BEFORE AN INDEPENDENT HEARING COMMISSIONER FOR WAITOMO DISTRICT COUNCIL

IN THE MATTER	of the Resource Management Act 1991 (the **RMA**)
AND	
IN THE MATTER	of an application by Taumatatotara Wind Farm Limited to change conditions of a land use consent for the Taumatatotara Wind Farm

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Evidence of Moira Anne Pryde (Bat Ecology)
for the Director-General of Conservation
Dated 8 November 2023

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Introduction

1. My full name is Moira Anne Pryde.

2. I have been asked by the Director-General of Conservation *Tumaki Ahurei* (**DGC**) to provide ecological evidence on the potential effects on bats of the proposal by Taumatatotara Wind Farm Limited (**Applicant**) to vary the conditions of its unimplemented windfarm resource consent to:

    a. Reduce the number of turbines from 22 to 8;

    b. Increase the maximum diameter of the rotor area from 111.5 m to 163 m; and

    c. Increase the tip height of the turbines from 121.5 m to 180.5 m.

Qualifications and experience

3. I am a Technical Advisor in the Ecosystems and Species Unit with the Department of Conservation (DOC).

4. I hold a Post-Graduate Diploma in Wildlife Management in Ecology from Otago University, Dunedin (2001) and a Resource Studies degree from Lincoln University, Christchurch (1996).

5. I have been employed by the Department of Conservation (DOC) since 1997.

6. I have considerable experience relevant to assessing this application including 20 years continuous experience of working with bats in New Zealand. I have extensive direct experience of radio-tracking; studying movements, survival of bats and finding roosts in native forests and fragmented habitats for example Eglinton (Fiordland) Grand Canyon (Waikato), Hanging Rock in South Canterbury and Whirinaki (Whakatane).

7. I have evaluated the significance of bats and potential impacts of development schemes in various cases including Amberfield housing development, Peacocke Structure Plan, roading projects and power schemes.

8. I obtained a permanent job with DOC in 2005 as a wildlife researcher. My work has involved active research and management of threatened species

as well as an advisory role where I comment as a bat expert on DOC permissions and Resource Management Act matters as well as giving advice to DOC operations staff and externals on monitoring birds and bats.

9. My role with DOC is wide ranging but has largely focused on forest birds and bats and the impacts predators have on these fauna as developing conservation recommendations to reverse population declines. An example is in the Eglinton Valley where we have been monitoring kākā, robins, bats and morepork.

10. The Eglinton Valley is a long-term study site in southern Fiordland that has been running since 1993. Various management methods have been applied involving predator control by trapping, bait stations and aerial 1080 operations. Outcome monitoring looks at endemic species abundance and survival. I analyse long-tailed bat data for this project to identify survival and population changes. I was also involved in the Canterbury (Hanging Rock) and Waikato (Grand Canyon) projects where we compared bat survival with the Eglinton data.

11. I belong to the Natural Heritage Group for Bats that advise on bat research in New Zealand.

12. I have been assessed as an E band trainer by the Department of Conservation Bat Recovery Group which means I am highly competent to catch, handle and mark bats as well as undertake survey and monitoring. This qualification also allows me to train others.

13. I run the National Database for the distribution of bats in New Zealand.

14. My current research involves comparing bat acoustic recorder data with mark-recapture studies to develop a low-cost monitoring technique for bats.

15. I have published 11 peer reviewed scientific papers 5 of which are on bats. I have produced management reports and best practice documents for bats in New Zealand.

16. I am familiar with the region having done bat work at Grand Canyon Cave and the surrounding region but have not visited the site.

Code of Conduct

17. I confirm that I have read the code of conduct for expert witnesses as contained in clause 9 of the Environment Court's Practice Note 2023 (the Code). I have complied with the Code when preparing my written statement of evidence.

18. The data, information, facts and assumptions I have considered in forming my opinions are set out in my evidence to follow. The reasons for the opinions expressed are also set out in the evidence to follow. This includes, where relevant:

    a. why other alternative interpretations of data are not supported;

    b. any qualification if my evidence may be incomplete or inaccurate without such qualification;

    c. any knowledge gaps and the potential implication of the knowledge gap;

    d. if my opinion is not firm or concluded because of insufficient research or date or for any other reason;

    e. an assessment of the level of confidence and the likelihood of any outcomes specified in my conclusion.

19. 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 that I express.

Scope of evidence

20. As already noted, I have been asked to provide ecological evidence on the potential effects on bats of the proposal by the Applicant to vary the conditions of its unimplemented windfarm resource consent to:

    a. Reduce the number of turbines from 22 to 8;

    b. Increase the maximum diameter of the rotor area from 111.5 m to 163 m; and

    c. Increase the tip height of the turbines from 121.5 m to 180.5 m.

21. My evidence will provide an ecological overview of general matters relating to bats and wind turbines that are relevant to the variation application. These general matters include:

    a. conservation status;

    b. life cycle and habitat needs;

    c. the potential impact on bats of wind turbines; and

    d. project development and monitoring – best practice.

22. I will then provide further ecological evidence specific to the project site and the proposed variations including:

    a. The presence of bats at the site and the ecological significance of the project site for bats;

    b. The potential effects on bats of the variation proposal;

    c. Comments on the proposed conditions.

23. In preparing my evidence I have relied on the evidence of Elizabeth Williams.

24. I have read the following documents:

    a. The application documents lodged with Waitomo District Council by Taumatatotara Windfarms Limited.

    b. The Council's s42A report by Chris Dawson dated 22 June 2023

    c. The Ecological Technical Report from Dr Leigh Bull dated 12 October 2023 for Waitomo District Council.

    d. Statements of evidence prepared for the Applicant by:

        i. Glenn Starr (Corporate 20 October 2023)

        ii. Simon Chapman (Ecology 23 October 2023)

Executive Summary

25. Long-tailed bats are threatened- nationally critical that is the highest category before extinction.

26. In sites that are not managed for predators, bats are declining between 5-9% per annum.

27. The original application for the Taumatatotara wind farm did not adequately assess the effects on bats.

28. Subsequent variations on the consent assumed there would be negligible effects on bats without doing any survey work.

29. Surveys done in 2021 detected bat activity but there were no follow up surveys to determine how the bats are using the habitat within the project site so that potential adverse effects could be avoided or minimised.

30. The final variations to the consent propose a reduction of 22 turbines to 8, a rotor diameter increase from 111.5 m to 165 m and a turbine tip height increase from 121.5 m to 180.5 m.

31. The applicant considers that because the number of turbines has been reduced and the overall rotor sweep area of all the turbines is smaller than the adverse effects on bats will both minimised and positive.

32. However, this fails to consider that the rotor sweep area of each individual remaining turbine will increase by 114% and the remaining turbines in the north have significant bat activity from the one survey.

33. Without adequate survey work to assess how bats are using the habitat within the project site throughout each season there is a risk that there will be adverse effects on bats and these adverse effects have not been properly quantified or avoided, remedied or mitigated.

34. The level of mitigation required and remaining residual effects cannot be assessed until the initial baseline surveys have been completed.

Conservation Status

35. There are two threatened bat species in New Zealand that may interact with windfarms, the long-tailed bat (*Chalinolobus tuberculatus*) and the lesser short-tailed bat (*Mystacina tuberculata*). Long-tailed bats have been identified at the windfarm site so this evidence is focusing on this species but there is the potential for short-tailed bats to be found on this site.

