BEFORE THE NEW PLYMOUTH DISTRICT AND
TARANAKI REGIONAL COUNCILS

IN THE MATTER	of the Resource Management Act 1991 ("the Act")
AND	
IN THE MATTER	of applications from NZTA to alter a designation and for resource consents for the Mt Messenger Bypass Project - SH 3 between Uruti and Ahititi ("the Project")

Eric Douglas Edwards

EVIDENCE ON BEHALF OF THE DIRECTOR-GENERAL OF CONSERVATION

(Invertebrates)

Dated: 24 July 2018

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1. QUALIFICATIONS AND EXPERIENCE

1.1. My full name is Eric Douglas Edwards

1.2. I am employed as a Science Advisor, Ecology with the Department of Conservation (hereafter termed **DOC**) in Science and Policy Group, Wellington.

1.3. I have a BSc in Zoology from University of Canterbury, and an MSc in Aquatic Ecology from the University of Otago. I have 25 years experience as a biologist with field ecological investigative roles for New South Wales State Fisheries Department, Australia (3 years), Otago University (1.5 years) and Department of Conservation (21 years). My expertise is in freshwater ecology, terrestrial invertebrates and more broadly, terrestrial ecology.

1.4. My current research/professional specialties are New Zealand & Polynesian Lepidoptera Assessment, conservation of threatened invertebrates and Invertebrate biodiversity assessment.

1.5. I Chair the Wasp Tactical Group – an integration of science and stakeholders applied to control of pest wasps. I advise MPI and other Ministries from time to time on invertebrate biosecurity matters. I advise or have advised conservation management for governments/NGO's and communities in Nauru, Tonga, Fiji, American Samoa and Samoa.

1.6. I have published in national and international journals in the areas of insect conservation, wasp pest control and stream ecology.

1.7. I am familiar with the proposed route of the Mount Messenger bypass generally and I attended a site visit on Tuesday 8th August 2017.

1.8. I have read the Environment Court's Code of Conduct for Expert Witnesses, and I agree to comply with it. I confirm that the issues addressed in this brief of evidence are within my area of expertise.

1.9. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed. I have specified where my opinion is based on limited or partial information and identified any assumptions I have made in forming my opinions.

1.10. My opinions rely in part on the Evidence in Chief presented by expert witnesses appearing for the Applicant, in particular the statements of evidence of Dr Corinne Watts.

1.11. In addition, in preparing my evidence I have reviewed the relevant documents provided as part of the Mt Messenger Project Notice of Requirement and Resource Consent applications (hereafter termed "**NOR**") including:

- AEE - Technical Reports 7a – Vegetation, 7c – Invertebrates and 8a - Landscape, Natural Character and Visual Assessment;
- Ecology Supplementary Technical Report - Terrestrial Invertebrates;
- CEMP Appendices C: Construction Drawings and D: Ecology and Landscape Management Plan.
- Supplementary evidence of Mr Roger MacGibbon.

2. KEY FACTS AND OPINIONS

2.1. My evidence covers the following matters:

2.1.1. My opinion that the distinctive and rare invertebrate habitat within the Mimi and Mangapepeke Valley floors will not be replaced by the proposal. Having said that, overall I consider that the larger Pest Management Area (PMA) now proposed by the Applicant would, if the targets are achieved, adequately compensate for effects on invertebrates.

2.1.2. The lack of detail around the biosecurity (pest management) measures proposed by the Applicant during construction, given the extensive revegetation activity that is proposed.

2.2. Dr Watts' evidence states:[1]

> *"The overarching ecological aim for the Project is to ensure no net loss of biodiversity values, or to achieve a net benefit of biodiversity values, within the medium term. For invertebrates, I consider this aim will be achieved by a range of measures to avoid, remedy or mitigate effects on ecological values…"*.

2.3. Dr Watts' evidence then lists these measures, which include route selection, use of design measures to minimise habitat loss, desktop and field assessments to understand effects, pest management during construction, the Peripatus Management Plan and the broader mitigation and offset programme for the Project.

2.4. I agree with Dr Watts that the invertebrate community values within the Project area are 'high'.[2] I disagree that the potential magnitude of unmitigated effects on terrestrial invertebrate community values is 'low' to 'moderate', based on an "*[i]n practice"* assessment.[3] I consider that the overall level of effects under the EcIA guidelines of 'High'[4] should continue to be relied upon, because the conservative assessment provided for in those guidelines is appropriate in this circumstance of uncertainty of effects. Having said that, this evidence focuses on the level of effects expected *after* mitigation.

[1] At [86].
[2] Watts EIC at [54(a)].
[3] Watts EIC at [55].
[4] As noted by Watts at [54(c)].

2.5. I agree that the widescale pest animal management and stock exclusion proposed[5] will have benefits for invertebrates[6]. Invertebrates will benefit from increased habitat complexity and abundance of habitat. However:

2.5.1. Not all invertebrate species will benefit from the management of possums, rats, stoats and browsing mammals.[7]

2.5.2. The construction and post construction earthworks and planting programme will likely cause the irreversible loss of around 10 hectares of high value invertebrate habitat in the Mangapepeke floodplain (valley floor). There are direct construction effects over approximately 5ha in this area, and indirect effects over much of the remaining wetland extent from fragmentation, changes to water tables, and water flows.

