Before the Fast-track Panel

Under: Fast-track Approvals Act 2024

In the matter of: FTAA-2603-1178 – Alternative to the Brynderwyn Hills Project (Brynderwyn Hills section)

Statement of advice: Dr Rhys Burns

Frogs, birds, lizards

DOC staff

20 October 2026

Department of Conservation
Te Papa Atawhai

Te Kāwanatanga o Aotearoa
New Zealand Government

Introduction

1. My full name is Rhys James Burns.

Instruction

2. I have been requested to provide expert advice to the Director-General of Conservation (DOC/the Department) for the purposes of his comments on the Alternative to the Brynderwyn Hills Project Fast-track application.

Qualification and Experience

3. I am a Senior Technical Advisor (Fauna) for the Department of Conservation based in Rotorua. I have a BSc (Hons) (1993) and a PhD (1997) in Biochemistry from the University of Otago. I have been employed by DOC for 27 years – 5 years as a Biodiversity Ranger and the other 22 years as a Technical Advisor for terrestrial biodiversity. In this role I have performed a wide variety of roles such as providing advice to staff regarding terrestrial conservation matters, advising on prioritising national aerial 1080 operations, and assessing and advising on Wildlife Act authorities including lizard salvage applications and wildlife translocations.

4. I am the leader of the Weka Recovery Group and the Kōkako Recovery Group and am a member of the Frog Recovery Group. I have been an expert witness for DOC on terrestrial fauna matters in several RMA cases including Mt Messenger Road Bypass, Kaiwaikawe Windfarm, Auckland Regional Landfill (Dome Valley) and Cambridge to Pairere Expressway. I am also a member of the Mt Messenger Ecological Review Panel, that advises New Zealand Transport Authority (NZTA) on ecological and pest control matters as they arise during the construction of this road bypass.

5. I currently also have a central role co-ordinating DOC's terrestrial ecology responses to listed and referred projects under the Fast-Track Approvals Act 2024 (FTAA). Other Fast-track projects I have provided expert terrestrial fauna advice to the Director-General on include Waihi North, Southland Windfarm (also under the Covid-19 Recovery (Fast-Track Consenting) Act 2020), Takitimu North Link Stage 2, Central and Southern Block mining (Taharoa Ironsands), and Belmont Quarry (land exchange).

6. I have a good understanding of Hochstetter's frogs, lizards and birds of this region. Work that is especially relevant to this application includes:

   i. Kaiwaikawe windfarm – expert witness for DOC for birds and lizards;

   ii. I was the lead DOC advisor on the Brynderwyn road realignment under Order In Council Emergency Regulations following Cyclone Gabrielle, where there were several significant Hochstetter's frog issues;

   iii. I have been an expert witness for DOC at the Environment Court on the Waste Management (NZ) Ltd. Auckland Regional Landfill project (Dome Valley), initially on birds, and more recently have also been the DOC lead on Hochstetter's frogs and lizards for this project.

   iv. I have been a member of DOC's Frog Recovery Group since 2004, which is charged with understanding the ecology and aiding the recovery of native frogs nationally.

   v. I have led and was lead author on the national conservation threat assessment of frogs in both 2017 and 2024. I was also a Panel member on a conservation threat assessment of frogs in the Auckland Region in 2026 (yet to be published).

Code of conduct

7. Whilst it is acknowledged this is not an Environment Court Proceeding, I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court Practice Note 2023. I have complied with the Code of Conduct in the preparation of this advice. Unless I state otherwise, this advice is within my area of expertise, and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

Scope of advice and expert opinion

8. My expert advice relates to the following:

   i. Adequacy of the applicant's surveys of Hochstetter's frogs, lizards and birds;

ii. Adequacy of the applicant's assessment of effects on Hochstetter's frogs, lizards and birds including any effects that are incomplete, understated, or not addressed;

iii. Adequacy of the applicant's proposed mitigation and management measures for Hochstetter's frogs, lizards and birds;

iv. Adequacy of the applicant's proposed compensation package for Hochstetter's frog.

v. Adequacy of the proposed resource consent conditions.

I have already prepared a statement of advice dated 29 July 2026 in the context of the Department's report under Section 51 of the FTAA, which focussed on issues relating to the wildlife approvals sought by the applicant. This statement expands on and supplements my earlier statement, and should be read alongside it.

Material Considered

9. In preparing this advice I have reviewed the following documents as part of the substantive application:

    a. Volume A, Main Application (dated 2 April 2026)

    b. Volume B, Appendix D04 – Assessment of Landscape and Visual Effects (Revision B, dated 13 July 2026)

    c. Volume B, Appendix D06 – Assessment of Effects on Terrestrial Ecology (A, dated 2 April 2026)

    d. Volume B, Appendix D07 – Assessment of Effects on Freshwater Ecology (Revision A, dated 2 April 2026)

    e. Volume B, Appendix D08 – Assessment of Effects on Avifauna Ecology (Revision A, dated 2 April 2026)

    f. Volume B, Appendix D10 – Construction Water Assessment Report (A, dated 2 April 2026)

    g. Volume B, Appendix D11 – Indicative Stormwater Drawings (dated 27 March 2026)

h. Volume B, Appendix D12 – Assessment of Effects on Groundwater (Revision A, dated 2 April 2026)

i. Volume B, RMA Approvals (dated 2 April 2026)

j. Vol B, Appendix E – Designation Conditions (dated 13 July 2026)

k. Vol B, Appendix E – Resource Consent Conditions (dated 13 July 2026)

l. Volume C – Wildlife Act Approvals (Revision A, dated 2 April 2026)

m. Draft Ecological Management Plan (Revision A, dated 13 July 2026)

n. A2BH – Ecological effects mitigation table (28 August 2026)

o. NC – A2BH – Proposed Frog Management Package – DRAFT v3, dated 28 August 2026

p. Brynderwyns Hills Alternative Project – Indicative Compensation Approach dated 7 October 2026 (and subsequent email from NZTA of 8 October 2026 with frog compensation calculation)

q. Aquatic Survey Information Maps, dated 7 October 2026

r. Terrestrial Survey Information Maps, dated 7 October 2026

s. NZTA's Proposed Amendments to Mitigation Package Since Lodgement (dated 9 October 2026)

t. Statements of advice of Dr Timothy Martin (dated 20 October 2026)

u. Statement of advice of Nicholas Goldwater (dated 11 August 2026) and addendum (dated 20 October 2026)

v. Statement of advice of Dr Amber McEwan (dated 11 August 2026) and addendum (dated 20 October 2026)

w. Statements of advice of Dr Richard Storey (dated 20 October 2026)

10. I undertook a site visit on 26 June 2026 where I visited several Zone 3 wetlands (south of Brynderwyn Ranges) on the indicative alignment, a native forest stream within the Brynderwyn ONL, two streams within the Manu Life Forest area west of Pilbrow Hill), the indicative alignment and wetlands on the northern slopes of the Brynderwyn Ranges, the proposed Northern Mitigation Site and the Waihoihoi Stream upstream of Glenmohr Road. I had further site visits on 1-3 October 2026, where I visited four waterways (at two separate sites) in the Brynderwyn Ranges that

are being considered as possible release sites for Hochstetter's frogs by the applicant. I also visited Waipū estuary, the lower Waihoihoi river near Waipū township, Waipū Gorge Scenic Reserve (Piroa Falls), and streams containing Hochstetter's frogs in the Waipū Gorge Forest Conservation Area, and Brynderwyn Scenic Reserve.

Summary

11. The scale and impact of this project means it will have a large and permanent effect on the Hochstetter's frog population in the Brynderwyn Ranges. If frogs are not captured and relocated elsewhere, an estimated 22,000 will be killed by being crushed or smothered when their habitat is destroyed, and at least another 20,000 frogs will be affected by fragmentation effects.

12. I consider there are a number of other effects on Hochstetter's frogs not addressed by the applicant, including long-term and cumulative effects. The number of frogs likely to be affected by these additional effects cannot readily be quantified due to uncertainty of effects and uncertainty of total frog populations in the areas impacted.

13. The Hochstetter's frog habitat to be destroyed is irreplaceable and the proposed mitigation measures are untested and unreliable at even a small scale. To rely on such unproven measures on a Project of this magnitude is highly risky.

14. No offsetting measures are offered by the applicant for the residual effects on Hochstetter's frog. Rather, only a compensation payment is offered for residual effects following implementation of mitigation measures. Any payment is proposed to only be paid if after 10 years it was determined there had been mortality of frogs salvaged from areas directly impacted by road construction. The details of how mortality rates will be determined is not known.

15. While there are methods available for lizard salvage that may mitigate some habitat loss by the Project, owing to the complexity of the habitat I consider lizards from several species will not be detected before habitat destruction, so they will be killed or injured. Two of the proposed Mitigation Sites have potential to be suitable as release sites for lizards but require better pest control measures for a longer period of time than that offered. If the number of lizards salvaged reaches a certain yet-to-be-established threshold, a predator-proof fence should be built and maintained to more reliably mitigate the effects of the Project on lizards.

16. The applicant should also undertake surveys for wetland birds during both breeding and non-breeding periods, and determine if kiwi are present within the Proposed Designation.

17. Release of high sediment loads during water diversion and other in-stream works have the potential to affect the downstream breeding habitat of New Zealand's rarest native bird, the tara iti/New Zealand Fairy Tern at Waipū estuary. Such works should only occur during the time of year that fairy terns are not present at the Waipū estuary.

Key Issues

Hochstetter's frogs

18. Hochstetter's frog is a 'deep endemic' species of Aotearoa New Zealand. Fossils of their ancestors indicate their basic anatomy is little changed in over 70 million years. They have primitive features such as no vocal sac (so only have a limited ability to vocalise, i.e. they do not 'croak'), lack of an external eardrum, inscriptional ribs, round pupils (as opposed to horizontal slits), vestigial tail-wagging muscles (despite having no tail), and nine presacral vertebrae compared to the eight found in nearly all other frogs[1]. They are thought to form an early branch in the evolution of all frogs globally, of which there are over 8,000 species.

19. They are a semi-aquatic species, in that they are considered to spend most of their lives close to small streams and seeps but can occasionally be found under cover within terrestrial habitats, tens or even hundreds of metres from the nearest running water. I agree with their main habitat requirements as described by the applicant[2].

20. Hochstetter's frog is a nocturnal species that emerges from daytime cover to feed on small invertebrates[3] in streamside habitat. They require streams with clean water and appear particularly sensitive to high sediment loads[4].

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[1] Worthy TH, Tennyson AJD, Scofield RP Hand SJ. 2013. Early Miocene fossil frogs (Anura: Leiopelmatidae) from New Zealand. Journal of the Royal Society of New Zealand 43: 211-230.
[2] Vol. B, App. D06, Section 2.3.3
[3] Shaw SD, Skerratt L.F, Kleinpaste R, Daglish L, Bishop PJ (2012). Designing a diet for captive native frogs from the analysis of stomach contents from free-ranging Leiopelma. New Zealand Journal of Zoology, 39(1), 47-56.
[4] McLennan, J. A. (1985). Some observations on Hochstetter's frog in the catchment of the Motu River, East Cape. New Zealand Journal of Ecology, 1-4; Easton, L. (2015). Determining the feasibility of a translocation by investigating the ecology and physiology of the threatened Hochstetter's frog (Leiopelma hochstetteri): A thesis submitted for the degree of Masters of Science at the University of Otago, Dunedin, New Zealand; Najera-Hillman, E. (2009). Leiopelma hochstetteri Fitzinger 1861 (Anura: Leiopelmatidae) habitat ecology in the Waitakere Ranges, New Zealand: A thesis submitted to the Faculty of Health and Environmental Sciences, Auckland University of Technology in fulfilment of the requirements for the degree of Doctor of Philosophy.

21. Hochstetter's frogs are found in isolated populations over the upper North Island (**Fig. 1**) and are considered to be clustered into at least 10 distinct genetic groups or 'clades'.[5] One of these groups is the 'Northland' clade, and the population in the Brynderwyn Ranges forms part of this clade (**Fig. 2**).

22. The Northland clade of Hochstetter's frog has been considered to have a national Conservation Threat Status of 'At Risk – Declining'[6] and an Auckland Regional Conservation Status of Regionally Declining[7]. The main cause of decline is considered to be habitat loss, pine forest harvest, and predation by rats (possibly both ship rats and Norway rats), mustelids and pigs. There is potential for other introduced predators to also impact upon Hochstetter's frogs, such as hedgehogs, cats and possums, should they come across them, or learn to hunt them.

23. Unlike other native New Zealand frogs, Hochstetter's frog does not appear to suffer from chytridiomycosis[8], a fungal pathogen that has caused large declines and even extinctions of frog species globally[9]. Therefore, the primary cause of their decline is considered to be mammalian pest predation and habitat loss or degradation.

[5] Fouquet A, Green DM, Waldman B, Bowsher JH, McBride PK, Gemmell NJ. 2010. Phylogeography of *Leiopelma hochstetteri* reveals strong genetic structure and suggests new conservation priorities. Conservation Genetics 11: 907-919.
[6] Burns RJ, Armstrong DP, Bell BD, Haigh A, Germano J, Rawlence NJ, Thurley T, Hitchmough RA, Makan T Michel P. 2025. Conservation status of amphibians in Aotearoa New Zealand, 2024. New Zealand Threat Classification Series 44. Department of Conservation, Wellington. 19 p.
[7] Melzer S, Hitchmough R, Van Winkel D, Wedding C, Chapman S, Rixon M, Moreno V, Germano JM. 2022. Conservation status of amphibian species in Tāmaki Makaurau/Auckland. Auckland Council technical report 2022/4, Auckland. [NOTE: a 2026 assessment has been completed but is not yet published].
[8] Eda ARAR, Bishop PJ, Altobelli JT, Godfrey SS, Stanton JL. 2023. Screening for Batrachochytrium dendrobatidis in New Zealand native frogs: 20 years on. New Zealand Journal of Ecology, 47(2), 3531.
[9] Xie GY, Olson DH, Blaustein AR. 2016. Projecting the global distribution of the emerging amphibian fungal pathogen, Batrachochytrium dendrobatidis, based on IPCC Climate Futures. PLoS One 11 (8): e0160746.

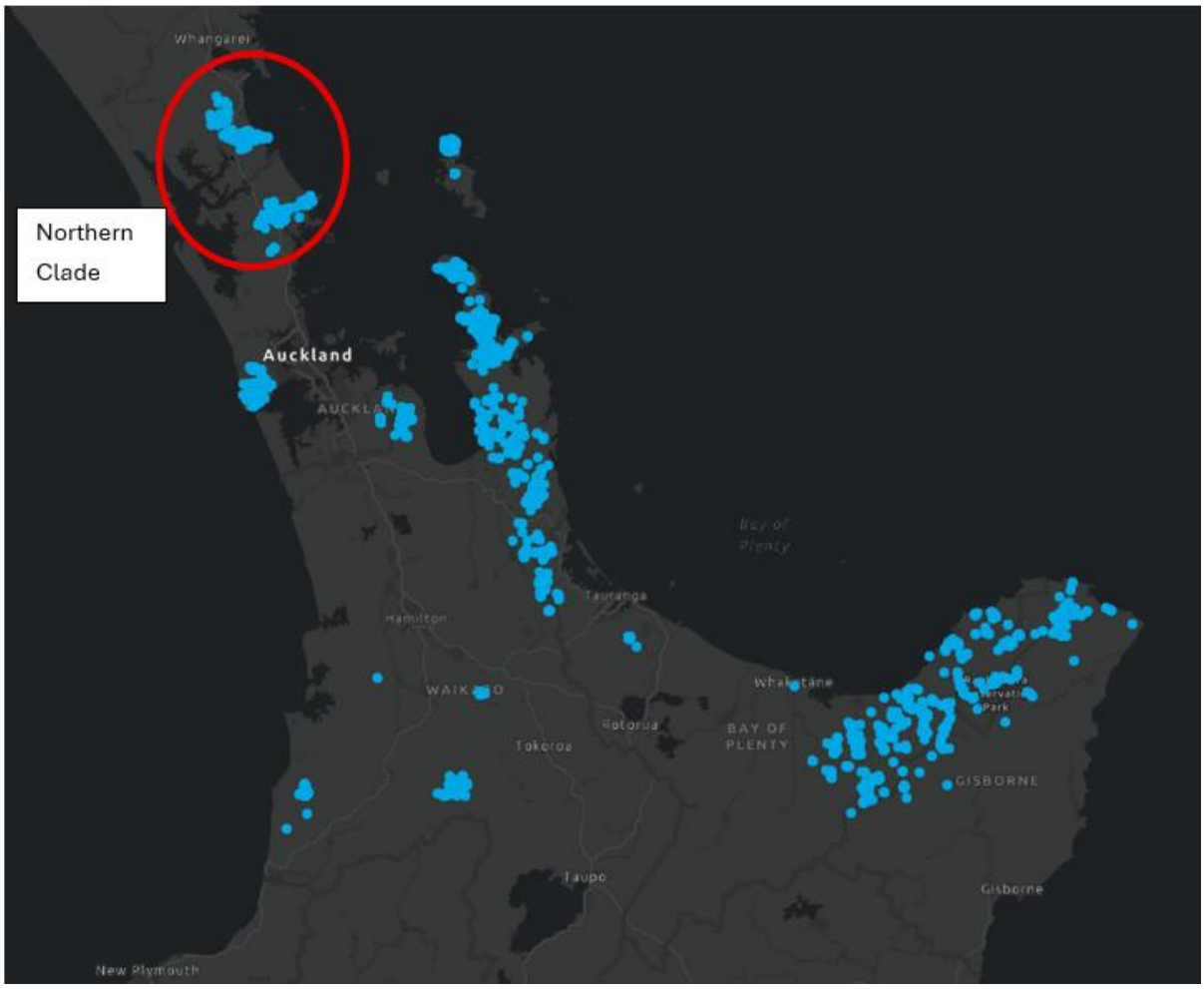


Fig.1. The location of the 'Northland Clade' compared to the location of other Hochstetter's frog records on the DOC herpetofauna database (accessed 15 July 2026).

24. The Northland clade is, as its name suggests, the northern-most clade of Hochstetter's frog, and the Brynderwyn population is near its northernmost limit. These populations not only represent the northern geographic extreme of Hochstetter's frogs but have also accumulated genetic differences not found in other clades. There is ongoing research to understand the significance of the genetic differences between clades.

25. The Brynderwyn population of Hochstetter's frog is one of four disjunct populations (that I have labelled 'Moir Hill', 'Dome Valley', 'Brynderwyn' and 'Mareretū') that together form the 'Northland' clade of Hochstetter's frogs (**Fig. 2**). Whether the populations are disjunct through natural or human-induced causes (e.g. habitat clearance) is unknown, but my observation is that most streams between the four populations are located on geological and topographical features that are unsuitable for Hochstetter's frogs. Due to unresolved taxonomy (i.e. the unknown degree of genetic and morphological difference between these populations and other Hochstetter's frog populations spread over the upper North Island) the Northland clade has the potential to be considered as either an Evolutionarily

Significant Unit (ESU), sub-species or perhaps even a unique species of Hochstetter's frog. Whichever taxonomic status the Northland clade is ultimately assigned as a result of current research, their genetic distinctiveness from all other Hochstetter's frogs[10] means they should still be managed akin to being their own species (e.g. not mixed with other clades). Whether each of the four main populations of this clade also have further genetic differences between them is unknown.



