 hectares).

If the grounds for planting swamp forest, ahead of hillslope forest types, is that it is a habitat type that is significantly reduced in extent at a national scale, then the applicant should ensure that 1) this is provided *as part of a planting package* that will result in *no net loss of forest area*, and 2) the applicant should provide further details as to the suitability of the proposed planting site for swamp forest species, as these species have very specific soil and hydrology requirements.

11.7 Pest management strategy

Section 4.4.2 of the mitigation report describes the pest management strategy and indicates that monitoring of pest animal densities will be used as a surrogate for biodiversity outcomes. It would, however, provide much more assistance in verifying the claimed positive benefits of pest control if quantitative information on biodiversity outcomes was collected as an element of the monitoring. In section 4.10 of the mitigation report it is suggested that avifauna, palatable plant regeneration, and forest canopy health will be monitored to assess biodiversity outcomes. As there is no information on design or methods of this proposed monitoring, its effectiveness cannot be assessed.

Claims about the difficulties in monitoring of bats, herpetofauna, and invertebrates are inconsistent with the claimed expectations of benefits to these taxa from pest control. If it is difficult to monitor these taxa, how can these benefits be observed and verified?

Potential effects of road construction on pest animal abundance are not addressed. Construction and operation of the road has the potential to affect mice, stoats, ship rats, and hares. While poorly understood, the effect of roads on the dispersal of alien species is an important consideration in New Zealand (Spellerberg and Morrison 1998). In Pureora Forest Park, mice were found to be more abundant in road edge cut over forest than in unlogged indigenous forest (King *et al.* 1996a, King *et al*. 1996b). Ship rats were also detected in high numbers along the road edge (King *et al.* 1996a), but were also noted to be widespread throughout indigenous forest. In Fiordland National Park, the Eglinton Road affected the behaviour of stoats, with females avoiding it and males showing a preference for it (Murphy and Dowding 1994). Male stoats were observed to scavenge road kill, and may also have been using the road as a linear feature for travel. Hares are not typically found in forest, but will inhabit roads and road margins. Hares can affect indigenous vegetation through browsing and also provide an additional food source for stoats (Smith *et al.* 2008). The potential increases in the abundance of mice, rats, stoats, and hares that could be caused by road construction should be addressed in the pest management strategy.

The impacts of mice on indigenous biodiversity are detailed on Pages 35-36 of the mitigation report, however, it is not clear if the proposed pest management strategy include mouse control.

On Page 37 of the mitigation report, it states that:

> "*A network grid with bait stations no further apart 100 metres is necessary to achieve effective and sustained possum and rat control (Smith at al 2009; Speedy et al 2007). Feral cats and mustelids (ferrets, stoats and weasels) can be controlled to low levels by secondary poisoning and periodic trap sets along the networks".*

A distance of 100 metres between bait stations will not effectively control mice. Moreover, with a reduction in ship rats and mustelids, it is likely that mouse numbers would significantly increase throughout the project area, resulting in adverse effects on invertebrates, lizards, seeds, and fruit. A much closer density of bait stations -a minimum of 25 metres (MacKay *et al.* 2007) - would be required to achieve low densities of mice. In saying that, the feasibility of establishing and servicing a 100 metre (or less) bait station grid would be difficult given the challenging terrain within the project area. There is also the possibility of interference by feral pigs, i.e. destroying or tampering with the bait stations.

It would be more effective to carry out aerial control operations on a three-year cycle in order to achieve and maintain low predator densities, in addition to intensive ground-based control of feral ungulates.

11.8 Information gaps

The applicant needs to ensure that the mitigation report adequately addresses the issue of goat control. If this is not effectively undertaken, any mitigation plantings are likely to fail.

12. BIODIVERSITY OFFSETTING APPROACH

12.1 Overview

The biodiversity offsetting approach used by the applicant does not represent good practice and cannot be relied on to support the conclusions of no net loss and net gain.

