Chapter 17: Noise and Vibration - Contents

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17. Noise and Vibration

17.1 Executive Summary

17.1.0 A noise impact assessment has been completed for the purpose of describing the potential noise impacts and likely effects on environmental receptors associated with the Loch Kemp Pumped Storage Scheme (the Proposed Development). For this purpose, the closest residential properties to the Proposed Development have been identified as noise sensitive receptors and an ambient noise survey has been completed to establish the baseline ambient noise at these key receptor positions.

17.1.1 The potential noise impacts have been identified as noise from temporary construction works together with operational noise.

17.1.2 To estimate the noise levels resulting from temporary construction works a quantitative assessment has been completed, using predictive noise modelling, in line with guidance provided in BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise.

17.1.3 Predictions have been based on sound emission data applicable to the construction plant and equipment forecast for use on the main construction activities, including site establishment works, lower control works (inlet/outlet structures) and works associated with upgrade, or construction, of new access roads/tracks.

17.1.4 Noise during operation of the plant has also been predicted and is assessed in accordance with BS 4142:2014. Sound emission data for operating equipment including pump/turbines, motor/generators, transformers, and ancillary plant are obtained from data acquired on similar installations.

17.1.5 The following key mitigating measures have been identified for the purpose of controlling noise levels produced by the construction and operation of the Proposed Development:

- Construction noise and vibration would primarily be managed through a Construction Noise & Vibration Management Plan (CNVMP), which would be formally approved by The Highland Council (THC) as the Planning Authority, prior to construction work commencing. An outline of this is included in **Volume 4, Appendix 17.3: Outline Construction Noise and Vibration Management Plan**.
- The Caledonian Canal System would be used for the delivery of abnormal load components of Electrical and Mechanical (E&M) equipment associated with the lower reservoir works of the Proposed Development, removing a large number of potential Abnormal Indivisible Load (AIL) movements from the road network. . Furthermore, the use of a track to connect the lower reservoir works area to the upper reservoir and dams, provides an opportunity to supplement rock quarried within the upper reservoir, with suitable tunnel spoil from the underground works, for dam construction.
- A temporary 2 m high timber acoustic barrier, 500 m long, would be installed to reduce noise to Braeholm (Noise Sensitive Receptor (NSR) 4) and other properties in Easter Drummond, from vehicle movements along the site access road.

17.1.6 The residual effects of impacts associated with the Proposed Development, with the mitigation measures included in the scheme, are summarised as follows:

- The increased noise from construction traffic associated with the development, travelling on the public road network will be <1 dB and would have a negligible magnitude of impact. **The significance of effect is predicted to be slight (not significant).**
- For the short-term construction of access tracks passing NSRs, the noise at the closest receptors, NSR 3 (Dell House) and NSR 4 (Braeholm) will be a medium magnitude of impact and a moderate significance of effect. Because of the very short duration of the noise (a few days only) this is considered **not to be a significant effect**.
- For the long-term construction phases during the daytime, the noise impacts would be low or very low and the vibration impacts also low. **The significance of effect is predicted to be slight (not significant)**.
- Where construction continues overnight (tunnelling works) the noise impacts would be very low and the vibration impacts would also be low. **The significance of effects is predicted to be slight in each instance (not significant).**
- Once into operation, the Proposed Development residual noise and vibration impacts would be low and the **significance of effect is predicted to be slight (not significant).**

17.1.7 The residual cumulative effects of the Proposed Development and other consented developments, can be summarised as follows:

- The cumulative assessment of road traffic noise during construction of the Proposed Development and other consented developments, at one road segment B852 (Bailebeag loc 3) is predicted to be **moderate significance of effect (significant).** This level of effect is wholly due to construction vehicles including Heavy Goods Vehicles (HGVs) associated with the Red John project. It should be noted that no HGVs associated with the Proposed Development at Loch Kemp would be using this road, only cars and other LGVs.
- The cumulative assessment of construction work from sources located on the site and from other consented developments concludes that the noise and vibration impacts would be low and the **significance of effects is predicted to be slight (not significant).**
- During operation of the Proposed Development, accounting for the additional effect of other already consented developments, the cumulative noise and vibration impacts would be low and the significance of effect **is predicted to be slight (not significant).**

17.2 Introduction

17.2.0 This Chapter considers the potential noise and vibration effects on environmental receptors, including cumulative effects, of the Proposed Development during construction and operation. In this case the sensitive receptors are the residential properties located closest to each aspect of the scheme. As described in **Chapter 3: Description of Development**, with proper maintenance the Proposed Development should remain functional indefinitely. If the project were to be decommissioned, it is anticipated that the potential noise and vibration effects would be equal to those during the construction period. As such, a separate assessment of potential decommissioning noise and vibration effects is not included in this Chapter. Where likely significant effects are predicted during construction and operation, appropriate mitigation measures are proposed, and the residual effects assessed.

