Public consultation on the revised wind energy development guidelines

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Please note that the views expressed in this submission are those of the signatories listed above and not necessarily the organisations that they represent. They are a consensus of the views and whilst that does not mean that every signatory agrees with every word of the submission it does mean that every signatory endorses various points made in the submission.

1 Introduction

1.1.1 On the 20th December 2019 a group of acousticians ('the group') submitted a holding response setting out concerns relating to the noise section of the Draft Revised Wind Energy Development Guidelines (the 'draft guidelines'). Within the holding response (included as Appendix 1) the group requested a meeting or workshop with the relevant Government departments, authors of the draft guidelines and other parties.

1.1.2 We received a response from Department of Housing, Planning and Local Government (DHPLG) inviting four members of the group to a meeting on the 25th February 2020 (after the current consultation period ends). Whilst we welcome the opportunity to discuss the draft guidelines at the meeting, given the complex and technical nature of wind farm noise assessment and our concerns regarding the content of the draft document, we would like to re-emphasise the importance we place on having further detailed interactive consultation prior to the publication of the finalised guidelines.

1.1.3 In our holding response we also stated that we would aim to produce a consolidated set of more detailed technical feedback, which we have now set out below.

2 Summary findings and key issues

2.1.1 The current structure of the document makes it difficult to understand the overall assessment process and methodology. This is likely to lead to inconsistencies in its application. It would be more helpful if it could be presented in a single chronologically-structured document to guide users and readers through its use.

2.1.2 The draft guidelines contain a number of technical errors, ambiguities and inconsistencies and requires further detailed review and amendment.

2.1.3 Whilst the setting of noise limits is a matter for Government policy, the justifications for the proposed noise limits is based upon a number of technical inaccuracies.

2.1.4 The exact form of the noise limits proposed is not clear given the discursive nature of the document and the presence of some highly contradictory statements.

2.1.5 The proposed methodologies for the assessment of Special Audible Characteristics do not sufficiently consider the possibility of contamination from other sources and there is limited experience in the specific application of some of these methodologies to wind turbine noise.

2.1.6 There is no guidance on how cumulative noise issues should be dealt with by planning conditions on individual development.

2.1.7 The proposed limit on low frequency noise does not represent the reference document cited to support it.

2.1.8 The requirements for assessment, monitoring and mitigation are extensive, will often be un-necessary and would involve considerable practical difficulties.

3 Basis of noise level limits

3.1 Overview

3.1.1 Although there is some ambiguity in the draft guidelines, there appear to be two separate sets of noise limits proposed:

- A noise limit referred to as the 'Relative Rated Noise Limit' (RRNL). The RRNL applies externally (i.e. within residents gardens), and is comprised of the measured noise level plus any necessary corrections for 'Special Audible Characteristics' (SACs). Two SACs (in addition to LFN) are considered in the draft guidelines; tonal noise and amplitude modulation; and
- A low frequency noise (LFN) limit covering the frequency range from 10 Hz to 160 Hz (inclusive). This noise limit would apply internally (i.e. within residents' properties).

3.1.2 Although the limits themselves are a matter for Government policy, a few technical points should be noted with regard to how these are derived and justified. The structure of the RRNL limit is such noise is limited to a level of 5 dB(A) above background noise, subject to a lower limiting value of 35 dB L_{A90} and an upper limiting value of 43 dB L_{A90}. We deal with these three elements separately below. The LFN limit is discussed in Section 3.7.

3.2 Lower limit

3.2.1 There is no justification in the draft guidelines for applying the lower limiting value of 35 dB L_{A90}. Reasons for the need of a lower limit, or for a different one such as the range of 35-40 dB(A) as set out in ETSU-R-97 and the 2006 WEDG guidelines, need to be explained.

3.3 Intermediate limit

3.3.1 The draft guidelines state that an increase of 5 dB(A) over existing noise levels is acceptable. However, there is no reason stated as to why that 'acceptable increase' applies only up to 43 dB(A). In high background noise areas (or at high wind speeds) background noise itself is likely to exceed 43 dB(A) and would therefore provide a degree of masking of the wind turbine noise. In addition, the low permitted level of wind turbine noise relative to background noise may make the measurement of wind turbine noise, and in turn compliance with the noise limits, very difficult to evaluate.

3.4 Upper limit

3.4.1 The draft guidelines state, on page 68, that:

"the RRNL may not exceed 43 dB(A) which is the upper limit set by these Guidelines consistent with the WHO Environmental Noise Guidelines for the European Region (WHO, 2018) metric for impacting human health."

3.4.2 Although the guidance of WHO clearly carries much weight it is important that it is read in the context of the WHO report as a whole and together with WHO's own assessment of the evidence for the limit. The 45 dB L_{den} level defined in WHO 2018 is based on a threshold of onset of significant annoyance, defined as 10% of Highly Annoyed people in the population. The WHO document notes in Section 2.6.3 that

"The GDG stresses that the aim of the current guidelines is to define an exposure level at which effects certainly begin"

3.4.3 It should be noted that the WHO recommendation for wind turbine noise is "*Conditional*" (as opposed to "*Strong*," which is used for other WHO recommendations). WHO defines this as follows:

"A conditional recommendation requires a policy-making process with substantial debate and involvement of various stakeholders. There is less certainty of its efficacy owing to lower quality of evidence of a net benefit, opposing values and preferences of individuals and populations affected or the high resource implications of the recommendation, meaning there may be circumstances or settings in which it will not apply."

3.4.4 Table 42 of the WHO document provides a summary of the strength of the recommendation and states:

"Evidence for a relevant absolute risk of annoyance at 45 dB L_{den} was rated low quality."

3.4.5 In addition, the WHO document itself is based on a very limited data set, which only estimated the L_{den} for the sites studied, rather than assessing it directly from wind statistics (see Appendix 2). This is acknowledged in the WHO document, which states that it:

"may be concluded that the acoustical description of wind turbine noise by means of L_{den} or L_{night} may be a poor characterization of wind turbine noise."

3.4.6 As discussed in the Appendix 2 to this document, the WHO recommendation was determined from studies based on worst-case or predicted downwind noise levels, with L_{den} values derived from those worst-case levels using a simplified correction factor. The calculations in the separate RPS report 'Draft Wind Energy Guidelines – Wind Turbine Noise Analysis' have several irregularities and should have instead referred to the noise levels in the original studies rather than estimating long-term averaged values by correcting back from L_{den} (See Appendix 2).

3.4.7 It is considered that the analysis used to back up the choice of a 43 dB(A) upper fixed minimum limit is technically flawed and that the information in the WHO document has been taken out of context.

3.5 Clarity of the noise limits

3.5.1 In this section on limits we consider that there is some confusion introduced by reference to L_{den} and other possible forms of limit.

