BEFORE AN EXPERT PANEL
SOUTHLAND WIND FARM PROJECT

Under the	**FAST-TRACK APPROVALS ACT 2024**
In the matter of	an application for resource consents, a concession, wildlife approvals, an archaeological authority and approvals relating to complex freshwater fisheries activities in relation to the Southland Wind Farm project
By	**CONTACT ENERGY LIMITED**
	Applicant

SOUTHLAND WIND FARM
TECHNICAL ASSESSMENT #11: NOISE

MIKLIN HALSTEAD

18 August 2025

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EXECUTIVE SUMMARY

1. The Southland Wind Farm (**Project**) is proposed to be constructed and operated as described by others. I have considered the construction and operational noise effects of the Project and discuss those effects in this document.

2. New Zealand Standard (**NZS**) 6808:2010 provides a suitable noise performance standard for wind farms which has been applied to this assessment. The standard establishes a noise limit for turbine noise of 40 dB L_{A90} or 5 decibels above the existing background noise level (L_{A90}), whichever is the higher.

3. The predicted noise levels from turbine operational activity complies with the limits recommended by NZS6808:2010 at all dwellings external to the wind farm. This is due to the distance between turbines and dwellings – at least 2.3 km separation. This is a larger separation than exists in many wind farms currently operating in New Zealand.

4. Noise levels predicted from other operational activities from the proposed wind farm will comply with the limits in the District Plans' noise provisions.

5. Construction activities will comply with the provisions of NZS6803:1999. A Construction Noise Management Plan will be prepared to address methods of compliance.

6. Conditions are recommended to offer controls over the above matters. The measures proposed to address potential effects are essentially those proposed during the previous COVID-19 (Fast-track Consenting) Act 2020 (**Covid Fast-track**) process for the Project (and which Southland District Council (**SDC**), in particular, was comfortable with).

7. On the basis of this assessment, all noise emissions related to the Project are reasonable.

INTRODUCTION

8. My full name is Michael Miklin Halstead. I am an Associate in the acoustical consulting practice of Marshall Day Acoustics Limited (**MDA**), and manage MDA's Wellington office. I have been engaged to assess the

construction and operational noise effects of the proposed Southland Wind Farm on the surrounding environment.

9. I hold a Bachelor of Engineering from The University of Washington, USA. For the past 38 years I have worked in the field of acoustics, noise measurement and control in USA, France and New Zealand. My work over the past 25 years has included noise control engineering work for various major corporations and city councils within New Zealand. I have previously been engaged as an expert witness before the Environment Court and at council level in relation to this work.

10. I have worked throughout New Zealand on a wide range of acoustic assessment projects, for a wide range of clients. Many projects have involved preparing reports and hearing evidence that address the acoustics effects of proposed developments. I have been involved with major environmental impact assessments for applicants such as Genesis Energy, Meridian Energy, Contact Energy, Mighty River Power, Mercury Energy and Shell Todd Oil Services.

11. As well as Southland Wind Farm I have undertaken assessments of numerous other wind farm proposals including Te Apiti, West Wind, Pohokura, Castle Hill, Te Rere Hau, Kaiwaikawa, Waipipi, Kaiwera Downs, Mt Munro, Huriwaka, Harapaki and Pahiatua wind farms.

12. I was the chairman of the committee to draft NZS 6801:2008 *Acoustics – Measurement of Environmental Sound* and 6802:2008 *Acoustics – Environmental Noise*, and was on the committee to draft NZS 6808:2010 *Acoustics – Wind Farm Noise*, representing the New Zealand Acoustical Society.

Code of conduct

13. I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court Practice Note 2023. This assessment has been prepared in compliance with that Code, as if it were evidence being given in Environment Court proceedings. In particular, unless I state otherwise, this assessment is within my area of expertise and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

Purpose and scope of assessment

14. The purpose of this assessment is to assess the potential effects of the Project on the noise environment, to inform the applications under the Fast-track Approvals Act 2024.

15. The scope of the assessment includes:[1]

    (a) Construction noise;

    (b) Operational noise from wind turbines; and

    (c) Operational noise from other activities.

16. I note that I prepared the noise assessment for the previous Covid Fast-track consenting process for the Project, and assisted with responses to comments made by SDC and landowners on the assessment and proposed management measures.

THE SOUTHLAND WIND FARM PROJECT

17. Contact Energy Limited (**Contact**) is seeking various approvals necessary for the construction, operation and maintenance of the Project. The Project includes up to 55 wind turbines and associated infrastructure.

18. The full project description for the Project is provided in Part A of the substantive application document. I do not repeat it in my assessment. The figures referred to in this assessment that include the reference (Part G) are included in Part G of the substantive application document.

19. I note that for the purposes of considering cumulative effects from all wind farms affecting noise sensitive properties (a requirement of the New Zealand wind farm noise standard, which I discuss below), I have considered noise emission from the adjacent Kaiwera Downs Wind Farm (**KWDF**).

20. The first stage of KDWF is currently operational, involving 10 wind turbines within the northern extent of KDWF site. A variation to consent relating KWDF Stage 2 (remaining site area) was granted in mid-2023.

[1] When assessing noise effects, I do so against the existing environment (in terms of noise and also receivers), which I describe in the relevant effects assessment sections.

For the purpose of this assessment, I have taken the 2023 design to represent noise effects from KDWF.

21. The general site outline is shown in Figure Noise-3 (Part G) including the KDWF to the north and Southland Wind Farm to the south. Figure Noise-3 (Part G) also shows the location of dwellings in the vicinity of both wind farms. The minimum separation distance between the southern-most turbines described in the 2023 consent for the KDWF site and those at the Southland Wind Farm is approximately 4km.

DISTRICT PLAN RULES AND NZ NOISE STANDARDS

22. The presence of noise does not necessarily constitute an adverse effect. The level and character of noise, and other factors such as the duration, frequency of occurrence, and the ambient noise environment are factors that contribute to the scale and extent of noise effects. New Zealand noise standards propose measurement and assessment methods, and in some cases limits and thresholds above which noise can produce adverse effects. Methods for assessing noise character and for considering other noise-related factors are also provided in the standards. District Plans refer to these standards, and set specific noise limits which apply to noise produced within each Zone in the Plans.

23. The proposed Wind Farm Site is located in the **Southland District** and is zoned Rural. A transmission line route and grid-injection-point (**GIP**) are proposed. The transmission line route and GIP are within the **Gore District.**

24. The District Plan rules relating to noise are reproduced in **Appendix D**. The applicable rules from these District Plans are summarised below.

Construction Noise

25. Construction noise is controlled in all of the applicable District Plans by NZS6803:1999. This standard sets noise limits which trigger additional consideration of mitigation methods and propose methods to manage and control noise to reasonable levels.

26. For a long-term project (longer than 20 weeks) the applicable trigger limits for construction noise received at residential locations (assessed at the façade of dwellings) are as follows:

Table 1 - Construction Noise Limits

Time Period		**dB L_{Aeq}**	**dB L_{Amax}**
Weekdays	0630-0730	55	75
	0730-1800	70	85
	1800-2000	65	80
	2000-0630	45	75
Saturdays	0630-0730	45	75
	0730-1800	70	85
	1800-2000	45	75
	2000-0630	45	75
Sundays and Public Holidays	0630-0730	45	75
	0730-1800	55	85
	1800-2000	45	75
	2000-0630	45	75

Operational Noise (other than turbines)

27. Noise from operational activity other than turbines, such as substation noise, vehicle noise on internal roads, and normal maintenance activities, are controlled as follows:

Table 2 – Permitted Activity Noise Limits

District	Daytime		Night-Time	
Southland – Boundary	7am – 10pm	65 dB L_{Aeq} 85 dB L_{AFmax}	All other times	45 dB L_{Aeq} 70 dB L_{AFmax}
Southland – Notional Boundary	7am – 10pm	50 dB L_{Aeq} 75 dB L_{AFmax}	All other times	40 dB L_{Aeq} 70 dB L_{AFmax}
Gore – Notional Boundary	7am – 10pm	55 dB L_{Aeq}	All other times	40 dB L_{Aeq} 75 dB L_{Amax}

Wind Turbine Operational Noise

28. Wind turbine noise is controlled by the methods and recommended noise limits in NZS6808, either by direct reference or by the exclusion of wind turbines from the applicability of NZS6802. There is reference to the 2010 version of NZS6808 in the Southland District Plan.

29. The 2010 version of NZS6808 contains improvements to the 1998 version which are generally accepted as best practice. The improvements provide a more rigorous method of measuring and assessing wind farm sound, which assists both the developer and the Councils in ensuring adequate protection from noise effects for the community.

30. I therefore consider it appropriate that the 2010 version of the NZS6808 should be applied for setting noise limits, and for measurement and assessment of wind turbine noise.

31. NZS6808:2010 sets a limit of 40 dB L_{A90} or the background noise level plus 5 dB, whichever is the higher. This limit is established as a function of hub height wind speed at the wind farm – so it acknowledges that in some cases the background noise level increases in windy conditions, and so permits a corresponding increase in the wind farm noise limit. The limit of 40 dB L_{A90} allows a quiet indoor sleeping environment, as prescribed by the World Health Organisation, with windows partially open for ventilation.

32. I have considered whether the “High Amenity provision” in NZS6808:2010 should apply to the Project. This provision considers that under special circumstances, a high amenity noise limit of 35 dB L_{A90} or Background + 5 dB should apply at night-time under certain wind conditions. The dwellings adjacent to the wind farm site do not constitute “special circumstances” as described in that standard, as the relevant permitted activity limits (40 - 45 dBA night-time in both District Plans) are typical of most district plans and cannot be construed as indicative of a highly protected noise environment.

33. Accordingly, the resulting recommended noise limit for turbine noise is 40 dB L_{A90} or the background sound level + 5 dB, whichever is the greater.

ASSESSMENT OF CONSTRUCTION NOISE EFFECTS

34. This section describes the inputs, assumptions, and outputs associated with the prediction of noise from construction noise and considers the effects of construction noise and appropriate mitigations.

35. Noise modelling has been carried out to estimate the noise level from construction activities. In the following sections I separately address the most significant construction activities:

    (a) Construction of turbine foundations and platforms;

    (b) Operation of a concrete batching plant;

    (c) Construction of internal roads;

    (d) Construction traffic noise on internal roads;

    (e) Blasting if required for foundation excavation; and

    (f) Construction of transmission lines and a grid injection point.

36. The locations referenced in this section are illustrated in Figure Noise-3 (Part G).

Turbine Foundation and Platform Construction

37. During turbine foundation and platform construction (including Operations and Maintenance (**O&M**) building and substation site construction) the dominant noise sources will involve the following:

(a) Large Bulldozer or Scraper;

(b) Loader;

(c) Dump trucks;

(d) Small cranes for form-work placement and loading / unloading;

(e) Delivery trucks (rebar, form-work);

(f) Concrete delivery trucks and pumping; and

(g) Trucks delivering turbine components.

38. Calculation of noise levels from the foundation and platform construction assumes the above fleet of machinery operates at each turbine site producing a total sound power level of **119 dB L_{WA}**.

