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Boolynamiscaune,

Miltown Malbay,

Co Clare

20/06/2026

ACP File Reference: PAX 03.324270

Description: Proposed windfarm within the townlands of Tooreen, Fahanlunaghta Glendine North, Curraghodea, Silverhill, Cloghaun More, Letterkelly, Doonsallagh East, Knockalassa, Slievealoughaun and other townlands, Co. Clare.

Dear Sir/Madam

I hereby wish to make the following observation on the proposed windfarm referenced above. The observation is arranged according to the following:

- 1. Background**
- 2. Existing SI Callan Wind Turbine Noise**
- 3. Residential Amenity/Over Proliferation of Turbines**
- 4. Groundwater and Private Domestic Wells**
- 5. H199**
- 6. Telecommunications/TV Signals/Aviation**
- 7. Shadow Flicker**
- 8. Hen harrier**
- 9. Peat Slippage/Soil Stability**
- 10. Grid Route over Private Lands**
- 11. Summary**
- 12. Expert Reports**

1. BACKGROUND

The history of three refusals and two withdrawals for this wind farm proposal must carry significant implications for this latest application. There is a strong and well-documented pattern of unresolved concerns, suggesting that the underlying issues relating to visual impact, environmental pollution risks, peat slippage, loss of residential amenities, endangerment of protected species, etc. have not been adequately addressed through successive iterations. It is understandable that the planning authorities may scrutinise the latest application with heightened scepticism. The current application attempts to

demonstrate substantive material changes in circumstances and design that could justify a different planning decision outcome on this occasion. It totally fails in this respect. Repetition alone does not strengthen a case, it just reinforces the fact that this development is fundamentally incompatible with planning policy and the receiving environment. The current application must be viewed as a cosmetic alteration rather than a genuinely revised proposal.

The Developers, as expected, have almost exclusively concentrated their efforts on attempting to address the three issues on which ABP refused permission in May, 2024. It is now claimed that new studies have led to revised proposals that will somehow cause ACP to change their minds.

It is noteworthy that Clare County Council (CCC) twice refused planning permission for this development and in doing so cited additional refusal reasons beyond those of ABP, including negative impacts on residential amenity and property values in the vicinity. I wholeheartedly agreed with all the reasons for refusal from both ABP and CCC. However, I must confess to being a little disturbed that ABP did not concur with CCC on the potential negative impact on the residential amenities of local residences.

2. EXISTING SL CALLAN WIND TURBINE NOISE

The relevance of the existing Sl Callan windfarm is crucial in the overall context of the Slieveacurry proposal. In my immediate area Sl Callan and Slieveacurry are separated by a valley that is less than 1km wide. Our homes are to be encircled on 3 sides by gigantic turbines. Our experience of Sl Callan turbines has been dreadful. For us the Slieveacurry wind farm would be a mere extension of the Sl Callan windfarm.

Since becoming operational in 2018, the nearby Sl Callan windfarm has been the subject of multiple noise complaints to CCC and elsewhere. It appears that the only relevant action taken by CCC was requesting consultants to re-measure noise levels at a nearby dwelling. Many locals viewed this process as shambolic as the consultants tasked with doing the reassessment were already closely associated with, and contracted to, the company (MKO) that prepared the EIAR and carried out the initial sound assessments at the EIAR preparation stage. The obvious absence of impartiality led to widespread disillusionment in the local community leading many people to conclude that making noise complaints to CCC was a waste of time.

The location of my home H134 (V95PNX2) makes it a prominent Noise Sensitive Location due to its location and proximity to a number of existing turbines. It is impacted to the south and west by up to at least 10 Sl Callan turbines. H134 is also highly susceptible to the proposed Slieveacurry turbines with several additional turbines just a short distance away

across the valley. Noise from these turbines can only add to the prevailing noise levels and H134 and other houses in the immediate vicinity.

Grave doubts about the operation of the Sl Callan windfarm were highlighted in a report by noise consultant Dick Bowdler, a Noise Consultant, Chartered Engineer and Chartered Physicist. Mr Bowdler totally contradicted the methodologies being used to justify the noise levels from Sl Callan. His report is also attached below (Bowdler Report).

Getting increasingly frustrated with noise levels and the lack of any meaningful enforcement action, I began doing basic sound measurements on my own some years ago. Purchasing basic dB meters initially, I gradually began to invest in, and in some cases, borrow more sophisticated and sensitive noise monitoring equipment.





Irrespective of the type of equipment being used, it quickly became apparent that the SI Callan turbines were operating at noise levels that were several dB above what is permitted in the Grant Of Planning Permission.

The relevant condition in question here is Condition 13 in the Grant of Planning Permission.

“During the operational period, noise levels resulting from the operation of the wind turbines, when measured at the nearest inhabited house, shall not exceed 43dBa. (15 mis Leq.) All sound measurements shall be carried out in accordance with ISO Recommendation R 1996 “Assessment of Noise with respect of Community Response as amended by ISO Recommendations R1996 1”

In 2023, a neighbour and I were able to secure a meter of the type and grade that was similar to that used by many consultants preparing windfarm noise measurements and predictions in EIARs. Over a short period of time, we regularly obtained sound levels approaching and exceeding 70dB in our immediate locality. It was then decided that we needed to have the Sl Callan turbine noise measured and assessed professionally, despite the massive personal costs involved. This happened in Sept/October 2025. The results contained in this report confirmed everything we suspected about the Sl Callan noise levels from the very first day they became operational in 2018. The report is attached below. (Huson Report H134 V95PNX2)

The professional that carried out the assessment is Les Huson of Huson & Associates, who is an eminent engineer and acoustician. He has expert standing based on his credentials - W Les Huson BSc (Hons) MSc CPhys MInstP MIOA MAAS.

The assessment was carried with the support of the neighbouring O'Halloran family and the Communities & Environmental Protection Alliance.(CEPA)

The professional assessment carried out at H134 must be seen as been totally objective:

- The professional involved had no vested interest in a particular outcome.
- The assessment occurred at random.
- Aside from the few people directly involved, nobody knew it was happening.
- The professional did not have any access or control as to the operation of the wind turbines.
- Assessment dates were set months earlier. Weather conditions could not have been anticipated.

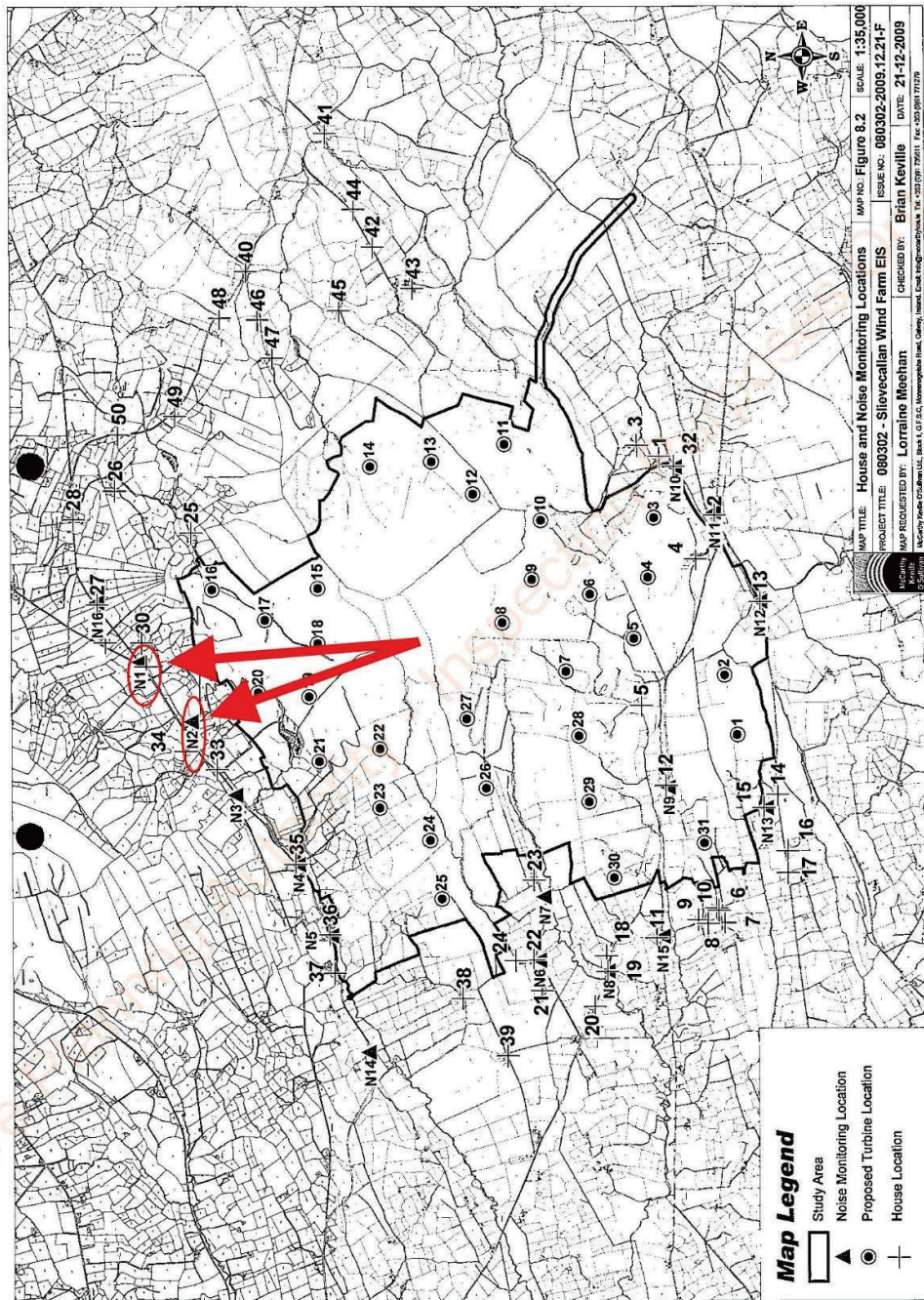
The report speaks for itself. There is nothing for me to add other than the fact that my long-held suspicions about noise levels have been totally confirmed.

Nonetheless, I feel it important to refer to the time interval from 3.00am on 3/10/25 to 3.00pm on 5/10/25. This is a 60-hour (2.5-day) time interval. In these two and a half days the levels never fell below 43 dB and on one occasion approached 70dB. It is remarkable how closely these professionally obtained noise levels concurred with the levels I was getting with the basic sound meters.

I did not just measure the noise at my own properties. I took many reading that showed excessive sound levels in the townlands of Boolynamiscaune, Letterkelly, Clohanbeg,

Clohanmore, Booluduff and Cloonanaha (adjacent to school and church). I also measured sound levels at my properties (H039) and (H200). Readings at all of these locations were regularly in excess of 50dB. I paid particular attention to two areas on and close to the R460 in Boolynamiscaune townland to the north of the Sl Callan turbines. These were the locations (N1 and N2) where noise assessments were carried out back at the time of the EIAR preparation for the Sl Callan windfarm application in 2009/2010.

The results contributed to the accumulating evidence as to the variance between actuality and prediction. I was getting noise levels up to 25dB above those predicted in the EIAR.



This map is from SI Callan EIAR: 8.3.3.1.2 Identification of Monitoring Locations

The levels of noise I recorded at N1 and N2 were truly astonishing and bear no resemblance to what was predicted in EIAR. These noise levels, coupled with those achieved by Huson at nearby H134 clearly demonstrate that the SI Callan noise predictions were totally non

representative of what currently exists. Why are we expected to trust that the Slieveacurry predictions are any better?

Noise prediction location N1 is particularly noteworthy. This location is feet away from a dwellinghouse that is among those most severely impacted by the turbine noise. A resident regularly sleeps in her sitting room because the turbine noise in her bedroom is just too excessive. Her bedroom is located to rear of house and suffers maximum exposure to the turbine noise. The proposed Slieveacurry turbines, being larger and more imposing, are to be located directly to the front of this dwelling at distances of approx 1Km. It is reasonable to expect there will be a similar impact to the front of the house as what currently prevails to the rear. The likely outcome is that this house may be uninhabitable.

Consultants preparing the EIAR assessments and predictions are allowed to take readings at one location and present them as being representative of a whole area. Recognising the impracticality of measuring noise levels at each and every house, the same consideration must be bestowed on others who have had a professional assessment at one residence. It must be accepted that the noise levels at H134 are equally representative of noise levels for dozens of houses in the surrounding area.

At various stages of the EIAR when referring to mitigation, the Developers via their consultants loudly profess that noise (and shadow flicker) is **entirely controllable**. We, the residents impacted by Sl Callan have seen little or no evidence of noise or shadow flicker ever being controlled, despite the litany of complaints being made. The windfarm operators and their local contacts are acutely aware of the noise level situation. One local resident has had court appearances relating to the impact of noise at his home. It would be reasonable to expect that the noise levels would be **controlled** with a view to lessening the burden on this particular home and others. There is no evidence of any such initiative having ever taken place on the part of the windfarm operators, monetary inducements apart. The Planning Authorities need to dwell on the implications of the noise being controllable and the potential for the “doctoring” of results in any noise assessment where the windfarm operator has any input into, or knowledge of an assessment being undertaken. This is why the assessment undertaken at H134 by the independent consultant without the knowledge of the windfarm operators must be viewed as the actual objective reality.

The residents impacted by Sl Callan noise levels are highly sceptical of predicted noise levels from Slieveacurry. These residents are influenced by the actuality of what they live with daily as opposed to predictions that totally underscore what happens in reality. We are mindful that it was the same consultants and developers who had predictions of dB levels in the 30s and 40s for Sl Callan when the actuality is dB levels in the 60s and 70s. Scepticism is entirely justified.

It is to be noted from the EIAR account of the pre-planning meetings that ACP requested that a **Robust Noise Impact assessment to be undertaken**. It might be expected that fresh noise measurements at the 5 documented locations would be undertaken or that other

additional locations would be added. Might it have been reasonable to expect that an additional noise monitoring station would have been added at or in close proximity to one of the residential locations that has been the source of noise complaints from the existing Sl Callan windfarm?

12.3.5.5 of the EIAR on Cumulative Assessment Screening states that:

All existing, permitted and proposed wind turbine developments must be considered cumulatively in the noise impact assessment.

Considering the fact that there are 60 hour periods where Sl Callan turbine noise levels have continuously remained way above the permitted levels (Huson Report H134 V95PNX2), it is difficult to understand how the “accumulated” noise levels from both wind farms combined, can even remotely align with the predicted noise levels in the EIAR.

It is my contention that the developers have not complied with the ACP request for a robust noise impact assessment to be undertaken. The assessment carried out is dated and flawed in many respects. The assessment methodology where Sl Callan turbine noise is factored out of measurements can hardly be consistent with obtaining overall cumulative noise levels. The absence of the presentation of measurements including Sl Callan noise indicates that the disclosure of such measurements may not be in Developer’s interests.

Sceptical about the accuracy of the Slieveacurry noise methodology employed, the local community have also commissioned Les Huson to carry out an independent peer review of the Slieveacurry noise assessments and predictions. This report is also attached. (Huson Peer Review Slieveacurry Noise Predictions)

This review also speaks for itself and casts serious doubt on the various methodologies used. I just want to refer to a couple of items referred to in the peer report.

It is particularly noteworthy that Mr Huson would identify the following issue that the EIAR ignored. On the northern edge of the Sl Callan windfarm there is a steep, almost vertical slope that extends roughly east-west for several hundred metres. Mr Huson refers to this as an escarpment. He proposes that this almost vertical escarpment has the ability to reflect (echo) sound back in the direction of houses such as H039 and others to the north of R460 and expose them to additional noise and sound effects. He is absolutely correct. Growing up in H039, it has indeed been my experience that sounds from the Slieveacurry/Curraghodea hilltop echoed back from the steep escarpment on the Sl Callan side of the valley. This was noticeable for a variety of sounds ranging from working machinery all the way to human voices. It was particularly obvious under certain weather conditions. The proposed Slieveacurry borrow pit on the brow of the hill at Curraghodea proposes to excavate over 100,000 m³ of rock by various means including use of explosives and the operating of heavy machinery. In addition to the works on the adjoining turbines, similarly located, this process will likely stretch out over an extended period. During this construction

phase houses like H039 and others will not just have the direct sounds from the construction, they will also have continuing echoes that will make the overall situation intolerable. When construction finishes, these houses will have direct turbine noise and echoes for an additional 35 years corresponding to the operating phase of the windfarm prior to decommissioning. This is a serious issue and one that has not been addressed in the EIAR. It demonstrates the perceptiveness and expertise of Mr Huson relative to his peers who prepared the EIAR.

Secondly, I have always felt that a sufficient land mass has not been secured for this proposed windfarm. Despite the impression created in the maps, the land mass is insufficient for a development of this scale, it is severely impacted by the absence of lands of non-participating landowners. These nonparticipating landowners have had lands included in the Study Area which gives rise to a number of additional issues.

The proposed turbines are mostly crammed on a ridge, and it now emerges that Mr Huson is contending that they are too close together. This has serious implications; one of these being that the noise from the turbines will likely be even greater as a result.

The ability to rely on the conclusions arrived at by Huson in his reports has given renewed hope to the impacted residents. CCC will be provided with a copy of these and other reports detailing the breach of planning conditions. It is to be expected that CCC will initiate enforcement proceedings on the operators of the Sl Callan windfarm. Should the council not proceed in this manner, then residents are looking at all alternative legal options including injunctions. Furthermore, it is with keen interest that we note recent judgements in Ireland whereby windfarm operators have had Nuisance judgements against them in the courts.

3. RESIDENTIAL AMENITY/OVER PROLIFERATION OF TURBINES

At the outset we need to look at the objectives stated in the EIAR with regard to impacts on the receiving environment.

Note: Extracts from EIAR in italics in the following sections

“The purpose of this EIAR is to document the current state of the environment on and in the vicinity of the Site and to quantify the likely significant effects of the Proposed Project on the environment. The compilation of this document served to highlight any areas where mitigation measures may be necessary in order to protect the surrounding environment from the possibility of any negative impacts arising from the Proposed Project.

As stated in the EPA Guidelines an assessment of the likely impacts of a development is a statutory requirement of the EIA process”

I would contend that the EIAR has utterly failed to accurately document the current state of the environment. Likewise, they have failed to quantify the likely significant effects of the

Proposed Project on the environment. While there are a multitude of shortcomings, I refer in particular to the issues of existing noise levels and the ignoring of several private domestic wells.

Additionally in the EIAR, the Developers regularly cite aspects of policies of the Clare County Development Plan. Particularly relevant are the objectives:

To strike an appropriate balance between facilitating renewable and wind energy related development and protecting the residential amenities of neighbouring properties;

It is the objective of the Council to support, in principle and in appropriate scales and locations, the development of wind energy resources in County Clare.

Included in the refusals of June 2021 and Jan 2022, CCC concluded that:

1. Height, scale and siting of the turbines proposed being prominent on the landscape and seriously injuring the visual amenities of the area thereby contravening Objective CDP 13.2 of the Development Plan.
2. Noise and disturbance generated from the turbines, cumulatively with other windfarms would seriously injure the amenities of residential property. The turbines would be visually overbearing and thus depreciate property values. The proposal is therefore contrary to Objective CDP 8.40 of the Development Plan.

As stated already, it is concerning that ABP did not concur with these aspects of the CCC decision when delivering their own decision in May 2024. Perhaps ABP relied on findings submitted by Developer consultants in arriving at their conclusion on the issue of the preservation of residential amenities. The Developers are submitting reasons as to why they believe that the ABP refusal reasons should be reversed. Well, the local community opposing the development hereby wishes to also submit findings with the objective of adding additional reasons for the refusal of this proposed development.

The loss of residential amenity due to the over proliferation of wind turbines is a particularly hot topic in the local and wider community at this time. From just a handful of people objecting to the Sl Callan “community” wind farm in 2010, we now have over a thousand people involved in objections to 3 local proposed windfarms ie Slieveacurry, Slievenalicka and Illaunbaun. What has caused this massive shift in public opinion locally? Personally, I feel it is the actual experience of having an existing windfarm in our locality. The experiences have been overwhelmingly negative with regard to Sl Callan. For our community, the so called “Community” windfarm has proved to be the greatest source of division in living memory. There is the fear of over proliferation and saturation and there is a shared feeling that enough is enough. According to the EIAR:

“A total of 19 applications relating to wind energy were identified within 25km of the Proposed Turbines”

People have heard the noise, have experienced the shadow flicker and the overbearingly visual overload of industrial turbines on an elevated serene rural landscape. The prospect of additional turbines that are 50m taller than the existing ones is horrifying for many people.

There is widespread horror that a local woman sleeps in her sitting room rather than her bedroom because of turbine noise that we were assured would be virtually inaudible. Other members of a family leaving their home at 3am due to turbine noise does not inspire confidence that developer consultants can be trusted. Chapters in an EIAR churning out reams about the preservation of residential amenities do little more than infuriate. There is huge anger towards the local authority for not enforcing planning conditions for which they have responsibility. A further source of acute anger is that the local community have to personally hire and fund independent noise experts with the legitimate feeling that this is something the Local Authority should be doing on our behalf. Accumulate these issues and it is easy to see why community antipathy towards the proposed Slieveacurry wind farm is at an all-time high.

4. GROUNDWATER AND PRIVATE DOMESTIC WELLS.

(extracts from EIAR in italics)

Sections of Chapter 9 in the EIAR deal with groundwater and the potential impact on private wells. This section shows a particularly high level of incompetence and indifference with regard to the assessment of risks to private wells in the region.

The EU Water Framework Directive and the opinion of the HSE need mention at the outset.

The WFD's Water Action Plan 2024 requires that all member states protect and improve water quality in all waters, with the aim of achieving Good status by 2027 at the latest. Any new development must ensure that this fundamental requirement of the WFD is not compromised.

It must be concluded that WFD refers to private wells in the context of the protection and improvement of **all** waters. It must also be concluded that where a new development is almost certain to contaminate private wells, then the WFD directive is not being adhered to.

HSE contribution

"The Proposed Project has the potential to have a significant impact on the quality of both surface and ground water. All drinking water sources, both surface and ground water, must be identified. Public and Group Water Scheme sources and supplies should be identified in addition to any private wells supplying potable water to houses in the vicinity of the Proposed Project. Measures to ensure that all sources and supplies are protected should be described". "Any potential significant impacts to drinking water sources should be assessed. Details of bedrock, overburden, vulnerability, groundwater flows, aquifers and catchment areas should be considered when assessing potential impacts and any proposed mitigation measures".:

Previous iterations of the EIAR totally ignored the existence of private wells. It is unbelievable that the current EIAR does exactly the same thing. The existence of several domestic wells has already been pointed out in prior objections and observations relating to this planning application.

The EIAR concludes:

There will be no impact on private wells as a result of the Proposed Project.

I guess if you ignore the wells, it is easy to arrive at that conclusion.

There are no wells with a locational accuracy of $\leq 50\text{m}$ mapped by the GSI within 1km of the Proposed Wind Farm Site.

Registration of Domestic Use Only Wells with GSI is not mandatory. The presentation in Figure 9.7 as a comprehensive picture of the domestic wells in this region is utterly unbelievable. If the Developers were interested in private wells, it should not be that difficult to check which dwellinghouses are connected to Group Water schemes and by implication work out that the remainder are dependent on private wells. It would be a valuable and sensible scoping exercise that obviously was not carried out.

However, due to the relatively shallow nature of the deepest excavations (3.5 - 8m), the hydrogeological regime and the $>500\text{m}$ setback distance from potential wells, significant effects on private wells are unlikely.

The conflation of the locations of dwellinghouse and private well setbacks is truly astonishing and shows a complete lack of understanding of reality. There is the assumption that if a house is at a setback distance of $>500\text{m}$ from a turbine or borrow pit then somehow the private well associated with this house must also be at a similar setback. It seems that the assumption being made is that the well is at the same location as the house or is on the “far” side of the dwellinghouse relative to the proposed development.

Let’s look at the reality on the ground for H039, H200 and H199. None of these properties are connected to a group water scheme and are entirely dependent on private wells. Wells are located as pictured below and are very close to proposed borrow pit, turbine 5 and the proposed grid route.



● Approx private well locations

Most of the wells in question are closer to a proposed borrow pit/turbine than they are to the actual dwellinghouses that they serve. They are located on elevated ground to facilitate a “gravity” flow of water down the gradient. This water supply arrangement for these properties has pertained for perhaps hundreds of years. There are at least 3 other wells that are similarly located that traditionally served houses now derelict. In some cases these wells are the primary water supply for livestock on these lands. Considering that many houses are being renovated due to the housing shortage and the generous restoration grants currently available, it would be very shortsighted to allow the destruction of these very viable water sources. The wells serving H039, H200 and H199 are within a few hundred metres of the proposed borrow pit. The well serving H199 is also in very close proximity to T5. It is inevitable that the construction works associated with this windfarm will pollute these wells. Being mindful of the proposed development and the potential risks, water samples from the wells are being collected and assessed on an ongoing basis.

An additional water source/well has been divined and earmarked to supply a derelict property that I own which is located not far from H039 and H200. This property has been ignored in the EIAR. It is on grounds that are considerably more elevated than H039 and H200.



Location: 52°51'34.49"N 9°17'21.74"W

To maintain a reasonable natural water pressure the well, by necessity, had to be in a more elevated position than the wells supplying H039 and H200. The position of this well is less than 100m from the proposed borrow pit and is also very close to T5. The application for the restoration of the vacant property under The Vacant Property Refurbishment Grant is currently in the pipeline. The property has been assessed by an engineer. The well will be constructed once the adjacent forest has been clear-felled. The licence for clear felling has already been issued and arrangements for the clear fell have already been made with a contractor.

The local Group Water scheme is not really an option here as the scheme does not come to the entrance for this property. I contend that it is my right as a landowner to place a well on my property at any location that is deemed optional by the appropriate professional. I do not feel that my options should be restricted by a potential polluting source on an adjacent property.

As this derelict house is already in close proximity to numerous Sl Callan turbines, its' desirability as a habitable location will be eliminated should the Slieveacurry windfarm be permitted. This property is located approx. 70m from the proposed grid route. Again, it has been totally ignored as regards any impact.

The grid route assessment also ignores the nearby private wells.

Due to the nature of the proposed 33kV underground cabling being mainly within the carriageway of public roads outside the Proposed Wind Farm Site and the shallow nature of the works, no assessment on potential wells located along the Proposed Grid Connection Site (public road or private land sections) was carried out due to the lack of potential effects.

The well serving H039 is less than 100m from the route of the proposed 33kV underground cable. As the cable route descends a steep gradient it also has the potential to pollute this well due to its sheer proximity.

Concrete and other cement-based products are highly alkaline and corrosive and can have significant negative impacts on water quality.

Thousands of tons of concrete are used in the foundation of a 175m tall turbine. Additionally, there will be tons of steel used for reinforcement. Nearby dwellinghouses have the prospect of tons of highly alkaline and corrosive concrete, in addition to tons of corroding steel being placed literally beside their private domestic wells, making pollution of the wells inevitable. Furthermore, the proposal is to leave this concrete and steel in the ground post decommissioning of the turbines. Many future generations are to be saddled with the burden and risk of this very badly thought-out proposal.

Potential health effects arise mainly through the potential for surface and groundwater contamination which can have negative effects on public and private water supplies.

Notwithstanding this, the Proposed Project design and mitigation measures ensures that the potential for effects on the water environment will not be significant. The Proposed Project will not give rise to significant effect on any potential down-gradient private wells for the following project design and geological reasons

The large set back distances between turbine and borrow pit location and downstream potential well locations due to project design (>500m);

This is nonsense. The location of wells is obviously unknown to the authors.

The short groundwater flowpath distances (30 – 300m);

An admission that a flowpath could be 300m is an admission that a private well within 300m of a borrow bit/turbine is at grave risk.

The Proposed Project design will involve relatively shallow excavations (3.5m -8mbgl) which are typically located on elevated ground where thereby lessens the true depth of the excavation;

This assertion is highly disputable in circumstances where the wells are also located on elevated ground.

The shallow excavation depths required for the Proposed Grid Connection Site underground cable route, etc

When a well is within 100m of the underground cable route, any excavation poses a risk.

In Chapter 2 Establishing The Cumulative Long List, Hydrogology and Hydrogeology the EIAR states that:

Due to the narrow nature of the proposed grid connection trench (~0.9m wide), a 250m buffer zone is an appropriate scale when considering potential cumulative effects on the water environment (End of CH 2 Background)

A 250m buffer zone considering cumulative effects? As already shown above, there are several wells and a restorable house ignored in the first 1.5km of grid route. There has been no meaningful assessment along this section of grid route to identify impacts.

5. H199.

This house has been included in the current EIAR, having been ignored in the previous EIARs. Perhaps its' location in close proximity to T5 was the motivation for its omission. It is an NSL and will also be severely impacted due to shadow flicker. Described as derelict, it still has electric and water utilities at hand. Cable broadband has been brought to the roadside entrance in anticipation of the impending renovation, presumably under The Vacant Property Refurbishment Grant.

EIAR on Residential Amenity

*Potential impacts on residential amenities during the operational phase of the Proposed Project could arise primarily due to noise, shadow flicker or changes to visual amenity. This will have a long-term significant negative direct effect on residential amenity..... The turbine locations have been designed to maximise turbine separation distances to dwellings in the area. **There are no Proposed Turbines within 700m (4 x tip height) of any sensitive receptors.***

Table 5.9 clearly illustrates that the emboldened statement above is factually incorrect in that there are 3 dwellings (sensitive receptors) at distances of less than 700m from the nearest turbine. H199 is particularly noteworthy in that **it is not the property of a participating landowner**. Indeed this actual distance is likely to be considerably less if the distance is taken to be a straight line as opposed to the distance calculated by following ground contours. The orientation of the turbine wingspan has the potential to reduce the effective separation distance even further.

Table 59 Maximum Potential Daily & Annual Shadow Flicker – Proposed Slieveacurry Renewable Energy Development, Co. Clare

House ID	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hours/week)	Max. Annual Shadow Flicker: Pre-Mitigation (hours/year)	Max. Annual Shadow Flicker: Adjusted for Average Regional Sunshine (hours/year)	Proposed Turbine(s) Giving Rise to Daily Shadow Flicker Exceedance	Mitigation Strategy Required (Daily)	Mitigation Strategy Required (Annual)
H023*	512883	681128	Dwelling	529	T2	01:26:00	179:48:00	54:56:20	T1, T2, T4, T5	Yes	Yes
H199	513358	680234	Dwelling	578	T5	00:33:00	24:14:00	7:24:17	T6	Yes	No
H023*	513394	680942	Dwelling	694	T5	00:48:00	38:15:00	11:41:15	T5	Yes	No
H021*	510900	679953	Dwelling	701	T3	00:43:00	122:24:00	37:24:00	T3, T6, T7, T9	Yes	Yes
H015	511947	681473	Dwelling	721	T1	01:24:00	106:56:00	32:40:27	T1, T2, T5	Yes	Yes
H200	513124	679838	Dwelling	726	T5	00:46:00	73:00:00	22:18:20	T6, T9	Yes	No
H035*	513408	680033	Dwelling	734	T5	00:00:00	0:00:00	N/A	N/A	No	No
H039	513135	679825	Dwelling	742	T5	00:46:00	72:27:00	22:08:15	T6, T9	Yes	No
H058	510961	678680	Dwelling	742	T7	00:00:00	0:00:00	0:00:00	N/A	No	No
H067	512875	681435	Dwelling	748	T2	01:05:00	91:06:00	27:50:10	T1, T2, T4, T5	Yes	No
H012	511286	681320	Dwelling	755	T1	01:00:00	102:34:00	31:20:23	T1, T3, T4	Yes	Yes
H020	512121	681532	Dwelling	791	T2	01:55:00	119:43:00	36:34:48	T1, T2	Yes	Yes
H046*	512787	679131	Dwelling	816	T6	00:51:00	75:56:00	23:12:07	T8	Yes	No
H040	513196	679763	Dwelling	809	T6	00:43:00	70:59:00	21:41:22	T6	Yes	No
H206*	512820	679156	Dwelling	812	T6	00:46:00	80:40:00	24:38:53	T8, T9	Yes	No
H057	510955	678584	Dwelling	816	T7	00:00:00	0:00:00	0:00:00	N/A	No	No
H022*	513494	681026	Dwelling	824	T5	00:42:00	40:35:00	12:24:02	T2, T5	Yes	No
H019	512018	681562	Dwelling	824	T1	01:35:00	98:12:00	30:00:20	T1, T2, T5	Yes	Yes
H207*	512834	679145	Dwelling	828	T6	00:41:00	67:50:00	20:43:37	T8, T9	Yes	No
H018	511977	681591	Dwelling	843	T1	01:22:00	84:25:00	25:47:38	T1, T2, T5	Yes	No
H016	511914	681606	Dwelling	847	T1	01:02:00	73:32:00	22:28:07	T1, T2, T5	Yes	No

It is difficult to have any confidence in an EIAR that so obviously, blatantly and repeatedly contradicts itself. The assertion that no property is within 700m of a turbine has been repeated on multiple occasions throughout the EIAR.

6. TELECOMMUNICATIONS/TV SIGNALS/AVIATION

It is noted with interest that the developers have seen the necessity to sign a protocol agreement with Dublin-based Broadcast and Communications company **2rn** regarding interference with TV and broadcast signals. Despite denials in previous EIARs that there would be any interference, the developers obviously have come to the de facto realisation that interference is very likely. The date of this contract is noteworthy (19/12/2024).

The same developers and consultants contracted a local dealer in 2010 at the time of the Sl Callan windfarm application. As this Local Dealer is still trading locally, it might have been expected that his company would have been contracted to deal with the fallout from Slieveacurry. In previous submissions, local residents called for this dealer to be scoped in the interests of giving the true picture as to the extent of the havoc caused locally to TV signals by the Sl Callan windfarm. Prior are currents submissions from locally impacted residents verify that Sl Callan has, and continues, to cause huge problems for TV and mobile phone communications.

This is from the EIAR for Sl Callan in 2010.

“The customer or viewer experiencing interference to television or radio reception will be requested to contact a Local Dealer, i.e. a television engineer or dealer who is considered to

be independent and to have the necessary skills and experience to assess the situation. The protocol document names John Flynn TV Rentals of Canada Cross, Miltown Malbay, Co Clare as the agreed upon Local Dealer. The Local Dealer will arrange directly with the viewer to make a visit to the viewer's house and assess the cause of the interference, and will take the necessary steps to remedy the interference. Following this, the Local Dealer will send a brief, written report to the windfarm developer and to RTENL. If the Local Dealer is of the opinion that the interference is due to the windfarm development, the Dealer will send an invoice in respect of the site visit and remedial work to the developer. If the Local Dealer identifies that the problem is due to some other cause, the Local Dealer will invoice the customer in the usual way."

Surely this Local Dealer is the best person to scope regarding existing interference and potential additional interference should Slieveacurry be permitted. Instead, there was widespread scoping which constituted meaningless box checking and a plethora of rhetorical queries. Was the Local Dealer not scoped because of what he might reveal?

I contend that The Local Dealer was purposely not scoped. If the Planning Authority need to get an accurate account of turbine impact on TV and telecommunications in the area since the commissioning of Sl Callan windfarm, there is nobody better placed to provide that other than the Local Dealer referenced above in the Sl Callan EIAR. Nonetheless the shift in the developer position on this issue is noteworthy and the local community are concerned and alarmed as to what lies ahead.

With regard to aviation the EIAR has chosen to ignore the concerns of the operator of the local airfield in Spanish Point. His concerns are well found judging by his previous submissions on this matter. ACP have asked the developers to take prior submissions into account. It is reckless and regretful that the concerns of the local airfield operator with regard to safety are being totally disregarded.

7. SHADOW FLICKER

If the Slieveacurry windfarm development is permitted, a number of local residences could be susceptible to shadow flicker multiple times on a given day. Add this to the incessant noise and this local valley sandwiched between Sl Callan and Slieveacurry windfarms will hardly be habitable.

It is with grave scepticism that I read of mitigation measures whereby turbines will be automatically turned off to protect residential amenities. The actuality of the situation is that in 8 years, my neighbours and I have never seen a Sl Callan turned off to prevent shadow flicker at a residence. I have several hours of recorded shadow flicker at a residence that completely corroborates this claim. Footage can be provided on request. Perhaps the

turbines and the technology have that capability but the fact that we have never seen it actually happen is perhaps a reflection of the contempt and disregard that the developers and operators hold for the local community. Why should we expect anything different from the Slieveacurry windfarm? The absence of any type of enforceable guarantee is what concerns many people. These particular windfarm developers in our area have a track record of ignoring planning conditions when it comes to noise and shadow flicker. The Local authority is either powerless or unwilling when it comes to any type of enforcement.

The shadow flicker issue should not be thought of just in terms of residences. We are an outdoor family and enjoy working and relaxing outdoors. We feel we should be able to enjoy all parts of our property and not be confined by something over which we have no control, no benefit from or no input into. Participating landowners signed documents acknowledging that their land would be subject to persistent and excessive shadow flicker. It is worth noting that nonparticipating landowners will have their lands equally subjected to excessive shadow flicker but have not been given any opportunity to indicate that the same exposure is acceptable to them. The prospect of our lands being subjected to prolonged exposure to shadow flicker negates any possibility of future commercial ventures involving outdoor recreational pursuits or activities.

I have good reason for having absolutely no confidence in the predictions for shadow flicker, any more so than what I have for noise assessments.

Table 5.9 on Maximum Potential Daily and Annual Shadow Flicker makes no sense and is a totally sloppy presentation.

