BEFORE A COMMISSIONER APPOINTED BY THE SELWYN DISTRICT COUNCIL

IN THE MATTER OF	the Resource Management Act 1991
AND	
IN THE MATTER OF	applications by KeaX Limited for resource consent to establish a solar array at 150 Buckleys Road, Brookside.

STATEMENT OF EVIDENCE OF WILLIAM REEVE

ON BEHALF OF THE APPLICANT

(ACOUSTICS)

Dated: 16 February 2024

KeaX Limited
Applicant
Campbell McMath
(campbell@keaenergy.nz)

Applicant
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1 INTRODUCTION

1.1 My full name is William Peter Reeve. I am employed as a Senior Acoustic Engineer with Acoustic Engineering Services.

1.2 I hold a Bachelor of Engineering with Honours from the University of Auckland. I am a member of the Acoustical Society of New Zealand.

1.3 I have over 12 years' experience in the field of acoustic engineering consultancy and have been involved with many environmental noise assessments on behalf of applicants, submitters and as a peer reviewer for Councils. My experience includes working for groups representing primary production interests in relation to noise and assessing energy infrastructure and other noise generating activities in rural catchments.

1.4 I was engaged by KeaX Limited in 2022 to undertake a noise assessment of a proposed solar array on Buckleys Road, Brookside. My assessment is based on data gathered from the following site investigations:

(a) I visited an existing KeaX Limited Solar Farm installation in the Wairau Valley and measured noise emissions there.

(b) I visited the subject site to observe the existing environment and deploy and retrieve ambient noise monitoring equipment.

1.5 In preparing this evidence, I have reviewed:

(a) The Application for Resource Consent and Assessment of Environmental Effects;

(b) All submissions as they relate to noise effects;

(c) The Section 42A report for Selwyn District Council including attached evidence from Jon Farren of Marshall Day Acoustics and recommended consent conditions;

(d) The 21 September 2023 Marshall Day Acoustics Peer Review.

1.6 Whilst this is a Council hearing, I acknowledge that I have read and agree to comply with the Environment Court's Code of Conduct for Expert Witnesses, contained in the Environment Court Practice Note 2023. My qualifications as an expert are set out above. Other than where I state that I am relying on the advice of another person, I confirm that the issues addressed in this statement of evidence are within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

2 EXECUTIVE SUMMARY

2.1 This Proposal is for solar panel arrays which will be connected to inverter / transformer skids distributed along a road which traverses the Site. The location for future batteries is relatively central within the Site, also along the road. At each skid location the air-cooling systems on the inverter and battery are expected to be the dominant source of noise.

2.2 The noise emitting items of solar farm plant would not operate outside of the 7 am to 10 pm daytime period defined by the PODP, seven days per week.

2.3 There will also be construction noise associated with the installation of the solar array and ancillary equipment. I have assessed noise from piling, civil works, panel construction and tree clearing which are expected to be the key stages.

2.4 I have undertaken ambient noise monitoring at the Site. This has confirmed that there are extended daytime periods where noise levels are between 38 – 48 dB $L_{Aeq\ (15\ min)}$, punctuated by occasional louder periods.

2.5 I have considered the results of this survey alongside the noise levels that the Partially Operative District Plan (PODP) deems appropriate in this environment, which is a daytime noise limit of 55 dB L_{Aeq} for a steady source, received at the notional boundary of residences.

2.6 I have also reviewed other guidance from NZS 6802:2008 and the World Health Organisation (WHO) which outline daytime noise limits

of between 50 and 55 dB L_{Aeq} for the reasonable protection of residential amenity.

2.7 When considering this, along with the relatively steady state nature of the noise source proposed, I consider that a 50 dB L_{Aeq} daytime limit for operational noise could be implemented as a reasonable control in this instance. This is more restrictive than the PODP limits and reflects the lower ambient noise environment. For completeness, a complementary night-time noise limit of 40 dB L_{Aeq} is also proposed.

2.8 For construction noise I consider it best practice to rely on the guidance outlined in the relevant New Zealand Standard 6803:1999 *Acoustics – Construction noise* (NZS 6803), which is used widely in New Zealand to control the effects of noise from construction activity and is the relevant standard in the PODP.

2.9 I have predicted operational noise levels expected from the equipment associated with the completed development, including future batteries, under worst case meteorological conditions. In this scenario the notional boundary of the dwelling situated at 324 Branch Drain Road is predicted to receive the highest operational noise level of 47 dB L_{Aeq}. All other dwellings will receive noise levels of 45 dB L_{Aeq} or lower.

