

2014)¹⁵ (BS 5228-2) for ground-borne vibration. These updated versions have therefore been adopted as the relevant versions upon which to base this assessment.

- 2.1.8 BS 5228-1 provides guidance on a range of considerations relating to construction noise including the legislative framework, general control measures, example methods for estimating construction noise levels and example criteria which may be considered when assessing impact magnitude. Similarly, BS 5228-2 provides general guidance on legislation, prediction, control and assessment criteria for construction vibration.

3. Scope and Methodology

3.1 Methodology for Assessing Construction Noise and vibration

- 3.1.1 Construction works include both moving sources and static sources. The moving sources normally comprise mobile construction plant and Heavy Goods Vehicles (HGVs). The static sources include construction plant temporarily placed at fixed locations and in some instances, noise arising from rock breaking activities where rock is to be worked through.
- 3.1.2 The analysis of construction noise has been undertaken in accordance with BS 5228-1 which provides methods for predicting construction noise levels on the basis of reference data for the emissions of typical construction plant and activities. These methods include for the calculation of construction traffic along access tracks and haul routes and also for construction activities at fixed locations such as the bases of turbines, site compounds or sub stations.
- 3.1.3 The BS 5228 calculated levels are then compared with absolute noise limits for temporary construction activities which are commonly regarded as providing an acceptable level of protection from the short-term noise levels associated with construction activities.
- 3.1.4 Separate consideration is also given to the possible noise impacts of construction related traffic passing to and from the Site along local surrounding roads. In considering potential noise levels associated with construction traffic movement on public roads, reference is made to the accepted UK prediction methodology provided by 'Calculation of Road Traffic Noise'¹⁶ (CRTN).
- 3.1.5 The nature of works and distances involved in the construction of a wind farm are such that the risk of non-negligible impacts relating to ground borne vibration are very low. Occasional momentary vibration can arise when heavy vehicles pass dwellings at very short separation distances, but again this is not sufficient to constitute a risk of moderate or major impacts. However, some activities associated with the Access Track works could generate vibration in proximity to dwellings and the potential vibration impacts will therefore be considered in this report.
- 3.1.6 No blasting for rock extraction from Borrow Pits (BP) would be undertaken (see Technical Appendix 2.2: Borrow pit Assessment), therefore, assessment of noise and vibration impact from blasting is not required.

3.2 Methodology for Assessing Wind Turbine Operational Noise

- 3.2.1 The ETSU-R-97 assessment procedure specifies that noise limits should be set relative to existing background noise levels at the nearest properties and that these limits should reflect the variation in both turbine source noise and background noise with wind speed. The wind speed range which should be considered is between the cut-in speed (the speed at which the turbines begin to operate)

¹⁵ BS 5228-2:2009-A:2014 'Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration'.

¹⁶ Calculation of Road Traffic Noise, HMSO Department of Transport, 1988.

for the turbines and 12 m/s (43.2 km/h), where all wind speeds are referenced to a ten metre measurement height (refer to Annex F – Wind speed Calculations for a discussion of how wind speeds are referenced to ten metre height).