39. The calculated sound levels at the façade of dwellings for turbine platform construction is detailed in **Table 3**. The maximum sound level received from the construction of all turbine platforms is less than 45 dB L_{Aeq} at all dwellings external to the project site. At all noise sensitive locations, the calculated noise from turbine foundation and platform construction activities complies by a significant margin with the daytime construction noise limit (70 dB L_{Aeq}) and complies with night-time construction noise limit of 45 dB L_{Aeq}.

Entrance and Construction Compound Construction

40. Construction of site entrances will occur at two locations – Venlaw Road and at the junction of Davidson Road and Kaiwera Downs Road. A construction compound will be established at the Davidson Road entrance. The construction of the entrances (and other roadworks) and the compound facility will be done using similar construction equipment as used for “Turbine Foundation and Platform Construction”.

41. The calculated sound levels at dwellings for noise generated associated with construction of the site’s entrances and Project Village is detailed in **Table 3**.

42. The construction of the construction compound would produce noise levels which at all external dwellings are less than the night-time construction noise limit of 45 dB L_{Aeq}, and its activities will easily comply

with all daytime noise limits. At one indicated dwelling (Dwelling 88) on Davidson Road East, construction of the compound will for a short time produce noise levels of up to 59 dB L_{Aeq}, and ongoing construction of the wind farm will produce noise levels of 41 dB L_{Aeq} at this dwelling. However, this dwelling is internal to the Project. At all external dwellings this work complies with daytime and night-time construction noise limits, and no further mitigation is required throughout that period.

Concrete Batching Plants

43. Up to two concrete batching plants will be established within the site. These are temporary operations associated with the construction of the Southland Wind Farm and will be disestablished once construction is completed. The preferred locations of the plants are shown in Figure Noise-3 (Part G). The "Concrete Batching West" location is approximately 2.8 km from the nearest dwelling. Other potential sites, including the "Concrete Batching East" location would be significantly further from dwellings and therefore would cause less noise at dwellings.

44. The sound power level used for the assessment of this activity is **110 dB L_{WA}**, as measured recently at a batching plant of similar size to the proposed plant. The calculated sound levels at dwellings for concrete batching is detailed in **Table 3** below. The maximum sound level received from concrete batching activities is well below the night-time construction noise limit of 45 dB L_{Aeq} at all dwellings external to the Project Site as shown in **Table 1**. A noise level of 45 dB L_{Aeq} is the most stringent (night-time) limit for construction noise specified in NZS6803:1999.

Internal Road Construction

45. With the exception of the dwellings near the entrance and construction compound areas, dwellings will receive noise from internal road construction which is similar to the noise levels of turbine platform construction.

46. The calculated sound levels at external dwellings for internal road construction may be assumed to be the same as "Turbine Pad Construction" in **Table 3**, excepting those properties where "Entrance and Construction Compound" lists a higher level.

Construction Traffic Noise on Internal Roads

47. Noise from construction traffic on Internal Roads (those roads will be constructed entirely on private property) will also comply with the noise limits in the Construction Noise Standard NZS6803:1999.

Heavy Vehicles

48. The most critical activity from a noise emissions perspective will be noise associated with the movement of aggregate and concrete. I have reviewed the roading and envelope layout for this project. I have assumed that for the highest intensity of earthworks (road construction and platform establishment) the noise effects can be conservatively modelled by assuming the constant presence of a truck on each of the roading sections. Noise levels would therefore be concentrated near the site entrance, and subsequently spread out as trucks diverge to the various turbine sites.

49. The trucks used in this assessment have sound power levels of **111 dB L_{WA}**.

50. The noise levels described by this assessment are listed in **Table 3**.

51. At all dwellings the calculated construction traffic noise levels are less than the night-time permitted activity noise limit (45 dBA L_{eq}).

Passenger Vehicles

52. Arrival and departure of people involved in construction is expected to add 150 vehicles inbound in the morning and 150 vehicles outbound at the end of the day. The steady noise level associated with passenger vehicles is calculated to be less than 25 dB L_{Aeq} at all dwellings, including those adjacent to the site entrances.

Blasting

53. Blasting may be necessary at some turbine platform sites. Noise from blasting is regulated on the basis of the “startle threshold” which according to British Standard BS5228 is 120 dB L_{Zpeak}. For blast charges typical of this type of work, the startle threshold would be achieved at a 1400 metre setback. Through good blast practice, noise levels are

expected to be significantly less than this within that radius, and will be kept well below the startle threshold where humans or stock are present.

54. Should it be necessary to conduct blasting which would exceed 120 dB L_{Zpeak} where dwellings or stock are present, the following practices shall be followed:

    (a) Use a proprietary shroud or temporary barrier around the blast hole drilling rig where practicable;

    (b) Undertake blasting between 9am and 5pm, Monday to Friday;

    (c) Explain the intended scheduled blasting windows (i.e. times and dates) are communicated to neighbours at the beginning of the project, and supply text warnings one hour prior to a blasting event;

    (d) Ensure that neighbours with stock on land within 800 metres of the blasting site are consulted at least two days in advance, so that paddock rotations can be used to minimise stock exposure to blasting noise;

    (e) Keep blasting windows tight (e.g. 10 minutes duration). If a window is missed, then blasting will not occur until the next scheduled window; and

    (f) Have an audible countdown sequence so neighbours know a blast event is imminent.

55. Blasting vibration is not significant at the distances relevant to this project.

Construction of Transmission Lines and a Grid Injection Point

56. Construction of the transmission lines would occur well away from dwellings. The closest that tower erection activities could come to a dwelling is approximately 500 metres. Construction noise would consist of an excavator, concrete delivery equipment and a crane. This is calculated to produce 37 dB L_{Aeq} at this closest dwelling during the brief period of the closest tower erections.

57. Stringing of lines may require helicopters over inaccessible areas remote to road access, and far from dwellings – typically at distances of at least

1.5 km. The noise from this activity is calculated to be 59 dB L_{Aeq}, which complies with daytime construction noise limits.

58. Any necessary helicopter deployment is expected to occur during daytime hours only. A more detailed review of the intended operation of helicopters in the Construction Noise Management Plan (**CNMP**) will ensure that reasonable noise levels are achieved at neighbouring properties.

59. Construction of the Grid Injection Point would occur at a distance of about 1500 metres to two dwellings. This is calculated to produce 35 dB L_{Aeq} during construction.

60. These activities easily comply with the construction noise standard limits.

Summary of Construction Noise Levels

61. The noise levels calculated in the above sections are summarised in **Table 3** for the dwellings where construction noise levels are the highest or represent the highest construction noise levels in their general areas. Other dwellings in the vicinity of the ones listed will receive lower levels of construction noise.

62. The first column in the table lists the noise level experienced at each dwelling in the extreme case that construction is occurring simultaneously at all sites – all turbine pads, entrance construction, substation construction, and batching plant operation. The remaining columns describe the more common case where construction noise is received from only one of those activities.

63. Blasting is not included in the “all activities” values, as these are separately considered above.

Table 3 – Predicted Construction Noise levels

Dwelling (number and address)	Sound Level (dB L_{Aeq}) All Activities All sites	Turbine Pad Construction Loudest site	Entrance and Construction Compound Establishment	Concrete Batching Plant	Internal Road Traffic
01 – 267 Venlaw Rd	42	32	39	--	31
20 – 696 Woods Rd	35	27	--	--	20
39 – 1403 Wyndham-Mokoreta Rd	43	37	--	--	29
42 – 1542 Wyndham-Mokoreta Rd	40	31	--	--	23
76 – 1380 Slopedown Rd	37	32	--	--	25
77 – 1288 Slopedown Rd	35	30	--	--	23
86 – 500 Kaiwera Downs Rd	39	29	37	--	33
88 – 57 Davidsons Road East	59	35	59	--	41
89 – 165 Davidsons Road West	41	24	33	--	31

Construction Noise Effects

64. The noise from construction activities will in most cases be received in the context of daytime rural activities, characterised by quiet periods dominated by bird and insect noise, stock and dog noise, and wind in vegetation, and punctuated by vehicles and farm machinery. At the dwellings near the Venlaw Road entrance, significant water course noise is present.

65. The ambient sound levels existing at various locations around the Project site are described in more detail in the following “operational noise” section. In general, the daytime background sound level at neighbouring dwellings (as described in the sections which follow) is around 30 dB L_{A90} during calm wind conditions.

66. The effects of noise from construction are considered against the existing noise environment. Noise levels which are 10 decibels above the

background (L_{A95}) sound level generally are considered acceptable as they are at similar levels to normal ongoing activities. Construction noise activities are generally tolerated and provided for at higher levels due to their temporary nature.

67. The calculations of construction noise at external dwellings given in the preceding section can be summarised as per **Table 4**, where the high value in the range represents the nearest dwellings at the loudest times, as examined above, and the lower value represents the more typical levels which would be experienced at the dwellings in the vicinity of the wind farm, as construction activities move further from them:

Table 4—Construction Noise Summary

Construction Activity	Typical Sound Level Range (dB L_{Aeq})
Turbine Foundation and Platform construction	20 - 37
Entry and Construction Compound Establishment	20 - 59
Concrete Batching	0 - 16
Internal road construction	20 - 37
Traffic noise from construction traffic	11 – 41

68. For all dwellings external to the Project, the construction noise effects will be slight as they are similar to, or slightly higher than typical daytime activity noise, and not more than 10 decibels above the “calm conditions” background noise level. For much of the time, wind noise would significantly mask construction noise sound, rendering it a negligible effect.

69. For the closest dwellings to the site, initial entrance and road construction will cause a noticeable increase in daytime noise levels, although noise levels will be far less than the daytime permitted activity noise limits and comply by a large margin with construction noise limits for long-term construction activities.

70. At all dwellings external to the Project, construction activities are predicted to comply with daytime and night-time permitted activity limits (and with the construction noise limits at all times) as shown in **Table 3**, and therefore they will have a negligible adverse noise effect.

71. Crushing carried out as described in the preceding section will comply with daytime and night-time permitted activity noise limits.

72. Blasting, if necessary, will be managed according to best practice, and is predicted to have minimal noise and vibration effects on dwellings. Noise and vibration management practices are described above. Should blasting be required closer to dwellings than the 1400m radius described in the blasting section above, these practices will mitigate noise and vibration effects.

73. Erection of transmission towers and construction of the grid injection point will easily comply with construction noise limits, and are of brief duration – and thus will have negligible noise effects.

Construction Traffic on External Roads

74. Noise from construction traffic on external roads, like noise from any other vehicles on the roads, is not controlled by noise limits in the District Plans or by construction noise limits. However, where a construction project causes a significant increase in vehicle movements on public roads, the increase in noise which results may be considered as part of the noise effects of the project.

75. I understand from reviewing the Transport Assessment report that the increase in traffic on SH1 and SH93 due to construction activities is not significant. On smaller roads near the site entrances, the construction-related increases relative to existing traffic flows are more significant.

76. At the western entrance to the site, on Venlaw Road, the existing traffic volumes are less than 100 vehicles per day. During construction this would increase by around 120 – 240 trucks per day (spread throughout the daytime hours) plus around 150 passenger vehicles per day (half occurring in the morning and half in the evening). At the Davidson Road entrance a similar number of passenger vehicles is expected.