36. DOC administers the Wildlife Act 1953. Bats are ”absolutely protected” wildlife under this Act.

37. Bats were once common in New Zealand and were regularly seen by early settlers before the 1900's with descriptions of being seen in their "scores", "hundreds" and "thousands" [1]. The range and the numbers of bats have declined significantly since humans arrived, and in many areas continue to decline and are threatened with extinction [2].

38. The long-tailed bat is now assigned to the category most at risk of extinction "Nationally Critical" [3]. This is assessed by a team who predicted a 70% decline over the next three generations of bats based on studies where the rate of decline was much greater in unmanaged populations (5-9% per annum) [4].

39. The central lesser short-tailed bat is classified as at risk- declining[5].

40. Declines in bats in New Zealand result from a combination of threats including habitat loss through land clearance, predation and competition by introduced predators, habitat degradation, fragmentation and disturbance at roosts. Introduced predators including stoats, rats, cats and possums have all been implicated in the decline of bats[6]. In the Eglinton Valley in Fiordland

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[1] O'Donnell CFJ 2000a. Conservation status and causes of decline of the threatened New Zealand Long-tailed Bat *Chalinolobus tuberculatus* (Chiroptera: Vespertilionidae). Mammal Review 30: 89–106.

[2] O'Donnell CFJ, Christie JE, Hitchmough RA, Lloyd B, Parsons S 2010. The conservation status of New Zealand bats, 2009. New Zealand Journal of Zoology 37: 297– 311.
O'Donnell CFJ, Borkin KM, Christie JE, Lloyd B, Parsons S, Hitchmough RA 2018. The conservation status of New Zealand bats, 2018. Department of Conservation, New Zealand Threat Classification Series 21. Department of Conservation, Wellington.
O'Donnell CFJ, Borkin, KM, Christie,J, Davidson-Watts I, Dennis G, Pryde M, Michel P. 2023. Conservation status of bats in Aotearoa New Zealand, 2022. New Zealand Threat Classification Series 41. Department of Conservation, Wellington. 18 p

[3] O'Donnell CFJ, Borkin, KM, Christie,J, Davidson-Watts I, Dennis G, Pryde M, Michel P. 2023. Conservation status of bats in Aotearoa New Zealand, 2022. New Zealand Threat Classification Series 41. Department of Conservation, Wellington. 18 p

[4] Pryde MA, O'Donnell CFJ, Barker RJ 2005. Factors influencing survival and long-term population viability of New Zealand long-tailed bats (*Chalinolobus tuberculatus*): implications for conservation. Biological Conservation 126: 175-185.
Pryde MA, Lettink M, O'Donnell CFJ 2006. Survivorship in two populations of long-tailed bats (*Chalinolobus tuberculatus*) in New Zealand. New Zealand Journal of Zoology 33: 85-89.
O'Donnell CFJ, Pryde MA, van Dam-Bates P, Elliott GP 2017. Controlling invasive predators enhances the long-term survival of endangered New Zealand long-tailed bats (*Chalinolobus tuberculatus*): Implications for conservation of bats on oceanic islands. Biological Conservation 214:156-167

[5] O'Donnell CFJ, Borkin KM, Christie,J, Davidson-Watts I, Dennis G, Pryde M, Michel P. 2023. Conservation status of bats in Aotearoa New Zealand, 2022. New Zealand Threat Classification Series 41. Department of Conservation, Wellington. 18 p

[6] O'Donnell CFJ 2000a. Conservation status and causes of decline of the threatened New Zealand Long-tailed Bat *Chalinolobus tuberculatus* (Chiroptera: Vespertilionidae). Mammal Review 30: 89–106.
O'Donnell CFJ 2000b. Influence of season, habitat, temperature, and invertebrate availability on nocturnal activity by the New Zealand long-tailed bat (*Chalinolobus tuberculatus*). New Zealand Journal of Zoology 27: 207-221.
Pryde MA, O'Donnell CFJ, Barker RJ 2005. Factors influencing survival and long-term population viability of New Zealand long-tailed bats (*Chalinolobus tuberculatus*): implications for conservation. Biological Conservation 126: 175-185.
O'Donnell CFJ, Christie JE, Hitchmough RA, Lloyd B, Parsons S 2010. The conservation status of New Zealand bats, 2009. New Zealand Journal of Zoology 37: 297– 311
Scrimgeour J, Beath A, Swanney M 2012. Cat predation of short-tailed bats (Mystacina tuberculata rhyocobia) in Rangataua Forest, Mount Ruapehu, Central North Island, New Zealand. New Zealand Journal of Zoology 39:257-260.

National Park, the population was declining at 5% per annum due to predators[7], whereas in South Canterbury the population was declining by 9% per annum due to a combination of predators, habitat fragmentation and poor-quality roosts [8].

Life cycle and habitat needs

41. Long-tailed bats have specific requirements in terms of their breeding sites, breeding behaviour, home range and foraging needs. Understanding how the species uses the landscape is extremely important to assess the effects of development projects such as windfarms.

42. Long-tailed bats shelter and breed in roost trees. They tend to select the oldest and largest trees in the landscape for breeding, largely because these are the trees with cavities that are well insulated and will protect the young when the adult females are feeding at night.

43. Long-tailed adult female bats congregate in roost trees in the summer months (November to February) to have their young. Bats form sub-populations known as colonies and these colonies of breeding females form maternity roosts. In other bat studies (e.g., Eglinton) it was found that there was very little mixing between the colonies and bats tended to move roost trees most nights. Colonies were faithful to a roosting area containing a number of roost trees and returned to that area each year[9].

44. The trees and the cavities that bats select to shelter and breed have specific characteristics that are rare in the landscape. In the Eglinton Valley only 1.3% of cavities had optimum characteristics for breeding roosts[10].

45. Long-tailed bat breeding cavities tend to be well insulated compared to other cavities and this provides significant energy conservation benefits. Typically, the temperature of a roost increases throughout the day and reaches a peak

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[7] Pryde MA, O'Donnell CFJ, Barker RJ 2005. Factors influencing survival and long-term population viability of New Zealand long-tailed bats (*Chalinolobus tuberculatus*): implications for conservation. Biological Conservation 126: 175-185.
[8] Pryde MA; Lettink M; O'Donnell CFJ 2006. Survivorship in two populations of long-tailed bats (*Chalinolobus tuberculatus*) in New Zealand. New Zealand Journal of Zoology 33: 85-89.
[9] O'Donnell CFJ 2000e. Cryptic local populations in a temperate rainforest bat *Chalinolobus tuberculatus* in New Zealand. Animal Conservation 3:287-297.
[10] Sedgeley JA; O'Donnell CFJ 1999a. Factors influencing the selection of roost cavities by a temperate rainforest bat (Vespertilionidae: *Chalinolobus tuberculatus*) in New Zealand. Journal of Zoology (London) 249:437–446.

at dusk when the adult females leave the roost. The temperature is retained until the females return at dawn[11].

46. In fragmented habitats such as the Taumatatotara turbine site (discussed further below) high quality roost trees are likely to be rare therefore bats are likely to be using a variety of trees including introduced species. Introduced trees tend to have lower thermal qualities compared to native trees. The trees that the long-tailed bats were using in rural South Canterbury were suboptimal for breeding with poor insulation leading to a low survival of young (24%) compared to the Eglinton Valley where the majority of young survive to fly[12].