Fig. 2. The four main disjunct populations of Hochstetter's frogs within the 'Northland' clade', from records on the DOC herpetofauna database (accessed 15 July 2026). Note: records of Hochstetter's frogs found during surveys for this development have not yet been uploaded to this database.

[10] Gleeson, D.; Clay, C.; Gemmell, N.; Howitt, R.; Haigh, A. 2010: Summary report: Leiopelma hochstetteri population genetic structure. Landcare Research Contract Report: LC 077. Unpublished report for the Department of Conservation. 18 p.

Adequacy of surveys for Hochstetter's Frogs

26. The applicant has described the Hochstetter's frog habitat within each Earthworks Zone 1 to 4, with high-quality habitat assigned to the native Outstanding Natural Landscape (ONL) area in Zone 2, and moderate quality assigned to Zentral forest, also within Zone 2. Both Zone 3 and Zone 4 are considered to have little to no suitable Hochstetter's frog habitat. I generally agree with this assessment.

27. During my first site visit, I inspected a stream within the ONL immediately north of its intersection with the Piroa stream, and visited two waterways in Zentral forest (one possibly suitable for Hochstetter's frog, the other unsuitable). Both align with the applicant's description. However, I consider the waterway I visited in Zentral forest to be of moderate-low quality for Hochstetter's frogs. I consider there is more uncertainty regarding the habitat quality in Zentral forest, as the applicant also describes other areas of Zentral forest (for example, sites with extensive native riparian margins and other sites with waterfalls) that could be of higher quality than the waterway I visited.

28. The detection of 60 frogs over a 25m 'double-count' transect indicates the native forest habitat within the ONL is of the highest quality for Hochstetter's frog. This density is far higher than other sites where this method has been used. The double-counting method employed by the applicant is a relatively new method aimed at quantifying Hochstetter frogs in streams[11]. As it is relatively new, only a few sites have so far been assessed, but the Brynderwyn ONL site contains a considerably higher density than other sites surveyed so far (**Table 1**).

Site	Transect Length (m)	Number of transects	Total length surveyed (m)	Mean No. frogs/100m equivalent	Maximum frogs/100m equivalent	Reference
Te Paparahi, Aotea/Great Barrier Island	100	15	1500	12.6	54	Johnson et al., 2024[8]
Brynderwyn (SH1 road realignment -project footprint)	12.6-41.7	7	144	12.5	31	WSP 2024[12]
Brynderwyn (SH1 road realignment – reference streams)	50-66	11	566	17.5	40	WSP 2024[9]

[11] Johnson CE, Herbert SM, Gilbert J, Armstrong DP (2024). A comparison of methods for estimating abundance of unmarked Hochstetter's frogs. New Zealand Journal of Ecology 48: 3572.
[12] WSP. 2024. Brynderwyn Hills Recovery Project. Hochstetter's Frog Survey and Salvage Report. Client Report prepared for New Zealand Transport Agency - Waka Kotahi. 64 pp.

Site	Transect Length (m)	Number of transects	Total length surveyed (m)	Mean No. frogs/100m equivalent	Maximum frogs/100m equivalent	Reference
Torere – pine forest	100	7	700	18.3	50	Burns & Oates, unpublished data
Torere – native forest	100	4	400	19.8	28	Burns & Oates, unpublished data
Brynderwyn – Zentral forest	50	27	1335	6.7	40	This application
Brynderwyn ONL	25	9	390	**50.8**	**240**	This application

Table 1. Summary of Hochstetter's frog populations using the double-counting method. For density comparison purposes, where transect lengths were less than 100m, frog numbers have been scaled to give an equivalent number of frogs over 100m (e.g. a 50m transect is multiplied by 2; a 25m transect is multiplied by 4). This is presented as mean and maximum number of frogs in the two columns also labelled "frogs/100m equivalent". The high density of Hochstetter's frogs in the Brynderwyn ONL is shown in bold.

29. The applicant has undertaken a considerable number of searches for Hochstetter's frog, often in steep terrain. This is particularly the case in the high-quality habitat of the Brynderwyn ONL. It is evident that not all areas could be searched for frogs, as the applicant describes areas that could not be surveyed due to dangerous, steep waterways and inaccessible waterfall features. I agree that these sites can be impractical or unsafe to survey for Hochstetter's frogs. Therefore, the density of frogs at these unsurveyed sites is unknown, yet the bases of these waterfalls, if they have accumulated sufficient rocks and other cover objects, have the potential to be equivalent to (or perhaps even better) than the higher quality habitat that could be surveyed. The applicant does not indicate the length of waterway (or proportion of waterways) that are considered too dangerous to survey, and whether this may constitute high-quality frog habitat.

30. While the applicant has undertaken a reasonable quantity of surveys throughout the Indicative Alignment, and enough surveys within the Northern Mitigation Site to provide a reasonable level of confidence regarding Hochstetter's frog densities, there has only been one transect survey carried out in the proposed Central Mitigation Site. A more complete survey of the Central Mitigation Site is essential as it is proposed to be used as a release site for salvaged frogs. This site contains the

greatest quantity of stream length for mitigation purposes, yet the quality of this habitat for Hochstetter's frogs, based on frog transects, is uncertain.

31. Comparing maps of surveyed transects and the mitigation release sites[13], the single transect taken in the proposed Central Mitigation Site found a moderate number of frogs (between 11 and 19). The lack of representative surveys raises considerable uncertainty whether this site contains the required quantity of suitable habitat to accommodate the thousands of frogs that are proposed to be released here. I consider at least another 20 transects throughout the proposed Central Mitigation Site should be undertaken to provide a reasonable level of confidence whether the site might be capable of providing suitable habitat for the long-term security for Hochstetter's frogs.

Assessment of potential adverse effects on Hochstetter's Frogs

32. The applicant has described effects on frogs as:

    a. Permanent Effects: direct habitat loss, fragmentation, edge effects, and operational effects (noise, vibration, water contamination from stormwater runoff, increased runoff into watercourses, groundwater and hydrology from construction cuts, and artificial lights);

    b. Short to Medium effects during construction: increased injury or death, (direct injury or death, increased predation and decreased breeding success), indirect construction impacts (sedimentation, curing cement altering water pH, noise, vibration, lighting and dust).

33. However, other potential adverse effects on Hochstetter's frogs have not been mentioned or not mentioned in full. I consider the additional effects not fully assessed for Hochstetter's frogs to be:

    a. Dewatering – this activity is proposed to be undertaken for either temporary construction or for permanent dewatering of ground water[14], particularly where the alignment requires deep cuts (up to 70-75m deep) that will be below groundwater levels. Dewatering activities are expected to reduce surface flow, impacting both small seeps, as well as intermittent and permanent waterways (**Fig 3**). Hochstetter's frogs rely on these waterflows, and require these habitats for shelter, feeding, egg-laying and 'nurseries' (for egg development, newly hatched larvae (tadpoles), froglets and young frogs). I consider reduction in baseline water flows in lower-order streams and seeps is likely to have adverse effects on Hochstetter's frogs. This is supported by

[13] Vol B, Appendix D06 – Assessment of Effects on Terrestrial Ecology, Appendices J, P and Q
[14] Vol B, Appendix D12, Section 4.2 & 4.3

the Statement of Advice of Dr Storey, with ecological effects on stream fauna often beginning at about 20 percent reduction in flow. The adverse effects of this reduced water flow are likely to be further exacerbated during drought conditions, providing even less suitable habitat for Hochstetter's frogs.

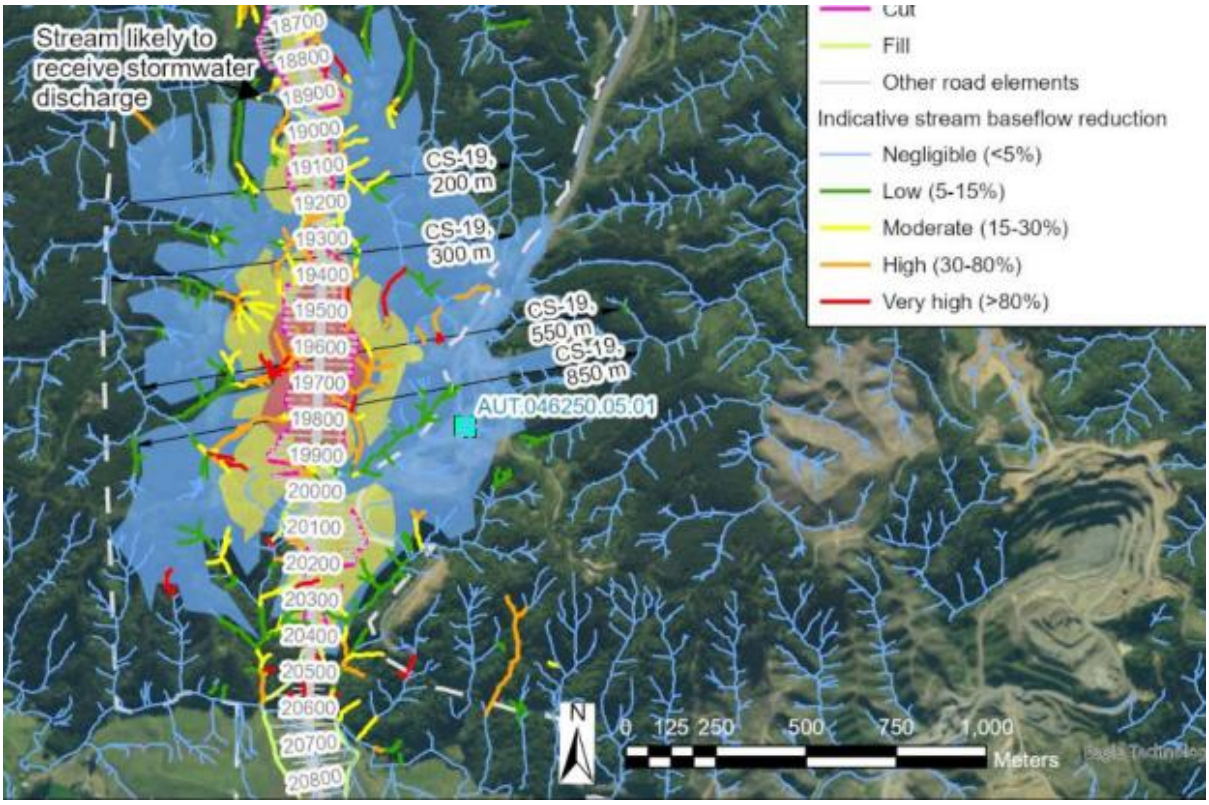


Fig. 3. Streams in Earthworks Zone 2, including the high-quality Hochstetter's frog habitat of Brynderwyn ONL, are expected to have permanent stream baseflow reductions, with some reductions above 80% (red colour). [Copied from Vol B, App D12, Fig.4].

b. Edge effects on streams – in-stream weed (**Fig. 4a & 4b**) and algae (**Fig. 4b & 4c**) due to direct sunlight once riparian habitat is removed – will have unknown impacts on frog habitat and behaviour including prevalence of suitable prey items, hunting behaviour and success, use of breeding sites, and in-stream movement behaviour;

c. Increased siltation downstream of the alignment, due to exposure of soils during enablement and construction phases, particularly by high intensity rain events during enablement, construction and operational phases. At initial operational stages, extensive areas of soil will still be directly exposed to rain on batter slopes, road verges and spoil fill sites, which may increase siltation downstream and adversely affect Hochstetter's frog habitat. Once a native plant canopy and leaf litter is established, siltation rates are likely to

decline, but it is uncertain how successful restoration will be on compacted soils and steep exposed batter slopes. Restoration is expected to take at least 10 years to achieve a 3m canopy, and 40 years to achieve an 8m canopy[15]. The time required to develop a leaf litter and duff layer is not described, but likely to take significantly longer. Each forest succession stage should reduce mobilisation of soil particles on these surfaces. Whether a leaf litter or duff layer can establish on steep batter slopes (of 30 degrees (1:2 gradient) to 45 degrees (1:1 gradient) slope) over time is not addressed by the applicant.

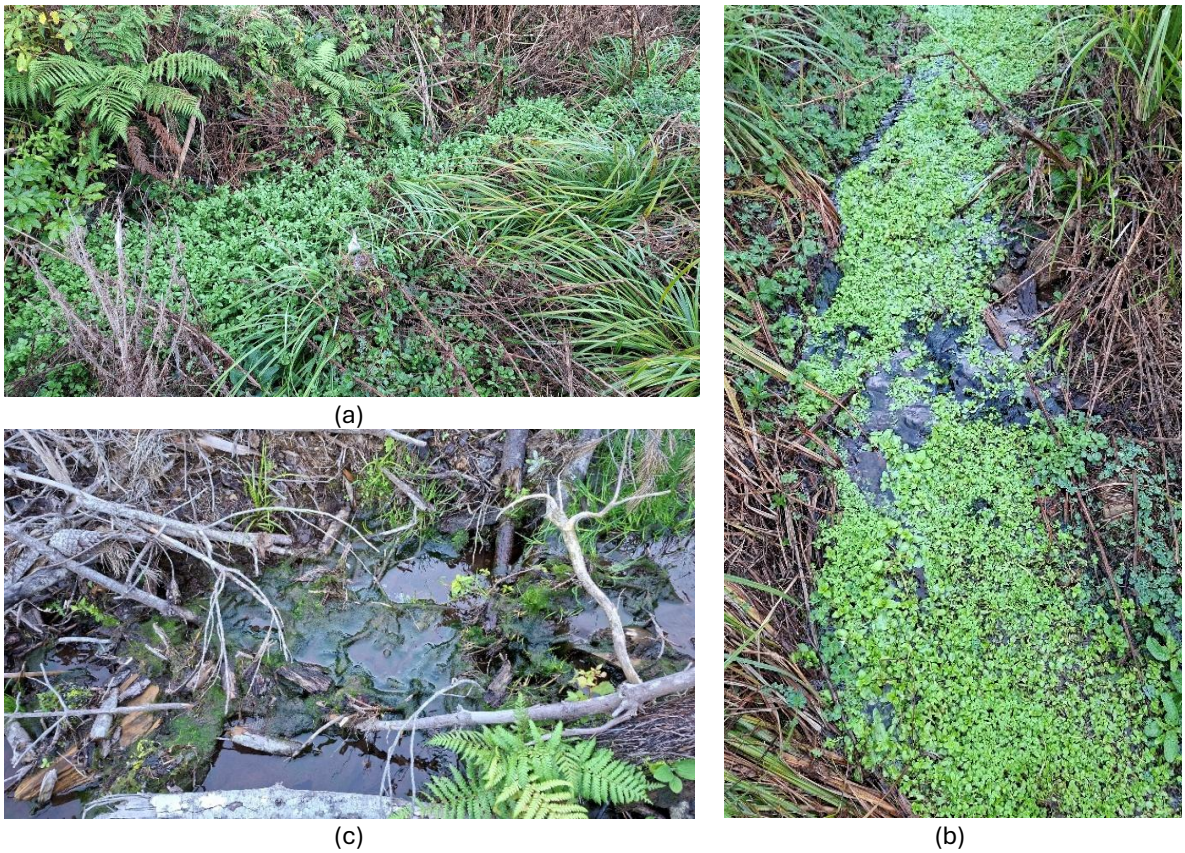


Fig. 4. In-stream weed growth (a, b) and algal growth (b, c) in streams containing Hochstetter's frog at Torere, Bay of Plenty, approximately 18 months following machine-assisted pine forest harvest. [Photos by the author].

d. Increased risk of downstream impacts due to deposition of spoil in at least 16 upper catchment sites on the Brynderwyn Ranges and northern slopes. The main risk is sedimentation of Hochstetter's frog habitat downstream of the spoil sites. This may occur during construction of the spoil sites, or at a later stage if the whole spoil deposition becomes mobilised. The possibility of how severe weather events or earthquakes could affect all spoil sites should be

[15] Vol B, Appendix D04 – Assessment of Landscape and Visual Effects, Section 5.1.4

addressed. In addition, some streams are proposed to contain multiple spoil sites, and other streams containing Hochstetter's frogs have multiple spoil sites in separate upper catchments. The risk of the cumulative effect of failure of any combination of these spoil sites should be assessed for impacts on Hochstetter's frogs.

e. Increased water velocity – culverts can increase the laminar water flow and may discharge waters at higher velocity than currently occurs in natural streams, potentially impacting on downstream Hochstetter's frogs and their habitat. Potential adverse effects include scouring of water courses and stream banks, depletion of stream-associated food resources, and physical dislodgement of cover objects or even frogs whereby they are washed downstream in high flows. If frogs are washed into a flooded Piroa Stream, I consider they would be at high risk of being unable to escape from the river and would be unlikely to survive;

f. Increased peak water flow through culverts – caused by faster runoff during heavy rain events from the roading pavement and compacted additional roading-related infrastructure (verges, batters, road drainage channels) – the volume of water released into downstream receiving Hochstetter's frog habitat may have higher peaks than under current natural conditions exacerbating normal flooding impacts on frog habitat;

g. Increased surge of water into natural streams – the *rate* at which streams increase in waterflow will potentially increase downstream of the Proposed Designation during all phases (enablement, construction, and operational) due to faster runoff of surface waters during rain events from hardened, compacted and steep exposed areas. This has the potential to have adverse effects on Hochstetter's frogs by reaching peak flows faster than currently occurs, giving Hochstetter's frogs less time to move to higher ground and minimise their risk of being washed downstream. Proposed swales and water detention ponds may mitigate this to some extent, but no data has been provided to demonstrate the effectiveness of these measures at reducing the rate of increase in waterway flow and mitigating impacts on Hochstetter's frogs;

h. Increased contamination of waterways from road runoff – the applicant has mentioned contamination[16] but hasn't specifically mentioned the various components that could contribute to this, such as heavy metals, polycyclic

[16] Vol B, Appendix D06, Assessment of Effects on Terrestrial Ecology, Table 20

aromatic hydrocarbons[17], microplastics or various other chemicals that can wash off roads, or the impact of accumulated roadside rubbish (e.g. glass, paper, plastics), or potential leachate from roadside rubbish (e.g. inks and dyes). The use of herbicides or pesticides within the alignment also has the potential to contaminate runoff and have adverse effects on Hochstetter's frogs located downstream. Chemical contamination is particularly important for frogs, as they can be exquisitely sensitive to environmental contamination. This is because frogs have a semi-permeable skin through which they absorb chemicals contained in the water, air or soils they are in contact with directly into their bodies, making them at greater risk from contaminants compared to humans or other animals with more impermeable skins or body coverings. These chemicals may then bioaccumulate within the frogs, causing harm. Eggs and larvae of Hochstetter's frogs are in contact with seep or stream water and may also be sensitive to these contaminants, potentially affecting their development. Suspended particles from runoff (e.g. hard plastics) can also settle in the sediments of receiving waterways, and may be resuspended during subsequent rain events, potentially prolonging their impact on Hochstetter's frogs;

i. Less water in some headwaters and seeps during drought conditions – due to increased short-term runoff of impermeable and compacted and exposed surfaces of the road, verges and batter slopes, ground water that would otherwise be released as seeps during drought periods but may no longer be available for release. This could have an additional cumulative effect with dewatering activities in affected waterways, as mentioned in (a) above;

j. Blasting during road construction has high risk of killing any frogs present close to the site not already salvaged. Blasting-induced pressure waves and noise also have the potential to have adverse impacts on frogs over a wider area;

k. Terrestrial vegetation removal – Hochstetter's frogs can also be found in terrestrial habitat (albeit in lower density than stream habitat). Their density and habitats (including sub-soil habitat) is largely unknown in terrestrial habitat. Their use of terrestrial habitat is likely to depend on environmental conditions (e.g. used more in heavy rain events), the number and quality of suitable cover objects available (e.g. rocks, logs, vegetation), suitable holes in the ground, and ability to burrow into the soil, leaf litter and duff layer. Any