77. At dwellings along these access routes, the character of the traffic already includes passenger vehicles and heavy vehicles; however the intensity of traffic leading to the western entrance would increase by 3 – 5 times along these smaller roads, and would be perceived as more constant, rather than sporadic, exposure to similar traffic noise levels.

78. For the intensive period where aggregate is being brought to site, residents along Venlaw Road will experience about 6 decibels more traffic noise from public roads than they presently do. This is a temporary effect, and is still within reasonable bounds. As such, no mitigation is necessary.

79. Only limited heavy vehicle traffic to both entrances during night-time is anticipated, relating to oversize turbine component delivery. At some points, overweight and over-size vehicles will bring turbine components to the Wind Farm site from South Port. Due to various constraints, these vehicles will travel through residential areas.

80. In general, the vehicles will be at least 20 metres from dwellings but in several cases, vehicles will pass as closely as 10 metres to dwelling façades. These movements will occur at night and would likely involve several vehicles moving in a small convoy, taking several minutes to pass each location along the route.

81. Vehicles at 10 metres from the dwellings' façades would produce a noise level of about 70 dB L_{Aeq} for a few minutes of minutes at each dwelling for each movement; more commonly at a distance of 20 metres or more, the sound level would be of the order of 65 dB L_{Aeq} or less.

82. Vehicles on the road are not controlled by noise limits, and night-time heavy vehicle movements are not atypical – deliveries, forestry trucks, street sweepers and other maintenance vehicles would produce similar levels of noise for similar durations during the night. These noises are anticipated in the general scheme of road usage.

83. Because there will be a significant number of such movements over a period of several weeks, I would consider this a temporary minor noise effect which is anticipated as part of normal road usage, similar to the effects of a forestry campaign. The effects can be minimised with normal best practice, including good maintenance of equipment, avoiding engine braking through towns, keeping cab windows closed while using radios, ensuring reversing (with associated alarms) is not necessary for manoeuvring, and ensuring that obstructions are cleared prior to vehicles arriving, so as not to require idling near dwellings. These matters will be addressed in the Construction Traffic Management Plan that will be prepared for the Project.

84. As the frequency of these vehicle movements is not dissimilar to forestry vehicle movements, this does not represent a significant change or noise effect.

OPERATIONAL NOISE —WIND TURBINE NOISE

85. This section documents the details used in the modelling process prescribed by NZS 6808:2010.

Model Inputs

86. The turbine model considered in this assessment is the Vestas V162 – 6.2 MW. The assumed characteristics of this model are detailed in the following sections. I note that the sound power level for this turbine is at the upper end of noise from turbines of this capacity. There are a number of turbines of similar capacity, suitable for installation at the site, which have lower sound power levels. Adopting this particular model for this assessment is therefore a worst-case assessment.

87. The sound emitted from a wind turbine varies with wind speed. The wind speed/noise relationship is described by the sound power level curve for the turbine which is plotted against wind speed. The typical shape of this curve describes a noise level relating to “cut-in”, where the rotor begins to turn at wind speeds of around 3 m/s, increases as the wind speed increases, until reaching a plateau when full generation power is achieved.

88. When reported as a single-number value, turbine noise is modelled on the basis of the wind speed at which the peak in sound power level occurs. The peak sound power level for the turbine modelled can be seen in **Figure 1** at 10 m/s. The sound pressure levels described include a +2 dB adjustment for uncertainty, to reflect the likely guaranteed values which would be offered by the manufacturer.

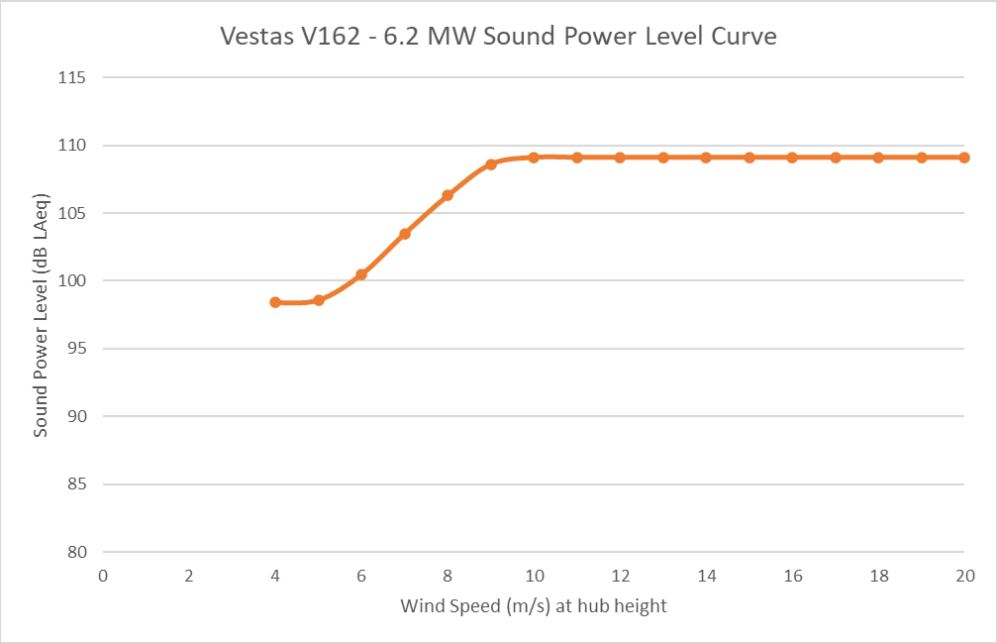


Figure 1 – Sound Power Level Curve

89. Each turbine has been modelled as a point source at the height of the nacelle for each turbine. This appropriately represents the observation that the noise generated by a wind turbine is mainly emitted from the tip of each blade, which reaches its maximum output as it passes downward through horizontal (at approximately the height of the hub), and to a nearly negligible extent from the nacelle (which houses the rotating machinery) and the body of the tower itself, which can radiate mechanical noise from the generator housing if not properly isolated.

90. The wind-turbine-specific implementation of ISO 9613 noise propagation model which includes the IOA UK Institute of Acoustics Good Practice Guide advice includes additional consideration of tip height when evaluating shielding from the turbine source, effectively placing some sound power at the highest point of the tip of the rotor.

91. The path taken by noise as it travels from turbine to dwelling affects the level and spectrum of sound received. The noise level decreases as it propagates further from the turbine, at a rate of approximately 6 decibels per doubling of distance as the sound is spread over progressively larger areas.

92. Additional attenuation of sound occurs due to absorption by air (primarily at high frequencies), by interaction with the ground (primarily at mid frequencies), and by limited shielding from terrain or other structures.

These factors are accounted for in the ISO 9613 sound propagation model and are represented in the calculations by incorporating detailed ground contours of the land between turbines and dwellings.

93. The ISO 9613 model is implemented in SoundPLAN v9.1 software, which is an internationally recognized and reviewed implementation of this model.

Model Outputs

94. Predicted noise levels for six dwellings near the wind farm are listed in **Table 5** below. Four of these sites are those which were selected for background noise monitoring as discussed in later sections. The two additional dwellings were chosen because they were a little closer to the 35 dBA noise contour. These dwellings collectively are the most exposed to wind farm noise, and are representative of other dwellings nearby. Other dwellings will receive less noise than the ones described in this section.

95. The predicted noise levels are expressed as decibels L_{Aeq} Sound Pressure Level, and do not include contribution from noise sources other than the wind turbines. Noise levels relate to the peak sound output, which occurs at a hub-height wind speed at the wind farm site of 10 m/s. The sound level at lower wind speeds will be less, as shown by the wind turbine sound power level curve in **Figure 1**.

96. In **Table 5**, two values are provided. The first is the noise level caused by the Southland Wind Farm in isolation. The second is the cumulative noise level calculated from Southland Wind Farm plus the consented configuration of the adjacent Kaiwera Downs Wind Farm with a total of 66 turbines as varied by the 2023 consent for that project.

Table 5 - Predicted Turbine Noise Levels

	Noise Level (dB L_{Aeq})	
Dwelling Number - Address	**Southland Wind Farm Only**	**Cumulative with Kaiwera Downs**
02 – 267 Venlaw Rd	31	34
20 – 696 Woods Rd	28	28
39 – 1403 Wyndham-Mokoreta Rd	34	34
42 – 1542 Wyndham-Mokoreta Rd	33	33
76 – 1380 Slopedown Rd	28	29
77 – 1288 Slopedown Rd	27	27

97. The operational turbine noise levels for the Southland Wind Farm-only and cumulative scenarios are presented graphically as noise contour line maps in Figure Noise-1 and Figure Noise-2 (Part G). I note that dwellings further from the Project site than those listed above will receive lower noise levels than those dwellings in **Table 5**.

Assessment of Operational Noise Effects

98. NZS6808:2010 requires that dwellings inside the modelled 35 dBA noise contour are further investigated to determine the background noise environment. This forms the basis for setting the noise limit (where the existing background noise level exceeds 35 dBA) and establishes a means for determining the contribution of turbine noise to the overall noise levels when measuring post-construction compliance.

99. For the proposed Southland Wind Farm layout, the cumulative noise level does not exceed 35 dBA at any dwelling (in other words, there are no dwellings inside the 35 dBA noise contour). This is due to the distance between turbines and dwellings – at least 2.3 km separation. This is a larger separation than exists in many wind farms currently operating in New Zealand.

100. Nevertheless, to ensure a robust basis for assessment of effects and measurement of compliance, I have taken noise measurements at four representative sites around the wind farm during Aug-Sept 2023. I have compared the calculated noise level of the wind farms at these dwellings

(and two others with slightly higher calculated noise levels) with the measured background noise levels at these four dwellings.

101. For completeness, I note that I have not measured (existing) background noise at all the properties nearby, but have carried out noise predictions for all dwellings nearby. The wind farm must comply with the noise rules at all dwellings, not just the ones measured, and so the noise predictions help to ensure that is the case.

102. The locations of these dwellings are shown in Figure Noise-3 (Part G).

103. Figures in Appendix E illustrate the relationship between wind speed and background sound level for each of the measurement sites, and the relationships between calculated turbine noise and measurement background sound level.

104. I also provide an overlay of the 40 dBA noise contour on cadastral boundaries in the map in Figure Noise-4 (Part G).[2] This contour is the cumulative noise level from the Southland Wind Farm, along with noise from the KDWF – including all turbines which will be operational once the second stage of KDWF is completed. Note that all of the KDWF turbines are outside the extent of this map and so are not shown.

105. The map indicates properties owned by landowners contracted to the wind farm (shaded blue), and Department of Conservation land (shaded green).

106. There are two properties inside the 40 dBA noise contour which are owned by Matariki Forest, who is a party to the wind farm agreement. These are shaded brown. Neither of these forested properties have a dwelling on them.

107. Dwellings at all other properties which do not have an association with the Project are outside the 40 dBA noise contour.

108. Descriptions of the noise levels and resulting noise effects for individual dwellings are as follows.

[2] I note this material was provided during the previous Covid Act consenting process, in response to a response to a request from SDC.

267 Venlaw Road

109. 267 Venlaw Road is located to the northwest of the Southland Wind Farm site, and to the southwest of the Kaiwera Downs site. This dwelling is one of several that receive similar levels of noise from both wind farms, and where the cumulative noise levels will be most significant. Noise from the Southland Wind Farm turbines is calculated to be 31 dB L_{Aeq} at full power; the cumulative noise level from both wind farms is calculated to be 34 dB L_{Aeq}.