47. Where long-tailed bats survive in a rural landscape such as Waikato and in South Canterbury, they often still select the oldest and largest trees available and, in many cases, these are introduced trees. In South Canterbury out of the 221 roosts that have been identified from 1999 to 2018, 63% of roost trees were introduced species including poplars, pines, willows, oak, acacia[13].

48. Roosting areas for colonies in the Eglinton were concentrated in areas ranging from 426-1391 ha per colony[14]. Identifying roosting areas is important for assessing the risk to bats from development projects as whole colonies could be killed if an active roost is felled. Additionally, if turbines are in the direct pathway of bats returning to roosts bats have a higher risk of getting killed.

49. As well as roosting area bats need foraging and socialising habitat to sustain them. The area that an animal uses is known as a home range. Colonies in the Eglinton have large home ranges up to 117 km^2 (11,700 ha) in the

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[11] Sedgeley JA 2001. Quality of cavity micro-climate as a factor influencing maternity roost selection by a tree-dwelling bat, *Chalinolobus tuberculatus*, in New Zealand. Journal of Applied Ecology, 38: 425-438.
[12] Sedgeley JA, O'Donnell CFJ 2004. Roost use by long-tailed bats in South Canterbury: Testing predictions of roost site selection in a highly fragmented landscape. New Zealand Journal of Ecology 28:1-18.
O'Donnell CFJ, Sedgeley JA 2006. Causes and consequences of tree-cavity roosting in a temperate bat, *Chalinolobus tuberculatus*, from New Zealand. Chapter 17 In: Akbar Z, McCracken GF, Kunz TH (eds.). Functional and Evolutionary Ecology of Bats. Oxford University Press, New York
[13] Department of Conservation. Unpublished data
[14] O'Donnell CFJ 2000e. Cryptic local populations in a temperate rainforest bat *Chalinolobus tuberculatus* in New Zealand. Animal Conservation 3:287-297.

breeding season with individuals flying nightly distances of 19 km between roosting and foraging areas[15].

50. Across the home range, individuals spread across the landscape and focus feeding in small clusters of habitats, that they visit every night depending on the age, sex and time of breeding[16].

51. Long-tailed bats are edge feeders and feed efficiently along the edges of forests, shelter belts, woodlots and above the canopy of the trees[17]. Shelter belts can just be a single line of trees but they provide shelter from the wind and darkness so bats can move along the edge without being detected by predators.

52. Recent research has highlighted the importance of open areas including pasture as habitat for bats both for foraging and commuting[18]. In the Eglinton Valley where I have worked for the last 20 years, long-tailed bats travel every night out of Fiordland National Park over farmland down to wetland areas to forage[19].

53. Bats at Grand Canyon Cave in Piopio were identified as eating the grass grub beetle (*Costelytra zealandica*)[20] . The grass grub beetle is found throughout New Zealand in tussock, improved grasslands and cropping areas. The larvae form causes damage to the roots of crops and the emergent beetles eat the leaves. The beetles swarm at dusk in summer potentially providing a good food source for long-tailed bats.

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[15] O'Donnell CFJ 2001. Home range and use of space by *Chalinolobus tuberculatus*, a temperate rainforest bat from New Zealand. Journal of Zoology (London) 253: 253-264

[16] O'Donnell CFJ 2000e. Cryptic local populations in a temperate rainforest bat *Chalinolobus tuberculatus* in New Zealand. Animal Conservation 3:287-297.

[17] Parsons S 2001. Identification of New Zealand bats (*Chalinolobus tuberculatus* and *Mystacina tuberculata*) in flight from analysis of echolocation calls by artificial neural networks. Journal of Zoology 253:447-456.
ODonnell CFJ 2000d Influence of season, habitat, temperature and invertebrate availability on nocturnal activity by the New Zealand long-tailed bat (*Chalinolobus tuberculatus*). New Zealand Journal of Zoology 27: 207-221.
O'Donnell CFJ 2005. Order Chiroptera. In King CM ed. The Handbook of New Zealand Mammals 2nd ed. South Melbourne, Oxford University Press. pp 95-109.

[18] Davidson-Watts Ecology (Pacific) Ltd. 2019. Long-tailed bat trapping and radio tracking baseline report 2018 and 2019. Southern Links, Hamilton. Report for AECOM, Auckland.
Bennett RS 2019. Understanding Movement and Habitat Selection of the Lesser Short-tailed Bat to Infer Potential Encounters with Anticoagulant Bait Masters of Science in Zoology, Massey University, Manawatu, New Zealand

[19] DOC unpublished radiotracking data

[20] Gillingham NJ 1996. The behaviour and ecology of long-tailed bats (Chalinolobus tuberculatus Gray) in the central North Island. Masters of Science, Massey University, Manawatu, New Zealand.

54. Long-tailed bats are long-lived (>20 years) and are slow to reproduce with only one pup a year so effects on breeding can take a long time to become apparent and the bats will take a long time to recover from adverse effects. This means that monitoring has to be long-term and robust.

55. Long-tailed bats are very small, about the size of a mouse with wings and weigh between 10-12 g.

The potential effects to bats from wind turbines

56. Long-tailed bats are vulnerable to death or injury from wind turbines due to collisions with the towers and blades and barotrauma from moving blades. Bats are at risk because (as set out above at paragraphs 51 and 52) they feed and commute in open and forest edge habitats similar to the site habitats that exist at sites proposed for windfarms e.g. Taumatatotara[21].

57. Barotrauma is caused by rapid decompression areas behind the moving blades resulting in internal haemorrhaging of the lungs of bats[22] . Recent literature questions the importance of barotrauma in bat deaths from wind turbines but the fact that significant numbers of bats are killed by wind turbines remains[23].

58. Bats are also potentially attracted to wind turbines out of curiosity as they may provide potential feeding and roosting opportunities[24].

[21] O'Donnell CFJ 2000. Influence of season, habitat, temperature, and invertebrate availability on nocturnal activity by the New Zealand long-tailed bat (*Chalinolobus tuberculatus*). New Zealand Journal of Zoology 27: 207-221.
O'Donnell CFJ, Christie JE, Simpson W 2006. Habitat use and nocturnal activity of lesser short-tailed bats (*Mystacina tuberculata*) in comparison with long-tailed bats (*Chalinolobus tuberculatus*) in temperate rainforest. New Zealand Journal of Zoology 33: 113-124.
Davidson-Watts Ecology (Pacific) Limited 2019. Long-tailed bat trapping and radio tracking baseline report. Southern Links, Hamilton. Report for AECOM, Auckland.
Borkin KM, Parsons S 2011. Home range and habitat selection by a threatened bat in exotic plantation forest. Forest Ecology and Management 262: 845-852.
Bennett R 2019. Understanding movement and habitat selection of the lesser short-tailed bat to infer potential encounters with nearby anticoagulant bait. Master's Thesis. Massey University.
Boffa Miskell Limited 2019. Project Central Wind: Bat monitoring Report-Summer 2019. Report prepared by Boffa Miskell for Meridian Energy Ltd.
[22] Baerwald EF, D'Amours GH, Klug BJ, Barclay RMR 2008. Barotrauma is a significant cause of bat fatalities at wind turbines. Current Biology 18: 695-696.
[23] Lawson M, Jenne D, Thresher R, Houck D, Wimsatt J, Straw B 2020. An investigation into the potential for wind turbines to cause barotrauma in bats.Plos One. https://doi.org/10.1371/journal.pone.0242485
[24] Cryan PM, Barclay RMR 2009. Causes of bat fatalities at wind turbines: hypotheses and predictions. American Society of Mammalogists.

