**BEFORE THE TARANAKI REGIONAL COUNCIL AND NEW PLYMOUTH DISTRICT COUNCIL**

**MT MESSENGER BYPASS PROJECT**

| | |
|---|---|
| In the matter | of the Resource Management Act 1991 |
| and | |
| In the matter | of applications for resource consents, and a notice of requirement by the NZ Transport Agency for an alteration to the State Highway 3 designation in the New Plymouth District Plan, to carry out the Mt Messenger Bypass Project |

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# STATEMENT OF EVIDENCE OF CORINNE HANNAH WATTS (TERRESTRIAL INVERTEBRATES) ON BEHALF OF THE NZ TRANSPORT AGENCY

25 May 2018

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## QUALIFICATIONS AND EXPERIENCE

1. My name is Corinne Hannah Watts.

2. I am an Invertebrate Ecologist at Manaaki Whenua Landcare Research, Hamilton.

3. I hold a Bachelor of Science majoring in biological sciences and geology, completed in 1996, and a Master of Science (first class honours in ecology) completed in 1999, both from Victoria University of Wellington. In 2006, I completed a Doctor of Philosophy (PhD) in zoology from the University of Canterbury.

4. I have more than 20 years' experience in research on the ecology, monitoring, restoration and management of indigenous invertebrate biodiversity across both conservation and productive landscapes. In particular:

   (a) I have expertise in preparing and implementing methodologies for ecological survey and assessment of invertebrate communities, and I have worked in a variety of locations throughout New Zealand;

   (b) I have designed and implemented numerous research projects examining the response of invertebrate communities to introduced mammal control and habitat restoration; and

   (c) I have developed new tools for translocation and monitoring of giant weta to reveal details of habitat use and behaviour.

5. Between 1994 and 1997, I worked for AgResearch (Wallaceville) as a laboratory technician. In 1998 and 1999, I was employed by Karori Wildlife Sanctuary in Wellington as an ecological technician. Since 1999, I have been employed by Manaaki Whenua Landcare Research (Hamilton) as an Invertebrate Ecologist. In addition, I am currently an Adjunct Professor in the School of Biological Sciences, Victoria University of Wellington.

6. In total, I have published 47 peer-reviewed scientific papers, and 83 client reports, book chapters, and other publications. These include international journal papers on invertebrate ecology, insect communities in restored wetlands, and on threatened New Zealand insects.

7. I am a member of the New Zealand Entomological Society, New Zealand Ecological Society, the International Society of Ecological Restoration, and I have an advisory role on the IUCN SSC Grasshopper Specialist group.

8. I confirm that I have read the 'Code of Conduct' for expert witnesses contained in the Environment Court Practice Note 2014. My evidence has been prepared in compliance with that Code. In particular, unless I state otherwise, this evidence is within my sphere of expertise and I have not omitted to

consider material facts known to me that might alter or detract from the opinions I express.

## EXECUTIVE SUMMARY

9. A desktop assessment combined with the findings from an invertebrate survey from within the Mt Messenger Bypass project (**"Project"**) footprint found a diverse invertebrate fauna, dominated by native taxa, from a range of trophic groups.

10. In particular, two species of peripatus, *Peripatoides suteri* and *Peripatoides novaezealandiae* were found within the Project footprint. The record of 3 specimens of *P. suteri,* classified as 'Vulnerable' on the IUCN Red List of Threatened Species, in two plots is important. However, neither of these species have a threat classification under the New Zealand Threat Classification System. Accordingly, a draft Peripatus Management Plan (Chapter 10 of the ELMP) has been prepared. The plan outlines the recommended procedure for pre-translocation survey in 'high-risk' habitat areas, site preparation, translocation timing, peripatus and habitat transportation, and the re-positioning of peripatus-occupied material.

11. In terms of the unmitigated effects of the Project on terrestrial invertebrates, a 'value' assessment of 'High' combined with an unmitigated 'magnitude of effects' assessment of 'Low' to 'Moderate' correlates to an conservative overall level of unmitigated effects of 'High', when applying Step 3 of the *Ecological Impact Assessment Guidelines for use in New Zealand: terrestrial and freshwater ecosystems* (March 2015) ("**EcIA guidelines**"), published by the Environment Institute of Australia and New Zealand ("**EIANZ**"). This assessment has been carried out on a conservative, precautionary basis.

12. The actual unmitigated effects of the Project on terrestrial invertebrates are likely to be lower than what has been conservatively assumed because:

    (a) the invertebrate fauna is 'typical' of communities inhabiting native forests of southern North Island and northern South Island;

    (b) the ecological condition of the forest within the proposed route is considered poorer, with fewer palatable plant species, compared to the nearby Parininihi;

    (c) approximately 1% of the available habitat in the wider Project area will be affected by the Project; and

    (d) it is likely that the taxa most affected by mammalian predation are already extinct in the Mt Messenger area.

13. A range of ecological mitigation and offset measures are proposed for the Project. These measures include pest control, habitat enhancement and

restoration planting, as well as measures that specifically target invertebrates (including the Peripatus Management Plan).

14. As there is a strong correlation between invertebrate assemblages and habitat structure, enhancements to habitat quality will benefit invertebrates. I support the mitigation and offset package which has been proposed, which in my opinion represents a sound and appropriate response to the effects of vegetation removal potentially affecting the terrestrial invertebrate communities during construction activities.

15. In summary, I consider that any effects of the Project on invertebrates are likely to be negligible (and may be positive) in the medium term.

## BACKGROUND AND ROLE

16. The NZ Transport Agency ("**Transport Agency**") has engaged me to advise it on its proposed Project to improve the section of State Highway 3 ("**SH3**") between Ahititi and Uruti, to the north of New Plymouth.

17. I prepared:

    (a) the Assessment of Ecological Effects – Terrestrial Invertebrates ("**Invertebrates Report**") included as Technical Report 7c, Volume 3 to the Assessment of Environmental Effects ("**AEE**") for the Project; and

    (b) the Ecology Supplementary Report – Terrestrial Invertebrates ("**Supplementary Invertebrates Report**") lodged with New Plymouth District Council ("**District Council**") and Taranaki Regional Council ("**Regional Council**") on 21 February 2018.