110. The background noise level was measured at this dwelling. These measurements show that the dwelling receives a significant amount of noise – around 45 dB L_{Aeq} – from the Mimihau Stream. At hub-height wind speeds above 15 m/s the wind noise raises the noise level further. It is likely that during summer months noise from the watercourse would decrease somewhat.

111. Cumulative wind turbine noise would comply with the NZS6808:2010 noise limit at all wind speeds by a significant margin.

112. Noise from the turbines is expected to be masked by watercourse noise as observed, although if the water flow reduces very significantly the wind farm may become a significant feature of the noise environment.

696 Woods Road

113. 696 Woods Road is located to the west of the Southland Wind Farm site. Noise from the turbines at full power is calculated to be 28 dB L_{Aeq}; noise from the Kaiwera Downs site is not calculated to significantly contribute at this measurement location.

114. The background noise level has been measured at this dwelling. The noise level in still conditions is around 20 dB L_{A90}, and is moderately wind-affected as wind speeds increase. There is significant scatter in the night-time noise levels at higher wind speeds; examining different wind directions does not demonstrate that the scatter can be attributed to wind direction. The average noise level is below 35 dB L_{A90} at all times, and so does not warrant any increase in the wind farm noise limit beyond the fixed 40 dB L_{A90} limit.

115. Turbine noise would comply with the NZS6808:2010 noise limit at all wind speeds by a large margin of about 12 dB.

116. Noise from the turbines is likely to be somewhat audible at low to moderate wind speeds – 6 to 12 m/s – but at lower and higher wind speeds would likely be dominated by other wind and activity noise.

1288 and 1380 Slopedown Road

117. 1288 and 1380 Slopedown Road are dwellings located to the east of the Southland Wind Farm site. Noise from the Southland wind farm turbines at full power is calculated to be 27 dB L_{Aeq} at 1288 Slopedown Road and 28 dB L_{Aeq} at 1380 Slopedown Road. The cumulative noise level from both wind farms as calculated to be 1 dB higher (29 dB L_{Aeq}) at 1380 Slopedown Road but is not calculated to increase the noise level at 1288 Slopedown Road.

118. The background noise level was measured at 1288 Slopedown Road, which reasonably represents the background noise environment at both of these properties. These measurements show that the night-time noise level is reasonably low in still conditions – as low as 18 – 20 dB L_{A90}, and that the site is moderately wind-affected. However, the noise level at night does not rise enough to warrant an increase in the noise limit from the 40 dB L_{A90} fixed limit.

119. Turbine noise would comply with the NZS6808:2010 noise limit at all wind speeds.

120. Noise from the turbines is calculated not to be the dominant noise source in the noise environment, but is likely to be somewhat audible at moderate wind speeds – 6 to 12 m/s.

1403 and 1542 Wyndham-Mokoreta Road

121. The dwellings at 1403 and 1542 Wyndham-Mokoreta Road are located to the southwest of the Southland Wind Farm site. Noise from the turbines at full power is calculated to be 34 dB L_{Aeq} at 1403 Wyndham-Mokoreta Road and 33 dB L_{Aeq} at 1542 Wyndham-Mokoreta Road. Noise from the Kaiwera Downs wind farm is not calculated to significantly contribute at these dwellings.

122. The background noise level was measured at 1542 Wyndham-Mokoreta Road, which reasonably represents the background noise environment at both of these dwellings. These measurements show that in still conditions the site is fairly quiet – 20 – 25 dB L_{A90}. It is significantly wind-affected at moderate to high wind speeds. At hub-height wind speeds above 14 m/s the noise limit would be increased by the “background + 5 dB” provision in NZS 6808:2010.

123. Turbine noise would comply with the NZS6808:2010 noise limit at all wind speeds.

124. Noise from the turbines is calculated to be the dominant noise source in the noise environment at moderate wind speeds – 7 to 12 m/s, but at lower wind speeds it would be dominated by general activity noise, and at higher wind speeds would be dominated by other wind noise.

Turbine Noise Effects

125. The noise level produced at all properties by turbines would be at levels considered reasonable – less than the night-time permitted activity noise limit, and such that World Health Organisation recommendations for sleeping environments would be met with windows open. This noise level is consistent with (or slightly more stringent than) the noise limit applied in the District Plan for noise sources such as water pumps, heat pumps, spa pools, and other noise sources that could impact on a dwelling. This noise level is extremely low compared to the noise received near an airport and has a very significantly lower degree of effect.

126. During the previous Covid Fast-track consenting process, some residents raised concerns that turbine noise may be off putting to farm workers, the low frequency noise could be disruptive to wildlife and humans, and that the audibility of the turbines could cause an erosion of amenity.

127. Noise in rural New Zealand is separated from the parcel of the working farm area and the residential area that exists inside the "notional boundary" of a dwelling. The level of noise was measured from the notional boundaries of the dwellings, not the property boundaries. The residential area receives similar noise amenity protections as a house would, to provide a reasonable amenity for sleeping and living activities. However, the working area of the farm does not have these protections,

so that there are no restrictions imposed on productive activities necessary to operate a farm.

128. The wind turbines used will produce much less low frequency sound than was common in older designs of wind turbines, where the rotors are downwind of the towers, or where active stall control is used to limit rotor speed. It is therefore not necessary to give “wind turbine noise” special regard when considering the likely effects it would create, relative to other noise sources controlled by the New Zealand noise standards. Stock and wildlife quickly adapt to the presence of new noise sources, and there is nothing particular to wind turbines which is disturbing to animals once the presence of the new noise is recognised and accepted.

129. Audibility is not a criterion for amenity. It is fundamental to our functioning as a community that normal activities produce noise; while we control the level of noise through noise limits, there is no expectation that noise will not be audible. To set a limit on the basis of audibility would make functioning as a society unviable.

NON–TURBINE OPERATIONAL NOISE

130. Other operational noise sources include substations, activities in the Operations and Maintenance facilities, and on-site road traffic. In this section the noise calculations and assessments of these sources are presented. These items are illustrated by the two green circles In Figure Noise-3 (Part G).

131. As outlined in the following sub-sections, these noise sources are required to meet the noise limits for permitted activities in the respective District Plans.

Substation Noise

132. The wind farm will have transformers located at one substation located within the wind farm, and will also have a switching station where the connection to the national grid is made. No significant noise will be produced at the switching station.

133. The substation located within the wind farm will have two transformers. The sound power spectrum used for modelling is **91 dB L_{WA}** taken from a review of three modern substation transformers which are substantially

larger than required for this project but are typical of modern substation transformers. Specifically, I have used the highest noise level from three such transformers I have measured, which is a 180 MVA 3-phase transformer, including cooling fan noise.

134. The calculated sound pressure levels are negligible (less than 0 dBA) at all dwellings. Noise effects will be negligible.

Operations and Maintenance Facilities

135. The O&M Facility would be built near the Site Entrance from Venlaw Road, adjacent to Thornhill Road.

136. I have assumed that operational noise from these facilities would include noise from air conditioner outdoor units, and machine shop noise breaking out through the fabric of the building, assumed to be a steel shed with internal linings. The outdoor sound power levels used to calculate noise emission from the sum of these activities is **69 dB L_{WA}.**

137. The calculated noise from the above O&M activity is negligible at all dwellings – far less than the existing background noise level under calm conditions. This will easily comply with District Plan noise limits and will have negligible noise effects.

Road Traffic Noise—Operational Stage

138. During the operation of the wind farm some access to the site will be required for ongoing maintenance and management of the wind farm. I have considered the noise effects from these vehicles on public roads and within the site.

Road traffic – External Roads

139. I understand that ten to 14 full-time equivalent staff may be employed to undertake routine operational maintenance of the turbines.

140. As this does not significantly change the flow rates on public roads, and will usually not involve additional heavy vehicle traffic, I conclude that there will be negligible noise effect resulting from operational road traffic.

Road traffic – Internal Roads

141. The impact of vehicles travelling along internal roads has been assessed by the same method as was used for construction traffic. Although most operational traffic is likely to involve light vehicles, heavy vehicles may occasionally be required for maintenance purposes.

142. The noise level from heavy vehicle activity will be 31 dB L_{Aeq} or less at all external dwellings and would occur only occasionally. This noise level easily complies with daytime and night-time noise limits and will have negligible noise effects – far less than farming and forestry truck operation which is already using the roads as a permitted (primary production) activity.

MEASURES TO REMEDY OR MITIGATE ACTUAL OR POTENTIAL ADVERSE EFFECTS

143. To ensure that compliance is achieved, and to address noise which may arise upon commencement of operation of the wind farm, I recommend that conditions be adopted requiring:

    (a) Construction and maintenance noise to be measured and assessed in accordance with NZS6803:1999 Acoustics – Construction Noise, with the long-term duration noise limits from NZS6803 to be applied.

    (b) A Construction Noise Management Plan to be prepared and provided to the District Council, as per NZS6803.

    (c) The Management Plan would enable any currently unanticipated breaches of the construction noise limits to be mitigated.

    (d) Non-turbine related operational noise to comply with the permitted activity limits in the District Plan(s), measured in accordance with NZS6801:2008 – Measurement of Environmental Sound and assessed in accordance with NZS6802:2008 – Acoustics – Environmental noise.

    (e) Operational noise from turbines to comply with NZS6808:2010 Acoustics – Wind Farm Noise. In particular, the conditions should provide for:

(i) sound levels to not exceed the background sound plus 5 dB ($L_{A90(10min)}$) or a level of 40 dB ($L_{A90(10min)}$), whichever is the greater, when assessed at the notional boundaries of neighbouring dwellings adjacent to the Wind Farm Site;

(ii) noise level predictions to be carried out and reported prior to construction; measurement / assessment of operational noise at the notional boundary of existing dwellings following construction; and compliance assessment reporting if necessary.

144. I note that these proposed conditions were refined in discussion with SDC during the previous Covid Fast-track consenting process. In my view they remain appropriate.

Miklin Halstead

APPENDIX A: GLOSSARY OF TERMINOLOGY

Background sound	The sound that is continuously present in a room our outdoor location. Often expressed as the A-weighted sound level exceeded for 90 % of a given time period i.e. L_{A90}.
Frequency	Sound occurs over a range of frequencies, extending from the very low (e.g. thunder) to the very high (e.g. mosquito buzz). Measured in units of Hertz (Hz). Humans typically hear sounds between 20 Hz and 20 kHz. High frequency acuity naturally reduces with age most adults can hear up to 15 kHz.
Noise	A subjective term used to describe sound that is unwanted by, or distracting to, the receiver.
Notional boundary	A line 20 metres from any side of a dwelling, or the legal boundary where this is closer to the dwelling. This definition is from NZS 6802:2008.
Octave band	The interval between one frequency and its double. Sound is divided into octave bands for analysis. The typical octave band centre frequencies are 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz and 4 kHz.
Rating level	A derived level used for comparison with a noise limit. Takes into account any and all corrections described in NZS 6801 and NZS 6802, e.g. duration, special audible character, residual sound etc. This definition is from NZS 6802:2008.
A-weighting	A set of frequency-dependent sound level adjustments that are used to better represent how humans hear sounds. Humans are less sensitive to low and very high frequency sounds. Sound levels using an "A" frequency weighting are expressed as dB L_A. Alternative ways of expressing A-weighted decibels are dBA or dB(A).
dB	Decibel. The unit of sound level.
L_{A90}	The A-weighted sound level exceeded for 90 % of the measurement period, measured in dB. Commonly referred to as the background noise level.
L_{Aeq}	The equivalent continuous A-weighted sound level. Commonly referred to as the average sound level and is measured in dB.
Nacelle	The housing at the top of the wind turbine tower, which houses the generating equipment. The turbine rotor revolves about the shaft at the height of the Nacelle. The height of the Nacelle defines the assumed location of the turbine as a noise source.