2.5.3. Additional effects could occur to both the Mimi swamp and Mangapepeke valley floor if sedimentation events occur.

2.5.4. The scale and size of the pest animal and pest plant management areas, and other mitigation activities proposed, would not *offset* the loss of the Mangapepeke floodplain habitat.

2.6. Given the complexities outlined in this evidence and the inability to achieve 'like for like' the measures for invertebrates should be described as a combination of direct mitigation and (otherwise) 'compensation'. I do however generally accept the Applicant's revised proposals as compensation for this loss. I agree with the statement in Mr MacGibbon's Supplementary evidence at [44] that:

> *"Invertebrates generally will benefit from the expansion of the PMA to 3650ha by the substantial increase in the volume of habitat that will occur as a result of reduced browsing pressure, while many species are likely to benefit from reduced predation especially by rats".*

[5] ELMP 39, 4.6.3.1 Potential replacement mitigation plantings locations; 111, 9.8 Management of farm livestock and in supplementary evidence of MacGibbon.
[6] Watts [74,75]
[7] As also acknowledged by Dr Watts.

2.7. I agree that benefits to invertebrates will occur from reduced predation from climbing shit rats; particularly tree dwelling invertebrates, which will become more available to birds.[8]

Insufficient biosecurity measures

2.8. Extensive revegetation activity is proposed but there is insufficient detail on the planting process and biosecurity measures[9] to ensure biosecurity risks are managed. There are risks from exotic predatory snails (Bergey et al. 2014), exotic slugs, exotic argentine ants and other invasive invertebrates (Mahlfeld 2000; Liebold et al. 2012) (in addition to potential weeds).

2.9. The conditions proposed to mitigate potential for pest incursion or the spread of new pests are inadequate and in my opinion, the proposed planting programme should not proceed until additional biosecurity measures are included. In this evidence I recommend possible conditions to improve biosecurity measures.

3. PROJECT AREA INVERTEBRATE ASSOCIATIONS AND MANGAPEPEKE WETLAND VALUABLE HABITAT

General habitat – invertebrate associations

3.1. As described by Dr Watts[10], invertebrates are an integral and intrinsic component part of each ecosystem documented in the surrounds of Mount Messenger. A broad range of habitats includes for example, parasitic and other relationships with birds, lizards, bats, feral animals and stock. Invertebrate associations also include species direct consumption of typically 10-15% of plant primary production produced annually in roots, stems, leaves and plant reproductive parts (Lamarre et al. 2012; Metcalfe et al. 2013). This occurs in streams, swamps, forests and on rock faces

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[8] However, on the ground, the interaction between mice and two species of rates is less clear and benefit for invertebrates less easy to predict.
[9] ELMP 122 – 131, 11 Biosecurity Management Plan and activities outlined throughout the ELMP for vegetation management and revegetation including at [29, 4.6.1 Propagation material] , [39, 4.6.3 Replacement mitigation planting], [44, 4.6.4.4 Plant specifications], [47, 4.6.6.1 Rehabilitation strategy] and [51, 4.7 Programme].
[10] AEE Technical Report 7C Invertebrates and Watts EIC.

(Dugdale 1996; Winterbourn et al. 2000; Collier and Smith 2006; Lamarre et al. 2012; Watts et al. 2014).

3.2. Invertebrates are key in litter and detritus processing releasing nutrients and energy for other organisms (Evans et al. 2003).

3.3. Thus, where ecosystems are classified, and vegetation pattern is interpreted, distinct invertebrate faunal components unique to each ecosystem are also being identified. Where an ecosystem class is identified as rare, then the invertebrate faunal association is also rare. Diversity in hydrologic pattern or geomorphology indicates diversity in invertebrate pattern (Crisp et al. 1998; Walker et al. 2006) as it does for plant pattern (Crisp et al. 1998; Walker et al. 2006). This is consistently similar (in principle) to aspects of integrity and habitat representation typically interpreted for vegetation state (see for example Walker et al. 2006).

3.4. Dr Watts points out:[11]

> *"Previous studies have found that beetle communities are strongly linked to vegetation types suggesting that any removal of vegetation will impact on the community present (Crisp et al.1998; Watts & Gibbs 2002; Watts et al. 2015). However, the amount of native forest habitat loss as a result of this Project (ca 33ha) constitutes less than 1% of the available forest habitat within the wider Project area (ca 4,430ha; Figure 1.2). This amount is unlikely to compromise the sustainability of terrestrial invertebrate populations in the forest after construction."*

3.5. A better assessment would take into account the rarity or importance of the habitat type potentially affected, and its value for invertebrates.

Distinctive invertebrate habitat

3.6. Invertebrate habitats include different classes of slope forest ecosystems and old, as well as seral, regenerating vegetation. They also include the

[11] AEE Technical Report 7c Invertebrates, page 25, 4.3.1 Habitat loss and degradation.

nationally rare mosaic of floodplain[12] and palustrine[13] wetland habitats. The Mimi and Mangapepeke valley floors represent extensive riverine floodplain that would experience intermittent inundation. Some of this wetland habitat is nationally rare. These wetland areas transition downstream to homogenous farm pasture habitats.[14] Although modification *has* occurred, much of the wetland hydrology processes remain.