18. I have had input into the draft Ecology and Landscape Management Plan ("**ELMP**") prepared for the Project, particularly as it relates to terrestrial invertebrates. I co-authored the draft Peripatus Management Plan, which is Chapter 10 within the ELMP.

19. I prepared a draft invertebrate survey methodology, which was refined through consultation with Dr Eric Edwards (DOC) and Dr Brian Patrick (Wildlands). The draft methodology was finalised, and the survey carried out.

20. I was involved in workshops discussing terrestrial invertebrates, including discussions with Department of Conservation ("**DOC**") and Wildlands subsequent to the invertebrate surveys.[1]

## SCOPE OF EVIDENCE

21. The purpose of my evidence is to outline the potential effects construction and operation of the Project would have on terrestrial invertebrates. I then discuss the mitigation, offset and monitoring measures proposed, and captured in the

[1] Wildlands are the consulting ecologists for both the District Council and the Regional Council in respect of the Project.

ELMP (including the draft Peripatus Management Plan), to address those potential issues, and assess the overall effects on terrestrial invertebrates with those measures in place.

22. My evidence addresses:

    (a) an overview of the existing terrestrial invertebrate ecology values of the Project area;

    (b) the methodology I followed in identifying the terrestrial invertebrate ecology values of the Project area and the effects the Project could potentially have on those values;

    (c) the results of my investigations into the terrestrial invertebrate ecology values and potential effects of the Project; and

    (d) my assessment of the potential effects of the Project on terrestrial invertebrates, including by reference to the proposed measures to mitigate and offset effects; and

    (e) responses to submissions and the Section 42A Report prepared by the District Council.

## THE EXISTING TERRESTRIAL INVERTEBRATE VALUES OF THE PROJECT AREA

23. The wider Project area (approximately 4,430 ha)[2] is situated in hill country of the North Taranaki Ecological District[3] in the larger Taranaki Ecological Region. Any flat land is mainly in pastoral farmland and the steep hill country is covered in indigenous vegetation.

24. As with many parts of New Zealand, there is a paucity of entomological knowledge around the wider Project area and the Mt Messenger area. However, the Mt Messenger area has been suggested as a ‘transitional zone’ for invertebrate species, lying at both the northern limit of southern population ranges, and at the southern limit of northern population ranges.

25. The wider area consequently supports a diverse invertebrate fauna. The area is distinctive in that it is one of the few North Island localities where a number of taxa that have predominately northern South Island distributions are also present.

## INVESTIGATION METHODOLOGY

26. My participation in the Project has included field assessment of two different alignment options (including the alignment now proposed for the Project). Initially, I carried out a desktop assessment. That was followed by fieldwork between February and December 2017. From this work I have gained a

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[2] The extent of the wider Project area is described in the evidence of Mr Singers.
[3] Refer Figure 1.2 AEE Vegetation report 7a.

comprehensive understanding of the terrestrial invertebrate community and their values within the wider Project area.

**Desktop assessment**

27. The desktop assessment included:

    (a) searching electronic databases of New Zealand insect collections and New Zealand published records; and

    (b) obtaining information from specialist taxonomists. Records from searching electronic databases and published data of invertebrates found at Mt Messenger were sent to relevant specialist taxonomists. Taxonomists were asked to:

        (i) comment on the compiled list of taxa;

        (ii) add any species they know have been found at Mt Messenger;

        (iii) comment on whether there were any threatened species known from that locality; and

        (iv) advise whether they knew of any threatened species found near (within 10 km of) Mt Messenger but not known from location that were not on the list.

**Field assessments**

28. In February 2017, I walked on or near the preliminary 'MC23' route in the Parininihi and Waipingao catchments, to the west of the Project footprint.[4] In July 2017, I traversed the majority of the Project footprint, except for areas which are too steep and hazardous. These have been assessed from nearby viewpoints.

29. A more detailed field assessment was carried out in October to December 2017. Invertebrate sampling occurred within 11 plots (10 x 10 m) placed within the Project footprint (where sites could be safely accessed) in areas of native forest and scrub habitats, as shown in **Figures 1A and 1B** below.

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[4] The location of the preliminary MC23 route is shown in Figures 1.2 and 3.1 of the Invertebrates Report. The (current) Project footprint is defined in the ecology reports included with the AEE, as well as in the evidence of Mr Singers.


***Figure 1A.*** *Map of the Project footprint (outlined in grey) showing the location of invertebrate plots in the Mimi catchment (marked with a blue symbol and labelled INV1-5).*