APPENDIX B: REFERENCED STANDARDS

NZS 6801:1991 New Zealand Standard NZS 6801:1991 - *Measurement of Sound*

NZS 6802:1991 New Zealand Standard NZS 6802:1991 - *Assessment of Environmental Sound*

NZS 6801:1999 New Zealand Standard NZS 6801:1999 *Acoustics - Measurement of Environmental Sound*

NZS 6802:1999 New Zealand Standard NZS 6802:1999 - *Acoustics - Assessment of Environmental Noise*

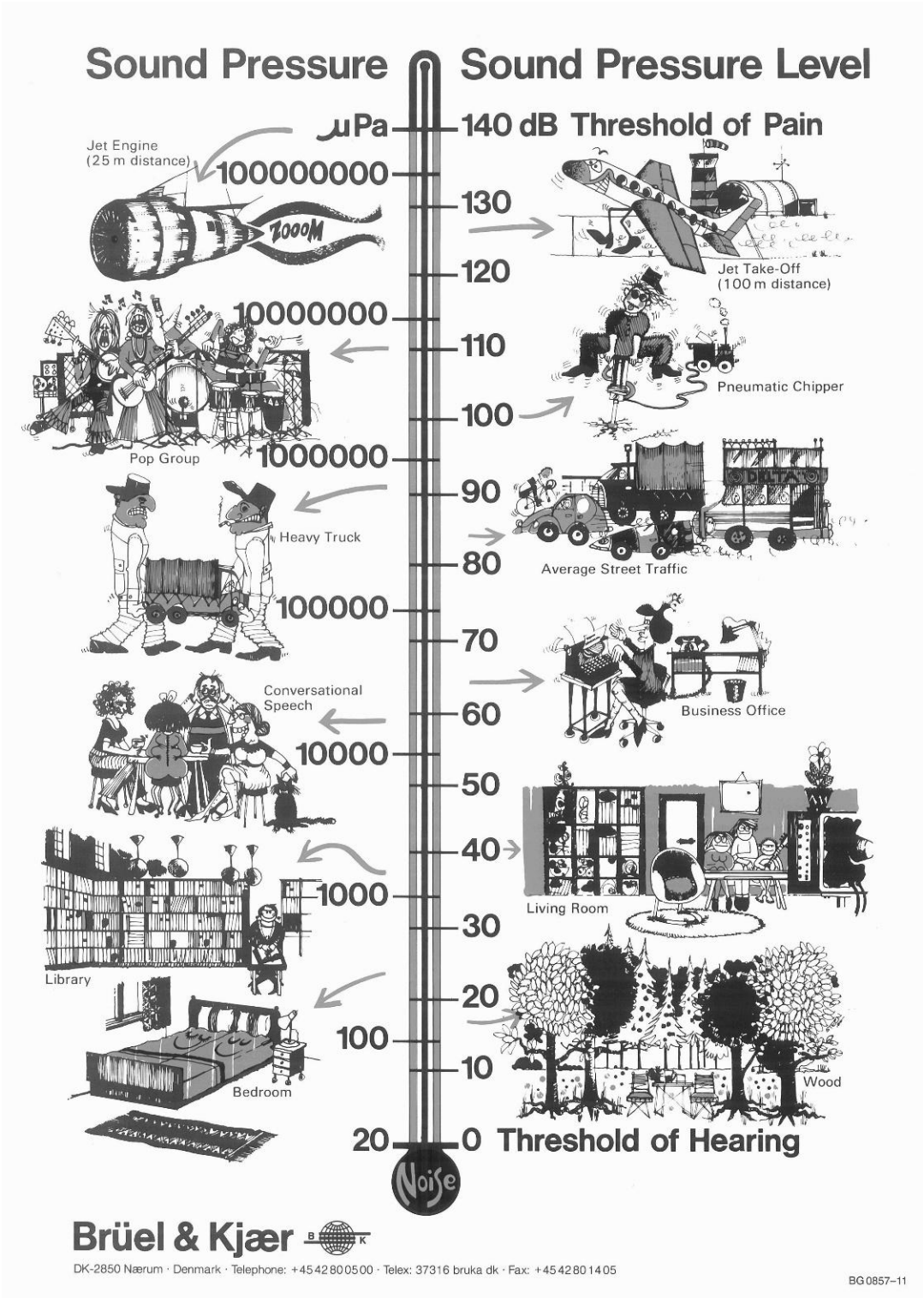
NZS 6803:1999 New Zealand Standard NZS 6803:1999 *Acoustics – Construction Noise*

NZS 6808:1998 New Zealand Standard NZS 6808:1998 - Acoustics – The assessment and measurement of sound from wind turbine generators

NZS 6808:2010 New Zealand Standard NZS 6808:2010 - *Acoustics – Wind farm noise*

APPENDIX C: TYPICAL SOUND LEVELS

The figure below is provided to give a day-to-day context for various sound pressure levels. A comparison can be drawn between the predicted noise levels in the preceding tables and typical noise situations shown in the illustration below, resulting from the given noise sources.



APPENDIX D: DISTRICT PLAN NOISE RULES

Southland District Plan

The following rules control noise emissions from activities in the Rural Zone, and from wind farms in general:

NOISE.R1 – Permitted Activities

All activities shall be Permitted Activities (unless specified below) provided that they comply with all of the relevant Noise Standards, Zone and district-wide rules.

NOISE.R2 – General Standards

Noise Measurement – Noise levels shall be measured and assessed in accordance with NZS 6801:2008 Acoustics – Measurement of Environmental Sound and NZS 6802:2008 Acoustics – Environmental Noise, except where another standard has been referenced in these rules, in which case that standard should apply.

Note: The only way to measure compliance with the plan is through the methods outlined above. No other method will be accepted.

NOISE.R8 – Noise From Wind Turbines

Noise from wind turbines shall comply with NZS 6808:2010 Acoustics – Wind Farm Noise.

NOISE.R12 – Construction Noise

Construction noise shall comply with NZS 6803:1999 Acoustics – Construction Noise.

GRUZ-PS4 – Noise

Except as provided in NOISE-R3 and NOISE-R4 to NOISE-R11, noise from all activities shall not exceed the following limits:

	Day time (7.00 am – 10.00 pm inclusive)		**Night-time (All other times)**	
	L_{Aeq} (15 min)	**L_{AF}, max**	**L_{Aeq} (15 min)**	**L_{AF}, max**
When measured at the boundary of any property zoned:[3]				
General Rural Zone (including MTO - Mountains Overlay)	65 dB	85 dB	45 dB	70 dB
When measured at any point within the notional boundary of any dwelling on an adjoining property zoned:[4]				
General Rural Zone	50 dB	75 dB	40 dB	70 dB

Note: The day time noise limits are intended to provide amenity for outdoor activities. Night-time noise limits are intended to allow for sleep amenity.

Where an activity shares a boundary with another Zone the activity must comply with the more restrictive noise limit.

Notional boundary means a line 20 metres from any side of a dwelling or the legal boundary where this is closer to the dwelling.

[3] Table 14 - GRUZ Noise Limits Within Property Boundary.
[4] Table 15 - GRUZ Noise Limits Within Adjoining Property Boundary.

Gore District Council

The Gore District Plan includes the following rules relevant to this project:

4.5 Noise

4.5.1 Rule

Unless otherwise stated, all activities shall comply with the following standards:

(1) Noise limits in rural and residential zones

On any day:	7.00 a.m. to 10.00 p.m.	55 dBA Leq
	10.00 p.m. to 7.00 a.m.	40 dBA Leq
	10.00 p.m. to 7.00 a.m.	75 dBA Lmax

Measured:

Rural zones	at any point in the notional boundary of any noise sensitive activity.
Residential zones	at any point in any other site.

(2) Exemptions on noise limits in rural and residential zones

The standards set out in (1) above shall not apply:

a) Where there is any noise sensitive activity on the same site as a noise source being assessed.

…

c) To activities of normal primary production or forestry activities.

d) To vehicle movement on public roads.

…

(6) Methods of measurement and assessment

Unless stated otherwise, sound shall be measured in accordance with the provisions of NZS 6801:1999 Acoustics - Measurement of Environmental Sound and assessed in accordance with the provisions of NZS 6802:1999 Acoustics - Assessment of Environmental Noise.

(7) Effect of non-compliance

Any land use activity which does not comply with the standards in (1) … above is a restricted discretionary activity.

The matters over which Council shall exercise its discretion are the adverse environmental effects of the matters with which there is non-compliance.

Chapter 7 of the Gore District Plan describes specific noise rules for Utilities:

7.9 Rules

…

(2) General standards for all utilities

…

b) Except as provided for in Rules 7.9(2)(e) and 7.9(7)(d) *[cabinets in road reserves]*, all utilities located within Rural and Residential Zones shall be operated in a manner that complies with the following noise limits:

On any day:

7.00 a.m. to 10.00 p.m.	55 dBA Leq
10.00 p.m. to 7.00 a.m.	40 dBA Leq

10.00 p.m. to 7.00 a.m. 75 dBA Lmax

Measured:

Within Rural Zones, at any point within the notional boundary of any noise sensitive activity.

…

e) Any utilities that do not comply with Rules 7.9(2) (a)-(e) are a **restricted discretionary activity**

The matters over which Council shall exercise its discretion are the adverse environmental effects of the matters with which there is non-compliance.

The definition of “notional boundary” in Chapter 11 the Gore District Plan is:

Notional boundary means a line 20 metres from the façade of a building containing a noise sensitive activity, or the legal boundary where this is closer to the building.

APPENDIX E: BACKGROUND NOISE AND CALCULATED TURBINE LEVELS

1. The following figures show, for each dwelling that has been assessed in detail, the measured background sound level (existing noise level vs wind farm wind speed scatter plots), and following these, the curves comparing calculated wind turbine noise level to the measured background sound levels.

2. In the background noise plots, each blue data point represents a 10-minute noise level measurement and corresponding wind speed measurement. The full set of data for both daytime and night-time is provided in the first figure of each pair, and the night-time only data is shown in a second figure. It is the night-time only data which is used to establish the noise limits applicable to the wind farm.

3. Each background noise graph also includes a line of best fit, with its describing equation displayed at the top of the chart. This line of fit is used to represent the background sound level in the comparison with turbine noise, shown in the graphs which follow.

4. The Turbine noise calculation graphs show the background noise regression line, the noise limit which is derived from it, and the calculated turbine noise levels. These turbine noise levels can be compared with the noise limit lines to understand compliance, and with the background noise lines to understand audibility.