59. Lesser short-tailed bats may also be vulnerable to turbines because, although they prefer old growth forest, they have been recorded flying along forest edges and in open areas[25].

60. Where bats are present, the construction of turbine sites can cause disturbance, direct deaths, injury, displacement through felling of roost trees during the construction of windfarm turbine sites and access roads.

61. There is also likely to be loss and fragmentation of feeding habitat and shelter within windfarm turbine sites and associated access routes.

62. Identifying the key flight paths that bats move through the landscape is essential to project development to minimise the risk to bats.

63. Any severance of habitat connectivity may lead to adverse effects on bats[26]. Wind turbines have the potential to interrupt flyways and kill bats if the turbine is located within a bat flyway.

64. There are also likely to be impacts of construction and long-term operation of turbines (noise, lighting, vibration) on feeding.

Project development and monitoring best practice

65. Wind energy production is going through rapid global expansion in response to climate change and to reduce greenhouse gas emissions. However, there is also a conservation risk to species from these turbines. There is now a wide range of literature from overseas research showing that bats are at risk from wind turbines[27].

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[25] Bennett R 2019. Understanding movement and habitat selection of the lesser short-tailed bat to infer potential encounters with nearby anticoagulant bait. Master's Thesis. Massey University.
O'Donnell CFJ, Christie JE, Simpson W 2006. Habitat use and nocturnal activity of lesser short-tailed bats (*Mystacina tuberculata*) in comparison with long-tailed bats (*Chalinolobus tuberculatus*) in temperate rainforest. New Zealand Journal of Zoology 33: 113-124.
[26] Hale JD, Fairbrass AJ, Matthews TJ, Sadler JP 2012. Habitat composition and connectivity predicts bat presence and activity at foraging sites in a large UK conurbation. PLOS ONE. https://doi.org/10.1371/journal.pone.0033300
[27] Barclay RMR, Baerwald EF, Gruver JC 2007. Variation in bat and bird fatalities at wind energy facilities: assessing the effects of rotor size and tower height. Canadian Journal of Zoology 85: 381-387.
Kunz TH, Arnett EB, Erickson WP, Hoar AR, Johnson GD, Larkin RP, Strickland MD, Thresher RW, Tuttle MD 2007. Ecological impacts of wind energy development on bats: questions, research needs and hypotheses. Frontiers in Ecology and the Environment 5: 315-324.
Cryan PM, Barclay RMR 2009. Causes of bat fatalities at wind turbines: hypotheses and predictions. American Society of Mammalogists.
Rydell J, Bach L, Dubourg-Savage M, Green M, Rodrigues L, Hedenstrom A 2010. Bat mortality at wind turbines in northwestern Europe. Acta Chiropterologica 12(2): 261-274.
Grodsky SM, Behr MJ, Gendler A, Drake D, Dieterle BD, Rudd RJ, Walrath NL 2011. Investigating the causes of death for wind-turbine-associated bat fatalities. Journal of Mammalogy 92: 917-925.

66. At this stage there is no research on windfarms and bats in New Zealand and therefore it is necessary to rely heavily on overseas research in the absence of local research[28]. As bats are using open areas[29] where turbines are being proposed and they roost in trees, it is highly likely they will be at risk from the turbines[30].

Baseline Monitoring

Monitoring actions

67. According to best practice baseline monitoring generally consists of several stages[31]. If the developer does not know if bats are present on the site, the first survey will be to determine if there are bats. The easiest way to record bats is to use an automatic bat monitor (ABM). Bats echolocate at a frequency that is too high for the human ear, so you need specialist electronics that record the signals. The echolocation call is recorded as a file which can be viewed using specialist software. These ABMs can be left for several weeks to record activity, so they are an efficient way to look for bat activity. From these ABM surveys you will gain an idea of the activity in the area. For example, one bat pass in several weeks of surveying may be a lower risk than several bat passes every night.

68. The next stage will be ABM surveys done throughout the year to determine if there are changes in activity over the seasons. Bats use different parts of

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Georgiakakis P, Kret E, Carcamo B, Doutau B, Kafkaletou-Diez A, Vasilakis D, Papadatou E 2012. Bat fatalities at windfarms in North-Eastern Greece. Acta Chiropterologica 14: 459-468.
Roscioni F, Russo D, Di Febbraro M, Frate L, Carrnaza ML, Loy A 2013. Regional scale modelling of the cumulative impact of wind farms on bats. Biodiversity and Conservation 22: 1821-1835.

[28] Rodrigues L, Bach L, Dubourg-Savage MJ, Karapandza B, Kovac D, Kervyn T, Dekker J, Kepel A, Bach P, Collins J, Harbusch C, Park K, Micevski B, Minderman J 2015. Guidelines for consideration of bats in wind farm projects – Revision 2014. Eurobats Publication Series No 6. UNEP/EUROBATS Secretariat, Bonn, Germany.
https://www.bats.org.uk/about-bats/threats-to-bats/wind-farms-and-wind-turbines
Clean Energy Council 2018. Best practice for the Australian Wind Industry
https://assets.cleanenergycouncil.org.au/documents/advocacy-iniatives/community-engagement/wind-best-practice-implementation-guidelines

[29] Bennett R 2019. Understanding movement and habitat selection of the lesser short-tailed bat to infer potential encounters with nearby anticoagulant bait. Master's Thesis. Massey University.
O'Donnell CFJ, Christie JE, Simpson W 2006. Habitat use and nocturnal activity of lesser short-tailed bats (*Mystacina tuberculata*) in comparison with long-tailed bats (*Chalinolobus tuberculatus*) in temperate rainforest. New Zealand Journal of Zoology 33: 113-124.

[30] Arnett E., Baerwald EF, Mathews F, Rodrigues L, Rodrıguez-Duran, A, Rydell J, Villegas-Patraca R, Voigt CC 2016. Impacts of wind energy development on bats: a global perspective.In Bats in the Anthropocene: Conservation of Bats in a Changing World (Springer), pp. 295–323.

[31] Clean Energy Council. Best Practice Guidelines for Implementation of wind energy projects in Australia 2018
https://assets.cleanenergycouncil.org.au
EUROBATS_6_wind turbines_engl_web_neu.pdf

the landscape at different times of the year[32] so if only one survey was done you may miss significant bat activity at other times of the year. Locations of recorders need to cover all proposed turbine sites and the surrounding areas to discover how bats are using the landscape, areas of hotspots and potential flight paths so that these areas can be avoided.

69. Once you have this information you can then decide what further work needs to be done. The tools that are available are more ABM surveys, thermal imaging to observe bats and their behaviour or attaching small transmitters so that you can follow bats to roosts and do all-night radio-tracking to look at flight paths and find roosts. I am aware of several windfarm projects in New Zealand that are currently following this approach in the pre-notification stage.

70. Radio-tracking provides a more robust method of determining how bats use a site. To undertake radio tracking, bats are caught and have transmitters attached and then followed to find the roosts. This type of work is resource intensive, but it provides detailed information on roosts and can be used to determine flight paths of the bats if night-time radio-tracking is done.

71. By doing this kind of study the home range of the colony is determined. Home range is a way of ecologists explaining the size of the habitat that an animal occupies. Radio-tracking is a standard method to determine the location of an animal by attaching a transmitter usually to their back. As bats are very small, the transmitters they carry only have a short battery life, so the data collected is a snapshot in time but provides an indication of how bats use the area. Home ranges include roosting, foraging and socializing areas that may change with season and intensity of use.