[17] O'Riley A, Pandey S, Langdon A, Wilkins A. 2002. Characterisation of road runoff contaminants from New Zealand roads, & effect of rainfall events. *Transfund New Zealand Research Report No. 228,* 119pp.

frogs in a terrestrial environment that survive vegetation clearance will have little chance of surviving if the site is subsequently cut or filled;

l. Mortality by vehicle collision – while the road and associated works will create a wide barrier for frogs over which they may not be able to cross, terrestrial movement may become more possible if planted native forest is able to establish and mature, alongside sufficient duff and leaf litter layers, and cover objects. I consider this may take a minimum of several decades. If this habitat does successfully establish, however, then frogs may be able to reach the State Highway by terrestrial dispersal, where they will then at risk of being run over by vehicles. This is known to have occurred in the Waitakere ranges, where a substantial number of Hochstetter's frogs have been killed by road vehicles;

m. Increased predation and risk of desiccation if attempting to move terrestrially in the area affected by works in the designation – at enabling, construction and operational phases. The width of the road and associated works will create a large barrier to Hochstetter's frog terrestrial movement and dispersal. While little is known regarding terrestrial movement of this species, and what may trigger this movement, they will be at increased risk if they move within the designation once works commence. There will be little cover or refugia to find if frogs find themselves far from cover as the sun rises. The lack of cover may also make them at increased risk of predation by rats, mice, cats, hedgehogs, mustelids and even pigs;

n. Cumulative effects of this development on the wider Northland clade of Hochstetter's frogs. Another development, also within the Northland clade of Hochstetter's frogs, has been proposed for the Waste Management Ltd.'s Auckland Regional Landfill (ARL), near Dome Valley. This proposed development may affect an estimated 500-2000 Hochstetter's frogs. In addition, a large proportion of the Northland clade is located within exotic pine forest. As the applicant has mentioned, if these trees are felled without suitable measures (e.g. setbacks) put in place, there is a considerable chance a high proportion of Hochstetter's frogs will be killed. This SH1 development through the Brynderwyn Ranges adds yet another pressure on this Northland clade, with high impact at a site containing a high-density population with significant habitat value (Brynderwyn ONL);

o. The proposed timing of Hochstetter's frog salvage (1 October to 30 April) is through at least some of the known breeding period for Hochstetter's frogs[18]. I consider it likely that most frog egg clusters will not be found and will inevitably be destroyed by the applicant if salvage operations occur during this period. This is demonstrated from another salvage operation in the Brynderwyn Ranges, where 150 frogs were salvaged over the summer period, of which 23 were froglet/metamorphs but no egg strings were found[19].

p. The fragmentation of Hochstetter's frog populations has not been described in full by the mapping provided[20]. The upper catchment area where the proposed Central Mitigation Site will be located will be fragmented by a downstream obstruction caused by the Project, but it is not shown as fragmented habitat. As the applicant has not detailed how the number of kilometres of frog stream habitat was calculated[21], it is uncertain if the number of frogs assumed to be fragmented by the Project includes this area. However, as the entire Central Mitigation Site will be fragmented and it is mentioned as containing 16km of stream[22], it does not appear to have been included in fragmentation calculations, which the applicant calculates to only be 3.2km[23]. This discrepancy is shown in **Fig. 5.** The stream is proposed to be culverted and filled within the Proposed Designation, yet the upper catchment is not coloured to indicate it is fragmented.

q. Impacts on frogs downstream of low-order stream habitat destruction has also not been mentioned. Many of the proposed cuts, fills and spoil sites will destroy Hochstetter's frog habitat. While frogs upstream of these sites have usually been considered for fragmentation effects, there has been no consideration of the requirements of frogs downstream of the impact area, and the requirements they may have to utilise upstream habitat. This habitat has the potential to be used for finding mates, breeding sites, food resources and dispersal. In addition, frogs downstream of the impact site may in turn be fragmented if the stream doesn't directly intersect with other streams containing suitable Hochstetter's frog habitat.

[18] Beauchamp AJ, Lei P, Goddard K. 2010. Hochstetter's frog (Leiopelma hochstetteri) egg, mobile larvae and froglet development. New Zealand Journal of Zoology 37: 167-174.
[19] WSP. 2024. Brynderwyn Hills Recovery Project. Hochstetter's Frog Survey and Salvage Report. Client Report prepared for New Zealand Transport Agency - Waka Kotahi. 64 pp.
[20] Vol B, App D06 – Assessment of Effects on Terrestrial Ecology, App P.
[21] Vol B, App D06 - Assessment of Effects on Terrestrial Ecology, Table 19
[22] Vol B, App D06 - Assessment of Effects on Terrestrial Ecology, Section 5.1.2
[23] Vol B, App D06 - Assessment of Effects on Terrestrial Ecology, Table 19

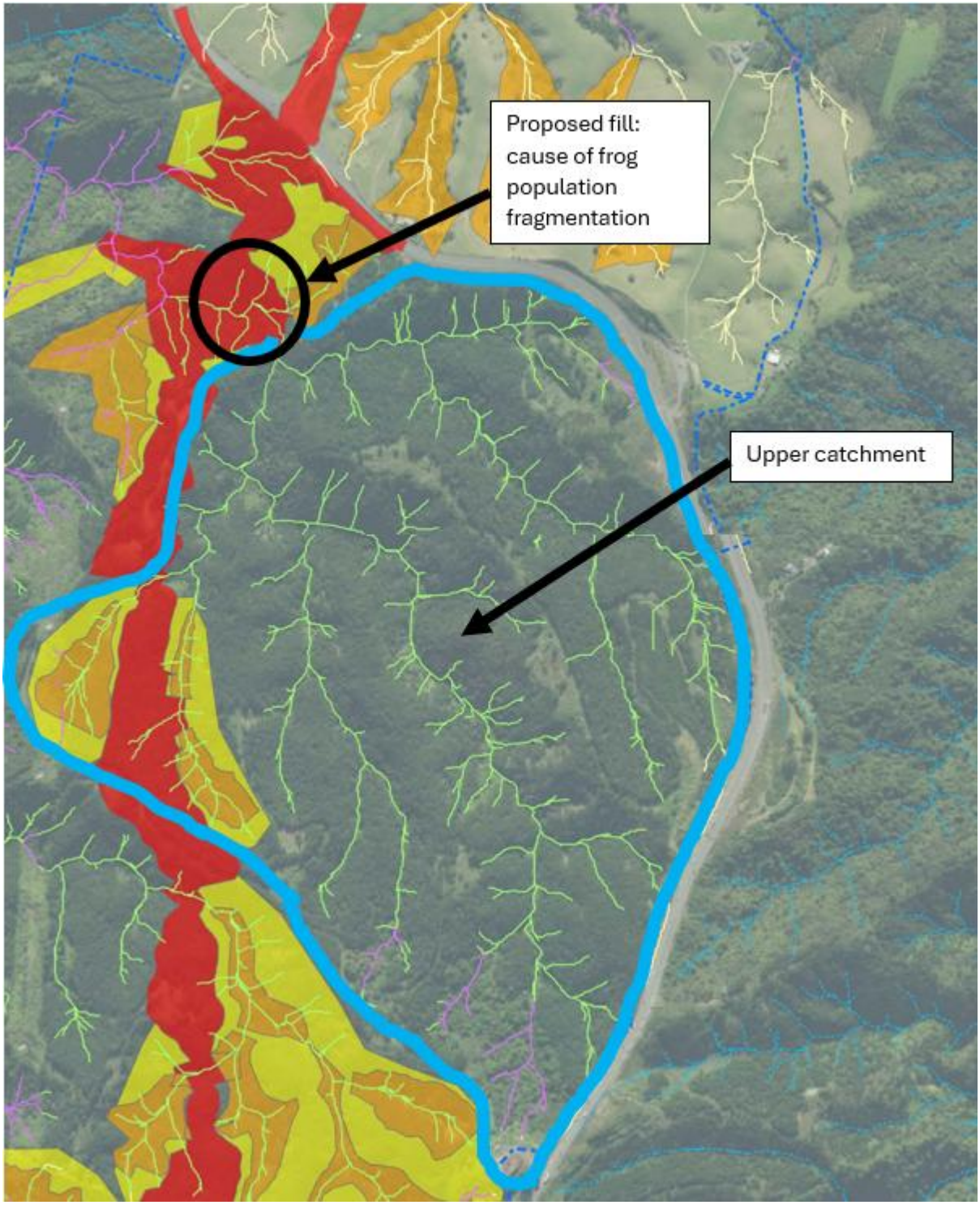


Fig. 5. Hochstetter's frog habitat fragmented by a fill within the Proposed Designation, with the majority of the upper catchment not mapped as being affected by fragmentation. The upper catchment boundary (ridgeline) is shown by a light blue line.

r. The effects of long-term fragmentation and isolation of Hochstetter's frogs have not been mentioned. These include genetic drift, erosion of genetic diversity and inbreeding depression. These have the potential to occur at several locations due to the potential isolation of small populations of frogs from larger populations. Isolation may occur due to culverting streams and

filling valleys and gulleys with spoil, making it difficult for frogs in upper catchments to connect and breed with other frogs. This is because frogs are unlikely to be able to traverse waterways to connect to other frogs, and some sites may also have surrounding terrestrial vegetation removed, potentially preventing frogs moving into other catchments via terrestrial habitats. These effects are very long-term (likely to be decades to centuries), but if the application is granted there will be permanent and irreversible effects on this population of frogs, with impacts on natural movement and dispersal patterns.

34. The applicant has mentioned sedimentation and noise as a temporary effect[24], yet as outlined at [38 (d)] I consider these are also likely to be long-term effects beyond the construction phase and are likely to occur throughout the operational phase.

35. The number of frogs potentially affected by the proposed development can be estimated by extrapolating the number of frogs found in surveys to that of other similar streams across the project construction area.[25] The applicant provides this data yet doesn't make the final calculation to explicitly show the estimated total number of Hochstetter's frogs likely to be directly and indirectly impacted. For clarity, I have provided these totals in **Table 2**. As mentioned above at [33(p)], at least two large areas of fragmented habitat do not appear to have been accounted for in the fragmentation mapping. It appears these unmapped areas have not been included in the summation of stream length.

Type of Effect	**Habitat type**	**Stream length affected (km)**	**Mean number of surveyed Hochstetter's frogs detected (per 100m)**	**Estimated total number of Hochstetter's frogs (per 100m)[a]**	**Extrapolated total Hochstetter's frogs affected**
Direct habitat loss	Streams in Exotic Forest	10.3	6.7	54.9	5,655
	Streams in Native vegetation	3.9	50.8	416.6	16,247
	Sub-total	*14.2*	*n/a*	*n/a*	*21,902*
Fragmentation	Streams in Exotic Forest	3.2	6.7	54.9	1,757

[24] Vol B, App D06 - Assessment of Effects on Terrestrial Ecology, Table 20
[25] Vol B, App D06 - Assessment of Effects on Terrestrial Ecology, Table 19

Type of Effect	Habitat type	Stream length affected (km)	Mean number of surveyed Hochstetter's frogs detected (per 100m)	Estimated total number of Hochstetter's frogs (per 100m)[a]	Extrapolated total Hochstetter's frogs affected
	Streams in Native vegetation	3.7	50.8	416.6	15,414
	Sub-total	*6.9*	*n/a*	*n/a*	*17,171*
Total		**21.1**	*n/a*	*n/a*	**39,073**

[a] This column is multiplied by 8.2 from the mean number of frogs detected from a single 'double-count' survey

Table 2. The number of Hochstetter's frogs assessed as being directly affected through habitat loss, or habitat affected by fragmentation effects (based on Vol B, Appendix D06, Table 19). The 90% decline in total frog abundance the applicant has assumed will occur during future pine harvesting is not included in Table 2, as any future pine harvest is a separate process and any actions should be protective of frogs under the Wildlife Act 1953.

36. The applicant has reduced the number of frogs in waterways that will be affected by exotic forest harvest by 90%. However, in my view this is a separate issue that raises questions of compliance with the Wildlife Act 1953 by forestry companies in pine forests containing Hochstetter's frogs. Reducing the density of Hochstetter's frogs by 90% assumes this issue will not be addressed by resource consent conditions or a Wildlife Act Authority at the time of harvest. Therefore, I do not agree that such a reduction in frog density within exotic forest is justified. In the calculations I have provided in **Table 2**, I have not applied this reduction of frogs in exotic forests.

37. As mentioned in the assessment of landscape effects[26], a slight movement of the current indicative alignment through the Brynderwyn ONL would result in the proposed fill embankment over the mainstem of the Piroa Stream to have greater impacts on the small streams (termed 'Western Piroa Tributary Stream' and 'Eastern Piroa Tributary Stream'), which would in turn have greater impacts on Hochstetter's frogs. Therefore, depending on final detailed design of the alignment, adverse effects have the potential to be substantially worse than the current indicative alignment would suggest.

[26] Vol B, Appendix D04 – Assessment of Landscape and Visual Effects, Section 4.5.3

Assessment of Proposed Mitigation Measures for Hochstetter's frogs

38. The author of the Terrestrial AEE has outlined recommended mitigation actions for effects considered as being 'Moderate' or higher[27]. For Hochstetter's frogs, the mitigation measures offered for each of these recognised adverse effects, and which the report indicates will reduce the level of effects from Very High to High, down to High to Low (Table 26) are as follows:

    a. permanent loss of habitat: minimisation of loss, where practicable of native vegetation and fauna habitat through detailed design and construction methodology;

    b. permanent habitat fragmentation: mitigation planting and enhancement of existing vegetation at potential 'Mitigation and Release sites';

    c. permanent indirect habitat loss & degradation via habitat fragmentation and edge effects – with mitigation by:

        i. habitat enhancement, buffer planting;

        ii. spoil site and culvert design do not cause hydrological changes downstream;

        iii. stormwater and runoff management by swales and detention ponds;

        iv. increased culvert diameters to allow for upstream frog movement in low flow conditions;

    d. operational disturbance: staging works and ensure frog hygiene protocols are followed;

    e. injury or death of Hochstetter's frog during habitat removal and displacement: salvage and relocation;

    f. Indirect disturbance during construction: sediment and other contaminant (e.g. concrete) control in works in proximity to potential frog habitat.

39. I regard these measures as being insufficient to address the likely impact of these effects recognised by the applicant and described at [32] above, and few if any measures are offered to mitigate the additional potential adverse effects described at [33].

40. For those potential adverse effects described at [32] (with offered mitigation summarised at [38]), I provide a more detailed assessment below:

[27] Vol B, Appendix D06 - Assessment of Effects on Terrestrial Ecology, Tables 23 & 26

a. The effectiveness of the detailed design and construction methods that are claimed to be able to minimise permanent vegetation loss within Hochstetter's frog habitat are uncertain. There is no quantification of the extent of Hochstetter's frog habitat that will be avoided or minimised during detailed design, and few options offered for alternative roading construction methods. Avoidance or minimisation measures such as bridging or tunnelling are not listed as being measures being considered. The proposal to create additional cover habitat at mitigation release sites (e.g. by adding rocks into streams) is inadequate and I do not agree the magnitude of effect will decline from High to Moderate[28] with the mitigation measures offered. I consider the only adequate mitigation for habitat loss is replication of this habitat by the creation of a new area with similar stream sizes, water quality, cover objects, mature native vegetation cover, topology and geology. However, I also regard this as being impossible to achieve, making the high-quality Hochstetter's frog habitat (in the Brynderwyn ONL in particular), irreplaceable.

b. Fragmentation of Hochstetter's frog stream habitat within the proposed designation is not addressed by any mitigation measures. The proposal to culvert Hochstetter's frog stream habitat, remove vegetation and apply soil up to the road level is highly likely to permanently fragment the Brynderwyn Ranges frog population. Planting and enhancement of vegetation at the two proposed frog release sites will have no impact on mitigating the effect of the proposal on frogs remaining in the ONL or other parts of the proposed designation. The planting measures will have substantial lag times to take effect by providing suitable frog dispersal habitat but are still not addressing the Brynderwyn Ranges fragmentation effect. Frog populations in the same waterway, but on either side of the proposed road will remain fragmented, and no mitigation is offered to address this. Therefore, I do not agree there is any significant mitigation of habitat fragmentation, and the magnitude of effect should remain 'High'[24] resulting in a 'Very High' Mitigated Overall Level of Effect.

c. The mitigation measures are a mixture of potentially suitable and untested approaches:

   i. Habitat enhancement (e.g. addition of rocks to provide more day-time surface cover objects) has an unknown and untested impact on the survivorship of Hochstetter's frogs;

[28] Vol B, Appendix D06 - Assessment of Effects on Terrestrial Ecology, Table 26

ii. Buffer planting between fragmented areas adjacent to the road may provide some mitigation, but I consider it would take decades to be effective, if suitable plants can be successfully established;

iii. Mitigation measures for stormwater runoff such as swales and detention ponds may mitigate some 'flash-flooding' of downstream Hochstetter's frog habitat, however steep-sided and lined water detention ponds near Hochstetter's frog habitat could also become a lethal and inescapable trap for Hochstetter's frogs. There has been no assessment provided to demonstrate whether the proposed measures will result in similar waterflows into receiving Hochstetter's frog waterways during heavy rain events;

iv. There is no evidence provided to support the notion that Hochstetter's frogs can move upstream through culverts (some of which are proposed to be hundreds of metres long), even in the low-flow conditions as suggested. In the Earthworks Zone 2 section of the Project, there are four culverts proposed over 200m long, and one of these is 372m long[29]. Of the seven culverts proposed for Earthworks Zone 2, five are designed to have a gradient of over 5%, with one 273m culvert (at CH 20040) having a gradient of 22.12%). I do not find it plausible that these structures can be overcome by Hochstetter's frogs. I consider a research project to address this aspect of Hochstetter's frog movement ecology would be required to understand whether frogs are able to move upstream within culverts of these dimensions, and whether this likelihood changes if culverts accumulate a bed of gravel, larger cobbles and other suitable frog cover objects over time.

d. Permanent operational disturbance is proposed to be mitigated by staging works and following frog hygiene protocols. I do not understand how these measures would be effective, as elsewhere in the application[30] it is stated this will occur during the operational phase of the project (i.e. when the road is open and vehicles are using it). However, the mitigation measures (staging works and having hygiene procedures when handling frogs) appear to be processes that would only be used at enabling or construction phases. I agree that when handling frogs, frog hygiene is important, but I also consider the act of moving them to a different location and catchment is likely to have a far

[29] Vol B, Appendix D11 – Assessment of Operational Stormwater and Flooding Effects, Appendix C, Table 6

[30] Vol B, Appendix D06 – Assessment of Effects on Terrestrial Ecology, Table 26

greater disturbance effect. I also describe additional measures that should be considered when moving frogs in DOC's s 51 Report[31].

e. Death and injury due to habitat removal are proposed to be avoided (for individuals captured) and minimised through salvage and relocation into two release sites. As described in my Statement of Advice for DOC's s 51 Report[32], I consider there are a number of reasons why salvaging Hochstetter's frogs – even through the proposed four phases – will fail to capture considerable numbers of them, which I anticipate could be several thousand frogs. Briefly, the area has steep and complex terrain, and as Hochstetter's frog are also found in subterranean habitat and under cover objects and in rock crevices too heavy to be accessed without machines, substantial numbers are likely to remain uncaptured during salvage operations. Some of the techniques offered are largely untested, for example frog barriers put in place once a stream length is searched and the so-called 'Judas' rocks. This is further assessed at [41-42]. Due to the comparatively low-quality or uncertain quality habitat offered by the release sites and only 5 years of pest control offered, I consider the level of effect should only change from 'High' to 'Moderate' (not to 'Low' as the applicant considers appropriate), giving an Overall Level of Effect following mitigation of 'High'. My reasoning for this is outlined in my consideration of the appropriateness of the two frog Mitigation Sites at [47 to 56].

f. Indirect Construction disturbance such as sedimentation, concrete (curing), noise, lighting and vibration are proposed to be mitigated by implementing sediment and 'other contaminant (e.g. concrete) control'. These measures do not address noise, vibration or lighting, and the applicant seems to consider these potential adverse effects are only present during construction activities. I consider sedimentation, noise, and vibration to also be potential adverse effects during the operational phase of the project. No mitigation measures are offered for these effects during this operational phase.

g. In summary, due to the uncertainty of their effectiveness and an absence of data to support these measures, I do not agree the magnitude of effect should be decreased after these proposed mitigation measures.