2.10 There may be times during the day when noise from the solar farm is clearly audible in the areas outside those dwellings, depending on the weather conditions and the presence or absence of other sources of environmental noise, like noise from birds or animals and agricultural activity. However overall, I expect even for 324 Branch Drain Road, the noise will not interfere with typical domestic activities and the noise effects will be minimal.

2.11 Construction noise has been designed to comply with noise limits of 70 dB L_{Aeq} and 85 dB L_{AFmax} outlined in NZS 6803 at all the adjacent receiver locations.

2.12 I recommend implementing a Construction Noise and Vibration Management Plan (CVNMP) for use during the construction phase of the project. The CNVMP should be prepared taking guidance from NZS 6803 and specifically include an element of community relations management and controls for 324 Branch Drain Road.

2.13 The acoustic peer review and s42a report record agreement with the methodology and findings of my assessment, subject to the provision of appropriate conditions of consent. I agree that the conditions of consent proposed by the Selwyn District Council acoustic reviewer are appropriate, subject to minor changes regarding operational times.

3 SCOPE OF EVIDENCE

3.1 My evidence addresses:

(a) The proposed noise generating activities;

(b) The receiving environment;

(c) Assessment of the potential noise impacts of the proposal;

(d) The submissions which raise noise issues;

(e) The s42A Officer's Report in relation to noise; and

(f) The proposed conditions of consent.

4 NOISE GENERATING ACTIVITIES

4.1 The Proposal is for the construction and operation of a solar array on the subject site.

4.2 The panel arrays will be connected to inverter / transformer skids distributed beside a roadway, with a central location for future batteries. The "Single Skid" location allows for one inverter and one transformer. The "Twin Skid" locations allow for two inverters and one transformer. The plant items will be arranged near each other to allow easy connection.

4.3 The air-cooling systems on the inverter and battery are expected to be the dominant source of noise. While there will be audible noise from the transformer and switchgear near the equipment, at distance the noise from the cooling fans will be dominant. I understand that the fan on the inverter is variable speed but will operate in some capacity constantly during operating hours.

4.4 The solar farm will also include other sources of noise such as small electric motors for the tracking system, operation of the site office and intermittent vehicle movements relating to staff moving to and from the Site and undertaking maintenance inspections. I expect noise from

those sources will be inconsequential considering both the frequency of occurrence, and noise level generated.

4.5 Noise emitting items of solar farm plant will not operate outside of the hours of 7 am to 10 pm, seven days per week, and I have therefore limited my assessment of noise from the activity to that time-period.

4.6 I note that the PODP daytime operational hours commence half an hour earlier, and finish two hours later than the previous Selwyn District Plan daytime operational hours, which applied at the time the application was made (being 7.30 am to 8 pm). My evidence therefore assesses the Proposal on the basis of the daytime period as defined in the new PODP standards. This aspect is discussed further below.

4.7 There will also be construction noise associated with the installation of the solar array and ancillary equipment. I have assessed noise from piling, civil works, panel construction and tree clearing which are expected to be the key stages.