Major problems with the offsetting approach are its limited selection of attributes and reliance on subjective information at most stages of the process. For example only broad ecological units (vegetation types) were used at the most resolved level (attributes) of the offsetting currency, and parameters of the offset calculation were mostly subjectively scored. The first problem means that the calculation does not 'capture what we care about' (for example habitat requirements of indigenous fauna, emergent trees, rare or distinctive plant species) and thus many important ecological values are not included in the loss-gain calculation. The second problem means that there is no factual basis underlying the choice of parameter values, thus they are not verifiable and are unsupported by ecological data from the site. A third problem is the way that condition is scored, which conceals the identity of forest tree species and the size of individual trees. Thus a successful outcome of the model could occur at a stage of very young forest of limited diversity that does not in any way resemble the mature forest that is cleared. The point at which no net loss is reached was obtained simply by declaring different parameter values for the condition of the impact, offset, and benchmark sites.

These problems, caused by a failure to use good practice, are in addition to the limitations of the condition-area currency used in the approach. In this currency, the condition of the offset site is traded-off against its area, thus if there is relatively low improvement in condition, a larger offset site can still reach no net loss. Also, the currency assumes that biodiversity gain scales evenly with area, but this is not likely to be the case, as natural areas tend to incorporate additional habitats as they increase in size.

Furthermore, the accounting model itself has major limitations in its treatment of uncertainty. The values entered into the model are all associated with uncertainty, but these uncertainties are not allowed to be entered into or multiplied through the model. For example, there are uncertainties in the baseline condition of impacted attributes, the condition of benchmark attributes, the condition of baseline offset site attributes, and the estimates of gain for each attribute. The model has only a single step where confidence in the information can be entered, but this simply represents a declaration by the user, rather than error associated with real ecological data.

The biodiversity offsetting approach used by the applicant is affected by all of the above factors, and as such cannot be relied on. These and other factors are described more fully below.

12.2 Choice of biodiversity offsetting approach

The offsetting report considers a biodiversity offsetting condition-area currency appropriate for use in the project because it is consistent with the New Zealand Government's best practice guidance. The ecological appropriateness of the condition-area currency has not been assessed. The Mt Messenger site supports complex indigenous forest and wetland vegetation that contains old growth trees and provides habitat for indigenous bats, birds, lizards, fish, and invertebrates. We are not aware of any case in New Zealand where a biodiversity offsetting approach has been used successfully to address significant adverse impacts on complex ecosystems such as this. In such cases biodiversity offsetting often provides veneer of objectivity that is not substantiated by a more detailed assessment.

The biodiversity offsetting accounting model used by the applicant is described by the authors of the framework as a "non-prescriptive, flexible 'empty shell' that the user populates by entering biodiversity measures, estimates, and discount rates" (Maseyk *et al.* 2015). Thus the quality of the outcome of the accounting model very much depends on the quality of the information entered, and the outcome can be easily manipulated by the values the user enters.

Maseyk *et al.* (2015) note that four standards should be adhered to if condition-area currencies are to account for complex biodiversity offset situations:

- Selected biodiversity attributes are inclusive of a meaningful range of biodiversity components that represent biodiversity types.
- Biodiversity attributes are selected to capture important biological states (e.g. different stages and/or ages of species).
- Parameters and values are empirically informed wherever possible and the use of unverifiable parameters of values is avoided.
- The currency is disaggregated, thereby ensuring trade-offs between dissimilar biodiversity.
- Currency limitations are understood and rules that address concealed loss are set outside of the model.

12.3 Choice of biodiversity attributes

Choice of components, types, and attributes is critical in biodiversity offsetting approaches, because if important ecological features are not included as attributes, they will not be accounted for in the loss-gain transaction, and may suffer net loss even though the outcome of the approach is no net loss or net gain. The applicant's offsetting approach selects only vegetation types as the biodiversity attributes in the model, and does not include all vegetation types, for example cliff vegetation. This is not consistent with good practice guidance, which requires a meaningful range of biodiversity components to be assessed. The mitigation report shows that in addition to effects on vegetation types, there are also residual adverse effects on significant large trees, At Risk and regionally distinctive plant species, bats, birds, lizards, fish, and invertebrates. Attributes for each of these biodiversity components should have been included in the offsetting model. The good practice definition of no net loss requires that no high value indigenous components should be substituted for other components.