41. The four phases of salvaging frogs proposed by the applicant have only been implemented once before – also in the Brynderwyn Range, during Order in Council

[31]DOC s 51 Report on Brynderwyn Hills Section, Appendix A at [18] to [21]
[32]DOC s 51 Report on Brynderwyn Hills section, Appendix A at [13] to [17]

emergency works on SH1 by the applicant[33]. Statistics showing salvage effort and success rate in each of the four phases over seven waterways totalling 144m are shown (**Table 3**).

Salvage Phase	Salvage description	Frogs salvaged	Person-hours	Frogs/ person-hours	Person-hours/m	Mean No. Frogs/20m transect equivalent
1	Daytime searches	116	232	0.50	1.6	16.1
2	Nocturnal searches	16	19	0.84	0.13	2.22
3a	Daytime search & 'Judas' rocks	11	62	0.18	0.43	1.52
3b	Machine-assisted search	7	15	0.47	0.10	0.97
Totals		**150**	**328**	**2.2**	**2.3**	**20.8**

Table 3. Hochstetter's salvage statistics over a total of 144m of stream in each of the four salvage phases at Brynderwyn Ranges.

42. **Table 3** indicates the Phase 1 daytime intensive searches, where as much habitat as possible is explored and removed, found the most frogs. However, this took the most time per metre of stream bed. This is likely due to the complexity of terrain, the time taken to dig into complex habitat, and processing of so many frogs. The most efficient method appears to be Phase 2, although far fewer frogs were recovered than Phase 1. The least efficient method was Phase 3a, with only 11 frogs found despite 62 hours of searching.

43. While barriers were used in an attempt to prevent frogs moving into the site once salvage had commenced, the effectiveness of the fences is not known, and frogs could potentially climb over them. Frogs found from Phase 2 onwards could either be those that were upstream in earlier phases and then moved into the salvage area during later phases, or frogs that had already been salvaged and released, moving back downstream. Of 7 streams salvaged, 5 streams had frogs released upstream within the same waterway (between 20 to 120m upstream). As frogs were not marked, it is not known if frogs found in later stages were those recolonising the

[33] WSP. 2024. Brynderwyn Hills Recovery Project. Hochstetter's Frog Survey and Salvage Report. Client Report prepared for New Zealand Transport Agency - Waka Kotahi. 64 pp.

stream that had been previously removed, different frogs recolonising, or frogs that had not been detected in earlier phases and had always been present in the salvage area. Therefore, the overall effectiveness of these four phases in detecting all frogs present is still uncertain.

44. If these statistics are applied over the 14.2km of waterway within the designation (**Table 2**) where frogs are to be salvaged, it would require 32,890 person-hours to salvage these frogs. For a work year comprising 1840 hours, this equates to 17.9 person-years. This doesn't account for time when frog surveys are unlikely to be possible, such as adverse weather events. In the Brynderwyn ONL, frog densities are much higher than those of the salvage areas (**Table 1**), there are complex streams such as waterfalls which would be slow to access and safely search, so this figure could even be an under-estimate.

45. The applicant's Salvage Protocols[34] show that complete salvage operations could be expected to be completed within 10 days before earthworks and vegetation clearance commence. Depending on the length of stream scheduled for clearance, this period of time seems relatively short to allow all four phases to be completed, including allowance for unsuitable conditions such as heavy rain or high wind events.

46. Overall, the author of the Terrestrial AEE report concludes that despite these mitigation measures, the proposal's overall 'Level of Effect' on Hochstetter's frog for habitat loss and fragmentation will be 'High'[35] and I agree. The author indicates offsetting or compensation measures are appropriate in this situation[36], but no offset plan is offered for Hochstetter's frogs. A recent compensation plan is assessed at [63 to 84].

47. Two mitigation sites have been offered where Hochstetter's frog can be released and pest control undertaken. In addition to these sites, an unknown area of Brynderwyn ONL is recommended for pest control. I agree that this additional pest control should occur, but there are insufficient details provided to assess whether this is likely to be adequate to enhance the remaining Brynderwyn frog population. The applicant should provide details regarding pest control method, spatial intensity, temporal intensity, timing, extent, duration, pest control targets, additional measures if targets are not met, as well as monitoring method, monitoring locations, monitoring duration, outcome targets and additional measures if frog targets are not met.

[34] Draft Ecological Management Plan, Section 2.6
[35] Vol B, Appendix D06 - Assessment of Effects on Terrestrial Ecology, Table 26
[36] Vol B, Appendix D06 - Assessment of Effects on Terrestrial Ecology, p 44

48. The Northern Mitigation Site contains 7.7km of stream habitat, and Hochstetter's frogs are currently resident in low to moderate-low densities[37]. I visited the westernmost upper catchment of this site on 26 June 2026, a site that is partly within the Indicative Alignment (and partly in areas that will be fragmented due to culverts supporting the alignment) but nevertheless is immediately upstream of the proposed northern mitigation site and so can provide a general understanding of habitat quality for Hochstetter's frogs in this waterway. I considered the site to be of generally low habitat quality for Hochstetter's frogs. The site was extensively trampled and pugged by livestock, and streams appeared to have moderate-high siltation. There appeared to be livestock-induced erosion of streambanks, and only intermittent cover objects in the waterways (e.g. rocks, vegetation, small cascades; **Fig.6a**) that would be suitable for Hochstetter's frogs. In one area near a confluence of two streams there was a relatively large clearing of exotic-dominated grasses, and at this site the stream gradient was very shallow. The stream flow was likewise slow, and areas of mud were present immediately around the stream, with cattle pugging also evident (**Fig.6b**). Such muddy streams in open areas provide little to no habitat for Hochstetter's frogs. If this is somewhat typical of downstream habitat and other waterways within the proposed mitigation site, then I consider the proposed northern release site to be of relatively low quality.



(a)



(b)

[37] Vol B, Appendix D06 - Assessment of Effects on Terrestrial Ecology, Appendix J, Sheet1

Fig. 6 a & b. Low-quality Hochstetter's frog stream habitat within the Indicative Alignment, but immediately upstream of the proposed northern release site for Hochstetter's frogs; (a) low gradient with minimal cover objects for frogs; and (b) open exotic-dominated clearing bordered by a muddy stream, stock pugging and stream bank erosion.

49. In addition, close to the proposed Northern Mitigation Site, the applicant is proposing to fill in watercourses containing Hochstetter's frog (albeit in low density) as part of the Indicative Alignment, and several adjacent areas immediately upstream from the release site are proposed to be used as spoil sites[38]. Therefore, if siltation, runoff, contaminants and other potential impacts do occur, this will impact the habitat downstream – i.e. within the northern mitigation site. Rather than creating a refugia, these mitigation sites may instead be placing frogs in harm's way.

50. The proposed mitigation measures in the Northern Mitigation Site that I consider will benefit frogs are:

    a. livestock exclusion (reduction of trampling, pugging, siltation into waterways, and reduced browsing on terrestrial plants resulting in higher quality terrestrial habitat when Hochstetter's frogs move away from streams), and

    b. pest control for 5 years.

51. However, I consider both these actions to be inadequate for frogs due to:

    a. Livestock exclusion will have a lag period until the terrestrial plants can moderate flooding impacts, stabilise stream banks and reduce stream siltation. I consider it would be important to ensure livestock are removed several years before any frogs are salvaged and released to the site to increase habitat quality that is likely to be required to accommodate substantially more frogs in this waterway;

    b. The feasibility of adequately fencing stock out of the northern mitigation site is uncertain, as the boundary bisects contiguous forest (**Fig. 7**). In addition, the main stream winds in and out of the mitigation site and the ability to fence across streams to prevent stock access yet accommodate flooding and in-stream debris is uncertain;

    c. The length of time offered for pest control will in my opinion be far too short to be able to fully establish and grow the population to replace that lost in the Brynderwyn ONL. As with other native New Zealand frogs, Hochstetter's frogs are long-lived but slow breeding[39]. Similarly to the Brynderwyn ONL, there are

[38] Vol B, Appendix D06 - Assessment of Effects on Terrestrial Ecology, Appendix P, Sheet 1

[39] Bell BD 2010. The threatened Leiopelmatid frogs of New Zealand: Natural history integrates with conservation. Herpetological Conservation and Biology 5: 515-528.

no details provided of the proposed pest control in order to assess the likelihood of success in controlling pests. The applicant should provide a Pest Management Plan with details regarding pest control methods, spatial intensity, temporal intensity, timing, extent, duration, pest control targets, additional measures if targets are not met, as well as monitoring methods, monitoring locations, monitoring duration, outcome targets and additional measures if frog targets are not met;

d. Challenges facing the feasibility of protecting frogs from predation by pest control measures in the proposed northern Mitigation site, where stream habitat is close to the boundary of the pest control area (**Fig. 7**). In addition, the largest waterway at this site, which may offer the best Hochstetter's frog habitat, will only be intermittently protected as the stream winds its way into and outside the pest mitigation area. Hochstetter's frogs may only be able to be adequately protected in a small, central core.

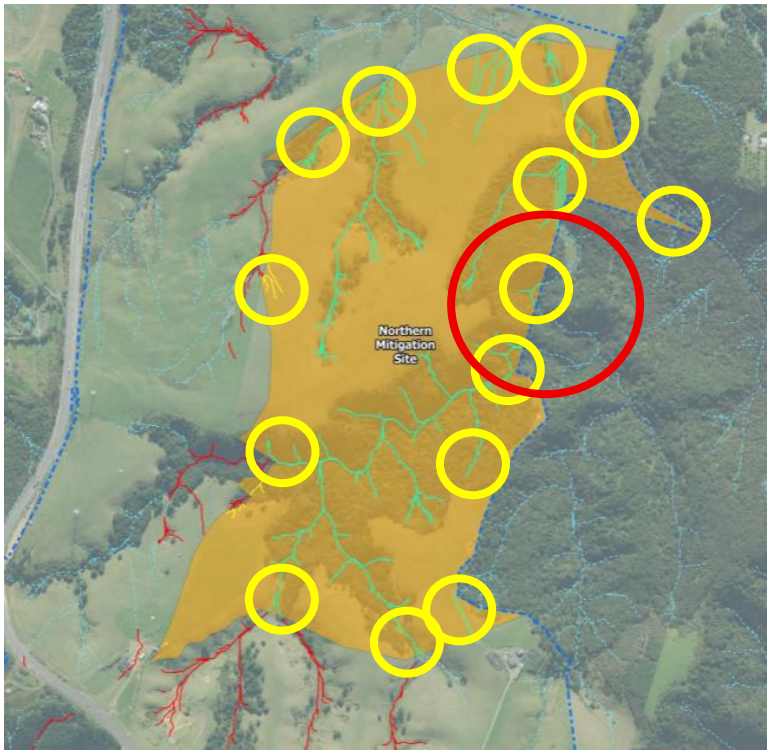


Fig. 7. Waterways within the Northern Release Mitigation site40 that are close to the mitigation (pest control) boundary (yellow circles), and so are highly vulnerable to continual animal pest reinvasion. The red circle shows where the main stream is only intermittently protected from animal pests.

[40] Adapted from: Vol B, Appendix D06 – Assessment of Effects on Terrestrial Ecology, Appendix Q, Sheet 1.

52. The Central Mitigation Site contains up to 16km of low to moderate quality Hochstetter's frog habitat. It is located between the current SH1 and the indicative alignment, on the summit of the Brynderwyn Hills, in pine forest habitat.

53. Only a few of these streams have native vegetation as a riparian margin, and most waterways are fringed by pine forest. If the pine forest continues to operate as a commercial forest and is harvested every 25 years or so, the habitat quality for Hochstetter's frog is likely to decline over successive harvests with increased silt loads, slips and pine harvest debris (e.g. slash) accumulating in streams, and frogs could be at heightened risk of population decline. In addition, if the proposed 10m riparian margins[41] are not strictly enforced, felled logs can crush riparian vegetation and directly impact streams. The percussive force of pine trees falling in frog habitat, and any dragging of trees through waterways may lead to direct killing of frogs. Subsequent effects such as increased siltation of streams, increased temperature extremes by removal of the riparian cover, increasing light and UV levels, and increased weed and algal growth (**Fig. 4**), have uncertain, but potentially detrimental effects on Hochstetter's frogs.

54. Therefore, despite a 10m setback being proposed, which I acknowledge is greater than the 5m minimum standard required by the National Environmental Standards for commercial Forestry (NES-CF), I consider Hochstetter's frogs are at high risk of adverse impacts by commercial pine harvest at the Central Mitigation Site. Before any frogs are released here, there should be a clear expectation that all riparian habitat suitable for Hochstetter's frogs needs to be retained following harvest operations, and it is logistically feasible to do so. If harvesting cannot guarantee the permanent retention of this riparian habitat (and so protecting the waterways contained by them), then I consider the site is unsuitable to be considered as a release site for salvaged Hochstetter's frogs. If frogs are released here, I support the intention of providing legal protection of these riparian margins through a robust mechanism that ensures their permanent protection.

55. The applicant also proposes that in-fill or remediation planting is required as mitigation measures to ensure all headwater, intermittent and ephemeral streams in the Central Mitigation Site have a full riparian margin. This indicates the offered 10m setback areas do not currently consist of riparian native habitat, and there may be substantial areas with little to no riparian margin. Quantification of the stream lengths with and without sufficient (10m) riparian margins in the Central Mitigation Site is not provided. Where riparian margins are required, there will also be a considerable time lag until the canopy and forest structure matures, providing the

[41] Vol B, Appendix D06 – Assessment of Effects on Terrestrial Ecology, Section 5.1.4

required shading and silt capture that is required for Hochstetter's frog stream habitat.

56. I consider neither the Northern Mitigation Site nor the Central Mitigation Site as being likely to be able to support a high density of Hochstetter's frogs. If approximately 20,000 frogs are salvaged from the Brynderwyn ONL and other parts of the designation, I do not think there will be sufficient habitat available over both proposed release sites to support this number of frogs, let alone the resident frogs. This is because the total waterway length at these two sites measures approximately 23.7 km, meaning an additional 84 frogs would need to be accommodated every 100m of waterway throughout both these sites. If the same 8.2-fold proportion of frogs are deemed to hide below immovable surface features and other cavities in these streams (this factor was shown in streams near the current Brynderwyn SH1 in 2023/24 surveys and emergency salvage works, when compared to manageable surface features), then this is the equivalent of 10 frogs per 100m of waterway. Based on frog survey results[42] the average frog density in the Northern Mitigation Site (from six 50m transects) is between 5 and 11.6 per 100m (the uncertainty is due to how transect results are grouped, as raw survey data was not provided). An increase of another 10 frogs per 100m would require the habitat to accommodate between a 186% or 300% increase in frog density. As only one transect was undertaken within the Central Mitigation Site, if adjacent transects (but within the Indicative Alignment) are included, habitat at this site holds 6.7 frogs per 100m. Following frog salvage and release, this would need to increase to 16.7 frogs per 100m, meaning these waterways would need to accommodate a 250% increase in frog density.

57. The Southern Mitigation Site is not considered suitable for Hochstetter's frogs by the Terrestrial AEE's author[43] and I will not consider it further.

58. The success of Hochstetter frog salvage and release operations is highly uncertain. There has been no documented salvage and release of Hochstetter's frogs into a waterway where the survival of individual frogs past a few days is known[44]. The best documented salvage and releases of Hochstetter's frogs have all occurred in the Brynderwyn Ranges[45], and all have been associated with improvements on SH1 by

[42] Vol B, Appendix D06, Appendix J, Sheet 1
[43] Vol B, Appendix D08 - Assessment of Effects on Terrestrial Ecology, Section 5.1.3
[44] Wren S, Bishop PJ, Beauchamp AJ, Bell BD, Bell E, Cisternas J, Dewhurst P, Easton L, Gibson R, Haigh A, Tocher M, Germano JM. 2023. A review of New Zealand native frog translocations: lessons learned and future priorities. New Zealand Journal of Ecology. 47: 3538.
[45] Parrish R. 2004. Report on Hochstetter's frog salvage on Pilbrow Hill, Brynderwyn Range, October/November 2004. Unpublished report, Department of Conservation. 4p. Beauchamp AJ, Parrish R, Butchart N. 2004. Trial transfer of Hochstetter's Frog (Leiopelma hochstetteri) in the Brynderwyn Hills, Northland, New Zealand. Unpublished report, Department of Conservation, Whangārei. 19p. WSP. 2024.

NZTA. To undertake this on such a large scale with no staging over time to test the suitability of release sites or using adaptive management approaches, is placing this population at risk of considerable losses – in the order of thousands to perhaps tens of thousands of Hochstetter's frogs.

59. The work undertaken in the Brynderwyn Ranges following Cyclone Gabrielle highlights the difficulty in the proposed approach to measure survivorship of released and resident frogs. Four streams were surveyed for frogs both before and after release of salvaged frogs. Overall, 106 frogs were found in initial surveys, 72 frogs were released into those sections of streams, and 109 frogs were subsequently found (for 2 streams, this appears to be 2 months later; for the other 2 streams it is difficult to tell from the report how long after release the last survey occurred). Whether those additional 3 frogs found represent natural fluctuations of resident frogs and there were few survivors, or represents either a fraction or high proportion of survivors, is not readily apparent. Further surveys of the same sites in subsequent seasons would be very useful in helping determine whether this survey method may be of use.

60. The applicant has also not provided sufficient details of how Hochstetter's frogs will be monitored to robustly and statistically prove the salvage and release process has been a success. Hochstetter's frog populations have proved difficult to reliably measure, but standardising protocols and developing new analytical methods are providing an increased confidence it can be achieved[46]. No matter which approach is taken, however, all require considerable monitoring effort of high quality over many years and the monitoring approach and resources to be adopted should be outlined to provide confidence it could be successful.

61. For additional adverse effects not considered by the applicant and outlined at [33] above, there are no mitigation measures offered. The variety of potential adverse effects outlined here should be quantified by the applicant, and an appropriate quantity, extent and duration of mitigation measures should be offered that reduce these impacts to no more than minor.