-H199 and H035 are located in close proximity. H199 is predicted to have 33 mins per day but H035 has 0. Likewise H058, H057 and several others are also predicted to be 0. There are many other anomalies that are too numerous to mention.

With regard to the cumulative effect of shadow flicker, I wish to reference the aforementioned property at Location: 52°51'34.49"N 9°17'21.74"W. This property already experiences shadow flicker from 2 Sl Callan turbines. It will additionally be impacted by shadow flicker from 2 or possibly 3 Slieveacurry turbines. Due to the property being completely ignored, how can the claim of a proper cumulative shadow flicker assessment be entertained?

8. HEN HARRIER

Following repeated attempts to downplay the existence of the protected Hen Harrier at the Slieveacurry site, it seems that the developers have finally accepted that they exist at this location. Several local landowners are part of Hen Harrier protection schemes. Three local

landowners claim (2024 and 2025) to have four separate nesting pairs on their lands. All would have been willing to disclose the location of these nesting pairs to the people carrying out the studies, had the approach been made. The only evidence of a nesting pair from the EIAR surveys dates to 2021.

The proposals to “relocate” the Hen Harrier population are extremely suspect. If we are serious about Hen Harrier preservation, the only sensible approach is to leave them in their natural existing habitat without disturbance. Ethically, it is questionable if landowners, already paid to incentivise hen harrier preservation, should even be giving consideration to causing further endangerment to this protected species in order to facilitate a non-essential and divisive project.

It is hard to believe that areas in, and close to the existing Sl Callan windfarm, can be considered alternative viable and realistic hen harrier forage locations. The Hen Harrier is being encouraged back into an existing windfarm. A proposed windfarm is the reason why the relocation approach is even being considered. It is a novel solution to claim that a problem caused by a proposed windfarm is to be solved by an existing windfarm.

In the ABP Grant of Planning for the Sl Callan windfarm, Condition 5 states:

5. Prior to commencement of development, the developer shall enter into a written agreement with the planning authority under section 47 of the Planning and Development Act, 2000 (as amended) in respect of implementation and monitoring (by a suitably qualified ecologist or environmental scientist) of the Conservation and Habitat Management Plan (submitted to An Bord Pleanála on the 24th day of May, 2011). The said Conservation and Habitat Management Plan shall be adhered to throughout the site for the life-time of the wind farm development.

Reason: To protect the natural heritage of the area, including the hen harrier.

Is ACP satisfied with the results and details provided with regard to this Condition 5?

9. PEAT SLIPPAGE AND SOIL STABILITY

Previous grounds for the refusal of planning permission from ABP and Clare County Council have cited the risk of peat slippage. It is difficult to see how the additional safety measures outlined in this EIAR will make any realistic difference. The ghost of Meenbog in Co Donegal should haunt and taint these same consultants for years to come. It is more than a little ironic that they would refer to the lessons learnt from Meenbog as being an additional safety feature for Slieveacurry.

I contend that the obvious lesson to be learnt from Meenbog is that large industrial scale windfarms should not be placed in upland areas where the prevailing ground condition is dominated by deep peat.

Also ignored in EIAR is a historic landslide in 1906. The site of this landslide is a mere 1km from the proposed Slieveacurry windfarm. There are numerous accounts of this landslide in local papers.

10. GRID ROUTE OVER PRIVATE LANDS AND TRACKS

I would like to draw attention to the shortcomings in the description of the proposed Grid Route, particularly the part that is to run over private lands. It is described on several occasions throughout the EIAR.

15.1.2.4 Proposed Grid Connection Site

The proposed 33kV underground cabling will continue from the wind farm road to the proposed extension to the existing Slievecallan 110kV substation located in the townland of Knockalassa. The proposed 33kV underground cabling exits the Proposed Wind Farm Site through forestry for approximately 0.83km, onto a farm track for 0.55km before entering the public road corridor via the R460 Regional Road. It stays within the public road corridor for approximately 1.55km. The proposed 33kV underground cabling then exits onto existing private access tracks, following these for approximately 4.17km before reaching the proposed extension to the existing Slievecallan 110kV substation. The total length of cabling within the Proposed Grid Connection Site measures approximately 7.1km.

Earlier in this submission, issues have been highlighted regarding the omission of private domestic wells and a derelict house from the grid route assessment.

I now wish to dispute the portion that refers to 0.55km of farm track. I totally reject the categorisation of this roadway as a farm track. On exiting the R460 the first 260m of this “farm track” forms the entrance/driveway to H039, H200 and the derelict but to be restored property described earlier. This right-of-way has existed for hundreds of years. In 2024, following agreement with the landowner this driveway was fenced, landscaped and upgraded. The landowner, who is a participating landowner, is most certainly of the opinion that this roadway does not form part of the proposed cable route. In previous EIARs and applications, the route was photographed which might be expected to add clarity but which really just caused further confusion. On this EIAR, there does not appear to be any photographs included. Appendix 6 contains this sketch of this section of the proposed grid route.

It certainly shows that it is the intent of the developers to use this driveway that they falsely refer to as a farm track.



The response of the Department of Transport to the proposal to take the cable along R460 must be noted. In addition to pushing for the application of an additional 7 conditions, The Dept state:

“The possible effect on the remaining available road space (noting that there may be need to accommodate other utilities within the road cross-section in the future or additional drainage for climate adaptation) on potential future development.”

My driveway is no more than 10ft wide in certain sections. I feel I am due the same consideration with regard to available road space. I wish to reserve the ability to connect to a Group Water Scheme, should an extension to the scheme facilitate that in the future. It is becoming increasingly obvious that underground drainage will need to be installed as surface water following heavy rain continues to damage and erode the road surface. Broadband and Telephone lines are currently being carried by poles at the edge of this driveway. I would like to have the option of putting these lines underground in the future. My consent to use this driveway for a cable route has never been sought or obtained. I wish to put it on record that I intend to use every legal option at my disposal to ensure that my driveway will not be used as part of this cable route.

I feel that the Developers are being deliberately vague with regard to this section of cable route. Why the absence of detail? Why describe it as a farm track as opposed to a driveway serving a number of dwellinghouses? Why the absence of photographs that were previously included? I urge the Planning Authority to make this a further reason for the refusal of this development.

11. SUMMARY

We already have a problematic windfarm beside our homes. The proposed Slieveacurry windfarm is removed by approximately 1km the existing Sl Callan windfarm. This effectively will appear in the landscape as a mere extension of the existing Sl Callan windfarm though the new turbines are 50m higher. The problems with the existing windfarm will be exacerbated in terms of noise, shadow flicker and overbearing visual impact. The lack of governance as regards enforcement and policing of planning conditions is of major concern. Major concerns exist regarding peat stability, water course and private well pollution. This is an extremely worrying period for people who have heavily invested in new homes in this area. For our family I can attest to the acute disappointment of recently constructing a new house and now finding that it is now about to become a non-viable home. One cannot sit outdoors or even open a window due to the incessant noise. Proposals with regard to mitigation ring hollow as we feel there has been no attempt at mitigating for the considerable noise that already exists. This community has contributed sufficiently to renewable energy targets by already hosting one windfarm on our doorsteps. Anything beyond that is just a total over proliferation of wind turbines in this area and constitutes a disproportionate burden on this community. A refusal of permission for this proposed windfarm development is the only way:

“To strike an appropriate balance between facilitating renewable and wind energy related development and protecting the residential amenities of neighbouring properties”

11. EXPERT REPORTS

A) Huson Existing Noise Report for H134 (V95PNX2)

B) Huson Peer Review Slieveacurry Noise Predictions

C) Bowdler Report on Sl Callan Noise

Yours Sincerely,
Patrick & Gerardine Lafferty

A) Huson Existing Noise Report For H134 (V95PNX2)

L HUSON & ASSOCIATES

REPORT

NOISE SURVEY

V95 PNX2

CLIENT: Lafferty, O'Halloran, CEPA

Job No LHA468
January 2026

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NOISE SURVEY

V95 PNX2

EXECUTIVE SUMMARY

Data from a noise survey completed between 12 September 2025 and 5 October 2025 at V95 PNX2 (dwelling) has been analysed to test compliance with permitted noise limits for the Slieve Callan Wind Farm and to assess if annoyance can be caused due to the characteristics of the sound (amplitude modulation, AM; low frequency noise, LFN; tonality and impulsiveness).

AM, tonality, low frequency noise, and impulsivity have all been observed during the survey when the wind turbines are operating, as assessed using ISO 1996.

When focussing on the night time period to reduce extraneous noise there is evidence of excessive amplitude modulation and low frequency noise that, using multiple assessment methodologies, indicates annoyance will be caused.

Individual AM events have an impulsive characteristic that according to ISO1996 would warrant a penalty to the measured sound levels prior to assessing compliance with the specified rating limit (43 dB, $L_{Aeq(15min)}$).

A significant low frequency characteristic was found in the 160 Hz 1/3 octave band that shows amplitude modulation of more than 10 dB at levels that are clearly audible.

Furthermore, a tonal penalty of 4 dB was determined for a 165 Hz tone within the 160 Hz 1/3 octave band. If each penalty was to apply cumulatively the total penalty could exceed 12 dB.

The permitted rating sound level of 43 dB, $L_{Aeq(15min)}$ was exceeded on multiple occasions during the survey period at night when extraneous noise was minimised, without corrections for sound characteristics.

Overall, a minimum cumulative adjustment penalty of 6 dB should apply for the different audible characteristics observed that effectively means the permitted noise limit becomes 37 dB, $L_{Aeq(15min)}$.

Prepared by

W Les Huson BSc MSc CPhys MInstP MIOA MAAS

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INTRODUCTION

A noise survey was completed between 12 September 2025 and 5 October 2025 at V95 PNX2 for the purpose of assessing noise primarily associated with the Slieve Callan Wind Farm.

The Slieve Callan Wind Farm has 29 Nordex N90 2.5MW wind turbines. The nearest wind turbine is approximately 620m to the south of V95 PNX2.

MEASUREMENT EQUIPMENT

Sound level meter/logger:
SVANTEK 977D s/n 99744
Date next calibration due: April 2026

Field Calibrator:
CEL 120/1 s/n 2221119 No calibration drift was evident during the survey period.
Date next calibration due: 15 August 2026

ILFN recorder s/n 17006, located inside the eastern dwelling at V95 PNX2.

MEASUREMENT LOCATION

The measurement location is shown in Figure 1 having coordinates 29U 481419 E, 5856750 N (WGS84).



Figure 1: Noise Logger Location, approximately 12m from nearest building

Figure 2 shows the measurement location in relation to the nearest wind turbines of the Slieve Callan Wind Farm. Images courtesy Google Earth.

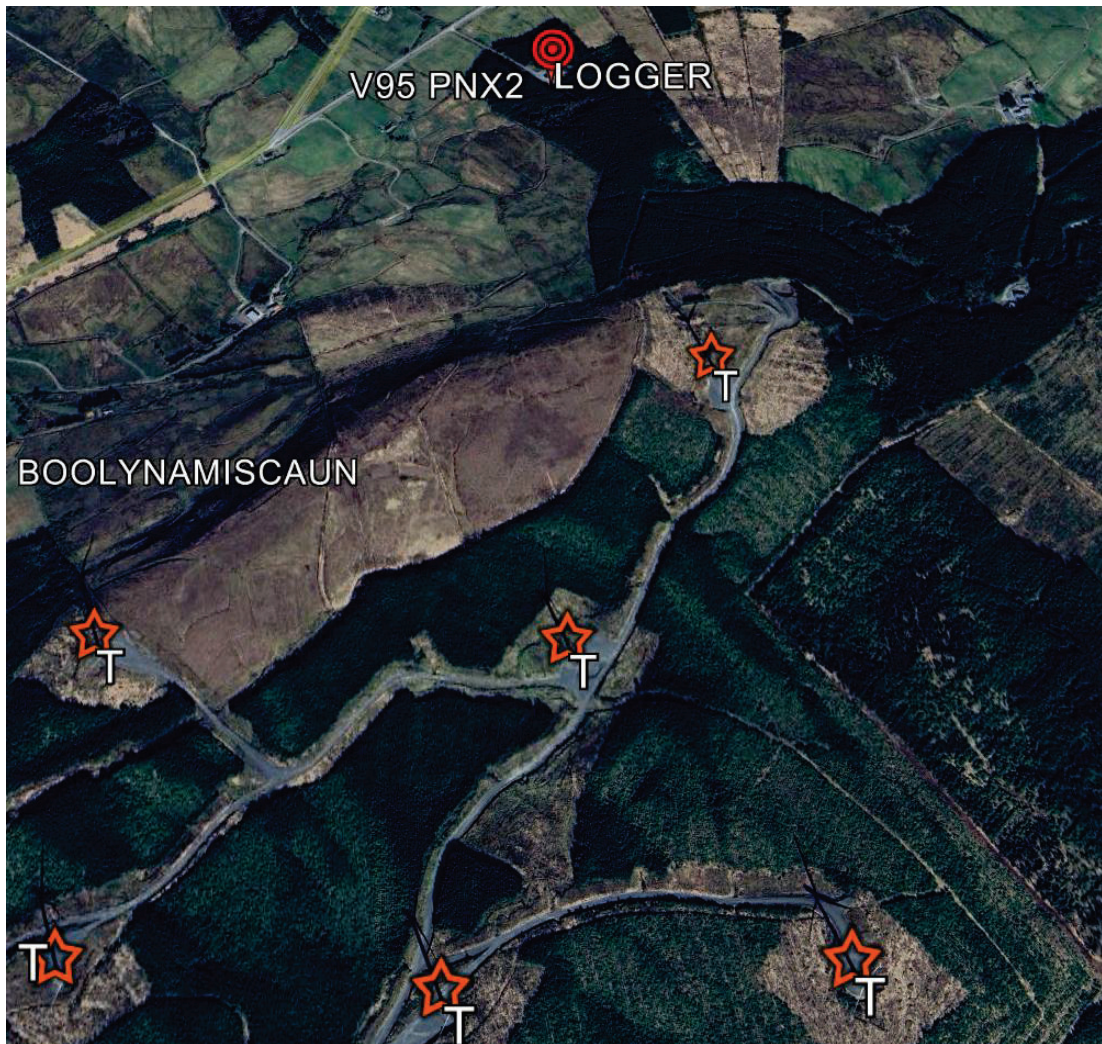


Figure 2 The nearest wind turbine is approximately 620m from dwelling



Figure 3 Photograph facing south of the logger installation and the nearest wind turbine.

NOISE LIMIT

Part of the development approval (An Bord Pleanála PL 03.237524, 22 August 2011) that relates to noise for the Slieve Callan Wind Farm is as follows:

"13. During the operational period, noise levels resulting from the operation of the wind turbines, when measured at the nearest inhabited house, shall not exceed 43dBA (15 minutes Leq). All sound measurements shall be carried out in accordance with ISO Recommendation R 1996 'Assessment of Noise with respect of Community Response' as amended by ISO Recommendations R 1996 1."

Development approval part 13 requires that the contribution of the operation of the Slieve Callan Wind Farm must not result in sound levels that exceed 43 dB(A) at any time. The 43 dB(A) noise limit is measured as an Leq value over a 15-minute interval, being the sound from the wind farm only, corrected for any characteristic of the noise such as tonality, impulsiveness, amplitude modulation or elevated low frequency.

The original ISO Recommendation R 1996, titled "Assessment of noise with respect to community response", was a foundational document for environmental noise regulation published in 1971. This recommendation has since been revised and replaced multiple times by the ISO 1996 series of International Standards.

The current standard is ISO 1996-1:2016, *Acoustics — Description, measurement and assessment of environmental noise — Part 1: Basic quantities and assessment procedures*. This version, confirmed in 2021, remains the current guidance and focuses on:

- Defining basic quantities for describing noise in community environments (e.g., equivalent continuous sound pressure level, sound exposure level).
- Describing basic assessment procedures to predict potential long-term annoyance responses from various noise sources (road traffic, aircraft, industrial, etc.).
- Providing adjustments to measured or predicted levels (called "rating levels") to account for specific sound characteristics like impulsiveness, tonality, amplitude modulation, and low-frequency content, which can increase annoyance.

ISO 1996-1 does not specify mandatory limits for environmental noise; instead, it provides the framework and principles upon which national authorities can develop their own standards and regulations.

In this instance, the authorities have set a rating value of 43 dB, $L_{Aeq(15min)}$ for the Slieve Callan Wind Farm. If sound characteristics warrant a 5 dB penalty to measurements then the compliance noise limit becomes 38 dBA (43 dBA minus 5 dB penalty).

The scope for the current ISO1996 describes the assessment methodology as follows:

“The sounds are assessed either singly or in combination, allowing for consideration, when deemed necessary by responsible authorities, of the special characteristics of their impulsiveness, tonality, and low-frequency content, and for the different characteristics of road-traffic noise, other forms of transportation noise (such as aircraft noise), and industrial noise.”

ISO 1996-2:2017 ‘Acoustics — Description, measurement and assessment of environmental noise Part 2: Determination of sound pressure levels’, Annex C (and related parts of ISO 1996-1), address low-frequency noise (LFN) by recommending methods to capture sound in lower frequency bands (like 1/3 octave bands) and by using metrics like the difference between C-weighted (dBC) and A-weighted (dBA) levels (C-A).

LFN significantly affects C-weighting but less so A-weighting, indicating potential annoyance even if A-weighted levels are low, with detailed assessment often involving indoor measurements and comparison to country-specific annoyance criteria.

Application of ISO 1996-1 and ISO 1996-2 to LFN

- **Frequency Analysis:** The standard guides users to analyse sound in specific low-frequency bands (e.g., 1/3 octave bands below 250 Hz or even lower) to identify dominant LFN components.
- **C-A Weighting Difference:** A simple indicator is the difference between the C-weighted sound pressure level (dBC) and the A-weighted level (dBA). A large difference (e.g., 15 dB or more) suggests significant low-frequency content that can cause annoyance, even if the dBA level is within limits.
- **Indoor Measurements:** LFN is often more perceptible indoors. Annex C discusses procedures for indoor measurements, acknowledging the need to account for building transmission loss, which varies with frequency.
- **Comparison with Thresholds:** Measured LFN levels (often dBC or band-specific) are compared against established annoyance thresholds or target values, which can differ by country (e.g., UK, Finland) and time of day (day/night).
- **Focus on Annoyance:** The objective is to assess impact. Annex C highlights that high C-A differences or specific low-frequency levels (like 44 dB at 160 Hz) outdoor can indicate annoyance, even if A-weighted levels are low.

ISO 1996-2:2017 (Annex C) shifts focus from overall A-weighted noise to detailed frequency analysis, using the C-A difference screening and indoor measurements to characterize and assess the annoyance potential of low-frequency sound components.

DATA ANALYSIS

$L_{Aeq,15-min}$ sound levels were measured throughout the survey period and the results are presented on a day-by-day basis in Figures 4 to 27. Above each L_{Aeq} chart is a spectrogram covering the frequency range below 35 Hz for each corresponding day measured indoor.

ISO1996 defines low frequency as “sound containing frequency components of interest within the range covering the one-third octave bands 16 Hz to 200 Hz”. This covers the frequency range from 13.9 Hz to 222.7 Hz.

Infrasound is generally considered to be sound containing frequencies below 20 Hz.

The infrasound and low frequency spectrograms show when the Slieve Callan Wind Farm was operating.

A spectrogram illustrates the frequency distribution of an acoustic signal, with colour coding used to denote variations in sound pressure level.

The vertical axis represents frequency, ranging from 0 Hz to 35 Hz.

Time is expressed along the x-axis in thousands of seconds with each spectrogram starting at midnight (UTC) for the next 24 hours on a given day.

Wind turbine noise contains a range of low frequency sounds when operating.

The repetition of low frequency sound pulses is related to the speed of rotation of the wind turbine blades.

When the rotor of a wind turbine turns the blades produce pulses at blade pass frequency and harmonics (the repetition rate that blades pass the tower and multiples of that repetition rate are called harmonics).

These harmonics present on a spectrogram as horizontal lines below 6 Hz, being multiples of the blade pass frequency (0.8 Hz, 1.6 Hz, 2.4 Hz etc.).

If the harmonics disappear then this indicates that the wind turbines have stopped spinning, either due to lack of wind or they have been intentionally stopped.

If these horizontal lines ‘wobble’ then this means that the wind turbine rotors are changing rotation speed slightly and the wind turbines would not be operating to produce maximum electrical power.

If a horizontal line changes in colour then the amplitude of the tone or pulse repetition at that frequency is changing in level (loudness).

The first and last figures (Figure 4 and Figure 27) show spectrograms covering less than 24 hours with Figure 4 starting at 7 pm, ending at midnight and Figure 27 ending at 3 pm.

Note: the spectrograms are in UTC but the L_{Aeq} charts are in summer time (UTC + 1hour).

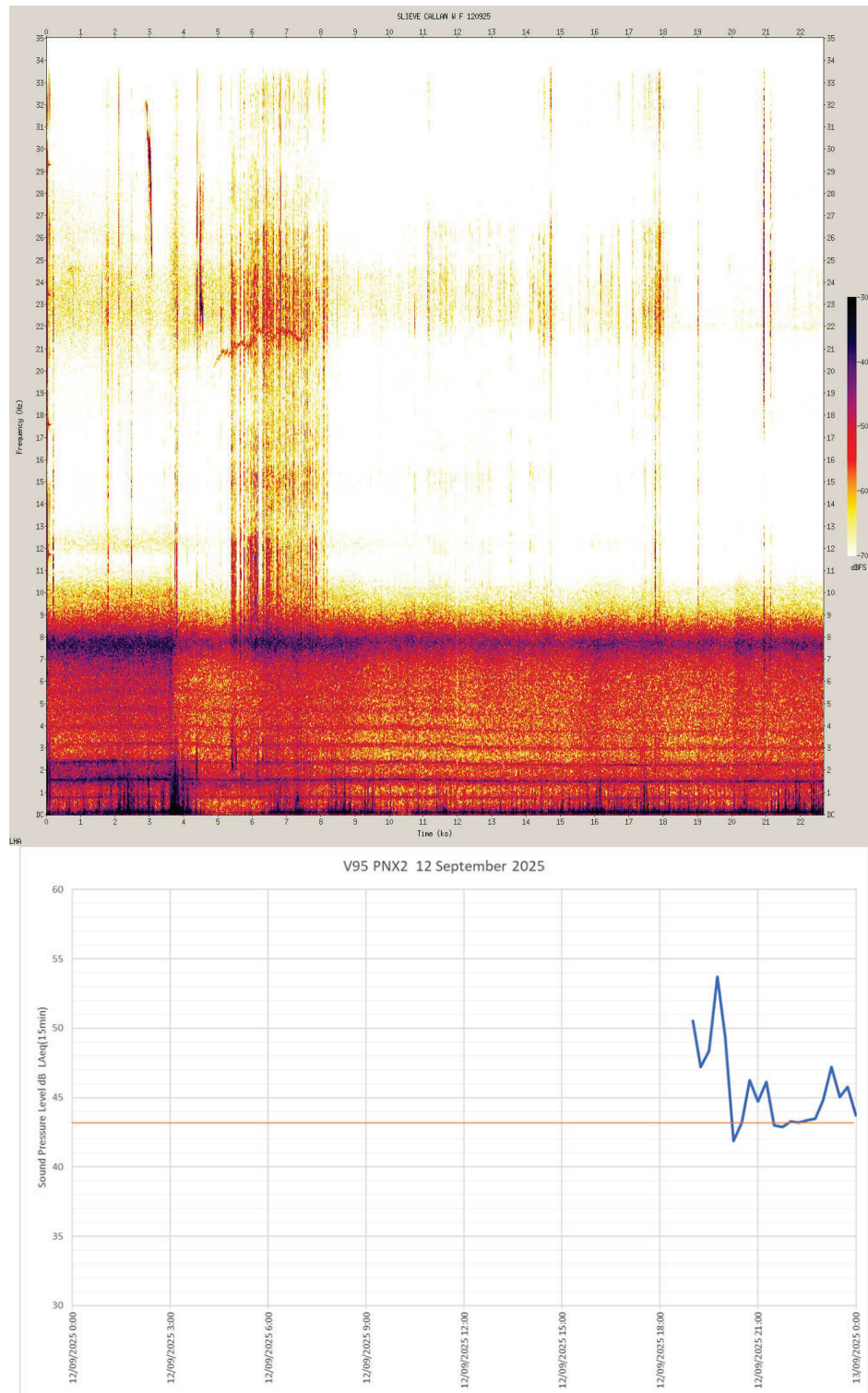


Figure 4

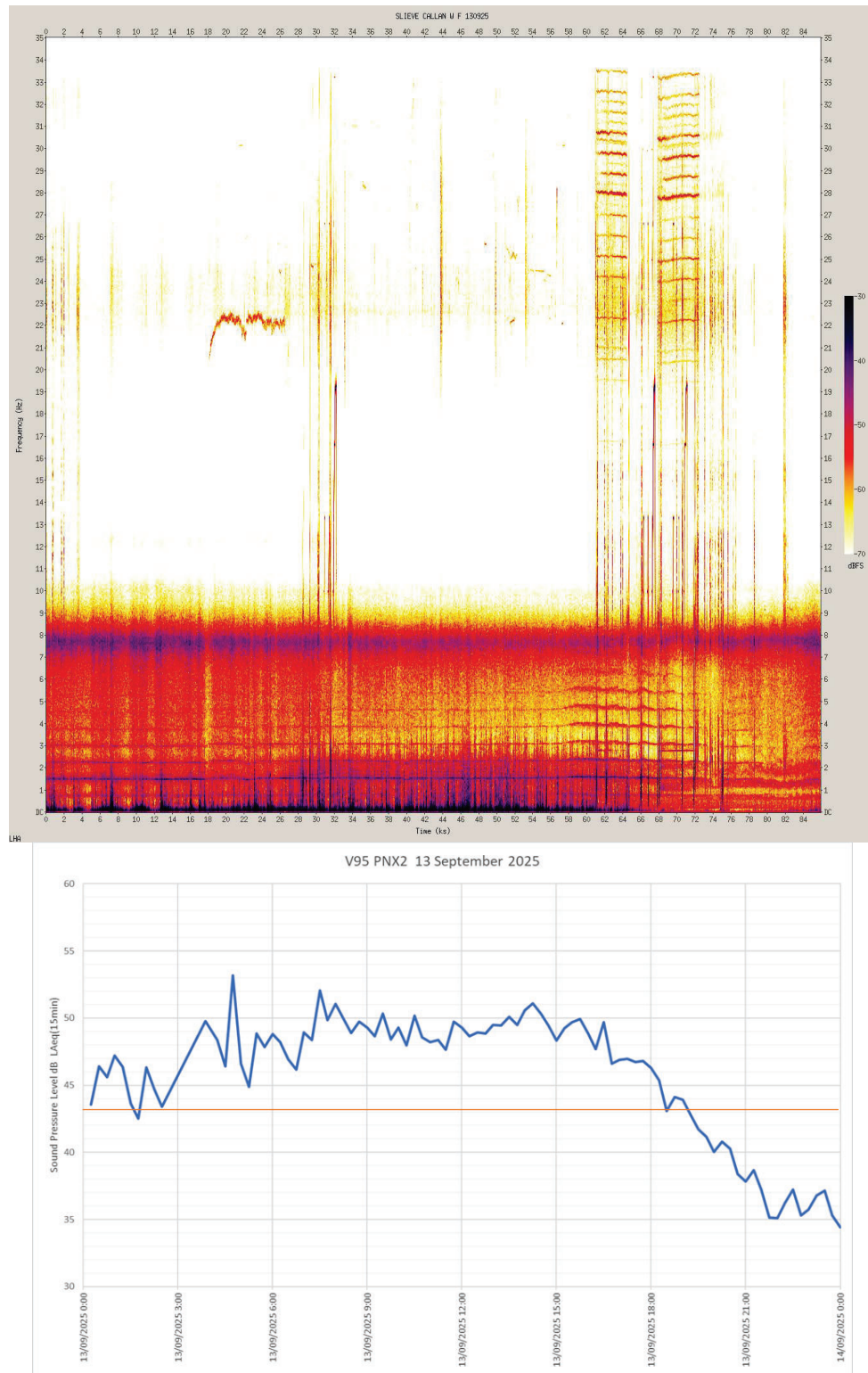


Figure 5

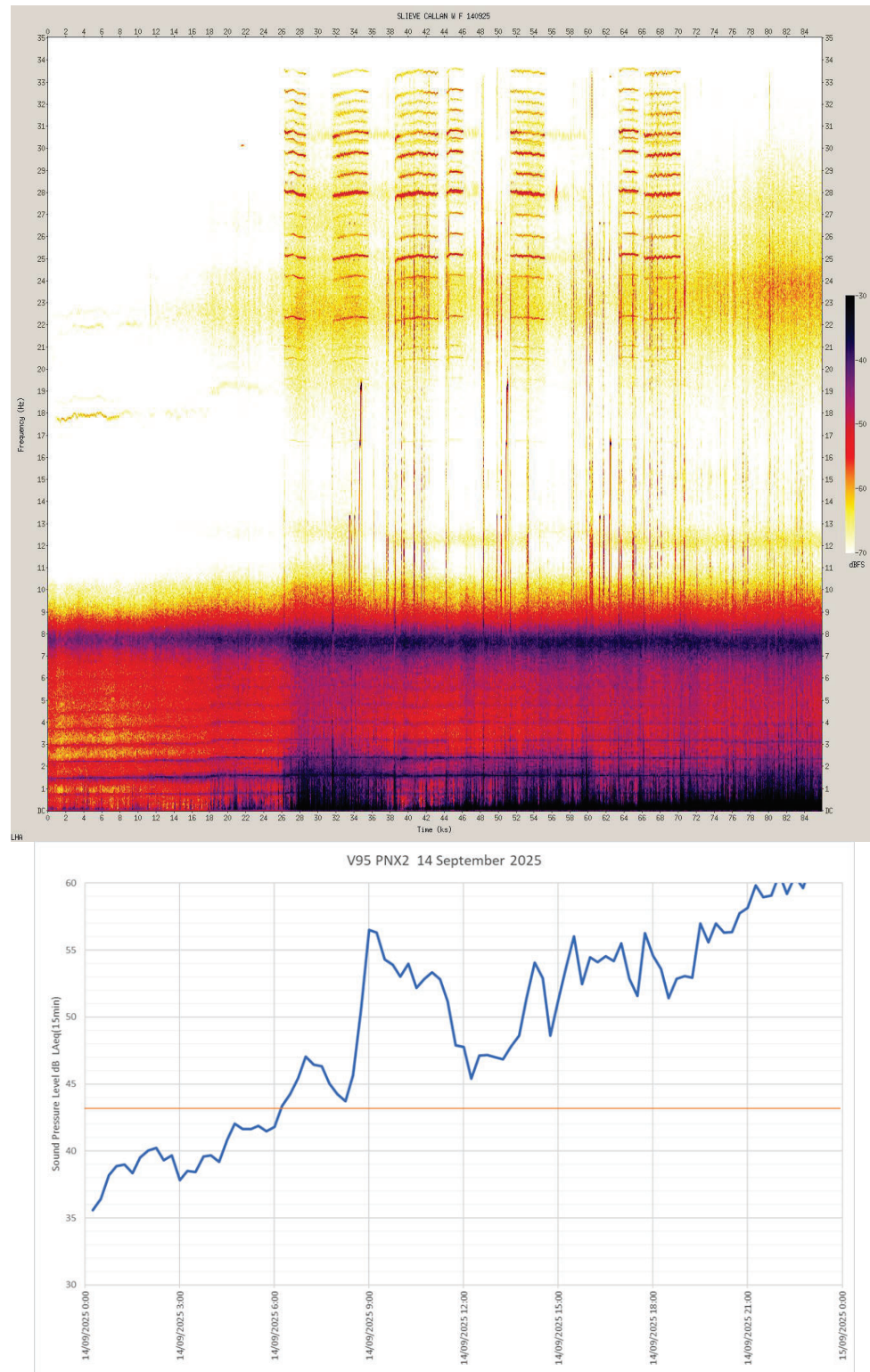


Figure 6

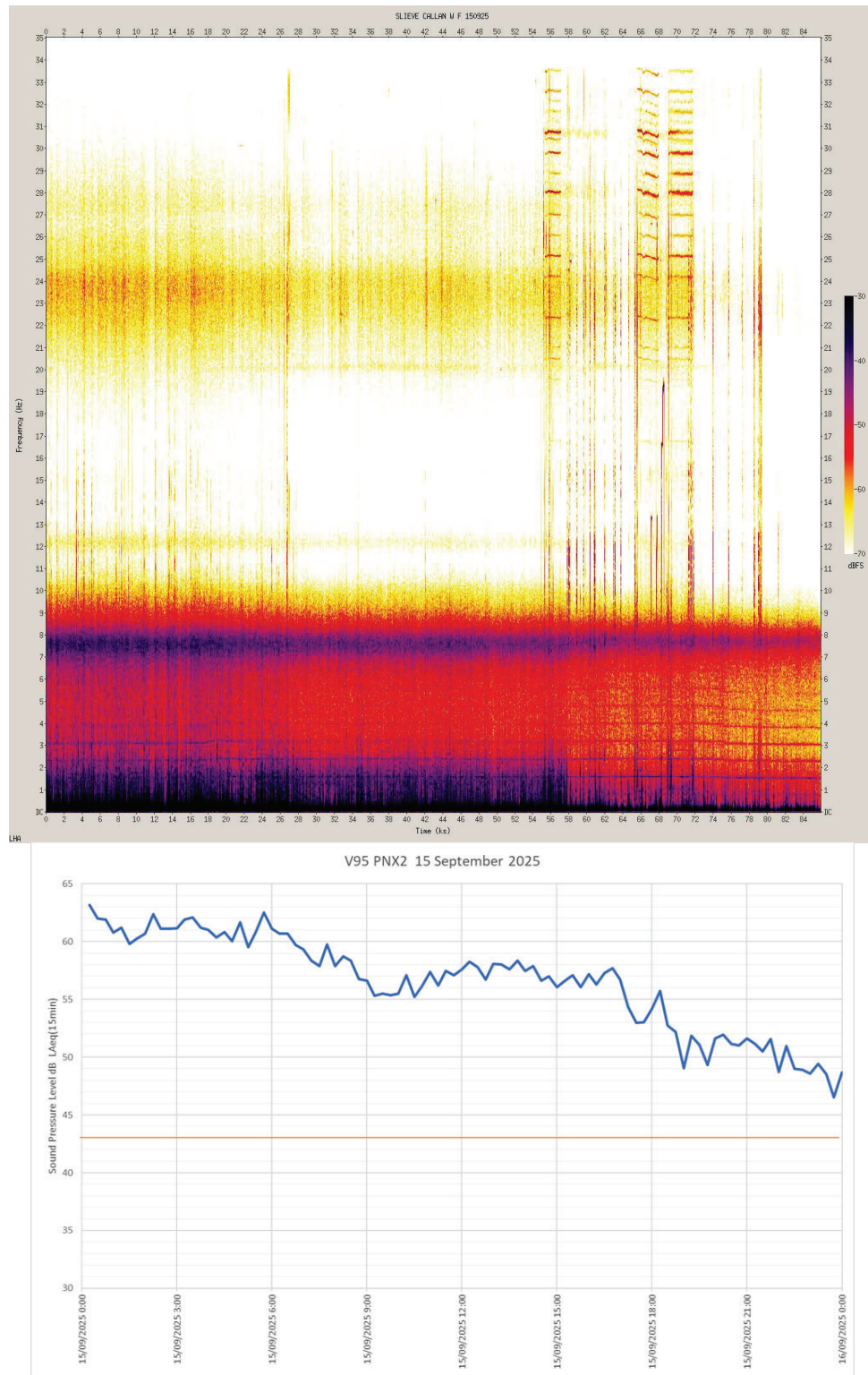
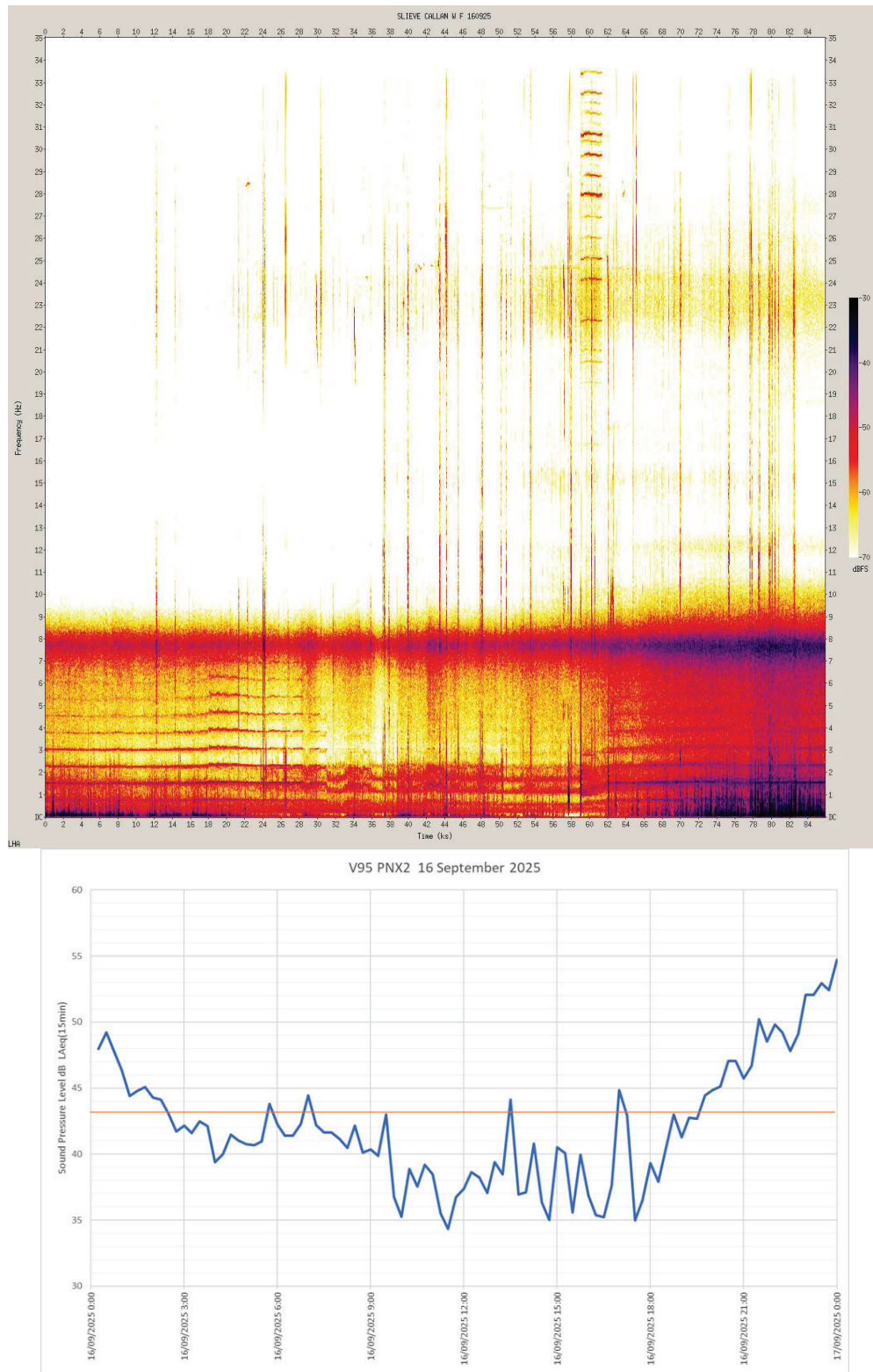