A review of attribute selection in New Zealand offsetting models (Wildland Consultants 2012) concluded with the following guidance for selection of biodiversity types, components, and attributes:

- Selection of biodiversity types, components, and attributes should cover a meaningful range of biodiversity features, including, if present, the following impacted elements:

  Types and Components

  - Originally rare ecosystem types (Williams *et al.* 2007);
  - Indigenous vegetation on wetlands and sand dunes;
  - Indigenous vegetation types;
  - Important fauna habitats;
  - Threatened, At Risk, and locally uncommon species; and
  - Indigenous vertebrate fauna guilds, including each trophic level (herbivore, predator), feeding guilds of avifauna (insectivore, frugivore, nectivore, carnivore), and indigenous fish.

  Attributes

  - Important plant species within a biodiversity type (e.g. those that attain at least 5% of the total tier cover, basal area, or count), and their size structure;
  - Ecologically important plant species (e.g. those that provide important habitat value for indigenous fauna) within a type, if they are present at lower abundance;
  - Indicator species, such as pollution-sensitive aquatic invertebrates which indicate stream condition, and palatable plant species that indicate the presence of herbivores;
  - All Threatened, At Risk, and locally uncommon species;
  - Species with large populations or congregations at the site;
  - Iconic species, including those valued by local stakeholders;
  - Important indigenous pollinators (e.g. tui, bellbird);
  - Important indigenous seed dispersers (e.g. kereru); and
  - Species richness within a biodiversity type (this can be measured both as alpha (within-sample) richness and beta (between-sample or whole site) richness.

- Counts or measures of individuals should be utilised wherever practical, e.g. counts of individuals, estimation of fauna population size or number of breeding pairs, measures of tree stem diameters. This will enable objective modelling of future biodiversity gains. Predictions based on objective counts and measures are also attractive in that they are verifiable over time. This is particularly important given the heavy reliance on subjective assessments in current offsetting approaches. Where this generates significant uncertainty, contingency strategies could be associated with time-predictions for achievement of offsetting milestones.

- Attributes should capture differences in the sizes and/or ages of individuals of species that vary strongly in these parameters, particularly where the size and/or age of individuals is strongly related to their ecological function. For example, trees, saplings, and seedlings of a long-lived tree species should be represented as different attributes.

12.4 Determining condition

Condition scores for attributes have largely been declared and are not based on quantitative counts or measures of biodiversity from the site. These declared condition scores are unverifiable and contrary to good practice which requires that objective counts and measures are to be used whenever possible.

The condition scores are based on 'ecological integrity' where this is defined by multiplying 'current state' and 'habitat condition'. Both seem to be indices of condition which is unusual. Values for weed cover aspects of these condition scores were obtained from unbounded recce plots, which are not suited to quantitative measures, but otherwise they were subjectively estimated.

A significant problem with the way ecological integrity is calculated for forest vegetation is that it is not based on species or the size of individual trees. Thus increase in condition does not capture the identity of the indigenous species that the offset vegetation contains, nor the sizes that individuals of the species reach. Valued species may not be present in the offset sites, and relatively young vegetation could achieve high condition values, yet still be far from the condition of benchmark vegetation based on structure and composition. Measuring stem diameters in fixed size vegetation plots is a practical and efficient way to collect high quality information on forest tree structure and composition, and ideal as an objectively measured attribute in offsetting models addressing impacts on indigenous forest (Wildland Consultants 2011).

12.5 Offset site condition

The condition of the forested offset sites ranges from 39-44, which seems artificially low given the concluding opinions of the offset report which state that these forests have higher abundance of significant trees and populations of threatened species, and thus are in better condition than the impact sites.

12.6 Estimated gains

Integrated pest management is selected as the main biodiversity offsetting action and is predicted to improve recovery and regeneration of palatable flora, especially palatable canopy dominants, and recovery of vulnerable fauna. Estimates of gain are purely subjective. Some of these estimates of gain are ecologically implausible. For example, planting of kahikatea-swamp maire forest in areas currently covered by wet pasture is expected to move from a near-zero ecological integrity value to a 50% ecological integrity value in 35 years. This implies that the planted vegetation will be two thirds of the way to benchmark condition in 35 years, which is ecologically implausible given the relatively slow growth rates of the species that would be planted in such forest. For example, the vegetation report describes the existing stands of pole kahikatea forest as young stands from 50-80 years old, and these pole stands would be far from benchmark condition in terms of their structure and composition.