3.5.2 Repeated references are made to L_{den} in the draft guidelines but there appears to be no requirement to assess this directly (although this, in itself, is unclear). Although the draft guidelines prescribe the Relative Rated Noise Limit (RRNL) they then include references to an assessment with a different metric, the L_{den}:

"Wind turbine noise assessment will be based on the L_{den} indicator" [TA1, p.163]; and,

3.5.3 The text in Section 5.7.10 makes references to L_{night}, L_{den}, L_{Aeq} and L_{A90} and states on page 70 that:

"Wind turbine noise assessment will be based on the L_{den} indicator"

3.5.4 The draft guidelines state on page 163 that the noise level:

3.5.5 "shall not exceed background noise levels by more than 5 dB(A) within the range 35-43 dB(A) or 43dB".

3.5.6 This statement is incorrect as it would only apply during the night periods. During the day and evening periods the actual background noise levels will not be considered (see Section 4). Given that the 'assumed' background noise levels that will be used for day and evening periods could be higher than the actual background noise levels, the RRNL could be greater than background plus 5 dB(A).

3.5.7 Section 5.7.11 appears to define the noise limit that should be complied with, but statements such as *"A Relative Rated Noise Limit (RRNL) in the range of 35 – 43 dB(A) shall apply"* or *"Additional limits can be set…"* are unclear. Technical Appendix 1 (TA1) then provides a technical specification of the noise limit. However, given the lengthy nature of the document and the lack of clarity in some of the text, this may lead to extended discussions or mis-interpretations of the requirements.

3.5.8 As we understand the draft guidelines, it is not intended that developments should comply with L_{den}. But if this were to be the intention, assessment of compliance in practice would be very difficult, as, yearly-averaged measured levels, which will include day-time measurements and be made across a range of conditions, are likely to be corrupted by a wide range of other sound sources and therefore be meaningless. Similarly, undertaking predictive assessments of compliance with L_{den} at planning stage would generally be difficult and there is no guidance provided as to how this could be done.

3.6 Use of background noise curves

3.6.1 The RRNL is to be set as 5 dB above the background noise level (subject to upper and lower fixed limits). For evening and daytime periods however, the RRNL is to be set 5 dB above an 'assumed' evening and day time background noise levels and *not* the actual background noise levels. Baseline monitoring and background noise is discussed in Section 4, where we detail why we believe the use of these 'assumed' levels are unsuitable.

3.7 Low frequency noise – zero tolerance approach

3.7.1 In addition to the RRNL, the draft guidelines refer to a zero tolerance approach to low frequency noise (LFN) and references two documents ('the first report' and 'the second report respectively)':

1. Moorhouse, Waddington and Adams, (2011), *Proposed criteria for the assessment of low frequency noise disturbance*, DEFRA Contract no. NANR45 revision 1 December 2011.

2. Moorhouse, A., Waddington D. and Adams, M., *Procedure for the assessment of low frequency noise complaints*, February 2005, Contract no NANR45 to the UK Department for Environment, Food and Rural Affairs (DEFRA); and

3.7.2 The aim of the first report (which was also originally published in 2005 and updated in 2011) was to:

"recommend a method for assessing low frequency noise (LFN), suitable for use by Environmental Health Officers (EHOs) in the UK."

3.7.3 It is however very important to note the context provided on page 62 of that document where the authors note:

"It is suggested that the proposed criterion be used not as a prescriptive indicator of nuisance, but rather in the sense of guidance to help determine whether a sound exists that might be expected to cause disturbance. Some degree of judgement by the EHO is both desirable and necessary in deciding whether to class the situation as a nuisance, and is likely to remain so. One of the main reasons is that, from the control cases, it is clear that problems do not necessarily arise when the criteria are exceeded. Indeed, we can conjecture that genuine LFN complaints occur only in a few such cases." (emphasis added)

3.7.4 The second report (which was actually also updated to 'Revision 1' in 2011) set out to:

"assist Environmental Health practitioners to handle complaints of low frequency noise as efficiently and correctly as possible"

3.7.5 The draft guidelines detail that criterion curve detailed in both NANR45 documents is to be used as an additional noise level limit to the RRNL, albeit one based on internal noise levels rather than external noise levels. More detail is provided below regarding LFN but it is worth noting at this point that the NANR45 documents are not meant to be used for the setting of noise level limits or to determine acceptability. Rather, as set out in the quote in paragraph 3.7.3 above, it is a method to determine the presence of low frequency noise that may require further investigation.

3.7.6 The first report also notes that:

"If the L_{eq}, taken over a time when the noise is said to be present, exceeds the values in Table 9 it may indicate a source of LFN that could cause disturbance. The character of the sound should be checked if possible by playing back an audio recording at amplified level."

3.7.7 As such, we feel that it is inappropriate to use the NANR45 criterion curve as a simple pass/fail criteria.

3.7.8 As discussed below in relation to SACs, contamination from sources other than the wind turbines, which is a definite possibility when considering internal noise measurements at low frequencies, could lead the proposed criterion to appear being exceeded. The draft guidelines do not make this sufficiently clear.

3.7.9 It is assumed that LFN noise limits are set out in Table 4.1 of the draft guidelines are meant to replicate the criterion curve in the NANR45 documents; however, the criterion curve in NANR45 uses L_{eq} as the noise metric, whilst Table 4.1 refers to L_{90}, which is incorrect. If L_{90} is to be used, how this L_{90} criterion was formulated and how it would be assessed needs to be specified. The first report notes that:

"If the noise occurs only during the day then 5dB relaxation may be applied to all third octave bands. If the noise is steady then a 5dB relaxation may be applied to all third octave bands."

3.7.10 It is unclear if the permitted relaxation of criteria during day-time periods in NANR45 should be applied or not. Although this is referred to in the text of the draft guidelines it is not apparent in Table 4.1.