62. Overall, I consider the mitigation package offered by the applicant to be inadequate to address the many potential adverse effects that may occur during enabling, construction and operational phases of the project, leaving a considerable quantity of residual effects remaining.

Brynderwyn Hills Recovery Project. Hochstetter's Frog Survey and Salvage Report. Client Report prepared for New Zealand Transport Agency - Waka Kotahi. 64 pp.

[46] Johnson CE, Herbert SM, Gilbert J, Armstrong DP. 2024. A comparison of methods for estimating abundance of unmarked Hochstetter's frogs. New Zealand Journal of Ecology. 48: 3572

63. In my opinion, the applicant has not offered adequate mitigation measures because the quantity and permanence of adverse effects of this proposal are so impactful upon Hochstetter's frogs, that there are no feasible or realistic measures to adequately mitigate them. The adverse effects of this road will not just be permanent, but irreversible. The Hochstetter's frog refugia of the Brynderwyn ONL and other areas within the proposed designation will never be the same again.

Assessment of offered Compensation Package for Hochstetter's Frogs

64. The applicant has recently offered a proposed compensation package for Hochstetter's frog, in recognition that there will be significant residual effects even after the proposed mitigation measures are implemented. This proposal has been assessed for compliance with best-practice compensatory framework.[47]

65. Despite occurring before compensation in the effects management hierarchy, no offset package has been offered for the loss of Hochstetter's frogs or their habitat. The applicant's ecologists have not provided reasoning as to why no offset package has been offered. As is stated at [40a] above, in my opinion, an offset package cannot be offered as the Hochstetter's frog habitat cannot be recreated, so any loss cannot be offset.

66. The applicant's compensation proposal is a payment of up to $5 million, on a *pro rata* basis, matched to the percentage mortality of salvaged Hochstetter's frogs. With an estimated 22,000 frogs acknowledged as required to be salvaged and relocated through mitigation measures, this equates to a payment of $227 for each frog mortality. However, the applicant is also proposing (28 August 2026 frog package) that it has a contingency approach whereby it can leave frogs if there are more than expected during salvage operations and pay compensation instead. How the number of frogs not salvaged during such a contingency will be calculated is unclear. It is also uncertain if the same *pro rata* payment (of $227 per frog) will be paid for these frogs that weren't salvaged.

67. The basis upon which any such payment will be determined appears uncertain. The applicant provides only one example of how this is proposed to work, with 100 frogs being moved to a site. If 30% are found to have died, then 30% of the compensation package will be paid. It is unclear if that payment would then be 30 frogs x $227 (= $6,810), or 30% of $5,000,000 (= $1,500,000). If it is the former, there is no indication of the number of sites that will be surveyed for mortality rates, with an

[47] Addendum statement of Mr Nicholas Goldwater

extrapolation made across remaining unmeasured sites; or whether every release site will be measured to provide a total compensation figure.

68. Determining the frog mortality rate with high certainty is also problematic. Unless genetic testing can be reliably demonstrated to be able to determine resident from released frogs, there will be no way to determine whether frogs found in subsequent years are survivors of resident or salvaged frog populations.

69. The methodology the applicant proposes to use to determine the compensation amount is highly uncertain.

70. The first measure is to determine the proportion of translocated frogs at each site. This is problematic as not all resident frogs can be reliably found. If this was attempted, fragile habitat such as in-stream leaf packs and vegetation, stacked pebbles and stones, seeps and stream banks would be altered to such an extent they may not provide suitable habitat for frogs for many weeks, months or more. The applicant has relied on an 8.2-fold total frog population compared to the readily surveyed population. It is unknown if this factor is consistent between streams, or if it is highly variable. In addition, the number of frogs discovered in daylight surveys may fluctuate along the same stretch of waterway over time, as some move to other more or less searchable refuges on different days, while others may move out of the surveyed length of waterway completely. Therefore, I consider there is uncertainty in relying on an 8.2-fold factor at all sites to determine the number of resident frogs, and so the proportion of released frogs. Likewise, when surveys are undertaken years later, it will not be known if the number of frogs found and be multiplied by 8.2 to obtain the total number of frogs in that waterway. This factor may change with higher densities of frogs caused by the relocation of salvaged frogs, and one possibility is more frogs could be forced into less desirable, readily searchable sites. If that were the case, applying an 8.2-fold multiplier for each frog found could vastly overestimate the total frog population in each waterway transect searched.

71. I consider there are other approaches that would be more informative of likely survival rates, rather than just total numbers of frogs. For example, the proportion of all size classes of frogs should ideally be similar in both initial and later surveys, particularly if these same proportion of salvaged frog classes are released into the site. Even if total frog numbers are similar, if a lower proportion of adults is found, it could indicate mortality of released or resident frogs (e.g. through competition), and this could be compensated for. On the other hand, a higher proportion of adults than originally located may indicate a lack of breeding in the intervening years, but could indicate higher survival rates of resident and salvaged frogs. With sufficient survey, these surveys could potentially provide information about the frog carrying

capacity of each measured stream length. That is, if despite many more frogs being released, the total density is similar to that before salvage, it may indicate streams are near carrying capacity, and most of the salvaged frogs are likely to have perished.

72. As an additional measure, I consider frog condition should be measured before and after salvage. This can be done by weighing each frog, accurately recording their Snout-vent length (SVL) with callipers, as well as assessing their "fatness score" [48]If frog condition (fatness) changes, this could indicate the streams have been over-stocked compared to more natural densities. The forearm width of each frog should also be measured, as combined with SVL this can indicate the sex of the animal. Therefore, any demographic change in sex ratio in a stream transect could potentially be detected.

73. The applicant has mentioned the parameters to determine translocation success will be included in the Frog Management Plan, but this is not currently available for assessment. Therefore, there is currently considerable uncertainty with how the outcome will be determined, and how feasible it will be. It is expected that for a project of this magnitude and potential impact the applicant would have detailed this in a draft Frog Management Plan for review prior to lodgement.

74. Whatever method or approaches are outlined in the Frog Management Plan, I consider a biostatistician will be required to provide expertise into the design and interpretation of the monitoring programme.

75. The applicant has outlined how the proposed $5 million compensatory amount was determined. The compensation quantum was calculated as the "cost of protecting … 22,000 frogs at existing … sites" using measures such as "pest management, fencing [and] legal protection". An area of 140ha is assumed to be suitable to hold these frogs, with a cost of $35,000/ha.

76. The intent of the compensation payment is to "protect and enhance existing Hochstetter's frog habitat". However, no compensation payment is offered for habitat loss or habitat fragmentation. Furthermore, the final payment is uncertain and dependent upon a currently unknown method to calculate loss of only salvaged frogs, and in addition comes with a lag period of 5-10 years after the effects have occurred. Due to this, I consider the compensatory payment unreliable with no certainty it can be used to "protect and enhance existing Hochstetter's frog habitat".

[48] Bell, B.D. (1978). Observations on the ecology and reproduction of the New Zealand native frogs. *Herpetologica* 34: 340-354.

77. The applicant has proposed several ways in which any payment of compensation could be spent. I will address each of these proposals in turn.

78. The first proposal (a) is to "legally protect, restore and enhance frog habitat and connectivity, including retirement of vulnerable plantation forest". There are many different actions included within this proposal. A break-down of assumed costs was provided to DOC in an email from the applicant[49]. The costs for enhanced protection of the 140ha area are as follows:

    a. Increased pest management $3,000,000
    b. Allowance for fencing $1,000,000
    c. Monitoring $ 500,000
    d. Legal protections $ 500,000

79. However, it is uncertain if this includes costs for purchase of land. The cost and effectiveness of fencing is uncertain as it does not specify the type of fence, and no quote is provided from an established provider for a defined site. Costs can increase substantially depending on the specific details of a site such as terrain, vegetation, accessibility and presence of waterways are required to be fenced. Pest management costs should be further broken down into costed actions over 35 years in order to assess how realistic these costs are.

80. The second proposal (b) is "stock exclusion, sediment and water-quality management, sustained pest control and predator-exclusion fencing". Many of these actions are expensive, (e.g. predator-proof fencing can cost $300,000-$600,000 per km installed, plus maintenance costs). The proposal contains a range of possible actions of variable cost, yet there is no financial allowance for the vastly different costs of each action, nor the implications for the protected area if more expensive options would need to be implemented. There is also no indication of the criteria to decide when different actions are required. It is uncertain if other costs required to support some of the proposed actions (e.g. pest eradication costs if a pest-proof fence is installed) have been sufficiently provided for with this level of financial compensation.

81. The third proposal (c) suggests "protection and enhancement of Brynderwyn Hills or wider Northland clade populations …". In my view, this suggestion could provide some meaningful compensatory actions, if a suitable site can be found, legally secured and conservation actions imposed. The most benefit for the Northland

[49] Email dated 8th October 2026 from Hannah Thompson (NZTA) to Jenny Clafferty

clade would occur in the most vulnerable population, which I consider to be the Moir Hill population (**Fig. 2**) as it appears to be the smallest population.

82. The fourth proposal (d) suggests "coordinated conservation programmes benefiting the Northland clade of other high-priority biodiversity sites". This suggestion is highly speculative, as it is not known if such a site exists, and what actions (and costs) would be needed to reliably achieve biodiversity outcomes.

83. The fifth proposal (e) states "long-term funding, protection or management directed to defined conservation priorities at an appropriate ecological-district or regional scale where equivalent frog-focused replacement cannot be demonstrated". Such a proposal would have no benefit to the Northland clade of Hochstetter's frog, and the long-term funding does not equate with the one-off compensation payment proposed after 5-10 years.

84. The sixth and final suggestion (f) is "research into additional monitoring, marking, tracking, genomic investigation or research where it demonstrates compensatory outcomes or materially improves knowledge of Hochstetter's frog". While such research may increase the knowledge of Hochstetter's frog and improve monitoring methods in the longer term, it is by no means certain to achieve these results. Depending on the time taken to achieve these results, it will also have no discernible direct impact on the Brynderwyn frog population. However, if successful, other Hochstetter's frog populations may benefit.

85. In summary, I consider all the suggested proposals are speculative with no certainty any could be implemented at a confirmed site or in time to benefit this population from the impacts of the Project. To increase the reliability of these actions, I consider the applicant should provide a list of real sites that have been well scoped to understand ecological values, an understanding of whether owners are willing to sell, costs are tailored to each site, and sites are well defined with maps. Further, a compensatory payment to achieve these actions would be more certain if an initial minimum payment was offered, topped up with the proposed *pro rata* payment to be later determined from the results of surveys. This could enable some of the proposed protective actions to be implemented even before effects occurred. Without realistic, grounded propositions at defined sites, I consider there is little credibility that any of these claimed actions could be implemented to protect Hochstetter's frog habitat. Additionally, none of these could come to pass if there was a very low payment, or no payment at all. In my view there should be high certainty that these measures can be implemented at suitable sites within acceptable timeframes before any compensatory payment is considered.

86. Proposed conditions to address compensation payments have not been provided, so I have been unable to make any assessment or provide any commentary, and I presume this opportunity will be provided at a further stage of the FTAA process.

Suggested priorities to minimise adverse effects on Hochstetter's frog

87. The applicant has proposed a designated route that requires extensive cutting and filling. I acknowledge I am not a roading engineer, but it is apparent to me the large cuts are required due to the decision to site the road at a very steep part of the Brynderwyn Range escarpment, with the road design constrained by a gradient suitable for vehicular traffic.

88. Options that I consider would lessen impacts on Hochstetter's frog such as bridging over streams are not proposed in this application.

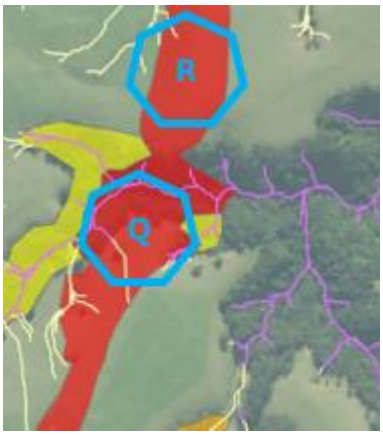
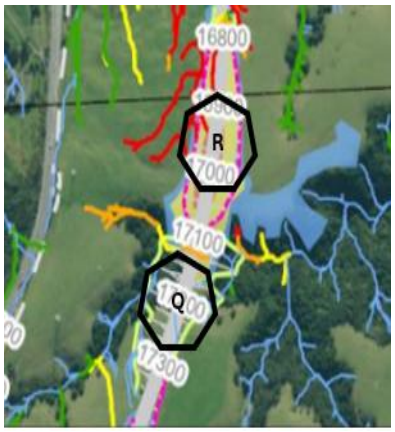
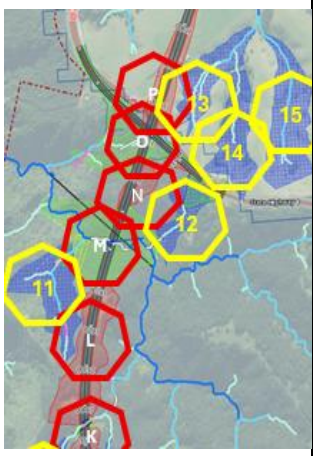
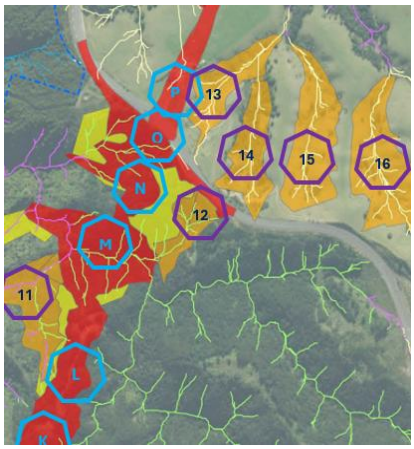
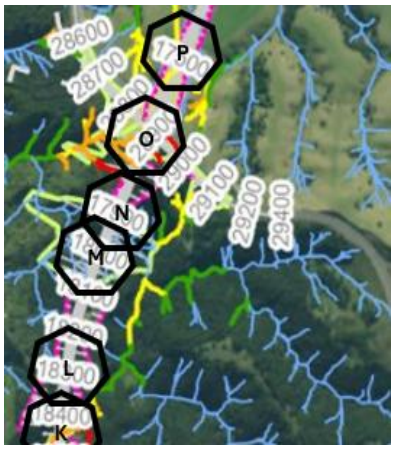
89. The applicant has provided additional maps[50] during discussions since the application was suspended on 11th August 2026. While these maps contain no new information to that provided in multiple reports within the application, they have the benefit of placing pertinent information on the same map (e.g. Hochstetter's frog survey information with cut and fill activities) to allow better comparison of data sets. As other impacts (such as dewatering and frog fragmentation) was not provided on the same map, I have attempted to show this alongside cut and fill activities (**Fig. 8**). However, the new maps provided (**Fig. 8, Column A**) are inconsistent with previous maps showing fill locations across streams (e.g. polygons labelled 'C' and 'E'). There is further uncertainty regarding the proposed activity at polygon 'E', as a substantial culvert (indicated by a black line) is proposed to be installed at this site. I assume the absence of fill in these stream crossings is an error in the new map. If no fill is going to be used at these sites and no bridging option has been offered, an explanation should be provided as to how the road is to be constructed over these watercourses.

90. Not all impacts could be considered from maps however, as no maps were provided for construction activities such as haul roads for moving machinery and materials, or roading required to access spoil sites by machinery.

91. Based on current frog survey data and the likely impact on frogs by each construction activity, I have attempted to outline the initial short-term impacts each separate major construction activity is likely to have on the current Hochstetter's frog population within the designation. I have listed these in order of

[50] Aquatic and Terrestrial Survey Information Maps (7th October, 2026)

greatest impact, in an attempt to demonstrate where I consider the greatest opportunities are for avoidance and minimisation of impacts on Hochstetter's frog (**Table 4**). More detail of the assessed impact of each activity is provided in **Appendix 1**. Where I consider possible, I also suggest alternatives options that could reduce these impacts. I acknowledge that I am not a roading engineer, and while these measures have not been assessed for feasibility or been costed and are likely to be more expensive than the current proposed activities, they could have other financial benefits through requiring fewer mitigation measures, survey and monitoring assessments and compensation payments.

	A	B	C
1			
2			

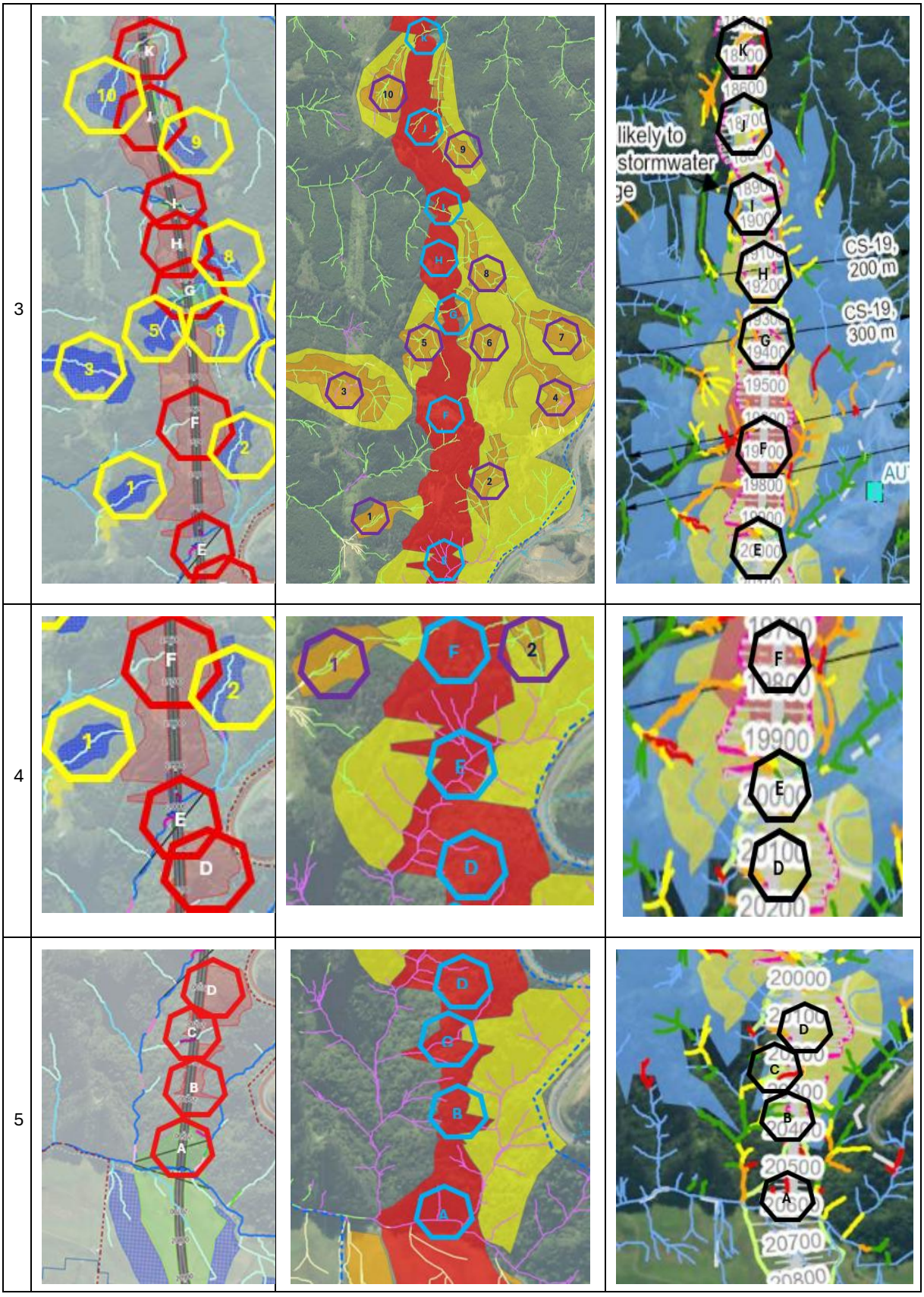


Fig 8. Maps showing major construction activities and effects on Hochstetter's frog on sections of the proposed designation. Column A[51] shows cut, fill and frog surveys with red polygons showing activities and yellow polygons showing spoil sites; Column B[52] shows direct construction impacts (cut or fill), and

[51] Terrestrial Survey Information Maps, provided by NZTA post-suspension, 7th October, 2026.
[52] Vol B, Appendix D06 – Assessment of Effects on Terrestrial Ecology, App. P.

fragmentation impacts on frogs with blue polygons showing activities and purple showing spoil sites; Column C[53] shows modelled dewatering impacts. Polygons labelled A to R represent major cut or fill activities and polygons labelled 1 to 16 show proposed spoil sites.