Similarly, it is proposed to plant 200 seedlings of each significant tree that is cleared. Adverse effects on significant rewarewa, tawa, and kamahi trees are not addressed, and it needs to be acknowledged that the planting of seedlings may have a relatively low success rate. Even if all of these seedlings survived and grew they could not offset the loss of canopy trees for hundreds of years.

13. INCONSISTENCIES BETWEEN APPLICANT'S REPORTS

There are significant inconsistencies in the reporting to date, both within individual specialist reports, and between specialists. This is a barrier to understanding what is proposed, and what the likely effects of the road will be, once the proposed mitigation package has been considered. The separation of disciplines, without a document that draws findings into a cohesive whole, is also likely to have resulted in the understatement of ecological values for some components. As examples, the reporting includes:

- Literature supporting the extent of edge effects to be 50-100 metres from a road edge, and the use of five metres of edge effects for the biodiversity offset calculations.
- Statements regarding the importance of 'like-for-like' when replacing habitats, which is then not reflected in the proposed mitigation plantings.
- Mitigation plantings proposed within areas of existing indigenous vegetation beyond the project footprint.
- The assessment of some habitat types as being of 'Low' ecological value, based on vegetation and flora values, when other disciplines assess that same habitat type as of 'High' value, based on its value as fauna habitat (e.g. mānuka-dominant scrub).
- The likely impacts of mice on ecological features and habitat values of the route, and the importance of intensive pest management to offset adverse effects, followed by the omission of mice from the list of pest animals to be targeted.

A summary of inconsistencies is provided in Table 2.

Table 2: Summary of inconsistencies between ecological reports provided by the applicant.

Issue	Vegetation Report	Other Specialist Reports	Mitigation Report	Outcome
Ecological equivalence of mitigation	16 indigenous vegetation communities within footprint (Table 3.1), including 19 hectares of tawa kohekohe rewarewa hinau podocarp forest (Table 4.4). Restoration planting of secondary scrub habitats (9 ha), swamp forest (6 ha, if available), and sedgeland wetland (1.37 ha).	Mitigation plantings would ideally reflect the vegetation communities removed (Herpetofauna, Section 5.3.2, Bat Section 5.4.2).	Preference for replacement of "like for like" (Section 2.1.2) Cut and fill areas alongside road not suitable for restoration of forest types removed (Section 4.2). Between two and six hectares of land is suitable for swamp forest plantings, pending site survey (Section 4.5.2).	Plantings only undertaken to compensate for loss of swamp forest (Section 4.2). No plantings to compensate for the loss of 19 hectares of tawa dominated forest. 19 hectare net loss in the extent of forest and scrub (34 hectares lost, 15 hectares planted). What is the solution if less than six hectares of land is suitable for swamp forest plantings (including the additional 2.3 hectares at Mimi Stream)?
Plan for existing SH3 route	-	Removal of existing SH3 route reduces vehicle collisions (Herpetofauna, Section 4.2). Construction of road creates a hard barrier that cannot be traversed (Herpetofauna, Section 4.2.2) Barrier effect of existing road may be less due to reduced use (Herpetofauna, Section 4.2.2) Existing road in effect decommissioned due to reduced vehicle movements (Bats, Section 4.2.3) Construction will shift existing road to the east, and pose less of a barrier due to tunnel and a bridge (Bats, Section 4.2.3).	-	Applicant refers to both the removal and retention of SH3. Applicant refers to roads being inaccessible to lizards, but also mortality due to vehicle collisions. Applicant states that the road is shifted to the east but existing road is kept, with an additional road built to east (Bats, Section 4.2.3).
Extent of edge effects	50-100 metres noted as supported by literature (Section 4.3.3). Five metres of edge effects included in calculations as a habitat loss equivalent.	Estimated at five metres.	Calculated using a five metre margin.	Edge effects significantly underestimated.
Ecological value of mānuka scrub, and the 1:1 ratio for replacement	Assessed as "Low".	Assessed as "High" or "Moderate" habitat suitability for nine lizard species, including three 'At Risk' gecko species (Herpetofauna, Section 3.1.3). Mitigation planting will not replace herpetofauna habitat within 10 years.	Applicant notes that in New Zealand, to account for time lag of restored habitat that multipliers of 1:1 to 1:150 have been applied. A 1:1 ratio is justified on the basis that habitat 'replanted immediately' (Section 2.1.3). However, applicant recognises that this vegetation also includes pole regeneration of podocarps.	Net loss, as habitat equivalency will not be reached for "many decades" (Mitigation, Section 4.2). A ratio of 1:1 is not appropriate.
Existing habitats within areas to be planted as mitigation	Vegetation communities within proposed swamp forest planting areas include "pukatea treefern fernland", "sedgeland" and "kahikatea forest" which are outside of the ancillary works area (Figure 3.3, crossmatched with Figures 4-6 of mitigation report).		Proposed swamp forest plantings (Figures 4-5) include areas beyond the ancillary works area that are already indigenous vegetation.	Plantings only contribute to mitigation if they are currently not indigenous habitats. Applicant needs to clearly show that these planted areas are not currently indigenous vegetation (e.g. pasture) and will result in a gain in the extent of indigenous vegetation.
Plantings of swamp forest species	Kahikatea, swamp maire, and pukatea are the key swamp forest species (Table 3.1).		Initial plantings to include wharariki. Swamp forest species to be planted once shrub layer well established.	Wharariki (mountain flax; *Phormium cookianum*) inappropriate for swamp forest plantings and will likely fail. Kahikatea is a light demanding pioneer species and is unlikely to establish if not planted at outset.
Health of forest to the east of SH3	Tawa, kohekohe, rewarewa, hīnau, podocarp forest (WF13) to the east of SH3, at the southern end of the route, is described in the report as being in "a high ecological condition" considered "within the top 10% remaining" in the Taranaki Region (Section 4.2.3). The ecological condition of forest to the east of SH3 is poorer (Section 1.5.2).		The ecological condition of habitats in the project footprint has been "greatly diminished over many decades by the largely uncontrolled impacts of browsing, grazing, and predatory animal pests and unfenced cattle.	The applicant repeatedly notes the reduced impact of the proposed road due to its route through more modified habitats to the east of SH3. However, from the applicant's own reporting it is clear that this justification only applies to the northern section of the route. It is unclear how this may have influenced biodiversity offset calculations.