4 Baseline monitoring and background noise levels

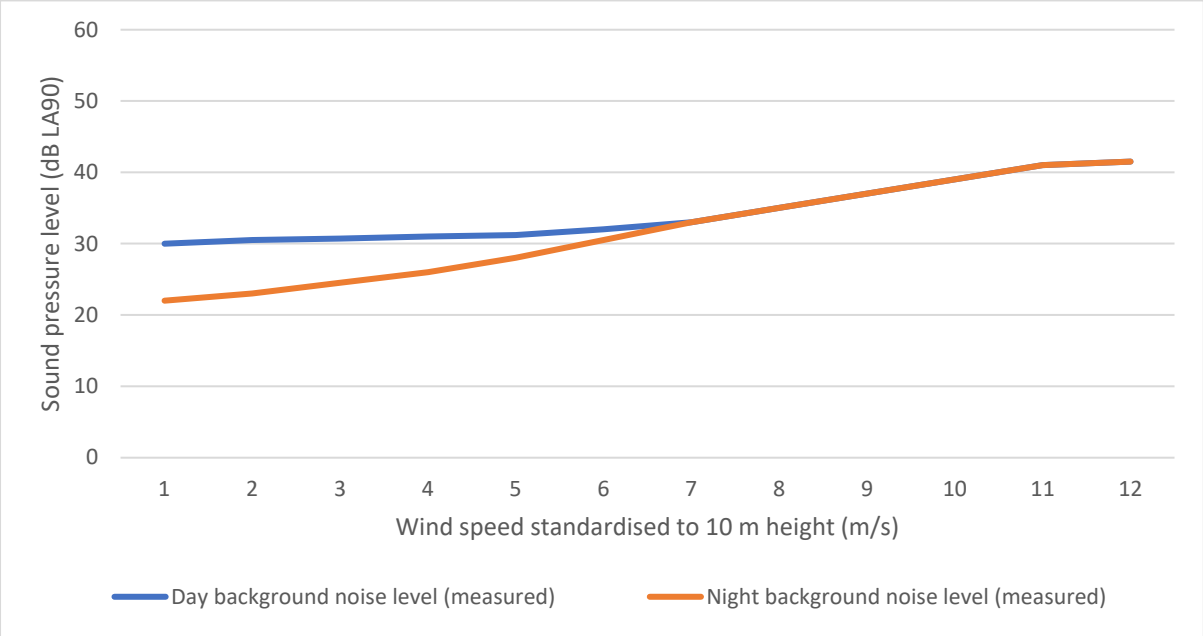
4.1.1 The draft guidelines clearly make reference to "*the 2013 approach to the IOA application of ETSU-R-97*" in line with the published IOA Good Practice Guide. This requires reasonable characterisation of baseline background levels over a period of typically several weeks (to capture a representative range of conditions). However, a lone reference in Section 5.7.13 to "*the annualised background noise level*" may introduce confusion and should be deleted.

4.1.2 The draft guidelines require background noise to be quantified only using data acquired during the night-time hours, with corrections of 5 and 10 dB(A) applied to derive evening and day-time background noise levels, respectively. Given that monitoring will be undertaken during the daytime and evening periods anyway, it does not make sense to assume these daytime and evening background sound levels, as opposed to using the actual data from these periods. The draft guidelines try to provide justification for this at page 164, stating "*noise during the night-time period is critical in determining the overall noise level and consistency with the WHO conditional recommendation*," however the proposed limits are not the WHO conditional recommendation so this is not relevant. In the next paragraph it discusses the difficulty in measuring wind turbine noise during the day, but at this point the discussion is about background noise (as opposed to operational noise) and there is no problem in measuring background noise during the day or evening.

4.1.3 If the argument is that the limit should be relaxed in the evening and day-time then that could be applied but as drafted the recommendation appears to be based on increased background levels during these periods that may well not occur in practice.

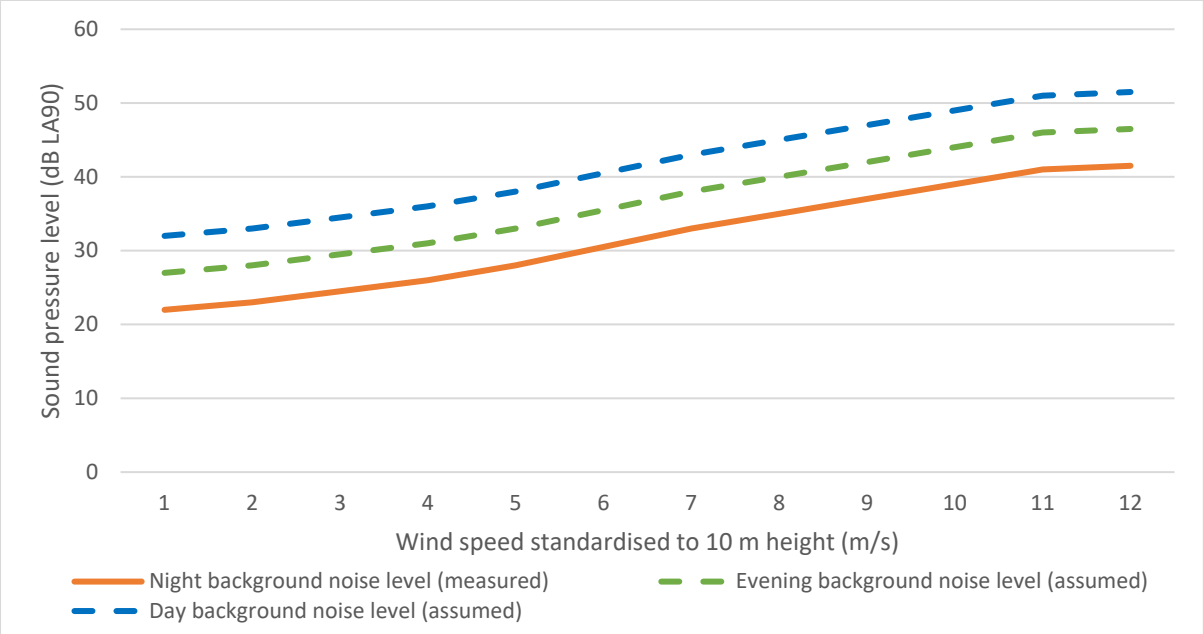
4.1.4 The proposed corrections for daytime and evening background noise levels assume that the increase in background noise during daytime or evening changes at the same rate with increasing wind speed as at night, however, this is not typically the case. An example of this can be seen in Figure 1, which illustrates the noise environment that may be found at a location where daytime activity (for example a busy road) may be the dominant sound source at low wind speeds. In this example it is not until 6 m/s that wind induced noise starts to have an effect on the measured noise levels. At night-time however, activity has died down and noise levels are therefore more influenced by changes in wind speed. It should also be noted that at higher wind speeds, noise levels for both daytime and night-time often converge as wind induced noise is the dominant sound source.

Figure 1 – Example of a typical set of day and night prevailing background noise curves



4.1.5 Figure 2 presents an example of background noise curves which may occur if the method used in the draft guidelines was adopted. In this example it can clearly be seen how the 'assumed' background sound levels for evening and day time periods may be overestimated, particularly at higher wind speeds.

Figure 2 – Example of 'assumed' background noise curves derived using the draft guidance



4.1.6 In the UK, background noise levels measured during quiet day-time periods (weekday evenings, Saturday afternoon and evening, and all-day Sunday) are used as the basis for setting limits during all day and evening periods. These 'quiet day-time' periods recognise the increased importance for enjoyment of the amenity of day-time periods during weekends and the quieter evenings during weekdays. The draft guidelines do not make any

distinction between day-time periods during weekdays and those at the weekends, which may be intentional, however we suggest this should be specifically discussed.

4.1.7 It is noted that (in general) the draft guidelines require background noise levels to be measured in the absence of turbine noise (which is consistent with the approach set out in ETSU-R-97 and the IOA GPG). The text in section 5.7.11 is however contradictory in that it states:

"for the avoidance of doubt, the noise levels associated with all other existing and approved natural and anthropogenic noise sources in the study area shall constitute the background noise"

4.1.8 The definition of 'existing or approved noise sources' (as included in the Glossary), includes wind turbines meaning that noise from existing turbine development is included in the background noise.