5 THE RECEIVING ENVIRONMENT

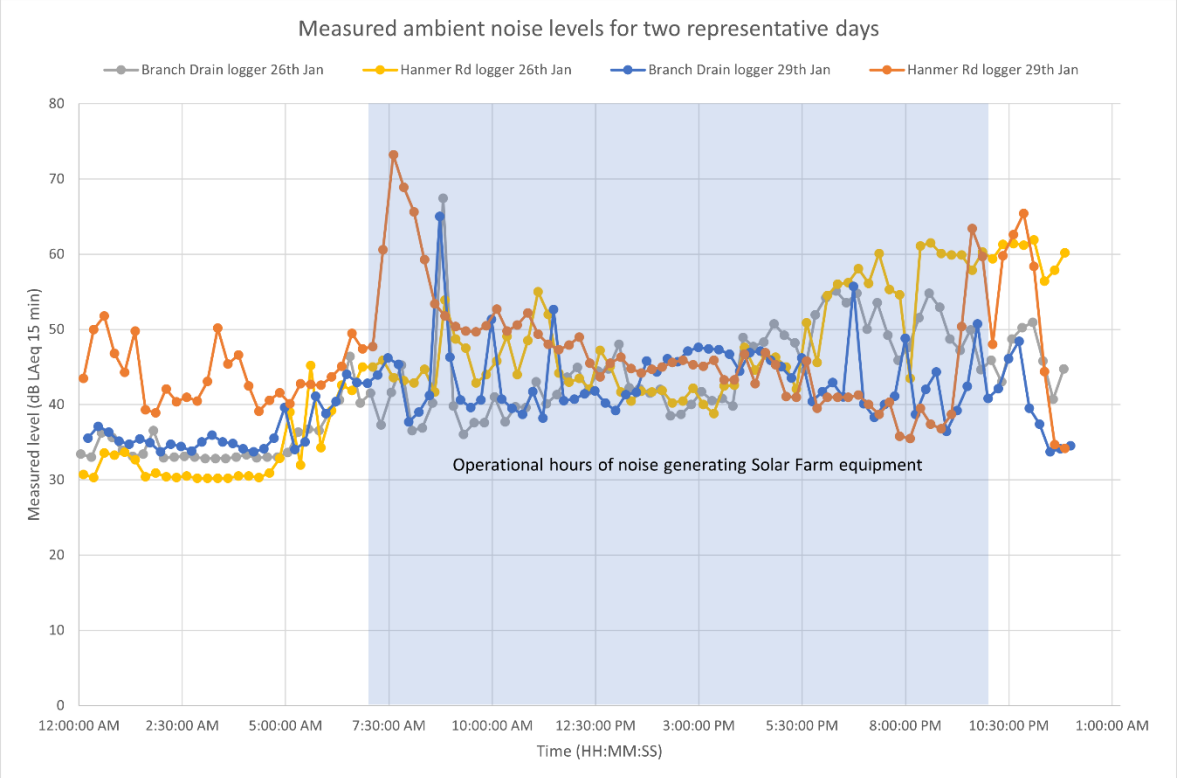
5.1 The Site and surrounding area are zoned General Rural under the PODP. The area is generally used for agricultural activities, with several dwellings in the wider area on a mixture of large and small land parcels.

5.2 To better understand the existing background noise environment in the area, I deployed noise monitoring equipment at two separate locations on the subject site on the afternoon of the 25th of January 2023 and collected this equipment on the 1st of February 2023. One noise logger was close to the western edge of the Site near 324 Branch Drain Road, and the second to the east near 870 Hanmer Road. These loggers recorded six days of data each, although on many days there were extended periods with moderate to high wind speeds.

5.3 During my visits to the Site, I observed that the existing noise environment was typical of a rural area distant from major roads in that it appears to be relatively quiet at times, with higher levels of sound associated with machinery and other rural activities present on a more transient basis.

5.4 The main contributors to the ambient noise environment, when wind speeds were low, were insects and birds, livestock, intermittent traffic on nearby roads and irrigator systems. Distant farm machinery was also audible at some locations. At higher windspeeds, wind generated noise in shelterbelts and other vegetation became more apparent. Some low-level electrical noise was observed close to the substation at the northwest extent of the Site.

5.5 I reviewed the monitoring data for days and periods when the wind speeds were relatively low during the proposed operational hours of the solar farm. This confirmed that in these conditions there are extended periods where noise levels are between 38 – 48 dB $L_{Aeq\ (15\ min)}$, often with several louder periods throughout the day. The results from two representative days are presented below. At higher windspeeds, there will be more noise induced by vegetation.



5.6 I note that the ambient monitoring does not demonstrate any notable change in background sound levels in the area between 7 and 7.30 am, or 8 pm and 10 pm. In this context, the proposed alignment with the PODP daytime hours is not expected to lead to any notable change in noise effects.

6 POTENTIAL NOISE EFFECTS OF THE PROPOSAL

6.1 I have considered what noise levels may be appropriate in this environment, based on reference to relevant accepted acoustic guidance and my further study of the existing noise environment in the vicinity of the site.

6.2 Under the PODP, the limits for noise received at the notional boundary of any dwelling on receiving sites are 55 dB L_{Aeq} between 7 am and 10 pm and 45 dB L_{Aeq} / 70 L_{Amax} outside these hours. Rural production activities using equipment which is mobile or portable during normal use is a permitted activity and not subject to these limits.

6.3 Because the PODP has exclusions for mobile rural production activities, it appears that the general limits are intended to apply to sources which are fixed in nature, for example a pump, machinery associated with a cowshed, or ventilation fans associated with a poultry farm.

6.4 NZS 6802:2008 *Acoustics – Environmental noise* outlines a guideline daytime limit of 55 dB $L_{Aeq\ (15\ min)}$ and a night-time noise limit of 45 dB $L_{Aeq\ (15\ min)}$ for *"the reasonable protection of health and amenity associated with the use of land for residential purposes"*. Where no time frames are given when noise limits apply, NZS 6802 prescribes the daytime period as between 0700 hours and 2200 hours (15 hours day, 9 hours night).