17.2.1 This assessment has been carried out by Spectrum Acoustic Consultants Limited. A table presenting relevant qualifications and experience of key staff involved in the preparation of this Chapter is included in **Appendix 4.1: EIA Team,** contained within **Volume 4** of this Environmental Impact Assessment (EIA) Report.

17.2.2 The noise emission that may be generated by the Proposed Development has been assessed in terms of the potential noise impact upon the nearest residential receptors, with consideration being given to whether the resulting effects would be 'significant'. In general terms this requires consideration of changes to, or increases in, environmental noise levels resulting from the Proposed Development.

17.2.3 To establish the current baseline noise level, the assessment presents the results of an ambient noise survey, comprising sampled attended and observed measurements made over a period of 2 days and nights, at each of the noise sensitive receptor locations identified as being near to the proposed development site.

17.2.4 The potential impact and likely effects of construction noise have been assessed by using predicted sound levels and measured ambient sound levels, to evaluate the resulting noise impact. This recognises the advice and guidance provided in the Scottish Government Technical Advice Note1 (TAN), which cites BS 5228-1, as providing the relevant guidance and code of practice relating to construction noise and BS 5228-2 as the relevant guidance relating to construction vibration.

17.2.5 The potential impact and likely effects of operating noise have been assessed by using predicted noise levels and comparing these with measured background sound noise levels, to evaluate the resulting noise impact. This recognises the advice and guidance provided in the Scottish Government Technical Advice Note1 (TAN), which cites BS 4142 being the relevant Standard for operating noise.

17.3 Scope of Assessment

Study Area

17.3.0 The key components of the Proposed Development are situated on land between Loch Ness and the village of Whitebridge, comprising two main areas of work: the upper reservoir (Loch Kemp) works and dams; and the lower reservoir (Loch Ness) works and powerhouse building, linked by a series of underground tunnels and an access track.

17.3.1 The upper reservoir works are located on high ground around Loch Kemp and are approximately 350 m from the closest noise sensitive receptor (NSR) (NSR 3: Dell House).

17.3.2 The lower reservoir works, including the powerhouse building, are located on the east shore of Loch Ness. The site of these works is approximately 2.1 km from the nearest existing NSR (NSR 1: Home Farm) located across Loch Ness immediately south side of the A82 and just outside the village of Invermoriston. Further along the loch shore to the north are additional existing noise sensitive receptors (NSR 2: Alltsigh Cottages) some 2.5 km from the powerhouse platform, quayside and pier area. Between these two receptors is land recently consented for a single residential property (NSR 5: Consented residential) some 1.2 km from the powerhouse platform and immediately across Loch Ness.

17.3.3 Vehicle access to the site and works would be via a single entry-point on the B862 just south of the village of Whitebridge. There is only one property set back along this track (160m) and is identified as a noise sensitive receptor (NSR 4: Braeholm).

17.3.4 The study area encompasses the area over which all desk-based and field data were gathered to inform the assessment presented in this Chapter. This comprises the area that includes the properties identified above as being closest to the lower and upper reservoir works, site establishment works and associated access roads/tracks. The positions of the NSRs are described in **Table 17.8: Description of Noise Sensitive Receptor Positions** and illustrated on **Volume 2, Figure 17.1 Noise Sensitive Receptors (NSRs) and Noise Monitoring Locations (NMLs).**

Consultation Responses

17.3.5 To inform the scope of the assessment for the Proposed Development, consultation was undertaken with statutory and non-statutory bodies. **Table 17.1: Consultation Responses** summarises the scoping and consultation responses relevant to the Noise and Vibration Assessment and provides information on where and/or how points raised have been addressed in this assessment.