5 Study area & noise sensitive receptors

5.1.1 The draft guidance at page 162 defines a study area as:

*"within which the predicted RRNL, at noise sensitive locations, may exceed 30 dB L_{A90} at up to 12 m/s wind speed or an area contained within a perimeter line offset by 3,000 metres (3 km) from the proposed, consented and existing wind turbines, whichever is the **lesser**,"* (emphasis added)

5.1.2 On page 185, however, the study area is defined with the same criteria but for whichever is the **greater**.

5.1.3 This also suggests that the study area is widened to take in any / all existing turbines irrespective of distance from any proposal for new turbines. This requirement should be clarified.

5.1.4 Page 185 also states:

"the planning application shall include a cumulative noise impact assessment incorporating the impact of all existing and approved (see Glossary) wind energy noise sources in the study area."

5.1.5 This suggests that the cumulative assessment need only consider other wind turbines within the defined study area (subject to paragraph 5.1.3 above), however, there may be instances where turbines outside of the defined study area may impact on cumulative noise levels. We suggest references are made to the guidance provided in IOA GPG (5.1.4 and 5.1.5) and to the article in the IOA Bulletin[1] which provide relevant discussion of factors to be accounted for when undertaking cumulative assessment (see further discussion below).

5.1.6 Section 5.7.7 defines noise sensitive locations but fails to make any distinction between the relative sensitivities of receptors. As such it appears that all types of receptor should be afforded the same protection and, therefore, assessed against the same noise level limits.

[1] Bowdler *et. al*., Wind farms cumulative impact assessments, Jan/Feb 2016 Acoustics Bulletin, UK Institute of Acoustics.

The same limits as defined for residential areas may not necessarily be relevant to all building types or to outdoor amenity areas. The RRNL noise limits appear to have been driven by research on human receptors and may therefore not be directly applicable to other areas.

6 Special audible characteristics

6.1.1 The draft guidelines refer to "special audible characteristics" (SAC) of wind turbine noise and in particular discuss tonality, amplitude modulation (AM) and low frequency noise (LFN). However, it is unclear whether all three of these potential characteristics are considered SACs for the purposes of assessment during the planning stage, routine compliance assessment or only for investigation of complaints. The draft guidelines need to be clear whether all of these potential characteristics are SACs and are to be included in assessment at each of these stages.

6.2 Consideration at the planning stage

6.2.1 The document suggests that assessment at the planning stage should evaluate the likely presence of SACs for a particular wind farm proposal and take this into account in the assessment to support the planning application. For example:

- The competent person should *"assess the proposed turbine design"* [TA 1, p.163] and estimate the likely penalty(ies) when considering the study area for the scheme.
- *"noise modelling of the wind energy development project carried out by the applicant in advance of and submitted with the planning application will test and demonstrate compliance with these limits including any presence of such special audible characteristics"* [5.7.12]

6.2.2 However, the presence of such SACs will be highly dependent on the specific turbine design, which will very rarely be known at the planning stage, and the on-site specific conditions, which cannot be accurately predicted.

6.2.3 Tonality from wind turbines is generally caused by structural resonances in the mechanical parts of the turbine and thus is highly specific not only to the turbine model but the specific components used, including tower height. The exact model of turbine to be used at the site will be the result of a future tendering process prior to construction, which is only undertaken once consent is obtained, funding can be secured and often after a significant period of time has elapsed, meaning that the turbine market may have changed.

6.2.4 Amplitude modulation from wind turbines is a highly complex field and the largest research project on the subject[2] concluded that it was likely due to the interaction between operational characteristics of the turbine and site-specific factors, which is not possible to predict at planning stage. This may result in developers having to make precautionary allowances for the potential occurrence of SACs, which may be irrelevant in practice.

[2] Wind Turbine Amplitude Modulation: Research to Improve Understanding as to its Cause and Effect, Renewable UK, December 2013.

6.2.5 It is unclear if there is a requirement to consider LFN at planning stage. There is no agreed procedure provided in the draft guidelines for prediction of LFN at indoor locations for receptors near to a proposed development. The lack of a defined methodology could lead to variability in approach and inconsistencies in assessment of SACs.

6.2.6 A more practical way to control SACs is through the use of planning conditions, such as those proposed, but it will simply be impossible to evaluate meaningfully earlier in the planning stage. Imposing control through compliance with planning conditioned limits will provide a strong incentive for scheme developers and operators to prevent the onset of SACs.

6.2.7 Similarly, whilst general BAT considerations to minimise the occurrence of the SACs can be explained and described, a more specific assessment (even for a particular turbine model) will generally not be possible.

6.3 Measurement and assessment of SACs

6.3.1 The draft guidance does not detail the exact methods of measurement and assessment of SACs, rather it points to several other documents, however, in the sections describing the assessment of SACs, the draft guidelines do not make sufficiently clear that "false positives" should be eliminated from the analysis. Specifically:

- Audible tonality levels may be caused by a large number of sources other than wind farms such as motor engines, generators, electrical plant, cattle, sheep, bird calls, etc.;
- Although the AM methodology referenced is relatively robust, it can still appear to be triggered by other sources or even simple wind noise in a minority of cases.
- The methods referenced are relatively complex and require careful application and interpretation by experienced practitioners; and
- The method to assess LFN appears to require internal noise measurements (although that is not clear and there are no detailed requirements specified) and can therefore be affected and corrupted by a large number of sources within the building (human activity, music, radio, fridges etc.).

6.3.2 This is an issue as the Technical Appendix is stated to *"take precedence over* [the guidance referenced] *where any conflicts arise"* (p.170).

6.3.3 The nature and variability of wind farm noise, subject to weather conditions with critical conditions that may not occur for many days or weeks, means that meaningful attended noise measurements are generally impossible in practice. Rather, extended unattended measurements are required using automatic noise loggers. The resulting large datasets then require careful analysis to eliminate any corruption as described above.

6.3.4 The draft guidelines require LFN to be measured in the event of a complaint and there is a zero tolerance to LFN (see discussion in Section 3.7 above). There are also likely to be significant practical difficulties in undertaking measurements internally, particularly in terms of access for long-term measurements. It should be noted that the second NANR report details that:

"The complainant should be asked to indicate a position where they can hear the noise, preferably where they can actually hear it at the time of the interview. This information will be required to assist in choosing a position for the microphone. A suitable position should be

determined precisely (within a few centimetres) since sound levels in a room can vary strongly with position."

6.3.5 Wind farm noise compliance monitoring can often last a number of weeks, particularly where there is a need to record data for specific wind conditions. If a complaint is made in a resident's bedroom then an extended measurement may be required in that location; this would usually require the residents to vacate the room for the duration of the survey. As discussed in Section 8, in the context of the proposed permanent monitoring these difficulties are clearly magnified.