Issue	Vegetation Report	Other Specialist Reports	Mitigation Report	Outcome
Ecological equivalence of mitigation	16 indigenous vegetation communities within footprint (Table 3.1), including 19 hectares of tawa kohekohe rewarewa hinau podocarp forest (Table 4.4). Restoration planting of secondary scrub habitats (9 ha), swamp forest (6 ha, if available), and sedgeland wetland (1.37 ha).	Mitigation plantings would ideally reflect the vegetation communities removed (Herpetofauna, Section 5.3.2, Bat Section 5.4.2).	Preference for replacement of "like for like" (Section 2.1.2) Cut and fill areas alongside road not suitable for restoration of forest types removed (Section 4.2). Between two and six hectares of land is suitable for swamp forest plantings, pending site survey (Section 4.5.2).	Plantings only undertaken to compensate for loss of swamp forest (Section 4.2). No plantings to compensate for the loss of 19 hectares of tawa dominated forest. 19 hectare net loss in the extent of forest and scrub (34 hectares lost, 15 hectares planted). What is the solution if less than six hectares of land is suitable for swamp forest plantings (including the additional 2.3 hectares at Mimi Stream)?
Age of podocarps within project footprint	Likely to be greater than 500 years old (Section 3.8).		Several hundred years old. Planting to recreate habitat equivalent to that lost will take "many decades" (Section 4.2).	Understatement of tree ages. Unclear what age (if any) has been considered in biodiversity offset calculations. If plantings are successful, replacement of equivalent habitats will take centuries, not decades.
Control of mice		Occupancy of mammalian predators is higher in edge habitats (Herpetofauna, Section 2.3.2).	"Targeted and enduring pest control has repeatedly shown substantial improvements in the survival and recruitment of… lizards". Mice will feed on invertebrates and seed in the forest and have been shown to greatly reduce lizard numbers (Section 4.4.1). Bait stations no further than 100 metres apart to achieve possum and rat control (Section 4.4.2).	The predation of lizards by mice is well established (Newman 1994). Fencing of habitats to exclude cattle can also causing proliferation of mice populations, with subsequent increases in predation by mice, and stoat numbers. The omission of mice control is not justified, may have unforeseen adverse effects, and cannot be effectively achieved by bait stations at 100 metre spacing.