Figure 7



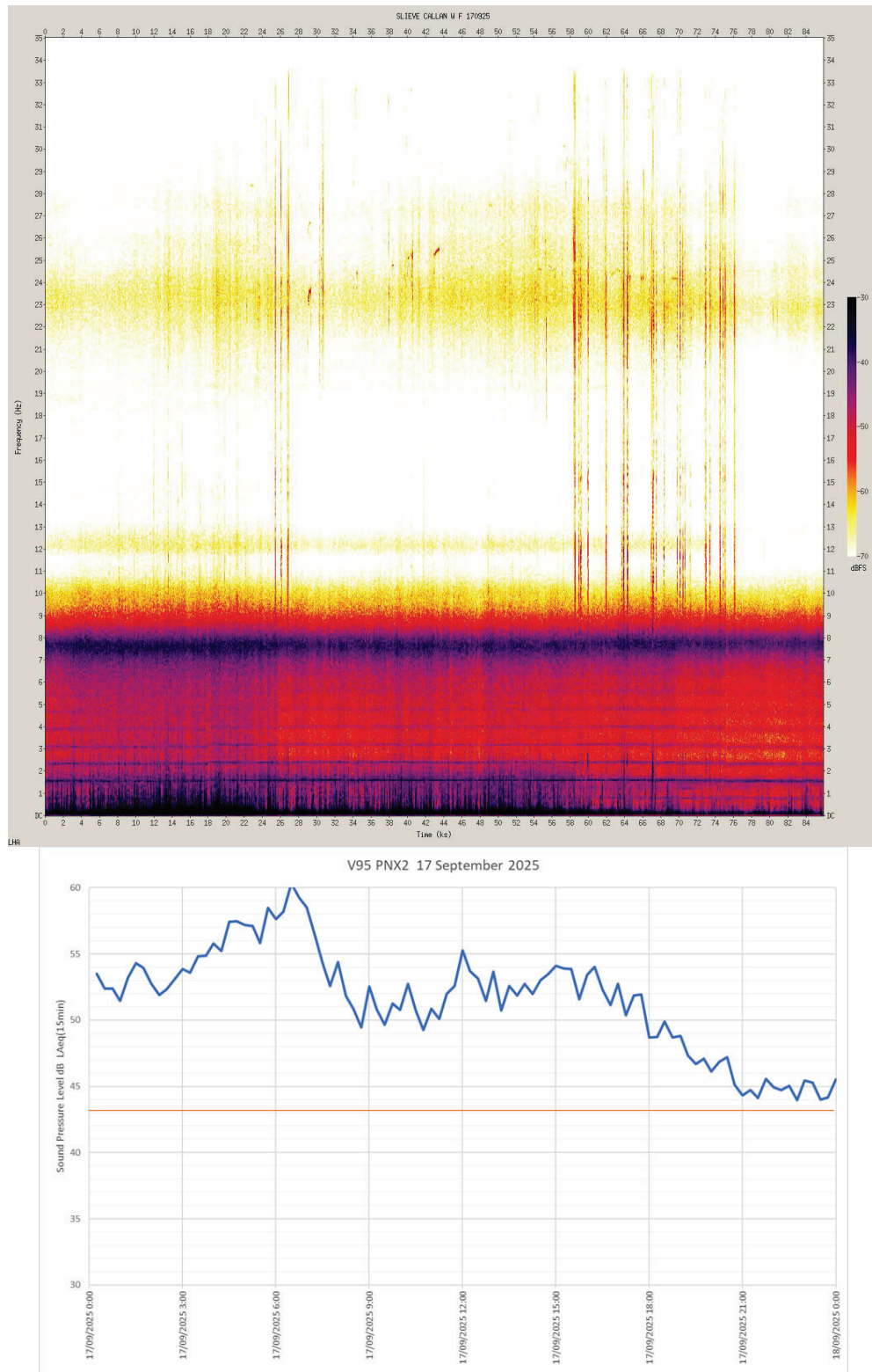


Figure 9

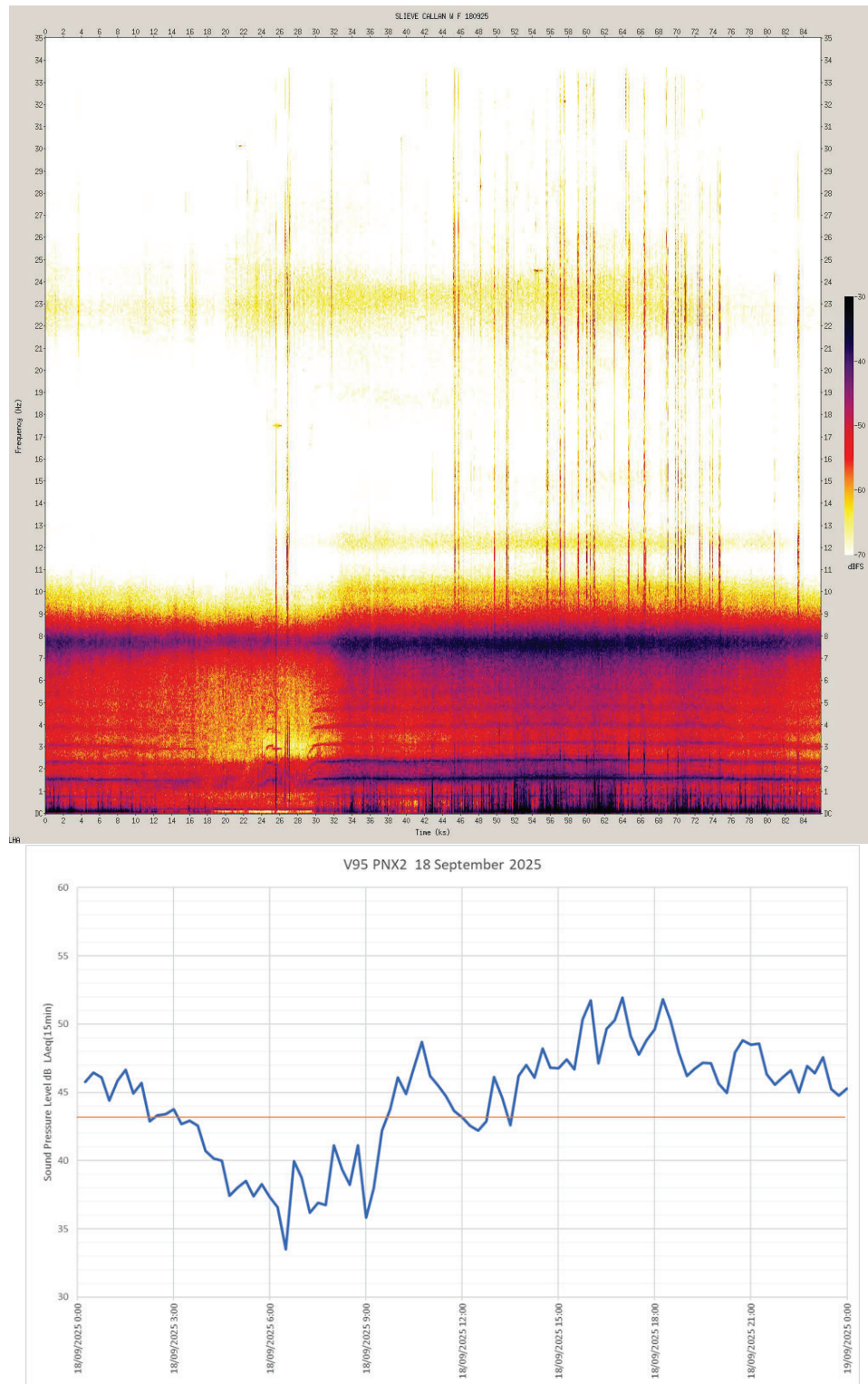


Figure 10

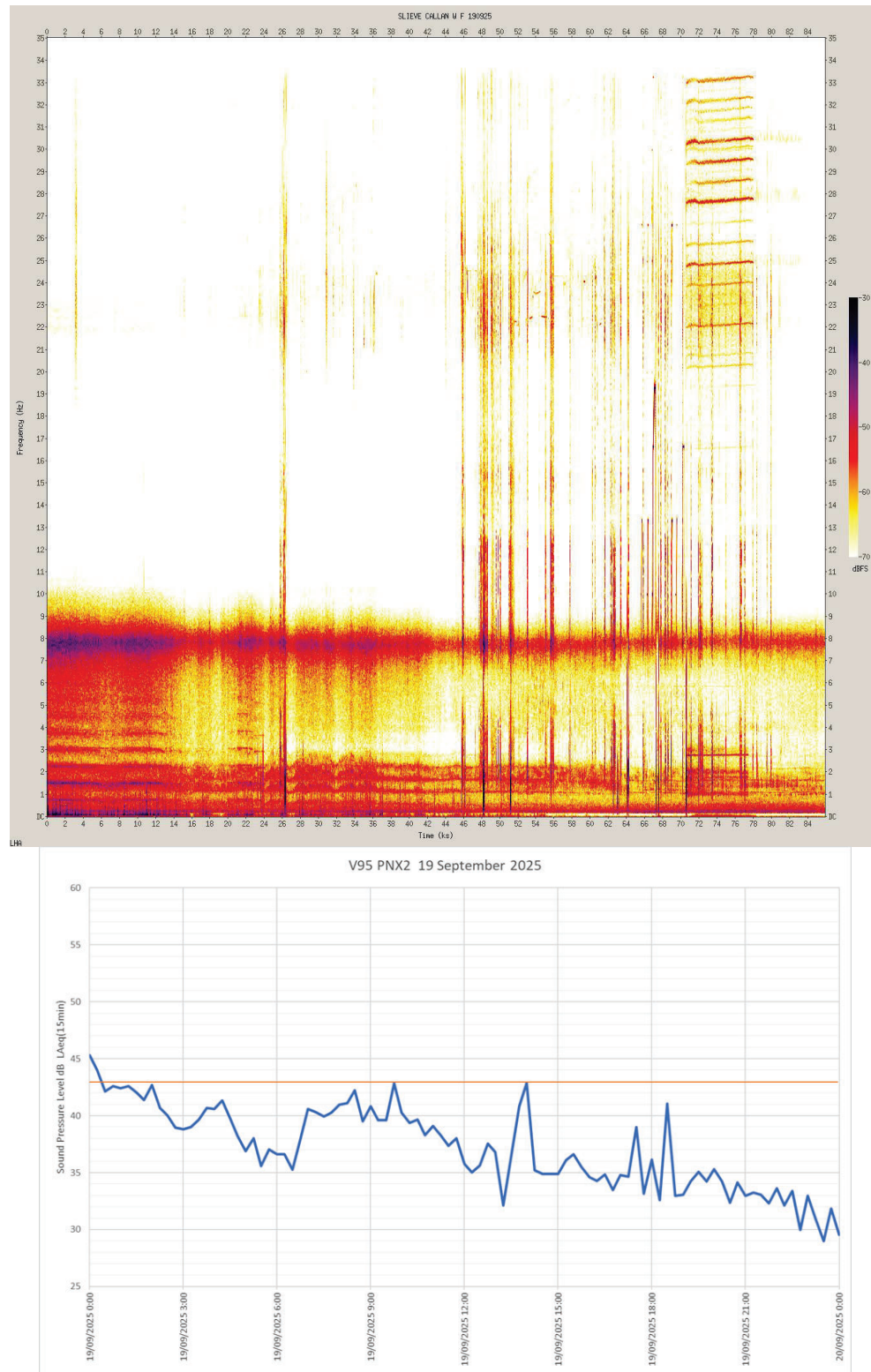


Figure 11

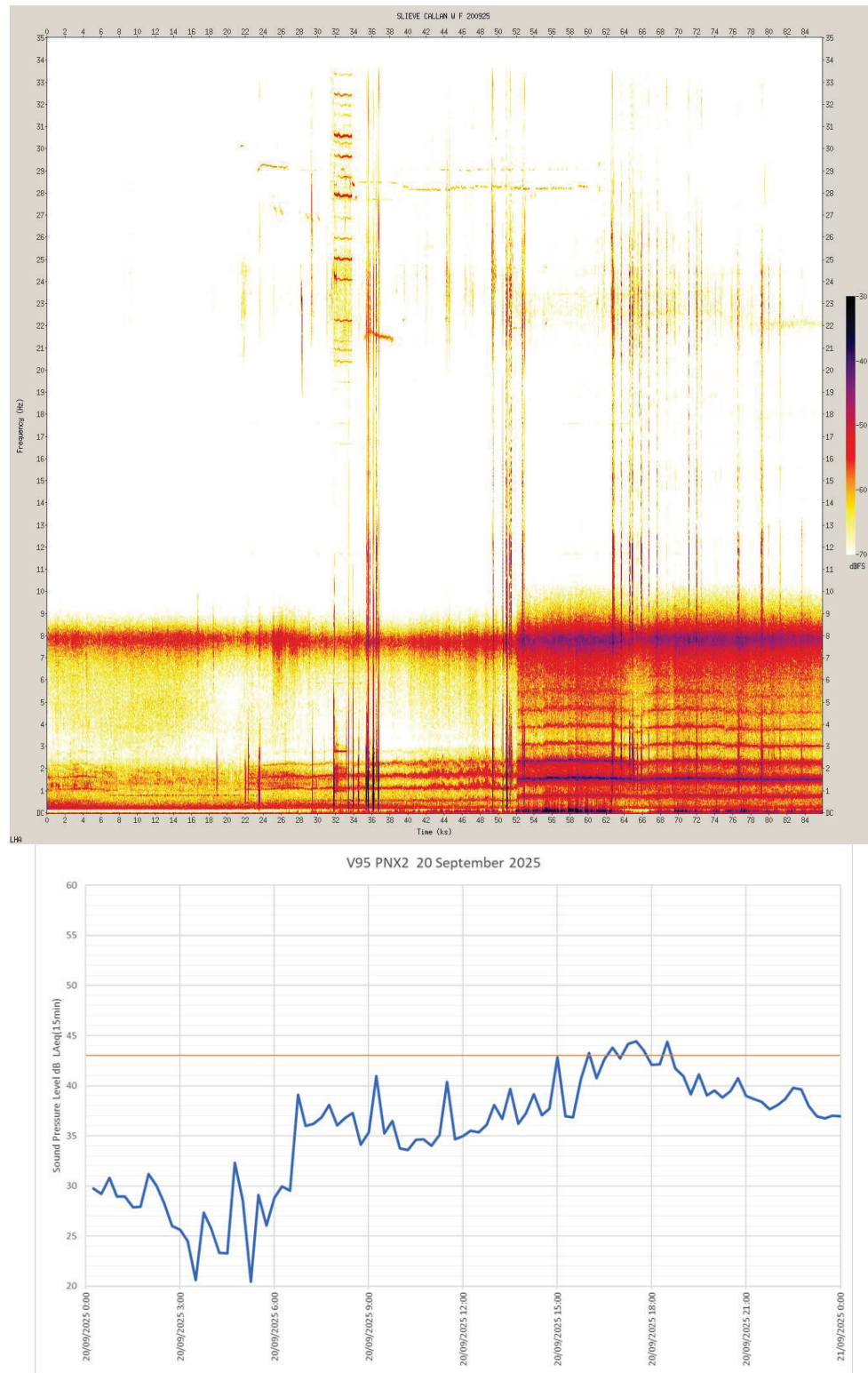


Figure 12

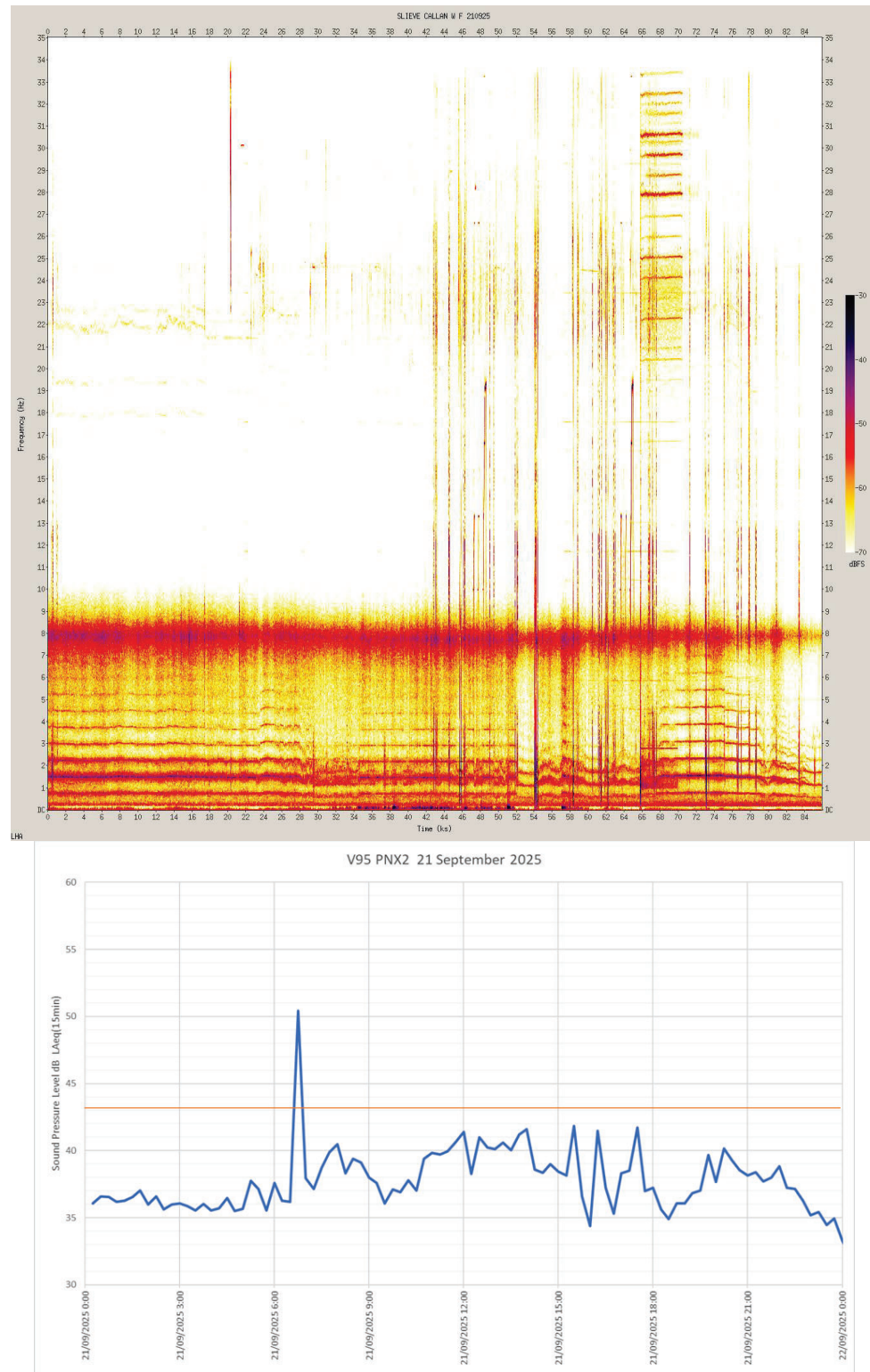


Figure 13

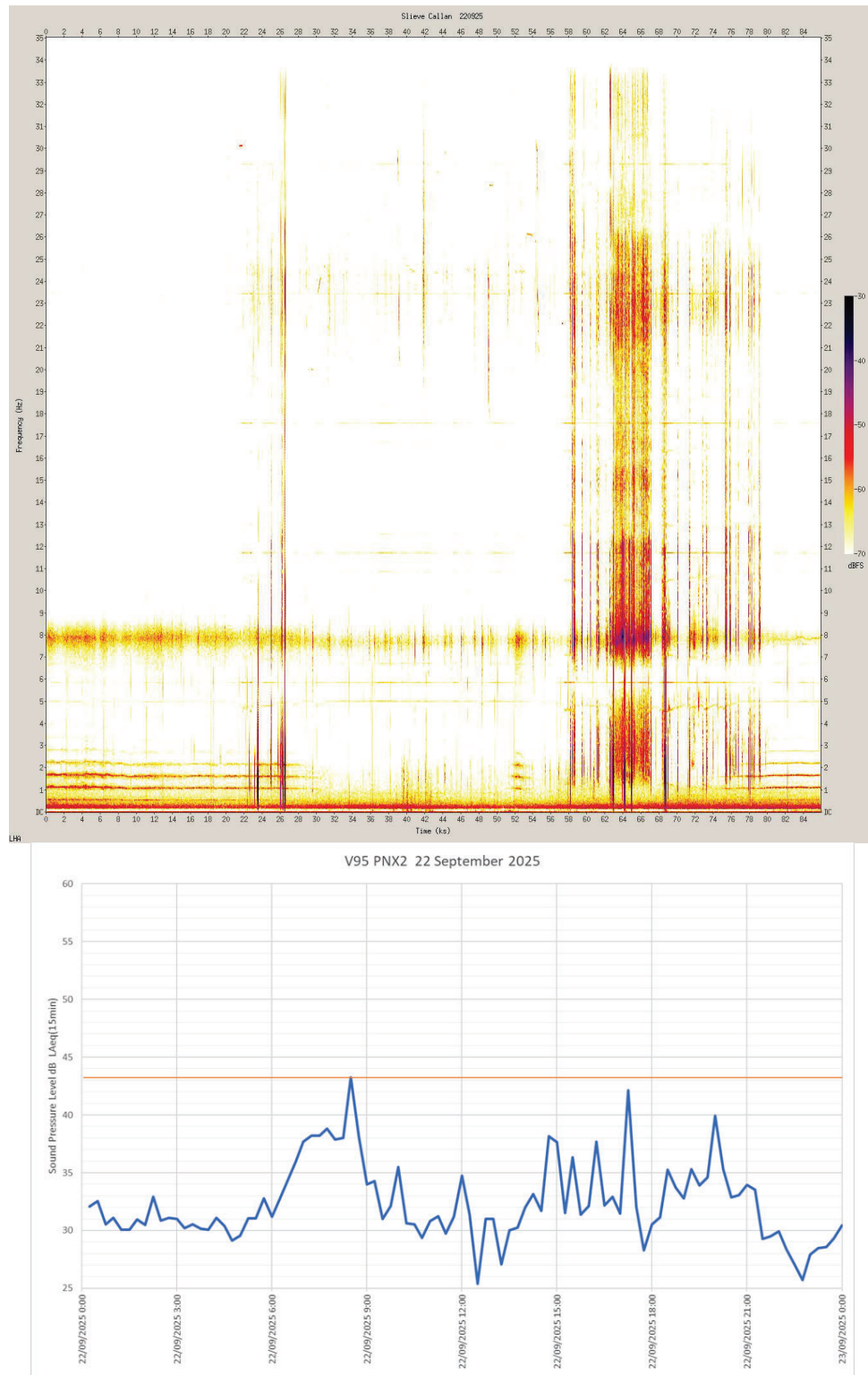


Figure 14

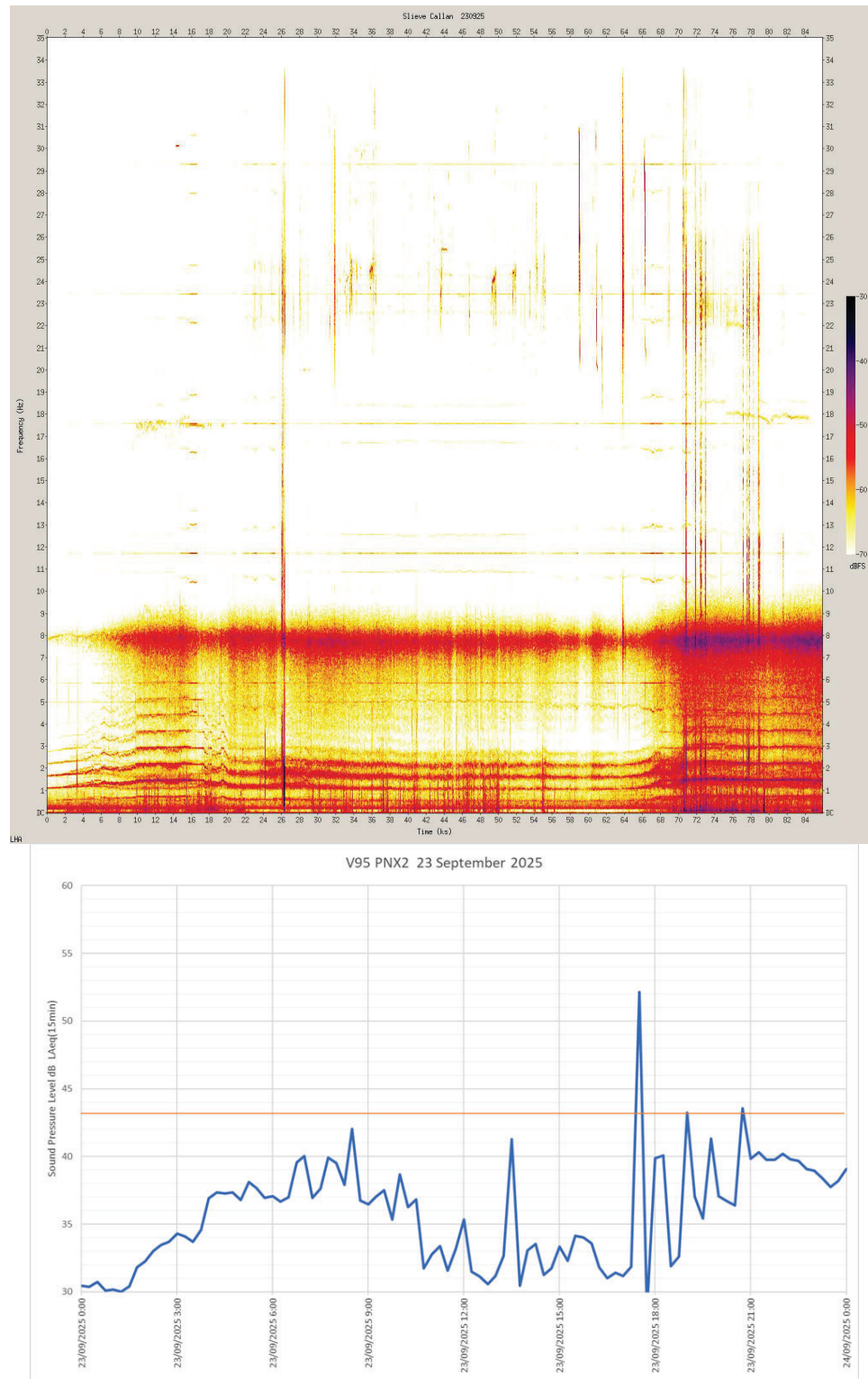


Figure 15

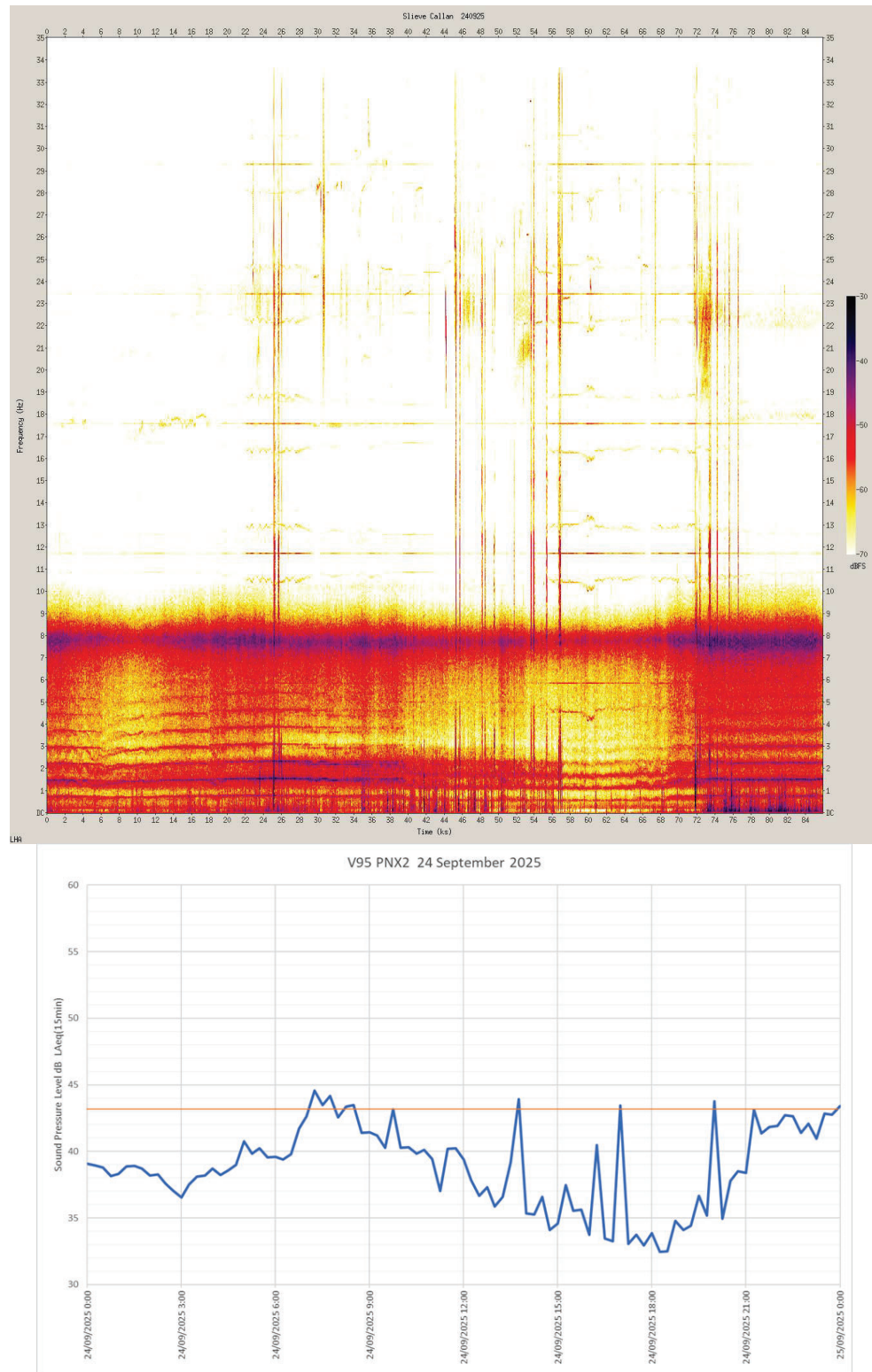


Figure 16

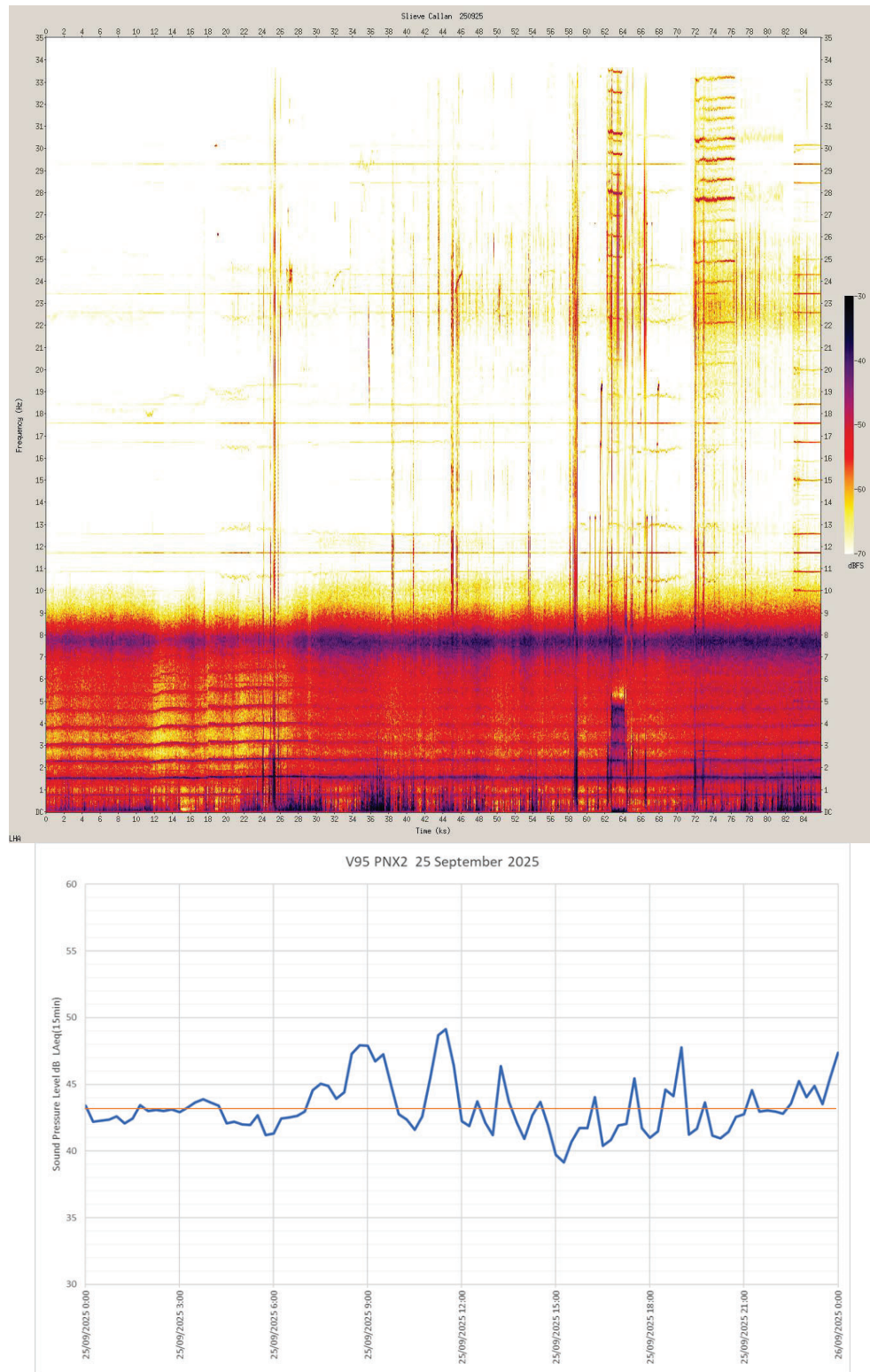


Figure 17

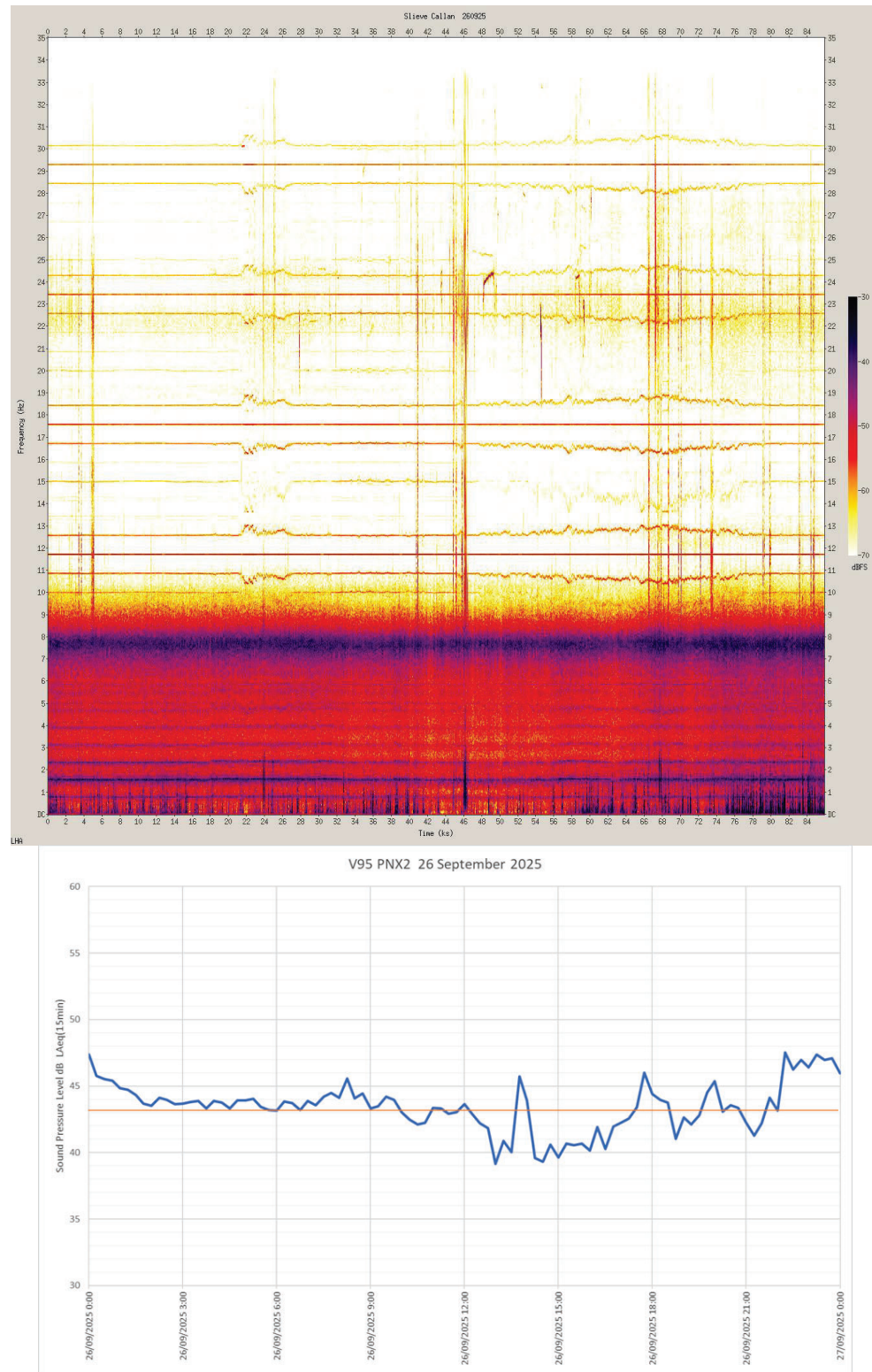


Figure 18

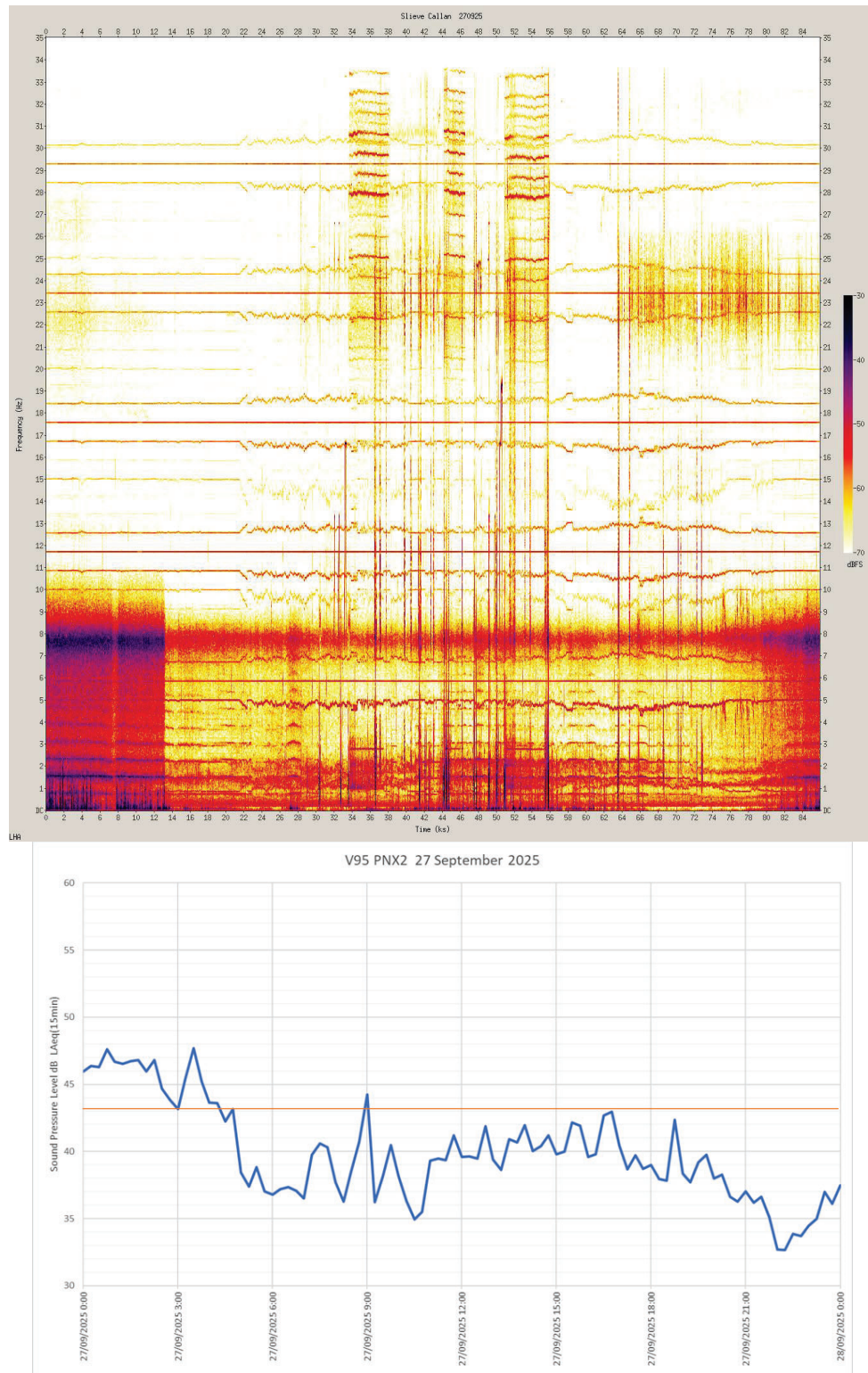


Figure 19

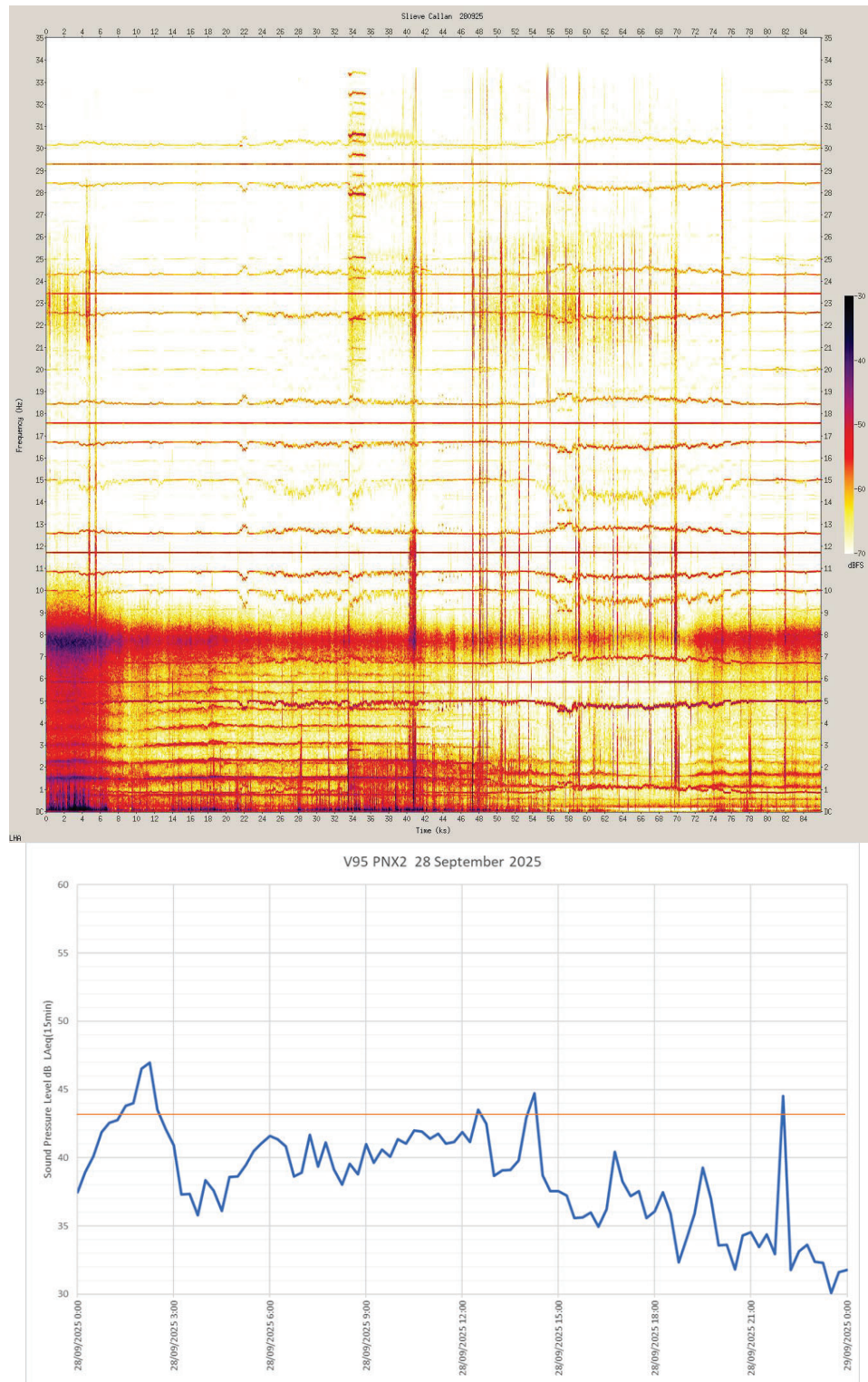


Figure 20

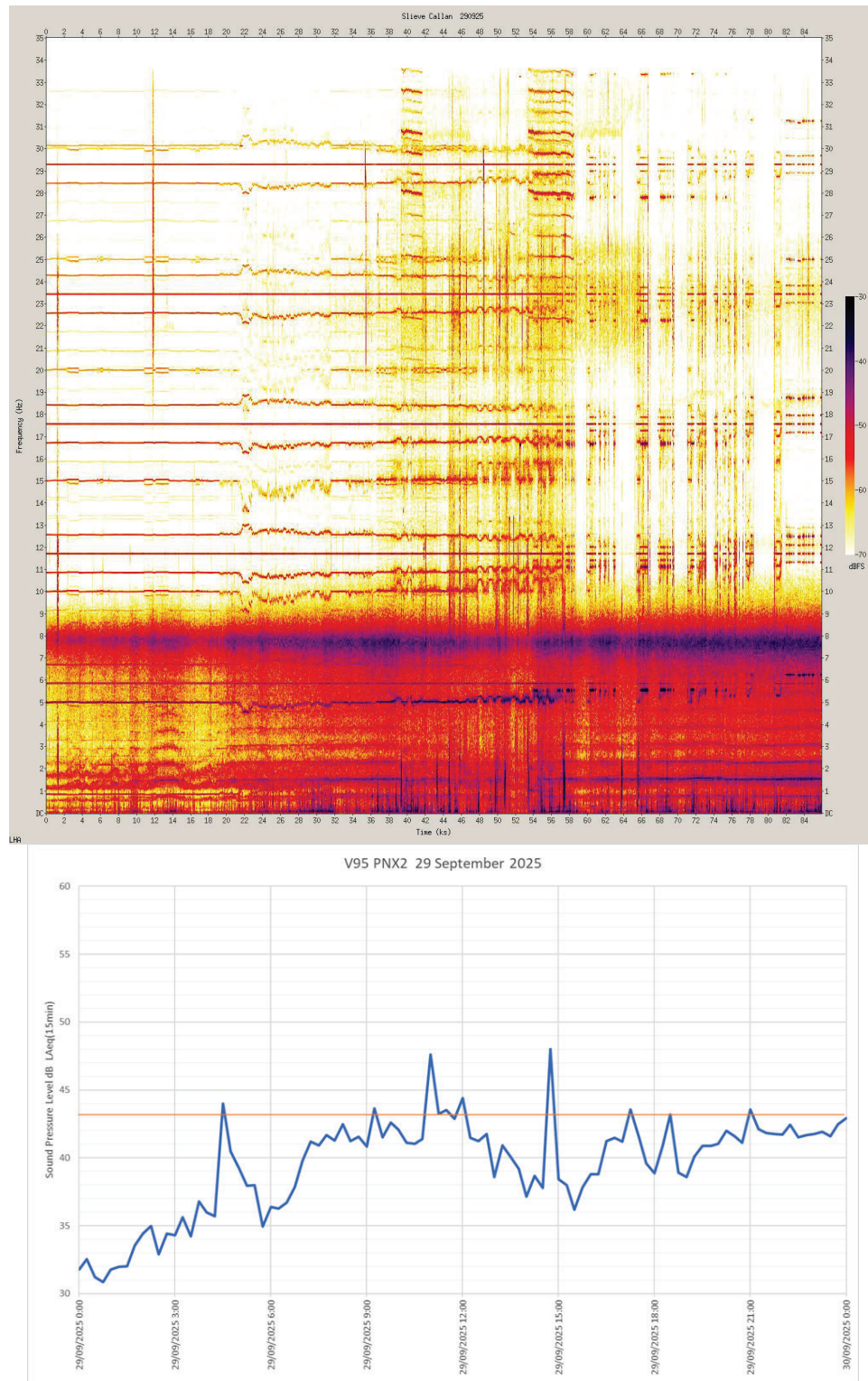


Figure 21

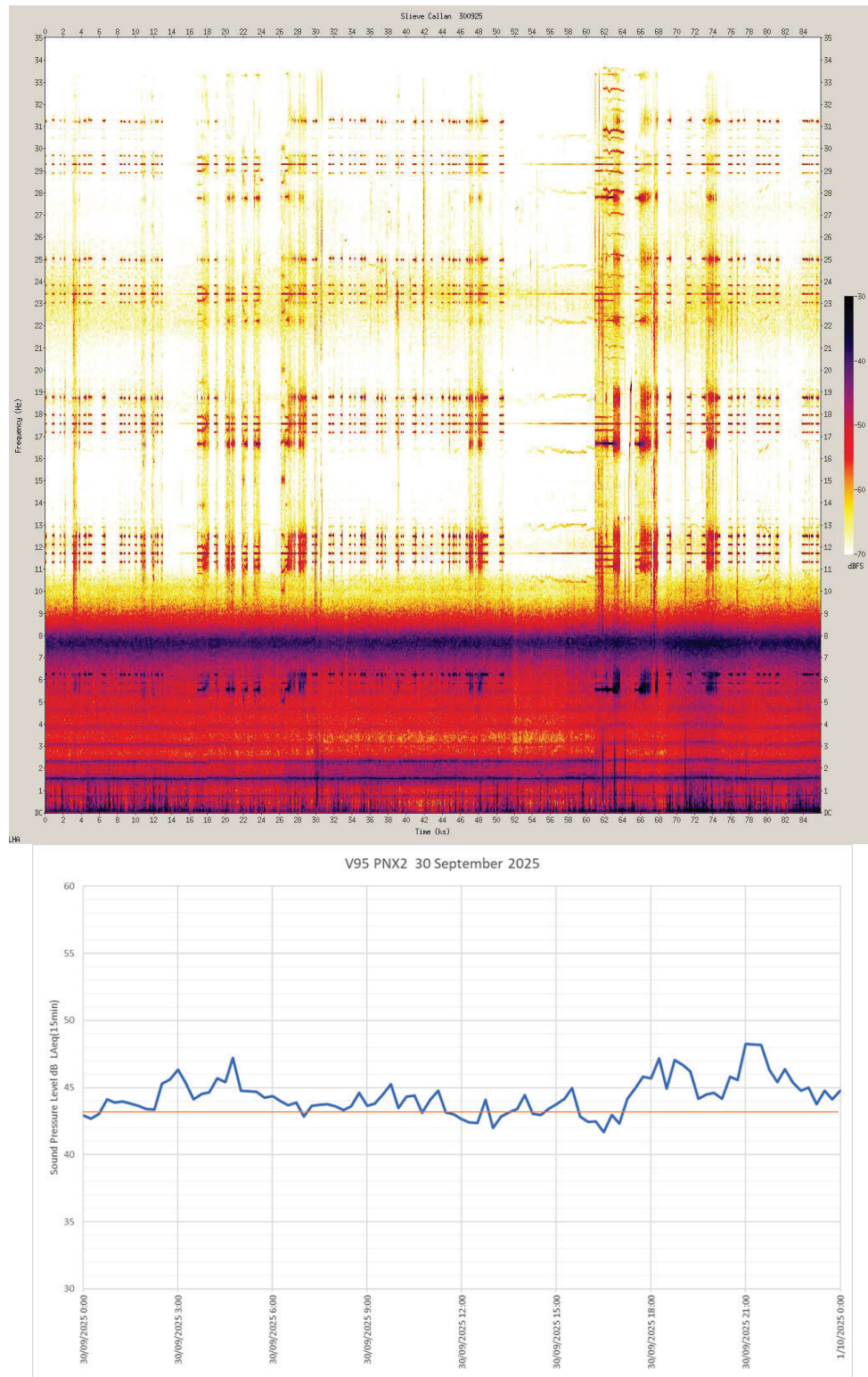


Figure 22

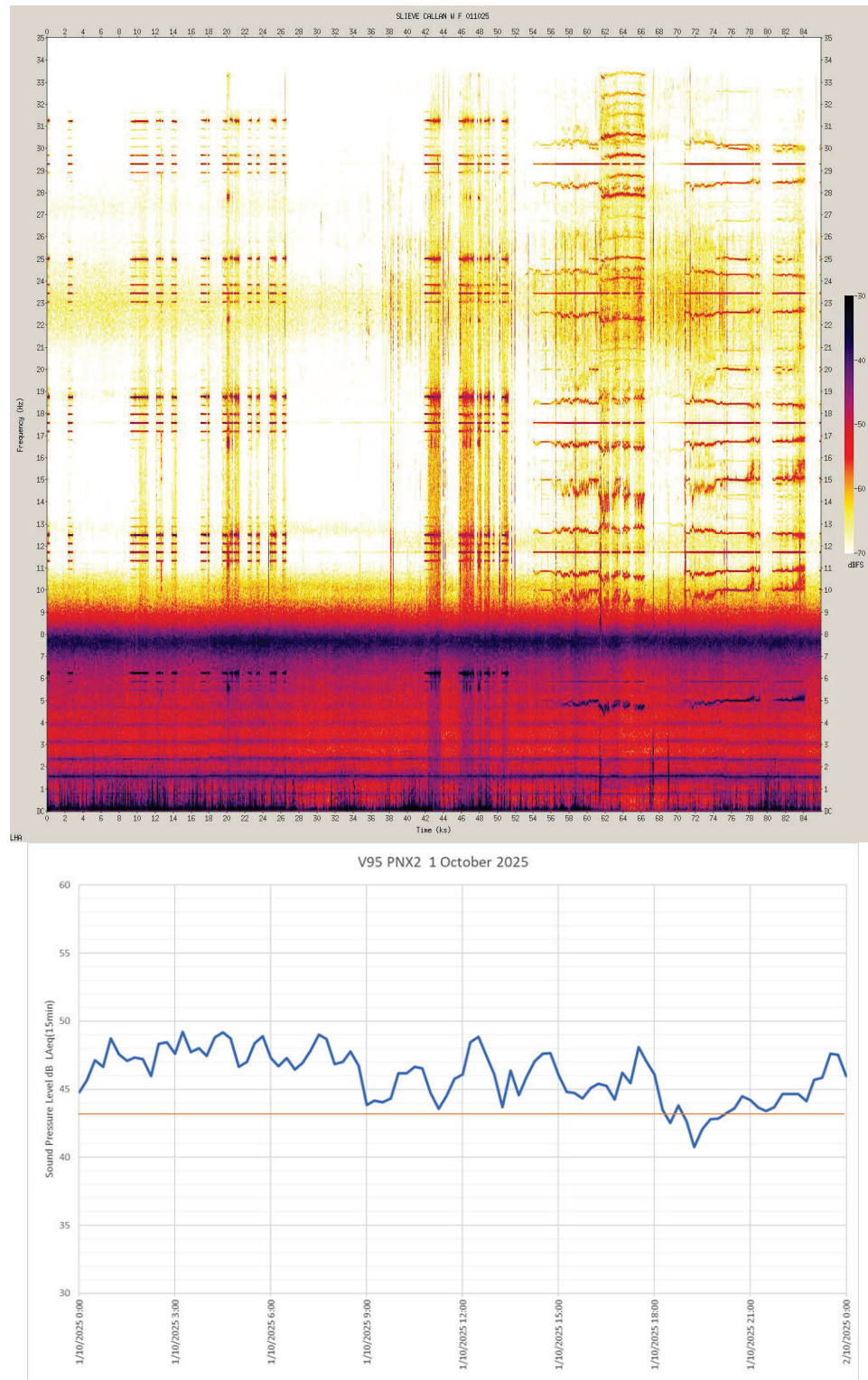


Figure 23

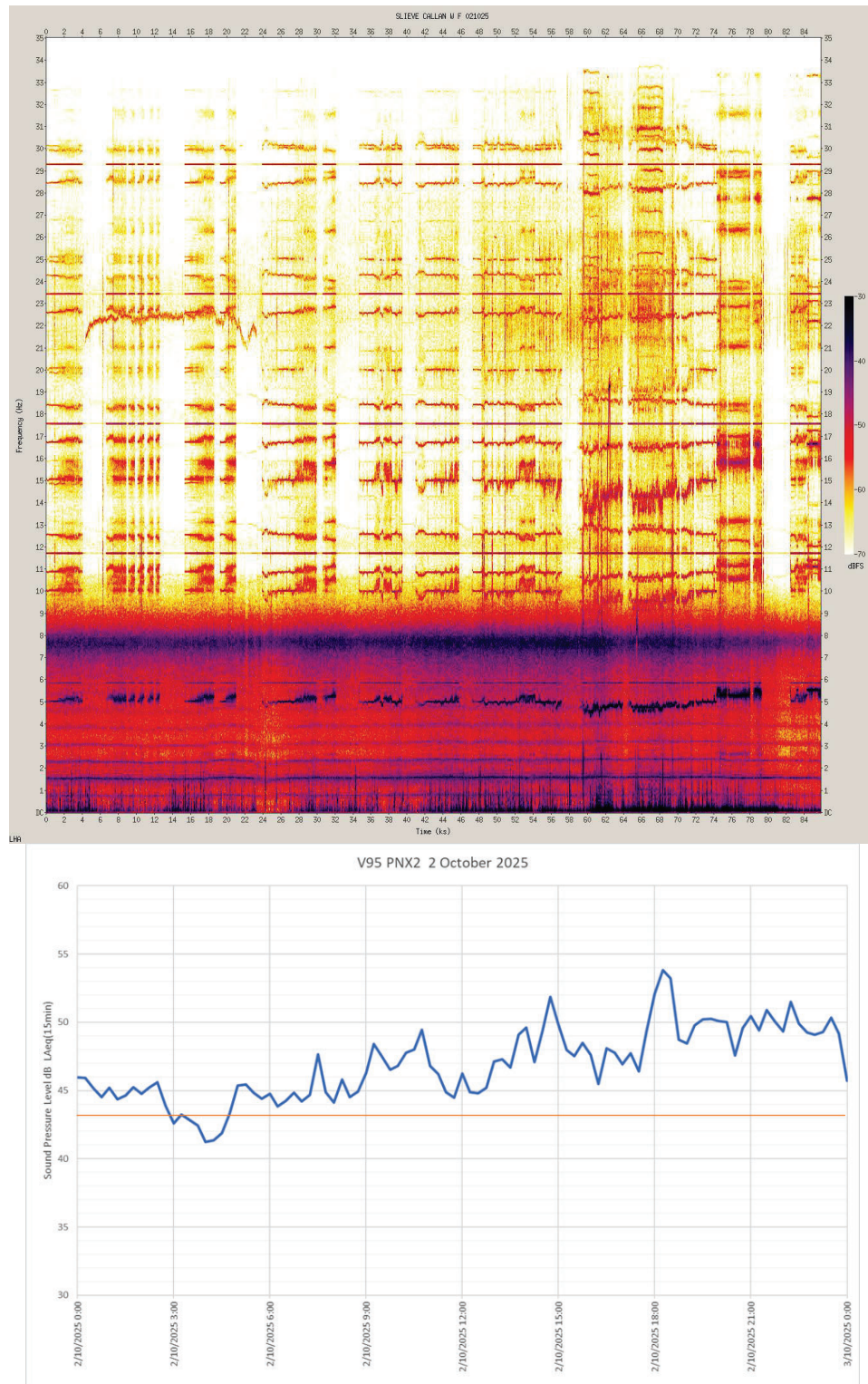


Figure 24