6.5 Guidelines for Community Noise, a document produced by the World Health Organisation (WHO) based on extensive international research recommends a guideline limit of 55 dB $L_{Aeq\ (16\ hours)}$ to ensure few people are seriously annoyed in residential situations. A guideline limit of 50 dB $L_{Aeq\ (16\ hours)}$ is recommended to prevent moderate annoyance. A guideline night-time limit of 45 dB $L_{Aeq\ (8\ hours)}$ is recommended to allow occupants to sleep with windows open.

6.6 The ambient measurement exercise I have described in paragraphs 5.3 to 5.5 confirmed that existing noise levels in the area will often be below the daytime noise limits outlined in the PODP and other guidance (50 – 55 dB L_{Aeq}).

6.7 When considering this, along with the relatively steady state nature of the noise source proposed, I consider that a 50 dB L_{Aeq} daytime limit could be implemented as a reasonable control in this instance.

6.8 For construction noise I consider it best practice to rely on the guidance outlined in the relevant New Zealand Standard 6803:1999 *Acoustics – Construction noise* (NZS 6803), which is used widely in New Zealand to control the effects of noise from construction activity and is included as a standard in the PODP.

6.9 Between 7:30 am to 6:00 pm on weekdays and Saturday, NZS 6803 outlines noise limits of 70 dB L_{Aeq}, and 85 dB L_{Amax} for long term duration activities exceeding 20 weeks. The noise limits are intended to be applied at 1 metre from the most exposed wall of dwellings.

6.10 Construction noise limits during the daytime are much higher than other general operational noise limits. NZS 6803 discusses how the provided limits provide for the *"reasonable protection of health and amenity"*, in the context of an activity which is inherently loud but occurs for a shorter duration. NZS 6803 notes that communities are often more tolerant of higher construction noise levels, provided they are no louder than necessary, and occur within appropriate hours of the day.

7 PREDICTED OPERATIONAL NOISE LEVELS

7.1 As outlined above, the most notable potential noise sources associated with the operation of the solar farm are expected to be the air-cooling systems on the inverter and batteries, along with some secondary transformer noise.

7.2 I have calculated the propagation of noise from these sources using computational noise modelling software SoundPLAN. This model implements the calculation standard ISO 9613 which means that predictions are representative of conditions favourable to sound propagation, such as light downwind conditions or ground-based temperature inversions.

7.3 All equipment, including the future batteries, has been modelled as operating at the same time.

7.4 I have used noise emission data for the equipment provided by the manufacturers for the inverter (a sound power of 98 dB L_{WA}) and battery (a sound power of 101 dB L_{WA}). The transformer noise levels have been predicted using guidance from the Australian and New Zealand Standard AS/NZS 60076.10:2009 *Power Transformers*. I have used a sound power of 75 dB L_{WA} for the single skid transformer and 78 dB L_{WA} for the double skid transformer.

7.5 A +5 dB penalty to the transformer noise levels has been applied to address the potential for special audible characteristics which is common from that source. No such penalty has been applied to the inverter or battery sources as I do not consider it likely the operation of these plant items would result in special audible characteristics.

7.6 This is consistent with my site visit to a similar KeaX installation in the Wairau Valley. This installation also has a similar skid arrangement with a single Power Electronics inverter, and a transformer. The inverter model is the previous generation of what is proposed on this site. In that case, the noise from the ventilation fan intake was dominant and not tonal.

7.7 324 Branch Drain Road is predicted to receive the highest operational noise levels, at 47 dB L_{Aeq}. All other dwellings will receive noise levels of 45 dB L_{Aeq} or lower. Noise from the operation of the Proposal will therefore be comfortably below a 50 dB L_{Aeq} daytime limit. It is also 8 dB below the PODP daytime limits.

7.8 While this noise level is well below the acceptable level in the zone, there may be times during the day when noise from the solar farm is clearly audible in the areas outside those dwellings, depending on the weather conditions and the presence or absence of other sources of environmental noise, like noise from birds or animals and agricultural activity. The noise levels inside those dwellings would be in the order of 10 to 17 dB lower (with windows open) than the external levels, depending on the aspect of the internal spaces. Overall, I expect even for 324 Branch Drain Road, the noise will not interfere with typical domestic activities and the noise effects will be minimal.