17.3.6 Full details on the consultation responses and scoping opinion can be reviewed in **Chapter 5: Scoping and Consultation**, and associated appendices.

Table 17.1 Consultation Responses

Consultee	Consultation Type	Date	Issue Raised	Response/Action Taken/Section
The Highland Council	Pre-application advice	8 June 2022	CONSTRUCTION NOISE Planning conditions are not used to control the impact of construction noise as similar powers are available to the Local Authority under Section 60 of the Control of Pollution Act 1974. Generally, people are tolerant of construction noise during typical working hours which are taken to be 8am to 7pm Monday to Friday and 8am to 1pm on Saturdays. Works for which noise is inaudible at the curtilage of any noise sensitive property could still be carried out out-with these times. If the applicant intends to undertake noisy work out-with the aforementioned times, they will be required to submit a detailed construction noise assessment for the written approval of the planning authority. Regardless of whether a construction noise assessment is required, it is expected that the developer/contractor will employ the best practicable means to reduce the impact of noise from construction activities. The applicant will be required to submit a scheme demonstrating how this will be implemented. Particular attention should be given to the use of tonal reversing alarms and ground compaction plant which are often the most intrusive noise generating elements of a large construction project	Construction activity outside of normal working hours is proposed to be undertaken associated with tunnelling. A construction noise assessment has been undertaken to cover out of hours work (see **paragraph 17.8.9**). However, a formal construction noise assessment has also been undertaken for normal daytime hours activity, for each phase of the project. (see **paragraph 17.8.2**). This quantifies the levels to be expected at each noise sensitive receptor and assesses these against appropriate noise criteria referenced within BS 5228-1. An outline Noise and Vibration Management Plan is included with this chapter (see **Volume 4, Appendix 17.3: Outline Construction Noise and Vibration Management Plan**) which adopts the need for best practical means for reducing construction noise. This includes the particular point of maximising the use of broad band reversing sounders on moving vehicles rather than traditional tonal devices which can be audible over large distances.
The Highland Council	Pre-application advice	8 June 2022	OPERATIONAL NOISE The information submitted suggests that operational noise or vibration will not be a significant issue however, a noise impact assessment will require to be submitted to demonstrate that.	An assessment of operational noise has been undertaken and is included in this chapter (see **paragraph 17.8.46**). Relevant Standards used and also the baseline noise monitoring locations, and method and duration of data acquisition, were agreed with THC Environmental Health Officer (EHO) prior to

Consultee	Consultation Type	Date	Issue Raised	Response/Action Taken/Section
			A survey of current ambient (LAeq) and background (LA90) noise levels at appropriate locations neighbouring the proposed site is required. Relevant standards and monitoring locations must be agreed beforehand with the Council's Environmental Health Officer.	undertaking the noise survey. See **Chapter 5: Scoping and Consultation** for further details.
Scottish Government ECU and The Highland Council	Scoping Opinion	21 October 2022	Para 3.45 Operational Noise. The applicant will be required to submit a noise assessment with regard to the operational phase of the development. The assessment should be carried out in accordance with good practice	An operational noise assessment is included in this chapter (see **paragraph 17.8.46**).
Scottish Government ECU and The Highland Council	Scoping opinion	21 October 2022	Para 3.46. Cumulative noise. The noise assessment must take into account the potential cumulative effect from any other existing or consented. Where applications run concurrently, developers and consultants are advised to consider adopting a joint approach with regard to noise assessments. The noise assessment must take into account predicted and consented levels from such developments. The applicant should agree appropriate limits with the THC EHO.	The potential cumulative effect of the Proposed Development along with other developments have been considered in this chapter (see **paragraph 17.8.56**). The methodology adopted in this chapter has been described within the scoping report. It is assumed that other developments in the area would use a similar or equivalent methodology, also approved by the THC EHO. Expected noise levels from other developments are considered qualitatively within this chapter (see **paragraph 17.8.56**). Assessment methodologies and documents have been agreed with the THC EHO and these include appropriate and recognised thresholds for significant and adverse effects, along with typical criteria generally considered acceptable. Specific criteria beyond these have not been discussed (yet) with the THC EHO.