Measures in response to baseline monitoring

72. Thorough baseline monitoring provides the best information so that good ecological decisions can be made.

73. Having good baseline monitoring information enables turbines to be sited so as to avoid high activity areas and flight paths and is therefore the best way

[32] O'Donnell CFJ 2000. Cryptic local populations in a temperate rainforest bat *Chalinolobus tuberculatus* in New Zealand. Animal Conservation 3:287-297.
Borkin KM, Parsons S 2011. Home range and habitat selection by a threatened bat in exotic plantation forest. Forest Ecology and Management 262:845-852.

to lower the risk to bats. The avoidance of high activity areas and flight paths should be considered at both the site selection stage and at the site design stage.

74. In addition to decisions around site selection, extensive international research has been carried out into mitigation strategies to minimise the effects of wind turbines on bats. This includes research on ultrasonic deterrents and curtailment.

75. Ultrasonic bat deterrents have had some success in deterring bats, but it is very species specific[33] and there would have to be trials done in New Zealand to test the effectiveness.

76. Overseas research on curtailment of the blades has found that stopping blades spinning at low wind speeds can reduce bat fatalities in the order of c.50 – c.85%[34]. This includes feathering, where the turbine blades are turned to point into the wind to reduce surface area and to slow or stop blade rotation at or below the cut-in speed.

77. Blanket curtailment strategies can mean that the turbines may be inactive when bats are not present so are not an ideal solution for the industry. Research has therefore been done on site specific curtailment strategies based on activity when bats are predicted to be present[35].

78. Curtailment periods can be determined by predicting times when bats will be active using on-site data (temperature, wind speed), or from observations. Environmental variables or bat activity should be measured from, or very

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[33] Cooper D, Green T, Miller M, Rickards E. 2020. Bat Impact Minimization Technology: An Improved Bat Deterrent for the Full Swept Rotor Area of Any Wind Turbine. Frontier Wind LLC, Rocklin, CA (United States).

[34] Arnett E, Schirmacher M, Huso M, Hayes J 2010. Effectiveness of changing wind turbine cut- in speed to reduce bat fatalities at wind facilities 2010. Report by Bat Conservation International. Report for Bats and Wind Energy Cooperative (BWEC).
Adams EM, Gulka J, Williams KA 2021. A review of the effectiveness of operational curtailment for reducing bat fatalities at terrestrial wind farms in North America. PLoS One, 16(11), p.e0256382.
Măntoiu DȘ, Kravchenko K, Lehnert LS, Vlaschenko A, Moldovan OT, Mirea IC, Stanciu RC, Zaharia R, Popescu-Mirceni R, Nistorescu MC, Voigt CC. 2020. Wildlife and infrastructure: impact of wind turbines on bats in the Black Sea coast region. European journal of wildlife research 66(3).
Bennett EM, Florent SN, Venosta M, Gibson M, Jackson A, Stark E. 2022. Curtailment as a successful method for reducing bat mortality at a southern Australian wind farm. Austral Ecology. 2022 Sep;47(6):1329-39.

[35] Adams EM, Gulka J, Williams KA 2021. A review of the effectiveness of operational curtailment for reducing bat fatalities at terrestrial wind farms in North America. PLoS One, 16(11), p.e0256382.
Friedenberg NA, Frick WF 2021. Assessing fatality minimization for hoary bats amid continued wind energy development. *Biological Conservation*, *262*, p.109309.
Voigt CC, Kaiser K, Look S, Scharnweber K, Scholz C 2022. Wind turbines without curtailment produce large numbers of bat fatalities throughout their lifetime: A call against ignorance and neglect. Global Ecology and Conservation 37.

near, every turbine site. Curtailment procedures can then be automated to reduce the time when harm could be caused. Research to date has formulated curtailment times for specific sites and types of turbine and cannot be generalised for use in other places[36].

79. Curtailment periods can also be instigated when bats are known to be present (live-curtailment). This has the advantage of reducing the amount of time that the turbines are not active when bats are not present. This technique is highly reliant on monitoring using bat detectors and the ability to switch the turbine off quickly[37].

Post Construction Monitoring

80. The efficacy of mitigation strategies to reduce harm to bats on windfarms in New Zealand is unknown therefore there needs to robust long-term monitoring.

81. A comprehensive monitoring scheme should focus on activity levels and mortality[38].

Activity level monitoring

82. The acoustic activity during construction of the turbines is important to assess whether the building of turbines causes any disturbance to bats. Once the turbines are operational it is even more important to measure bat activity at nacelle height as this is the area of greatest potential impact. Monitoring should last at least three consecutive years. Data should be standardised using the same detectors with the same sensitivity, at the same location within the nacelle. The data should consider the season, time of night and weather including temperature and wind speed[39].

83. Thermal imaging and infra-red cameras will help to understand how bats are using the turbine areas[40] and should be used along with the detectors.

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[36] Adams EM, Gulka J, Williams KA 2021. A review of the effectiveness of operational curtailment for reducing bat fatalities at terrestrial wind farms in North America. PLoS One, 16(11), p.e0256382.
[37] Rabie PA, Welch-Acosta B, Nasman K, Schumacher S, Gruver J P2022. Efficacy and cost of acoustic informed and wind speed -only turbine curtailment to reduce bat fatalities at a wind energy facility in Wisconsin. Plos One https://doi.org/10.1371/journal.pone.0266500
[38] EUROBATS_6_wind turbines_engl_web_neu.pdf
[39] EUROBATS_6_wind turbines_engl_web_neu.pdf
[40] Horn JW, Arnett EB, Kunz TH 2008. Behavioural responses of bats to operating wind turbines. Journal of Wildlife Management 72: 123- 132.

Mortality monitoring

84. Mortality is the greatest impact to bats from wind turbines. The main method to reduce mortality is curtailment but this may not be 100% effective. Monitoring of mortality is therefore necessary to assess the efficacy of the mitigation strategies.

85. International research shows that the number of carcasses found does not equal the real number of deaths as the count process is biased due to a number of factors including predators/scavengers removing the carcasses, searcher efficiency, type of vegetation under the turbines, time invested in the searches, bats being injured and then flying away to die later[41]. Due to their small size, long-tailed bats will be hard to see if they are killed by wind turbines therefore the search protocols need to be rigorous.

86. Monitoring is therefore recommended in three stages:

a) carcass searches;

b) trials to obtain correcting factors for the bias and

c) following steps 1 and 2, an estimation of true mortality rate.

87. Ideally the area searched should be within a radius equal to the total height of the turbine. In most cases this will be impractical. The Eurobats manual recommends that the radius should not be less than 50m and if possible kept free of vegetation. If the area is a square, then it should be sectioned into 5 m transects with searchers checking 2.5 m on each side. If it is a circle, then searchers can walk in a circle holding a rope 50 m long checking 2.5m each side and then reducing the length of rope by 5 m for each rotation[42]. Depending on the terrain the area searched on each transect may have to be reduced or a trained search dog may be helpful[43]. If the entire area cannot be searched, then there needs to be correction for the final mortality estimate.

[41] EUROBATS_6_wind turbines_engl_web_neu.pdf
[42] EUROBATS_6_wind turbines_engl_web_neu.pdf
[43] Dominguez del Valle J, Cervantes Peralta J, Jaquero Arjona F 2020. Factors affecting carcass detection at windfarms using dogs and human searchers. Journal of Applied Ecology 57: 1926-1935.