Road Section	Activity (size)	Total Impact of Section on Frogs	Possible Effects Management Type	Suggested Mitigation Activity	Total Impact on Frogs after Effects Management	Impact of effects Management Measures	Order of Impact on frogs
E	Fill (large)	Very High	Avoid/ Minimise	Bridge	Low	Very High	**1**
M	Fill (large)	Very High	Avoid/ Minimise	Bridge	Low	Very High	**2**
C	Fill (medium)	High	Avoid/ Minimise	Bridge	Negligible	High	**3**
11	Spoil site (2.10 ha)	High	Avoid	Spoil deposited elsewhere	None	High	**4**
2	Spoil site (1.17 ha)	High	Avoid	Spoil deposited elsewhere	None	High	**5**
O	Fill (large)	High	Avoid/ Minimise	Bridge	Low	High	**6**
F	Cut (v. large)	High	n/a	n/a	High	None	**7**
A	Fill (large)	Medium-High	Avoid/ Minimise	Bridge	Negligible	Medium-High	**8**
3	Spoil site (3.30 ha)	Medium-High	Avoid	Spoil deposited elsewhere	None	Medium-High	**9**
4	Spoil site (3.47 ha)	Medium-High	Avoid	Spoil deposited elsewhere	None	Medium-High	**10**
10	Spoil site (1.46 ha)	Medium-High	Avoid	Spoil deposited elsewhere	None	Medium-High	**11**
8	Spoil site (1.29 ha)	Medium-High	Avoid	Spoil deposited elsewhere	None	Medium-High	**12**
6	Spoil site (1.88 ha)	Medium-High	Avoid	Spoil deposited elsewhere	None	Medium-High	**13**
9	Spoil site (1.27 ha)	Medium-High	Avoid	Spoil deposited elsewhere	None	Medium-High	**14**
K	Fill (small)	Medium-High	Avoid/ Minimise	Bridge	Very Low	Medium-High	**15**
Q	Fill (large)	Medium	Avoid/ Minimise	Bridge	Very Low	Medium	**16**
I	Fill (medium)	Medium	Avoid/ Minimise	Bridge	Very Low	Medium	**17**
7	Spoil site (1.67 ha)	Medium	Avoid	Spoil deposited elsewhere	None	Medium	**18**
J	Cut (v. large)	Medium	n/a	n/a	Medium	None	**19**

[53] Vol B, Appendix D12 – Assessment of Effects on Groundwater, Fig. 2 & Fig. 4.

Road Section	Activity (size)	Total Impact of Section on Frogs	Possible Effects Management Type	Suggested Mitigation Activity	Total Impact on Frogs after Effects Management	Impact of effects Management Measures	Order of Impact on frogs
L	Cut (large)	Medium	n/a	n/a	Medium	None	**20**
G	Fill (medium)	Medium-Low	Avoid/ Minimise	Bridge	Low	Low	**21**
B	Cut (medium)	Medium-Low	n/a	n/a	Medium-Low	None	**22**
H	Cut (medium)	Medium-Low	n/a	n/a	Medium-Low	None	**23**
D	Cut (mediu m)	Low	n/a	n/a	Low	None	**24**
5	Spoil site (1.88 ha)	Low	Avoid	Spoil deposited elsewhere	None	Low	**25**
12	Spoil site (1.50 ha)	Low	Avoid	Spoil deposited elsewhere	None	Low	**26**
1	Spoil site (1.25 ha)	Low	Avoid	Spoil deposited elsewhere	None	Low	**27**
14	Spoil site (2.19 ha)	Low	Avoid	Spoil deposited elsewhere	None	Low	**28**
N	Cut (small)	Low	n/a	n/a	Low	None	**29**
R	Cut (medium)	Low	n/a	n/a	Negligible	None	**30**
16	Spoil site (3.51 ha)	Very Low	Avoid	Spoil deposited elsewhere	None	Very Low	**31**
15	Spoil site (3.34 ha)	Very Low	Avoid	Spoil deposited elsewhere	None	Very Low	**32**
13	Spoil site (1.60 ha)	Very Low	Avoid	Spoil deposited elsewhere	None	Very Low	**33**
P	Cut (medium)	Negligible	n/a	n/a	Negligible	None	**34**

Table 4. Estimated initial impact of each major planned activity (labelled in Fig. 8) within the Proposed Designation (PD) on Hochstetter's frogs, in order of greatest to least impact. Where deemed feasible, suggestions are made of actions to reduce this impact.

92. If actions were taken as suggested in Table 4, then I consider the impacts on Hochstetter's frog could be considerably reduced. The actions with the greatest impact are bridging waterways and avoiding spoil deposition sites within the Hochstetter's frog habitat. I do not consider there are any alternatives to the cuts required so these impacts cannot be avoided or mitigated within the Indicative Alignment. Likewise, dewatering activities associated with cuts appear unlikely to be able to be avoided.

Lizards

93. Lizards will be adversely affected by the project due to the loss of substantial areas of habitat, some of which (particularly the Brynderwyn ONL and lowland forest remnants) are of high quality, and likely to harbour low to moderate numbers of lizards of several different species. Lizards will also inevitably be killed and injured by the project, as the extensive nature of the proposal and deployment of methods such vegetation felling, blasting, soil deposition and the use of large machinery over several years of enabling and construction works will harm lizards that are not detected.

94. I agree with the applicant's assessment regarding the six lizard species that are potentially found within the Proposed Designation.

95. I also agree with the description of habitats used by these lizard species.

Adequacy of surveys for Lizards

96. The Proposed Designation corridor was searched for lizards using a variety of methods.

97. The most effective searches were those in grasslands, modified habitat and vegetation edges.

98. Sixteen copper skinks have been found through searching a portion of likely habitat within the Proposed Designation and Indicative Alignment. However, there are large areas that have not been surveyed, although the locations and intensity of manual habitat searches are not provided. The detection of a gecko footprint in a tracking card and other reports of geckos indicates the presence of species that were not able to be detected during surveys for this Project.

99. Spotlight searches were also undertaken for nocturnal geckos, but the only indication I can find for their location was in the searching for snails and two locations[54] , one of which was outside the Proposed Designation.

100. Searches using Artificial Cover Objects (ACO's) occurred at 15 sites, 14 of which were in the Proposed Designation.

[54] Vol B, Appendix D06 – Assessment of Effects on Terrestrial Ecology, Appendix C, Sheets 6 & 8

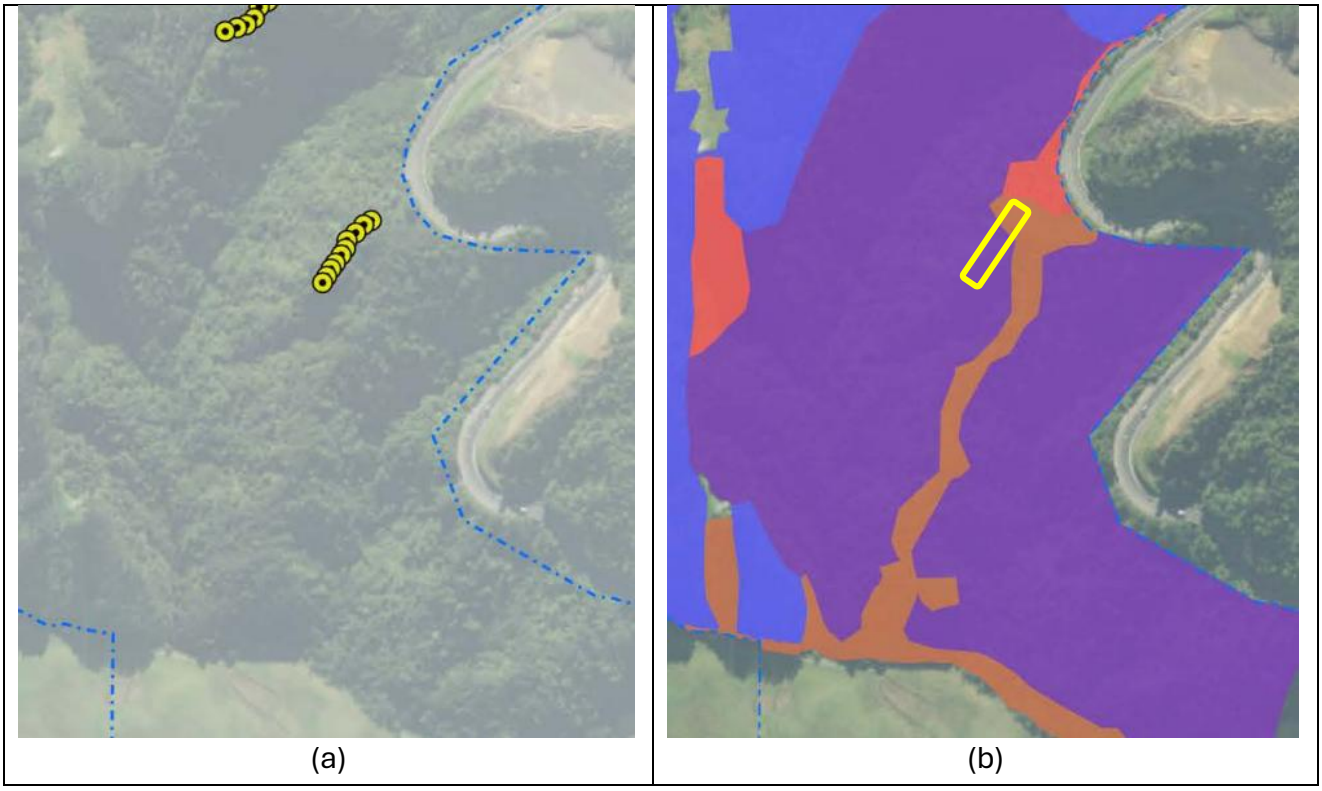


Fig. 7 Location of (a) ACO's within Brynderwyn ONL[55]; and (b) the same location shown on a vegetation map[56] with yellow box the approximate location of the line of ACO's.

101. I consider these results are broadly similar to the Cambridge to Piarere Expressway project, where a few copper skinks were found in initial surveys. However, after more extensive efforts, over 400 copper skinks have now been found and salvaged, and surveys have not yet been completed. I expect it is likely that once more intensive salvage operations occur, there will be a similar number of copper skinks found at this project site.

102. Despite the efforts taken to confirm the presence of various lizard species within the Proposed Designation, I still consider there are considerable gaps in understanding of lizard species and density. In particular, there appears to have been limited survey of the high-quality Brynderwyn ONL forest habitat. Some spotlight surveys have occurred in a small area, and one line of 10 ACO's were also sited down one spur. However as shown in **Fig. 7**, much of this spur habitat wasn't the mature kohekohe-taraire-tawa-podocarp/broadleaf habitat, but kanuka forest. Kanuka forest represents an early successional stage to more mature habitat and reflects disturbance to the site in the recent past. It appears as if perhaps only 6 to 7 of the 10 ACO's were located in the high-quality mature forest habitat. I assume

[55]Vol B, Appendix D06 – Assessment of Effects on Terrestrial Ecology, Appendix A, Sheet 5
[56] Vol B, Appendix D06 – Assessment of Effects on Terrestrial Ecology, Appendix E, Sheet 7

the limited survey in the Brynderwyn ONL is due to the steep terrain and dense vegetation, making the site challenging to survey for lizards, particularly at night.

103. I consider the applicant has performed an adequate survey in the grassland and grassland-forest edge habitat within the Proposed designation, with 11 of the 15 ACO lines occurring here. However, I consider the surveys in forested habitat are not sufficient to provide high confidence in the survey results in these habitats. Only one line was greater than 50m into native forest (and approximately one-third of that line was in kanuka forest), one was on the edge of native and exotic forest, and only one line was located in exotic forest. Another line appeared to be located less than 50m inside a native forest area, but this site is heavily browsed by stock and the line ran parallel with the forest edge.

104. The main comment I have of the survey was it is not proportionally representative of the habitat types within the Proposed Designation, with a heavy representation from the grassland/forest margins, and little from the forested area. Given the challenges of the terrain and vegetation of the native forest habitat, however, I can understand why more forest sites were not surveyed.

105. ACO's are generally used to survey for skinks, but no passive survey methods were used to find arboreal geckos. In my opinion, closed-cell foam wraps around tree trunks in native and exotic forest, and deployed for 12 months, could have been used to provide a better gauge on gecko diversity and abundance.

<u>Assessment of potential adverse effects on Lizards</u>

106. The author of the Terrestrial AEE for the applicant recognises the following potential adverse effects on lizards:

    a. Direct loss of potential high value habitat (for At Risk lizards);

    b. Habitat fragmentation and edge effects;

    c. Injury or death during habitat removal;

    d. Disturbance such as noise, vibration, vehicle strike and lighting.

107. I agree with the assessment of these effects on copper skinks (Table 18), but do not agree that the potential adverse effects on other lizard species are either Low or Very Low-Low. Due to the current uncertainty of lizard density in forest ecosystems and using precaution, I consider this should be Moderate. The applicant has provided this assessment based on their inability to detect these species during their surveys. However, as explained at [74] above, I consider the survey effort in forested habitats was insufficient to have high confidence that other species are not present or in very low densities claimed. The incidental observation of gecko

species within the Proposed Designation[57] (App I) also provides evidence other lizard species are present.

108. In addition to the effects mentioned in the Terrestrial AEE, I also consider the following effects of the Project could be detrimental to lizards:

    a. Drowning in water retention ponds;

    b. Roadside rubbish.

109. Water retention ponds are to be installed along the alignment to mitigate the effects of hard surfaces exacerbating floods and to contain contamination from road runoff. However, if these structures are lined with a plastic sheeting, it may be very slippery, particularly when wet, and lizards may not be able to escape.

110. Roadside rubbish also has the potential to adversely impact lizards. Discarded bottles and cans may entrap lizards, and plastic bottles and bags may cause overheating and suffocation. Rubbish may also leach chemicals, microplastic and heavy metals into the environment and lizards may consume these substances through their prey.

Assessment of Proposed Mitigation Measures for Lizards

111. The footprint of the project is very large, with 99ha of terrestrial vegetation to be removed, including 29 ha of moderate to high-quality native forest habitat.

112. Three sites are proposed for Mitigation purposes – the Northern, Central and Southern Mitigation Sites. For lizards, I assess these as:

    a. Northern Mitigation Site – I have visited this area and while it is affected by stock, has potential to provide suitable habitat for lizards found within the Proposed Designation when livestock are excluded, the understorey allowed to partially recover, and pest animal control is undertaken. In addition, the terrestrial vegetation planting proposed will provide additional habitat extent to lizards at this site, albeit after a considerable lag period until it at least forms a continuous canopy;

    b. Central Mitigation Site – I have visited a portion of this site and as it is an active commercial pine forest with ongoing disturbance, do not consider it suitable to release lizards into;

    c. Southern Mitigation Site – I have not been within the proposed release site but have walked around some of its margins. The site has potential for lizards and, as with the Northern Mitigation Site, if livestock are excluded and sufficient

[57] Vol B, Appendix D06 – Assessment of Effects on Terrestrial Ecology, Appendix I

animal pest control is undertaken, it should prove to be able to provide sufficient habitat for lizard species. The revegetation of surrounding farmland will also be of long-term benefit to lizards released here.

113. The applicant proposes planting of 29.8ha from pasture in the Northern Mitigation Site and 9.7 ha in the Southern Mitigation Site, giving a total 39.5ha of new terrestrial forest habitat. This is greater than the 29ha of native forest estimated to be lost, but there will be a significant lag time until it is available for lizards to utilise. However, planting of relatively fast-growing manuka adjacent to the Mitigation Sites should allow geckos to use these sites in a shorter frame, particularly elegant gecko. However, to add resilience to the forest and structural and habitat diversity, underplanting by a variety of emergent and understorey species that are utilised by lizards should be undertaken.

114. The permanent effect of fragmentation of lizard populations as a result of the Project is proposed to be mitigated by revegetation planting in the Northern and Southern Mitigation sites. However, this planting will not address the fragmentation of lizard populations remaining on either side of the new State Highway. The 4-lane highway, plus median strip, verges, swales, batters and spoil deposition sites will in my opinion constitute an insurmountable for lizards. I consider mitigation measures that more directly aim at overcoming these effects could be the establishment of native forest on spoil sites and batters as close to the road as possible, and pest control in habitat either side of the alignment. Pest control will also help to address edge effects, where there are likely to be an increase in lizard mortality due to increase in predators that often prefer hunting on forest edges such as cats, hedgehogs and ferrets. Lizards along the newly created forest edges may also be more vulnerable to native predators such as kingfisher. As the fragmentation and edge effects are permanent, so too should be the pest control, if this effect is to be effectively managed.

115. During habitat clearance, particularly forest removal, it is unlikely to be feasible to effectively search for lizards in all forested habitat and the entirety of each tree that is felled. Lizards specialise in hiding – it is their main defence from predators. As such they can find tiny holes and cracks they can squeeze into, can burrow under bark and can even penetrate into the tree stem itself as it ages and begins to decay. Others camouflage themselves in dense vegetation and others may hide in plants perched high in the forks of large trees.

116. Despite the low number and diversity of lizards currently detected within the Proposed Designation, I consider it likely there will be several other species present, possibly in moderate numbers. This is because the habitat is of high

quality, and Auckland and Northland regions are known to have reasonably high densities of lizards remaining in many lowland native forest sites.

117. Detection and salvage of lizards in dense native forest habitat is difficult, and I consider the currently proposed techniques insufficient to detect all lizards present. It is my opinion that removing forested habitat will result in the killing of many lizards, and most will be killed without being detected. For example, some will be inside trees that are felled, and could die from the impact of hitting the ground.

118. Despite these limitations, the Lizard Management Plan (LMP) provides sufficient detail on several methods to be deployed when salvaging lizards that in my opinion will help to prevent some lizard deaths by being able to detect more lizards. However, as with the Hochstetter's Frog Management Plan (HFMP), the LMP also fails to:

    a. set targets for pest control that will benefit lizards;

    b. state outcome targets for lizards against fixed timeframes;

    c. provide additional measures to be triggered if measured outcomes are not achieved.