Consultee	Consultation Type	Date	Issue Raised	Response/Action Taken/Section
Scottish Government ECU and The Highland Council	Scoping opinion	21 October 2022	Para 3.47 Cumulative noise. The assessment should include a map showing developments which may have a cumulative impact and all noise sensitive properties including any for which a financial involvement relaxation is being claimed.	**Volume 2, Figure 1.2: Site Context** shows the location of other developments considered within the Noise and Vibration cumulative effects assessment. However, a risk-based approach has been used in consideration to most cumulative noise impacts. Where there is for example a very low risk of a cumulative noise effect, then a simple qualitative approach, is considered sufficient. For example, the 1,500 MW Coire Glas pumped storage scheme is identified as a project to be evaluated. However, it is 26 km from the Proposed Development site at Loch Kemp, and this distance is considered alone to be sufficient to ensure there will be no cumulative effects for noise and vibration. There is however a higher risk in relation to temporary increases in road traffic noise from public roads, and this aspect is considered in more detail within the chapter (see **paragraph 17.10.27**).
Scottish Government ECU and The Highland Council	Scoping opinion	21 October 2022	Para 3.48 Noise Exposure. When assessing the cumulative impact, consideration must be given to any increase in exposure time. Regardless of whether cumulative levels can meet relevant criteria, if a noise sensitive property subsequently becomes affected by noise from more than one direction this could result in a significant loss of respite.	The metric Laeq,T applies over a period of time T which is typically 1 hour during daytime. If a sound is present for only part of an hour and a second source is added also with a short duration, the metric Laeq,T will sum these two sounds numerically correctly reflecting any increase in exposure time. Noise from different directions may affect different residential facades, however in many cases they may affect one façade, such that the cumulative effect is additive. Assessments in this chapter do assume that sources of noise from different directions are fully additive (independent of the dwellings influence), in order for the worst case scenario to be considered

Consultee	Consultation Type	Date	Issue Raised	Response/Action Taken/Section
Scottish Government ECU and The Highland Council	Scoping opinion	21 October 2022	Para 3.49 – 3.51 Background Noise Measurements. If background noise surveys are required, these should be undertaken in accordance with good practice guidance. It is recommended that monitoring locations be agreed with the Council's Environmental Health Officer. Where a monitoring location is to be used as a proxy location for another property, particular care must be taken to ensure it is not affected by other noise sources such as boiler flues, wind chimes, etc. which are not present at that other property. Difficulties can arise where a location is already subject to noise from an existing development. It is recommended that the developer's noise consultant liaises with Environmental Health at an early stage to discuss any issues regarding the proposed methodology	Background noise survey duration, methodology, and measurement positions were submitted to THC prior to the survey. THC EHO then formally responded. See **Chapter 5: Scoping and Consultation** for further details. Care was taken to ensure proxy measurement locations were not subjected to localised sources of noise at the proxy location.
Scottish Government ECU and The Highland Council	Scoping opinion	21 October 2022	Para 3.52. Construction Noise and Vibration. Given the location, construction noise and vibration may be an issue at sensitive properties. Further, consideration will need to be given to construction traffic and a construction noise assessment will be required alongside the application	A construction noise and vibration assessment has been undertaken within this chapter. (see **paragraphs 17.8.1 and 17.8.21**). The noise from moving construction traffic along tracks on the site, including the access road, has been assessed. Noise from construction traffic (HGVs/LGVs/cars) travelling on public roads has also been assessed (see **paragraph 17.8.36**). This includes a cumulative effects assessment including construction phases of other developments. (see **paragraphs 17.8.56** and **17.10.20**)