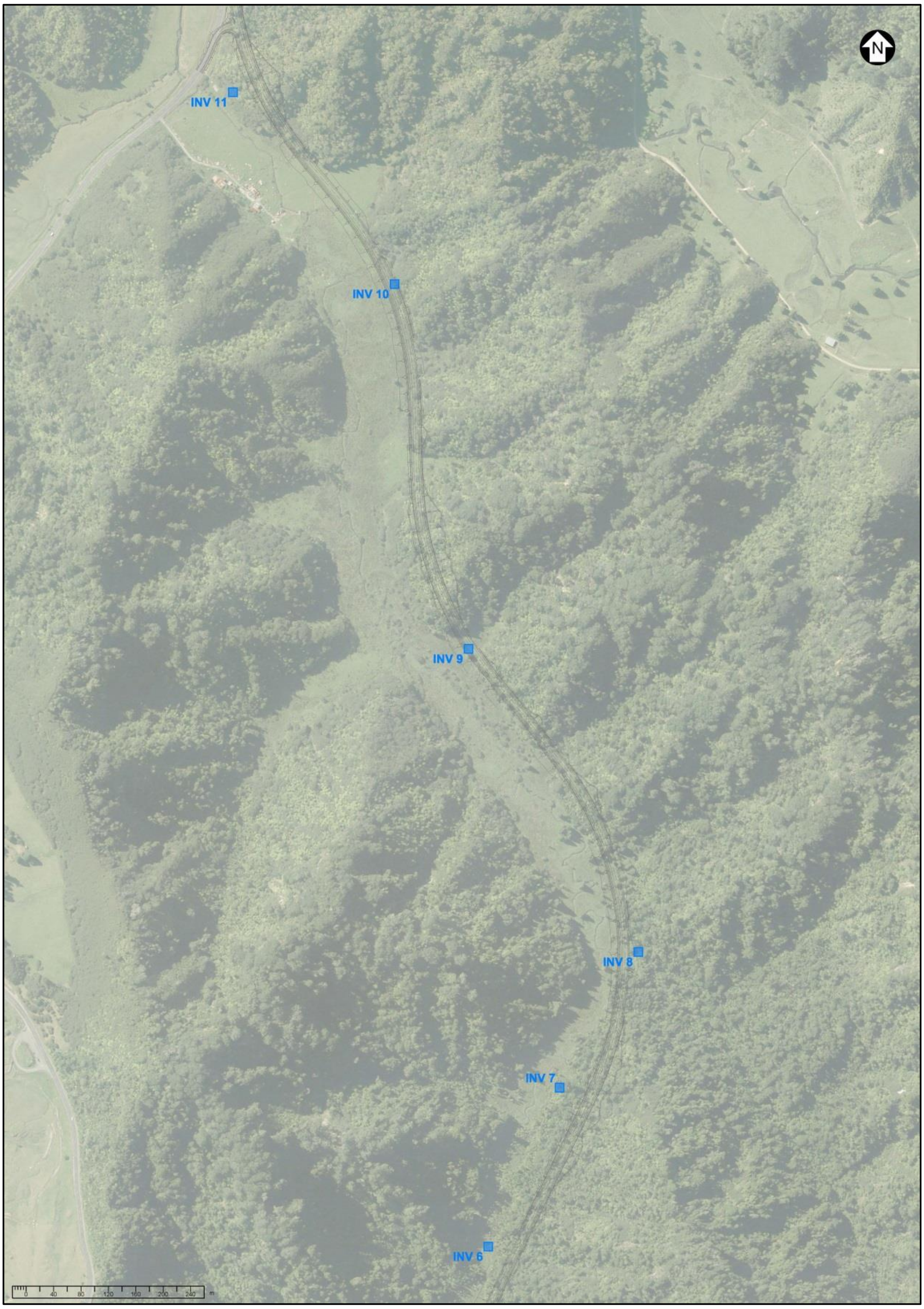


***Figure 1B.*** *Map of the Project footprint (outlined in grey) showing the location of invertebrate plots in the Mangapepeke Valley (marked with a blue symbol and labelled INV6-11).*

30. Three types of invertebrate sampling occurred including:

(a) malaise traps;

(b) pitfall traps; and

(c) below-ground sampling.

*Malaise traps*

31. Malaise traps were used to collect flying insect fauna inhabiting foliage. These traps resemble open-sided tents made of fine mesh cloth, and were used to collect insects that fly or are blown into the trap (see **Figure 2** below).

32. At each invertebrate plot (11 in total), one malaise trap (Figure 2) was placed in the centre of the 10 x 10 m plot.

33. Traps were set for one month, from 30 October to 26 November 2017. Captured invertebrates were collected, sorted and identified to Order level.[5] Any ecological trait data known about the specimens, including trophic group and native / introduced status, were noted.

***Figure 2.*** *A malaise trap used to collect flying insects, particularly flies, wasps and beetles.*

[5] Stephen Thorpe, a taxonomic consultant, has knowledge of the New Zealand invertebrate fauna and carried out the identifications for the Project.

*Pitfall traps*

34. Pitfall traps were used to sample the ground-dwelling invertebrate fauna (see **Figure 3** below).

35. Four pitfall traps were placed 5 m away from the each corner of the malaise trap within each of the 11 invertebrate plots (meaning a total of 44 pitfall traps were employed). Traps were set for one month from 30 October to 26 November 2017. Captured invertebrates were collected, sorted and identified to Order level.[6]

***Figure 3.*** *A pitfall trap used to collect ground-dwelling invertebrates. A plastic cup was sunk vertically into the ground so that the rim of the cup was flush with the ground. A cover (placed beside the trap for the purpose of the photo) was positioned a few centimetres immediately above the trap to minimise the amount of debris and water entering the trap.*

*Below-ground sampling*

36. As the potential adverse effects of the Project on the terrestrial invertebrate communities are most likely to occur during the construction phase, additional sampling occurred below-ground, focussing on earthworms. One or two 50 × 50 cm pits (22 in total) were excavated and randomly dug within or near to the 11 invertebrate plots to survey earthworms between October and December 2017. Three layers were hand-searched using a headlamp: litter, top 10 cm of soil, and 10–30 cm deep soil. All soil was returned and litter placed back on top. In the laboratory, each earthworm was weighed and identified to recognised taxonomic units (hereafter, referred to as species). Any earthworms collected in the pitfall traps were extracted and identified.

[6] Identification was carried out by Stephen Thorpe.

## INVESTIGATION RESULTS

37. As with many parts of New Zealand, there is a paucity of entomological knowledge around the wider Project area and the Mt Messenger area. In addition, the taxonomic knowledge of New Zealand terrestrial invertebrates is very uneven across major groups. Large-bodied invertebrate groups (for example, weta) are better known than small and cryptic species. Moreover, only a small proportion of the records from New Zealand's entomological collections are electronically databased and therefore readily accessible.

38. The investigations described in my evidence have enabled an understanding of the invertebrate community within the Project footprint that is better surveyed than for most of the country.

### Desktop review results

39. The database and published literature search found a total of 179 invertebrate taxa recorded in the general vicinity of Mt Messenger.[7] I have assumed that these species are likely to be present in the wider Project area (ca 4,430 ha), and therefore are potentially within the Project footprint.