119. The EMP offers up to 3 years post-release pest control at all mitigation sites, although the mitigation actions[58] offer 5 years. I consider either of these timeframes unlikely to be sufficient to allow the lizard population to recover to near pre-construction numbers. The effectiveness of pest control measures to benefit lizards are uncertain, as it is difficult to suppress predators to such low densities that lizard populations increase. In my opinion, a more effective solution would be to build a pest-free fence in high-quality habitat and release any salvaged lizards within the fence.

120. I consider that in a project of this magnitude, having a predator-proof fence to release lizards into is justified, and provides much greater certainty of outcomes than pest control measures. This has occurred in other major roading projects such as the NZTA Otaki to Levin Bypass project, where a new lizard enclosure was built specifically for the project, and in the Cambridge to Piarere Expressway project where an existing pest-proof enclosure was utilised to release lizards into.

121. While the applicant considers geckos to be in low abundance throughout the Proposed Designation, I consider a predator-proof fence would be justified if the number of skinks or geckos salvaged or detected surpassed a certain stated

[58] Vol B, Appendix D06 – Assessment of Effects on Terrestrial Ecology, Section 5.1.4

threshold, following sufficient efforts to detect them. This threshold would indicate the effects of the Project on lizards are large enough to justify the development of a predator-proof fence and provide far greater certainty of outcomes for lizards. The fence could be sited in high-quality habitat within either the Northern or Southern Mitigation Sites.

122. Water retention ponds should either not be with plastic sheeting, or materials should be placed into the ponds (e.g. ropes) that would allow any lizards that inadvertently fall into these ponds to readily find them and can readily climb out to safety.

123. Roadside rubbish should be cleared on a regular basis, and any lizards found dead or injured should be reported on and handed into the Department of Conservation.

Avifauna

Adequacy of surveys for Avifauna

124. The primary assessment tool for the presence of avifauna species potentially affected by the Project is desktop analysis from a variety of sources. While this provides an understanding of the broader landscape that is used by birds, there has been limited survey within the Proposed Designation or Indicative Alignment. As the majority of the Proposed Designation is private land, access is limited to the general public and there have been relatively few reported bird counts over large parts of the Proposed Designation.

125. The applicant appears to have undertaken only limited surveys within the Proposed Designation, with 12 five-minute bird counts that may have all been undertaken on the one day the site was visited by the report's author (on 29 October 2025). This appears to be the only bird study that was specifically directed at the Proposed Designation or Indicative Alignment and appears to have been primarily aimed at forested sites only[59].

126. While 5-minute bird counts provide some understanding of the bird activity in an area, this method is difficult to use to provide an estimate of abundance of each bird species at a site, as there is so much variation in bird calling, display and movement behaviour, all of which affect the ability to detect birds. However, it is more informative than just presence data.

127. There were no targeted surveys for birds in other habitat types such as wetlands, streams, rivers or grasslands within the Proposed Designation, and no nocturnal

[59] Vol B, Appendix D08 – Assessment of Effects on Avifauna Ecology, Appendix A, Map 2.

surveys undertaken. In addition, there were no surveys conducted in each season throughout the year to determine whether there were changes in the composition or abundance of avifauna at different times of the year.

128. A significant gap in survey effort was the lack of comprehensive surveys for wetland birds, amongst the most threatened grouping of avifauna affected by this development. The applicant should have undertaken monitoring for bittern, spotless crake, marsh crake and fernbird at each wetland within the Proposed Designation that may have offered suitable habitat. Surveys for booming male bittern should have occurred during their peak booming period (October to November) and playback call surveys should have been undertaken for cryptic wetland bird species, particularly at wetlands the Avifauna AEE's author has described as having good habitat for such species.

129. Northland is a known hotspot for bittern, so understanding the number of bittern that may be breeding within the Proposed Designation and affected by the Project is crucial in understanding the impacts of the Project. Australasian bittern are most easily detectable during the breeding season when males make a loud 'booming' call, but are essentially non-verbal for the other 9-10 months of the year, as female bittern are for the entire year.

130. There were also no targeted avifauna survey in streams and rivers to assess the abundance of species located in these areas and downstream catchments. For example, the number of shags using any colonial shag nesting or roosting sites within catchments is useful information to know in order to better assess potential effects of the Project.

131. There is a possibility that North Island brown kiwi are present in the Proposed Designation. It is recognised by the Avifauna AEE's author that a high-density kiwi population was present a few kilometres from the proposed designation in January 2020[60]. Despite another 6 years elapsing, and re-establishment of a kiwi population being pursued in the eastern Brynderwyn Ranges since 2013[61] no kiwi monitoring was undertaken to determine if kiwi had recently spread into the Proposed Designation corridor. Surveys from the Piroa Conservation Trust showed the presence of male kiwi less than 2km from the Proposed Alignment[62]. A thorough kiwi calling survey should occur within the entire forested areas (both native and exotic) of the Proposed Designation, as well as an additional buffer of at least 500m. The extent of this buffer is required as kiwi territories can extend that far, particularly

[60] Vol B, Appendix D08 – Assessment of Effects on Avifauna Ecology, Appendix D
[61] https://www.piroaconservation.org.nz/
[62] https://www.piroaconservation.org.nz/assets/files/PCT-KiwiSurvey2025.pdf

in low density populations. The best kiwi survey times are during the new moon phase in May.

132. Survey within the Proposed Designation is important, particularly for a development of this scale and the level of permanent impacts it will impose. The use of a 5km buffer to capture other data sources and acceptance of kiwi and kākā as likely to be present is useful, but is somewhat undermined by Table 11 in the Avifauna AEE showing whether a species has been detected in the Indicative Alignment and elsewhere within the Proposed Designation. Confirmation of the presence of these species provides more confidence that mitigation measures are required and will be adopted. It is not surprising that wide-ranging, sparse, cryptic or nocturnal species are listed as not present in these areas, as no targeted surveys were made for them. Despite the applicant accepting it is likely kiwi are present in low density, this is not reflected in Table 11, where kiwi are not recorded as being present. A targeted survey would remedy that.

133. Even when Threatened or At Risk species are found within the Proposed Designation, they are not always clearly articulated as being present. For example, fernbird (At Risk – Declining) has been recorded within the Indicative Alignment (Map 5), yet wasn't shown on the map of all Threatened and At Risk avifauna species (Map 19).

134. I consider that a more complete assessment of avifauna species should also attempt to determine a measure of the abundance of these species, not just an indication of their presence or absence in the wider area or Proposed Designation. Therefore, I regard the surveys inadequate in that the author has mainly relied on a desktop assessment using other sources. For a project of this magnitude I would expect the applicant's ecologist to have spent more time on-site and be able to provide a confident measure of abundance of avifauna species likely to be affected by the Project.

135. The bird counts used from other sources are unlikely to have been undertaken with this project in mind, so are not likely to have concentrated on high-priority sites (e.g. all wetland sites), nor sampled evenly across the Proposed Designation. There should be assessments of bird presence and abundance in all major habitat types present within the Proposed Designation and potential mitigation sites, e.g. native forest, exotic forest, wetlands, and exotic pastural grasslands. Assessment should also have occurred in each of the four seasons, to capture any seasonal changes in use of the site by birds. The use of bird recorders could also have been used to try to detect vocal birds that may be intermittently present e.g. long-tailed cuckoo (Threatened – Nationally Vulnerable).

Assessment of potential adverse effects on Avifauna

136. The Avifauna AEE has listed four potential adverse effects on avifauna as a result of the project:

    a. Direct habitat loss;

    b. Injuries and/or mortalities;

    c. Disturbance and/or displacement;

    d. Artificial lighting.

137. However, I consider additional adverse effects on avifauna are:

    a. Fragmentation;

    b. Edge effects;

    c. Sedimentation of waterways and estuaries;

    d. Habitat degradation – dewatering; road runoff

    e. Potential drowning in retention ponds.

138. I agree that the project would result in the permanent loss substantial avifauna habitat. The Indicative Alignment has been assessed as removing 370 ha of landcover habitat, consisting of 21.2 ha of native forest and broadleaved indigenous hardwoods, 13.8 ha of manuka/kanuka shrubland, 62.7 ha of exotic pine forest, and 267 ha of grassland[63]. However, the 'Construction Footprint' is anticipated to have a loss of only 114.9 ha across 35 different terrestrial vegetation communities[64]. This means the Indicative Alignment is more than three-fold larger than the Construction Footprint, but I am unsure of the difference between these two descriptions. The 'Glossary of Defined Terms'[65] defines Indicative Alignment as 'all areas where physical disturbance (both temporary and permanent) will occur as a result of construction (e.g. alignment, earthworks cut and fill, spoil sites)', which I interpret to be the same as the 'Construction Footprint'. The report's author hasn't explained why there is such a large difference, and if other habitats comprise this difference (e.g. wetlands or riverine ecosystems).

139. The quantity of potential wetland habitat suitable for avifauna within the Proposed Designation has been provided, and by my calculations in the Table provided[66], totals 11.72 ha over 20 wetlands. However, the area of wetland extent is only given

[63] Vol B, Appendix D08 – Assessment of Effects on Avifauna Ecology, Table 4.
[64] Vol B, Appendix D08 - Assessment of Effects on Avifauna Ecology, Appendix B
[65] Vol A – FTAA Substantive Application – Main Application
[66] Vol B, Appendix D08 – Assessment of Effects on Avifauna Ecology, Table 9

as 2.44 ha elsewhere [67], and when mitigation is considered, only wetlands 11, 12, 13, 14 and 24 within the Proposed Designation are identified as being suitable as avifauna habitat[68]. I am uncertain where this discrepancy between the two measures of wetland extent arises. However, I note that the total extent of affected wetland habitat assessed by the applicant is disputed by Dr Martin in his statement of advice (at [131] to [196]). Any change in the extent of recognised wetland habitat will directly affect any assessment of the quantum of impact on wetland avifauna also.

140. Similarly, there has been no quantification of freshwater habitat used by birds that will be directly affected by the project, but impacts have been recognised by considering bird species that use riverine, estuarine and coastal habitat that may be impacted by the Project. However, quantification of impacted streams is provided in non-avian reports[69], indicating 5.78km of perennial stream length directly affected.

141. Culverting of streams is not regarded as stream loss by the applicant's freshwater ecologists[9] but I consider any streams that are culverted will no longer be available as habitat or feeding sites for birds, so should count as habitat loss for avifauna. The applicant has estimated total perennial stream culvert length for the Indicative Alignment as 3377m[70].

142. The applicant is also seeking to divert the main stem of the Waihoihoi river. This river provides habitat for a range of freshwater avifauna species, such as shags, and this habitat will be permanently lost as it is directly within the Indicative Alignment.

143. An accurate assessment of the quantity of all habitats affected by the proposed Project is important to gain a more complete understanding of the impacts on avifauna, as all habitat types in this area are used by birds, be they native or introduced.

144. Death or injury to avifauna during both construction and operational phases of the Project is listed as a potential adverse effect. I largely agree with the author's assessment, but consider North Island brown kiwi to be particularly at risk of injury or death, due to their habit of hiding under dense vegetation, fallen windfall or holes during daylight hours, when construction activities will occur.

145. Disturbance and displacement is also listed as another potential adverse effect. I agree with the comments in the report regarding this matter.

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[67] Vol B, Appendix D08 – Assessment of Effects on Avifauna Ecology, Table 12
[68] Vol B, Appendix D08 – Assessment of Effects on Avifauna Ecology, Section 5
[69] Vol B, Appendix D07 – Assessment of Effects on Freshwater Ecology, Section 4.2.1
[70] Vol B, Appendix D07 – Assessment of Effects on Freshwater Ecology, Table 15

146. Lighting may also cause adverse impacts on avifauna. I agree with the applicant that seabirds are unlikely to be affected by either construction or operational phases of the new road. However, if there is considerable construction activity at night, it has the potential to impact on the behaviour of some nocturnal birds such as kiwi or ruru. I consider these impacts are likely to be less than minor. Kiwi are wary of lights and tend to avoid approaching them, and ruru may use them for their benefit of they in turn attract insects such as moths, which they can prey upon. Lighting is only proposed to be used sparingly at a few intersections once the road is operational and is of limited extent. However, if these lights are near wetlands, they may affect nocturnally active wetland birds, such as bittern by casting light over their habitat. This may modify their behaviour and cause them to avoid some areas.

147. Fragmentation could also occur as a result of the road for species with limited powers of locomotion or dispersal. This is usually not problematic for birds, but flightless birds such as kiwi can more readily have their populations fragmented by ground-based barriers.

148. Edge effects may also operate along the length of the alignment, due to changes in habitat conditions following construction of the road. Edge effects such as increased sunlight, wind and higher density of introduced animals such as browsers (e.g. rabbits) and predators (e.g. cats, ferrets), and invasive plants can limit the ability of avifauna to fully utilise this habitat. However, it is difficult to quantify the extent to which edge effects occur, and it is likely the distance varies for each avifauna species and may also change in extent over time.

149. The applicant has not assessed potential impacts on avifauna species that do not have primary habitat within the Proposed Designation. This includes species found in riverine, estuarine or coastal habitats downstream of the Project. Tara iti/fairy tern is New Zealand's most threatened bird species, with less than 50 individuals remaining. They prey on small surface-schooling fish species in estuaries, lagoons, harbours and coastal waters. There are three feeding territories of fairy tern currently in the Waipū estuary (**Fig. 9**), which is the receiving environment for two of the catchments (Waihoihoi and Ahuroa) affected by this Project. Fairy terns frequent this estuary from August to March, and one pair regularly breeds on the adjacent Waipū spit, representing approximately 15% of the global breeding population for this species. Additional release of sediment into these waterways has the potential to increase stream turbidity and affect the clarity of the Waipū estuary. A reduction in clarity of the estuary waters has the potential to affect the abundance, distribution and catchability of the fish species on which tara iti rely

upon. Any impact on food resources could adversely affect adult condition, chick provisioning rates, and ultimately breeding success.

150. The applicant has provided information showing there will be an increase in suspended sediment discharged into the Waipū river catchment as a result of this Project[71]. As Dr McEwan outlines in her Statement, these percentages could be inaccurate and may be substantially higher. I consider more information about these potential impacts should be provided and an assessment undertaken on how this might impact the downstream riverine, estuarine and coastal habitats of tara iti and other birds. This should include assessments of any construction or engineering failures that may cause unintended release of sediment, and the possibility of extreme weather events increasing the risk and exacerbating the effects of any such discharges. I consider this assessment is justified for tara iti in particular, as this species is so critically close to extinction. Any significant changes in its environment has the potential to have a high impact for the species as a whole, so should be carefully considered and assessed.

[71] Vol B, Appendix D10 – Construction Water Assessment Report, Table 8

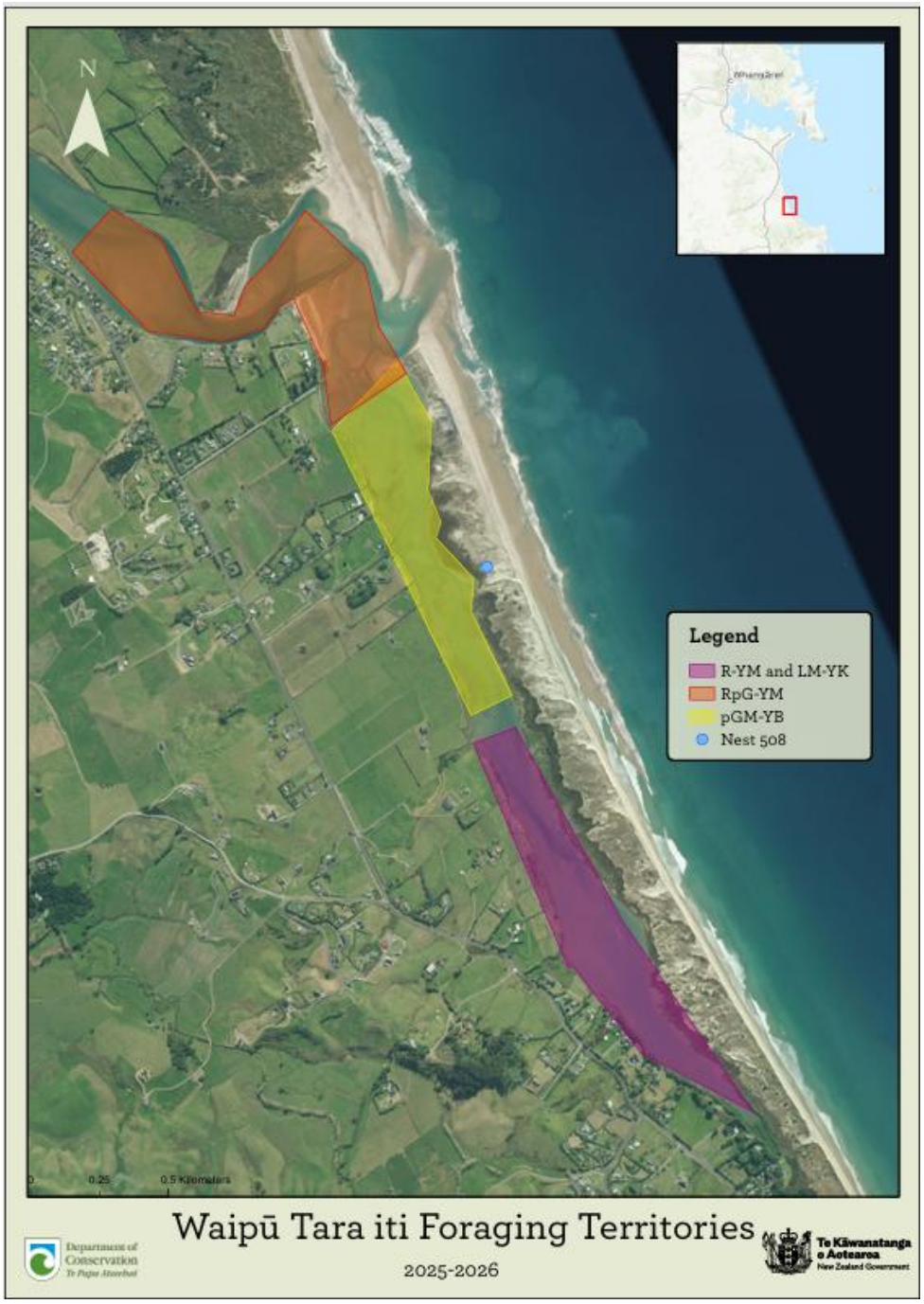

Fig. 9. Foraging Territories of Tara Iti/Fairy tern at Waipū estuary, 2025-26[72].

151. Other effects not considered by the applicant include habitat degradation, and dewatering that will occur at several sites across the Designation. These have the potential to have adverse effects on avifauna by reducing the quality or causing complete loss of habitat. This will have the potential to affect wetland, stream or terrestrial vegetation habitat near the proposed alignment on either a temporary or permanent basis. Accurate and reliable wetland maps, alongside accurate

[72] Tahon C. 2026. Monitoring and Management of Tara Iti (*Sternula nereis davisae*) and other shorebirds at Waipū. 2025-2026 Breeding season. New Zealand Department of Conservation. 50pp.

vegetation mapping and modelled impacts of dewatering effects on wetlands, streams and terrestrial vegetation are crucial in understanding potential impacts on avifauna habitat.

152. As described at [33(g)] above, road runoff contains a variety of chemicals and substances that may be detrimental to animal health, including avifauna. Avifauna have the potential to be affected by runoff into streams and wetlands. Contaminants have the potential to accumulate, particularly in wetlands due to lower velocity water having less ability to disperse these substances.