- 3.2.2 Separate noise limits apply for the day-time and night-time. Day-time limits are chosen to protect a property's external amenity whilst outside their dwellings in garden areas and night-time limits are chosen to prevent sleep disturbance indoors. Absolute lower limits, different for day-time and night-time, are applied where the line of best-fit representation of the measured background noise levels equates to very low levels (< 30 dB(A) to 35 dB(A) for day-time, and < 43 dB(A) during the night).
- 3.2.3 The day-time noise limit is derived from background noise data measured during the 'quiet periods of the day' defined in ETSU-R-97: these comprise weekday evenings (18:00 to 23:00), Saturday afternoons and evenings (13:00 to 23:00) and all day and evening on Sundays (07:00 to 23:00). Multiple samples of ten-minute background noise levels using the $L_{A90,10min}$ measurement index are measured contiguously over a wide range of wind speed conditions (a definition of the $L_{A90,10min}$ index is given in Annex A). The measured noise levels are then plotted against the simultaneously measured wind speed data, and a 'best-fit' curve is fitted to the data to establish the background noise level as a function of wind speed. The ETSU-R-97 day-time noise limit is then set to the greater of either: a level 5 dB(A) above the best-fit curve to the background noise data over a 0-12 m/s wind speed range or a fixed level in the range 35 dB(A) to 40 dB(A). The precise choice of the fixed lower limit within the range 35 dB(A) to 40 dB(A) depends on a number of factors: the number of noise-affected properties, the likely duration and level of exposure and the consequences of the choice on the potential power generating capability of the wind farm.
- 3.2.4 ETSU-R-97 clearly indicates that the day-time limit is intended to lie within the range from 35 dB(A) to 40 dB(A). Therefore, one can conclude that there must be projects where 35 dB(A) is appropriate and conversely, projects where 40 dB(A) is appropriate. Within ETSU-R-97 there is a specific example: "A single wind turbine causing noise levels of 40 dB(A) at several nearby residences would have less planning merit (...) than 30 wind turbines also causing the same amount of noise at several nearby residences". Therefore, where a project offers relatively low power generating potential, the day-time limit should naturally tend towards the lower end of the range, unless the number of noise affected properties and the extent to which those properties would be affected by the higher noise levels is sufficiently low to justify noise limits tending towards the upper end of the range. Conversely, sites with relatively large power generating capacity should naturally justify limits towards the upper end of the range. The appropriate choice of value is considered subsequently in Section 5.6 in this Report.
- 3.2.5 The night-time noise limit is derived from background noise data measured during the night-time periods (23:00 to 07:00) with no differentiation being made between weekdays and weekends. The ten minute $L_{A90,10min}$ noise levels measured over these night-time periods are again plotted against the concurrent wind speed data and a 'best-fit' correlation is established. As with the day-time limit, the night-time noise limit is also set as the greater of a level 5 dB(A) above the best-fit background curve or a fixed level of 43 dB(A). This fixed lower night-time limit of 43 dB(A) was set in ETSU-R-97 on the basis of World Health Organization (WHO) guidance¹⁷ for the noise inside a bedroom and an assumed difference between outdoor and indoor noise levels with windows open. In the time since ETSU-R-97 was released, the WHO guidelines were revised to suggest a lower internal noise level, but conversely, a higher assumed difference between outdoor and indoor noise levels. Notwithstanding the WHO guideline revisions, the ETSU-R-97 limit remains consistent with current national planning policy guidance with respect to night-time noise levels. In addition, following revision of the night-time WHO criteria, ETSU-R-97 has been incorporated into planning guidance for

¹⁷ Environmental Health Criteria 12 – Noise. World Health Organisation, '980.

Wales, England and Scotland and at no point during this process was it felt necessary to revise the guidance within ETSU-R-97 to reflect the change in the WHO guideline internal levels. The advice contained within ETSU-R-97 remains a valid reference on which to continue to base the fixed limit at night.