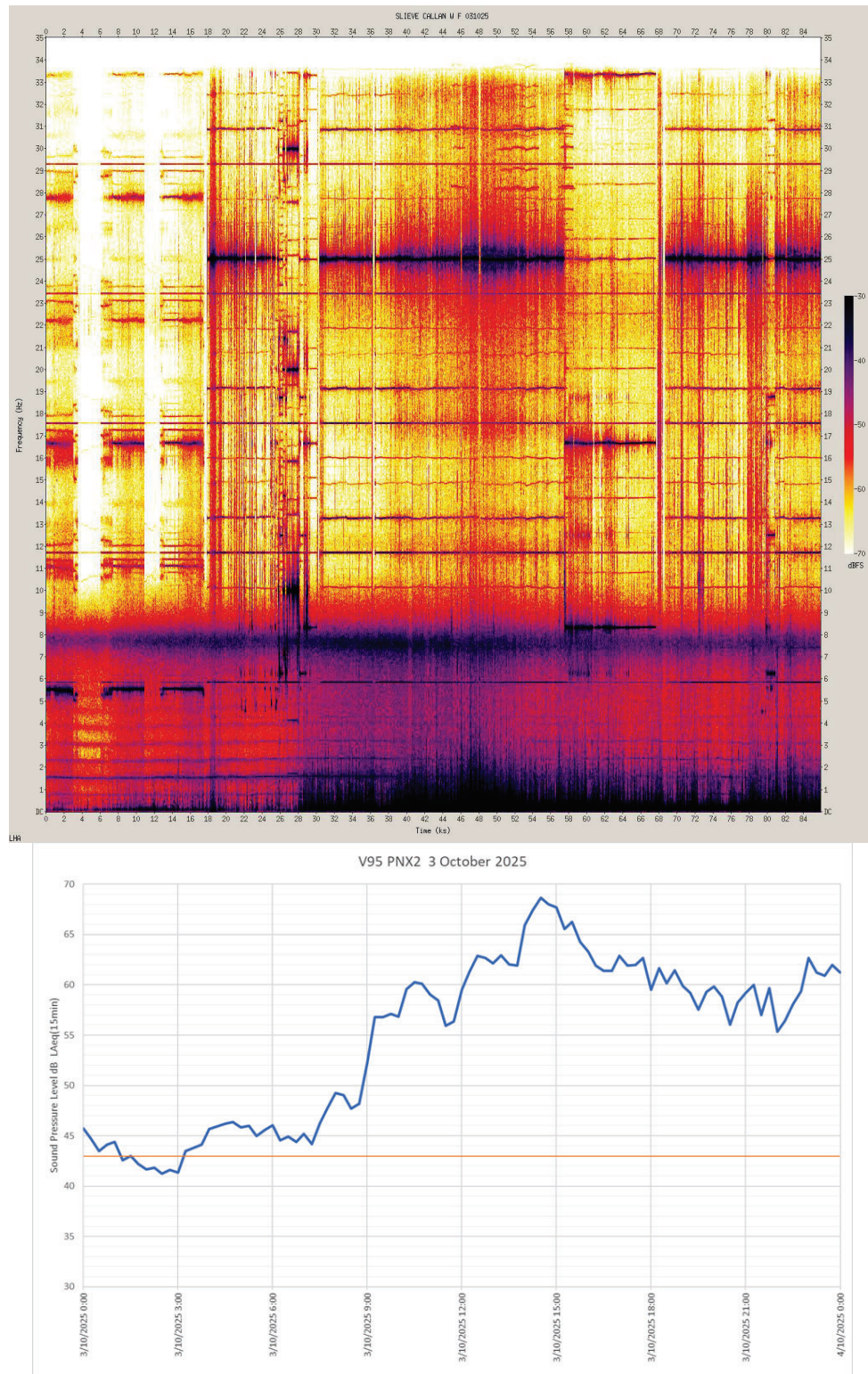


Figure 25

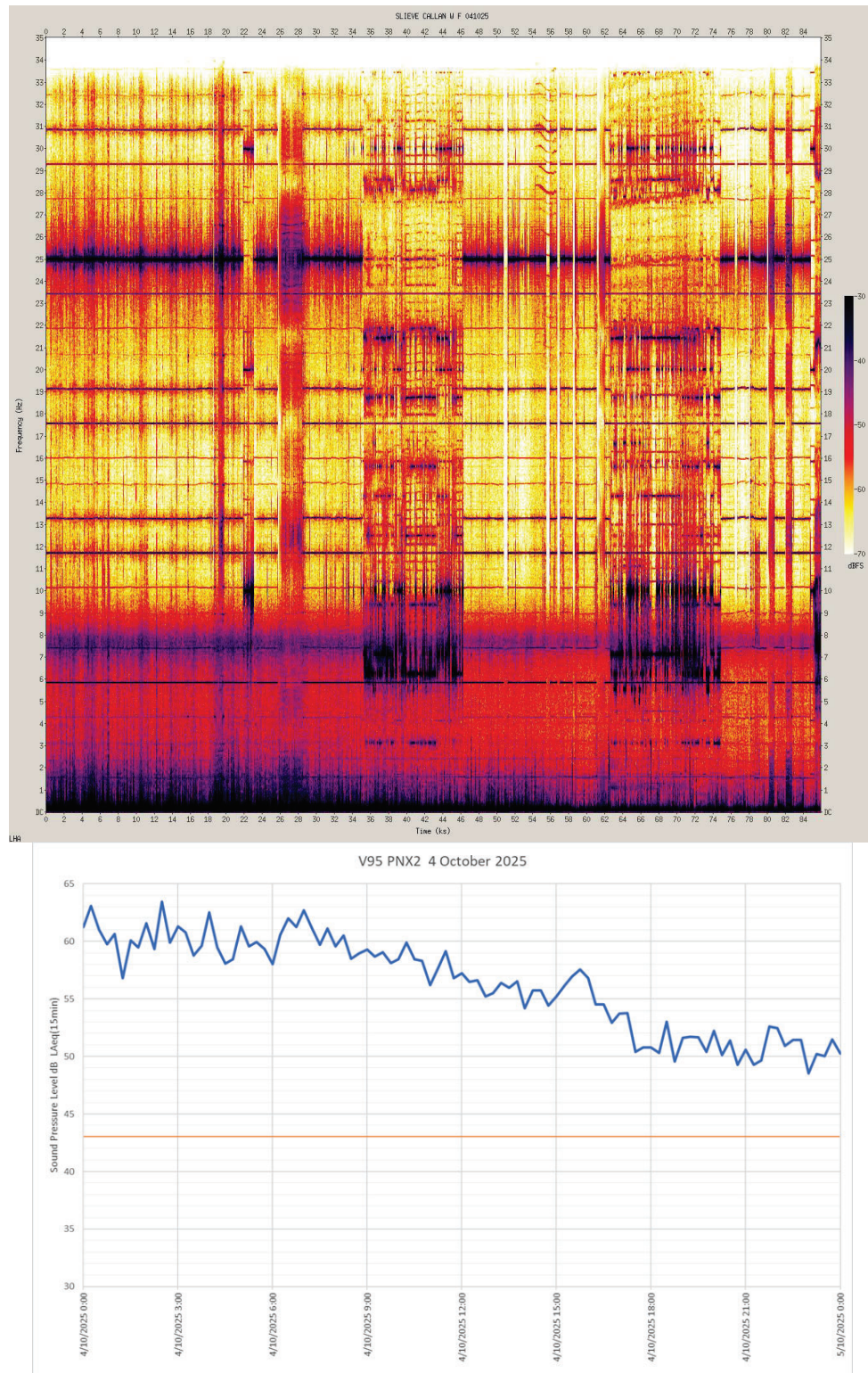


Figure 26

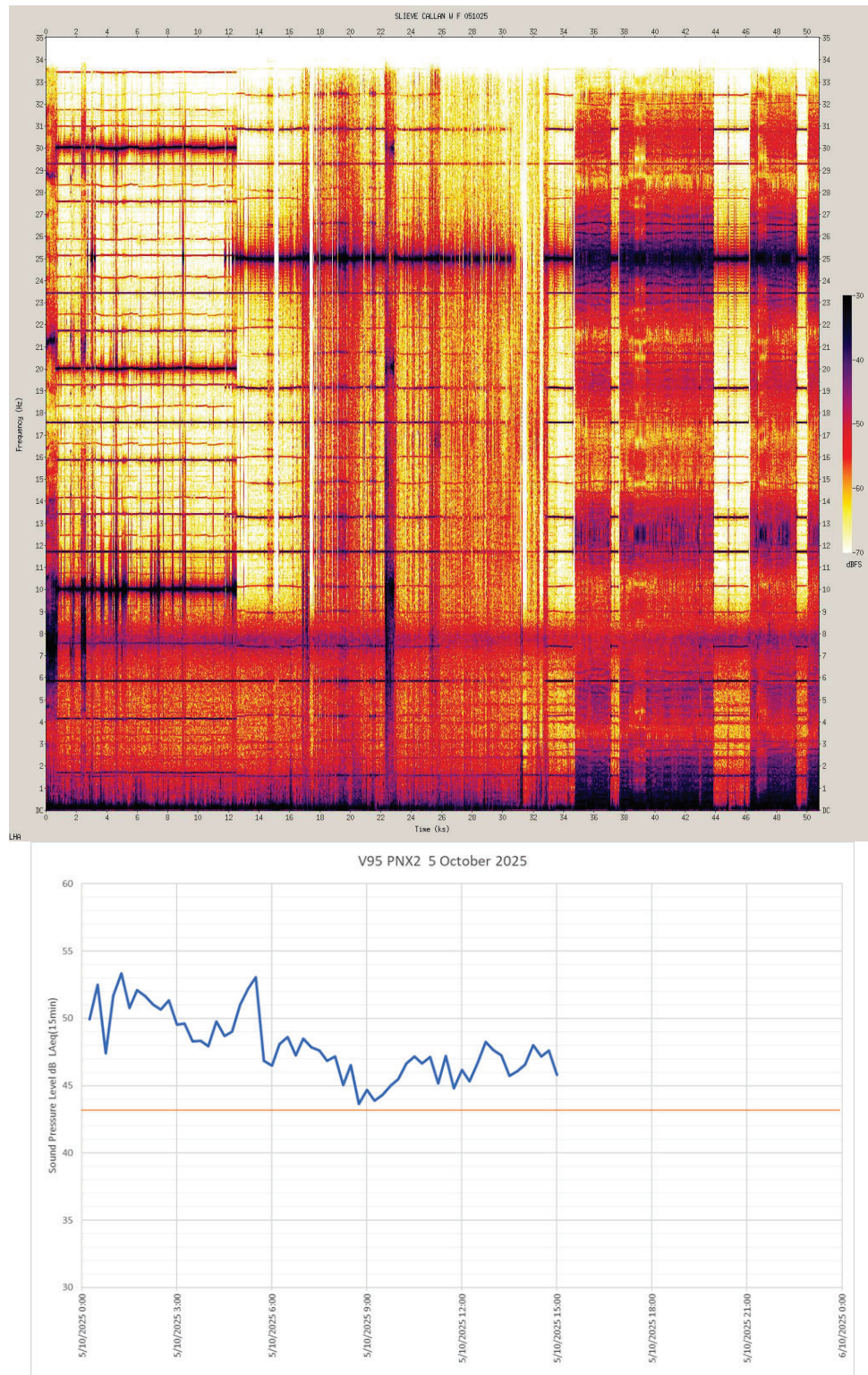


Figure 27

ANALYSIS OF SPECIAL AUDIBLE CHARACTERISTICS

The external logger (SVAN977D) was set to collect data in one-third octave bands for three weightings of A, C and Z, sampled at the rate of 100 ms. WAV files were also collected by the logger continuously at the rate of 12 kHz separated into 30-minute duration files. The ILFN logger recorded WAV files continuously at the rate of 500 Hz separated into 20-minute duration files. The data was also summarised into $L_{Aeq}(15min)$ samples, as required by the permit.

Detailed analyses excluded periods of rain.

Amplitude Modulation

'Normal' AM, expected to be an unobtrusive impost from a wind turbine operation, is when the peak to trough variation in A-weighted sound level does not exceed 3 dB.