Consultee	Consultation Type	Date	Issue Raised	Response/Action Taken/Section
Scottish Government ECU and The Highland Council	Scoping opinion	21 October 2022	Para 3.53 Construction Noise and Vibration. Planning conditions are not used to control the impact of construction noise as similar powers are available to the Local Authority under Section 60 of the Control of Pollution Act 1974. However, where there is potential for disturbance from construction noise the application will need to include a noise assessment. A construction noise assessment will be required in the following circumstances: • Where it is proposed to undertake work which is audible at the curtilage of any noise sensitive receptor, out with the hours Mon-Fri 8am to 7pm; Sat 8am to 1pm; or • Where noise levels during the above periods are likely to exceed 75dB(A) for short-term works or 55dB(A) for long-term works. Both measurements to be taken as a 1hr LAeq at the curtilage of any noise sensitive receptor. (Generally, long-term work is taken to be more than 6 months).	It is expected that some construction noise will be audible during evening and night periods. A construction noise assessment for night has therefore been included in this chapter. (see **paragraph 17.8.9** and **Plate 17.4**) In order to be able to establish whether daytime construction levels exceed 75 dB(A) for short-term works or 55 dB(A) for long-term works, it has been necessary to undertake a prediction and this is included within this chapter. In addition, the predicted levels are then also assessed against BS 5228-1 criteria.
Scottish Government ECU and The Highland Council	Scoping opinion	21 October 2022	Para 3.54 Construction noise and vibration. If an assessment is submitted it should be carried out in accordance with BS 5228-1:2009 "Code of practice for noise and vibration control on construction and open sites – Part 1: Noise". Details of any mitigation measures should be provided including proposed hours of operation.	The construction noise assessments included within this chapter have been undertaken in accordance with BS 5228-1. Hours of proposed construction activity are included in **paragraph 17.8.8**
Scottish Government ECU and The Highland Council	Scoping opinion	21 October 2022	Para 3.55. Regardless of whether a construction noise assessment is required, it is expected that the developer/contractor will employ the best practicable means to reduce the impact of noise from construction activities. Attention should be given to construction traffic and the use of tonal reversing alarms.	Best practical means as required in BS 5228-1 will be employed as described within this Standard, and are included within the outline Construction Noise and Vibration Management Plan (see **Volume 4, Appendix 17.3: Outline Construction Noise and Vibration Management Plan**).

Issues Scoped Out of Assessment

17.3.7 There are no aspects of potential noise and vibration impact that have been scoped out of this assessment.

17.4 Legislation, Policy and Guidance

Legislative Context

17.4.0 The following legislation has been considered in the assessment:

- The Environmental Noise (Scotland) Regulations 2006;
- Environmental Protection Act 1990; and
- The Control of Pollution Act 1974 (in reference local authority's powers to control noise from construction sites).

Policy Context

17.4.1 The following policy has been considered in the assessment:

- PAN 1/2011. The Scottish Government Planning Advice Note PAN 1/2011 (March 2011) provides advice on the role of the planning system in helping to prevent and limit the adverse effects of noise. The PAN promotes the principles of good acoustic design and a sensitive approach to the location of new development. In particular it identifies the following issues that may be relevant when considering noise issues during the preparation of a development plan:
- Avoidance of significant adverse noise impacts from new developments;
- Applying noise impact criteria reasonably;
- Use of mitigation measures to manage noise impacts; and
- Protection of quiet areas, and avoidance of development significantly adversely affecting Noise Management Areas.

Technical Guidance

17.4.2 The following technical guidance has been considered in the assessment:

- Information and advice on noise impact assessment (NIA) methods is provided in the associated Technical Advice Note (TAN): Assessment of Noise (2011). It includes details of the legislation, technical standards and codes of practice for specific noise issues. Whilst this TAN acknowledges that it does not offer prescriptive guidance on noise assessment, nor should it be considered exhaustive in extent, the methodology adopted for this assessment takes account of this guidance in identifying and evaluating the key noise impacts of the Proposed Development for the purpose of informing the planning decision process.

17.5 Methodology

Noise and Vibration Impacts Assessed

17.5.0 A range of noise and vibration impacts are assessed. These include:

- Construction noise;
- Construction vibration;
- Construction air overpressure (from blasting);
- Road traffic noise during construction (on public roads); and
- Operating noise.

17.5.1 Each of the above listed types of impact requires a different assessment methodology to be adopted. Each has some element of fieldwork and/or desk calculations. Assumptions and limitations are considered with each section.

17.5.2 The approach for each type of impact is informed by the key stages of an assessment methodology indicated in paras 2.9-2.14 of TAN 1/2011 but in this instance comprises:

- Identification of NSRs and rating of sensitivity;
- Establishing the current (baseline) ambient noise level at NSRs;
- Quantitative assessment to determine (by prediction) the magnitude of each of the identified main potential impacts;
- Qualitative assessment, to allow consideration of other (lesser) potential impacts where a more detailed predictive-based assessment is considered impracticable, or unnecessary; and
- Evaluation of the significance of effects through the relationship of the receptor's sensitivity and the magnitude and duration of impacts.