3.7. Information mapping geomorphic and climate drivers of ecosystem class-invertebrate habitat types shows that the valley floors of both the Mimi and Mangapepeke Valleys include poor draining gley soils with a permanently high water table. [15]

3.8. AEE Technical Report 7a depicts this as "WF8" – a warm forest series 8 (named for two commonly associated trees kahikatea, pukatea forest).[16] Singers and Rogers (2014) summarise the natural mature undisturbed vegetation association as:

> *"Podocarp, broadleaf forest of abundant kahikatea, with occasional to abundant pukatea, kiekie and supplejack, and locally rimu, tawa and swamp maire, particularly on organic and gley soils with a high water table".*

3.9. The AEE Technical Report 7a Vegetation[17] notes that only 2.45% of original extent now remain for this class of ecosystem in the Taranaki Region, making it ecologically rare.

3.10 As stated in that Report, this forest vegetation mapped as WF8, was likely formerly dominant throughout the floor areas of both catchments. Some vegetation has been modified both by pest animals and for farming purposes. Thus habitats now include exotic grasses, sedges and rushes present together with native sedges, rushes, shrubs and trees.

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[12] Riverine floodplain: Wetlands associated with rivers, streams, and other channels, where the dominant function is continually or intermittently flowing freshwater in open channels. The riverine hydrosystem includes open flowing waters and both the beds and margins (riparian zones) of channels. .. the riverine hydrosystem extends only so far as flowing channels retain a current influence, which can be defined as the extent covered by the mean annual flood (Johnson and Gerbeaux 2004).

[13] Palusterine: All freshwater wetlands fed by rain, groundwater, or surface water, but not directly associated with estuaries, lakes or rivers (Johnson and Gerbeaux 2004).

[14] AEE Technical Report 8a Landscape, Natural Character and Visual assessment: Figures 4.4 - 4.10; copied and attached as Appendix 1 to my evidence.

[15] Singers and Rogers 2014; AEE Technical Report 7a Vegetation – 3 Results of vegetation classification.

[16] Page 18, Figure 3.1 and page 22, Table 3.1.

[17] Page 46, Table 4.2 - Historic and current extents of WF8, WF13 and WF14 forest ecosystem units in the Taranaki Region.

3.11 For the Mimi and Mangapepeke valley floors these habitat features can be seen in aerial imagery, oblique pictures and maps among numerous applicant reports.[18] The contrasting transition to homogeneous farm pasture habitats downstream of the sites for proposed construction activities can also be seen on application images (Appendix 1).

3.12 If original edaphic factors and episodes of inundation continue then indigenous invertebrate dominance, and many wetland specialist invertebrates, would be expected to be retained in this nationally rare habitat.

Wetland specialist invertebrates are present throughout mid and lower Mangapepeke valley floor

3.13 Although little invertebrate sampling was able to be targeted at the Mimi wetland, some winged stages of wetland insects were sampled in the Mangapepeke areas by Dr Watts.[19] Both these valley floors can be expected to be important for invertebrates, as supported by evidence from the Mangapepeke valley floor habitats contained in AEE Technical Report 7c. I have drawn from the appendices to that Report and compiled wetland associated species documented by Dr Watts from the Mangapepeke valley floor, refer my Appendix 2.

3.14 These include:

- a beetle hosted on podocarp trees including kahikatea;
- several marsh inhabiting beetle and fly species;
- flies and true bugs on rush, sedge and buttercup; and
- some specialist micro-parasites of wetland bugs and flies.

Effects on Mangapepeke wetland faunal habitats

3.15 Construction drawings for habitats in the Mangapepeke floor[20] show placement of proposed fill, provisional fill sites, temporary stockpile areas, silt fences, permanent stormwater drains, main access roads, minor access roads, permanent stormwater wetlands (open-water ponds), decanting earth bunds, sediment retention ponds/treatment ponds,

[18] Eg. AEE Technical report 7a Vegetation; AEE Technical Report 8a Landscape, natural character and visual assessment.
[19] AEE Technical Report 7c Invertebrates.
[20] CEMP Appendix C.

temporary clean water drains and pipe/flumes and temporary dirty water drains and pipes.

3.16 Setting aside fragmentation effects, the area proposed to be occupied by construction related infrastructure is approximately half of the Mangapepeke valley floor area, or approximately 5 ha.

3.17 The construction drawings also show considerable disruption to wetland hydrologic integrity from covered over and raised areas of fill, main access roads and extensive redirection of channelled water and runoff (over land) water flows.

3.18 The various chapters of the draft Ecology and Landscape Management Plan (ELMP) outline numerous measures to regenerate indigenous dominance where these high value invertebrate habitats of the Mangapepeke catchment currently exist. However these are not measures that would restore. Rather, new habitats and new faunal associations would result that are not 'like for like' faunal associations.

3.19 Overall for the site, it appears there would be a shift towards running water ecology, running water habitats, and a lesser extent of palustrine and floodplain wetland habitats. In this respect, I disagree with the ELMP statement that[21] *"Ultimately the upper Mangapepeke valley will transform into a diverse, high value swamp/wetland ecosystem"*, in so far as the proposal will remove a nationally rare ecosystem class and then build a new hydrologic regime colonised by fauna in a new pattern after construction.

4. INSUFFICIENT BIOSECURITY MEASURES

4.1 Pest infections of rooted plants commonly develop in nursery environments and can then be transferred, together with propagated plants, to re-vegetation sites (Mahlfeld 2000; Liebold et al. 2012).