88. If possible, every turbine should be monitored or for larger wind farms a sample of turbines could be monitored stratified by habitat.

89. Searches are recommended every 3 days to try and reduce any effect of scavenging.

90. The monitoring should be over the entire activity cycle of the bats (spring,summer and autumn).

91. Carcass removal trials need to be done 4 times a year to estimate the removal of carcasses from scavengers and predators.

92. Searcher efficiency trials need to be done to test the ability to detect the small carcasses. The ability of searchers to detect carcasses will vary with vegetation, season, weather and observer. Carcasses should be randomly placed in the search area and then the searcher should proceed with the normal survey. This will assess the percentage of carcasses that are found by the searcher[44].

93. For example, during a study at the Te Uku windfarm in New Zealand, observers were not able to detect the small carcasses placed on site to test their effectiveness at finding them. No adjustments were made to account for this[45] . This means that the results of the three years monitoring were unreliable.

94. There are different algorithms to estimate bat mortality[46] based on the number of carcasses found and corrected for scavenging and the ability for searchers to find the carcasses.

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[44] Korner-Nievergelt F, Brinkmann R, Niermann I, Behr O 2013. Estimating bat and bird mortality occurring at wind energy turbines from covariates and carcass searches using mixture models. Plos One 8(7).
Korner-Nievergelt F, Behr O, Brinkmann R, Etterson MA, Huso MMP, Dalthorp D, Korner-Nievergelt P, Roth T, Niermann I 2015. Mortality estimation from carcass searches using the R-package carcass – a tutorial. Wildlife Biology 21: 30-43.
Dominguez del Valle J, Cervantes Peralta J, Jaquero Arjona F 2020. Factors affecting carcass detection at windfarms using dogs and human searchers. Journal of Applied Ecology 57: 1926-1935. https://doi.org/10.1111/1365-2664.13714

[45] Boffa Miskell Limited 2019. Project Central Wind: Bat monitoring Report-Summer 2019. Report prepared by Boffa Miskell for Meridian Energy Ltd.

[46] Korner-Nievergelt F, Korner-Nievergelt P, Behr O, Niermann I, Brinkmann R, Hellriegel B. 2011. A new method to determine bird and bat fatality at wind energy turbines from carcass searches. Wildlife Biology 17(4):350-63.
Rydell J, Bach L, Dubourg-Savage MJ, Green M, Rodrigues L, Hedenström A. 2010 Bat mortality at wind turbines in northwestern Europe. Acta Chiropterologica. 12(2):261-74.
Bernardino J, Bispo R, Costa H, Mascarenhas M.2013. Estimating bird and bat fatality at wind farms: a practical overview of estimators, their assumptions and limitations. New Zealand Journal of Zoology 40(1):63-74.

95. The challenges of monitoring the long-tailed bat means that not many carcasses will be found, but any carcasses that are found will be highly significant because this species is threatened nationally critical (i.e. one step away from extinction due to their rate of decline).

The presence of bats at the site

96. Bat surveys were done at the Taumatatotara site by the applicant in February 2021 using 17 standard DOC bat detectors. Two of the recorders failed and out of the 15 working recorders, 12 recorded long –tailed bats (80% detection rate). Pass rates varied from 0-12.7 passes per night. This is what I consider a moderate number of passes rate and does not give any indication of numbers of bats. High activity was found near turbines 1,7 and 11 with a maximum of 12.7 passes per night (total of 253 passes over 19 nights) near turbine 11[47]. No short-tailed bats were detected but they have been recorded 20km from the site, so it is possible they are on the site but have not been detected.

The ecological significance of the project site for bats

97. For the reasons discussed below, as the site contains patches of forests and open pasture that is likely bat habitat and the survey shows that bats are using the site, then the site is bat habitat and therefore significant.

98. I understand from the various descriptions in the Applicant's application documents, the section 42A report and from my knowledge of the general area (see above at paragraph 16) that the Taumatatotara site is within a fragmented rural landscape including a diverse mixture of forest and open areas (including pasture).

99. As described above (particularly paragraphs 44- 53) this type of environment is known to provide opportunities for long tailed bat roosting including trees with holes in them, edges of forest and open areas for foraging.

100. Grand Canyon Cave and the Whareorino Conservation area are within 15 km of the site and have colonies of long-tailed bats. Long tailed bats can easily fly up to 25km a night so the bats using these areas could also be

[47] Ecology Report 10 Aug 21 (Figures 1 and table in section 5.3.1).

using the Taumatatotara site. Alternatively, the Taumatatotara site may have a separate colony of bats.

101. As stated in the previous section, the presence of long tailed bats at the site has been confirmed by the survey work undertaken by the Applicant. At paragraphs 116 and 117 below, I discuss my views on the shortcomings of this survey work, the resulting information gaps and the need for further survey work to be undertaken. While these information gaps exist, it is possible to say with certainty that:

a) long tailed bats are present at the site; and

b) the environment at the site is consistent with bat habitat in that it would provide roosting and foraging opportunities.

102. Accordingly, as long-tailed bats are a threatened - nationally critical species, in my opinion their presence at the project site triggers the significance criteria according to the Waikato Regional Policy Statement (WRPS), Part 5, Appendices, Table 28[48].

> *"Ecological values*
>
> *3.It is vegetation or habitat that is currently habitat for indigenous species or associations of indigenous species that are:*
>
> - *classed as threatened or at risk, or*
> - *endemic to the Waikato region, or*
> - *at the limit of their natural range."*

103. Habitats that support critically threatened species are significant. In areas where long-tailed bats are not managed for predators they are declining at between 5-.9% per annum[49]. The breeding potential of every individual is crucial to minimise incremental loss and the threat of extinction. Therefore, the bats around the Taumatatotara project site are important because of their nationally critical threat status, the rate of decline of the species and the rarity of bats persisting in the rural environment nationally.

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48 RPS2022-Part-5-Appendices.pdf (waikatoregion.govt.nz)

49 Pryde MA, Lettink M, O'Donnell CF. 2006 Survivorship in two populations of long-tailed bats (Chalinolobus tuberculatus) in New Zealand. New Zealand Journal of Zoology 33(2):85-95.

104. As noted, recent bat research has highlighted the importance of fragmented habitat such as pasture and isolated trees for bats commuting and foraging[50] so identifying these flyways is[51]essential for successful bat management.

105. To determine the value of individual trees, clusters of trees, waterways and open areas for long-tailed bats and how bats are using this landscape a far more comprehensive network of survey work would need to be done covering all seasons over all the turbine sites and surrounding area.

106. Best practice would mean this should include the methods described above at paragraphs 67-71, including radio tracking.

107. Maintaining the function and the structural connection of actual and potential roosts and commuting flyways is important for the survival of bats. Turbines have the potential to sever these connections. If these connections are severed then the significance of the habitat will be reduced. Understanding how the bats are using the habitat on the project site as part of their home range and using this knowledge is important for successful management.

The potential effects on bats of the variation proposal

108. I understand that as the applicant has applied to vary the conditions of its existing consent under section 127 of the RMA, this requires an assessment of the effects that is the actual and potential effects on the environment of the change of conditions.

109. In order to assess the actual and potential effects of the change in the conditions, the effects of the original consent must be known.