- 3.2.6 The exception to the setting of both the day-time and night-time lower fixed limits occurs in instances where a property occupier has a financial involvement in the wind farm development. Where this is the case then the lower fixed portion of the noise limit at that property may be increased to 45 dB(A) during both the day-time and the night-time periods alike.
- 3.2.7 The noise limits defined in ETSU-R-97 relate to the total noise occurring at a dwelling due to the combined noise of all operational wind turbines. The assessment will therefore need to consider the combined operational noise of the Proposed Development with other wind farms in the area to be satisfied that the combined cumulative noise levels are within the relevant ETSU-R-97 criteria. ETSU-R-97 also requires that the baseline levels on which the noise limits are based do not include a contribution from any existing turbine noise, to prevent unreasonable cumulative increases.
- 3.2.8 To undertake the assessment of operational noise in accordance with the foregoing methodology the following steps are required:
- specify the number and locations of the wind turbines on all wind farms;
 - identify the locations of the nearest, or most noise sensitive, neighbours;
 - measure the background noise levels as a function of site wind speed at the nearest neighbours, or at least at a representative sample of the nearest neighbours;
 - determine the day-time and night-time noise limits from the measured background noise levels at the nearest neighbours;
 - specify the type and noise emission characteristics of the wind turbines;
 - calculate the noise immission levels due to the operation of the wind turbines as a function of site wind speed at the nearest neighbours; and
 - compare the calculated wind farm noise immission levels with the derived noise limits and assess in the light of planning requirements.
- 3.2.9 The foregoing steps, as applied to the Proposed Development, are set out subsequently in this assessment.
- 3.2.10 Note that in the above, and subsequently in this assessment, the term ‘noise emission’ relates to the sound power level actually radiated from each wind turbine, whereas the term ‘noise immission’ relates to the sound pressure level (the perceived noise) at any receptor location due to the combined operation of all wind turbines on the Proposed Development.
- 3.3 Methodology for Assessing Operational Noise – non-turbine sources
- 3.4 Noise from non-wind turbines sources associated with the Proposed Development, such as fixed plant associated with the substation compound and the battery storage compound, will be assessed using the BS 4142 standard. This standard provides a method for rating the potential impact of noise at noise-sensitive receptors (NSRs), such as residential dwellings, from fixed plant installations based on the background noise levels that prevail on a site. This is compared to a “rating level” of noise which is based on the predicted L_{Aeq} level with the potential addition of penalties to account for some characteristics of the sound which can increase the level of noise impact perceived by the receptors of the dwelling. The four acoustic features to be considered in the application of rating corrections are:
- Impulsivity: A correction of up to +9 dB can be applied for sound that is highly impulsive, considering both the rapidity and overall change in sound level. Subjectively this can be a

- penalty of +3 dB for impulsivity that’s just perceptible, +6 dB for clearly perceptible and +9 dB for highly perceptible.
 - Tonality: Sound ranging from non-tonal to prominently tonal can have a correction of up to +6 dB. Subjectively this can a +2 dB penalty for just perceptible tone, +4 dB for clearly perceptible, and +6 dB for highly perceptible.
 - Intermittency: Sound that has identifiable on/off conditions and is readily distinctive against the residual acoustic environment a +3 dB penalty can be applied.
 - Distinctiveness: Where the specific sound characteristics are neither tonal or impulsive but readily distinctive against the residual acoustic environment, a penalty of +3 dB can be applied (where no tonal or impulsive penalty have been applied).
- 3.4.1 BS 4142 advises on considering the context of the situation for the assessment: this requires consideration of factors such as the nature of the area and, particularly at night-time, and the absolute level of the specific noise considered. The impact magnitude is then determined on the basis of the difference between rating level and background, with consideration of these contextual factors:
- A difference of around +10 dB is likely to be an indication of a significant adverse impact, depending on context;
 - A difference of around +5 dB is likely to be an indication of an adverse impact, depending on context; and
 - A difference of +0 dB or less is an indication of the specific sound source having a low impact, depending on the context.
- 3.4.2 BS 4142 advises “Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant, than the margin by which the rating levels exceeds the background. This is especially true at night”. Therefore, the BS 4142 assessment accounts for impact based on absolute predicted and rating levels as well as margin over background. Typically, where this predicted level is below 30 dB(A) absolute level or 35 dB(A) rating level the noise impact is considered low.
- 3.5 Criteria – Construction Noise and vibration
- 3.5.1 BS 5228-1 indicates a number of factors are likely to affect the acceptability of construction noise including site location, existing ambient noise levels, duration of site operations, hours of work, attitude of the site operator and noise characteristics of the work being undertaken.
- 3.5.2 BS 5228-1 informative Annex E provides example criteria that may be used to consider the magnitude of any construction noise impacts. The criteria do not represent mandatory limits but rather a set of example approaches intended to reflect the type of methods commonly applied to construction noise. The example methods are presented as a range of possible approaches (both facade and free field noise levels, hourly and day-time averaged noise levels) according to the ambient noise characteristics of the area in question, the type of development under consideration, and the expected hours of construction activity. In broad terms, the example criteria are based on a set of fixed limit values which, if exceeded, may result in a large impact unless ambient noise levels (i.e. regularly occurring levels without construction) are sufficiently high to provide a degree of masking of construction noise.
- 3.5.3 Based on the range of guidance values set out in BS 5228 Annex E, and other reference criteria provided by the World Health Organization (WHO) and PAN50 Annex A: The Control of Noise at Surface Mineral Workings (1996) / Minerals Policy Statement 2, Annex 2: Noise / Minerals Technical Advice Note (Wales) 1: Aggregates (MTAN1), the following impact assessment scale has been derived. The values have been chosen in recognition of the relatively low ambient noise typically observed in rural environments. The presented criteria have been normalised to free-field day-time