4.2 In this invasion pathway, there are risks from exotic predatory snails (Bergey et al. 2014), exotic slugs, exotic argentine ants, plant sucking

[21] ELMP page 19 at 3.5.3 "Swamp forest restoration planting."

insects, mites, nematodes and other invasive invertebrates (Mahlfeld 2000; Liebold et al. 2012) (in addition to potential weeds).

4.3 Current conditions detailed in the ELMP do not discuss biosecurity hygiene activities within nurseries where plants are grown to prevent invertebrate pest invasions there.

4.4 The ELMP does not discuss use of invertebrate expertise to inspect rooted plants for pests potentially arriving at Mount Messenger replanting sites.[22] For example, the measure for invasive Argentine ants is to consider containment if an incursion is later discovered. However, no site surveillance programme for Argentine ants or any other potential new invertebrate incursion associated with replanting programmes is proposed.

4.5 No nursery inspections for exotic ants (several species) are proposed. For potting mix arriving at the project area, no inspection for pest invertebrates is proposed.

4.6 In identifying plague skinks and one species of exotic ant, the Application acknowledges a level of environmental risk. However in my opinion, the risk is associated with a much broader range of invertebrates (and other pest organisms) sourced from possibly a range of different nursery locations over a period of up to 7 years[23] (and maybe longer) which, overall, increases the chance of incursions.

4.7 Surveillance for weeds but not other pests at six-month intervals[24] is a long interval to wait and see what pests are apparent among the stockpiles and cleared areas. No surveillance schedule is noted for these areas once plantings are present.

5 POTENTIAL EFFECTS OF SEDIMENTATION ON INVERTEBRATE FAUNA

5.1 I agree with Dr Drinan's concerns regarding the response to sedimentation events currently proposed in the Construction Water

[22] ELMP 122 – 131, 11 Biosecurity Management Plan.
[23] 29 (a) Vegetation (vii) Restoration planting as follows: 8(a)The Requiring Authority shall complete restoration planting within three planting seasons of the completion of construction works, unless natural conditions during Construction .. adversely limits seedling propagation for indigenous plant species, in which case completion would be delayed to reflect the availability of suitable seedlings.
[24] ELMP page 28, 4.4.5 Mulching and storage of wood and soil

Management Plan (CWMP). For event-based monitoring (which the Applicant proposes only for the Mimi kahikatea swamp forest) no responses other than further monitoring and the improvement of sediment and erosion control practices are identified. Yet there are potentially significant adverse effects on invertebrate fauna including wetland specialist invertebrates in both floodplain environments.

6 CONDITIONS OFFERED

6.1 Recommended invertebrate biosecurity actions/conditions for the Project site are set out here.

6.2 All plants and soils (potting mix) brought (or to be brought) to the Project Area should be inspected by a person qualified to survey or identify invertebrate pests.

6.3 Nurseries where rooted plant material is sourced: Independent inspection and sampling by a person qualified to recognise soil invertebrate pests and, stem/foliage dwelling invertebrate pests. To identify invasive species such as some species of earthworms, landsnails and beetles. Specimens or samples may need to be sent to a laboratory diagnostics team. A minimum two inspections per year. In the event pest invertebrates were found and nursery managers were carrying out control, an increased number of checks would be needed.

6.4 Prior to any planting activity in each part of the Project Area where planting is proposed an inspection must be carried out by a person qualified to survey for invertebrate pests. This may involve sending soil, litter or plant dwelling invertebrates for laboratory species determination. This would appropriately identify existing pest status, and benchmark the potential arrival of any new invasive invertebrate species.

6.5 Within the growing season of any plantings and a year after any planting activity a person qualified to survey or identify invertebrate pests should carry out invertebrate pest surveillance of the Project Area and any plantings.

7 REFERENCES

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Watts C, Thornburrow D, Cave V, Innes J 2014: Beetle community changes following pest mammal control at two biodiversity sanctuaries in Wellington, New Zealand. Journal of the Royal Society of New Zealand 44, 61 - 87.

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APPENDIX 1

Image series and captions copied verbatim from - AEE Technical Report 8a. Landscape, natural character and visual assessment. This sequence of images is from the Mangapepeke Valley Floor:

Figure 4.4 – Farm buildings and valley flats at 3072 Mokau Road, from SH3 looking south. The northern valley near SH3 is characterised by the pastured flats contained by steep surrounding bush slopes and the farm buildings and machinery of the farm property at 3072 Mokau Road.