7.9 I also note, that for the following reasons, I consider the predicted levels are likely to be conservative, and noise levels will often be considerably below the predicted level:

(a) Both my measurements of the second-generation inverter at Wairau, and the manufacturers data for the third-generation inverter show that this source has some directionality. It is likely that the battery will exhibit similar characteristics. However, all sources have been modelled as dispersing sound uniformly in all directions.

(b) The third-generation inverter has a variable speed fan, and the manufacturers data indicates that noise levels reduce in the order of 10 – 12 dB, depending on orientation, when the fan speed is reduced.

(c) The modelling does not account for any local screening provided by the batteries or inverters to each other, or from the panel array itself. Indicative modelling shows that there will likely be a small inherent benefit from panel screening for some dwellings.

8 PREDICTED CONSTRUCTION NOISE LEVELS

8.1 I have predicted construction noise using four activity groups. These represent piling (using a piling rig and a truck), civil works (using an excavator, grader and truck), panel construction (using a telehandler, hand-tools and a truck) and tree clearing (using a chainsaw, loader and a truck).

8.2 The sound power levels for this equipment were sourced from British Standard BS 5228-1:2009 *Code of practice for noise and vibration control on construction and open sites*, and AES's noise source database.

8.3 While the construction activity will move around the Site, I have modelled the noise from each activity group at the closest distance to each receiver, to capture a worst-case situation. These predicted noise levels may only be received for a matter of days at any one location.

8.4 I understand there could be more than one piling rig used on the Site concurrently, however the piling teams would be spaced apart and there would not likely be a noticeable increase in the cumulative noise level from piling at any one receiver location. I have assumed that the

piling rig may be driving for 30% of any given 15-minute assessment period.

8.5 Solar panels have been setback from 324 Branch Drain Road to enable construction noise levels to comply with the noise limit of 70 dB L_{Aeq} and 85 dB L_{AFmax} at all the adjacent receiver locations.

8.6 While the noise from construction activity can comply with the noise limits, the duration of the construction activity, and the likelihood that noise levels will at times be significantly higher than the background noise levels, means that it is appropriate to be considerate of neighbours to minimise noise effects as far as practicable. I therefore recommend implementing a Construction Noise and Vibration Management Plan (CNVMP) for use during the construction phase of the Proposal. The CNVMP should be prepared with consideration of the guidance from NZS 6803 and specifically include an element of community relations management.

9 SUBMISSIONS

9.1 Noise is raised as a matter of general concern in submissions and I have paraphrased concerns below and provided a response.

9.2 Submissions by Robinson at 79 Buckleys Road, and Haurere Farms Ltd appear to raise concerns about the possibility of sleep disturbance due to the proposed activity – referencing the WHO guidelines. Since the key noise generating aspects of the activity will only operate during the daytime period, I am not sure whether these concerns relate to unease about rest during the daytime period, or a misunderstanding about the proposed operational hours.

9.3 The WHO Guidelines for Community Noise outlines a 45 dB $L_{Aeq\ (8\ hour)}$ threshold, to allow residents to sleep with windows open without experiencing disturbed sleep. This is a night-time control.

9.4 In this case, predicted daytime noise levels are 45 dB L_{Aeq} or below at all existing dwellings in the vicinity of the Site, except for 324 Branch Drain Road, which has a predicted level of 47 dB L_{Aeq}. This demonstrates how low the predicted levels are – in that they generally meet a night-time standard at most dwellings even during the daytime

period. As I have noted above, I also consider my predictions to be conservative.

9.5 I also note that the underlying District Plan limits, and other wider guidance do not typically provide any protection for sleep during the daytime, and this would be unusual due to the restrictions it would place on normal activities. Ambient noise monitoring has also confirmed that daytime noise levels in the area are often higher than the WHO Guideline values.

9.6 The Kewish submission (324 Branch Drain Road) includes a request for sound barriers / walls around inverters. Local screening of inverters has been considered previously when inverters were proposed to be distributed across the Site – including closer to this dwelling. Under the current proposal, similar noise levels have been achieved without screening, by locating noise generating equipment in a more central location on the Site.

9.7 Previous investigations have shown that due to the height of the noise source, the required access clearances around equipment, and the number of sources, it is difficult to achieve a noticeable reduction in noise level with practical screening configurations (either at source or receiver). As I have discussed above, one of the conservatisms inherent in my predictions is that, no screening has been allowed for the batteries to each other, when this will likely occur due to the clustered central location.