267 Venlaw Road

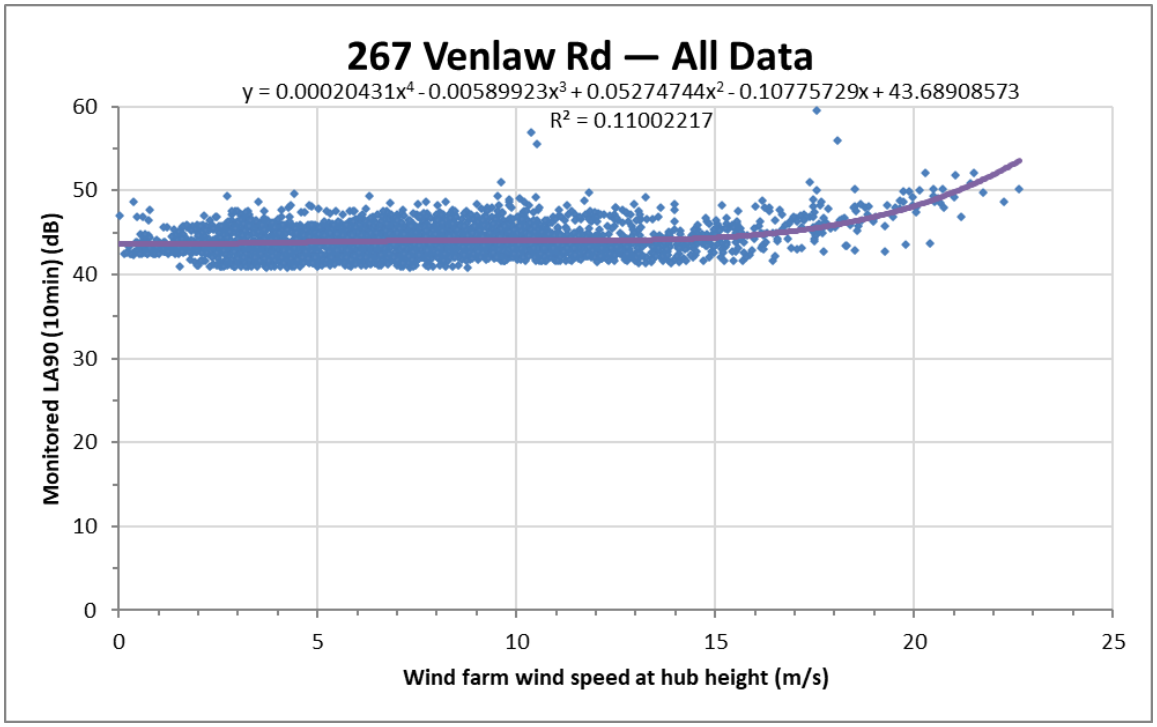


Figure 1 – Background Noise Measurements at 267 Venlaw Road

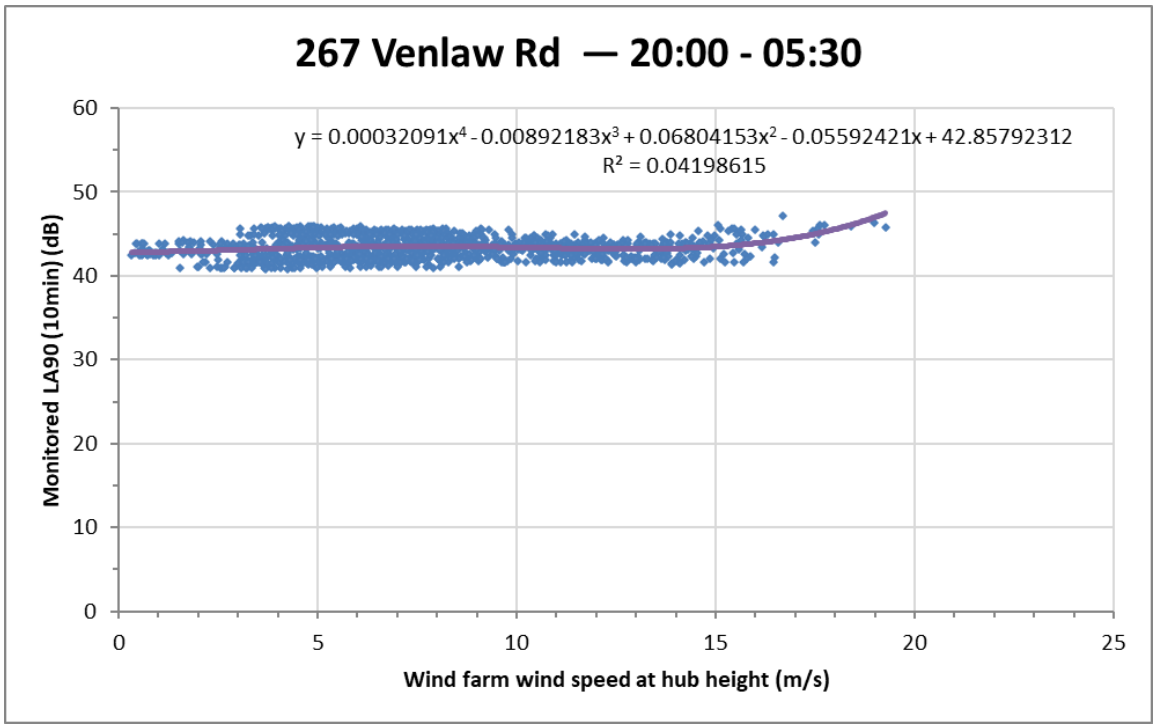


Figure 2 – Background Noise Measurements at 267 Venlaw Road, Night-time Only

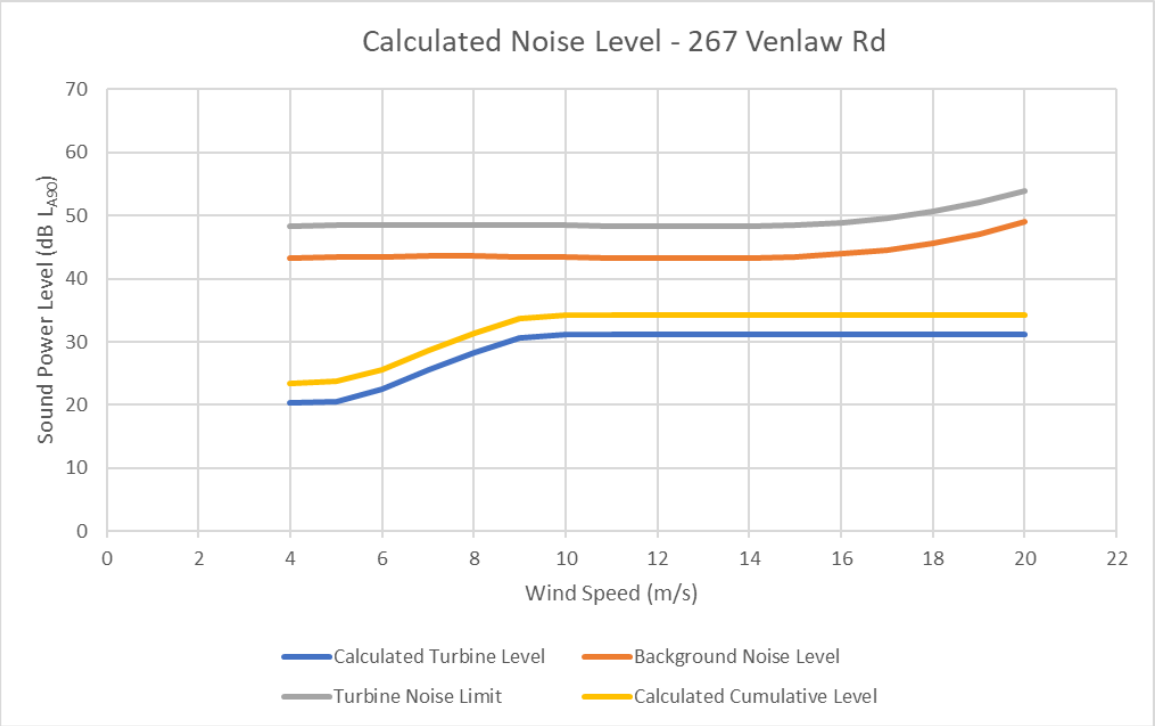


Figure 3 – 267 Venlaw Road Turbine and Background Noise Relationship

696 Woods Road

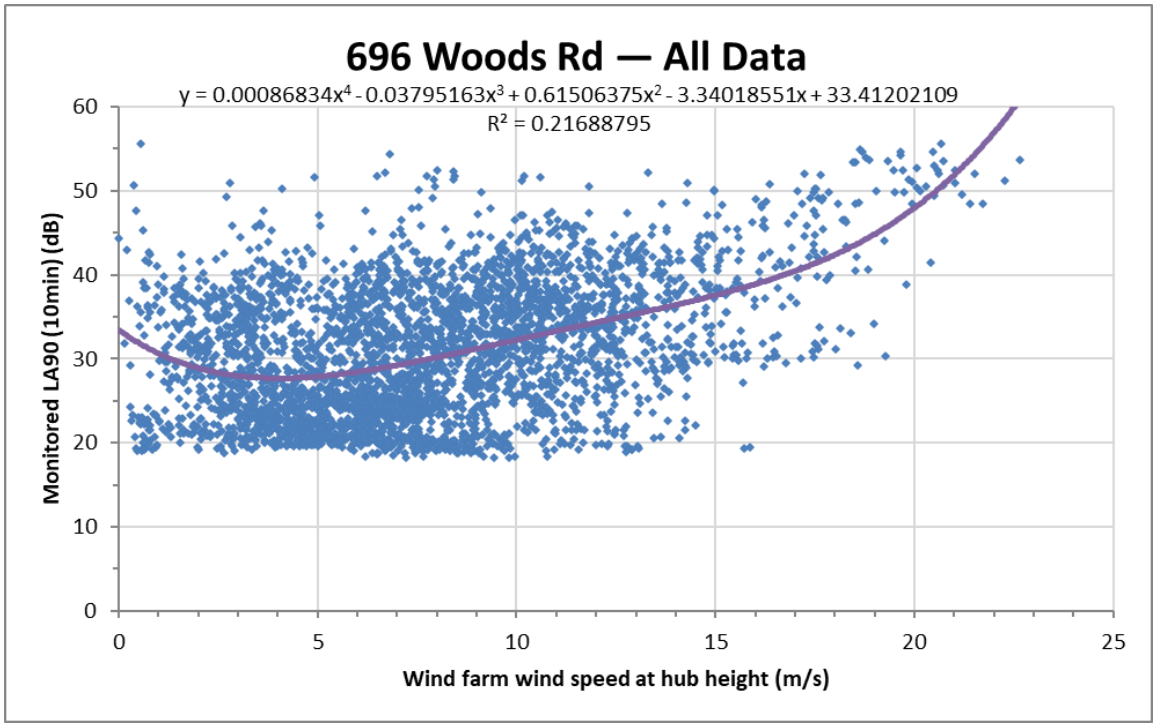


Figure 4 – Background Noise Measurements at 696 Woods Road