Construction Noise Criteria

17.5.3 Noise from construction related works is assessed differently to noise from permanent industrial installations, as it is recognised that construction noise is an inevitable by-product of required works and that the construction works represent a temporary operation.

17.5.4 The Scottish Government TAN, states that for Environmental Impact Assessments (EIA) and for planning purposes BS 5228: 2009 (Parts 1 and 2) are applicable, respectively, as the relevant codes of practice for noise and vibration. Part 1 of the code of practice incorporates the 2005 and 2006 Defra updates on construction plant noise and provides noise level and exposure matrices that have been used on major infrastructure projects across the UK.

17.5.5 BS 5228-1 provides the relevant advice on assessing and predicting noise from construction works. The Standard additionally provides information on construction noise levels from various plant and construction operations and provides recommendations on procedures and mitigation that can be adopted to reduce the impact of construction noise.

17.5.6 Annex E 'Significance of noise effects' of BS 5228-1, provides example criteria for the assessment of potential significance of noise effects. However, a pragmatic approach for assessing the noise effects

of construction works is advised, with guidance applying to projects of significant size. The advice for lesser projects is that the effects of construction noise may not need to be assessed, or may only require a general consideration of noise effects, for example, to advise on the appropriate actions that might need to be considered to minimise effects.

17.5.7 For the purposes of determining the potential significance of noise effects BS 5228-1 provides two main approaches, the first based on fixed noise limits and the second based on ambient noise change for which that given in E.3.3 (2-5dBA change method) is considered the most appropriate.

17.5.8 The approach of considering ambient noise change is also used in The Scottish Government TAN: 'Assessment of Noise'.

17.5.9 Construction noise is deemed to produce a potential significant effect if the total noise (construction noise plus pre-construction ambient noise) exceeds the pre-construction ambient noise by 5dB, or more, subject to lower cut-off values of LAeq,T 65dB, 55dB and 45dB from construction noise alone, for the daytime, evening and night-time periods, respectively; and a duration of one month or more.

17.5.10 It should however be noted that construction activities of less than one month duration cannot be classified as potentially significant at these cut-off values; the implication being that higher cut-off values would apply in such cases of short-term noise

17.5.11 BS 5228-1 advises in section E.4, the trigger levels for noise insulation eligibility. Although it covers short-term noise, even this has to be for a period of at least 10 days in 15 consecutive days. Under these circumstances the trigger level would be typically Laeq,T 75 dB over the daytime period 08:00-18:00.

17.5.12 However, during the short-term activity of upgrading access tracks, the daytime noise at levels at the nearest NSRs will likely arise for only 2-3 days, as the track construction equipment moves past the property, so even at levels of Laeq,T of 75dB, such a brief exposure would not be sufficient to meet this short-term threshold. Nevertheless, it remains a useful point of reference for short-term noise levels.

17.5.13 BS 5228-1 also considers the opposite situation of long-terms works, citing by example large scale and long-term earth moving activities (Annex E5). It suggests a limit of Laeq,1hour 55 dB is adopted during daytime for these types of activities, but only where the works are likely to occur for a period in excess of 6 months. This limit would be relevant in the case of this proposed development where the duration of large-scale earth and rock moving activity is in excess of 6 months.

17.5.14 BS 5228-1 does not provide a scale grading magnitude of noise impacts, however, the BS 5228 defined noise effect criteria of 5dB noise change, subject to lower cut-off values being exceeded, can be used to develop a classification in accordance with the low/medium/high descriptors in **Table 17.3: Magnitude of construction noise impacts, including 5228-1 defined threshold of potential significant effects for long-term activities in excess of 6 months** . In this example the lower cut off value for the daytime period (LAeq,T 55dB) has been used reflecting guidance on large scale and long-term earth moving. For the evening and night time periods this would be substituted for 55dB and 45dB, respectively as advised within the Standard for these periods.