153. Water retention ponds placed along the alignment to capture storm water also have the potential to trap grounds birds (i.e. kiwi). This is particularly so if the ponds are lined with plastic sheeting material, as this provides less purchase ability than other natural or artificial materials. If kiwi to fall into such a lined pond, or one that has very steep walls, then if it has residual water, kiwi may drown. If ponds have no water but kiwi are still unable to escape, they may starve, die of heat exhaustion or be subject to increased predation by a passing predator.

Assessment of Proposed Mitigation Measures for Avifauna

154. The applicant proposes to mitigate adverse effects on avifauna by:

    a. Minimising habitat loss;

    b. Preparation of an Avian Management Plan to avoid direct and indirect impacts including nesting avifauna;

    c. Replacing wetland (2.44ha) and terrestrial habitat (39ha) at 1:1 ratio that may be used by wetland birds and kākā respectively;

    d. Minimising and shielding any operational lighting.

155. I agree with those approaches, but also add:

    a. The Avian Management Plan should also include methods to detect and avoid kiwi that may be present in construction areas during daylight hours. It should also take account of North Island brown kiwi having a different breeding season than most other birds (June – February) and eggs having a long incubation period;

    b. Wetland and terrestrial habitat replacement should be at a higher ratio than 1:1 due to lag effects and uncertainty about wetland function and whether like-for-like replacement will be achieved.

156. Wetland replacement is recommended to be sited away from the proposed road alignment, presumably to minimise impacts such as noise lighting and vehicle strike. However the applicant's suggestion is to site the wetland adjacent to the current SH1, which is likely to still be of use for vehicular traffic. I consider a replacement wetland should be sited a considerable distance (e.g. 1km) from any major road to minimise adverse effects such as collision risk.

157. Wetland replacement for bittern habitat should also be aimed at replacing potential habitat that bittern may use intermittently. Bittern can use a wide range of wetland habitat, and use a landscape-wide network of wetlands of various types to forage or roost intermittently.

158. Riverine habitat will also be lost due to the realignment of the Waihoihoi river. Even though the realigned river will have measures taken to provide avifauna habitat, there is likely to be a lag period until it becomes more suitable. If possible, the applicant should seek to develop the new habitat while maintaining the old habitat for as long as possible. This could potentially be done by allowing half the river to flow through the new alignment until the habitat somewhat stabilises, and partially maintaining the existing habitat. At that stage the realigned river could slowly be increased in flow and the displaced river length dewatered. This could give avifauna an increased ability to more seamlessly transition to the habitat provided by the new alignment, minimising lag effects.

159. Kiwi can disperse into the site anytime, surveys should occur immediately before any construction or enabling works that requires forest vegetation clearance. I consider it appropriate to undertake comprehensive nocturnal surveys for kiwi in the month of May immediately before any works occur. This will allow time to further develop the Avian Management Plan to minimise and mitigate effects on this establishing kiwi population during enabling and construction works.

160. Fragmentation of habitat is an adverse effect that hasn't been fully addressed by the applicant. I consider other mitigation measures should be undertaken such as:

    a. Development of a revegetation plan to replant spoil areas and batter slopes back into terrestrial forest habitat. This will also contribute to mitigation of edge effects along the road;

    b. Placement of replacement wetland and terrestrial habitat adjacent or as close as possible to current similar habitat. This will allow avifauna to move into the new habitat more easily and may help support a larger population of avifauna at each replacement site.

161. If kiwi become established within the designation corridor, they will require bespoke mitigation measures to overcome the effects of fragmentation. Kiwi are particularly prone to fragmentation as being flightless they have more difficulty traversing barriers than most flighted birds. Their young have an innate dispersal instinct, however, and as this population increases, more kiwi will begin attempting to cross the road, and so be at an increasing risk of collision by vehicles using the road at night. Mitigation measures to protect this expanding kiwi population include options such as strategically placed fencing and predator control, as has occurred at the Mt Messenger bypass in northern Taranaki. Shorter culverts should also be designed to allow kiwi passage at the outset of the project, using a square box culvert design where possible. The current culvert design is to have a circular cross-section[73], which in my opinion would make them less suitable to also function as kiwi underpasses. The very long culverts will also need to have a permanent barrier installed to prevent kiwi ingress, including young and sub-adult birds. Similar mitigation measures may also need to be considered on the existing SH1 as the kiwi population increases, as presumably this route will still be open to vehicular traffic.

162. Edge effects on avifauna are another adverse effect not addressed by the applicant. This could be somewhat mitigated by revegetation of native forest habitat along the road edge where forest has been lost, including on soil deposition sites and batter slopes. In addition, animal pest control and weed control should be undertaken in forested areas to mitigate potential increased predation on forest avifauna and habitat degradation as a result of edge effects.

163. Works that have the potential to release increased sediment loads into the Waipū river catchment should avoid being undertaken during the August to March period when fairy tern are using the Waipū estuary. The applicant has not proposed any avoidance or mitigation measures for tara iti.

164. Road runoff should be aimed at capturing and treating heavy metals, hydrocarbons and other material along the entire alignment that may be transported into soils, waterways and wetlands, where they could be detrimental to avifauna health.

165. Water retention ponds should be constructed in such a way that the slopes are not so steep that kiwi cannot climb out of them, and the surface material (including natural substances) provides sufficient purchase for a kiwi to scramble up. I consider a 1:3 slope should be sufficient, and the material should not be lined with a slippery substance such as plastic sheeting or clay.

[73] Vol B, Appendix D11 – Assessment of Operational Stormwater and Flooding Effects, Appendix C, Table 6.

Other Matters

Alternative Routes

166. A consideration of alternative routes has been provided by the applicant[74]. While I am not considering alternative routes as part of this review, the sheer scale of the impact on biodiversity values can only realistically be avoided by a different alignment. An alternative to this proposed route, to the west of the Brynderwyn Ranges appears to largely avoid high value Hochstetter's frog habitat. If a road was instead constructed in the large gap between the 'Brynderwyn' and 'Mareretū' Hochstetter's frog populations (**Fig. 2**), this would represent a significantly better option for Hochstetter's frogs.

167. A multi-criteria analysis (MCA) framework was followed, but no information is provided regarding ecological factors considered, or their weighting. In my opinion, the shortlist Option A or B as shown in Figure 2 are likely to have the least impact on Hochstetter's frogs and lizards, based on avoidance of forested habitat, and absence of Hochstetter's frog records through this area. I am uncertain about the impact on birds as there is no avifauna information provided regarding impacts of alternative routes.

168. I consider the permanent impact of the selected project route on Hochstetter's frogs in the Brynderwyn ONL to be extremely high, even after the mitigation currently proposed. This site is irreplaceable for Hochstetter's frogs and cannot be recreated at Mitigation release sites.

Cumulative Effects on the Northland clade of Hochstetter's Frogs

169. Another development, also within the 'Northland' clade of Hochstetter's frogs, has been proposed for Waste Management (NZ) Ltd.'s (WMNZ) Auckland Regional Landfill (ARL), near Dome Valley. This proposed development is estimated to affect 500-2000 Hochstetter's frogs. The proposed mitigation, management and monitoring for this proposal is significant, including the establishment of a predator-fenced area, complete salvage of all Hochstetter's frogs in the landfill valley, and monitoring of release sites for 35 years. Despite being of much larger magnitude than the ARL proposal, that proposed roading development proposes mitigation measures far less than WMNZ has proposed.

170. The potential impact on Hochstetter's frogs at ARL is recognised as being significant, yet the number of frogs the 'Alternative to Brynderwyn's' proposal is

[74] Vol B, RMA Approvals, Section C5.2

likely to adversely effects is 20 to 80 times larger. This proposed roading development likely represents the largest single direct threat to both the Brynderwyn population of Hochstetter's frogs, and to the entire Northland clade. Its impacts will also be cumulative to the effects of the ARL.

171. Another pressure on the Northland clade of Hochstetter's frogs is the use of a large extent of their remaining habitat for exotic commercial pine forests. While pine forests can support Hochstetter's frogs while the forests are maturing, there are high risks to Hochstetter's frogs when forests are felled[75]. If these forests do not have an intact riparian margin that is maintained during felling operations, a high proportion of Hochstetter's frogs may be killed. The proportion killed may depend on factors such as slope, which influences the felling method employed by logging companies (e.g. ground-based, machine-harvested or hauler-harvested). Small topographic features such as gorges or waterfalls that are present within a forest may offer additional refugia to frogs and could help increase the proportion of frogs that survive harvesting operations. However, the rate at which critical features such as suitable breeding sites re-establish and the population can begin to recover (in the presence of introduced predators) is unknown.

172. In the long-term, the effects of climate change are likely to adversely impact on Hochstetter's frogs also. Droughts, high temperatures and forest fires may be amongst the greatest threats to Hochstetter's frogs as the climate begins to substantially warm as projected over the next decades to centuries. Due to their semi-permeable skin, frogs need to constantly adjust their water balance between their body and external environment and as such are considered particularly sensitive to thermal extremes. This may be one reason most frogs are nocturnal, as atmospheric moisture levels are higher at night, and they can hide in a moist environment during the day. The thermal tolerance of New Zealand frogs is expected to be tested as the climate warms, and there may be physiological limits beyond which they cannot tolerate. Of all the locations that Hochstetter's frogs are currently found (**Fig. 1**) climate projections show the highest temperatures are forecast for the area occupied by the Northland clade.

173. In summary, the Northland clade of Hochstetter's frogs is suffering from a variety of pressures and are expected to decline over coming decades. The cumulative impact of all these pressures could precipitate a steeper decline than currently recognised and result in far fewer frogs being present, making them increasingly vulnerable to extinction in the long-term. The siting of the Alternative to Brynderwyn

[75] Author, unpublished data

project within one of the strongholds of this Northland clade is likely to cause a significant impact on the Hochstetter's frog population.

Other mitigation measures for Hochstetter's frogs and other NZTA roading projects

174. The proposed mitigation measure of applying mammalian pest control for 5 years[76] compares poorly with mitigation accepted as being required at the ARL. This consists of long-term pest control over 35 years that aims to achieve a documented net gain of Hochstetter's frogs, as well as the establishment of a predator-proof fenced area that will also likely be of benefit to Hochstetter's frogs.

175. The proposed mitigation for the project is also dwarfed by the mammalian pest control and outcome monitoring occurring *in perpetuity* that the same applicant (NZTA) is undertaking as mitigation for the Mt Messenger Bypass project. While that project doesn't impact native frogs, it is aimed at recovering and sustaining long-tailed bats, birds and lizards to mitigate and offset the effects of the road.

176. In my view, the mitigation measures for this project should be more aligned with these other similar projects, and be considerably greater than that currently proposed.

Proposed Conditions

177. I have reviewed the proposed designation, wildlife approval and resource consent conditions, and make the following comments, in line with the discussion in my statement above.

178. D36 should also include methods to minimise impacts on indigenous birds through blasting and other potential adverse effects (e.g. other noise, lighting, vibration). This could include exclusion zones and limited activities during the peak bird breeding season.

179. RC14 (a) – there should also be a procedure to prevent pooling of water around curing concrete after it is poured within construction Zone 2, due to the presence of Hochstetter's frogs. This is because these frogs are sensitive to changes in pH, which happens when pooled water is in contact with curing concrete.

180. RC35 (a) (iv) the period for which indigenous vegetation will be maintained for, has no units – it is stated as '5' with unknown units

181. WA4: I do not consider 20 working days is sufficient time for DOC to fully assess and certify the Ecological Management Plan (EMP). It will require several DOC

[76] Vol B, Appendix D06 – Assessment of Effects on Terrestrial Ecology, Section 5.1.4

ecological experts to assess the EMP, and, as earthmoving consents are proposed to expire in 20 years (REF), the DOC ecologists may have had no previous involvement with the project.

182. WA6: any proposed staging of the EMP should also include the overall aim of the entire EMP, so the overall impacts and broad mitigation measures are not lost with a more focussed approach.

183. WA12: at the end of the first line, should add "… but not limited to:"

184. WA12: the Lizard Management Plan (LMP) should state the objectives sought after release of the lizards, and provide the monitoring methodology required to provide confidence each lizard species has reliably established to population levels within the release sites that were present within the designation prior to the development occurring.

185. WA14: release of lizards should only occur up to 30 April inclusive.

186. WA16(d): at the end of the first line, should add "… but not limited to:".

187. WA17: the Hochstetter's Frog Management Plan (HFMP) should state the objectives sought after release of the frogs, and provide the monitoring methodology required to provide confidence Hochstetter's frogs have reliably established to population levels within the release sites that were present within the designation prior to the development occurring.

188. WA25: pest control offered for three (3) months prior to transfer is acceptable; however, post-release pest control of only three (3) years is offered (this is inconsistent with other parts of the application that states 5 years post-release pest control). In either case, pest control should be undertaken to achieve pest control targets, and should be aimed at achieving a stated, measurable outcome for the Hochstetter's frog, lizards and birds affected by the development. I consider 3 or 5 years' pest control is inadequate to ensure frog and lizard populations recover to near pre-existing development levels following their transfer and release.

189. WA25: Pest control is also offered within the Brynderwyn ONL adjacent to the final alignment, but there is no mention of it in this EMP. Again, pest control targets and other factors should be included in this Pest Management Plan.

190. WA29: Reporting should continue until outcomes targets for all species have been achieved. The proposed reporting period of only 2 years only seems to cover the transfer of frogs and lizards to release sites. These species should continue to be monitored and reported on until populations have reliably established to required levels.

Appendix 1.

Assessment of Impacts of each proposed major roading activity in the Brynderwyn Ranges on Hochstetter's frogs

Road Section	Activity	Severity of initial impact of activity on frogs located in this Section	Relative impact on number of frogs within Proposed Designation	Total Impact of Section on frogs within Proposed Designation
A	Fill (large)	SHL: **VH** F: **ML**	SHL: **L** F: **VH**	Med-High
B	Cut (medium)	SHL: **VH** THL: **VH** D: **ML**	SHL: **L** THL: **VL** D: **L**	Med-Low
C	Fill (medium)	SHL: **VH** THL: **VH** F: **ML** D: **VH**	SHL: **M** THL: **VL** F: **L** D: **ML**	High
D	Cut (medium)	SHL: **VH** THL: **VH**	SHL: **L** THL: **L**	Low
E	Fill (large)	SHL: **VH** THL: **VH** F: **ML** D: **neg**	SHL: **VH** THL: **ML** F: **VH** D: **neg**	Very High
F	Cut (very large)	SHL: **VH** THL: **VH** D: **VH**	SHL: **L** THL: **M** D: **H**	High
G	Fill (medium)	SHL: **VH** THL: **VH** F: **M** D: **H**	SHL: **L** THL: **VL** F: **L** D: **L**	Medium-Low
H	Cut (medium)	SHL: **VH** THL: **VH** D: **H**	SHL: **VL** THL: **L** D: **L**	Medium-Low
I	Fill (medium)	SHL: **VH** THL: **VH** F: **ML** D: **L**	SHL: **VL** THL: **neg** F: **VH** D: **L**	Medium
J	Cut (very large)	SHL: **VH** THL: **VH** D: **H**	SHL: **M** THL: **M** D: **ML**	Medium
K	Fill (small)	SHL: **VH** THL: **VH** F: **M** D: **H**	SHL: **M** THL: **VL** F: **M** D: **M**	Medium-High
L	Cut (large)	SHL: **VH** THL: **VH** D: **L**	SHL: **VL** THL: **ML** D: **L**	Medium
M	Fill (large)	SHL: **VH** THL: **VH** F: **ML**	SHL: **VH** THL: **M** F: **VH**	Very High
N	Cut (small)	SHL: **VH** THL: **VH** D: **H**	SHL: **ML** THL: **L** D: **L**	Low
O	Fill (large)	SHL: **VH** THL: **VH** F: **H** D: **H**	SHL: **M** THL: **L** F: **L** D: **L**	High
P	Cut (medium)	SHL: **VH** THL: **VH** D: **M**	SHL: **neg** THL: **neg** D: **neg**	Negligible
Q	Fill (large)	SHL: **VH**	SHL: **ML**	Medium

Road Section	Activity	Severity of initial impact of activity on frogs located in this Section	Relative impact on number of frogs within Proposed Designation	Total Impact of Section on frogs within Proposed Designation
		THL: **VH** F: **H** D: **M**	THL: **VL** F: **L** D: **L**	
R	Cut (medium)	SHL: **VH** THL: **VH** D: **H**	SHL: **neg** THL: **VL** D: **L**	Low
1	Spoil site (1.25 ha)	SHL: **VH** THL: **VH** F: **H**	SHL: **L** THL: **VL** F: **L**	Low
2	Spoil site (1.17 ha)	SHL: **VH** THL: **VH** F: **H**	SHL: **H** THL: **ML** F: **M**	High
3	Spoil site (3.30 ha)	SHL: **VH** THL: **VH** F: **H**	SHL: **MH** THL: **L** F: **M**	Medium-High
4	Spoil site (3.47 ha)	SHL: **VH** THL: **VH** F: **H**	SHL: **MH** THL: **L** F: **ML**	Medium-High
5	Spoil site (1.88 ha)	SHL: **VH** THL: **VH** F: **H**	SHL: **L** THL: **neg** F: **L**	Low
6	Spoil site (1.88 ha)	SHL: **VH** THL: **VH** F: **H**	SHL: **MH** THL: **neg** F: **VL**	Medium-High
7	Spoil site (1.67 ha)	SHL: **VH** THL: **VH** F: **H**	SHL: **MH** THL: **L** F: **VL**	Medium
8	Spoil site (1.29 ha)	SHL: **VH** THL: **VH** F: **M**	SHL: **M** THL: **L** F: **H**	Medium-High
9	Spoil site (1.27 ha)	SHL: **VH** THL: **VH** F: **H**	SHL: **MH** THL: **L** F: **ML**	Medium-High
10	Spoil site (1.46 ha)	SHL: **VH** THL: **VH** F: **H**	SHL: **MH** THL: **ML** F: **L**	Medium-High
11	Spoil site (2.10 ha)	SHL: **VH** THL: **VH** F: **H**	SHL: **H** THL: **M** F: **ML**	High
12	Spoil site (1.50 ha)	SHL: **VH** THL: **VH** F: **H**	SHL: **L** THL: **neg** F: **L**	Low
13	Spoil site (1.60 ha)	SHL: **VH** THL: **VH** F: **H**	SHL: **VL** THL: **neg** F: **neg**	Very Low
14	Spoil site (2.19 ha)	SHL: **VH** THL: **VH** F: **n/a**	SHL: **L** THL: **neg** F: **none**	Low
15	Spoil site (3.34 ha)	SHL: **VH** THL: **VH** F: **n/a**	SHL: **VL** THL: **neg** F: **none**	Very Low
16	Spoil site (3.51ha)	SHL: **VH** THL: **VH** F: **H**	SHL: **VL** THL: **neg** F: **neg**	Very Low

Estimated initial impact of each section of the road from major planned activities within the Proposed Designation on Hochstetter's frog. The 'Total Impact' column is my assessment of the combination of the 'Severity' and 'Relative Impact' columns. Impact codes are: SHL=

Stream Habitat Loss; THL = Terrestrial Habitat Loss; F = Fragmentation; D = Dewatering; Severity of Impact and Population Impact: VH = Very High; H = High; MH = Moderate-High; M = Moderate; ML = Moderate-Low; L = Low; VL = Very Low; Neg = Negligible. Spoil sites areas (in hectares) are estimates based on maps provided.