6.3.6 There is limited experience in the application of the proposed AM and tonality assessment methods, and associated penalties, and no scope exists within the draft guidelines for changing the approach prescribed. Although the IOA measurement and rating of AM is relatively robust, there are still some questions to be resolved in relation to the application of any associated penalties[3] It should be clarified if there is scope for changing these methods if updated guidance becomes available.

7 Cumulative noise

7.1.1 In a number of places (including pages 63, 163) the draft guidelines state that the RRNL applies to the cumulative effects of the proposed development along with other existing and approved developments. However, p.192 provides a suggested planning condition which applies the RRNL only to *"...the combined effects of the development hereby approved…"*. If the suggested condition were to be applied to a number of wind energy developments within an area, this could result in the requirement stated on pages 63 & 163 being broken. This point is mentioned at page 77.

7.1.2 Page 77 (bullet point 2) states that where an existing development has a noise limit as a condition of its planning permission, this should be the level assumed in the cumulative assessment of a proposed development. Section 5 of the IOA GPG states that this should be the starting point of a cumulative assessment, but allows for lower levels to be assumed where these can be justified with reference to a number of factors, such as the presence of 'controlling properties' or the existence of significant headroom between predicted levels and the applicable limits. This allows for robust cumulative assessments to be carried out whilst avoiding the sterilisation of areas, which may otherwise be suitable for wind energy development.

7.1.3 The GPG also recommends that limits applied to proposed developments are reduced to allow for the effects of existing wind turbines.

7.1.4 Page 77 (bullet point 2) also suggests that where no limit has been applied to an existing wind farm the appropriate level should be determined through monitoring and / or prediction. This introduces the contrary possibility that a lower level would be assumed for a wind farm with no planning conditions to control noise than would be the case if limits had been conditioned.

[3] Some discussion is set out in "Wind Turbine Noise Amplitude Modulation Penalty Considerations". Proceedings of the Institute of Acoustics, Vol. 40. Pt. 1. 2018.

7.1.5 In some cases, cumulative noise effects can be a more significant issue than those from individual developments and the draft guidelines should therefore provide additional guidance on this matter. It is suggested that this could be provided in Technical Appendix 2 (and on p.77) by making reference to the existing guidance referenced in Section 5.1.5 above.

8 Compliance monitoring

8.1 Scale

8.1.1 Overall the requirements are significantly more extensive than those seen for most wind turbine developments in Ireland and internationally. We have a number of technical concerns about whether the proposed compliance assessment approach would result in effective, efficient and relevant control of noise during operation. This topic was given extensive consideration at the time the ETSU-R-97 guidelines were formulated and the recommended approach is to undertake post-construction monitoring only in the event of specific complaints, due to the potential for access complications. We accept, however, that it would be feasible to measure at non-residential locations more routinely but doing so may not address the aims of the guidelines, which is to show compliance with RRNL at noise sensitive receptor locations.

8.1.2 Although some planning consents do require a single post-construction monitoring survey even in the absence of complaints, the requirement for permanent monitoring with quarterly reporting is challenging, even for large wind farm sites. As noted in the draft guidelines, measuring the levels with sufficient accuracy, even at night-time, can be difficult and once the variability associated with weather conditions etc. is reasonably controlled, there is no expectation that noise levels from the wind farm would change significantly unless the operational parameters of the turbines change. Therefore, the specification of yearly or repeat measurements may be unnecessary.

8.1.3 Where measurements at receptors are undertaken, wind farm shut downs may be required to determine the specific contribution of the wind farm being assessed (as at many receptors background noise will be the dominant noise source, particularly at higher wind speeds). The need for wind farm shut downs could be extensive and complex, particularly if there are a multiple wind farms that could influence the measured level at a property or if there is a requirement to consider the potential for false positives associated with the assessment of SACs.

8.1.4 The requirement for “yearly” monitoring and statements about “annualised background” may be interpreted by some practitioners as requiring averaging together of large datasets over one year of measurements or the calculation of L_{den} values (though we assume that the RRNL is not to be quantified as an L_{den} level). This could also result in lengthy assessments with a large volume of data, which may not necessarily assist authorities and residents in understanding the situation, and the volume of information could obscure the presence of key issues.

8.1.5 The inconvenience to residential neighbours of having noise-measurement equipment installed either outside or (more significantly) within their properties for long-term periods should also be considered. It may be difficult in some cases to obtain the necessary consent.

8.1.6 It would generally be more meaningful to undertake targeted measurements over a specific period of several weeks or months as long as a representative range of conditions is covered, either covering conditions relating to specific complaints or (in the absence of specific complaints) worst-case conditions (generally downwind from the turbines). Further guidance is provided in the IOA GPG Supplementary Guidance Note 5 (post completion measurements, July 2014) and either reference should be made to this guidance or specific guidelines provided.

8.1.7 It is noted that environmental monitoring is discussed in Section 7.9 of the draft guidelines which states:

"An agreed monitoring/management programme, funded by the developer, can provide reassurance for both the planning authority and any concerned third parties that these conditions are being observed in the day-to-day operation of the wind energy development, and that in the event of a breach, appropriate remedial action will be taken. Such a programme would be particularly relevant in the initial operating period of the development, within the first 2 years, possibly with provision for further monitoring if the problem persists."

8.1.8 Whilst this text is preceded by text which notes that "*Effective monitoring is necessary to provide evidence of compliance with planning conditions addressing issues such as noise limits*" it is unclear why a distinction is being made particularly given that noise emissions can be accurately predicted and that planning conditions can require detailed investigations in the event that complaints are received.

8.1.9 The inflexible requirement for measurements at a minimum of 4 properties may not be relevant for some sites in very sparsely populated areas where only 1 or 2 properties (or possibly no properties) are sufficiently close to allow or warrant operational and/or background measurements. Reporting noise compliance at survey locations that are in non-prevailing wind directions may not be feasible within the allowed timeframe.

8.1.10 The need to assess SACs requires more specialised equipment, and collection of large quantities of data such as audio recordings, which will be time-consuming and may be unnecessary if not focused on specific cases in which the likely presence of these characteristics is identified (through the nature of specific complaints made).

8.1.11 Section 5.7.7 of the draft guidelines appears to require measurements specifically at financially involved properties; however noise complaints are less likely[4] at these locations. It is stated in Section 5.7.7 that financially involved properties include locations "*where the wind energy development is developed as part of a community scheme or with community involvement through an equity share"*. The costs involved with such monitoring may discourage the development of community schemes and the need to consent to permanent monitoring may also mean that individuals choose not to take part in such schemes.