110. The adverse effects of the wind turbines as proposed by the original application on bats were never assessed by the applicant. In the original application in 2006 for 22 turbines, it was acknowledged that bats were likely to be on-site but no formal surveys were done. It was assumed that bats

[50] Bennett RS 2019. Understanding Movement and Habitat Selection of the Lesser Short-tailed Bat to Infer Potential Encounters with Anticoagulant Bait Masters of Science in Zoology, Massey University, Manawatu, New Zealand.
[51] Berthinussen A, Altringham 2012. Do bat gantries and underpasses help bats cross roads safely? https://doi.org/10.1371/journal.pone.0038775.

could avoid wind turbines due to their ability to echolocate[52]. International research has shown this to be incorrect[53].

111. In 2011 an application was made to increase the height of the 11 northern turbines from 110 to 121.5m. The ecological report states that "*there will be no discernible increase in mortality risk associated with strike for birds or bats*". The risk to bats had never been quantified in the first place. Again, no survey work was undertaken at the time.

112. In 2020 a further application was made to increase the turbine height of the 11 north turbines from 121.5 to 172.5m and increase the rotor diameter from 110 to 155m and delete the southern 11 turbines from the project[54]. It is noted that the southern turbines had some bat activity (in the 2021 survey) and wetland areas that were considered suitable for bat foraging[55].

113. Finally, the updated variation proposal as confirmed in 2023:

    a) removed 3 further turbines (turbines 2, 4 and 9);

    b) increased the height to 180.5 m; and

    c) increased the maximum diameter of the rotor area to 163 m.

114. The final assessment of ecological effects of the turbine changes provided with the application states that any effects are both minimised and positive[56].

115. Without knowing the original effects of the consent, and in light of the matters set out below, to state that the ecological effects are minimised and positive from the variation is inappropriate.

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[52] Kessels & Associates Ltd. 2004. Ecological assessments of proposed wind farms, Taumatatotara West Road, Taharoa. Report prepared for Ventus Energy Ltd, dated 17 December 2004.

[53] Baerwald EF, D'Amours GH, Klug BJ, Barclay RMR 2008. Barotrauma is a significant cause of bat fatalities at wind turbines. Current Biology 18: 695-696.
Cryan PM, Barclay RMR 2009. Causes of bat fatalities at wind turbines: hypotheses and predictions. American Society of Mammalogists.
Barclay RMR, Baerwald EF, Gruver JC 2007. Variation in bat and bird fatalities at wind energy facilities: assessing the effects of rotor size and tower height. Canadian Journal of Zoology 85: 381-387.
Kunz TH, Arnett EB, Erickson WP, Hoar AR, Johnson GD, Larkin RP, Strickland MD, Thresher RW, Tuttle MD 2007. Ecological impacts of wind energy development on bats: questions, research needs and hypotheses. Frontiers in Ecology and the Environment 5: 315-324.

[54] Attachment 7 – Ecology Memorandum

[55] Craig J, Chapman S 2021. Ecological Effects assessment of the existing 22 turbine consented activity plus the proposed tip height variation in response to S92 requests

[56] Chapman S 2020. Taumatatotara T4 wind farm. Ecology New Zealand, Auckland.

Information gaps

116. Lack of information on how the bats are using the wind turbine site makes it very difficult to assess the risk to the bats of the variation proposal.

117. In 2021 in response to S92 requests for further information a bat survey was completed. Bats were detected at 12 out of 15 (80%) detectors. Detection rate per night was between 0-12.7 passes per night. In my experience of surveying around the country – this is a moderate pass rate[57].

118. In a fragmented habitat pass rates can be highly variable and the relationship to actual numbers of bats is unknown. However even with just one survey, significant activity has been detected alerting that more survey work needs to be done.

119. As explained in paragraph 15 above further survey work covering all seasons, at all the proposed turbine sites and the associated areas are required to assess the possible effects on bats.

Comment on specific variations to the consent conditions

120. Under the variation proposal, the height of the turbines will be increased from 121.5 m to 180.5 m.

121. Building high turbines will not resolve the risk of bat-deaths and injury because bats can fly high (>60 m) and may be attracted to higher blades or the tower and nacelle, e.g. to inspect it as a potential roost[58].

122. The turbines heat the air, and invertebrates can be attracted to higher levels[59] and this may in turn attract bats.

[57] Craig J, Chapman S 2021. Ecological Effects assessment of the existing 22 turbine consented activity plus the proposed tip height variation in response to S92 requests
[58] Cryan PM, Barclay RMR 2009. Causes of bat fatalities at wind turbines: hypotheses and predictions. American Society of Mammalogists.
Cryan PM, Gorresen PM, Hein CD, Schirmacher MR, Diehl RH, Huso MM, Hayman DT, Fricker PD, Bonaccorso FJ, Johnson DH 2014. Behaviour of bats at wind turbines PNAS 111 42: 15126-15131.
Horn JW, Arnett EB, Kunz TH 2008. Behavioural responses of bats to operating wind turbines. Journal of Wildlife Management 72: 123- 132.
[59] Cryan PM, Barclay RMR 2009. Causes of bat fatalities at wind turbines: hypotheses and predictions. American Society of Mammalogists.
Cryan PM, Gorresen PM, Hein CD, Schirmacher MR, Diehl RH, Huso MM, Hayman DT, Fricker PD, Bonaccorso FJ, Johnson DH 2014. Behaviour of bats at wind turbines PNAS 111 42: 15126-15131.
Horn JW, Arnett EB, Kunz TH 2008. Behavioural responses of bats to operating wind turbines. Journal of Wildlife Management 72: 123- 132.

123. The air space provides essential habitat for insectivorous bats (e.g., the long-tailed bat) and other aerial wildlife and is likely to change depending on season and habitat[60].

124. Bats do not use air space randomly and males and females use the airspace differently depending on their energetic needs and the times of year[61].

125. Mr Chapman has said in his evidence that it is highly unlikely that bats will be flying at height in windy conditions and therefore they won't be affected by wind turbines[62]. However, it is known that bats can fly well above the canopy of trees that are at least 30 m high. If there is a new structure in the environment, then it is quite possible that bats will be attracted to either the turbines or the associated insects.

126. Under the final variation proposal, the number of turbines will be reduced from 22 to 8 turbines.

127. Reducing the number of turbines will not necessarily reduce the effects on bats especially if the remaining turbines are taller and have a wider rotor area. In this instance the variation proposal means that the height of each turbine is proposed to increase from 121.5m to 180.5m (48.5%). The rotor diameter for each individual turbine would increase from 111.5m to 163m (46%).

128. While the Applicant confirmed in September 2023 that a further 3 turbines (2, 4 and 9) would be removed (in addition to turbines 12 – 22), the turbines with the highest recorded bat activity as detected by the Applicant's survey work (turbines 1, 7 and 11) still remain. As surveys have not covered all seasons then there may be other turbines that will have high activity at other times of year so would represent a further risk to bats.