Table 17.2: Magnitude of construction noise impacts, including 5228-1 defined threshold of potential significant effects for long-term activities in excess of 6 months

Change in ambient noise level ($L_{Aeq,T}$) and lower cut-off value for CNL (daytime)	Magnitude of Impact	BS 5228-1 defined Noise Effects
Noise change 0dB	No change	Not significant
Noise change <=1dB	Very low	Not significant
Noise change <=5dB	Low	Not significant
Noise change >=5dB and CNL <= 55dB	Medium	Not significant
Noise change >=5dB and CNL >55dB	High	Potentially significant

17.5.15 BS 5228 does not include a sensitivity scale for different categories of receptor, instead stating that the evaluation criteria are generally applicable to the following resources, which in accordance with Table 2.1 (of the TAN) are considered to have equal high sensitivity to noise:

- Residential buildings
- Hotels and hostels
- Buildings in religious use
- Buildings in educational use, and
- Buildings in health and/or community use

17.5.16 All residential NSRs considered in these assessments have a high sensitivity.

17.5.17 Where the magnitude of impacts are high, there is potential for a significant effect to arise. Where the magnitude of impacts are medium, low or very low, the effects are not significant.

Construction Noise Criteria - Assumptions and Limitations

17.5.18 Construction activities at different locations across the site are assumed to occur simultaneously which will give a worst-case, but more robust, assessment.

17.5.19 It is assumed that use of construction equipment will be broadly as recommended by manufacturers so that noise levels generated will be reasonably represented by generic data published within BS 5228-1.

17.5.20 Construction equipment will be assumed to be suitably maintained and operation is in accordance with BS 5228-1, and that best practical means will be adopted for noise mitigation and this will include extensive use of broad band rather than narrow band reversing sounders on moving vehicles.

17.5.21 It is assumed that where there are likely to be potential noise impacts from particular events that residents are formally warned in advance of the reasons for this and the duration of the events.

Construction Ground Vibration Criteria

17.5.22 Guidance on potential effects of vibration levels is provided in Annex B of BS 5228-2, with Tables B.1 and B.2 of the Standard providing, respectively, guide values for human response and cosmetic damage to buildings. The guidance is summarised in **Table 17.3: Effects of Vibration, taken from BS 5228-2**.

Table 17.3: Effects of Vibration, taken from BS 5228-2

Effect on people/building	Vibration level Peak Particle Velocity (mms^{-1})
Vibration might be just perceptible in the most sensitive situations and at most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.	0.14
Vibration might be just perceptible in residential environments.	0.3
It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.	1.0
Vibration is likely to be intolerable for any more than a very brief exposure to this level.	10.0
Guide values to avoid cosmetic damage to buildings – Residential buildings.	15.0 at 4Hz increasing to 20.0 at 15Hz increasing to 50.0 at 40Hz and above
Guide values to avoid cosmetic damage to buildings – Industrial buildings.	50.0 at 4Hz and above

17.5.23 Note c) to Table B.1 of BS 5228-2 states that single, or infrequent occurrences at the levels indicated in Table 17.3 would not necessarily correspond to the stated effect, in every case.

17.5.24 In line with the above guidance, it is considered that assuming appropriate warnings are provided to residents, vibration levels of below 1.0 mms-1 would be tolerated and therefore would have a negligible adverse impact. Some degree of adverse impact would occur when vibration (either continuous, or for frequent periods) exceeds Peak Particle Velocity (PPV) 1.0 mms-1.

17.5.25 Whilst the table does not provide guidance as to the potential different effects within the PPV range 1–10 mms-1 the magnitude of adverse impact would likely increase from small (1-3mms-1), to medium (3-7 mms-1) to large (7-10 mms-1).

17.5.26 At PPV levels above 10 mms-1, the more usual concern is potential building damage and commonly a PPV limit is set at this level to ensure the PPV 15 mms-1 threshold for cosmetic damage is adequately protected.

Construction Ground Vibration Criteria -Assumptions and Limitations

17.5.27 It is assumed that where there are likely to be potential vibration impact at NSRs relating to low level vibration events, residents are formally warned in advance of the reasons and the duration of these events.

Construction Air Overpressure Criteria

17.5.28 Annex G of BS 5228-2 provides information on blast generated air overpressure, which can produce airborne pressure waves at both audible (above 20Hz) and inaudible (below 20Hz) frequencies.

17.5.29 The Standard states that there is no known evidence of air overpressure causing structural damage to buildings, however, it is noted that a poorly mounted pre-stressed window might crack at 150dB (Lin), with most windows cracking at 170dB (Lin). This would suggest avoidance of levels within this range.