40. Searching entomological databases and relevant literature identified the forest ringlet (*Dodonidia helmsii*), a threatened invertebrate of conservation interest, as having previously been found in the vicinity of Mt Messenger, though no local surveys have been carried out since the 1990s.[8] The forest ringlet is now largely confined to altitudes above 500 m above sea level (asl), therefore it is unlikely to be present in the vicinity of the Project footprint, noting that the highest point within the Project footprint is approximately 180 m asl, and that the tihi (summit) of Mt Messenger itself is 306 m asl. Although *Gahnia pauciflora* and *G. setifolia* have been occasionally observed within the Project footprint,[9] no signs of adult or larvae activity were detected during walkovers and field assessments within the Project area, which are discussed below.

41. The specialists I contacted noted some important invertebrate records of endemic taxa known only from a few locations, including in the vicinity of the wider Project area. For example:

    (a) the ground beetle, *Parabaris lesagei,* which is only known from eight populations in the North Island;[10] and

[7] The list of taxa is included as Appendix B to the Invertebrates Report. While the exact location of these recorded taxa is unknown, the precise locality of each specimen record is noted as "Mt Messenger".
[8] The, forest ringlet is classified by DOC as 'At Risk: Relict, Serious Decline'. It has been observed within 6km of Mt Messenger at Uruti (Museum of New Zealand Te Papa Tongarewa Entomology Online Collection)[8]. The cause of decline is unknown but habitat loss, predation by introduced wasps, birds and rodents, as well as impacts of feral pigs on host plant abundance have been suggested as contributing factors.[8] Larvae of the forest ringlet are known to feed on *Gahnia* and *Chionochloa* species on the edges of forest clearings.
[9] See Assessment of Ecological Effects – Vegetation (Technical Report 7a, Volume 3 of the AEE).
[10] Larochelle & Larivière 2005.

(b) the plant bug, *Cyrtorhinus cumberi,* which is also only known from a few populations with Mt Messenger being a significant site for these insects.[11]

**Project footprint walkover**

42. During the July 2017 walkover along the Project footprint, I found that:

    (a) leaf litter appeared patchy with the presence of pig rooting and cattle in the lower reaches of the valley along the Mangapepeke Stream;

    (b) there was an abundance of deadwood within the forest; and

    (c) there was a low diversity of ground cover plants and a sparse understorey plant community.

43. The forest had a varied emergent tree layer including a number of epiphyte species. However, overall my observations accord with Mr Nicholas Singers' conclusion that the ecological condition of the forest within the Project footprint is considered poorer, with fewer palatable plant species, compared to the nearby Parininihi (to the west of the existing SH3). This is due to the absence of consistent animal pest control, lack of fencing, and the presence of grazing stock.[12]

**October to December 2017 field assessment**

44. The late-2017 sampling programme provided more information about the invertebrate species actually present within the Project footprint. The sampling programme provided a 'snap-shot' of the invertebrate community present. The one month sampling period is a routine period, and was appropriate to obtain a robust dataset.

45. In total:

    (a) 4,987 invertebrates from 259 taxa in 24 Orders were collected in malaise traps:

        (i) Diptera, Hymenoptera and Coleoptera were the most abundant and species-rich Orders caught (excluding the Orders that were too small and/or too numerous to count);

        (ii) the majority (95%) of taxa found were native and were from a variety of trophic guilds;

    (b) 2,391 invertebrates (excluding groups that were not counted), comprising 172 taxa from 21 Orders were captured in pitfall traps:

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[11] Larivière, pers. comm., 2017

[12] Particularly in the Mangapepeke Valley, as noted in the Assessment of Ecological Effects – Vegetation (Technical Report 7a, Volume 3 of the AEE) and in Mr Singers' evidence.

(i) Coleoptera, Hymenoptera, Amphipoda, and Diperta were the most abundant Orders counted, with Coleoptera being the most species-rich group (87);

(ii) native taxa from a variety of trophic groups dominated (94%) the pitfall trap samples collected;

(c) 39 native earthworms representing 8 species, 18 introduced earthworms representing five species, as well 11 specimens that were not identifiable due to sampling damage or being too juvenile were collected. Of the native earthworms collected, three likely represent new species, one is classed as “Data Deficient” and four are considered “Not Threatened”.

*Fly species*

46. Four species of fly, all caught as singletons or doubles, were found in the malaise traps and are noteworthy:

(a) *Chelipoda n.sp,* a new species. This specimen is the only known specimen of this species;[13]

(b) G*ondwanamyia zealandica*, in the genus of minute flies that was only very recently recognised. There are two known species, one in Chile and the other in New Zealand. The single specimen found within the Project footprint is only the second record for the New Zealand species;[14]

(c) *Parentia whirinaki*, a Dolichopodid fly that is predacious. This species is known from two specimens collected in Whirinaki Forest and has a New Zealand Threat Classification as ‘Naturally Uncommon’;[15] and

(d) *Zealantha thorpei*, an Anthomyzid fly whose larvae live in grasses or sedges. This species is listed in the New Zealand Threat Classification as ‘Naturally Uncommon’. It is known from the North Island and northern South Island and more recently it has been found to be very common in suburban Auckland so it is likely that its threat classification will be revised.

*Peripatus*

47. Two important taxa found in the pitfall traps were *Peripatoides suteri* and *Peripatoides novaezealandiae*. These species are live bearing (ovoviviparous), with *P. suteri* having 16 pairs of legs, while *P. novaezealandiae* has 15 pairs of legs.

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[13] A single specimen from samples collected from the Project footprint is quite unlike anything recorded before, and so almost certainly represents a new species.
[14] The first specimen was found in native forest near Auckland.
[15] Andrew et al. (2012).

48. One specimen of *P. suteri* was found at Invertebrate plot 3 in nikau-dominated vegetation (see Figure 1A), while another specimen was found at Invertebrate plot 10 in modified kānuka-pasture vegetation (see Figure 1B). *Peripatoides suteri* is found in Taranaki, Coromandel, Whakapapa, and the Waitakere Ranges.[16] It is only known from a few sites within native forests in Taranaki. This species is listed as 'Vulnerable' on the IUCN Red List of Threatened Species.