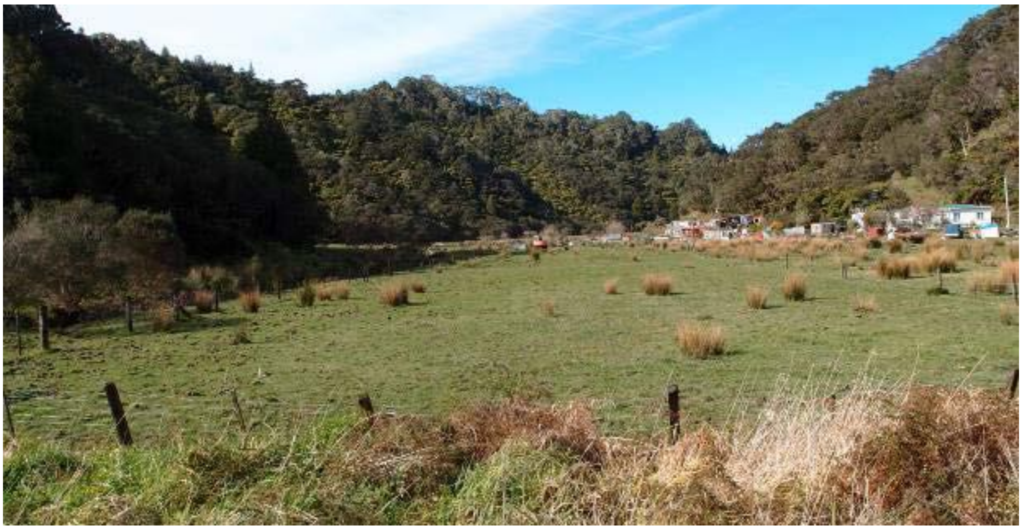

Figure 4.5 – Looking south towards the farm at 3072 Mokau Road from SH3. The farm complex at 3072 Mokau Road is on the western side of the valley flats and includes an array of farm machinery and other materials. The grazed valley flats are well defined by the bush edge of the immediately adjoining bush slopes .

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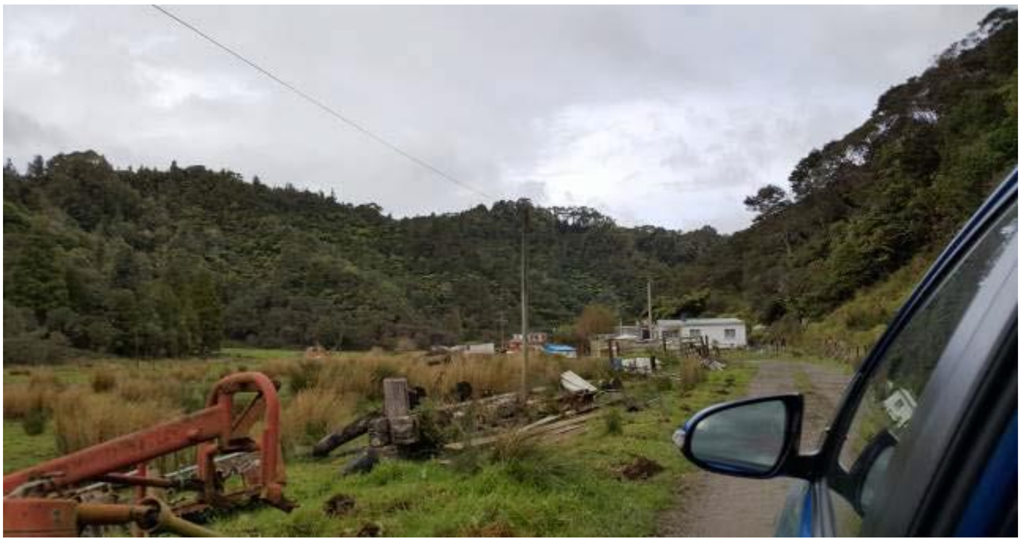


South of the farm complex, the pastoral qualities of the valley flats become less