8.1.12 Requiring measurements to start within 4 weeks of commissioning of some turbines (as set out in Section 5.7.12 of the draft guidelines) means the monitoring may include the site operating only partially, which may lead to issues with SCADA data availability and would not provide an appropriate test against the RRNLs. Requiring reporting to be submitted within 3 months of first use of the development may not always allow sufficient time to

[4]Pedersen, E, van den Berg, F, Bakker, R & Bouma, J (2009). Response to noise from modern wind farms in The Netherlands. Journal of the Acoustical Society of America, 126 (2), 634-643.

undertake all of the required monitoring, analysis and reporting, and there would need to be scope to extend monitoring at the discretion of the LPA, for example if conditions to date were not suitable (see above comment in paragraph 8.1.9)).

8.2 "Immediate" mitigation

The draft guidelines explain that measurements of LFN may be mandated and reviewed by the Local Planning Authority by a practitioner of their choosing, and draft findings can then be used as a justification to require turbine shutdown without an opportunity for the operator to scrutinise these findings. Although the assessment should be undertaken by a "competent person", this is not precisely defined and may not necessarily include practitioners with previous experience of wind turbine noise assessments, or specific experience of analysis of SACs in particular. There is also some reference to what LPAs will be under obligation to do.

8.2.1 For example, regarding LFN:

"Having been notified by the planning authority of its interim determination, the relevant wind turbine(s) must be taken out of operation by the operator until such time as the operator has demonstrated to the satisfaction of the relevant planning authority that noise reduction measures have been completed and, any other steps that the authority requires have been taken to ensure compliance. The planning authority may then approve a testing programme to demonstrate compliance and return the turbine(s) to operational service, subject to which the turbines may be returned to operational service."

8.2.2 This is also problematic as *"the relevant wind turbines"* may be impossible to determine in practice: it is generally not possible to determine from the measurements (which show total noise levels) the particular turbines that are causing particular criteria to be exceeded or which specific turbines may be associated with the presence of specific features, without a complex testing procedure. Any measurement has associated uncertainties, and this should be recognised and accounted for in this context.

9 Miscellaneous points

9.1 Competent person requirement

9.1.1 A requirement for assessments to be undertaken by a competent person is welcomed, however the definition included in the glossary states:

"The competent person shall hold an appropriate qualification in acoustics, engineering, science or a related field along with a recognized professional qualification in accordance with the list of regulated professions in Schedule 1 of the European Union (Recognition of Professional Qualifications) Regulations 2017 (S.I. No. 8/2017) or those regulated by another EU Member State. The competent person shall also have a minimum of five years' experience with an appropriate combination of, expertise and knowledge of the latest and most appropriate scientific methodology and assessment procedures for the correct interpretation of acoustic data."

9.1.2 Schedule 1 does not list acoustician as a profession nor is there reference to membership of the Institute of Acoustics (IOA), as there is for MRTPI for planners, for example. We would request the definition is amended to include reference to the IOA.

9.2 Construction Noise

9.2.1 The draft guidelines make reference to British Standard BS 5228. BS 5228 provides a series of values that represent the thresholds for significant effects. On page 199 the draft guidelines state that:

9.2.2 "In the event of construction or decommissioning noise exceeding these thresholds, work will cease until appropriate mitigation measures are put into effect to reduce noise levels to these thresholds."

9.2.3 It should be noted however that the values in BS 5228 do not represent absolute thresholds which must not be breached.

9.2.4 In relation to baseline / compliance monitoring the draft guidelines state:

9.2.5 "The developer shall measure the background noise to include all routes, roads, lands and establish background noise before mobilization and during construction proposed monitoring methodology and frequency shall be specified in the CEMP."

9.2.6 The purpose of undertaking such measurements is unclear. Measurement of background noise levels at these locations is not normally necessary as assessments can instead consider either absolute levels or the change in traffic flow levels. If compliance measurements were to be required the scope would require further consideration, particularly if assessments undertaken at the planning stage had predicted that impacts would be negligible.

9.3 Air overpressure limits

9.3.1 Page 199 of the Draft Guidelines states:

"When blasting is required air overpressure from any required blasting shall not exceed a limit value of 125 dB(linear) max peak, with a 95% confidence limit when measured at the nearest noise sensitive location. No individual air overpressure value shall exceed the limit value by more than 5 dB(Linear)."

9.3.2 Air overpressure can be significantly affected by atmospheric conditions and as a result it is very difficult to predict air overpressure levels or determine where levels are likely to be at their highest. For every blast, air overpressure levels will vary depending upon conditions. As such it is rare to measure air-overpressure against a set of limits; rather, measures are adopted to minimise air overpressure through appropriate blast design. In this regard BS5228-2:2014+A1:2019 (BS5228) states:

"Although monitoring of air overpressure can be undertaken, due to the uncertainties with meteorological conditions, it is not possible to predict the location of the maximum air overpressure.

Additionally, pressure variations in the atmosphere due to windy conditions can mask the blast generated air overpressure levels. For these reasons it is not accepted practice to set

specific limits for air overpressure. In order to control air overpressure the best practical approach is to take measures to minimize its generation at source."

9.3.3 BS5228 refers to Scottish Planning Advice Note PAN 50 for additional guidance on the control of air overpressure from blasting. PAN 50 *'Controlling the environmental effects of surface mineral workings'*, states in paragraph 35:

"The levels of air overpressure and noise can be significantly affected by meteorological conditions. Areas in which levels are enhanced will generally be downwind. In addition noise can be affected by a range of weather conditions, e.g. temperature inversion or low cloud can concentrate / direct the effects to specific areas around the blast site. Once a blast is set up and the holes charged firing must proceed under safety regulations, irrespective of weather conditions. There is also a range of weather conditions which can increase overpressure effects. Because of these factors it will be difficult to define and enforce appropriate planning conditions." (emphasis added)

9.3.4 PAN 50 goes on to note in paragraph 38:

"Planning conditions should relate where practicable to performance i.e. they may set limits for ground vibration. However it is not advisable to do the same for overpressure as this would imply a degree of control by the operator that is not in fact possible, due to compounding meteorological effects… It should be noted that an operator will always be concerned with maximizing efficiency of a blast i.e. directing maximum energy into breaking or loosening rock and therefore minimizing lost energy i.e. overpressure."

10 Summary

10.1.1 We feel that significant amendments to the noise sections of the draft guidance are required. In particular we are concerned that the lack of clarity and some of the inconsistencies and contradictory text in parts of the guidelines could, in themselves, lead to future disputes or discussions, which would go against the aim of the document.

10.1.2 We recommend that following consideration of the points included in this document (and any other relevant consultation responses) that an updated draft of the noise text is circulated for further discussion. We would note that all of the key noise related documents that are referenced in the draft guidelines (ETSU-R-97, the IOA GPG and the IOA AMWG report) were subject to extensive discussion, peer review and / or consultation; given the complex technical nature of the subject matter we feel that a similar approach is appropriate in this case too.

10.1.3 It is essential that the final guidance is appropriate, clear and robust. We feel that the scale of changes required cannot be realised through one round of consultation and a one-hour meeting. We are also mindful that we, as a group, represent a small cross section of the acoustics community and would recommend that any further consultation seeks the input of the Institute of Acoustics to allow all members to provide feedback.