49. A smaller specimen of *P. novaezealandiae* was also found at Invertebrate plot 10.

50. Peripatus inhabit damp environments within and beneath logs and leaf litter,[17] and can reach quite high densities even though they have a very restricted distribution.[18]

51. The presence of peripatus in such modified kanuka-pasture habitat present within invertebrate plot 10 is intriguing. Peripatus have been found in marginal habitats, such as in logs in tussock grassland and exotic plantations, and under rocks near glaciers elsewhere in New Zealand.[19]

## EFFECTS ASSESSMENT INCLUDING MITIGATION, OFFSETTING AND MONITORING

52. The invertebrate survey from within the Project footprint found a diverse invertebrate fauna, dominated by native taxa, from a range of trophic groups. It is encouraging that the invertebrate fauna sampled along the proposed realignment were dominated by native taxa. This indicates that these habitats are useful for native invertebrate conservation and that the invertebrate communities of these habitats, even within highly modified forest, have a high resistance to invasion.[20]

53. It is expected that 31.676 ha of indigenous vegetation (forest and secondary scrub) will be loss with construction of the Project.

### "Unmitigated" effects assessment under EcIA guidelines

54. The Invertebrates Report and Supplementary Invertebrates Report set out the process and reasoning I followed in determining the overall potential magnitude of "unmitigated" effect of the Project on terrestrial invertebrates, in line with the EcIA guidelines. By way of summary:

    (a) I have assessed the terrestrial invertebrate community values within the wider Project area as 'High', noting that:

[16] Department of Conservation 2014
[17] Department of Conservation 2014
[18] Gleeson, pers. comm. 2018
[19] see references in Department of Conservation (2014)
[20] Watts et al. (2014) also found very few (1.1%) introduced beetle species in the fenced sanctuary Zealandia in Wellington city despite its urban location.

(i) a small number of 'threatened' or 'at risk' species are known to be present following the field assessment work (for example, *P. suteri*), while other high value species may also be present (but have not been actively identified);

(ii) the amount of forest that will be lost through the Project (19.712 ha) is less than 1% of the habitat in the wider Project area (ca 4,430 ha);

(iii) due to a lack of pest and stock animal control, the ecological condition of the forest in the Project footprint is poorer, with fewer palatable species for invertebrates, than Parininihi (to the west of SH3);

(iv) the invertebrate fauna is generally typical of those in inhabiting native forests of the southern North Island and northern South Island;

(b) I have assessed the magnitude of unmitigated effects on terrestrial invertebrate community values as 'Low' to 'Moderate', noting that:

(i) the main effects arise during construction, and are:

(1) the possible introduction of new, including exotic, invertebrates during construction (discussed further below);

(2) direct mortality of invertebrates during vegetation clearance and/or earthworks;

(3) habitat loss, modification and disturbance (through earthworks and vegetation clearance);

(4) habitat degradation through edge effects; and

(5) habitat severance / fragmentation;

(ii) while previous studies suggest loss of vegetation will impact on beetle communities, again, the amount of native forest habitat that will be lost is less than 1% of the forest habitat in the wider Project area. This is unlikely to compromise the sustainability of terrestrial invertebrate populations;

(iii) the native vegetation within the Project footprint has already been fragmented, meaning the effects of additional small areas of fragmentation are likely to be insignificant;

(iv) edge effects are likely already having pronounced effects on invertebrate communities along the SH3 margins;

(c) the 'value' and 'magnitude' assessments lead to an overall level of effects assessment of 'High' under the EcIA guidelines; and

(d) this is a conservative, precautionary assessment. It takes a conservative approach to what constitutes a 'moderate' loss or alteration of baseline conditions, and of the possibility that there will be a 'moderate' loss of known populations and ranges of relevant species. I note also that it is likely that the taxa most affected by mammalian predation are already extinct in the Mt Messenger area.

55. In practice, I consider it likely the true level of overall unmitigated effects would be 'Low' to 'Moderate'. In any event, a range of mitigation and offset measures that will benefit invertebrates are proposed, as discussed below.

**Measures to avoid, mitigate and offset potential effects on invertebrates**

56. A range of measures to avoid, minimise, mitigate and offset potential effects on terrestrial invertebrates have been put in place or are proposed for the Project. These measures include:

(a) measures that avoid effects through Project route selection and design;

(b) measures that specifically target invertebrates; and

(c) the broader pest control, habitat enhancement and restoration planting measures proposed to mitigate and offset the overall effects of the Project on ecological values.

57. Mr Roger MacGibbon discusses the measures proposed to address the effects of the Project on ecological values in his evidence. I discuss those measures as they relate to invertebrates below.

*Avoiding effects through route selection and design*

58. The options considered for the Project included alignments to the west of SH3 which would have resulted in adverse effects including the loss of more significant habitats, severance of a nationally important vegetation sequence and effects on associated regionally and nationally significant flora. Overall, the selection of the current Project footprint has meant effects on invertebrates within the higher quality Parininihi forest have been avoided

59. Moreover, half of the options considered for the Project in 2017 excluded the use of structures (bridges and tunnels) and instead had large cuts and fills, which would have resulted in considerably more significant ecological effects through both habitat loss and potential effects on native fauna.

60. The design of the Project has helped reduce effects on ecological values (including on invertebrate habitat values), most obviously through the inclusion of the tunnel and the bridge over the high-value Mimi Valley swamp forest. As discussed by Mr MacGibbon and Mr Kenneth Boam, other iterative

adjustments have been made to the design of the Project, and the Project footprint, following the input of Project ecologists in order to reduce the impact of the Project on ecological values.

*Measures that specifically target invertebrates*

61. A number of measures are proposed specifically to address effects on invertebrates, including:

    (a) targeted pest management during construction; and

    (b) a Peripatus Management Plan.