defined with a predominance of sedge / rushland vegetation. These grazed valley flats however remain distinct from the surrounding bush with a clear 'bushline' boundary. Overall these transitional areas are of moderate landscape quality representing a mix of modified and natural landscape characteristics.

Figure 4.6 – Valley flats south of the farm complex at 3072 Mokau Road with intact bush
slopes, grazed flats and fragmented bush edge areas.

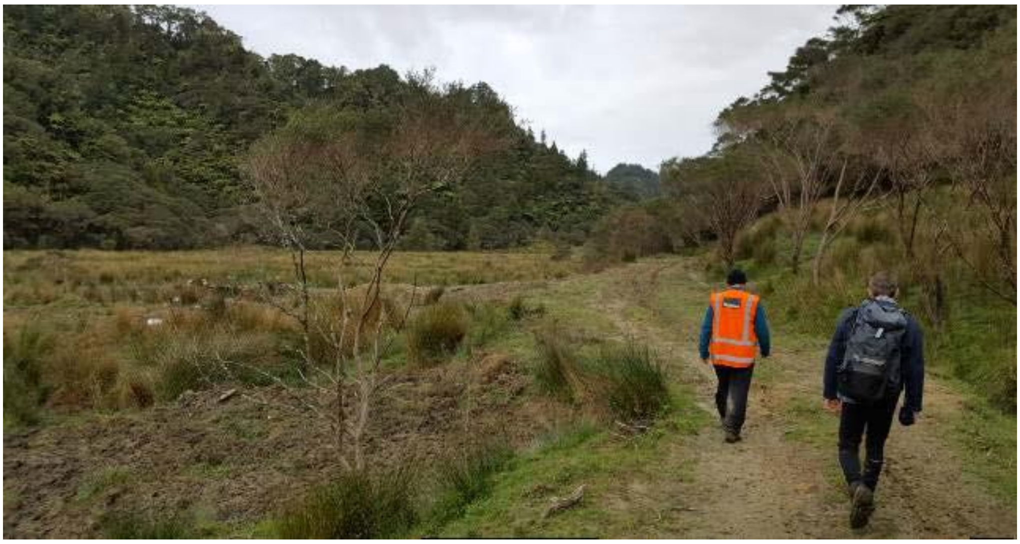
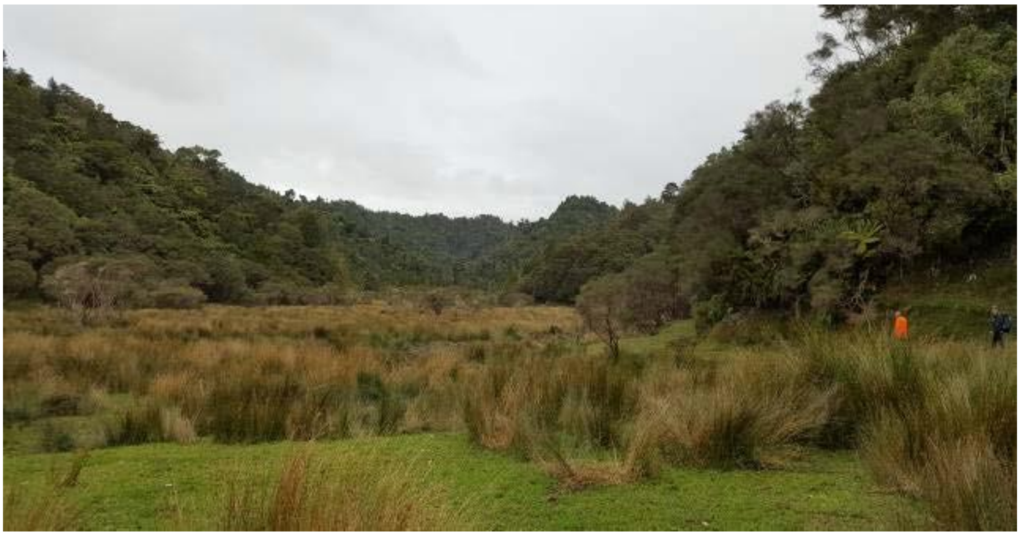