14. SUMMARY OF KEY ISSUES

14.1 Location of survey effort in relation to the project site

A key commonality between the specialist reports (with the exception of the aquatic assessment) is the argument that the eastern block is of lower ecological value due to the relative lack of animal pest control to the east of SH3 (relative to the Parininihi block, to the west of SH3, that has had 15 years of pest control). Whilst this difference in pest control history may be an acceptable generalisation for the route as a whole, it is problematic for the application because of the following:

- The lack of evidence presented regarding the relative forest health of the tracts to the east and west of SH3, and field observations (on 5 September 2017) that at least northern rata to the east of SH3 (a browse-sensitive species) are in good health. The applicant also notes that at least one area within the project area, to the east of SH3, is in high ecological condition and of high ecological value, but this is lost in the generalisation. The applicant also recognises that further field work is needed to determine baseline forest condition (Vegetation report, Section 5.6).
- The temporal nature of this assessment, given that the health of the forest to the east of SH3, if it is notably degraded, could be rapidly improved within 5-10 years if a pest control plan was implemented. The considerable weight that is applied to differences in forest health, as assessment criteria, is therefore questionable.
- The transfer of survey results (so far focused on forest to the west of SH3) to the relatively unstudied forests to the east of SH3 (e.g. the terrestrial invertebrate and herpetofauna reports are largely based on habitat assessments and or surveys of areas to the west of SH3). Currently, the applicant argues for both the transferability of ecological knowledge between "similar habitats" to the east and west of SH3, whilst also basing the assessment of ecological effects on the habitats to the east of SH3 being of lower value.

The applicant acknowledges the need for further surveys to investigate for herpetofauna, invertebrates, and bats to the east of SH3, but has nevertheless proceeded with their reporting and assessment of ecological effects. The applicant also notes that the suitability of proposed mitigation sites needs further investigation (e.g. field surveys to determine extent of land available for swamp forest plantings). As such, the applicant should qualify or temper their conclusions, as using the applicant's own words, they are based on "limited information", "extrapolation", "assumptions", and a "level of uncertainty" (all from the Herpetofauna report, Section 4.3.2). Firm conclusions regarding the potential effects of the road, and the proposed mitigation, cannot be made until the forthcoming survey work has been completed. This is likely to require revisions to the existing reporting by the applicant.

14.2 Lack of consistency within and between the applicant's specialist reports

As discussed in Section 5 above, there are significant inconsistencies in the reporting to date. These need to be addressed by the applicant to ensure that the ecological values assigned to habitats are accurate as an appraisal of the habitat as a whole (e.g. collectively considering vegetation, flora, and fauna values of each habitat type), and to ensure that the proposed mitigation package is likely to achieve no net loss of biodiversity values.

14.3 Statements not supported by sufficient evidence

Throughout the reporting, the applicant makes statements not supported by the field investigations, or relevant literature. These are particularly problematic where used to support the applicant's assessment of effects, and likely mitigation outcomes. Key examples include:

- The downgrading of values for habitats in the project footprint to the east of SH3 relative to habitats in the existing pest management area to the west of SH3. As this is a key component of the applicant's assessment of route options and potential adverse effects of road construction, the relative health of the forest tracts should have been supported by field data (e.g. foliar browse index, seedling ratio index).

- The prediction that pest control over a 560 hectare area will result in a 'halo' effect, with species reaching carrying capacity within the pest controlled area, and subsequently dispersing to and increasing populations in adjacent habitats. Pest control is unlikely to benefit bat populations when undertaken at this small scale, and long-tailed bats are known to return to their natal social group to breed.

- The applicant uses a five metre allowance for edge effects, with no supporting evidence. Furthermore, the applicant provides evidence that edge effects in forest commonly extend 50-100 metres.