62. These measures are discussed below.

Managing pests during construction

63. Introduction of new, possibly exotic, invertebrate taxa not currently known from the Mt Messenger area could occur during the construction phase, especially when vehicles are coming onto the site for the first time. For example, an overseas study suggests that the probability of introduced earthworm invasions is significantly increased with the occurrence of road construction.[21]

64. The risk of pest invertebrate introductions will be managed by measures outlined in the ELMP and Construction Environmental Management Plan ("**CEMP**"). These measures include ensuring construction vehicles are cleaned between jobs as far as practicable as a requirement under the CEMP.[22]

65. There is also a risk of pest invertebrates being introduced to the site via nursery planting stock used for habitat enhancement. For example, Argentine ants (*Linepithema humile*) pose a threat to native invertebrates and other fauna at Mt Messenger. Accordingly, under the Biosecurity Plan chapter to the ELMP, all potting mix, imported fill, mulch and topsoil will be inspected for Argentine ants prior to importation to site.[23]

66. Together, these measures appropriately address the risk of pests affecting invertebrate values during construction.

Peripatus effects and management

67. The potential effects of the construction and operation of the Project on peripatus are:

    (a) direct mortality of peripatus during vegetation clearance and/or earthworks;

    (b) habitat loss; and

[21] Cameron et al. 2007
[22] Purdy R. Draft Construction Environmental Management Plan.
[23] MacGibbon R. Biosecurity Plan. Chapter 11, ELMP

(c) habitat modification and disturbance.

68. Due to these potential effects of the Project on peripatus and their habitat, and given the threat status of *P. suteri*, a Peripatus Management Plan has been prepared as Chapter 10 to the draft ELMP. The Peripatus Management Plan requires the following key steps to be taken to address potential effects of the Project on peripatus:

(a) pre-construction habitat assessment;

(b) translocation of peripatus found in the Project footprint to a safer, appropriate location adjacent to the Project footprint; and

(c) the relocation to that translocation area of peripatus habitat elements.

69. As discussed above, the presence of *P. suteri* in the highly modified kanuka-pasture habitat of Invertebrate plot 10 is intriguing. While the management plan proposes translocation of peripatus and their habitat from within the Project footprint, finding them in such modified habitats suggests they can tolerate such habitats.[24]

70. The Peripatus Management Plan draws on the experience gained through the Caversham Valley SH1 widening project in Dunedin. Translocation of *P. novaezealandiae* in their woody habitat, translocation of individual animals, and creation of new woody material were the main mitigation actions undertaken to compensate for the removal of 0.5 ha of peripatus habitat required (MacGibbon 2012).

71. I am the co-author of the Peripatus Management Plan, and consider it appropriate in addressing the potential effects of the Project on peripatus.

72. In addition to actions outlined in the Peripatus Management Plan, finding peripatus within the Project footprint reiterates the importance of 'recycling' habitat elements such as logs as during vegetation clearance.[25] These logs represent vital habitat for peripatus and other invertebrates and could be placed into existing forest or into roadside areas that are being replanted after construction. As discussed below, habitat recycling is proposed for the Project under Section 4 of the Landscape and Vegetation Management Plan of the ELMP.

**The broader ecological mitigation and offsetting programme**

73. Mr MacGibbon discusses the broad ecological mitigation and offsetting programme for the Project, designed to achieve no net loss in biodiversity 10 years following construction, and a net gain in biodiversity by year 15. The actions proposed are set out in the ELMP.

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[24] Peripatus have been found in marginal habitats, such as in logs in tussock grassland and exotic plantations, and under rocks near glaciers elsewhere in New Zealand (see references in Department of Conservation 2014).
[25] Corinne Watts and Liz Deakin. Peripatus management plan. Chapter 10, ELMP.

74. I expect this programme will have beneficial effects for terrestrial invertebrates, through pest management, restoration plantings, and habitat enhancements.

75. As there is a strong correlation between invertebrate assemblages and habitat structure, enhancements to habitat quality will benefit invertebrates. I support the mitigation and offset package which has been proposed, which in my opinion represents a sound and appropriate response to the effects of vegetation removal potentially affecting the terrestrial invertebrate communities during construction activities.

*Pest management*

76. Predation of New Zealand's native invertebrate fauna by introduced mammals has been widely recognised as a major conservation concern.[26]

77. Invertebrates are frequently reported in the diet of invasive mammals.[27] The eradication or control of mammals (particularly rodents) have resulted in varied responses from invertebrate communities including altered invertebrate abundance,[28] species richness,[29] and behaviour.[30] Some invertebrates, however, have shown no response to mammal control.[31]

78. These studies illustrate that the interactions between reducing mammal densities and resident invertebrate populations can be complicated and complex to predict. For example, the removal of mammal pests is likely to increase insectivorous bird species, therefore significant increases in the abundance of invertebrates should not always be expected,[32] although populations of large-bodied invertebrates may increase.[33] It is likely that the taxa most affected by mammals, and which would contribute most to community-level changes following mammal control, are already extinct in the Mt Messenger area, and on mainland New Zealand generally.

79. In addition to the complexity of food-web dynamics, a lack of studies examining the impacts of mammal control or eradication on invertebrate populations in New Zealand hampers predictive scenarios for many invertebrate taxa.

80. Nevertheless, I support the extensive pest management programme proposed for the Project. There is a clear link between the health of vegetation communities, and the health of invertebrate communities. The pest management programme will lead to significant enhancement of the health of

[26] Buckley et al. 2012; Leschen et al. 2012; Mahlfeld et al. 2012; Sirvid et al. 2012; Stringer et al. 2012; Trewick et al. 2012.
[27] see references in Innes et al. 2010.
[28] Green 2002; Watts et al. 2011, 2014.
[29] Sinclair et al. 2005.
[30] Rufaut & Gibbs 2003; Watts et al. 2011.
[31] Craddock 1997; Van Aarde et al. 2004; Sinclair et al. 2005; Rate 2009.
[32] Sinclair et al. 2005; Watts et al. 2014.
[33] Watts et al. 2011; Byrom et al. 2016.

the vegetation communities in the area subject to management. That is expected, in turn, to lead to benefits for invertebrate communities.

*Restoration plantings and habitat enhancements*

81. As noted above, there will be value to the invertebrate community in replanting cuts, fills, and other disturbed areas with native plants along the Project footprint to reduce edge effects, especially to restore forest floor litter communities. The recovery of native invertebrate communities in restored sites is considerably accelerated, and will eventually become similar to mature forests when areas are actively replanted with native plants.[34]

82. Recycling habitat elements, such as logs as forests are cleared, assists the recovery of invertebrate populations.[35] These logs represent important habitat for invertebrates and could be placed into existing forest or into roadside areas that are being replanted after construction. Direct transfer of habitat, the salvage and replacement of intact 'sods' of vegetation together with underlying soil, minimises soil disturbance, and allows the transfer of reasonably intact ecological communities.