Appendix 1 - Holding response

20/12/2019

Holding response setting out concerns relating to the noise section of the Draft Revised Wind Energy Development Guidelines

This initial response has been produced by a group of acousticians as listed at the end of this document ('the group') in response to the release of the Draft Revised Wind Energy Development Guidelines ('the draft guidelines') on 12th December 2019. The group is made up of acousticians who act for wind farm developers, Councils, Government bodies and residents groups. It contains several of the authors / contributors to ETSU-R-97, the Institute of Acoustics Good Practice Guide ('the IOA GPG') and the Institute of Acoustics Amplitude Modulation Working Group, which are all referenced extensively in the draft guidelines.

All members of the group are members of the Institute of Acoustics and are either based in Ireland or have worked on wind farm projects in Ireland.

Wind farm noise is obviously a very technical subject and having reviewed the draft document section on noise, we are of the opinion that the guidance contains a number of technical errors, ambiguities and inconsistencies and that it requires further detailed review and amendment. In particular we are concerned that the lack of clarity and some of the inconsistencies in parts of the guidelines could, in themselves, lead to future disputes or discussions, which would go against the aim of the document.

We wish to be clear that the setting of suitable noise limits is a matter for Government policy, and it is only aspects of technical accuracy and clarity with which we, as a group, are concerned.

We are very concerned about the consultation timescales outlined in the document and would note that this is insufficient to allow a formal response to be collated by the Institute of Acoustics (IOA). We would therefore request that an extension is allowed to enable the IOA to undertake its own consultation with its members. Notwithstanding the request for an extension to the consultation timescales, the group will seek to provide feedback within the existing 10 week consultation period and are keen to work with Department of Housing, Planning and Local Government (DHPLG) / Department of Communications, Climate Action and Environment (DCCAE) to ensure that the final guidelines are clear and robust.

Given the technical nature of the issues raised we believe that interactive consultation is required and would like to request that a meeting / workshop is arranged between representatives of the group, the Irish Branch of the IoA, Local Authority representatives in the IoA, the relevant Government departments and the authors of the draft guidance.

Key areas that require further consideration include:

- Baseline noise assessment;
- Consideration of World Health Organisation guidelines;
- Application of noise limits;
- Cumulative assessment;
- Planning conditions and the way these should account for cumulative effects;
- Corrections to account for noise character; and
- Compliance monitoring.

We would welcome the opportunity to discuss this further with the representatives of DHPLG, DCCAE and authors of the noise section. The group are aiming to produce a consolidated set of more detailed technical feedback by the 27th of January and would be grateful if you could confirm whether you would be able to meet with representatives of the group after this date.

20/12/2019

This document has been agreed by the following individuals. Please note that the views expressed in this document are those of the individuals and not necessarily the organisations that they work for:

James Mackay, MIOA (TNEI).
Peer Reviewer of IoA GPG and GPG Supplementary Guidance Note Author.
Jim Singleton, MIOA (TNEI).
Michael Reid, MIOA (Arcus Consultancy Services Ltd).
Matthew Cand, MIOA (Hoare Lea).
Author of the IOA GPG and IOA AM Guidance documents.
Dr John Mahon, MIOA (Fehily Timoney & Company).
Dr Andy McKenzie, FIOA (Hayes Mckenzie Partnership).
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Chair of IoA Wind Turbine Noise Working Group, Author of the IOA GPG and IOA AM Guidance documents, Author of ETSU-R-97.
Dr Simon Jennings, AMIOA (Limerick City and County Council).
Dick Bowdler, FIOA (Wind Farm Noise Consultant).
Organiser of Biennial Wind Turbine Noise Conferences.
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Chair IoA Irish Branch.
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Chair of IoA Amplitude Modulation Working Group, Peer Reviewer of IoA GPG.

Appendix 2 - The draft guidance and WHO – RPS report "wind turbine noise analysis"

As we have emphasised, the setting of limits is a policy decision and not one that we, as a group, wish to comment on. However, in 2.1 of "Strategic Environmental Assessment Environmental Report" it says that "*The draft Guidelines have had regard to best international practice and seek to be consistent with World Health Organisation (WHO) Guidance in relation to noise emanating from wind turbines".* We consider that, in some respects, that is not the case or that, if it is, the reasons are not clear.

First in regard to the WHO noise guidance for wind turbines (Ref 1) the key recommendation states at 3.4, that "*For average noise exposure, the GDG conditionally recommends reducing noise levels produced by wind turbines below 45 dB L_{den}, as wind turbine noise above this level is associated with adverse health effects*". It is important in interpreting this to understand how it is derived. The methodology is set out at the bottom of page 81 of the WHO guidance and it is worth repeating the relevant part here:

"*Two publications containing descriptions of four individual studies were retrieved (Janssen et al., 2011; Kuwano et al., 2014). All four studies used measurements in the vicinity of the respondents' addresses; the noise exposure metrics used in the three original studies (Pedersen, 2011; Pedersen & Persson Waye, 2004; 2007) included in Janssen et al. (2011) were recalculated into L_{den}. The noise levels in the studies ranged from 29 dB to 56 dB. Different scales were used to assess annoyance, with slightly different definitions of "highly annoyed" and explicit reference to outdoor annoyance in the data used for the Janssen et al. (2011) curve. Construction of the ERFs provided in the two publications differed and they were therefore not further combined in a meta-analysis. Fig. 16 shows the %HA from the two publications. The 10% criterion for %HA is reached at around 45 dB L_{den} (where the two curves coincide)*."

The recommendation is based on the level as L_{den} at which 10% of people are highly annoyed (HA) and we can follow the procedure adopted by WHO in reaching its conclusion. In deriving the appropriate L_{den} level, WHO used four research projects: the two Swedish and the one Dutch surveys summarised in Ref 2 and the Japanese survey in Ref 3. The graph at Fig 16 of Ref 1 is made up of two parts. The thinner curves are identical to the lower set of curves (HA) in the right hand graph (outdoors) in Fig 1 of Ref 2. The thicker blue curve is taken directly from the blue curve in Fig 12 of Ref 3. According to WHO the 10%HA point is reached where the curves from the two papers cross "at around 45dB" though the actual figure is less than this. It can be seen from the right hand graph of Fig 1 of Ref 2 and, more accurately, from the last of the four equations in Section C of Ref 2, that 10% highly annoyed (HA) occurs at an L_{den} of 43.5dB.

We can also see from Ref 2 that the original relationship between annoyance and noise level in the three constituent studies was based on the downwind noise level at each property calculated at a wind speed of 8 m/s at a height of 10 m ("Downwind Level" - DL). This was converted in Ref 2 to L_{den} by the addition of 4.7 dB as shown in Paragraph B on p3747. In the case of Ref 3, the value used to convert to L_{den} (in fact to L_{dn} but the small difference appears to have been ignored) was an addition of 6 dB. It is not clear whether the original data are downwind levels or some sort of average.