- The applicant claims that the existing SH3 will pose less of a barrier to fauna such as lizards, when traffic use declines due to the construction of the new road. No evidence is provided to support this statement.

14.4 Likely success of pest management approach

The applicant places considerable weight on pest management to address the adverse effects of road construction on vegetation and habitats, herpetofauna, lizards, birds, and invertebrates. Whilst it is agreed that pest management could and should form a key part of the mitigation package, the relatively small scale at which it is proposed is not supportable. The area of pest control proposed, calculated using a biodiversity offsetting accounting model, totals 562 hectares (comprising a core area of intensive pest control at 222 hectares and a buffer of 340 hectares). This falls well short of the pest controlled area likely to result in significant positive benefits for bats (3,000 hectares, as discussed in Section 3.7.2 of this report), and will only likely result in positive effects for birds as the area would effectively be an extension to control occurring to the west of SH3, in the Parininihi block.

As noted by the applicant, mice are also likely to be having adverse effects on biodiversity values. If mice are not controlled, their impacts may be accentuated by a combination of stoat and ship rat control, and habitat changes that arise from cattle exclusion (e.g. growth of rank grassland). The extent and type of pest animal control should therefore be designed on the basis of the predator-controlled area requirements of the indigenous species adversely affected by road construction. This will require a significant increase in the area to be controlled, and, preferably, the inclusion of mice as a target species. It is unlikely that any meaningful control of predators will be achieved without incorporating aerial operations.

No post-construction monitoring is proposed for some components of the ecology of the site (e.g. for bats, lizards, invertebrates) on the basis that the relationship between pest control and benefits to indigenous biodiversity is well-proven. Whilst this is correct in a broad sense, outcomes of pest control will be strongly influenced by site specific variables, and the methods used, including extent and timing. Given that most of the mitigation package is dependent on the proposed pest control resulting in ecological benefits, post-construction monitoring should be regarded as essential.

15. CONCLUSIONS

By the applicant's own acknowledgement, reporting to date is indicative only and will be subject to refinement and change pending further site investigations. It appears that this has primarily arisen due to a late change in what was predicted to the preferred route and, as a result, most of the ecological surveys undertaken to date have focussed on habitats beyond the project footprint, to the west. Accordingly, many of the conclusions are based on the transfer of knowledge from ecological surveys to the west of SH3, to the project footprint, with associated assumptions and inferences. Additionally, some components of the biodiversity of the site (e.g. invertebrates) will only be surveyed within the project footprint for the first time in the upcoming summer. The applicant's assessment of ecological effects should be revised following further surveys of the project footprint.

There are significant inconsistencies in the reporting, both within the individual specialist reports, and between disciplines. If these inconsistencies are carefully identified and addressed, it will greatly improve the accuracy and robustness of the applicant's assessment.

The applicant also needs to provide supporting data and or references for many of the statements that support the comments and assessments made. Some of this data may be collected during the upcoming field season. Additional research and/or field investigations by the applicant may lead to significant changes for both the assessment of ecological effects and the mitigation package proposed.

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APPENDIX 1

SITE PHOTOGRAPHS

SEPTEMBER 2017

Plate 1: Tawa-kamahi forest with emergent podocarps in the upper Mangapekepeke Stream valley. The rerouting of SH3 to the north of Mount Messenger will pass along the lower slopes of this valley. 5 September 2017.

Plate 2: Northern rata with a fully-foliaged crown on an upper hillslope to the east of the existing route of SH3, Mount Messenger. 5 September 2017.

Plate 3: Southern end of proposed tunnel entrance (nīkau stand, photograph centre) for the proposed rerouting of SH3, Mount Messenger. 5 September 2017.

INVERTEBRATES FROM MOUNT MESSENGER

Based on collections by Tim Martin, 5 September 2017.
Identified by Brian Patrick 21-22 September 2017.

Collembola (springtails)
An unidentified springtail species was common in the leaf litter sample from under tawa forest at the southern end of the proposed route. It appears to be a widespread species characteristic of deep leaf litter. Springtails are an ancient group of insect-like animals with six legs together with a forked spring under their tail. They feed on dead leaves. Most of our 400 species are endemic.