For example, if the repetitive 'swish' sound from the rotating blades of a wind turbine reaches a maximum value of, say, 32 dB(A) in an ambient sound of 30 dB(A), when the 'swish' noise is not present (between each 'swish'), then the AM is 2 dB.

AM can also occur within a frequency range where, for example, a tone might change regularly in loudness.

The following analysis has checked each 10-second period throughout the period from 10 pm to 11 pm on 15 September 2025. An example is shown in Figure 28 representing the 53rd 10-second sample of de-trended A-weighted sound level measured after 10 pm on 15 September 2025.

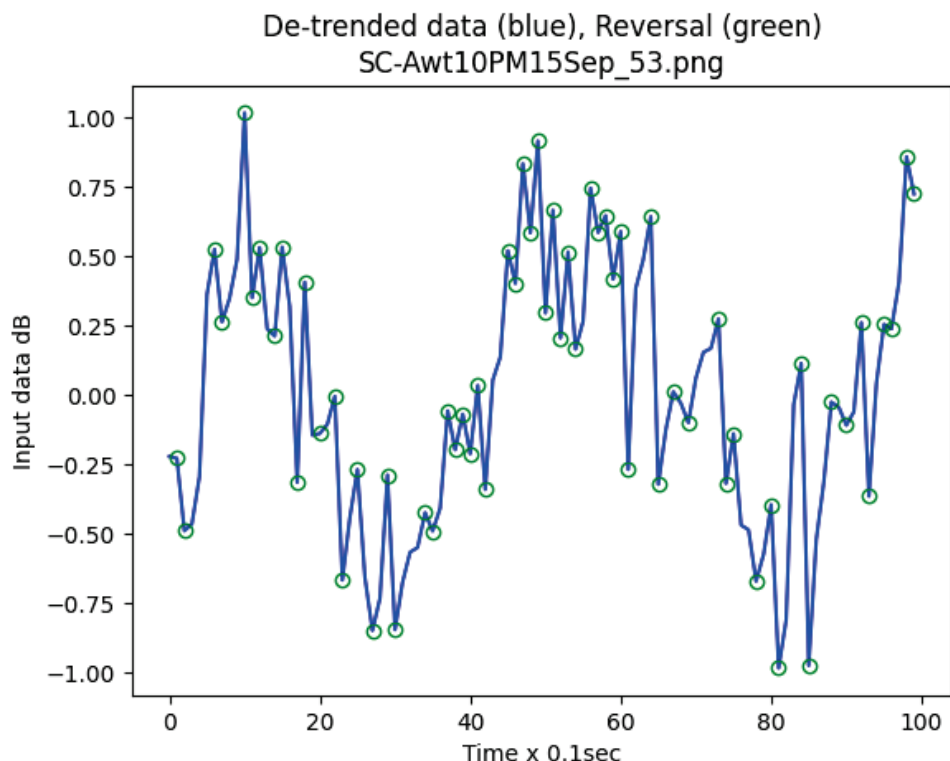


Figure 28

In the example of Figure 28 there are no AM values that exceed 3 dB.

An AM value is the level change between each successive reversal and the maximum AM value is shown in Figure 28 to be about 2 dB. A reversal denotes a peak or trough.

The recorded audio was listened to and it was noted that wind noise from tree foliage was masking A-weighted modulation, however, there was a distinct tone that varied in level.

Tonality and AM

Figure 29 shows a spectrogram that illustrates the audible tone which is centred around 165 Hz.

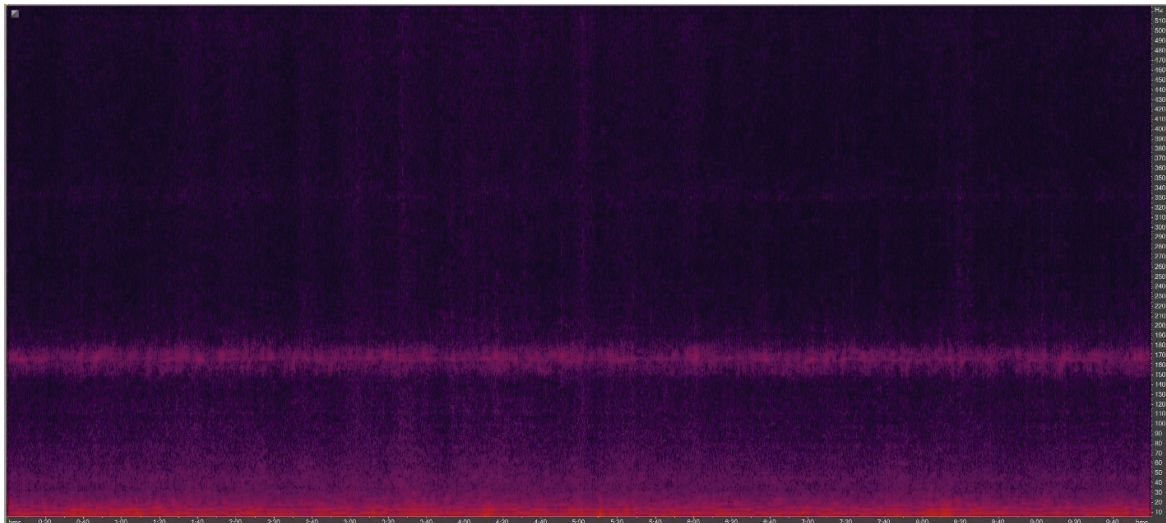


Figure 29

Figure 30 shows an example 10-second sample of the variation in sound level of the 160 Hz 1/3 octave band.

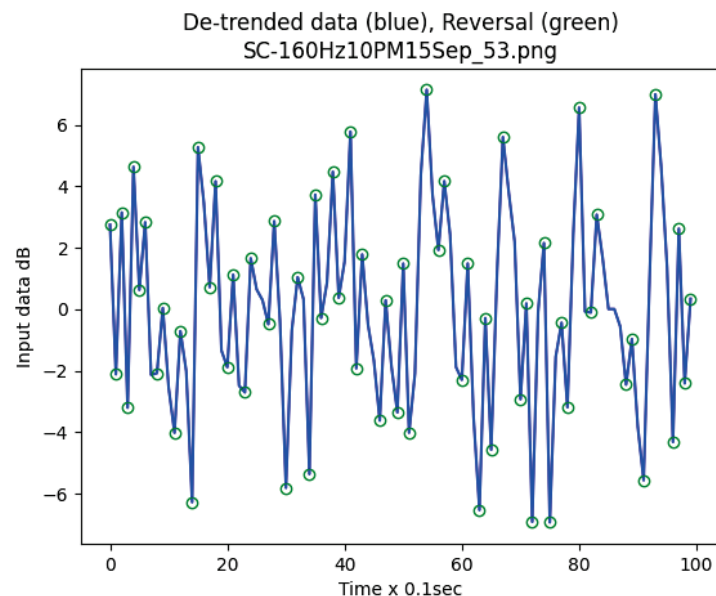


Figure 30

AM of the 160Hz 1/3 octave band regularly exceeds 10 dB peak to trough.

An analysis of the 165Hz tone was completed in accordance with ISO/PAS 20065 that is referenced in ISO 1996.

An average delta L (tonal audibility) of 8.7 dB was calculated for the 165 Hz tone that warrants a tonal adjustment of 4 dB. However, the tone also exhibits strong AM that would suggest an additional adjustment.

The blade pass frequency (BPF) for the Nordex wind turbine when operating at full power is approximately 0.8 Hz. The combined blade pass frequency for two Nordex wind turbines depends on whether the rotations synchronise. If synchronised then the BPF remains at 0.8 Hz. If out of phase (fully asynchronous) then the BPF becomes 1.6 Hz. Observable BPF depends on the number of wind turbines in proximity to the measurement location.

The maximum number of times that AM, caused by the swish sound from many wind turbines, occurs depends on the relative synchronisation.

Figure 29 shows the number of times that A-weighted AM, caused by the swish sound from many wind turbines in the morning (2.40 am to 3 am) of 23 September 2025, exceed 3 dB when measurements were less influenced by extraneous noise.

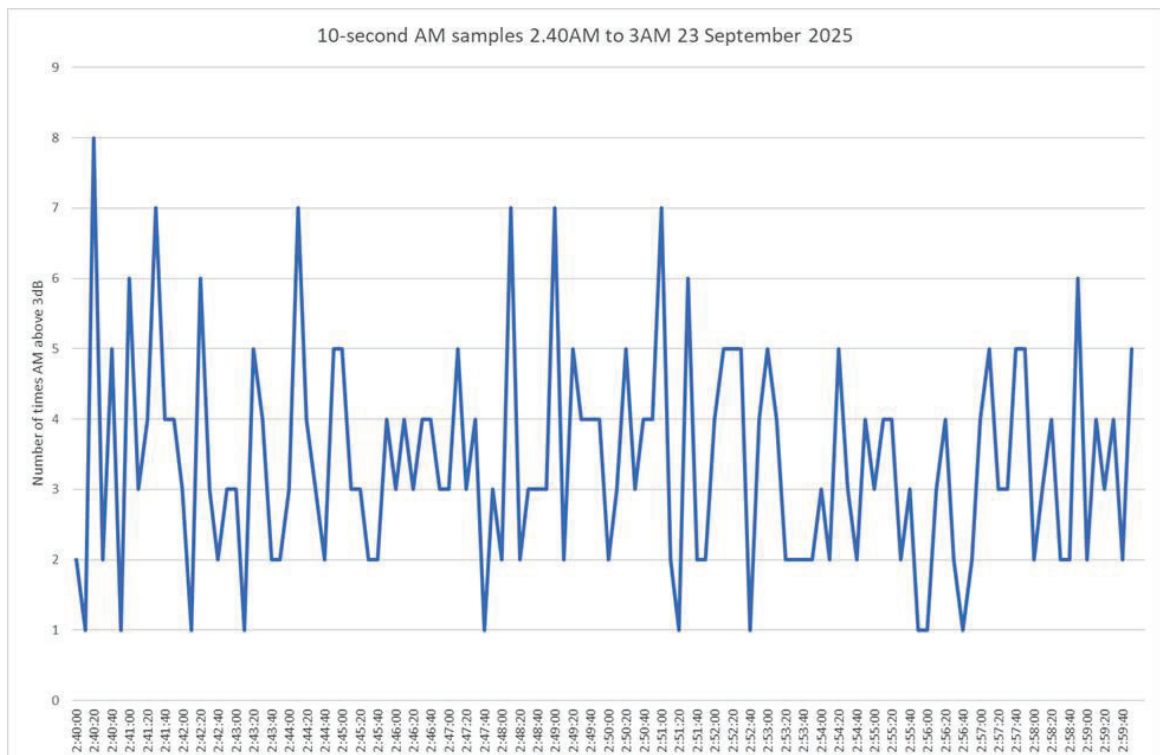


Figure 29

The number of times that an AM value has exceeded 3 dB does not indicate the level of those exceedances. For example; occasions of a 'whump' or 'thump' type sound common to wind turbines that present as intermittent high levels of AM cannot be gleaned from Figure 29 but the regularity of AM values higher than 3 dB is evident.

Figure 30 shows an example 10-second A-weighted AM sample where there are AM values greater than 6 dB that warrant the application of a penalty.

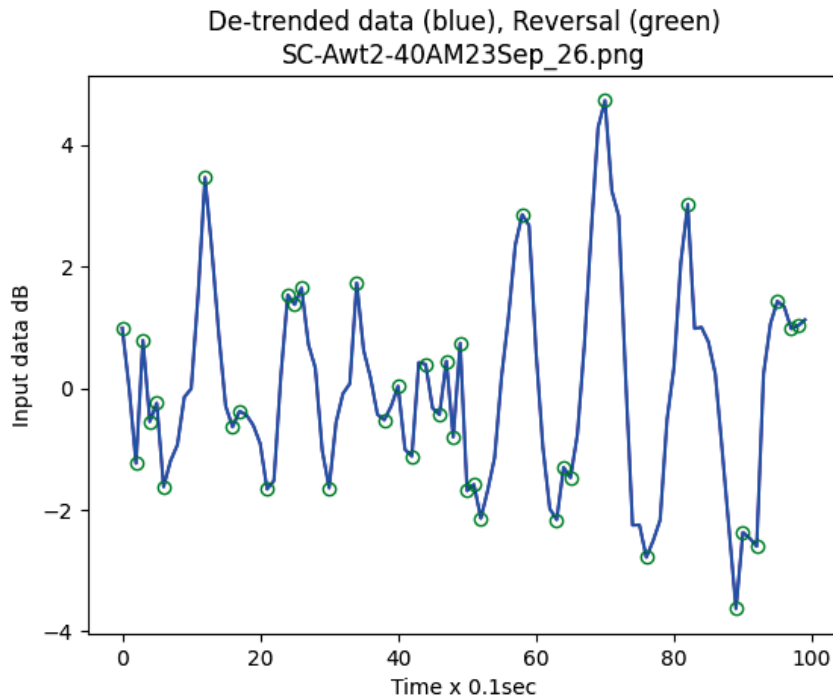


Figure 30

Impulsiveness

The rate of change of sound level associated with each peak classifies most AM events as having an impulsive character (sound level increase faster than 10 dB/second).

Impulsiveness warrants an additional penalty to measured LAeq sound levels.

Low Frequency Noise

Assessment of the adverse impacts of low frequency noise (LFN, typically 10-200 Hz, including infrasound below 20 Hz) vary internationally but generally focus on annoyance, sleep disturbance, and other health effects rather than just hearing damage. Traditional A-weighted measurements undervalue low frequencies.

Common methods include spectral analysis, weighting networks, and national or regional criteria curves, often applied indoors where complaints occur. These vary by country but share elements like third-octave band measurements and thresholds based on audibility or acceptability.

One common quick assessment method is to check if there is an unbalanced spectrum. This is where there is a high proportion of low frequency sound and this can be checked by comparing LAeq sound levels with the LCeq sound levels measured during the same period.

A difference of $L_{Ceq,10min}$ minus $L_{Aeq,10min}$ greater than 15 dB indicates significant LFN presence and Figure 31 presents the differences obtained during the survey period.

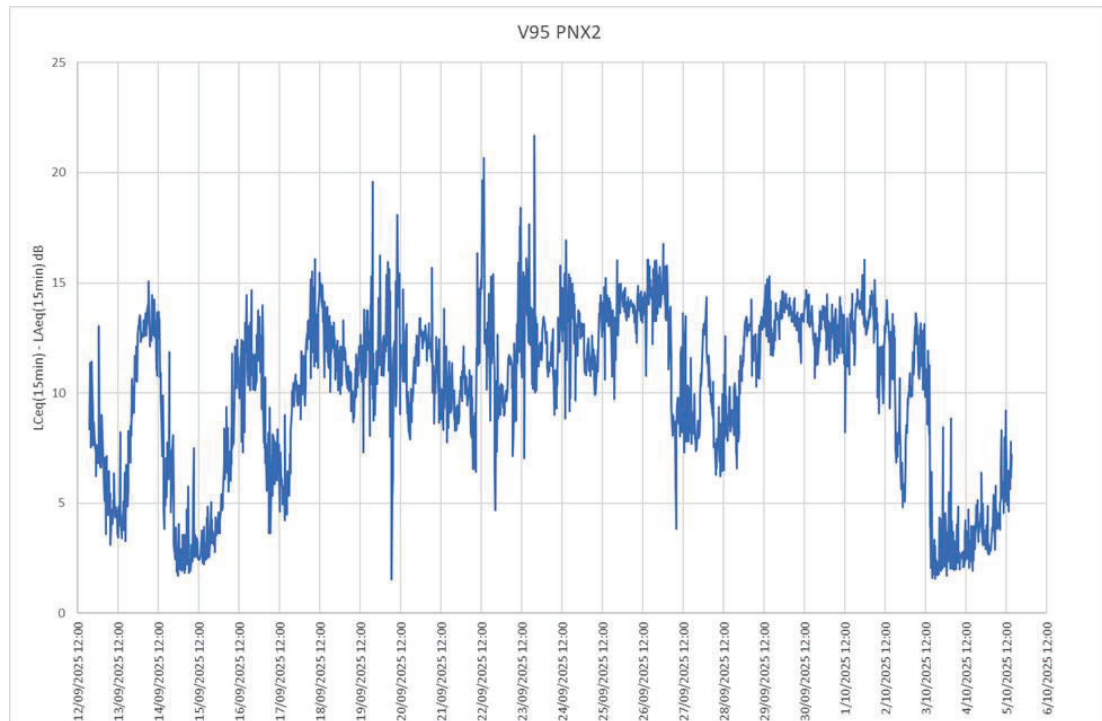


Figure 31

The difference between L_{Ceq} and L_{Aeq} can be influenced by extraneous noise from wind in trees that may indicate a false negative (indicating no LFN when there is strong LFN).

For example, although there is a high level of LFN in the 160 Hz 1/3 octave band the difference between L_{Ceq} and L_{Aeq} is well below 15 dB in the evening of 15 September 2025.

In cases such as this it is common to measure sound pressure levels in bands (e.g., 10-160 Hz) and compare values obtained to reference curves.

Exceedance of reference curves signal potential adverse impact, with additional penalties for tones (+5 dB) or fluctuations (AM). These methods are used in standards like DIN 45680 (Germany), which sets night-time limits (e.g., 95 dB at 10 Hz, 33 dB at 100 Hz) averaged over the loudest hour.

The UK use the DEFRA Procedure (NANR45) comparing against an indoor 1/3 octave curve (10-160 Hz, e.g., 92 dB at 10 Hz, 43 dB at 50 Hz, 34 dB at 160 Hz).

Downey and Parnell (Assessing low frequency noise from industry – a practical approach, ICBEN 2017) suggest a correction for outdoor to indoor attenuation so that DEFRA NANR45 can be applied to outdoor measurements. This method is used by the EPA in Victoria, Australia.

The outdoor threshold limit in the 160 Hz third-octave band using DEFRA NANR45, for which LFN indicates problematic disturbance, is 44 dB.

Figure 32 shows that the 160 Hz third-octave regularly exceeded 44 dB (red line) in the evening of 15 September 2025 and this indicates that low frequency annoyance is to be expected.

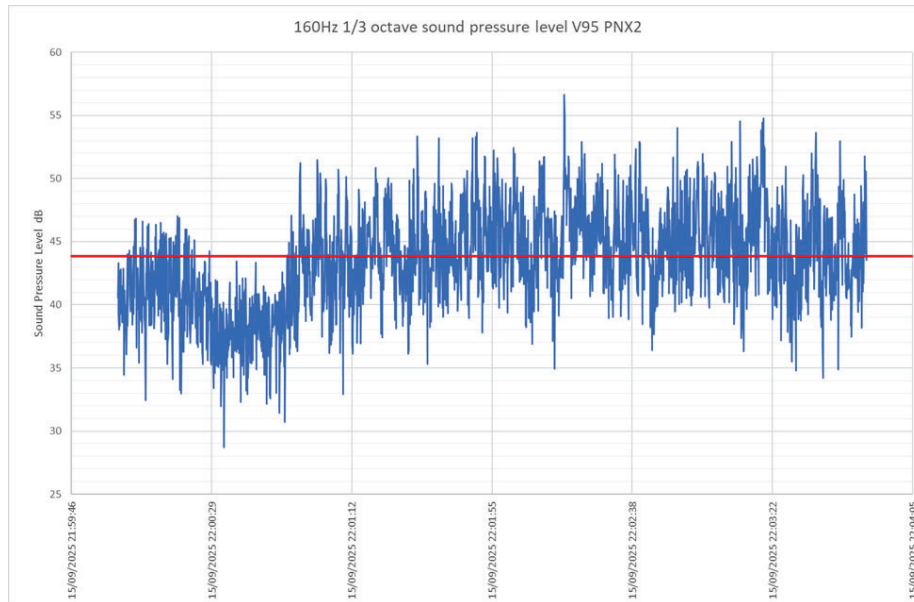


Figure 32

SUMMARY

The permitted rating sound level of 43 dB, $L_{Aeq(15min)}$ was exceeded on multiple occasions during the survey period.

When focussing on the night time period to reduce extraneous noise there is evidence of excessive amplitude modulation and low frequency noise that, using multiple assessment methodologies, indicates that annoyance will be caused.

Individual AM events have an impulsive characteristic that according to ISO1996 would warrant a penalty to the measured sound levels prior to assessing compliance with the specified rating limit (43 dB, $L_{Aeq(15min)}$).

A significant low frequency characteristic was found in the 160 Hz third-octave band that often shows amplitude modulation higher than 10 dB at levels that are clearly audible.

Furthermore, a tonal penalty of 4 dB applies to this 165 Hz tone within the 160 Hz 1/3 octave band when assessed using ISO 1996.

Overall, a minimum cumulative penalty of 6 dB should apply for the different audible characteristics that effectively means the permitted noise limit becomes 37 dB, $L_{Aeq(15min)}$.

However, if each penalty was to apply cumulatively the total penalty could exceed 12 dB which would change the permitted noise limit to 32 dBA.

Notwithstanding the non-compliance with authorised sound levels in the permit, it has been found that measured LFN sound levels are unacceptable and liable to cause annoyance.

B) Huson Peer Review Slieveacurry Noise Prediction

HUSON & ASSOCIATES

Peer Review of Proposed Slieveacurry Wind Farm Planning Application (PAX03.324270)

W Les Huson BSc(Hons) MSc CPhys MInstP MloA MAAS

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Slieveacurry Wind Farm Review.docx
JUNE 2026

INTRODUCTION

Huson & Associates has been commissioned by the Miltown Locals Say No To Windfarm group to review an Environmental Impact Assessment Report (EIAR) prepared by MKO Planning and Environment Consultants for Slieveacurry Ltd containing Chapter 12 ‘Noise and Vibration’ (NVA) prepared by AWN Consulting Ltd to support a Planning Application lodged with An Coimisiun Pleanála (Case Ref. PAX03.324270) on 5 May 2026 for the Slieveacurry Renewable Energy Development. The application is for a wind farm containing up to nine wind turbines.

The proposed wind farm development (see Figure 1) has been deemed suitable for assessment by An Coimisiun Pleanála (ACP). A similar application was assessed and refused by Clare County Council with a subsequent Appeal to An Bord Pleanála that was also dismissed (8 Feb 2023).

This review also considers the grounds for refusal by Clare County Council and An Bord Pleanála (ABP-312728-22) of the prior application that was refused. The prior application had wind turbines fundamentally in the same location as the current application but without turbine T9.

An application for the Illaunbaun Wind Farm lies to the north-west, currently under review by ACP, and the application documents for this wind farm have also been reviewed insofar that they relate to the Slieveacurry Wind Farm application.

This review has been prepared by W Les Huson BSc(Hons) MSc CPhys MInstP MIOA MAAS (brief CV in Appendix A). Referenced papers can be made available on request.

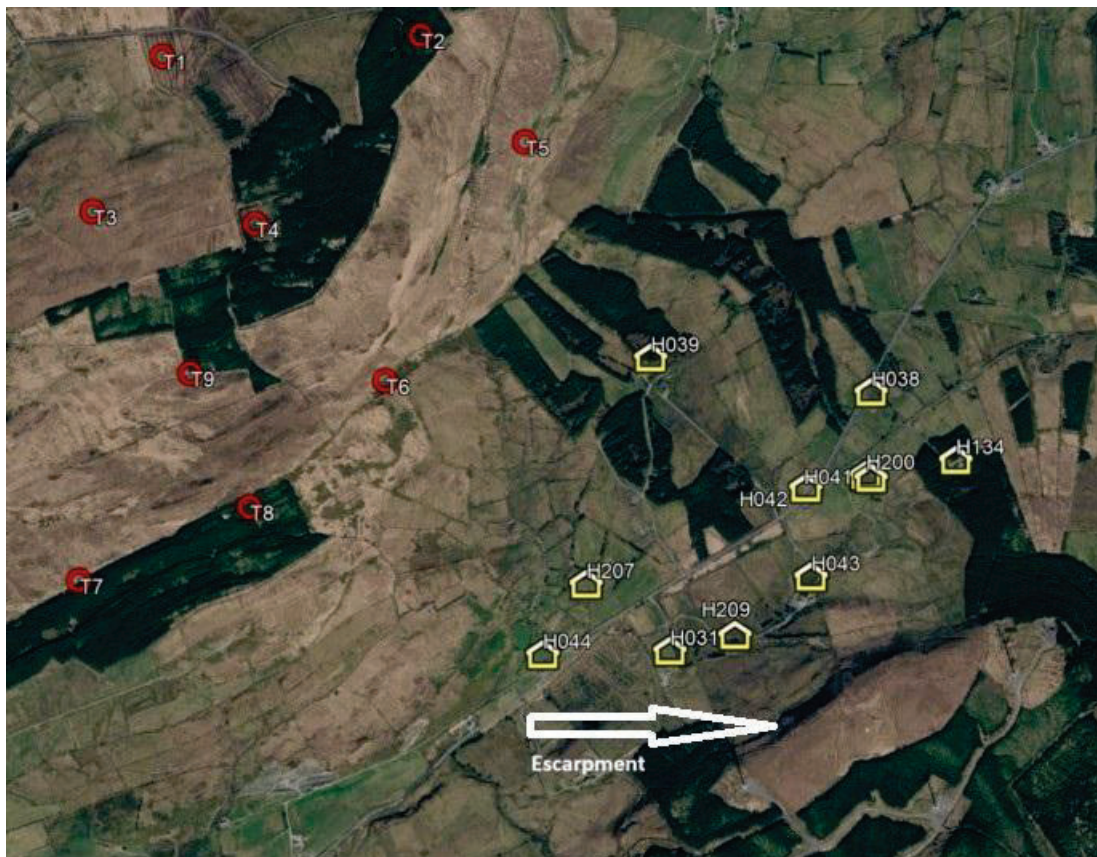


Figure 1 Location of wind turbines (T) and some NSLs

SUMMARY

An Coimisiún Pleanála would be justified in dismissing the Slieveacurry Wind Farm Application for the following reasons:

- The minimum recommended setback of 10 times the rotor diameter, a best practice setback distance of 1.5 km for the proposed wind turbine rotor diameter of 150m, has not been applied with one dwelling (H033) being only 529m from the nearest wind turbine.
- The wind turbines are located too close to each other that will result in increased wake turbulence that in turn will increase noise emission and the characteristic of amplitude modulation. The NVA has not considered these effects.
- Noise compliance with WEDG 2006 should have been completed at 10 m/s, not 8 m/s. All wind speeds in this report refer to standardised height of 10 m above ground level.
- WEDG 2006 target noise limits have been misinterpreted in the NVA to produce higher proposed noise limits.
- WEDG 2006 requires: “Any existing turbines should not be considered as part of the prevailing background noise”. Background noise measurements have all been corrupted by noise from the Slieveacallan Wind Farm and the method chosen to correct this interference is not mathematically sound and introduces increased uncertainty. A more representative and recent background survey that can be used as proxy for dwellings surrounding the Slieveacurry Wind Farm, that is less influenced by extraneous noise from the Slieveacallan Wind Farm, is that provided in the Illaunbaun Wind Farm planning application currently under review by ACP.
- Target day time noise limits should be lower at 35 dB(A) in 10 m/s wind speed.
- Predicted sound levels in the NVA are too low.
- When less optimistic noise model inputs are used the predicted noise levels shown in the NVA will be at least 2 dB higher.
- The current WEDG 2006 does not reflect best practice and is outdated, but if applied properly, shows that this proposed wind farm is non-compliant.
- The requirement from WEDG 2006 that ‘*that there is no significant increase in ambient noise levels at any nearby noise sensitive locations*’ has not been addressed in the NVA.
- Ambient sound levels are shown at times to be below the 17 dB(A) instrument noise floor in wind speeds up to 10 m/s at H161 compared with cumulative sound levels optimistically predicted to be more than 38dB(A) at this location.

- The soundscape in the area will change by more than 20 dB for the surrounding Community if the wind farm is approved and this is contrary to the requirement of the WEDG 2006.
- According to the Environmental Protection Agency, Ireland’s ‘Guidelines on the Information to be contained in Environmental Impact Assessment Reports’ (EPA, 2022), the impact of the proposed development when operational will cause a ‘Very Significant’ to ‘Profound’ effect. Accordingly, the development application presents an unacceptable impact and should be refused.
- The layout of the nine wind turbines is such that excessive amplitude modulation will arise but the NVA has not accounted for any penalty due to this or other special audible characteristics (tonality, impulsive sound).
- The sound power levels for the wind turbines of the Slieveacallan Wind Farm that were input to the cumulative noise predictions are too low by 0.5 dB that will translate to higher cumulative sound levels.
- The NVA has listed several dwellings as being derelict, yet, these properties could be occupied in the future. It is not appropriate for the NVA to set daytime and night time noise limits at 55 dBA for these properties.
- Current best practice in assessing wind farm noise should be reflective of target noise limits set in Germany and the Australian States of New South Wales and Tasmania.
- Low frequency noise impact has not been assessed, despite this being discussed in the NVA.
- With noise model inputs used in the NVA and no consideration of special audible characteristics there will be 181 noise sensitive locations (NSLs) that exceed the correct noise limit target of 35 dB(A) at 10 m/s.
- With more conservative noise model inputs (+2dB) and no special audible characteristics 207 NSLs will exceed the correct noise limit target at 10 m/s.
- If special audible characteristics were to warrant a 5 dB penalty with the correct noise model inputs, then all 208 NSLs considered in the NVA will exceed the correct noise limit target at 10 m/s.
- The NVA does not refer to any noise predictions for the substation and only refers to an unspecified detailed future design. The NVA is deficient in this regard.
- An escarpment to the south east of the proposed development has the potential to increase noise levels through reflection for dwellings between it and the proposed Slieveacurry Wind Farm that are shown in Figure 1.

The following expands upon these issues.

PLANNING GUIDANCE ON NOISE FROM WIND FARMS

The Irish Government Department of Environment Heritage and Local Government document ‘*Wind Energy Development Guidelines, 2006*’ (WEDG 2006) detail the current guidelines to set noise limits for wind energy developments.

The NVA has adopted the principles of WEDG 2006 but has added interpretations contained in UK wind farm noise guidance using ETSU-R-97 ‘The Assessment and Rating of Noise from Wind Farms’ with further guidance from the Institute of Acoustics in 2013; ‘A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise’ (GPG) to change recommended noise limits in WEDG 2006.

It should be recognised that the scope of the GPG was not to examine noise limits described in ETSU-R-97. The GPG states that “The approval of this guide by the IoA Council should not be seen as an endorsement of the noise limits within the ETSU-R-97 document since the setting of these limits is a policy matter for Government.”

Furthermore, the GPG is only applicable for those involved in the assessment and rating of wind turbine noise when applying ETSU-R-97 assessment procedures. The GPG may not be appropriate guidance if other assessment procedures are used.

WEDG 2006 requires updating and a DRAFT WEDG 2019 was prepared but not formally adopted as it remains under review.

The limits proposed in the WEDG 2006 broadly align with the UK guidance found in ETSU-R-97 that reflects but does not reference WHO guidance in 1997. However, noise limits to protect sleep were reduced by 5 dB in subsequent WHO guidance in 1999 that remain current.

WEDG 2006 does not require that ETSU-R-97 or guidance on its implementation be used to assess wind turbine noise.

WEDG 2006 states that “*Good acoustical design and carefully considered siting of turbines is essential to ensure that there is no significant increase in ambient noise levels at any nearby noise sensitive locations.*” This requirement is a test that has not been addressed in the NVA.

WEDG 2006 has been drafted to balance the objectives of providing renewable power with acoustic amenity and for quiet areas states; “*in low noise environments where background noise is less than 30 dB(A), it is recommended that the daytime level of the LA90, 10min of the wind energy development noise be limited to an absolute level within the range of 35-40 dB(A).*”

Justice Richards observed the following in a recent Supreme Court nuisance noise case (Uren v Bald Hills Wind Farm S ECI 2020 00471) 25 March 2022 in Australia:

“*The generation of renewable energy by the wind farm is a socially valuable activity, and it is in the public interest for it to continue. However, there is not a binary choice to be made between the generation of clean energy by the wind farm, and a good night’s sleep for its neighbours. It should be possible to achieve both.*”

A recent court case in Ireland (Ms Justice Emily Egan) echoes this observation:

“There is not a binary choice to be made between the generation of clean energy by the wind farm and a good night’s sleep for its neighbours. It should be possible to achieve both.”

The WEDG 2006 does not set fixed noise limits. The guideline provides advice for local authorities (Councils) to develop their own planning guidelines for noise that can differ from those suggested in WEDG 2006. In this regard, for example, the Limerick County Council has set low frequency noise guidelines that are not contained within the WEDG 2006 and they also allow a night time noise limit of 38 dB(A), L90, or Background plus 5 dB. Many other local councils have set noise criteria for wind farms that differ from those in the WEDG 2006.

BACKGROUND NOISE MEASUREMENTS

NVA, Appendix 12-5 and NVA Table 15, has chosen to set lenient target noise limits in the daytime at 45 dB(A) L90 or background plus 5 dB, whichever is the greater, where background noise levels were >30 dB(A) from five residences (A, B, C, D and E) around the proposed development, all of which were acknowledged to be affected by noise from the Slieveacallan Wind Farm.

Several proxy locations are suggested to be representative of the five background measurement locations. For example, Background measurements at location E (H006) is suggested to be representative for H002, H003, H004, H006, H008, H011, H012, H013, H014, H026, H069, H115, H116, H117, H118, H119, H140, H141, H142, H143, H144, H145, H146, H160, H161, H162, H163, H177, H178, H180, H181, H182, H183, H186, H187, H188, H189, H190, H191, H192, H198, and H213.

Conversely, if one of those proxies had background measurements unaffected by noise from the Slieveacallan Wind Farm then that could be used as a proxy to represent those listed above.

The NVA has suggested correcting their background noise measurements by removing data outside particular wind directions and to further correct the corruption from the Slieveacallan Wind Farm by ‘removing’ its contribution.

However, the ‘removal’ method of correction is to simply take LAeq predicted noise levels, corrected by 2 dB to LA90 and then to take predicted LA90 levels away from background measurement data. This correction methods is not mathematically sound and it is preferable to use background data from a representative location in the area that is unaffected by noise from other wind farms.

It would have been possible to use background noise measurements taken for the Slieveacallan Wind Farm before it was constructed but this data would be more than 16 years old.

I suggest that the background survey data (November 2023) from NML2 in the Illaunbaun Wind Farm application to ACP is the most recent and reliable background noise survey upon which to set target noise limits for all NSLs surrounding the proposed Slieveacurry Wind Farm.

It should be noted that measured background sound levels regularly fall below 20 dB(A) in wind speeds up to 8 m/s. When consideration is given to the compression of sound level measurements close to the noise floor of the sound level measurement instruments¹ the real average background sound levels at many noise measurement locations (NMLs) will be well below 30 dB(A), justifying the lower target base noise limit of 35 dB(A) from the range suggested in WEDG 2006 during the daytime.

¹ Huson, W. Les. “Constraints imposed by and limitations of IEC61672 for the measurement of wind farm sound emissions” 6th International Conference on Wind Turbine Noise, Glasgow 20-23 April 2015

This effect is also highlighted in BS 4142:2014+A1:2019, section 8.1 which notes: “Care is necessary in circumstances where background sound levels are low to ensure that self-generated and electrical noise within the measurement system does not unduly influence reported values, which may be the case if the measured background sound levels are less than 10 dB above the noise floor of the measuring system.”

‘Guidance Note for Noise Assessment of Wind Turbine Operations at EPA Licensed Sites (NG3)’ has been referenced about infrasound and low frequency (12.3.5.9) but the NVA has not mentioned that it also provides compliance limits in the daytime between 35 dBA and 40 dBA for quiet daytime environments of less than 30 dBA that echoes the lower limits in WEDG 2006.

For situations where the *average corrected* background noise level is <30 dB(A) the NVA has elected to apply the least stringent noise limit of 40 dB(A) and no noise sensitive locations (NSLs) have been assigned the 35 dB(A) base noise limit.

Background sound levels that set target noise limits generally increase with wind speed and the background measurements at H162 from the Illaunbaun Wind Farm application to ACP shows this effect in the following table.

Location		4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s
H162 (NML2)	Day	20.0	20.7	21.7	23	24.6	26.3	28.1	30.1	32.1
	Night	20.3	21.3	22.5	23.9	25.4	26.9	28.6	30.3	32.1

VIBRATION

Section 12.3.7 refers to vibration generated by the wind turbines. Whilst ground borne vibration is expected to be low there is the possibility of induced building vibration due to acoustic emissions from wind turbines. The mechanism producing this effect is described by Kelley².

NOISE LIMITS

The 2018 World Health Organization (WHO) Environmental Noise Guidelines for the European Region suggests a provisional outdoor target noise limit for wind farm noise of <45 L_{den}. This roughly equates to 37.3 dB, LAeq³ and supports the lower noise level target of 35.3 dB(A), L90 (37.3 dB LAeq – 2 dB), not that proposed in the NVA.

Based on background measurements that were unaffected by noise from the Slieveacallan Wind Farm, reported in the Illaunbaun Wind Farm EIAR (NML2, November 2023) for dwelling H162 in winds less than 11 m/s, the target noise limit should be 35 dB(A) in the day time.

Again, the NVA is not applying best practice.

² N.D.Kelley. A Proposed Metric for Assessing the Potential of Community Annoyance from Wind Turbine Low-

Frequency Noise Emissions. Windpower '87 Conference and Exposition October 5-8, 1987 San Francisco, California.