Figure 4.7 – rough pasture transitioning up the Mangapepeke Valley framed by the
surrounding bush slopes and ridgelines.



The Upper Mangapepeke Valley

This relatively extensive area of rough grazed mixed vegetation flats continues southwards up the valley (see above) and includes bush edges characterised by Kahikatea forest remnants in some areas and isolated large individual native trees. These transitional areas represent further increases in landscape quality as the natural landscape qualities become more predominant.
Figure 4.8 – Kahikatea remnant bush edge featuring large prominent individual trees (left of frame).

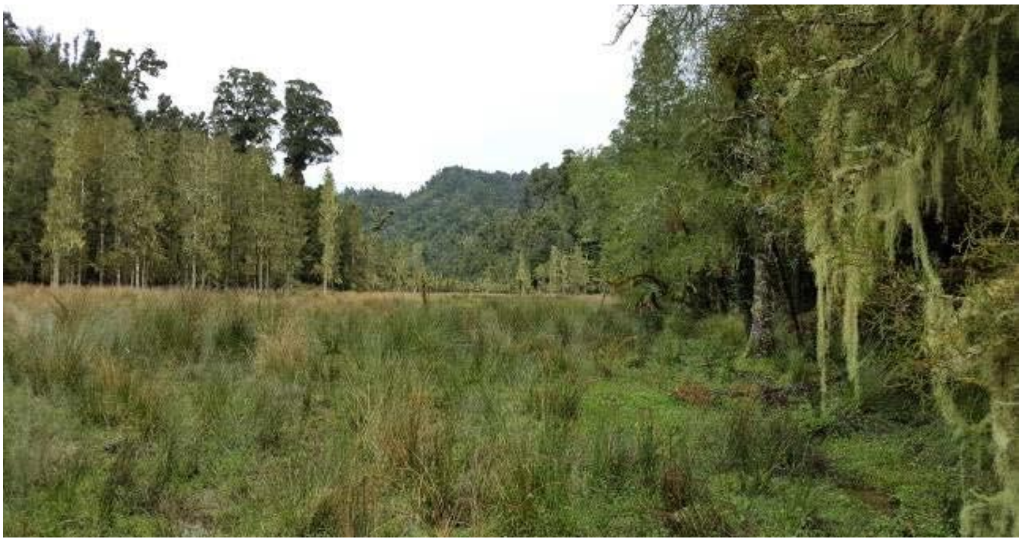
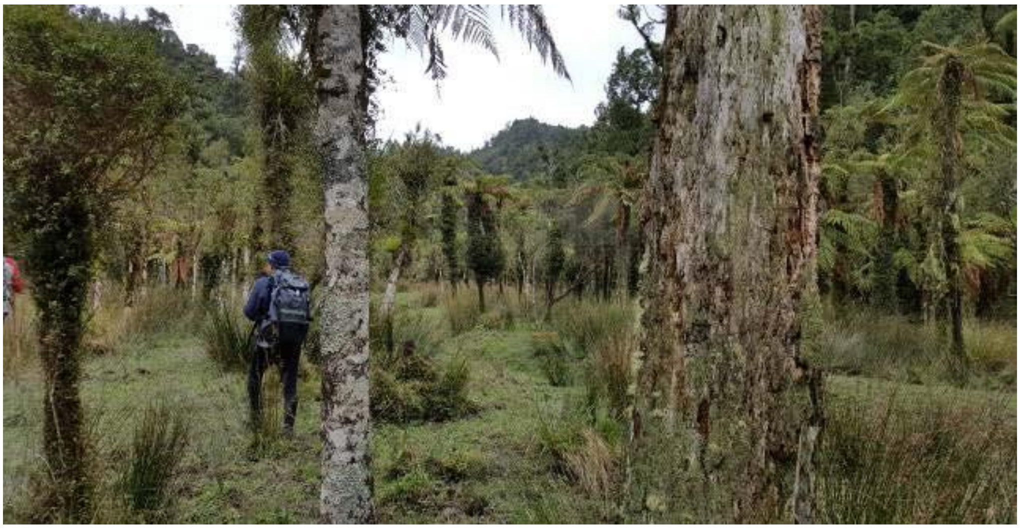
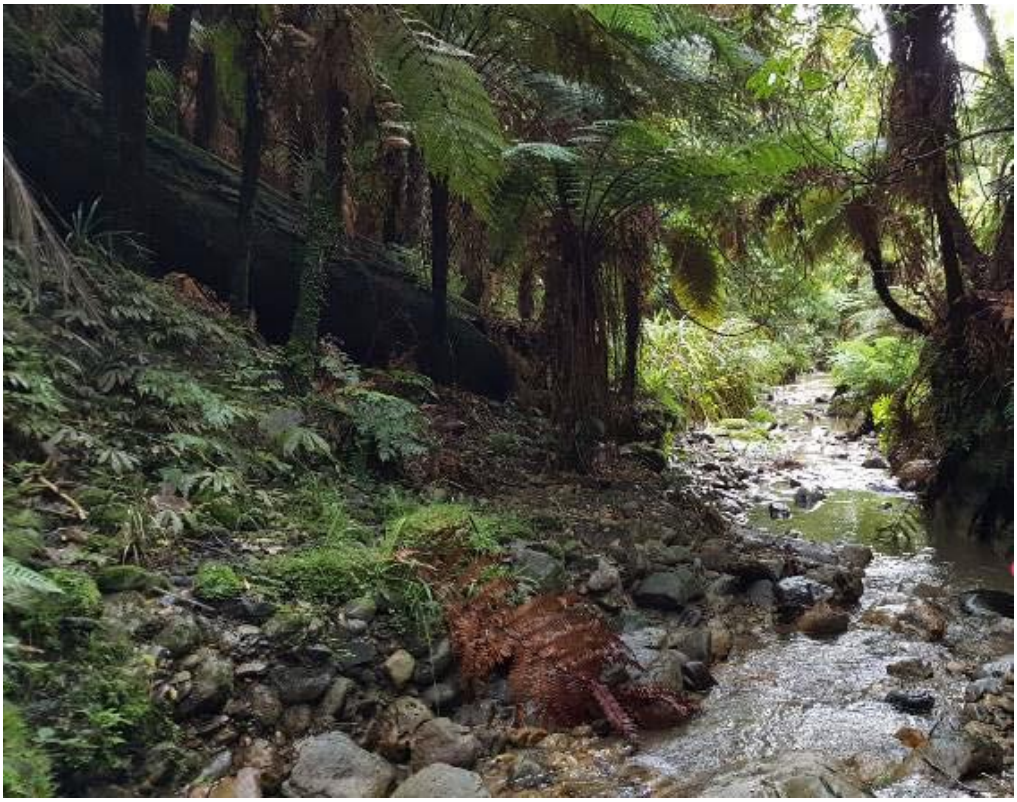


Figure 4.9 – Rough pasture / bush transition



The character of the valley floor transitions again to a more mixed lowland forest character still further south (above) before becoming more enclosed and broken reflecting the more incised and steep upper catchment terrain of the first order Mangapepeke Stream systems (below). This upper catchment area is of moderate- high landscape and natural character value due to the unmodified stream corridor and indigenous vegetation cover combined with relatively strong ridge and spur landforms.

Figure 4.10 – Moderately high natural character of the Upper Mangapepeke Stream corridor



Appendix 2. Native wetland inhabiting insects recorded in plots nearby to Managapepeke valley floor wetlands by Dr Watts (2018) and information on their habitat associations. Many insects have a larval stage dwelling in a particular habitat –for example a wetland type of plant, and an adult winged stage that disperses. In this case, the adult dispersal stages have been sampled by Dr Watts and I have drawn on her habitat notes or sourced them from literature. An oblique aerial map of the plot locations is provided in Watts (2018) Figure 2.1b page '2b'