Blattodea (cockroaches)

Blattidae
Platyzostera novaeseelandiae (black cockroach)
The black cockroach was in the leaf litter from under tawa forest at the southern end of the proposed route. This species is distributed from the northern part of the South Island and throughout the North Island and can be locally common in damp areas of mature forest in leaf litter and under bark.

Coleoptera (beetles)

Chrysomelidae
A small unidentified species was present in the samples from the Mount Messenger Saddle. The larvae and adults feed on foliage of various trees and shrubs. Most of New Zealand's 150 species are endemic.

Curculionidae (weevils)
Supplejack appeared to have the damage of the adults of a medium-sized weevil species. The sample was from tawa forest at the southern end of the proposed route. This large family of New Zealand beetles has several thousand species, most of which are endemic.

Diptera (flies)

Tipulidae
An unidentified species was found in the in tawa forest at southern end of proposed route. Over 600 species of this family of flies are found in New Zealand with the majority endemic. The larvae feed in rotting vegetation or logs where they play a key role in decomposition.

Lepidoptera (moths & butterflies)

Nepticulidae
Stigmella hakekeae
Leaf mines of this tiny moth species were found on *Olearia rani* - a new host record (Donner and Wilkinson 1989) - on Mount Messenger Saddle. This moth species has a large

distribution from the Bay of Plenty southwards to Stewart Island in lowland and montane forests.

Gracillariidae

Acrocercops zorionella
Larvae were mining the leaves of *Coprosma robusta* in tawa forest at southern end of proposed route and . This colourful and distinctive species is widespread in New Zealand forests and a specialist leaf miner on larger-leaved *Coprosma* species.

Oecophoridae

Gymnobathra sarcoxantha
Larval cases were found in the leaf litter sample from under tawa forest at the southern end of the proposed route. It is a widespread species of mature forest where its larvae feed on damp leaf litter.

Tortricidae

Philocryptica polypodii
Characteristic larval leaf mines were found on the epiphytic fern *Pyrrosia elaegnifolia* on the Mount Messenger Saddle. It is a distinctive moth found in forests nationwide wherever its larval host plant thrives.
Unidentified species
Leaf-roller damage on *Gaultheria*

Geometridae

Cleora scriptaria
Larval defoliation on *Hedycarya arborea* and *Alseuosmia macrophylla* was evident on the Mount Messenger Saddle. This is a widespread and often common larger moth of forested areas. It is dark-coloured with variable markings. The larvae feed on a wide range of forest tree species.

Declana junctilinea
The foliage of both *Metrosideros fulgens* and *Rubus cissoides* had the distinctive damage of this geometrid moth, which feeds nationwide on a wide range of tree and shrub species. The medium-sized adults are distinctive and colourful in appearance. Here it was found on the Mount Messenger Saddle and in tawa forest on the southern end of the proposed route above swamp forest.

Epiphyrne verriculata (cabbage tree moth)
Larvae of cabbage tree moth on *Cordyline banksia* on Mount Messenger Saddle. It is a well-known and widespread geometrid moth that is a specialist defoliator on all the cabbage tree species.

Ischalis gallaria
Larvae on *Parablechnum novae-zelandiae* on the Mount Messenger Saddle. Although a widespread forest moth species, it is never common.

Pseudocoremia rudisata
Much larval damage to the leaves of *Olearia rani* in tawa forest at southern end of proposed route. It is a widespread and often common moth of forest and shrubland nationwide where its larvae feed on many of the larger-leaved *Olearia* species.

Sarisa muriferata
Characteristic foliage defoliation of the fern *Pyrrosia elaegnifolia* was present on the Mount Messenger Saddle. Like its host plant, this colourful moth is widespread in forested areas and can be locally common.

Xyridacma veronicae
Larval feeding was obvious on the foliage of *Hebe stricta* on the Mount Messenger Saddle. This moth is a specialist foliage feeding moth on many of our *Hebe* species from coastal to low alpine areas nationwide.

Noctuidae

Feredayia graminosa
Characteristic feeding damage of the foliage of *Melicytus ramiflorus* on the Mount Messenger Saddle was found of this attractive green moth. This moth is widespread on this host plant, nationwide.

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