³ Davy, J.L., Burgemeister, K., Hillman, D. *et al.* A Review of the Potential Impacts of Wind Turbine Noise in the Australian Context. *Acoust Aust* **48**, 181–197 (2020). <https://doi.org/10.1007/s40857-020-00192-4>

Section 12.3.5 of the NVA states: “The Guidelines (DoEHLG 2006) are based on detailed recommendations set out in ETSU-R-97. The ETSU-R-97 document has been used to supplement the guidance contained within the Guidelines (DoEHLG 2006), where appropriate and necessary.”

Guidelines DoEHLG 2006 (WEDG 2006) is not based upon detailed recommendations set out in ETSU-R-97, rather, it was considered and bears similarity to parts of ETSU-R-97 such as the target night time noise limit and the use of LA90 to measure and assess wind turbine noise.

WEDG 2006 is a workable stand-alone document and the NVA should not rely on guidelines from the UK Institute of Acoustics (currently under review) that are specifically used to implement ETSU-R-97.

WEDG 2006 outlines the current assessment requirements which do not refer to or require interpretations from the UK IoA Good Practice Guide that in some cases alter WEDG 2006 recommended noise levels.

Section 12.5.2 of the NVA outlines a rationale for the choice of noise limits that are used in the NVA.

The rationale to adopt a 43 dB(A), L90 or *Background plus 5 dB, whichever is the higher* noise limit at night is a less stringent target than WEDG 2006 recommends.

The proposed night time noise limit in the NVA is too lenient by allowing night time noise limits greater than 43 dB(A), L90.

WEDG 2006 references Environmental Protection Agency (2003) Environmental Noise Survey - Guidance Document, EPA Wexford, that has been superseded by Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4).

The NVA (12.3.6.1 and 12.5.2) references NG4 for guidance on establishing if NSLs can be considered to be in ‘low background noise’ areas. ‘Low background noise areas’ are required to be assessed when applying WEDG 2006.

NG4 suggests that a daytime noise criterion of 45dB(A), Leq, applies in ‘areas of low background noise’. The parameter referenced in NG4 is a rating value (LAr), based on LAeq so the LA90 target noise limit is 43 dB(A), LA90 (45dB minus 2 dB to represent LA90).

The NVA author shows in Table 12-5 that in the Evening this reduces to 40 dB(A), Leq (38 dB(A), L90) and at night the criterion reduces to 35 dB(A), Leq (33 dB(A), L90).

NG4 also has recommended criteria for Quiet Areas and properties surrounding this development comply with a designation of ‘Quiet Areas’ for their location. Under these circumstances the criteria changes to noise from the proposed development to be at least 10dB below the average daytime, evening and night time background noise levels measured during the long-term baseline noise survey.

NVA section 12.5.2 use NG4 as a reference document to suggest noise criteria for the proposed wind farm that are at least 10 dB higher than NG4 recommends at night for both Quiet Areas and ‘areas of low background noise’.

Likewise, the proposed daytime noise limit of 40 dB(A), L90 is 7 dB higher than the evening period for ‘areas of low background noise’ and at least 10 dB higher than the NG4 criteria for Quiet Areas.

If WEDG 2006 is to apply to this proposed development then the lower day time noise limit of 35 dB(A), L90 should apply and, in addition, consideration must be given to any significant increase in noise levels.

The NVA suggests that: “In line with ETSU-R-97 guidance (see Section 12.3.5.1), a fixed lower threshold of 45 dB LA90 or a maximum increase of 5 dB above background noise (whichever is the higher) is proposed for NSLs identified as being involved in the project.”

However, WEDG 2006 does not differentiate between NSLs involved in a wind farm project or not, it states: “In the case of wind energy development, a noise sensitive location includes any occupied dwelling house, hostel, health building or place of worship and may include areas of particular scenic quality or special recreational amenity importance.” WEDG 2006 noise limits apply to *any* occupied dwelling whether they are associated with the project or not.

The NVA has listed several dwellings as being derelict, yet, these properties could be occupied in the future. It is not appropriate for the NVA to set daytime and night time noise limits at 55 dBA for these properties. The NVA predicts noise levels above 40 dB for ‘derelict’ dwellings H005, H034, H035, H045, H046, H199, H206, H207 and H209.

In the NVA, section 12.5.2 it has been incorrectly interpreted that when background sound levels become greater than 30 dB(A) at higher wind speeds that the lower range of noise limits suggested in WEDG 2006 (35 to 40 dB(A), L90) do not apply and the limit suddenly reverts to 45 dB(A) L90. This is incorrect.

The test of a quiet area is made at lower wind speeds (below 5 m/s according to BS4142 and NG4 where wind-induced noise on a microphone is minimised) and once determined applies at all higher wind speeds.

Section 12.5.3 of the NVA confirms that background sound levels at low wind speed, when there is no corruption from the Slieveacallan Wind Farm, demonstrate that the NSLs can be defined as areas of low background noise.

As wind farms operate 24/7 the limiting criterion for this development should be 35 dB(A), L90 during the day time (WEDG 2006 includes ‘evening’ into the description of ‘day time’) and predicted noise levels must be compared to this limit to assess if the development is acceptable.

A 35 dB(A), L90 noise limit during the day is based upon a day time background level of 28.1 dB(A), L90 at 10 m/s measured at H162.

Thus, the lower limit should be set at 35 dB(A) in wind speeds at or below 10 m/s.

In summary, the noise criterion suggested in the NVA for the proposed development at 8 m/s is too high by 10 dB during the daytime period if the WEDG 2006 limits are to be applied correctly. Additionally, for associated landowners the proposed limit at night is 2 dB too high.

Dwellings associated with the proposed development should have the same target noise limits as other non-associated NSLs.

Under these circumstances the predicted sound levels from the NVA at many dwellings exceed the appropriate recommended noise limit and ACP will be justified in refusing the proposed development.

The predicted sound levels for this development are overly optimistic. With appropriately set noise model inputs to reflect a conservative assessment the degree of non-compliance is greater by at least another 2 dB.

The NVA (12.4.4.2) has suggested hopefully and naïvely that:

A warranty will be provided by the manufacturer of the selected turbine to ensure that the noise output, including tonality, is controlled.

NOISE PREDICTIONS

Cumulative noise contour predictions in the NVA (Appendix 12-4) are made for the 8 m/s wind speed case.

For the 9 m/s wind speed case the predictions are the same.

Appendix 12-5 lists cumulative predicted sound levels at different NSLs for integer wind speeds up to 9 m/s.

The NVA does not explain why the sound power levels for the Slieveacallan Wind Farm wind turbines have only 1.5 dB added for uncertainty rather than 2 dB that was applied for the Illaunbaun and Slieveacurry wind turbines. The additional 0.5 dB will translate to higher predicted cumulative noise levels.

The test from WEDG 2006 for a low noise environment is not separated into that during the Day or Night.

At 10 m/s the day and night background noise level is less than 30 dB(A) that justifies the area to be classified as a ‘low noise environment’. The noise limit at this wind speed should be 35 dB(A), not 45 dB(A).

A lower limit from the range 35 to 40 dB(A) from WEDG 2006 is recommended as it matches recommendations in NG4 for the evening.

At 8m/s the NVA is suggesting that a higher noise limit of 45 dB(A) should apply, based on background measurements, all of which the NVA admits have been affected by noise from the Slieveacallan Wind Farm. I strongly disagree.

The NVA is suggesting a target noise limit of 40 dB(A) or 45 dB(A) during the Day, dependent on corrupted background sound levels, and 43 dB(A) at night. Again, I disagree.

The target noise limit during the day should be 35 dB(A) at 10 m/s and below, not 45 dB(A) as claimed in the NVA for all noise sensitive locations.

The NVA predicts a sound level at NSL H039 of 43.2 dB(A) at 8 m/s, when applying the optimistic noise model inputs used in the NVA. This exceeds the NVA suggested night time limit by 0.2 dB.

However, if more conservative noise model inputs are used where the receiver height is 1.5m and the ground absorption value, G, is 0 then the predicted sound level for this dwelling becomes 45.2 dB(A).

Under both noise model prediction scenarios, the predicted sound level at NSL H039 exceed the correct 35 dB(A) daytime noise limit at 10 m/s and below.

The NVA has used very optimistic noise modelling and assumed that the sound from the proposed wind farm will not be tonal, impulsive or have any significant amplitude modulation characteristics that, in my experience, often occur.

The NVA (12.5.3) does not provide any noise predictions for the substation and defers to future detailed design. It is common knowledge that substation noise has tonal characteristics and the NVA should have included noise predictions for the substation to compare against the recommended 35 dB(A), LAr noise criterion. The NVA has suggested a target level of 35 dB(A), Leq, rather than LAr

LA90 statistic or LAeq

Use of the LA90 statistic does not capture short term noise events that are often observed from wind farms. Such noise events are often referred to as ‘whump’ or ‘thump’ type sounds are thought to be caused by wind flow delamination across the rotor blades when wind conditions change.

The benefit of a condition requiring the LAeq is that such events can reflect the extent of intermittent louder sounds that the LA90 statistic cannot.

However, if an LA90 level is specified as a noise condition then an added provision to prevent impulsive noise or tonality could be applied.

Such a condition was applied for the Cloghan Wind Farm in Offaly, as follows:

Noise levels emanating from wind farm noise when measured at the nearest noise sensitive properties, i.e. dwelling houses, shall not exceed 43 dB(A) LA90(10 minutes). There shall be no tonal or impulsive noise and measurements shall be made in accordance with ISO recommendations R1996-1 (Acoustics-description and measurement of environmental noise, part 1; basic qualities and procedures).

BEST PRACTICE

WEDG2006 is outdated and not currently ‘best practice’.

The most recent (29 July 2025) review of best practice in setting wind farm noise limits has been completed by the EPA of Tasmania, Australia, that has revised its wind farm noise guideline limit and set 35 dB(A), Leq as the appropriate base noise limit to be met. A copy of the Policy is in Appendix D.

Current best practice in wind farm noise guidance is also provided in the Australian States of New South Wales and Queensland where night time target noise limits are set at 35 dB(A) Leq or background plus 5 dB with additional penalties for special audible characteristics such as tonality, impulsiveness, and amplitude modulation.

Germany also has for a long time had a night time noise level limit of 35 dB(A) Leq.

Wind farms have been approved under these target noise limits and a good balance has been struck to provide renewable energy and protect the nearby population.

A target noise limit of 35 dB(A), Leq approximates to 33 dB(A), L90 that lies 2 dB below the lowest recommended day-time absolute limits in WEDG 2006 for quiet areas and reflects modern expectations for the protection of a nearby community.

NOISE MODEL

The NVA has used the ISO 9613-2 noise model that includes ground absorption and used manufacturer's data from Vestas for the V150. Vestas manufacturer's data normally includes a clause for 'Limitations', as follows:

These values as stated in the present document are to be regarded as “best estimates” for the octave band performance for the turbine. The values are to be regarded as informative and cannot in any way be used as guaranteed for any projects.

Given such *limitations*, it would be expected that uncertainty values greater than 2 dB would be appropriate.

ISO 9613-2 prediction results are sensitive to the value of ground absorption/attenuation effect, G, that can range between 0 and 1. G=0 indicates no ground absorption and G=1 represents full ground absorption of sound.

A paper by Brittain and Charalampous⁴ shows the inadequacy of the ground effect calculations in ISO 9613-2 for a source height of 100m, which conveniently approximates the hub height of the proposed candidate wind turbines in the NVA.

The NVA has used a value of G=0.5 in the ISO 9613-2 noise model for all the ground between the wind turbines and all noise sensitive receivers with an artificial receiver height of 4m (in practice all sound level surveys are completed at a height of between 1.2m to 1.5m).

The peculiarities of the ground effect calculation in ISO 9613-2 show that predicted sound levels for a receiver height of 4m there is a 2 dB difference in predicted sound levels depending on whether G=0 or G=0.5 is used. G=0 produces typically 2 dB higher predicted sound levels than when G=0.5 is used and 4 dB higher compared to G=1.

It is best practice to err on the side of conservatism and use G=0 when using ISO 9613-2.

This point was made by Eric Sloth, one of the authors of the JOULE⁵ study in his presentation (Appendix B) where he advises that if ISO 9613-2 is to be used for wind farm noise predictions, then G=0 should be used with additional corrections to account for site effects such as inflow turbulence.

The NVA has not accounted for any site effects that can increase wind turbine sound power levels.

Furthermore, the NVA *assumes* that there will be no special audible characteristics from whatever wind turbine is chosen to be used in the wind farm. Only test results can confirm this assumption but none have been supplied in the NVA.

⁴ Brittain, F., Charalampous, P: 'Assessing Accuracy of ISO 9613-2 for Calculating Ground Effects of Stack Height and Distance Using Olive Tree Labs OTL Suite'. NOISE-CON 2016, Providence, Rhode Island, 13-15 June, 2016

⁵ Bass, J., Sloth, E., Bullmore ‘Development of a Wind Farm Noise Prediction Model,’ JOULE project JOR3-CT95-0051, 1998

The ISO 9613-2 noise model has a stated limitation for its calculations in conditions where the source to receiver average height does not exceed 30m and when average propagation enhancement from vector wind does not exceed 1m/s to 5m/s measured at a height above ground between 3m and 11m.

ISO 9613-2 for this wind farm application is being applied well outside of its intended use.

The NVA has not commented on the uncertainty associated with the use of ISO 9613-2. The preferred IEA method recommended in the JOULE report suggests a standard deviation uncertainty of 0.004dB/m.

For a propagation distance of 1000m this translates to +/-4 dB (+/- one standard deviation). ISO 9613-2 predictions are estimated in Table 5 of the standard to have an uncertainty of +/-3dB at 1000m if all inputs are accurate but notes that:

“The estimates of accuracy in table 5 are for downwind conditions averaged over independent situations (as specified in clause 5). They should not necessarily be expected to agree with the variation in measurements made at a given site on a given day. The latter can be expected to be considerably larger than the values in table 5.”

The JOULE study also noted the following:

“As a result of the measurements just described it has been concluded that:

- Noise levels at all distances from the source do vary, even if the source of sound has a constant power level.
- The measured variation in noise levels increases with increasing distance from the source.
- Based on typical wind speed ranges of between 0ms⁻¹ and 10ms⁻¹ encountered during the experimental measurements, the one standard deviation spread of noise levels either side the mean level was found to increase at a rate of approximately 0.004dB(A) per meter increase in the source to receiver separation distance.”

The fact that wind farm sound levels vary with increasing distance (assuming all wind turbines emit a constant sound level) suggests that the use of the L90 statistic underestimates the true impact of noise from a wind farm.

Whilst it is advantageous to use an L90 statistic to reduce extraneous noise effects on a measurement it unfortunately underestimates the true higher levels of noise caused by the wind farm.

This underestimation can be compensated for by adding the standard deviation of 0.004dB/m measured in the JOULE study, in which case the predictions in the NVA would be increased by about 3 dB for the nearest dwellings.

A more realistic estimation of the higher sound levels from a wind farm is the predicted sound level using the simple IEA model (cut down ISO 9613-2 with corrections) plus the addition of one standard deviation uncertainty.

For a dwelling 1000m away the prediction should use the IEA model output plus 4dB (0.004dB/m at 1000m).

The American National Standards Institute (ANSI) published ANSI/ACP 111-1⁶ to ensure predictions of sound from wind farms are repeatable, uniform, and more easily understood by all interested parties.

ANSI/ACP 111-1 draws on existing standard methods in ISO 9613-1, ISO 9613-2, and IEC 61400-11 to establish a uniform method of predicting future project sound levels such that predevelopment sound assessment results and predictions used in research can be readily compared. The standardisation of predictions ensures a robust and repeatable process that improves regulatory confidence in the results and reduces potential confusion.

The apparent wind turbine model-specific sound power level should be determined in accordance with IEC 61400-11 for the downwind location. Using this sound power level as the basis, propagation modelling should be conducted in accordance with the ISO 9613-2 standard (Acoustics—Sound Attenuation During Propagation Outdoors Part 2: General Method of Calculation) using either of two sets of parameters, identified as Option 1 and Option 2:

Option 1

- A. Ground factor of $G=0$.
- B. Receptor height of 1.5 meters for consistency with existing standards.
- C. Turbine modelled at hub height using vendor's apparent downwind sound power level specified consistent with IEC 61400-11.
- D. No other model adjustments.

Option 2

- A. Ground factor of $G=0.5$.
- B. Receptor height of 4 meters.
- C. Turbine modelled at hub height using vendor's apparent downwind sound power level specified consistent with IEC 61400-11.
- D. A model adjustment of + 2 decibels.

Option 1 and Option 2 produce the same result only when the correction factor of +2 dB is added to predicted sound levels using Option 1.

As there is now (2022) a National Standard, rather than an outdated guideline (IoA GPG, 2013) to standardise ISO9613-2 noise model inputs I urge An Coimisiun Pleanála to only consider the recommendations of ANSI/ACP 111-1 when assessing wind farm noise predictions.

When applied to this proposed development the predicted sound levels offered are all 2 dB too low.

Another issue that can arise is the reflection from certain structures that ISO9613-2 does not consider.

A 50 m high escarpment shown in Figure 1 can enhance sound levels through reflection for the NSLs shown.

⁶ American National Standards Institute (ANSI). April 2022. Standard ACP 111-1, Wind Turbine Sound Modeling.

WIND TURBINE LAYOUT

It is customary in the design of a wind farm to take account of the distances between wind turbines to minimise noise emissions and to maximise efficiency. An outline of such design considerations can be found in ‘NSW Wind Energy Handbook 2002’: Sustainable Energy Development Authority of NSW (SEDA).

From page 53 of the SEDA document:

“A wind-farm layout must take into account that turbines have substantial ‘wakes’, which interfere with each other depending on wind direction and spacing. The general rule of thumb for spacing (the ‘5r-8r rule’) is five times rotor diameter abreast and eight times rotor diameter downwind.”

Appendix B of the IEC61400-11 standard indicates that at high wind speeds, wind turbulence becomes the primary source of sound. It suggests that these effects should be minimized during testing and optionally reported.

A general outline of site layout considerations has been provided by Suzlon Energy. A summary of site effects from Suzlon is provided in Appendix C that suggests the *minimum* wind turbine separations to be 3r-5r, depending on wind direction. For a wind turbine layout that is exposed to wind from multiple directions the design limit is 5r.

In the current layout of the Slieveacurry Wind Farm, the distance between the nearest neighbouring wind turbine towers is typically less than 420 m.

The V150 wind turbines have a rotor diameter, ‘r’, of 150 m. The spacing between the turbines is 2.8 times the rotor diameter (2.8r), which is significantly less than the recommended 8r spacing to reduce wake turbulence effects from SEDA and 5r spacing suggested by Suzlon.

An increase in wake turbulence from the wind turbines will lead to higher noise emissions and lower efficiency of the wind farm.

The NVA has not considered the potential increase in sound power caused by wake effects.

AMPLITUDE MODULATION (AM)

The NVA discusses AM at length in the NVA (section 12.3.5.11) but reaches no conclusion on a penalty scheme to account for this special audible characteristic. Section 12.7.4.1.1 suggests that the UK IoA ‘Preferred Method’ is a reliable and robust method to assess AM. This is not true; the reference method greatly underestimates the occurrence of AM for peak to trough levels exceeding 3 dB and it fails to properly assess multiple wind turbines.

With some modifications it has been used in IEC 61400-11-2 but that is for a single wind turbine, not many turbines in a wind farm.

NG3 describes AM under the heading of ‘Temporal Characteristics’ and states for AM

that: *“The mechanism behind this is not clearly understood. However, features which are thought to enhance this effect are:*

- ☐ *close spacing of turbines in linear rows*

- ☐ tower height to rotor diameter ratio less than approximately 0.75
- ☐ stable atmospheric conditions
- ☐ topography leading to different wind directions being seen by the blades at different points in their rotation”

Note that the tower height (100m) to rotor diameter (150m) ratio is 0.66. (V150)

It can safely be assumed that AM *will* be an observable effect at NSLs because the turbine spacing is too close, the tower height to rotor diameter ratio is 0.66 (less than 0.75), and stable atmospheric conditions will occur from time to time.

An Coimisiun Pleanála should consider that AM is to be expected for this wind farm configuration that would warrant an additional penalty to predicted sound levels that have not been applied in the NVA.

A recent research paper by Colas et. al.⁷ published in 2025 quantifies the amount of increased AM and sound power caused by increased wake turbulence resulting from wind turbines spaced too close together.

Colas simulated wind turbines with large-eddy simulation (LES) plus an aero acoustic model and parabolic-equation sound propagation. They compare three layouts: aligned (downstream in the wake), side-by-side, and staggered with the following results for downstream in the wake:

- Wake-induced flow focusing and turbulence increase downwind sound pressure levels (SPL) by several dB relative to a single turbine.
- AM depth increases by several dB in regions where the downstream turbine’s wake-modified emission dominates.
- AM is highly sensitive to the relative rotor phase; certain angular offsets maximize constructive interference in the modulated component.

While Colas et al. focus on configuration rather than explicit “rotor diameter-spacing rules,” the aligned case corresponds to a downstream turbine placed within the strong part of the wake (typical farm spacings of order 4–7 rotor diameters). The fact that they see “several dB” increases in both SPL and AM depth is a direct quantification of the effect of wake-enhanced inflow non-uniformity on AM.

ETSU-R-97 incorrectly addressed amplitude modulation and made a sweeping assumption that such a characteristic was rare in modern wind farms.

This is not the case and it is now recognised that amplitude modulation is the most intrusive sound characteristic of wind turbines and that tonality and impulsiveness also occur at many wind farms.

The current UK IoA GPG refers in section 7.2 to ongoing research. Since the publication of the GPG in 2013 there has been much ongoing research and amplitude modulation is known to be a significant concern for residents near modern wind farms.

⁷ Colas, J. Emmanuelli, A. Dragna, D. Stevens, R. J. A. M. “Modeling wind farm noise emission and propagation: effects of flow and layout” arXiv:2508.13128v2 [physics.flu-dyn] 19 Aug 2025

The following figures illustrate A-weighted sound levels over a 10-minute period that were recorded at a rate of ten samples per second 800 m from two MM82 2MW wind turbines outside a dwelling.

The measurement was taken when the wind turbines were operating in the early hours of the morning when there was no extraneous insect, bird or animal sound but there was sound from wind in trees and foliage. This was confirmed by listening to the audio recordings taken at the same time.

Figure 2 shows the 100ms ‘short’ LAeq values and a single LA95,10min level for the data.

LA95 was calculated for this figure because the limit for this wind farm is in terms of LA95.

However, the LA90 would only be slightly higher at approximately 38 dB(A).

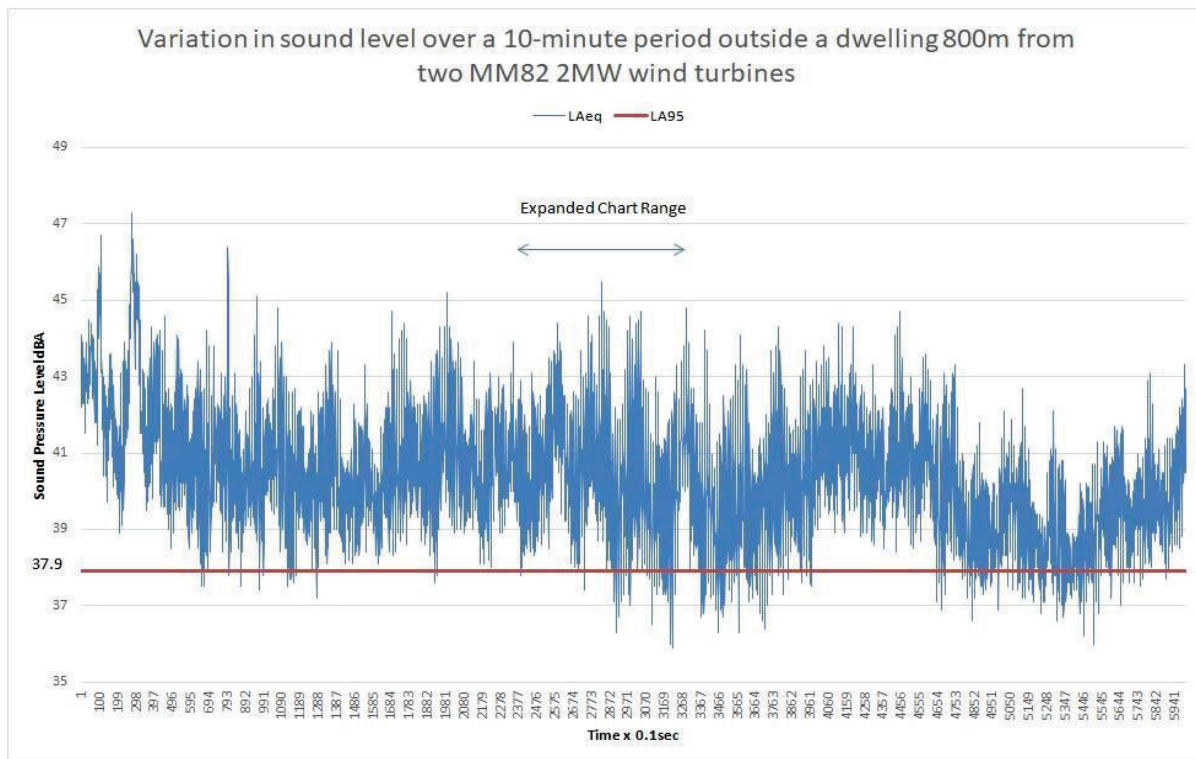


Figure 2

An expanded range from Figure 2 is shown in Figure 3 to provide more detail.

The repetitive variation in sound level is caused by sound from the two wind turbines as the blades rotate.

Sound caused by wind in trees and foliage is random, not repetitive as shown in these two charts.

Each peak and trough repetition can be linked to each time a blade passes through a part of the swept area.

As each wind turbine operates independently of others the small difference in rotation speed between these two wind turbines is causing the peak and trough repetitions to combine yielding a trace that can appear to synchronise at blade passing repetition to the time when the blades are out of synchronisation yielding an apparent doubling of the blade passing repetition.

For a wind farm containing many wind turbines the peak and trough level and repetitions vary randomly.

However, when synchronised the sound levels add together to produce an overall higher sound level compared to when the individual turbine blades lose synchronisation.

Figure 2 shows the interacting effect for two wind turbines where the first part of the 10-second chart shows the turbines to be out of synchronisation with a generally lower sound level variation peak to trough compared to later in the chart where the turbine blade rotations synchronise causing higher overall peak to trough sound level changes.

An unfortunate disadvantage in using the L90 statistic is that the character of sound level changes during any 10-minute measurement are lost and sound level variations are greatly underestimated.

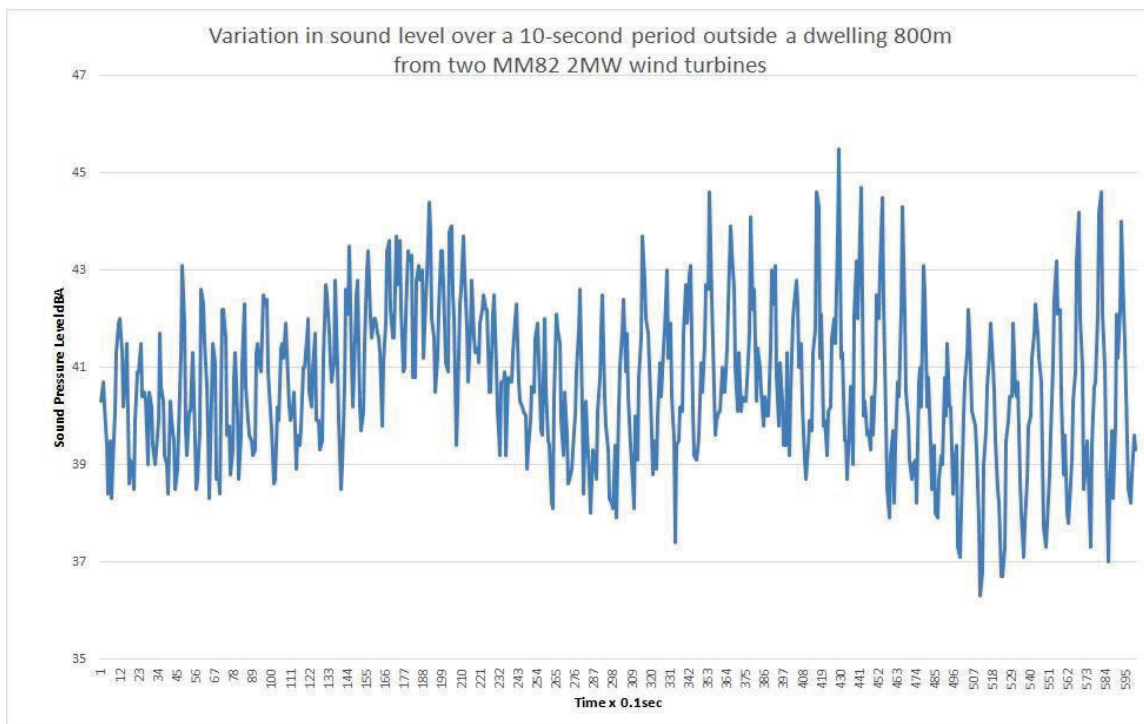


Figure 3

A common observation of unusual sound level change occurs when ‘whump’ or ‘thump’ is described by observers.

Whump and thump are thought to originate from the aerodynamic sound of wind turbine blades when they encounter wind turbulence or are incorrectly adjusted for the incoming wind that causes a blade to stall temporarily. Placing wind turbines too close to each other will increase wind turbulence and increase AM^{8,9} and the instances of ‘whump and thump’ sounds.

The occasional whump and thump sounds are much louder than normal wind turbine sounds and the fact that they would not occur for more than 9 minutes in any 10-minute recording means that the LA90 centile would not identify such events.

⁸ Sinayoko, S. ‘On predicting wind turbine noise and amplitude modulation’ 6th Int. conf. wind turbine noise, 2015

⁹ Buck, S. et al ‘Experimental validation of a wind turbine turbulent inflow noise prediction code’, AIAA Journal 2016
Slieveacurry Wind Farm

Sound levels vary throughout the measurement period in the 10-minute duration of the chart above (Figure 1) ranging from a maximum level of just over 47 dB(A) to a minimum level of about 36 dB(A). From the 6000 sound level samples the single statistical L95 parameter obtained from this chart is 37.9 dB(A), shown as a red line across the chart.

The L90 centile is only sensitive to the lowest 10 % of sound levels within any 10-minute sample. For example, in the chart above there could be sound levels that reached 100 dB(A) for up to 9 minutes that would have no bearing on the calculated L95 value of 37.9 dB(A) or L90 of 38 dB(A).

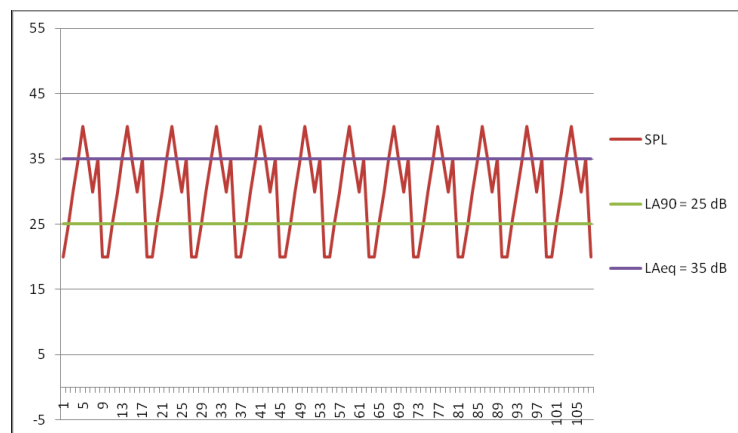
The IoA AM Preferred Method fails to correctly evaluate AM from just two wind turbines and fares even worse when more than two wind turbines combine to produce AM.

A report¹⁰ was prepared for DEFRA that outlines a wind farm noise statutory nuisance complaint methodology. Section 5.4.5 of this report (NAN-R-277) explains the difference between a centile statistical noise metric such as an L90 and the energy averaging Leq as follows:

“5.4.5 Noise Indices

By convention wind farm noise in the UK is measured using the LA90,10-minute noise index, as it is argued that this index minimises the influence of extraneous noise. However, excepting ETSU –R-97, there are few if any standards that set noise limits using this index. Additionally, it is argued that because the LA90,10min index focuses on the quietest periods in the measurement period it is relatively insensitive to rapid fluctuations in noise level where the noise varies rapidly over a short period e.g. as with aerodynamic/amplitude modulation, and the impact of such characteristics can be underestimated using the LA90,t noise index.

However, elsewhere in the world the LAeq,t index is preferred for wind turbine noise. Use of the LAeq,t or derivatives for environmental noise measurement is recommended by international standards and bodies e.g. ISO 1996 and the WHO, and British Standards such as BS 4142, BS 7445 and BS 8223. Additionally, there are a range of standards and guidance that offer guideline and recommended values of LAeq,T noise levels against which to weigh any measurement. The energy averaging nature of this index means it tends to be biased towards the highest noise levels that occur during a measurement. The figure below shows an indicative sound pressure level trace of a time varying noise signal (SPL) and the approximate LAeq,t and LA90,t values.



¹⁰ NANR277 “Wind farm noise statutory nuisance complaint methodology DEFRA (2011)

Figure 13 $L_{Aeq,t}$ and $L_{A90,t}$ values of an indicative time varying noise signal”

The current GPG also explains in section 7.1 that the guide cannot provide a definitive set of AM conditions for a wind farm, despite suggesting some options.

There is a current noise condition in force for the Denbrook Wind Farm that addresses AM limits, which has been accepted by the High Court in the UK, as follows:

“Condition 20

At the request of the local planning authority following receipt of a complaint the wind farm operator shall, at its expense, employ a consultant approved by the local planning authority, to assess whether noise immissions at the complainant’s dwelling are characterised by greater than expected amplitude modulation. Amplitude modulation is the modulation of the level of broadB(A)nd noise emitted by a turbine at blade passing frequency. These will be deemed greater than expected if the following characteristics apply:

- (a) A change in the measured $L_{Aeq, 125 \text{ milliseconds}}$ turbine noise level of more than 3 dB (represented as a rise and fall in sound energy levels each of more than 3 dB) occurring within a 2 second period.
- (b) The change identified in (a) above shall not occur less than 5 times in any one minute period providing the $L_{Aeq, 1 \text{ minute}}$ turbine sound energy level for that minute is not below 28 dB.
- (c) The changes identified in (a) and (b) above shall not occur for fewer than 6 minutes in any hour. Noise immissions at the complainant’s dwelling shall be measured not further than 35 m from the relevant building, and not closer than within 3.5 m of any reflecting building or surface, or within 1.2 m of the ground.”

An Coimisiún Pleanála may wish to consider Condition 20 of the Denbrook Wind Farm as a model AM condition for any future wind farm that they approve.

Conditions referencing the IoA AM Preferred Method should be avoided for wind farms.

INFRASOUND, LOW FREQUENCY NOISE (ILFN) AND HEALTH EFFECTS

The EIAR (Chapter 5) has referred to the Health Service Executive (HSE) Position Paper on Wind Turbines and Public Health (2017) but only insofar that published scientific evidence is inconsistent and sparse. So, some published research supports there being adverse health effects and other research does not support there being adverse health effects from wind turbines.

Chapter 5 of the EIAR lists several other references to health effects, many of which are outdated. For example, Chapter 5 section 5.5.1(3) refers to a ‘A Rapid Review of the Evidence’, NHMRC 2010 but neglects to note that the NHMRC subsequently awarded AU\$3,300,000 to two universities to investigate the issues, recognising that there was not enough evidence to base a conclusion upon.

The NVA (12.3.5.9) has cited several references from the UK Institute of Acoustics (UK IoA) generally supporting the idea that low frequency and infrasound from modern wind farms are insignificant and that there is no need to consider these effects in any noise impact assessment.

However, it is now recognised that infrasound and low frequency sound is emitted from wind turbines and that the infrasonic pulses are unlike any other environmental sound source.

Furthermore, advice from the UK IoA to its Members has no relevance to the assessment process in Ireland. For example, the UK IoA’s guidance conflicts with Limerick County Council’s planning requirements for wind farms, which specifically calls for a low-frequency noise assessment.

Figure 4 shows the change in infrasound levels near to the Cape Bridgewater wind farm measured inside a nearby stone dwelling during changes in operation from stopped to 15% and 45% power generation.

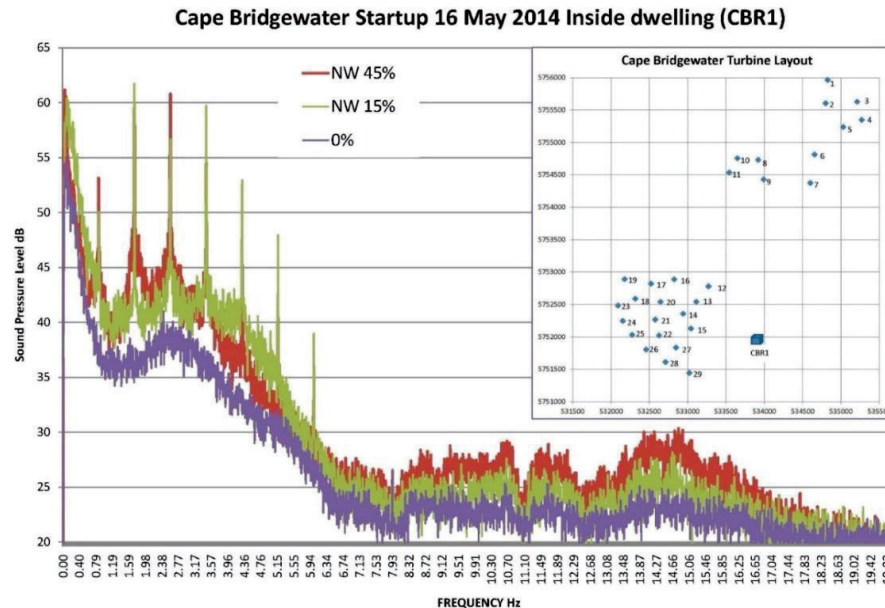


Figure 4

References that have used the dB(G) filter to assess wind farm ILFN are not credible because the G weighting filter attenuates the blade pass pulses and the harmonics associated with those pulses (<5Hz).