noise levels occurring over a time period, T, equal to the duration of a working day on-site. BS 5228-1 Annex E provides varied definitions for the range of day-time working hours which can be grouped for equal consideration. The values presented in Table 1 have been chosen to relate to day-time hours from 07:00 to 19:00 on weekdays, and 07:00 to 13:00 on Saturdays.

Table 1 - Construction Noise and Vibration Impact Assessment Criteria

Impact	Noise Level dB LAeq,T		Description	Vibration Level (PPV) mm/s
	4 weeks or more	up to 4 weeks		
Major	> 75	> 85	Trigger level for noise insulation works, or costs thereof, as set out in E.4 of BS 5228-1.	> 10 mm/s
Moderate	> 65 ≤ 75	> 75 ≤ 85	Most stringent threshold values for potential significant effects given in Annex E of BS 5228-1 for example methods relevant to proposed development is exceeded.	> 1 mm/s and < 10 mm/s
Minor	> 55 ≤ 65	> 65 ≤ 75	Noise is likely to be audible, but unlikely to change behaviour. of BS 5228-1 thresholds not exceeded.	> 0.3 mm/s and < 1 mm/s
Negligible	≤ 55	≤ 65	At least 10 dB below the most stringent criteria provided in of BS 5228-1.	< 0.3 mm/s

The values presented above relate to noise impacts that occur during working hours from 07:00 to 19:00 on weekdays, and 07:00 to 13:00 on Saturdays. Alternate criteria would apply to noise impacts outside of these hours. For noise impacts 13:00 to 19:00 on Saturdays and 07:00 to 19:00 on Sundays the above thresholds would reduce by 10 dB(A) in each category. For noise impacts 19:00 to 07:00 on any day the above thresholds would reduce by 20 dB(A) in each category.

- 3.5.4

When considering the impact of short-term changes in traffic, associated with the construction activities, on existing roads in the vicinity of the Project, reference can be made to the criteria set out in the Design Manual for Roads and Bridges (DMRB¹⁸). A classification of magnitudes of changes in the predicted traffic noise level calculated using the CRTN methodology is set out: for short-term changes such as those associated with construction activities, changes of less than 1 dB(A) are considered negligible, 1 to 3 dB(A) is minor, 3 to 5 dB(A) moderate and changes of more than 5 dB(A) constitute a major impact. This classification can be considered in addition to the criteria of Table 1.
- 3.5.5