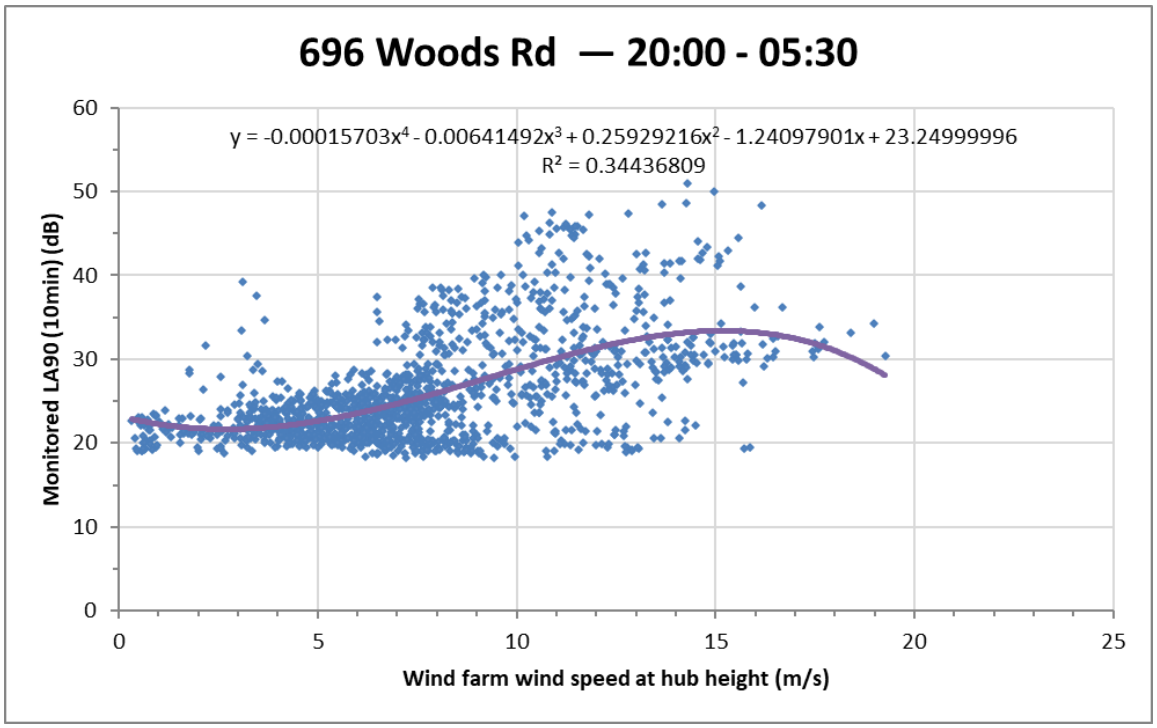


Figure 5 – Background Noise Measurements at 696 Woods Road, Night-time Only

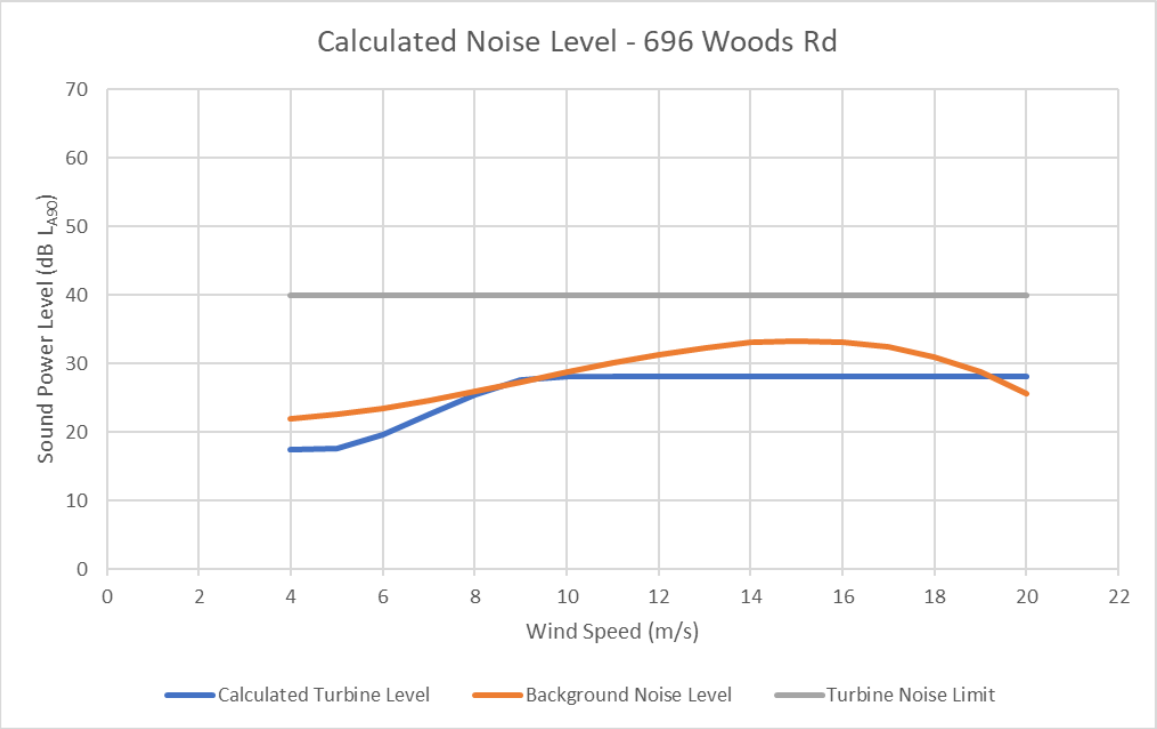


Figure 6 – 696 Woods Road Turbine and Background Noise Relationship

1288 Slopedown Road

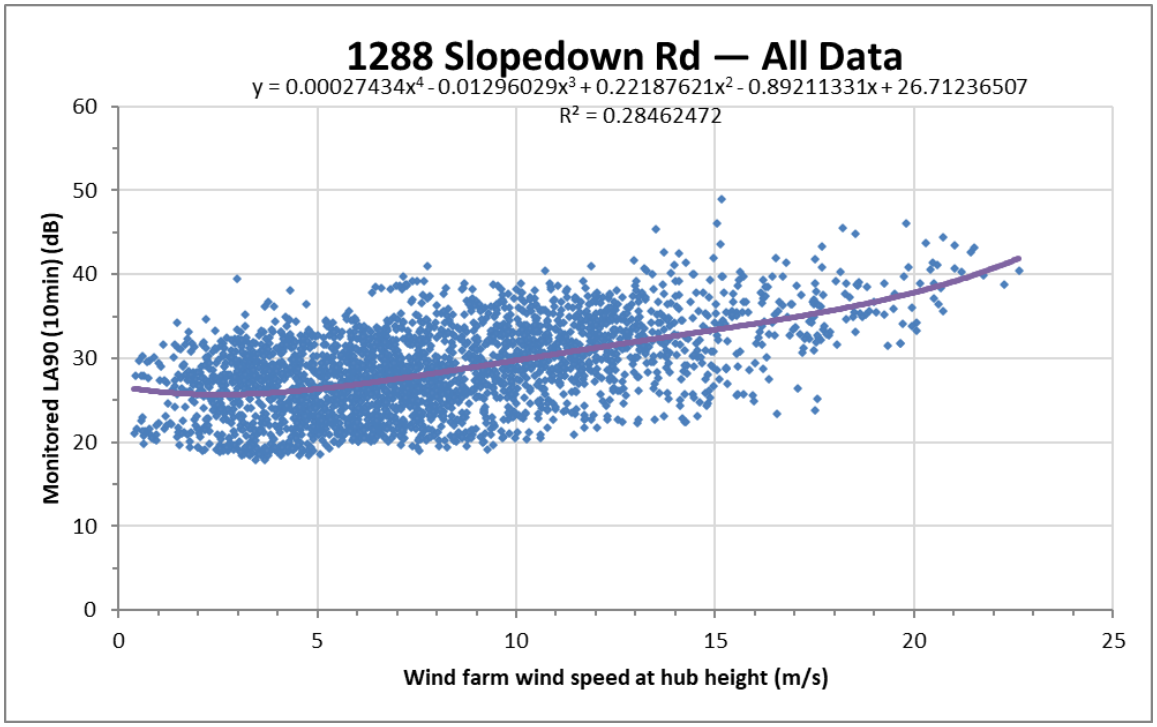


Figure 7 – Background Noise Measurements at 1288 Slopedown Road

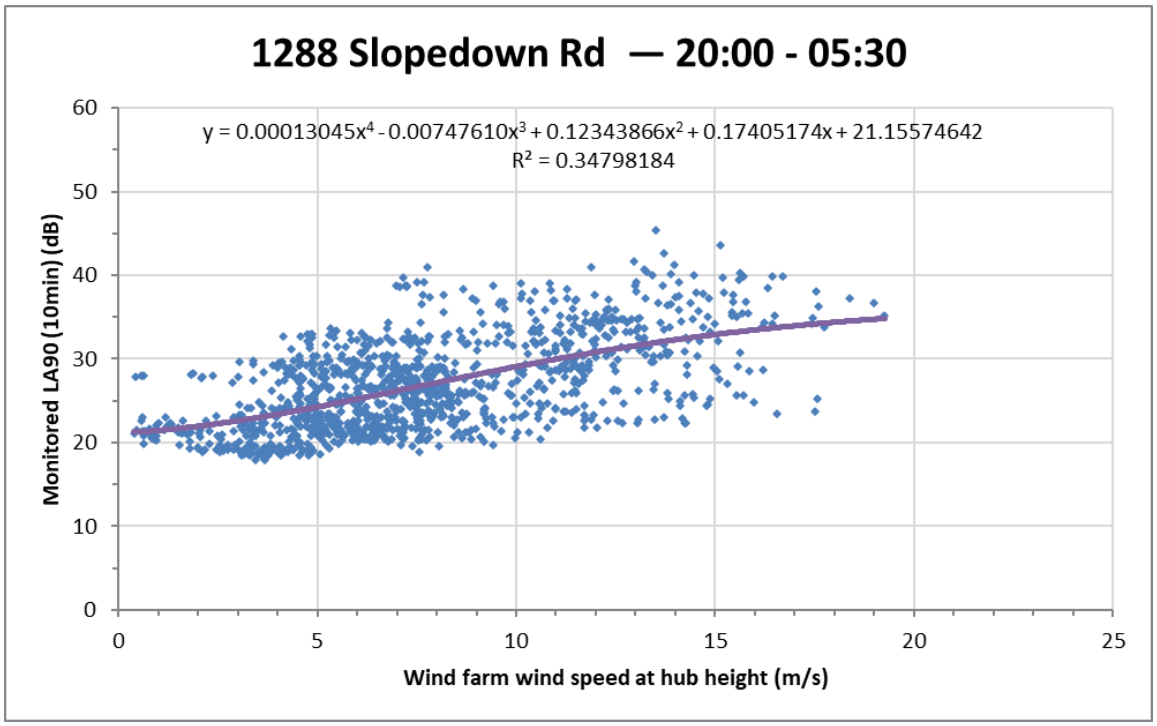


Figure 8 – Background Noise Measurements at 1288 Slopedown Road, Night-time Only