So when we look at the WHO value of 45dB as a recommended L_{den} value, it should be noted that this is derived from DL in the case of the Ref 2 reports and from a similar but perhaps not identical measure in the case of Ref 3. Taking Ref 2 as an example a DL in the original survey methodology of 38.8dB resulted in 10%HA, which was translated by WHO into an L_{den} of 45 dB. Taking Ref 3 the equivalent value in the original survey would be 37.5 dB. In Ireland and some other countries the measure used is L_{A90} so the limit of 45dB L_{den} recommended by WHO is based on an L90 DL of 36.8dB – say around 37 dB from Ref 2. It is not clear whether the lower level of 35.5 from Ref 3 is a DL or not and so the more reliable level is an L_{A90} of 37 dB.

In summary, the WHO recommendation of 10%HA at 45 dB L_{den} is derived from the original data that shows 10%HA at a DL of around 37 dB. The uncertainties in the studies referenced should be borne in mind.

The Health Canada study (Ref 4) which post dated the deadline for consideration in the WHO report, broadly supports this conclusion and says: "*Consistent with Pedersen et al. (2009), the increase in WTN annoyance was clearly evident when moving from [30–35) dB to [35–40) dB, where the prevalence of WTN annoyance increased from 1% to 10%. This continued to increase to 13.7% for areas where WTN levels were [40–46] dB. The prevalence of WTN annoyance was higher outdoors, during the summer, and during evening and nighttime hours. Pedersen et al. (2009) also found that annoyance with WTN was greater outdoors compared to indoors*." The Pedersen report referred to (Ref 5) relates to the Netherlands study in Ref 2.

The RPS report accompanying the Draft Guidance seeks to demonstrate that the upper level proposed in the draft guidelines is consistent with WHO guidelines. It takes the level of 43 dB, adds 2 dB for the $L_{Aeq} – L_{A90}$ difference and a further 6.4 dB to convert to an L_{den} assuming turbines are running at full power and the property is downwind of the turbines all the time. This results in a value of 51.4 dB. It then argues, rightly and reasonably, that the noise level at a property will vary according to wind speed and direction and that the value of 51.4 dB is the maximum value. The report has analysed wind data and concludes that the "true" L_{den} (that is the L_{den} taking account of wind speed and direction variation) is between 7.1 and 9.4 dB less than 51.4. Just taking the worst case of 7.1 dB (which is the value for those closest to the turbines) and starting at the L_{A90} of 43 dB, the RPS report argues that the "true" L_{den} is 1.3 dB more (plus 8.4 minus 7.1) than the L_{A90} or 44.3 dB – within the WHO recommendation. Looking at it the other way round, the RPS report says that the L_{A90} DL is 1.3 dB less than the L_{den}.

This procedure hides the reality of the situation. The argument set out in the RPS report for converting the proposed level of 43 dB DL to L_{den} may be perfectly reasonable but without looking at the whole context it does not tell the whole story. What has happened here is that the research work used by WHO – or at least that in ref 2 – concluded that a DL of 37 dB measured as L_{A90} resulted in 10%HA. WHO converted this to a L_{den} of 45 dB and RPS converted this back again by a different method to a DL of 43.7 dB. So what started as a value of 37dB for 10%HA ended nearly 7 dB higher merely by translating the number to another parameter by one method and then back again by another. We do not suggest that anything devious has been done by anyone here, merely that the procedure is flawed.

Even if it is a policy decision to ignore the context argument set out above, the methodology in the RPS report is technically wrong. If we look at Table 5-2 we can see that the percentage of time when there are low wind speeds at evening or night has been calculated. However, the percentage of **time** has been applied to the number of decibels, which is technically incorrect. The percentage of time must, of course be applied to the time. Similarly, in Table 4-2, the percentage of **time** a property is up

wind is assumed to be 35% but then that percentage has been applied to the number of decibels difference between upwind and downwind and not to time. The same applies to Table 5-3.

Assuming RPS figures for percentage times are correct and looking just at the nearest locations, the calculation should be as follows:

So the "simple" L_{den} calculation for a turbine level of 43 dB, before allowance is made for wind direction, curtailment etc. is 51.4 dB. As described elsewhere in the RPS report, 2 dB is added to convert to Leq and 6.4 dB for evening and night penalties. The table below shows the breakdown.

It is assumed that during constraints and curtailments all the turbines are turned off. This seems to be implied at 4.4.1 of the RPS report. The upwind and downwind periods therefore exclude the curtailment and constraint periods. The basic level in the dB column is 40.3dB in downwind conditions (43 minus 2.7 for wind direction adjustment) and 38.3 in upwind conditions (43 minus 2.7 for wind direction and minus 2.0 for upwind correction near the source). The "Partial" column shows the partial dose for each time period making up the total L_{den}.

	Hrs	Weight	dB	Partial	Notes
Day	4.2	0	38.3	30.7	35% of time upwind
	7.8	0	40.3	35.4	Rest of Day
Evening	0.5	5	0	-	13.7% low wind, constrained or curtailed
	1.2	5	38.3	30.3	35% of remaining time upwind
	2.3	5	40.3	35.1	Rest of Day
Night	2.4	10	0	-	30.5% low wind, constrained or curtailed
	2.0	10	38.3	37.5	35% of remaining time upwind
	3.6	10	40.3	42.1	Rest of Day
L_{den}				46.9	Including +2dB for Leq

So, for the example dataset included in the RPS report, the calculated level does not comply with WHO recommendation of 45 dB.

It should be noted that the relationship between the DL level at a given receptor and the L_{den} level will be site specific and will be influenced by a number of factors including; the wind conditions at the wind farm site, the relative location of the receptor to the wind turbines (i.e. whether it is usually up wind or down wind of the turbines), the presence of other wind farms in different locations, the noise emission profile of the installed turbines (i.e. how noise varies with wind speed) and the level of curtailment that is in place. Accordingly, it is not possible to provide a simple conversion factor between DL levels and a resulting L_{den}.

References in Appendix

1. *Environmental Noise Guidelines for the European Region*. WHO 2018

2. Janssen SA, Vos H, Eisses AR, Pedersen E (2011). *A comparison between exposure–response relationships for wind turbine annoyance and annoyance due to other noise sources*. J Acoust Soc Am. 130(6):3746–53.

3. Kuwano S, Yano T, Kageyama T, Sueoka S, Tachibana H (2014). *Social survey on wind turbine noise in Japan*. Noise Control Eng J. 62(6):503–20.

4. Michaud at al.. "Exposure to wind turbine noise: Perceptual responses and reported health effects," J. Acoust. Soc. Am. 139(3), 1443–1454.

5. Pedersen et al. *Response to noise from modern wind farms in The Netherlands*. J. Acoust Soc. Am. 126(2), 634.