129. Overall, the statement in the Applicant's evidence (see paragraph 2.6, Chapman; paragraph 2.5 Starr) is correct that the combined rotor sweep area across all of the turbines will decrease (by 14%) due to the reduction in the number of turbines. However, if you look at the individual rotor sweep area

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[60] Davy CM, Squires K, Zimmerling R 2020. Estimation of spatiotemporal trends in bat abundance from mortality data collected at wind turbines. Conservation Biology 35:227-238.
[61] Roeleke M, Blohm T, Kramer-Schadt S, Yovel Y, Voigt CC 2016. Habitat use of bats in relation to wind turbines revealed by GPS tracking. Scientific Report 6 28961. https://doi.org/10.1038/srep28961
[62] Chapman S 2023

of each turbine from 2011 to 2023, there will be a 114% increase in the area covered for each turbine[63]. This means that for any bat that is flying near a turbine there will be a greater chance of being in the rotor sweep area. Therefore, although the number of turbines has decreased along with the combined rotor area, the large increase in the individual turbines that are left has the potential to cause more damage to bats, if they go close to the rotor blades.

130. It will therefore be very important to assess the risk of each turbine and identify if it is within a bat flight path.

Conclusion on the potential effects on bats of the variation

131. In my opinion I disagree with the applicant that any effects on bats will be minimized and positive due to the variation of the consent. Without knowing the original effects of the wind farm, I also cannot say that there will be reduced effects on bats due to the reduction in the number of turbines in light of the increase in height and rotor area.

132. There has not been adequate work to determine how the bats are using the site. The single survey shows high activity at three of the remaining turbines. If turbines are in the flyway of bats, then there is a risk of killing bats.

133. In conclusion there is not enough information to identify the potential effects of the modification of this proposal. The effects are unlikely to be positive especially as there are three turbine sites that have high levels of activity and further survey work may find there is high activity at other sites at different times of the season.

Response to specific points in Mr Chapman's evidence

134. At 4.3.2 Mr Chapman points out the bat species that are affected by the wind turbines are generally migratory and implies that as New Zealand bats are not migratory, they are therefore not at risk from wind turbines. I disagree with this as the risk is due to the bats flying through the turbine site area not because they are migratory. New Zealand long-tailed bats and to some

[63] Williams E, 2023 Evidence in Chief
Starr G, 2023 Evidence in Chief

extent short-tailed bats use open areas and fly long distances each night[64]. If the turbines are situated next to roosting areas or in flight paths the bats will be at risk from the turbines.

135. Mr Chapman also states in 4.31 that the Te Uku wind farm did not show that there were any bat fatalities in the three-year post construction monitoring. As the long-tailed bat is threatened -nationally critical, rare, and very small, it will be difficult to find carcasses. This means monitoring has to be rigorous. The Year 3 annual report for the Te Uku wind farm states that there were carcass detection trials to test the efficiency of the searches. The overall detection rate for the carcasses that had been placed at the site was low (37.5%) and of the "tiny" carcasses (which a bat would be) – the detection rate was 0[65]. The monitoring that was done was therefore inadequate to detect mortality.

136. I refer to the Summary from Mr Chapman section 10.1a where Mr Chapman states that the updated variation removes 13 turbines. My understanding is that 14 turbines are being removed.

137. Mr Chapman states that the level of effects is avoided at the southern end of the wind farm by the removal of turbines 12-22 (sections 10.1a and b). He concludes in section 10.3 that any residual effects from the remaining turbines will be minimised and positive. I disagree with this conclusion as there are three remaining turbines with high activity, the rotor sweep area and the size of the turbines have been increased and there has been insufficient survey work to determine how bats are using the site.

Response to specific points in Dr Bull's evidence

138. I agree with the technical review provided by Dr Bull that outlines at paragraph 16. "there was still insufficient site-specific information to determine the ecological effects of the proposed turbine changes".

139. In paragraph 19, Dr Bull notes that after bat surveys were done in 2021 detecting bats throughout the wind farm, no further studies were done and instead the applicant moved straight to mitigation and compensation

[64] O'Donnell CFJ, Christie JE, Simpson W 2006. Habitat use and nocturnal activity of lesser short-tailed bats (*Mystacina tuberculata*) in comparison with long-tailed bats (*Chalinolobus tuberculatus*) in temperate rainforest. New Zealand Journal of Zoology 33: 113-124.

[65] Boffa Miskell Limited 2014. Project Te Uku Post-construction Avifauna & Bat Monitoring: Year 3 Annual Report. Report prepared by Boffa Miskell Limited for Meridian Energy Limited.

including a bat deterrent and a small area of predator control. Dr Bull states that the conclusions of mitigation and compensation are not supported by the data. I agree with Dr Bull, the presence of bats needs further investigation to assess the effects on the bat population.

140. In paragraph 23 Dr Bull highlights that the applicant's ecologist expected to find high levels of bats in the southern part of the wind farm and yet two of the highest activity areas were in the northern half of the wind farm. I agree with Dr Bull's comment that this highlights the importance of survey work rather than relying on a desk top review or assumptions about suitable habitat.

Comments on the proposed conditions

141. To summarise the points I have made above:

a) I am concerned about the proposed variation in the consent because there is not enough information to assess the adverse effects to bats.

b) As there was no assessment on the adverse effects on bats on the original application, to say there will be a positive effect on bats from the variation is inappropriate.

c) Research into bats and windfarms internationally shows that bats similar to New Zealand species are killed by turbines.

d) Further surveys are required to assess the adverse effects on bats from the variation of the proposal.

e) The variation in the consent results in turbines that are significantly larger than the original consented turbines. If these turbines are placed along a flight path between a roost site and a foraging area, then there will be a risk of killing bats.

142. In the event that the application is granted, I make the following comments about the proposed conditions in so far as they relate to bats.

143. Condition 38 recommends a pre-construction bat survey. There would need to be a comprehensive survey that covers the whole site, over four monitoring sessions between October and April to describe habitat patterns. This would cover all turbine sites and these monitors would be paired with a

non-turbine site. Additional monitors should also be placed at potential flyways.

144. Depending on the results of these surveys more work may be required including thermal imaging or radio-tracking.

145. The results of the pre-construction surveys may result in a re-positioning of the turbine sites.

146. Once the surveys have been completed and the risk of adverse effects to bats is measured then mitigation can be considered.

147. In my opinion high activity sites should trigger mitigation that could be in the form of curtailment. Curtailment has been proven to reduce the number of fatalities of bats.

148. Condition 44A states that automatic bat detectors will be placed at turbines 1,7 and 11 and run for 12 months to give data to analyse with wind speed. It is unclear from this condition what will be the result in collecting this data. Further survey work may require bat detectors at other turbines not just these ones. My recommendation would be to measure bat activity, wind speed and temperature at all turbines. The objective of this would be to assess activity and implement mitigation measures such as curtailment. If curtailment is being used the detectors should be there permanently to detect changes over time. Having detectors in place at the turbines before they are operational means that the bat activity can be assessed before and after the turbines become operational and then assessed over time.

149. Condition 41 recommends a post construction Bat Mortality Monitoring Plan but does not explicitly say for how often the checks are made. Given the problems that the Te Uku wind farm had in finding test small carcasses, the searching needs to be robust and possibly a dog will be required. Best practice is to monitor for 3 years, every 3 days and is outlined in section 15.

150. Condition 42 talks about a significant adverse effect from the mortality monitoring. Any bat death is significant given the small numbers of bats that are left so any bat death would trigger a review of the turbine operation.

151. Condition 44C is for compensation for residual effects. As the effects of the proposal have not been adequately assessed it is unclear what the residual effects will be.

152. Condition 53 – “The consent holder shall avoid the removal of pole stand Rimu where practicable”. If any trees have to be cut down, then the bat tree protocol[66] should be followed.

Moira Pryde

DATED this 8th day of November 2023

[66] doc-bat-roost-protocol-v2-oct-2021.pdf