The WHO 2018 Environmental Noise Guidelines completed the most comprehensive peer review of studies in this area and states: “Five low-quality systematic reviews of wind turbine noise effects on mental health and well-being have been carried out (Ellenbogen et al., 2012; Kurpas et al., 2013; Merlin et al., 2013; Onakpoya et al., 2015; Schmidt & Klokke, 2014). These reviews differed in their conclusions and delivered inconsistent evidence that wind turbine noise exposure is associated with poorer quality of life, well-being and mental health.”

Because there were differences of opinion from the research that was cited the WHO rated this work of low quality: “Therefore, the evidence for no substantial effect of wind turbine noise on quality of life, well-being or mental health was rated very low quality”.

However, it is incorrect to suggest that there is *no* evidence that wind farm noise can cause adverse health effects. The WHO rate the research demonstrating no adverse health effects as low quality.

The meaning embedded in the WHO’s phrasing is critical to how its guidance is interpreted.

The WHO refers to a lack of evidence for no adverse effect, not a lack of evidence for an adverse effect.

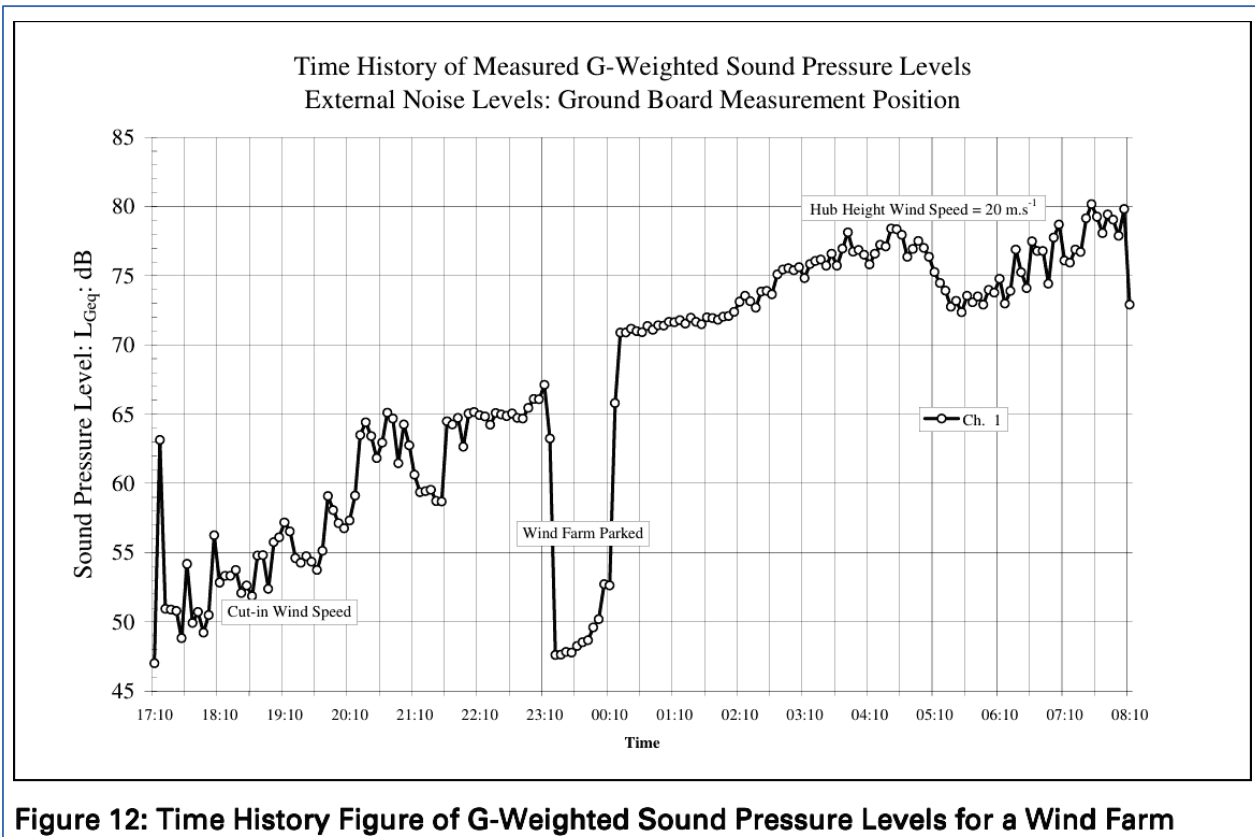
Research is ongoing but one of the published papers in 2019 by researchers at Flinders University (Nguyen, D. P., Hansen, K. et al. Wind farm infrasound detectability and its effects on the perception of wind farm noise amplitude modulation, Acoustics 2019) stated in its conclusions that: “Overall these preliminary results suggest that WF noise complaints could potentially be governed to some degree by the presence of infrasound” and that “ We found that self-reported noise sensitive individuals can detect the presence of low-level infrasound (48 ± 2 dB(G)) above chance.”

The finding that infrasound at levels of 48 ± 2 dB(G) can be observed by individuals is in stark contrast to the generally used limit of perception of 85 dB(G).

Although the G-weighted filter significantly attenuates the blade pass and associated harmonics from a wind turbine it is worth noting that the 2006 Hayes McKenzie report show the result of an on/off test in that report, shown below (Figure 12 from reference).

An extract from this report explains that “Wind turbine noise may result in internal noise levels within a dwelling that is just above the threshold of audibility,” that was assumed to be 85 dB(G).

The 2019 Flinders University research changes the threshold of audibility of wind farm noise to 48 +/- 2 dB(G) which would change the conclusion in the Hayes McKenzie DTI report; ‘The measurement of low frequency noise at three UK wind farms’, URN no. 06/1412 from 2006.



Much of the recent research into human response to wind farm generated infrasound has been based on *synthesised* wind farm sound played to subjects in a laboratory”

A paper by Cooper, S. (“The use of synthesised or actual wind turbine noise for subjective evaluation purposes” PROCEEDINGS of the 23rd International Congress on Acoustics 2019) is critical of the use of synthesised wind farm infrasound signals and has noted that it was the change in amplitude of the infrasound signal that was observed to be a significant factor in subject disquiet.

Unfortunately, the issue of adverse health effects from wind farm generated infrasound remains contentious and authorities may wish to consider an appropriate condition when approving future wind farm developments if ongoing Australian, or other relevant international research, finds adverse health effects from infrasound.

My own measurements at the Cape Bridgewater Wind Farm, also confirmed by S Cooper in his 2014 study¹¹, showed that low frequency sound from the output shaft of the gearboxes to the generators exceeded DEFRA NAN-R-45 indoor recommended guideline values at 32 Hz.

Furthermore, the 32 Hz tones were modulated in frequency and random in level.

The NVA has not considered low frequency noise impacts. The A-weighting filter significantly attenuates low frequency noise, which is why DEFRA NAN-R-45 uses unweighted one third octave sound levels in the frequency range from 10 Hz through to 200 Hz.

Low frequency sound is an important issue that should be reported in an EIAR. An example requirement has been implemented in Planning by the Limerick County Council that applies the Danish low frequency guideline limits.

I have recently measured low frequency sound outside a dwelling during on/off testing near to a newly constructed wind farm. Figure 5 shows the results of measurements at the dwelling that is approximately 2 km from the nearest 3.6 MW wind turbine.

Measurements of the 40 Hz, 50 Hz, 63 Hz and 80 Hz one third octave unweighted sound levels before, and after the shutdown period, just prior to midnight, show that the threshold values of DEFRA NAN-R-45 were exceeded. Outside measurements were corrected to indoor levels for typical building façade attenuation according to Downey and Parnell (2017).

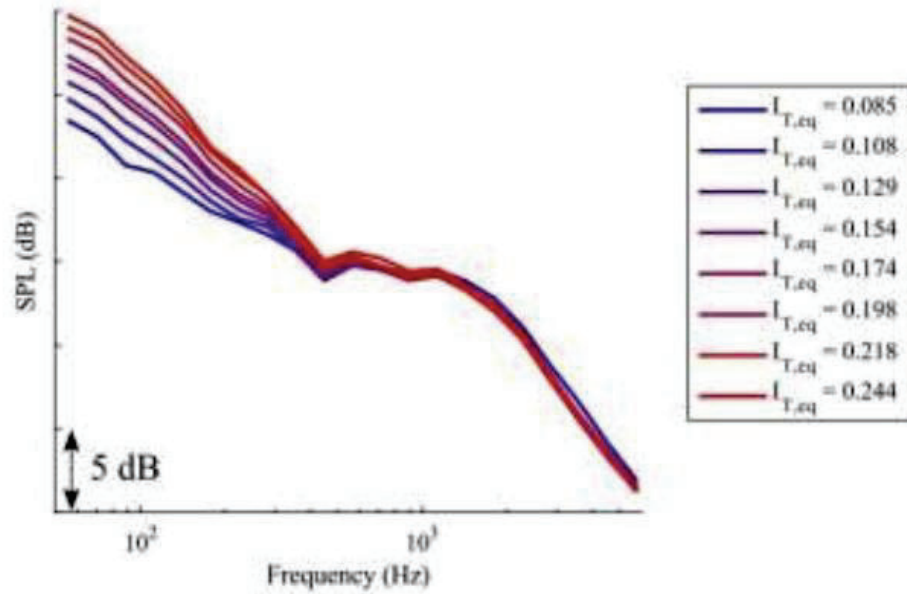
The occupants of the dwelling had complained about low frequency noise nuisance from the nearby wind farm and in this instance, the complaints were justified.

Both Colas and Buck show that wake turbulence from wind turbines spaced too close together cause increase in low frequency sound from downwind turbines.

Buck et al.¹² studied the turbulent inflow noise experimentally on a full-scale wind turbine with a 108 m diameter and 2.3 MW capacity. The purpose of the study was to assess the effect of inflow turbulence on wind turbine noise. Fifty hours of sound data were collected by 12 microphones mounted at different angles. The results showed a high correlation between turbulence intensity and noise levels. Buck shows the correlation between turbulence intensity and sound pressure level in the following chart:

¹¹ Cooper, S. "The results of an acoustic testing program - Cape Bridgewater Wind Farm" The Acoustic Group Report 44.5100.R7MSC, Nov 2014

¹² Buck, Steven & Oerlemans, Stefan & Palo, Scott. (2016). Experimental characterization of turbulent inflow noise on a full-scale wind turbine. Journal of Sound and Vibration. 385. 10.1016/j.jsv.2016.09.010.



The correlation between turbulence intensity and sound pressure level [Steven Buck]

The NVA has mistakenly dismissed ILFN as an issue.

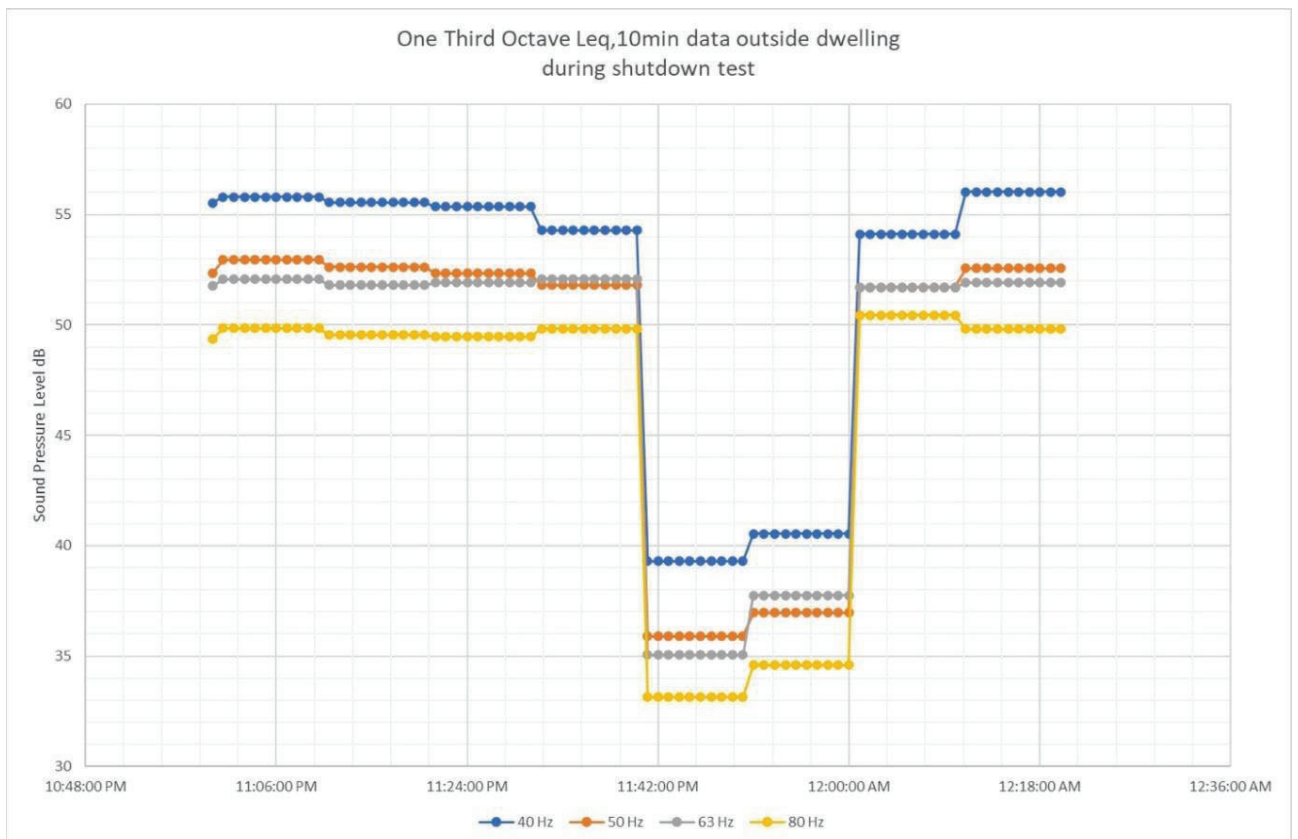


Figure 5

It would be advisable to measure current ambient ILFN at the NSLs to supplement A-weighted Background survey results.

Low frequency noise predictions should also be completed in frequencies below that which ISO9613-2 allows. ISO9613-2 is only applicable for the octave bands from 63 Hz through to 8 kHz.

The NVA is deficient in the assessment of ILFN.

SETBACKS

The NVA has mentioned in section 12.3.7 that dwelling H033 is 529m from a wind turbine.

The HSE position paper also refers to best practice for setback distance from any turbine to a dwelling of 10 times the rotor diameter. This equates to a best practice setback distance of 1.5 km for the proposed candidate wind turbine rotor diameter of 150m.

Wind turbines are proposed to be less than 530 m from the nearest dwelling so best practice according to the HSE position paper has not been applied.

Clare County Council (CCC) reasons for refusal

CCC list four reasons for refusal dated 20 January 2022, of which only Reason 2 refers to noise, as follows:

“It is an objective of the Clare County Council Development Plan, 2017-2023, as varied, as set out under Objective CDP 8.40 € to strike an appropriate balance between facilitating renewable and wind energy related development and protecting the residential amenity of neighbouring properties. Having regard to the scale and height of the turbines as proposed, the location of the site on this open landscape and the proximity to existing residential properties, it is considered that the consequential noise and disturbance generated from the proposed wind turbines in combination with existing and permitted windfarms would seriously injure the amenities of residential property in the vicinity. Furthermore it is considered that the proposed turbines would be visually overbearing on existing properties and thus depreciate the value of property in the vicinity. The proposed development would therefore be contrary to Objective CDP 8.40 of the development plan and be contrary to the proper planning and development of the area.”

Most of the deficiencies highlighted in this peer review of the EIAR and NVA are reflected in the concerns of the CCC that provided its reasoning for refusal.

The Appeal to An Coimisiun Pleanála was also dismissed.

The main difference between this and the earlier application is the addition of an extra wind turbine (T9).

CONCLUSIONS

The NVA does not provide any confidence that an acceptable noise impact will result from the proposed development.

An Coimisiun Pleanála should dismiss/refuse the Slieveacurry Wind Farm application.

The NVA within the EIAR does not consider site effects or audible characteristics such as low frequency, tonality or amplitude modulation.

The assessment methodology adopted in the NVA follows guidelines that have been shown to be deficient and are currently under review.

The WEDG 2006 guidelines recommend a range of acceptable sound levels during the day but the NVA has elected to choose the highest noise limit in the range that could be applied, based upon what I consider to be an incorrect evaluation of the test for a low noise environment.

The NVA predicts optimistic sound levels that demonstrate increases in noise of more than 10 dB for the surrounding residents that conflicts with the objectives of WEDG 2006.

The impact assessment approach from IEMA for operational noise from the development has not been applied correctly.

If it was properly applied then the development would have an impact described as ‘Very Substantial Effect’ according to IEMA Guidelines and ‘Very Significant’ and ‘Profound’ effect according to ‘Guidelines on the Information to be contained in Environmental Impact Assessment Reports’ (EPA, 2022). This is contrary to the suggestion in the NVA (12.6.3.1.1) that operational noise is ‘not significant’.

Appendix A

CV of William Leslie Huson QUALIFICATIONS

BSc (Hons) Applied Physics, UK 1975

MSc Sound and Vibration Studies, Institute of Sound and Vibration Research, Southampton, UK
1977

PROFESSIONAL AFFILIATIONS

Chartered Physicist, UK

Member of the Institute of Physics, UK

Member of the Institute of Acoustics, UK

Member of the Australian Acoustical Society

Member of the AV0001acoustics working group for Standards Australia

Australian representative for the International Institute of Noise Control Engineers (I-INCE)

Technical Study Group 5 *A GLOBAL APPROACH TO NOISE CONTROL POLICY* (Now
disbanded after completion of the scope of work defining this group – see <http://www.i-ince.org/data/iince061.pdf>)

EXPERIENCE

Since graduating I have been involved in several scientific areas of research and development. My early experience was in constructing a microwave device to measure the temperature of plasma inside a nuclear fusion experimentation device at the UKAEA, Culham Laboratory in the UK. I then worked in research and development of thermal imaging devices prior to completing a Masters in Sound and Vibration Studies. My work since then (1977) has been primarily associated with acoustics and vibration both terrestrial and underwater.

Prior to 1991 I worked as a Sound and Vibration consultant in the UK for 12 years with involvement in a wide range of industries.

For the past 35 years I have worked in Australia as a noise and vibration consultant and have operated through my own consultancy firm for the past 29 years. I am experienced in modelling acoustic propagation from a variety of sources such as railways, roads, aircraft, underwater ordnance, wind farms, pile driving, blasting and numerous types of industry.

I have also prepared the Brisbane Noise Survey in 1998 for the Brisbane City Council and was the author of the Noise Impact Assessment Planning Scheme Policy for Brisbane City Council's City 2000 Planning Scheme.

Of relevance to wind farm related assessment is the work I completed for the Toora Wind Farm in 2002 which involved detailed analysis of pre and post construction noise data using NZS6808 1998

to check compliance with license conditions. NZS6808 is based upon ETSU-R-97. My experiences in the analysis of wind farm noise data led to a paper that was presented at the joint Australia and New Zealand Acoustics conference in 2006; “Review of the Application of NZS6808 to wind farms in Australia.” This paper highlighted the sources of error that were implicit and allowed in the NZS6808, 1998 standard and ETSU-R-97. The latest version of the NZS6808 standard (2010) addresses a number, but not all, of the data analysis error concerns described in my paper. ETSU-R-97 and the Institute of Acoustics Good Practice Guide to the Assessment and Rating of Wind Turbine Noise is regularly referenced when interpreting parts of NZS6808 in Australia and I am familiar with this document and the supporting Supplementary Guidance Notes (GPG).

Over the past thirteen years I have been independently gathering sound data in the audible and infrasound parts of the acoustic spectrum at numerous wind farms in Australia, the UK and Ireland. A summary of some of this research work on infrasound was presented in a peer reviewed paper: Huson, W. Les. “Stationary wind turbine infrasound emissions and propagation loss measurements.” 6th International Conference on Wind Turbine Noise, Glasgow 20-23 April 2015. I have investigated the Preferred IoA Method for the assessment of amplitude modulation (AM) in detail and applied it to several wind farm measurements taken outside dwellings near to numerous wind farms in Australia and the UK. The findings of this work are the realisation that the Preferred IoA Method is only suitable for assessing a single wind turbine, that the resulting AM values greatly underestimate short term peak to trough amplitude modulation levels observed, and that the Method is wholly unsuitable to assess AM (peak to trough amplitude modulation) from multiple wind turbines.

Detailed analysis of AM from wind farms has revealed that many AM events also exhibit impulsiveness when evaluated according to BS 4142:2014+A1:2019.

Appendix B

Presentation by E Sloth



Problems related to the use of the existing noise measurement standards when p
noise from wind turbines and wind farms.



Erik Sloth Vestas

Niels Christian Møller Nielsen VESTAS
Ejler Kristensen BONUS Energy
Bo Søndergaard DELTA



Overview

- Noise Measurements (IEC 61400-11:2002)
 - Short description of the measurement method
 - Use of measurement results, including influence on inaccuracy.
- Noise prediction
 - Terrain and meteorology influence on the actual emitted sound
 - Methods used in noise calculations
- Noise assessment
 - Descriptors
 - Noise limits
 - Further investigations needed

Noise Measurements (IEC 61400-11:2002)

We correct for:

Air pressure

Air temperature

Standard terrain
roughness $z = 0.05$ m

All recalculated to 10 m
wind speed

We do not correct for

Actual inflow angles

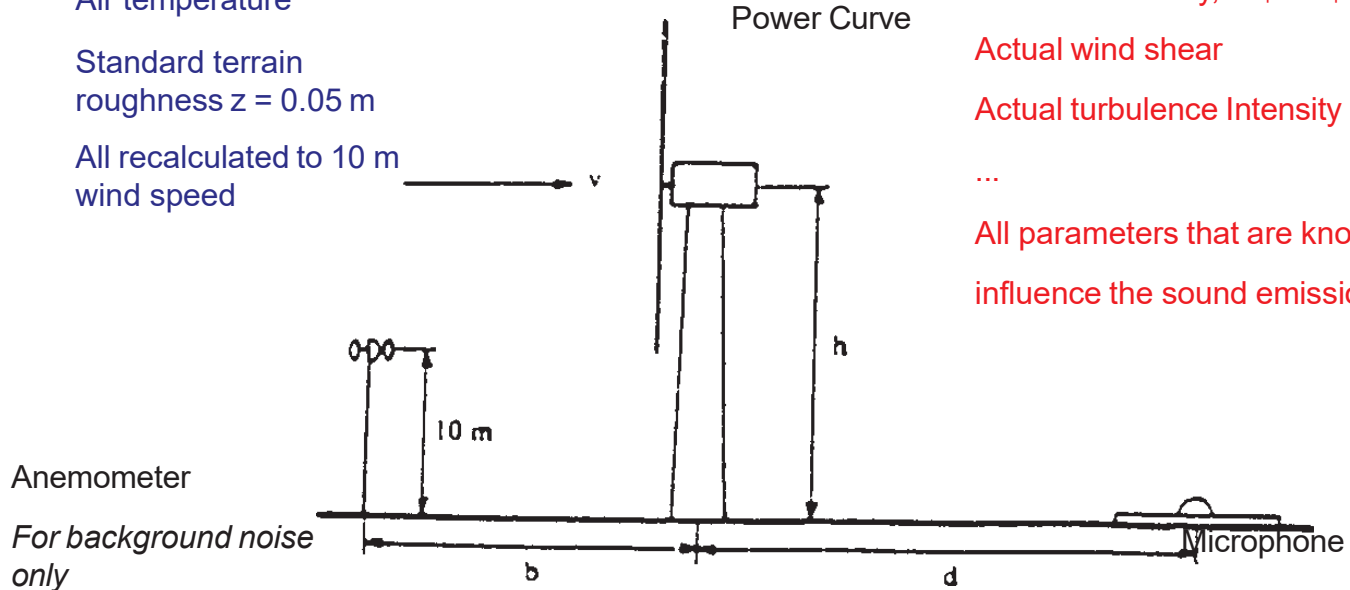
Actual air density, except in the power curve

Actual wind shear

Actual turbulence Intensity

...

All parameters that are known to
influence the sound emission



Noise Measurement

- The results are standardized noise levels, which are fairly comparable from measurement to measurement on a given turbine type.
 - The wind turbine is used as a wind speed meter through a power curve measured on an ideal site (IEC 61400-12) OBS impossible if actual terrain does not fulfill conditions
 - Other parameters influence the noise level: relative humidity, turbulence, inflow angle, wind shear, turbine pitching are not accounted for.
 - The result is a fairly good tool for verification of warranties, but not a good tool for predicting noise at imission points where people actually can get annoyed.
-
- The Sound Power Level related to the produced power or at least the sound power level as a function of hub height wind speed could be a more basic relationship

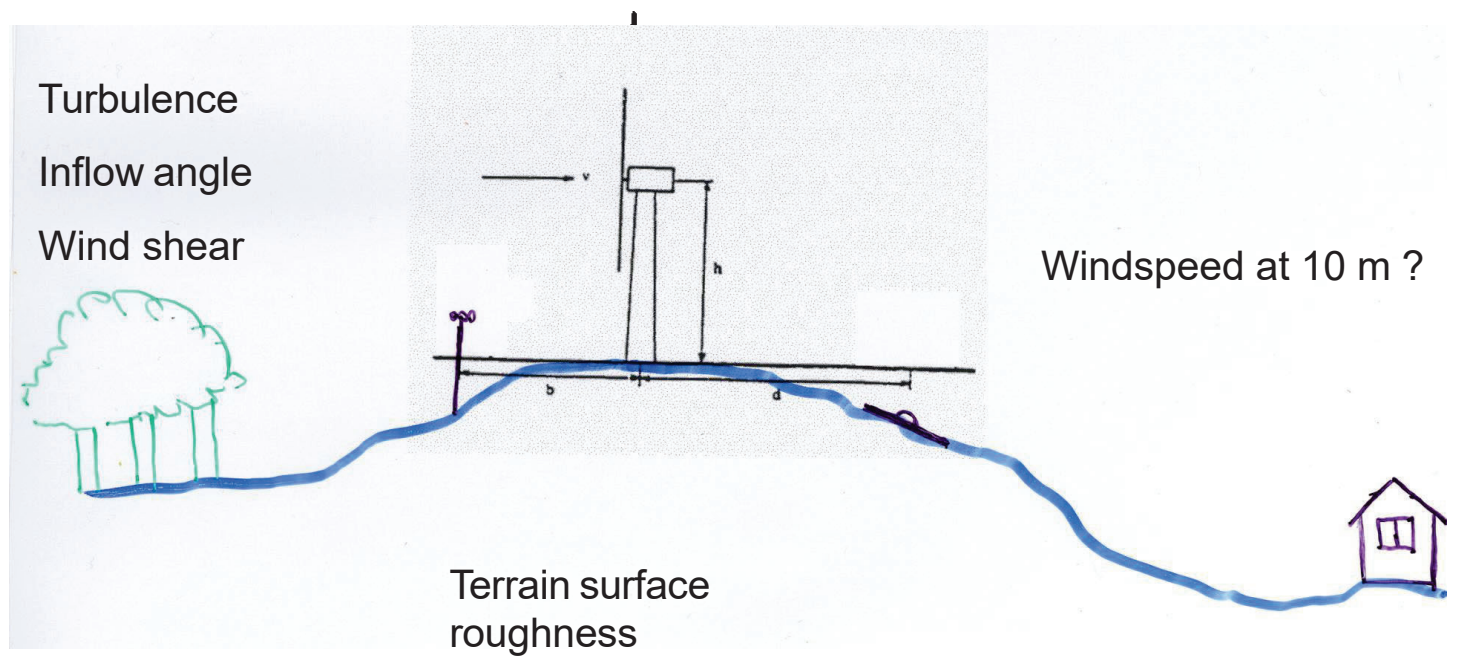
Typical problems in using the measurement results

- Where do we see the major deviations from standardized conditions during actual use of measurement results
- The wind turbines are almost always raised at sites where roughness differ from the standardized completely flat measurement site.
- Further we see different air density
- different wind shear
- different turbulence in inflow air
- different inflow angles
- Finally we often see other hub heights than used during documentation

Use of measurement results

For noise control measurements

For noise level calculations



Conclusion on measurement results

- The differences in site conditions creates differences in emitted sound power level.
- The differences could be both increased and decreased emitted sound power levels in real life applications
- The differences will transfer directly to the imitted sound power levels, and may thereby create increased annoyances in real life
- Therefore – site specific sound power levels should be used unless a good safety margin is present using standardized emission levels.

Uncertainty

- According to IEC 61400-11:2002 the standard deviation of a measurement results is app. 0.9 – 1.5 for an ideal site
- If the measurements are made at a site with considerable turbulence intensity or wind shear the standard deviation can be app. 2.0 dB
- The result is that when used for calculating the noise from a wind farm at an imission point, some WTG will be higher than the expected level and some will be lower.
- To correct for this, the measured inaccuracy cannot be placed upon the total calculated level, but must be included in the calculations.
- The result is that the higher the number of WTG's in the project is, the smaller the resulting inaccuracy.
- If the results are used for calculating the noise from a wind farm the standard deviation should be calculated as the weighted standard deviation

$$\sigma_{res} = \sigma_{method} + \sigma_{source} = \sigma_{method} + \frac{\sqrt{\sum (\sigma_i \cdot 10^{L_i/10})^2}}{\sum 10^{L_i/10}}$$

Solution to the outlined problems

- Accept that different sound power levels should be used in predictions and warranties.
- Avoid using sound power levels that include inaccuracy in predictions unless there is a good safety margin.
- The inaccuracy should be included in the calculation – the higher the number of WTG's the less the probability that all are in the high end of the uncertainty interval
- Use sound power levels that at least are corrected for: hub height, wind shear, air density, turbulence, inflow angle
- Be careful to make sure that the background noise measurements and wind conditions at the turbine positions uses the same reference position.

Noise level calculation models

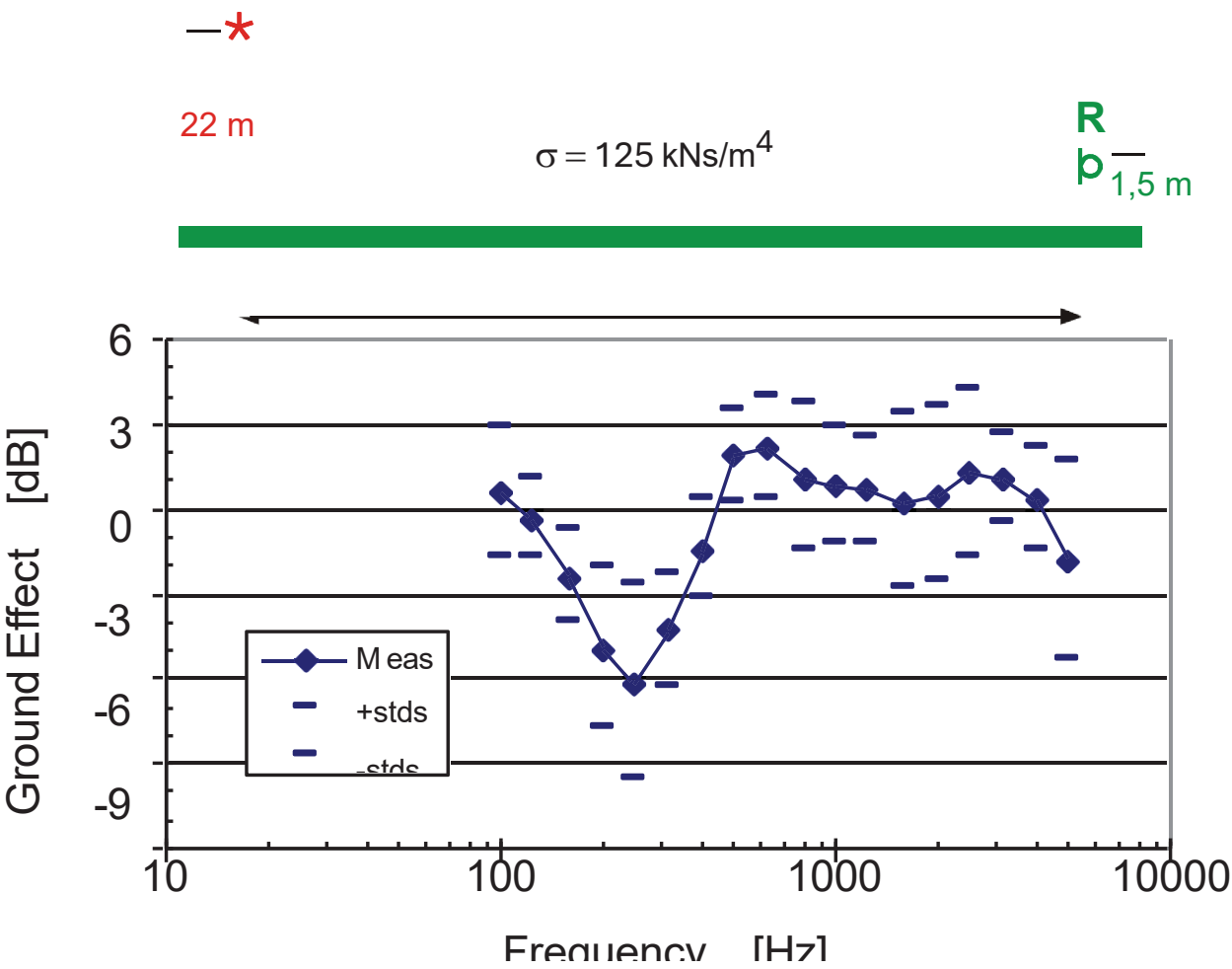
- There are lots of different noise level calculation models:
 - ISO 9613-2 which is the model that we see the most
 - VDI 2714
 - Concawe
 - BS 5228
 - General Prediction Method (Danish)
 - Danish EPA Guidelines
 - Netherlands Guidelines 1999
 - Swedish method (land/sea)
 -
- Most of the methods are developed for noise from Industry, wind speeds below 5 m/s and standard meteorological conditions and must be suspected to give poor results at larger distances.
- ISO 9613-2 is known sometimes to overestimate the terrain effects if soft ground is used
- Manufacturers, developers, consultants and authorities have an interest in a noise level calculation model developed specifically for wind turbine noise

Noise calculation models

- In an EU project JOR3-CT95-0065 a model for wind turbine noise propagation (WiTuProp) was developed giving good results
- The WiTuProp model takes into account
 - meteorological conditions:
 - Wind speed / terrain surface roughness and direction
 - Air temperature and air temperature gradient
 - Relative air humidity
 - The ground type
 - Flow resistivity for grassland and harder surfaces
 - Screening (by terrain or screens / barriers)
- WiTuProp is a special case of a more comprehensive model developed later:
NORD2000