Section B.2 of BS 5228-2 provides advice on human response to vibration in terms of Peak Particle Velocity (PPV). For PPV below 0.3 mm/s, this would be unlikely to be perceptible for residential receptors and impacts would be negligible. Levels between 0.3 and 1 mm/s would correspond to minor impacts, and levels between 1 mm/s and 10 mm/s would represent a moderate impact as they could cause complaint but could be tolerated with prior explanations. Levels of 10 mm/s and above would represent a major impact (see Table 1). BS 5228-2 also advises that any risk of building damage, even for sensitive buildings, would only occur at much stronger vibration levels (above 10 mm/s), therefore these criteria would also provide protection in this regard.
- 3.6

Criteria - Operational Wind Turbine Noise
- 3.6.1

The acceptable limits for wind turbine operational noise are clearly defined in the ETSU-R-97 document, and these limits should not be breached. Consequently, the test applied to operational noise is whether or not the calculated wind farm noise immission levels at nearby noise sensitive properties lie below the noise limits derived in accordance with ETSU-R-97. Depending on the levels of background noise the satisfaction of the ETSU-R-97 derived limits can lead to a situation whereby, at some locations under some wind conditions and for a certain proportion of the time, the wind farm

18 The Highways Agency, Transport Scotland, Transport Wales and The Department for Regional Development (Northern Ireland) (2020). 'Design Manual for Roads and Bridges, LA 111 Noise and vibration', revision 2.

noise may be audible. However, noise levels at the properties in the vicinity of the Proposed Development will still be within levels considered acceptable under the ETSU-R-97 assessment method.

3.7 Criteria - Operational Non-Wind-Turbine Noise

- 3.7.1

The noise impact of non-turbine sources (substation and battery storage) will be considered in line with the method of BS 4142 which considers the difference between the source considered and background noise levels, taking into account contextual factors. In particular, a noise rating level not exceeding 35 dB would be considered low in absolute terms¹⁹. Table 2 outlines the resulting impact magnitude criteria.

Table 2 – Operational Noise Impact Criteria – non-wind turbine sources (excluding further contextual considerations)

Impact	Description
Major	Rating level exceeds background by 10 dB or more, and is greater than 35 dB(A)
Moderate	Rating level exceeds background by 5 dB to 10 dB, and is greater than 35 dB(A)
Minor	Rating level exceeds background, by a maximum of 5 dB, or is less than 35 dB(A)
Negligible	Rating level equal to, or less than, background or less than 25 dB(A)

3.8 Consultation

- 3.8.1

Prior to undertaking the background surveys, a summary of the likely proposed monitoring locations and the use of historical baseline data was forwarded to the Environmental Health Department of South Lanarkshire Council (SLC) for comment; no response was received to this email²⁰, however response from SLC on the scoping report was positive and in agreement with the proposed approach as well as the use of historical background data²¹. This consultation was based on a preliminary project layout which was of a larger extent than the currently proposed layout.
- 3.8.2

The installed noise monitoring position was selected to be representative for the purpose of an ETSU-R-97 assessment and in line with current good practice (when complemented by the historical data). The noise monitoring locations are shown on the plan in Annex B. Further information about the Snar Farm monitoring location, the equipment used and pictures of the survey position are presented in Annex C.

4. Baseline

4.1 General Description

- 4.1.1

The Proposed Development is located in an area of relatively low population density with a few scattered residential properties surrounding the Site. The nearest built-up area is Leadhills village 1 kilometres (km) to the south and Abington village 1.5 km to the north of the Site. There is also A74(M) motorway road along the east of the Site, which represents a dominant influence on the noise environment for properties located in its vicinity, such as those in the settlements of Crawford and

19 Consideration of the levels set out in Table A1 in Annex A highlights that an external level of 35 dB(A) would be considered low in the context of World Health Organisation guidelines for community noise, as internal levels within habitable spaces would be at least 10 dB lower even with an opened window.

20 Email sent: 10/04/2025 to kenny.joyes@southlanarkshire.gov.uk – subject: 1015801 - Ravengill Energy Park - EHO Consultation - Noise

21 Scoping response to ECU0006172 – Ravengill Energy Park (SLC Ref: P/25/0683) received on 17/06/2025