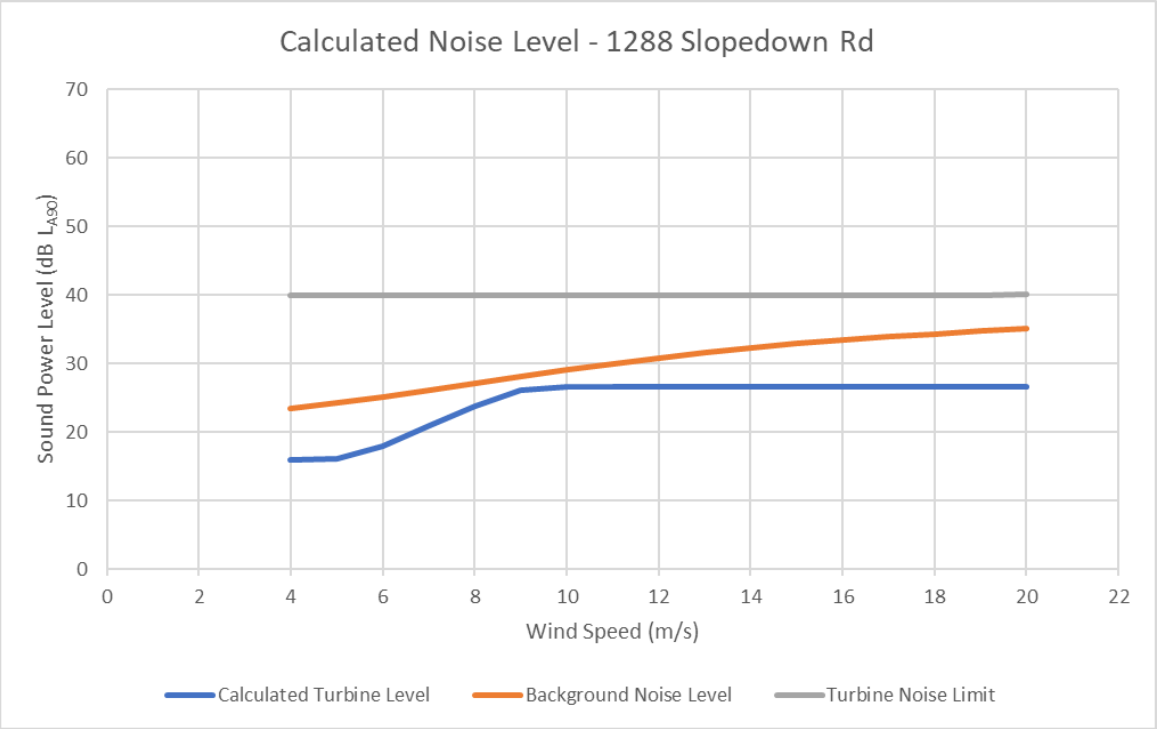


Figure 9 – 1288 Slopedown Road Turbine and Background Noise Relationship

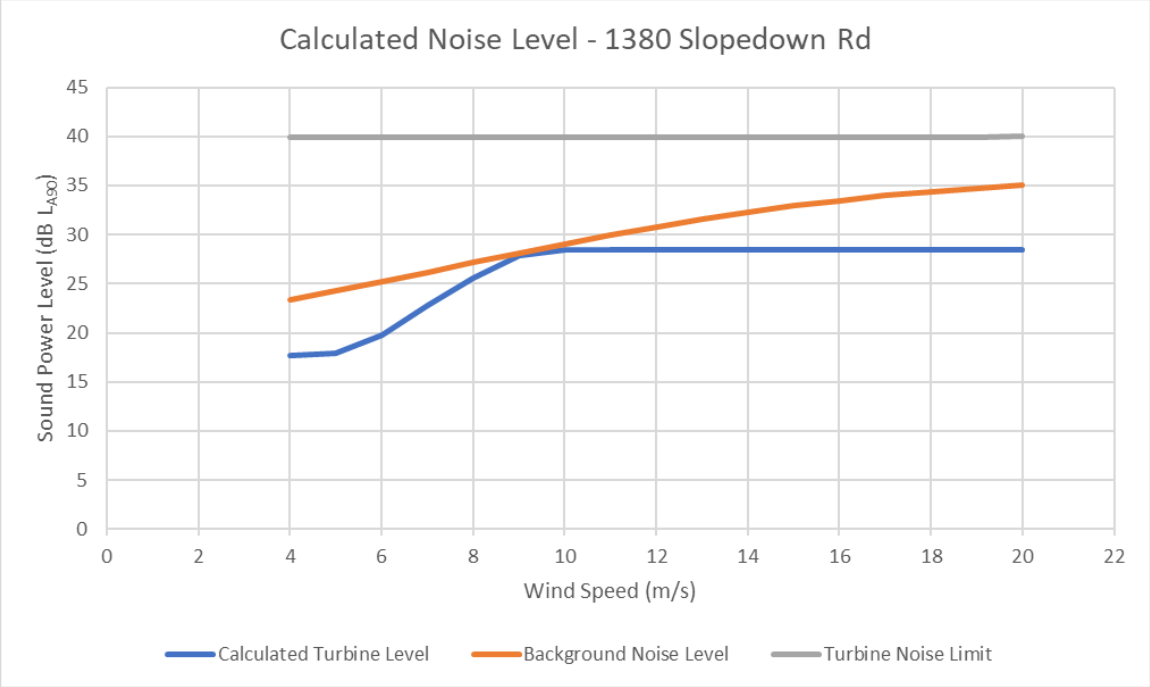


Figure 10 – 1380 Slopedown Road Turbine and Background Noise Relationship

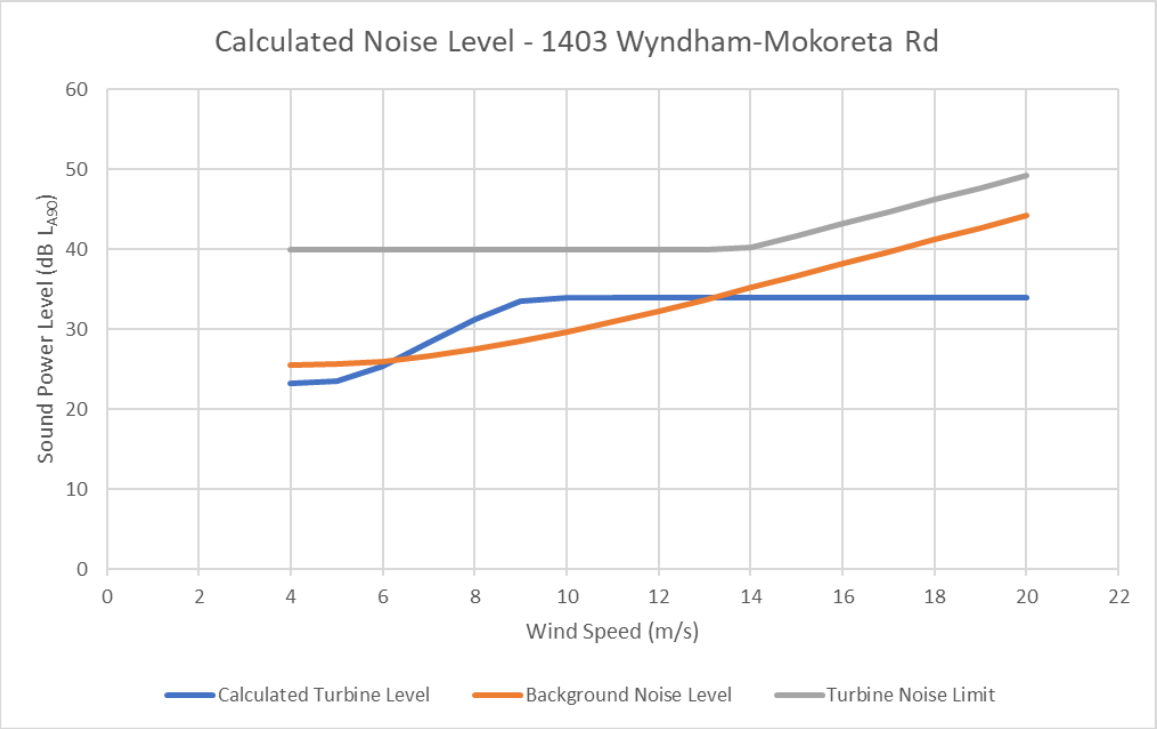


Figure 11 – 1403 Wyndham-Mokoreta Road Turbine and Background Noise Relationship

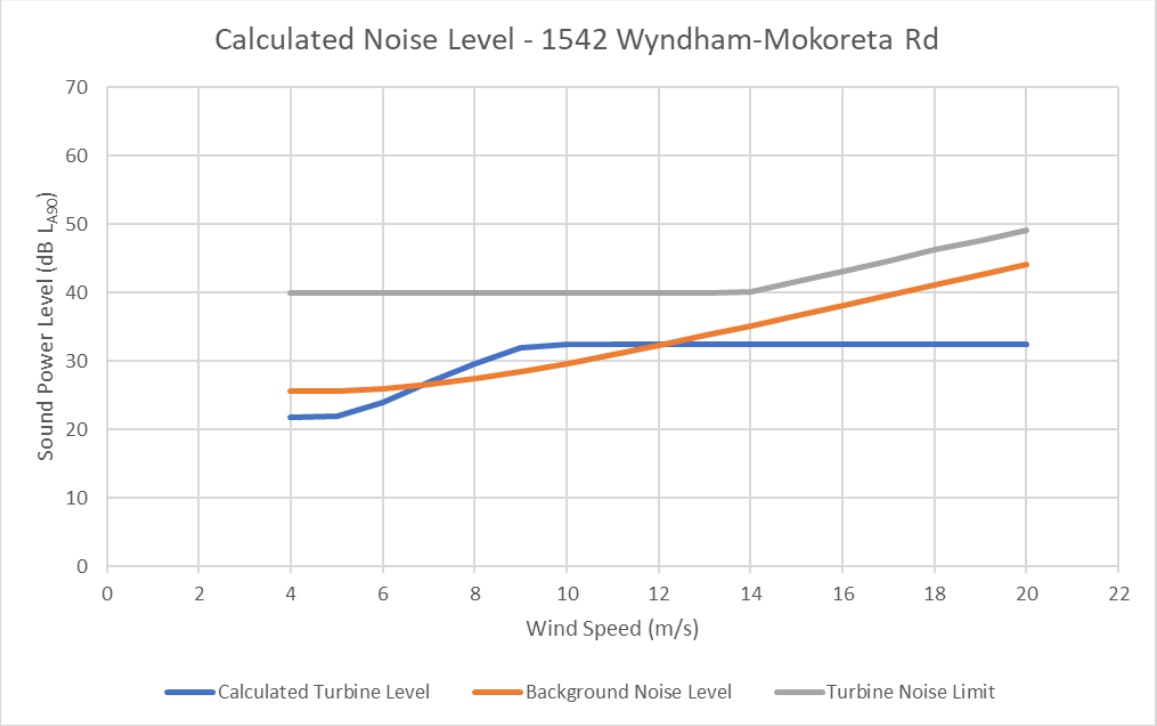


Figure 12 – 1542 Wyndham-Mokoreta Road Turbine and Background Noise Relationship