Nord2000 / WiTuProp vs. ISO 9613-2

S



400
m

10

100

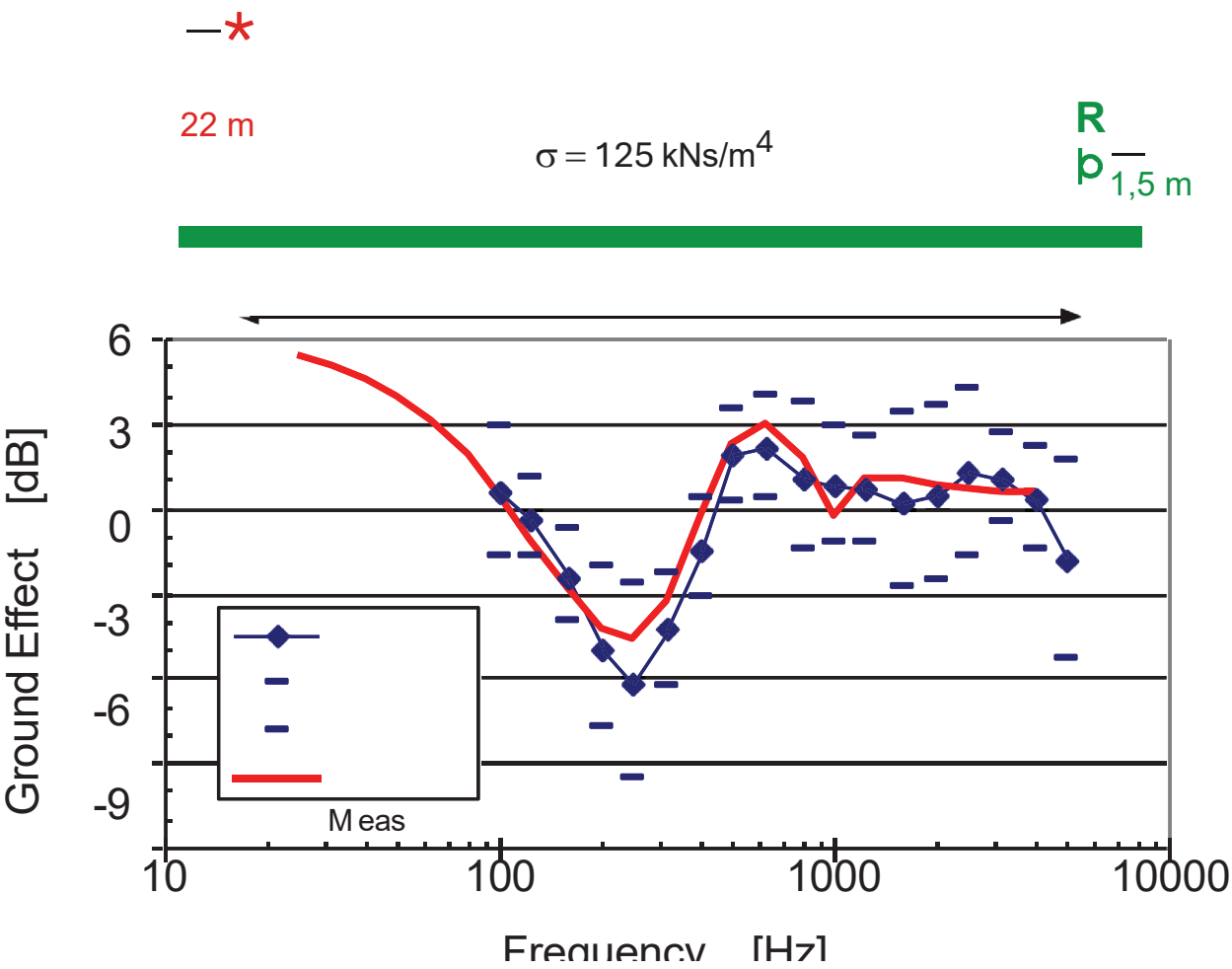
1000

10000

Frequency [Hz]

Nord2000 / WiTuProp vs. ISO 9613-2

S



400
m

10

100

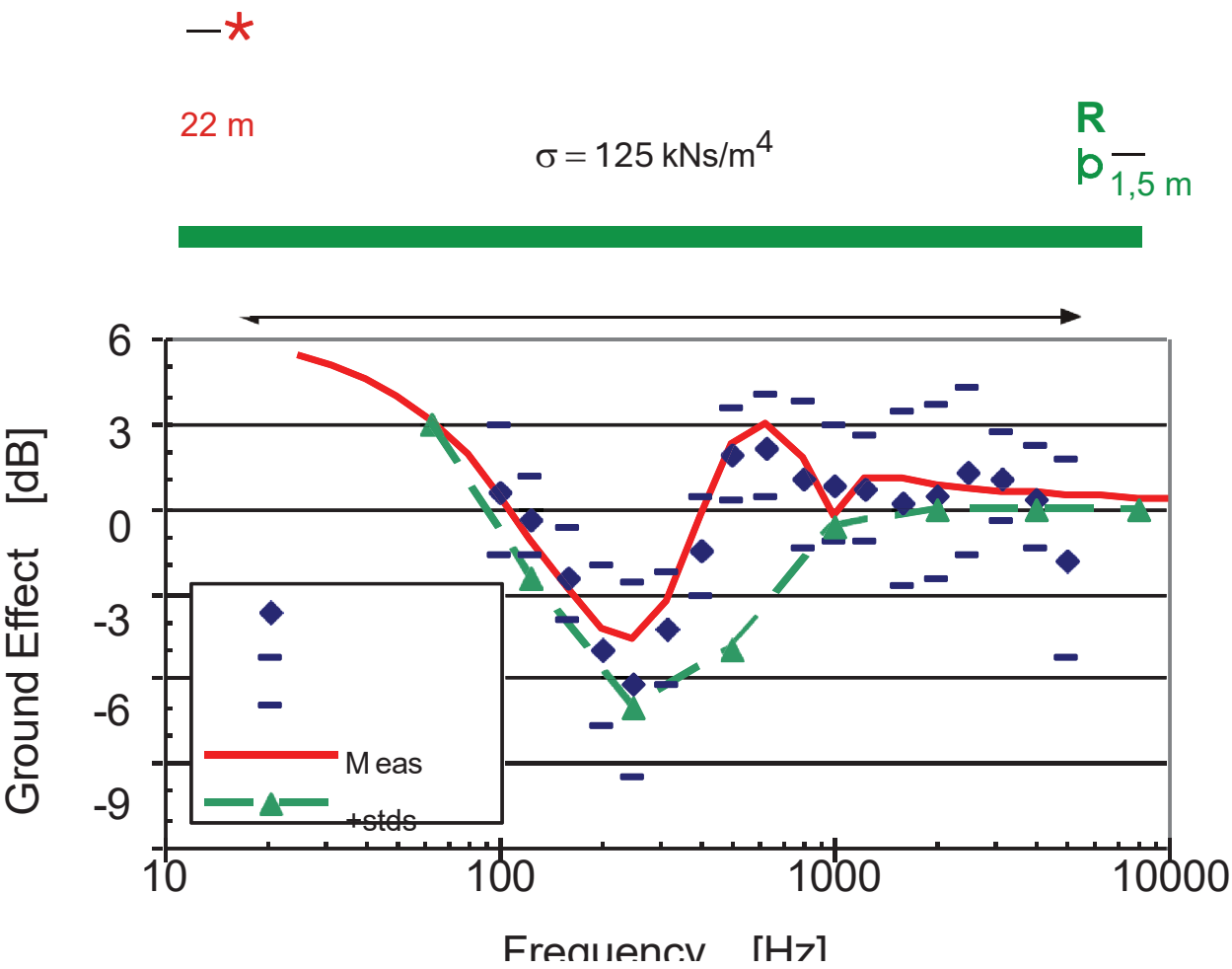
1000

10000

Frequency [Hz]

Nord2000 / WiTuProp vs. ISO 9613-2

S



400
m

10

100

1000

10000

Frequency [Hz]

Nord2000 model

- Meteorological conditions are better covered
- Complex terrain profiles (hill/valley)
- Mixed ground
- Terrain roughness
- Improved screen modelling
- 1/3 octave-band results
- Physical model – NOT empirical

Recommendation if the advanced model is not used:

- Use ISO 9613-2
- Make sure that hard terrain is used
- Be careful when defining screening effects from terrain - specially edge effects can be difficult to model

Noise Assessment

- The noise level at the imission points are normally given as an A-weighted noise level at different wind speeds.
- A tonality evaluation is normally included for the receiving points.

What do we know of the annoyance of the noise:

- We know that noise from wind turbines sometimes annoys people even if the noise is below the noise limits.
- Often people complaints on low frequency noise which many investigations often show in not present
- The noise limits are usually adapted from industrial noise limits and are based upon the principle that a given percentage of the population will feel annoyed when the limit is exactly fulfilled.
- Evaluation of tonality in the turbine noise is more based on the reproducibility of the results than on pure knowledge on what is actually annoying

Noise assessment

- Other descriptors need to be investigated to understand the annoyance caused by wind turbines
 - Low frequency noise and Infrasound – we cannot see it in our measurements
 - Modulation – may be the parameter that is heard as low frequency noise
 - Masking – which noise can mask noise from wind turbines
 - Other characteristics
 - ..
- This mean that tape recordings should me made on all sites in order to enable later analysis of up till now unrecognized parameters.
- In order to enable listener tests, artificial head investigations should be made
- We as a producer cannot cover this alone, since the local rules always need to be followed

Our recommended research program

- Artificial head measurements on real turbines of different sizes
 - Background noise measurements on real sites
 - Listener tests on obtained results
 - These measurements are being made on a test basis during our Danish measurements
-
- General Research that is needed in this area includes
 - Psychoacoustic experiments
 - Listener test
 - Measurements at low frequencies
 - Analysis for other characteristics
 - ..



Questions ?



Appendix C

Suzlon Energy – Site effects

Siting of Wind Farms: Basic Aspects

When searching the internet for the definition of the word “layout” I came across following:

Layout in word processing and desktop publishing refers to the arrangement of text and graphics. The layout of a document can determine which points are emphasised and whether the document is aesthetically pleasing. While no computer program can substitute for a professional layout artist, a powerful desktop publishing tool can make it easier to lay out professional looking documents (source: www.webopedia.com)

In principle the same is valid for wind farm planning: The term layout in wind industry is used for choosing optimal locations for wind turbines. Tools like flow models help to identify the best positions, but cannot replace the engineer making the final decision by balancing interests.

So what is that engineering experience, what factors influence the decision?



Jessica Rautenstrauch, wind energy consultant from Anemos, Germany, at work.

© Paul Langrock (www.unendlich-viel-energie.de)

Wind resource

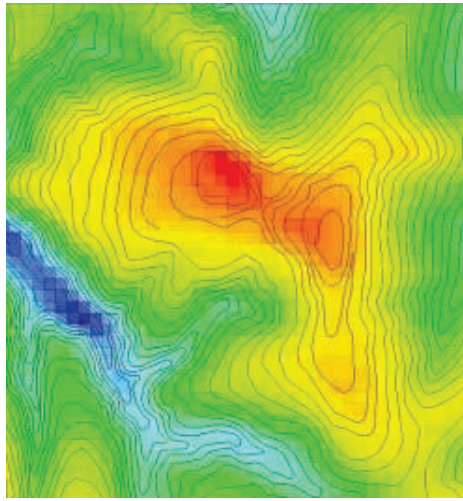
The wind resource is the most obvious factor to concentrate on when choosing a wind turbine location. We have a wide range of options to determine the wind resource of the site. The quality of the tools varies significantly and so does their price.

Common sense is a good starting point. Nature itself helps to guide us to suitable sites. Flagging of trees – permanent flagging and not the temporary bending in the wind – shows us the prevailing wind direction and is a good indicator for the strength of the wind.

However because of the uncertainty involved, using common sense as the only tool is of course insufficient. For any bankable estimate of the energy yield on-site wind speed measurements are required. The number of measurement masts required for a specific site depends next to the size of the project mainly on the complexity of the terrain. The measurement height should be minimum 2/3 of the expected future hub height. An increase in measurement height beyond this leads to a reduction of the uncertainty in the energy estimate. The measurement period must be one year or more to avoid any seasonal bias. Since the wind speed varies also inter-annually typically up to +/-12% a long-term correction is highly recommended.

The measured wind regime is extrapolated across the site to derive a resource map of the site using different flow models /4, 5/. A wind map like the one in Graph 1 can then be used to identify the windiest locations.

However additionally technical constraints should be taken into account when developing a layout /3/. A number of site specific wind load parameters can be extracted from the wind speed measurement. They are used to optimize the technical suitability of the chosen layout and the wind turbine type for the site specific wind regime.



Graph 1: Example Wind Resource Map. The colours denote the energy content of the wind, red high and blue low energy content.

Technical restrictions

Wind turbines are designed for specific conditions. During the construction and design phase assumptions are made about the wind climate that the wind turbines will be exposed to. In rough terms: For very complex sites with high wind speeds “heavy-duty” versions of wind turbines are available, which are sturdier but also more costly. Low wind speed sites in flat terrain do not put so high demands on the on the wind turbine structure, hence the construction can be more light-weight and hence cheaper. The different turbines have been classified by the IEC, class 1 being the highest wind speed class. The following table is a simplified summary of the IEC classification /1/.

IEC class	I	II	III	IV
V_{ave} (m/s) annual average wind speed at hub height	10	8.5	7.5	5
V_{ref} (m/s) 50-year maximum 10-minute wind speed	50	42.5	37.5	30

Table 1: IEC classes

But not only the wind speed but also other parameters play a role and have to be checked, when developing a layout for a specific turbine.

One of the most important parameters is the turbulence intensity. Turbulence intensity quantifies how much the wind varies typically within 10 minutes. Because the fatigue loads of a number of major components in a wind turbine are mainly caused by turbulence, the knowledge of how turbulent a site is of crucial importance.

We have to distinguish between two different sources of turbulence. Turbulence is generated by terrain features – which is referred to as ambient turbulence intensity - as well as by neighbouring wind turbines – which referred to as induced turbulence (Figure 1). Sources of ambient turbulence are for example forests, hills, cliffs or thermal effects. Thus ambient turbulence can be reduced by avoiding critical terrain features. But the wake-induced turbulence has far more impact than the ambient turbulence intensity /2/. Decreasing the spacing increases the turbulence induced by the wakes of neighbouring wind turbines meaning that there are limits to how close you can space the turbines. As a general rule the distance between wind turbines in prevailing wind direction should be a minimum of the equivalent of five rotor diameters. The spacing inside a row perpendicular to the main wind direction should be a minimum of three rotor diameters.

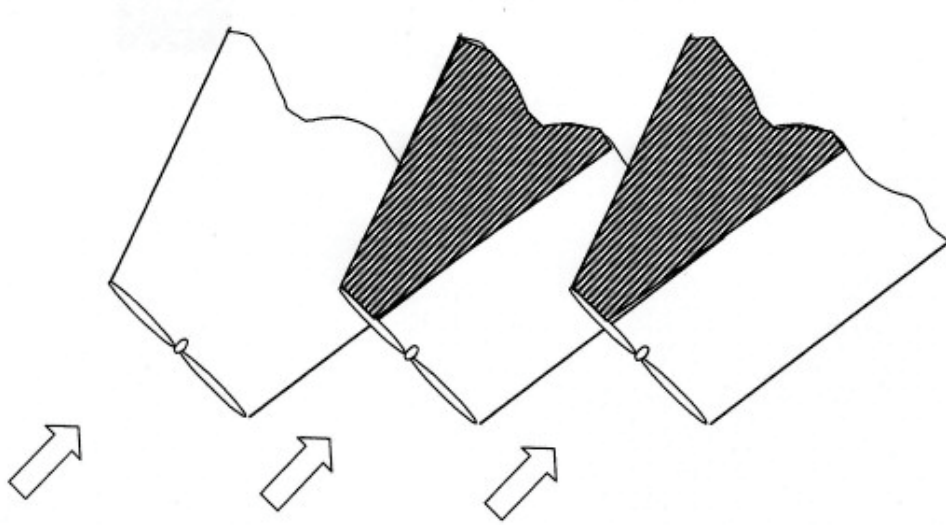


Figure 1: Shadowing in wind farm

If a layout is too close the resulting fatigue loads might be too high. In order to then ensure the lifetime of the main components wind sector management might have to be applied, meaning that some wind turbines might have to be switched off when they are operating in the wake of the neighbouring wind turbine.

Another parameter which has to be checked when developing a layout is the flow inclination, velocity tilt or in-flow angle. When wind turbines are to be placed on steep slopes or cliffs the wind might hit the rotor not perpendicular but at an angle. This angle is related to the terrain slope. With increasing height above ground level the effect of the terrain slope is normally reduced such that the terrain slope is only of indicative use to estimate the velocity tilt. A large in-flow angle will not only reduce the energy production but will also lead to an increased level of fatigue of some of the mayor components.

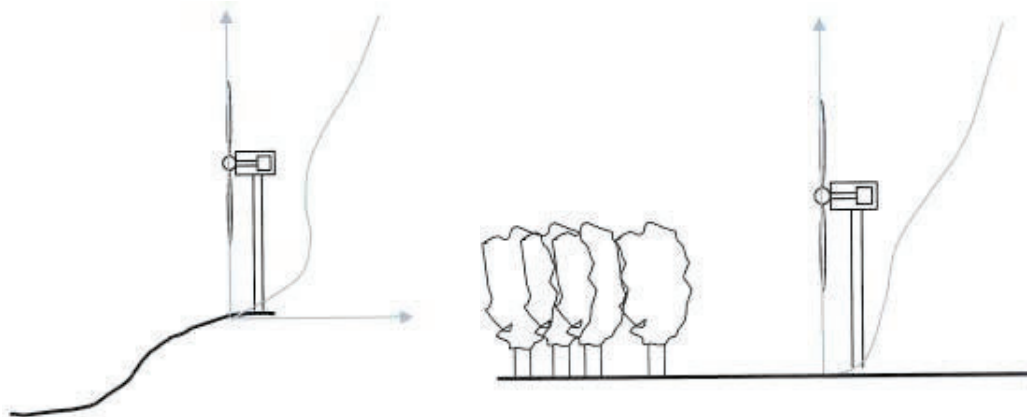


Figure 2: Distorted wind profile at steep slope (left) and behind a forest (right)

Furthermore a steep slope might cause a negative gradient across some parts of the rotor (Figure 2).

Normally the wind speed increases with increasing height. In flat terrain the wind speed increases logarithmically with height. In complex terrain the wind profile is not a simple increase and additionally a separation of the flow might occur, leading to heavily increased turbulence. The resulting wind speed gradients across the rotor lead to high fatigue loads particularly on the yaw system.

Obstacles like forest can have a similar effect on the wind profile and should be thus avoided.

Planning constraints

Next to the wind resource and technical considerations a good layout should also take planning constraints into account. The visual impact is course the most obvious. A layout that follows the shape of the terrain rather than straight rows of wind turbines appears to be less intrusive. Noise is another important parameter to take into account. Next to noise also the impact due to flicker at the nearest inhabited houses should be estimated. The accepted levels vary from country to country.

Electro-magnetic interference can cause problems. Hence placing wind turbines in a transmission corridor should be avoided.

Some areas on site might have to be excluded from development due to other factors related to fauna, flora and archaeology.



**Jessica Rautenstrauch, wind energy consultant
from Anemos, Germany, at work.**

© Paul Langrock (www.unendlich-viel-energie.de)

Summary

A large number of parameters have to be taken into account when developing a layout. Some work can be done using tools, but in the end the balance between financial, technical and planning constraints can be best done by an experienced engineer.

Literature

- /1/ IEC 61400-1, Ed.2 – Wind Turbine Generator Systems – Part 1: Safety Requirements, FDIS 998
- /2/ S. Frandsen, St.; L. Thøgersen, L.: Integrated Fatigue Loading for Wind Turbines in Wind Farms by Combining Ambient Turbulence and Wakes; Wind Engineering, Vol. 23 No. 6, 1999
- /3/ K. Kaiser, W. Langreder: Site Specific Wind Parameter and their Effect on Mechanical Loads, Proceedings EWEC, Copenhagen, 2001
- /4/ E.rik L. Petersen, N. G. Mortensen, L. Landberg, J. Højstrup and H. Frank: (, Wind Power Meteorology Part I: Climate and Turbulence, Wind Energy, 1, 25-45 (1998), Risø-I-1206, 1997
- /5/ E. L. Petersen, N. G. Mortensen, L. Landberg, J. Højstrup and H. Frank: Wind Power Meteorology Part II: Siting and Models, Wind Energy, 1, 55-72 (1998)

Wiebke Langreder

Suzlon Energy: www.suzlon.com

Appendix D

EPA Tasmania wind farm noise policy

Application

This policy is adopted by the Board of the Environment Protection Authority (EPA Board) for the purpose of assessing wind energy projects and requiring conditions or restrictions in respect to wind farm noise under the *Environmental Management and Pollution Control Act 1994* (EMPCA).

This policy supersedes any previous policy of the EPA Board in respect to operational noise criteria for wind energy projects. This policy does not apply to construction noise.

This policy applies from 31 July 2025 and will apply to all wind energy projects currently under assessment. It remains in place until revoked.

Technical terms

L_{Aeq} means the A-weighted equivalent continuous sound level.

L_{A90} means the A-weighted sound level that is exceeded for 90% of the measurement period.

dB means decibel.

$dB(A)$ means decibel when stating A-weighted sound pressure level.

Design Criteria

The predicted equivalent noise level at any noise sensitive premises should not exceed the greater of:

- a) **35 dB(A) $L_{Aeq, 10 \text{ min}}$; or**
- b) **Background (L_{A90}) + 5 dB(A).**

This design criteria applies to all noise emissions from the activity, inclusive of wind turbines and all ancillary infrastructure. It has been set for the protection of sensitive receivers during periods of low background noise.

The background noise for day, evening and night-time must be calculated separately to determine the applicable (lowest) background level, and is not to be averaged across a 24-hour period.

For predictive purposes, a difference of ~2 dB between measured $L_{A90, 10 \text{ min}}$ levels and $L_{Aeq, 10 \text{ min}}$ emissions from the activity must be noted. The predicted noise levels should be adjusted for special audio characteristics and/or the applicable adjustment factors must be discussed.

The EPA South Australia *Wind farms environmental noise guidelines 2021* (or the most recent revised version of that document) is to be used for assessing whether a wind farm can meet this design criteria, except where that guideline may be inconsistent with this policy.

Noise Measurements

If approved, wind energy projects will contain conditions and restrictions to enforce the design criteria. The following guidance is provided for the interpretation of EPA Board wind energy project noise requirements:

1. It is generally acceptable for wind turbine noise to be measured in L_{A90} , but note that alternative techniques may be required (including measuring in L_{Aeq}) to better detect special audible characteristics (dominant and intrusive characteristics) and noise fluctuations or intermittent noise.

2. An appropriate conversion factor must be added to the measured L_{A90} level to derive the representative L_{Aeq} noise level. To be representative of L_{Aeq} , generally applying +2 dB(A) conversion factor to the measured L_{A90} level is acceptable.

3. Where special audible characteristics (dominant and intrusive characteristics) are detected from any wind farm noise, a correction factor must be applied in accordance with the *Tasmanian Noise Measurement Procedures Manual*.
4. The EPA South Australia *Wind farms environmental noise guidelines 2021* (or the most recent revised version of that document) is to be used for all wind farm noise measurements, except where that guideline may be inconsistent with this policy.

29 July 2025



Andrew Paul

Chair

Environment Protection Authority Board

C) Bowdler Report on Sl Callan Noise

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SLIEVE CALLAN WIND FARM

REVIEW OF THE NOISE COMPLIANCE REPORT 26TH APRIL

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1 INTRODUCTION

- 1.1 Following complaints of noise from the Slieve Callan Wind Farm, AWN Consulting (AWN) carried out a compliance report for MKO. I assume this report was requested by Clare County Council (CCC) but I have not seen documentation regarding the request for the report.
- 1.2 This report is my review of that compliance report and presents my opinion as to whether the procedures carried out to inform the report are in accordance with good practice and so whether the results obtained are correct.
- 1.3 I give my opinion as a noise consultant with experience in environmental noise and in noise within the planning system in the UK and Ireland over 50 years. My qualifications and experience` are set out in an appendix.

2 BACKGROUND

- 2.1 The wind farm known as Slieve Callan was submitted for planning approval to Clare County Council (CCC) in 2010. CCC granted permission on 19th August 2010 subject to conditions including Condition 19 that dealt with noise.
- 2.2 CCC's decision was appealed to An Bord Pleanala (ABP) by a number of parties. The Inspector reported in March 2011 and ABP confirmed the grant of Permission with a different set of Conditions including Condition 13 on noise which, though having similarities, was not the same as the original council condition.
- 2.3 At some point CCC asked the wind farm operator to produce a compliance report to establish whether the noise from the wind farm met the planning condition though I have not seen the text of any request or order. This compliance report was carried out by AWN and dated 6th September 2019 (Compliance Report).
- 2.4 Resonate, an acoustic consultancy, appear to have been commissioned by CCC to review the AWN report which they did in a letter of 16th November

2019 (RR). AWN responded with further information on 27th January 2020 (AWN Supplementary).

- 2.5 Amplitude Acoustics (which I believe to be the same or the successor business to Resonate) replied on 11th February 2020 (AA Letter). On 22nd July 2020 CCC wrote to MKO confirming that the wind farm met the conditions of the grant of planning permission.
- 2.6 The turbine locations are set out in Table 3.1 of the ES except that turbines 3 and 31 were excluded as Condition 3 of the ABP Decision. House locations are set out in Table 8.10 of the ES.

3 ESSENTIAL ACOUSTIC POINTS

- 3.1 It is necessary to understand a few basic acoustic points to understand the documents and my report. Sound is measured in decibels (dB). This is a logarithmic measure of the sound energy. A halving of sound energy results in a reduction of 3dB and a doubling of energy an increase of 3dB. This is because ten times the logarithm of two (halving or doubling) is 3dB.
- 3.2 Sound varies in frequency and the sensitivity of the human ear varies with frequency as well. To allow for this we use “A-weighting”. The A-weighting is an internationally standardised measure of the total sound, approximating to loudness, and is measured directly with a sound level meter. All the measurements referred to here are A-weighted.
- 3.3 Sound varies also with time and so there are many measures by which to describe a sound and they can all give different results. For example minimum, maximum and average levels will normally all be different. There are two measures used to describe sound for the purpose of assessing environmental noise. They are the “equivalent continuous sound level” (LAeq) and the “level exceeded for 90% of the time” (LA90). The LAeq is a sort of average (though it is a logarithmic average). The LA90 is a measurement close to the minimum.

4 THE NOISE CONDITION

4.1 Condition 13 in the planning permission says:

During the operational period, noise levels resulting from the operation of the wind turbines, when measured at the nearest inhabited house, shall not exceed 43dBA (15 minutes Leq). All sound measurement shall be carried out in accordance with ISO Recommendation R 1996 “Assessment of Noise with respect of Community Response” as amended by ISO Recommendations R 1996 1.

4.2 Like many planning conditions, this needs some interpretation. In 3.1 of the Compliance Report AWN sets out its interpretation of the condition. This relies heavily on the best practice advice in “The Assessment and Rating of Noise from Wind Farms” (ETSU-R-97) and the Institute of Acoustics “A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise” (IOAGPG). These are both used in wind farm assessments in the UK and are widely used in Ireland. The particular points where these documents are relied upon are:

- It is best practice to measure over a 10-minute time interval rather than a 15-minute one.
- It is best practice to measure wind turbine noise as LA90. ETSU-R-97 says that LAeq for turbine noise is 2dB more than LA90, so the measurements should be carried out as LA90 and then 2dB should be added. The reason for this is that measurement of LA90 is more likely to yield a result because the measurements will not be affected so much by intermittent noise from other sources.

4.3 The interpretation of planning conditions in general has been the subject of scrutiny by the courts and the Supreme Court decision in *Kenny v Dublin City Council* sets out the position from Paragraph 24 onwards. The position is set out in some detail over several paragraphs but I will quote just two sentences from paragraph 25:

Consequently, the planning permission is to be interpreted according to objective criteria. The subjective beliefs either of the applicant or the planning authority are not relevant or admissible as aids to interpretation.

- 4.4 In my opinion, and with reference to the judgement in Kenny, the interpretation used by AWN – effectively to replace ISO 1996 in the condition with ETSU-R-97 and IOAGPG is not justified. It is true that the last sentence of condition 13 is not accurate and loosely written, but its meaning is clear. ISO Recommendation R1996 was issued in 1971; the full standard ISO 1996-1 was issued in 1982 and replaced in 2003. The full standard was not an amendment to the Recommendation, as condition 13 suggests, but replaced it. Nevertheless it seems a clear interpretation of the condition that “All sound measurements shall be carried out in accordance with ISO 1996-1”.
- 4.5 ISO1996 is not a standard to be discarded lightly in this case. It is the main standard in Europe for, as its title says, the “Description, measurement and assessment of environmental noise”. In 8.3.3.1.1 of the ES, it says that it was used in the noise monitoring carried out for the original Noise Impact Assessment. A condition specifying ISO 1996 was set originally by CCC in their original consent for this wind farm. At the appeal, no objection was raised to the condition. ABP have routinely used ISO 1996 in wind farm noise conditions and the condition applied in this case was, as far as I can tell, universally used for wind farms around the time of this one, although it is the case that there was no consistency between whether L90 or Leq was used in the limits themselves. For example, 02.236608 in 2010 and 13.238964 in 2011. ISO 1996 is also still specified by ABP, for example 306924-20 in 2021.
- 4.6 I could see that, if the alternative methodology proposed by AWN could achieve the same result as ISO 1996-1 but more reliably, say, then there might be an argument for using it. I do not believe that is the case here and AWN did not produce an argument to that effect or indeed any argument for not using ISO 1996-1. For the purposes of clarification I do not consider the use of 10 minutes rather than 15 minutes to be significant.
- 4.7 The reason for the use of LA90 is set out in ETSU-R-97 and quoted in 3.2.1 of the Compliance Report: “*The use of the LA90, 10min descriptor for wind farm noise allows reliable measurements to be made without corruption from relatively loud, transitory noise events from other sources*”. I agree that this is correct, but the noise limits then have to be set as LA90. The compliance report goes on to say that “*It was proposed to use the measured LA90*”

parameter to determine the operational turbine noise levels for this assessment. In order to derive an LAeq level for assessment of compliance 2dB will be added to the measured LA90, this approach is in line with best practice guidance contained in the IOA GPG". This last phrase is not correct. IOAGPG is predicated on all the measurements and the planning condition being defined as LA90. The LA90 limits set out in ETSU-R97 are certainly derived by subtracting 2dB from limits set elsewhere in LAeq but in ETSU-R-97 and in IOAGPG **measurements** are made in LA90 and the **limits** are in LA90. No measurement as LAeq is part of the procedure. In this case the condition states that measurements are made as LAeq (through the specification of ISO 1996) and the noise limit is in Leq. What AWN have done here is to measure as LA90 and compare that to a limit in LAeq using an arbitrary difference of 2dB. If we knew that in any set of measurements of wind turbine noise the difference between LAeq and LA90 was always 2dB, that argument would be acceptable. But there is no reason why, in the field, the difference would be 2dB for various reasons.

- Sometimes complaints are related not only to the level of noise but to amplitude modulation – the noise level rising and falling with the rotation of the blades. If that is the case, the difference between LAeq and LA90 might quite likely be more than 2dB.
- Turbine noise can vary as the wind speed or wind direction vary over a 10- or 15-minute period and again this might mean the difference was greater than 2dB.
- Turbines might be operating in different noise modes in different wind conditions or at different times of day.

4.8 The most significant reason that ETSU-R-97 and IOAGPG do not deliver the same result at ISO 1996-1 is that ISO 1996-1 not only requires the measured sound pressure level to be taken into account but also takes account of characteristics of the noise such as impulsivity and tones.

4.9 I can also see that, if it is not possible to carry out the measurements as set out in the planning condition then it may be necessary to adopt another procedure. There are undoubtedly potential challenges in making the measurements in LAeq rather than LA90. I think AWN are correct in that members of the acoustic community generally in Ireland as well as in the UK

(where ETSU-R-97 and IOAGPG originate) consider that best practice is to measure wind farm noise as LA90 and to set wind farm noise limits as LA90. This is also the case in Australia and New Zealand but is not generally so in most of Europe or in North America. It is my view that a person testing compliance is not at liberty to change the methodology in the planning condition.

- 4.10 It is quite likely that measuring as LAeq would mean that accurate noise measurements could not be made at a greater number of wind speeds. However, this is not uncommon in environmental noise measurements and there are ways to get over the problem – for example by carrying out parallel measurements at a location closer to the turbines or simultaneously carrying out sound power level measurements of the nearest turbines.

5 THE MEASUREMENTS AND ANALYSIS IN THE COMPLIANCE REPORT

- 5.1 This section of my report looks at the findings of the Compliance Report on the basis that the methodology used in the report was acceptable notwithstanding my criticisms in section 4 above.
- 5.2 In section 4 of the compliance report it says that measurements were made at H22, the nearest inhabited house. In fact H22 is not the nearest inhabited house. This seems to be a typographical error repeated throughout the report, since Table 1 which purports to give the co-ordinates of H22, actually gives those for H25. It is important that the location of the measurements is clearly demonstrated with evidence. There are photographs in Fig 2 of the Compliance Report which should show clearly where measurements were made. I have not had the opportunity of visiting the site so I cannot identify it. The rest of this section assumes that the location is H25.
- 5.3 The choice of equipment for the measurement of sound and wind and its deployment appears to conform with good practice except possibly the windshield. It is not known whether this is compliant because it is not described and the copies of the photographs that I have are inadequate to identify it though I am aware that AWN normally use enhanced windshields.

- 5.4 In 5.1.2 of the compliance report it states that measurements were analysed when the measurement location was downwind of the primary turbines. I agree that downwind levels are often considered to be the worst case. However, in the case here the nearest turbine is less than 500m and the difference between upwind and downwind levels may not be great or there may be no difference at all. This is shown in Fig 6 of IOAGPG and seems to be borne out by the analysis in the AWN Supplementary. This point was raised in RR and responded to in AWN Supplementary.
- 5.5 Using the argument that turbine noise does not rise further above a wind speed of 8m/s, the Compliance Report concludes, at Table 8, that the wind farm is compliant with the condition. Resonate pointed out that this did not comply with good practice and that background noise measurements were required if the total noise (background plus turbine noise) exceeded the noise limit – which it did here above 8 or 9m/s. I agree with Resonate regarding this.
- 5.6 In response, AWN, in the AWN Supplementary, produced background noise measurements that had been carried out during turbine shut down. Table 1 of the AWN Supplementary lists the background noise levels measured at 8, 9 and 10m/s. Table 2 shows the measured total noise level taken from Table 4 of the Compliance Report. The figures in Table 1 are then deducted (logarithmically) from those in Table 2 to produce the figures in Table 3 all in accordance with good practice, though this is only done for wind speeds of 8, 9 and 10m/s as these are the only ones available. Table 4 then shows the turbine noise LAeq or the total noise, compared with the noise limit.
- 5.7 If we look at the results in Table 4, the turbine noise level at 10m/s is 43.9dB. On page 5 of the AWN Supplementary it says *“Review of the graphed data above clearly shows an increase in the total measured noise level with increased wind speed starting at 9m/s. Bearing in mind that the turbine manufacturers data states that the turbine noise emissions should reach a maximum at 8m/s, the elevated measured noise levels at 10m/s and above are undoubtedly effected by the background noise sources most likely due to wind generated noise”*. But that cannot be the case because the level of 43.9dB is for the turbine noise only, the background noise has been deducted from it. We can see from Table 1 that the background noise due to the wind

generated noise is 33.2dB, 10dB less (although measured as L90 not L90+2).

- 5.8 At 11 and 12 m/s wind speed it is suggested again that this is background noise. But, if we look at Figure 1 of the AWN Supplementary it looks unlikely that the background noise rises above 40dB at 12 m/s if the trend is extrapolated. However, the fact is that there are insufficient background noise measurements to be certain.
- 5.9 Although the sound power level of turbines generally levels off at around 8m/s, that depends on how the turbines are operated. It could be that turbines are operating in noise-optimised mode in certain conditions to meet specific noise targets. If, for example, the turbines were run in a noise optimised mode at wind speeds up to 8m/s and then in a higher noise mode after that, then the maximum noise level would not be at 8m/s it could continue rising with wind speed until it ran in full mode. We do not know what mode the turbines were running in during the tests nor what they are normally run in.
- 5.10 I have modelled the turbine noise using good practice set out in IOAGPG and the Nordex N90/2500HS run in full noise mode and note that the measured wind turbine noise levels in Table 3 of the AWN Supplementary are significantly less than the calculated levels – by about 5dB at 6, 7 and 8m/s. This is a larger margin than would be expected and suggests the possibility that turbines are being run in reduced mode in some situations. The calculated maximum noise level at H25 in full mode is 45.8dB measured as LAeq. But it is important to note that may not be the level they are actually operating at.

6 CONCLUSIONS

- 6.1 I do not consider that the Compliance Report properly interprets planning condition 13. However, this would ultimately be a matter for the courts or at least for a legal opinion.
- 6.2 If the interpretation used in the Compliance report is correct, then its conclusions are that the noise limit in condition 13 is not exceeded at wind

speeds up to 9m/s, the limit is exceeded at 10m/s and compliance has not been established on way or the other at 11 and 12 m/s.

6.3 Further clarification is required to conclude the compliance testing regarding:

- The measurement location;
- The windshield used;
- Turbine running modes during the tests and under normal conditions;
- Further measurements of background noise levels

APPENDIX– QUALIFICATIONS AND EXPERIENCE

I have been a noise consultant for fifty years. I was one of the original members of the Institute of Acoustics (IOA), our professional body, when it was founded in 1974 and I have been a Fellow since 1977. I am also a Chartered Engineer, a Chartered Physicist, a Fellow of the Chartered Institution of Building Services Engineers and a Member of the Chartered Institute of Arbitrators.

I am keen to promote good acoustic consultancy and to ensure that our profession uses best practice. As part of this I encourage debate and am active in organising conferences and meetings. I am the organiser of the biennial International Wind Farm Noise Conferences run by Institute of Noise Control Engineering, Europe, the next one of which is to be held remotely in May 2021. I am co-editor of a book entitled “Wind Turbine Noise” which was published in 2011. In January 2009 I instigated the “Prediction and Assessment of Wind Turbine Noise” (PAWTN) – frequently known as the IOA Bulletin Article. This dealt with some issues of good practice which are either missing from ETSU-R-97 or are ambiguous. It has largely been incorporated into the “IOA Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise” (IOAGPG).

Over my consultancy career I have carried out or reviewed over 500 noise assessments of various types. About 90% of these were on behalf of developers. I have given evidence at many public inquiries on non-wind farm development. I have reviewed over 400 wind farm applications and I have given evidence at nearly 40 wind farm inquiries. I have advised government on wind turbine noise and jointly project managed the large research programme on amplitude modulation for RenewableUK – the wind industry’s trade association. I have made presentations to British and European wind industry trade associations and to objectors’ conferences. I frequently speak at meetings of Environmental Health officers about wind turbine noise.