9.8 The submission from Haurere Farms also raises a more general concern, noting *"noise pollution generated by the solar panels has the potential to cause serious harm to the health of those surrounding land users, especially where residential activities are being undertaken".*

9.9 Other submissions also raise general concerns around health impacts (Casey) along with potential changes in rural amenity (Robinson, Casey, Kewish) and concerns around the "acoustics in area" (Krygsmann).

9.10 These submissions do not provide enough detail to understand to what degree concerns about amenity or health impacts are related to noise emissions.

9.11 Regarding the Haurere Farms submission, the WHO guidance I have referred to earlier in my evidence is concerned with avoiding moderate noise effects on the typical population. I accept that there will be a different individual response to the same noise due to many factors including subjective noise sensitivity, attitude to the noise generator and the like.

9.12 However, the noise levels I have predicted, on what I consider to be a conservative basis, are below the thresholds discussed in this guidance for protection against levels of annoyance in the community. I consider the proposed noise limits to be a reasonable and conservative control given the ambient noise monitoring I have undertaken at the site.

10 SECTION 42A OFFICER'S REPORT

10.1 Mr Richard Bigsby prepared the section 42a report for Selwyn District Council (SDC) in relation to KeaX Limited's land use consent application. On acoustic matters, Mr Bigsby relies on the acoustic peer review undertaken by Mr Jon Farren of Marshall Day Acoustics.

10.2 Mr Farren generally records agreement with the methodology and findings of my assessment, subject to the provision of appropriate conditions of consent. Mr Bigsby accepts that adverse noise effects would be appropriately mitigated by the conditions of consent Mr Farren has provided, and a set of Recommended Conditions of Consent is provided in Appendix J to the section 42a report.

10.3 Conditions 15, 16 and 19 relate to construction noise and require a Construction Noise and Vibration Management Plan to be provided to and certified by Council. This Plan would need to demonstrate that the piling methodology selected and mitigation employed is the best practicable option. Compliance with the Construction Noise Standards in NZS 6803 would be required by Condition 19. I agree that this represents a reasonable set of construction noise and vibration controls for this site.

10.4 The construction work hours specified in Condition 13 are consistent with the Application and would limit work to weekdays between 7.30 am and 6 pm. This generally aligns with when the PODP (by referencing NZS 6803) has the most lenient 70 dB L_{Aeq} noise limit for long term construction noise. However, the same limit also applies on

Saturday (again between 7.30 am and 6 pm). Further discussion with the Applicant has identified that enabling construction activities on Saturdays will likely reduce the overall length of time it takes to complete some key noise generating activities such as piling – which could be perceived positively by nearby receivers. I recommend the condition is revised to enable this flexibility.

10.5 I also note that 6803 also has "shoulder periods" between 6.30 am – 7.30 am and 6 pm – 8 pm when the limits are not as permissive as during core daytime hours but would typically allow for lower noise set-up / machinery maintenance type activities – particularly where the setback to receivers is large. It may be beneficial to update Condition 13 so that it does not preclude low noise construction activities from occurring at these times. I have suggested a possible wording to Ms Kelly.

10.6 Mr Farren has suggested a monitoring condition to confirm the operational noise levels and that the overall noise generated will not attract a +5 dB penalty for special audible characteristics. While I think this is unlikely to be the case, I agree that it is reasonable to include this provision.

10.7 I generally agree with the noise limit condition Mr Farren has proposed for operational noise from the site (Condition 17 in Appendix J to the s42a). However, as described earlier in my evidence, I recommend that the daytime and night-time hours are updated to reflect the current daytime provisions in the PODP.

11 **CONCLUSION**

11.1 My key conclusions are as follows:

(a) Operational noise levels associated with the solar farm are predicted to be well below the PODP noise limits at the relevant receivers.

(b) The Applicant is willing to adopt a set of noise limits which are 5 dB lower than the PODP limit. I consider this to be a reasonable and conservative control given the ambient noise monitoring I have undertaken at the Site.

(c) My analysis confirms that noise from construction activity can comply with the noise limits outlined in NZS 6803 and the PODP.

(d) Given that construction noise levels will at times be significantly higher than the background noise levels, I recommend implementing a CNVMP for use during the construction phase of the project. The CNVMP should be prepared with consideration of the guidance from NZS 6803 and specifically include an element of community relations management.

(e) The acoustic peer review generally records agreement with findings of my assessment, subject to appropriate conditions of consent. The Applicant is willing to adopt the conditions proposed by the acoustic reviewer, with some changes to reflect updates to proposed operational times.

William Peter Reeve

16 February 2024