83. A critical component for fast rehabilitation of invertebrates is the salvage and immediate reuse of living profiles with intact plant / soil sods and mulching of wood, as this can conserve plants, poorly-dispersing invertebrates and complex mycorrhizal interactions.[36] This is provided for in Section 4 of the Landscape and Vegetation Management Plan of the ELMP.

**Post-construction monitoring**

84. Interpreting changes in the invertebrate community after management manipulation is difficult, as both the abiotic and biotic factors affecting the fauna are complex, and such interactions within ecosystems are poorly understood.[37] It is therefore recommended that invertebrates do not need to be monitored in the mitigation and biodiversity offset site(s) (including the Pest Management Area discussed by Mr MacGibbon). Any such monitoring would likely be of little real benefit.

85. Nor is post-construction monitoring necessary to address effects arising from the Project. I note that it is appropriate and reasonable to assume that the general level of benefits for invertebrates will accrue from the proposed pest management programme, restoration planting, and habitat enhancement. Through these efforts, along with the specific actions targeted at invertebrates discussed above, I expect that there will ultimately be no net loss (and most likely a net benefit) for terrestrial invertebrates affected by the Project.

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[34] Reay & Norton 1999.
[35] Brennan et al. 2005.
[36] Simcock et al. 1999; Watts et al. 2008; Boyer et al 2011; Simcock and Ross 2017.
[37] Watts et al. 2014.

**Conclusion on effects**

86. 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 including:

    (a) selection of a route option that avoids the generally higher ecological value land to the west of the existing SH3;

    (b) use of structures (a tunnel and a bridge) as well as other design refinements to minimise habitat loss and severance;

    (c) a robust understanding of effects through detailed desktop and field assessments;

    (d) pest management during construction; and

    (e) a Peripatus Management Plan.

87. The broader mitigation and offset programme for the Project (including the pest management area, restoration plantings and habitat enhancement) will also benefit invertebrates.

88. In summary, I consider that any effects of the Project on terrestrial invertebrates are likely to be negligible in the medium term.

**RESPONSE TO SUBMISSIONS AND SECTION 42A REPORT ON TERRESTRIAL INVERTEBRATES**

89. I respond below to terrestrial invertebrate issues raised in submissions on the Project and in the District Council Section 42A report on the Project.

**DOC submission**

90. DOC's submission includes a section headlined "invertebrate effects".[38] I would like to acknowledge the submissions points that provide:

    (a) DOC supports the assessment methodology employed (to date) in respect of invertebrates; and

    (b) DOC supports the proposal to address the potential for exotic invertebrates being establishing during construction. As discussed above, actions to that end are required under the draft ELMP (and therefore the proposed conditions).

91. The remainder of DOC's submission on invertebrates addresses two broad points:

[38] Paragraph 9 of the DOC submission.

(a) DOC seeks monitoring of invertebrates during and post construction to detect potential invasion events;

(b) DOC queries my view (expressed in the Invertebrates Report) that the mitigation and offset measures proposed will ensure any residual effects on terrestrial invertebrates are adequately addressed, and/or will benefit the general health of terrestrial invertebrate communities, with DOC noting:

(i) the complexity of ecosystems and species present, the risks associated with some of the proposed activities, and the need to demonstrate the no net loss goal of offsetting;

(ii) that there is a risk to invertebrates arising from sedimentation that needs to be managed through erosion and sediment controls; and

(iii) that pest management may lead to mouse plagues, and therefore unintended consequences for invertebrates.

92. My responses to these submission points are as follows.

*Monitoring*

93. I agree that minimising the likelihood of exotic invertebrates establishing in the area due to the Project is important. As discussed above, there are measures proposed to mitigate the risk of exotic invertebrate invasion during construction. I consider those measures appropriately address that risk, and that monitoring is not necessary.

94. In any event, I do not consider such monitoring would be effective in identifying any effects arising from the Project. Apart from the invertebrate survey carried out in October to December 2017 for this Project, there have been no other surveys of the invertebrate fauna at Mt Messenger. If an exotic taxa were to be found within the Project area during and post–construction in the survey suggested, it would be very difficult to determine whether it had:

(a) invaded the area due to activities related to the Project (e.g. associated with dirty earth-moving vehicles); or

(b) arrived in the area under their own dispersal ability and possibly been present for a time but undetected.

95. Therefore, I am of the view that during and post-construction monitoring would have little benefit. Actions to prevent the introduction of invasive invertebrate species, such as Argentine ants, are outlined in Chapter 11 of the ELMP. I support those actions.

*Mitigation and offsetting*

96. As discussed above, I consider that the specific, targeted actions for addressing effects on invertebrates, together with the broader mitigation and offsetting programme proposed for the Project, will mean any effects on terrestrial invertebrates are likely to be negligible in the medium term. I have taken into account the nature of the local environment in arriving at that assessment (as discussed through my evidence and in the technical reports). In terms of sedimentation risks, I note that overall there will be a relatively small earthworks footprint. Total earthworks for the Project equate to approximately 36 ha with approximately 25 ha in the Tongaporutu Catchment and 11 ha in the Mimi Catchment. These areas of earthworks are 0.12% and 0.09% of the catchment area as a whole respectively. On a subcatchment basis the project earthworks equate to 7.4% of the total area immediately upstream of the Project in the Tongaporutu Catchment and equate to 1.2% of the total area immediately upstream of the Project in the Mimi Catchment.

97. In addition, the ecology of the Mangapekpeke Stream valley is accustomed to frequent flooding and sediment deposition. Water quality sampling has found high concentrations of suspended sediment and settlable sediment during flood events, and sedimentation is obvious on the stream bed and on the flood banks along the Mangapepeke Stream (refer to Mr Keith Hamill's evidence). Mr Singers describes in his evidence that recent silt deposition from flooding is common and likely also limits ground vegetation coverage. Mr Graeme Ridley’s evidence describes erosion and sediment control measures.