Taxon (species)	Common name	Plot records	Habitat notes	Source of habitat information
Rhinorhynchus rufulus	A weevil beetle in the family Nemonychidae	6	On podocarp trees including kahikatea	Watts C 2018 a: Assessment of Ecological Effects – Ecology supplementary report - Terrestrial Invertebrates
Amplectopus sp.	Marsh beetle in the family Scirtidae	6 & also 2,3,5	Larvae typically predatory in aquatic habitats -marsh waters	Klimaszewski J, Watt JC 1997: Coleoptera: family-group review and keys to identification. Fauna of New Zealand Series 37. Manaaki Whenua Press, Lincoln, Canterbury.
Scirtidae species	Marsh beetles	In all plots but abundant Plot 7	Larvae predatory in aquatic habitats. A number of species are likely present in these wetlands.	Edwards ED 1995: Contribution of terrestrial invertebrates to stream food-webs. Unpublished MSc Thesis, University of Otago, Dunedin, New Zealand.
Ceradontha species	A leaf miner fly, family Agromyzidae	5-10, abundant in 6	Larvae in wetland rushes including Juncus species.	Spencer KA 1976: The Agromyzidae of New Zealand (Insecta: Diptera), Journal of the Royal Society of New Zealand, 6:2, 153-211.
Liriomyza species	A leaf miner fly, family Agromyzidae	6,8,9	New Zealand species known from leaves of a range of herbs in damp places and also leaves of some shrub species.	Spencer KA 1976: The Agromyzidae of New Zealand (Insecta: Diptera), Journal of the Royal Society of New Zealand, 6:2, 153-211.
Phytomyza species	A leaf miner fly, family Agromyzidae	6,9	Species known mining leaves of *Ranunculus* species buttercups. *Ranunculus* species in the valley associated with open wet areas among sedge, rush and grass sward	Spencer KA 1976: The Agromyzidae of New Zealand (Insecta: Diptera), Journal of the Royal Society of New Zealand, 6:2, 153-211.
Zealantha thorpei	A small fly species, family Anthomyzidae	9	Larvae live in grasses or sedges	Watts C 2018 a: Assessment of Ecological Effects – Ecology supplementary report - Terrestrial Invertebrates
Ceratomerus lobipennis	A small fly species, family Brachystomatidae	6	Larvae inhabit streams, adults predatory among nearby vegetation.	Sinclair BJ 2017: Ceratomerinae (Diptera: Empidoidea: Brachystomatidae). Lincoln, N.Z. Landcare Research.
Ceratomerus sp.	A small fly species	7	Larvae inhabit streams, adults predatory among nearby vegetation.	Sinclair BJ 2017: Ceratomerinae (Diptera: Empidoidea: Brachystomatidae). Lincoln, N.Z. Landcare Research.

Taxon (species)	Common name	Plot records	Habitat notes	Source of habitat information
family Ceratopogonidae	Small biting midge flies	2-11, abundant 5,10	Larvae generally wetland, wet soil and water margin inhabitants	Winterbourn MJ, Gregson KLD, Dolphin CH 2006: Guide to the Aquatic Insects of New Zealand. Entomological Society of New Zealand. 108 pages.
family Empididae	Aquatic dance flies, >10 species recorded	1-11 except 8	Range of aquatic habitats	Merritt RW, Cummins KW (Eds.) 1996: An introduction to the aquatic insects of North America. 3rd. Edition. Kendall/Hunt, Dubuque, Iowa, 862 pp.
Ditrichophora sp.	Shore flies, Ephydridae	6,7, abundant in 6	Larvae in freshwater wetlands	Drake CM, 2006: British Ephydridae (Diptera). Published online. Sourced 24 May 2018 at https://diptera-in-beeld.nl/Ref-Key%20Ephydridae%20British%20key%20-%20new%20(2006)-C.M.Drake.pdf
Hyadina species	Shore flies, Ephydridae	6,9	Larvae in freshwater wetlands	Drake CM, 2006: British Ephydridae (Diptera). Published online. Sourced 24 May 2018 at https://diptera-in-beeld.nl/Ref-Key%20Ephydridae%20British%20key%20-%20new%20(2006)-C.M.Drake.pdf
Hydrellia species	Shore flies, Ephydridae, several species	3,6,8,9,10,11 , abundant in 6	Larvae in a range of freshwater wetlands	Drake CM, 2006: British Ephydridae (Diptera). Published online. Sourced 24 May 2018 at https://diptera-in-beeld.nl/Ref-Key%20Ephydridae%20British%20key%20-%20new%20(2006)-C.M.Drake.pdf
Gynoplistia species	A cranefly species, family Limoniidae	1, 3-10	Larvae in a range of freshwater wetlands or under plants on wet soils	Theischinger G 2007: The Limoniinae (Diptera: Tipulidae) of Australia III. The genus Gynoplistia MACQUART. Stapfia, Bulletin 29. Austria. 106 pages.
Helophilus species	A hoverfly species, family Syrphidae	6	Larvae and adults in wetlands	Speight MCD 2011: Species accounts of European Syrphidae (Diptera), Glasgow 2011. Syrph the Net, the database of European Syrphidae, vol. 65, 285 pp., Syrph the Net publications, Dublin.
Rhopalimorpha species	A sheild bug species, family Acanthosomatidae	6,9	Inhabits and feeds in sedges	Larivière M-C, Larochelle A 2004: Heteroptera (Insecta: Hemiptera): catalogue. Fauna of New Zealand 50. 330 pages.
Xestocephalus ovalis	A leafhopper species, family Cicadellidae	6	Most often on grasses, sedges and rushes in marshy areas	Larivière M-C, Fletcher MJ, Larochelle A 2010: Auchenorrhyncha (Insecta: Hemiptera): catalogue. Fauna of New Zealand 63, 232 pages.
Chorebus rodericki	A micro-parasitic wasp, family Braconidae	4,5,6,7,9,10	Parasitises wetland inhabiting shoreflies (Ephydridae)	Berry JA 2007: Alysiinae (Insecta: Hymenoptera: Braconidae). Fauna of New Zealand, 58, 95 pages.
Gonatopus alpinus	A micro-parasitic wasp, family Drynidae	9	Parasitises leafhoppers	Gourlay ES 1954: The Dryinidae, a Family of Hymenoptera New to New Zealand. New Zealand Entomologist, 1, (4) 3-5.