98. Specific risks with the slope and also the flood plain and environments such as the kahikatea wetland to the south of the tunnel portal have been recognised and are being addressed in the Construction Water Management Plan and Specific Construction Water Management Plans. In this respect I rely on the evidence of Mr Ridley, who concludes that a range of erosion and sediment control measures to minimise sediment generation and yield from the Project. Additionally, a monitoring programme (referred to as the Construction Water Discharges Monitoring Programme) will be implemented during construction of the Project to monitor sediment discharges to the immediate stream environments following rainfall events. Based on these results, the need for improvements or further treatment measures will be assessed.

99. I acknowledge that mice could potentially be an issue for invertebrates within the Project footprint when other mammals are controlled. This issue is discussed in more detail by Mr MacGibbon.

100. Therefore, mouse control could be a desirable management regime for invertebrates from an ecological perspective. However, whether it is physically possible to undertake effective mouse control at Mt Messenger is an issue. As we know from Maungatautari Ecological Island and other mainland sites (mainly fenced sanctuaries), the procedure for effective mouse

control has not yet been found for lager areas. In addition, the terrain at Mt Messenger is too steep and difficult to negotiate to establish a ground based bait station grid that would effectively control mice.

101. That notwithstanding, I reiterate the points I have expressed above, namely that:

(a) there is a clear link between the health of vegetation communities, and the health of invertebrate communities;

(b) the pest management programme (that is, with no specific mouse control element) will lead to significant enhancement of the health of the vegetation communities in the area subject to management; and

(c) that is expected, in turn, to lead to benefits for invertebrate communities.

**Forest and Bird submission**

102. Forest and Bird's submission expressed concern that the diversity of macroinvertebrate species that may be present in the catchments were not adequately measured. They requested that a survey of adult macroinvertebrates be undertaken to assess biodiversity values in the catchments.

103. I consider these gaps have been addressed in the terrestrial invertebrate monitoring, as malaise traps collected the adults of taxa that have larval stages in freshwater. Mr Brian Smith (Freshwater Biologist, NIWA, Hamilton) identified the adults of freshwater taxa collected using malaise traps within the Project footprint.

104. A total of 26 individuals from three Orders (Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies)) were collected in five malaise traps (see **Appendix 1**). Eleven aquatic insect species were identified, including two taxa that had a threat classification. These were:

(a) *Alloecentrella incisus*, a small Helicophidae caddisfly. It is considered '*Range Restricted'* but Mt Messenger is within its known distribution range.

(b) *Spaniocercoides watti*, a stonefly that is classified as 'Data Deficient' by Grainger et al (2014); this is the most southern record for the species.

105. The presence of these species does not change the overall terrestrial invertebrate community values or effects assessment undertaken using the EcIA approach.

106. I attach Mr Smith's memorandum on this matter as **Appendix 1** to my evidence.

**District Council Section 42A Report**

107. The District Council's Section 42A Report (relying on input from Wildlands) raises the following concerns in respect of invertebrates:

(a) Lepidoptera (butterflies and moths) are closely associated with vegetation of different community types, and they can contribute significant biodiversity in the Project area. No targeted surveys of Lepidoptera, including forest ringlet, were undertaken; and

(b) *Vespula* and *Polistes* wasps should be controlled in the proposed Pest Management Area to address the adverse effects of the new forest edge and general forest disturbance.

108. My responses to these points are outlined below.

109. No Lepidopterists were available to carry out a targeted survey within the timeframes of the Project. However, Lepidoptera were common (424 specimens from six species) in the malaise traps so some sampling did occur. During fieldwork within the Project footprint, eight *Gahnia* plants were searched. However, no sign of adult or larvae activity were detected. The forest ringlet is now largely confined to altitudes above 500 m asl, therefore it is unlikely to be present in the vicinity of the Project footprint, noting that the highest point within the Project footprint is approximately 180 m asl, and that the tihi (summit) of Mt Messenger itself is 306 m asl. This position was agreed in formal meetings with the Wildlands invertebrate ecologist (Brian Patrick).

110. New Zealand has no native species of social wasps, but five introduced species have established. Two of these are *Vespula* species (German and common wasps) that typically nest underground inside and outside the forest with a single colony containing thousands (sometimes tens of thousands) of individuals at the peak of the season (later summer-Autumn). *Vespula* wasps have been shown to have predation and competitive effects on some native invertebrate species when their densities are above an ‘ecological damage threshold’ in honeybee beech forests of the South Island.[39] If this occurs, then benefits from integrated mammalian pest control can be eroded.

111. There is some uncertainty of their impact on native invertebrate taxa inhabiting forests of the North Island. However, there is potential for an effect from wasp numbers increasing as they are strong flyers and can be attracted to disturbance and human activity, and will favour flying along forest edges. The net increase in forest edge as a result of the Project is 3845 m.

112. To address any adverse effects of the creation of this new forest edge and general forest disturbance as a result of the road, monitoring and response strategies for *Vespula* wasps along the new road margins could be

[39] Beggs and Rees 1999.

considered.  This is now appropriately provided for in the updated ELMP attached to Mr Peter Roan's evidence.

113. Paper wasps (*Polistes* species) favour more open, sunny habitats on forest margins and shrublands, and are known not to nest under forest canopy. Paper wasp nests are smaller (up to a few hundred individuals at most) and attached to shrubs, grasses and flax leaves.  *Polistes* wasps are only attracted to living proteins (e.g. live caterpillars), so cannot be controlled with current bait products.  The only effective control to date is to destroy nests when found.  I do not consider the monitoring and further control of *Polistes* wasps to be warranted because their colonies, and therefore their likely impact on the invertebrate community, are not as large as *Vespula* wasps and there is no other effective control known.  If nests are found accidentally then they will be destroyed.

**Corinne Watts**

**25 May 2018**

## **APPENDIX 1**:

**Memorandum of Mr Smith to me re aquatic insects captured in malaise traps**