Construction Air Overpressure Criteria - Assumptions and Limitations

17.5.30 It is assumed that where there are likely to be air overpressure impact at NSRs, residents are formally warned in advance of the reasons and the duration of these events.

Road Traffic Noise Criteria During Construction

17.5.31 For the purpose of classifying the magnitude of impact from traffic noise (on new or improved roads), The Scottish Government TAN cites the advice provided in the Design Manual for Roads and Bridges (DMRB).

17.5.32 The DMRB (in Table 3.1, included in Volume 11, section 3 part 7), provides a classification of magnitude of impact for traffic noise (in the short-term), based on change in LA10,18h noise level, which is reproduced here as **Table 17.4: DMRB Classification of Magnitude of Noise Impacts Against Change in Traffic Noise Level**.

Table 17.4: DMRB Classification of Magnitude of Noise Impacts Against Change in Traffic Noise Level

Noise Change - $L_{A10,18hour}$ (dB)	Magnitude of Impact
0	No change
0.1-0.9	Negligible adverse
1.0-2.9	Minor adverse
3.0-4.9	Moderate adverse
Over 5	Major adverse

17.5.33 The DMRB notes that this classification table can be used for the assessment of noise impact associated with construction traffic on the local road network.

17.5.34 DMRB does not include a methodology for assigning an overall significance of effect in relation to the magnitude of impact. However, this may be determined by reference to the framework defined in the TAN (reproduced as **Table 17.5: Significance of Noise Effects, (TAN: Noise Assessment Table 3.2)**), which assigns a level of significance (of noise effect) based on the sensitivity of NSRs and the magnitude of adverse impact. It may be noted that for the purpose of assessing traffic noise, the magnitude of impact is related to noise change in terms of LA10,18 hour.

Table 17.5: Significance of Noise Effects, (TAN: Noise Assessment Table 3.2)

Magnitude of Impact	Level of Significance Relative to Sensitivity of Receptor		
	Low	Medium	High
Major	Slight / Moderate	Moderate/Large	Large/Very Large
Moderate	Slight	Moderate	Moderate/Large
Minor	Neutral/Slight	Slight	Slight/Moderate
Negligible	Neutral/Slight	Neutral/Slight	Slight
No change	Neutral	Neutral	Neutral

17.5.35 For the purpose of traffic noise assessment, the NSRs would be residential properties and in accordance with Table 2.1 (of the TAN) the sensitivity would be classed in the high category.

17.5.36 For projects which are likely to produce less significant changes to traffic noise, the DMRB also includes a screening process, identifying the threshold criteria for traffic noise assessment as a noise change of LA10,18-hour 1 dB, requiring an increase in traffic flow of around 25%. This noise change represents the smallest increment in noise increase that is generally regarded as being discernible, in terms of a short-term change.

17.5.37 Procedures for calculating road traffic noise are described in The Department of Transport, Welsh Office document: 'Calculation of Road Traffic Noise' (CRTN).

Road Traffic Noise Criteria During Construction - Assumptions and Limitations

17.5.38 The procedure considers the impact over an 18-hour period (day and evening) and whilst this gives a good picture for the whole day, it does not consider changes that might arise over shorter periods of the day.

Operational Noise Criteria

17.5.39 Guidance is provided in The Scottish Government TAN, and BS 4142, relating to the assessment of industrial and commercial sound. It should be noted that TAN makes reference to an earlier version of BS 4142, published in 1997. The Standard was substantially revised in 2014, and therefore it will be the later version of the Standard that will be considered in this assessment.

17.5.40 The procedure included in the TAN uses the concept of ambient noise change, which is also used in the approach provided in BS 5228-1, for the assessment of impact from construction noise. However, it should be noted that the TAN assessment example (using BS 4142 to establish receptor sensitivity) and noise change (to assess impact) is specific to noise from an operating industrial development. In this case this would be the noise generated during normal operation of the commissioned installation running during the day and night periods.

17.5.41 A quantitative assessment of noise impact from industrial and commercial operations may be made based on the following approaches:

- An estimate of the change in ambient noise level LAeq,T before and after the industrial development is operational. This being the approach defined in The Scottish Government TAN: Assessment of Noise; and
- The difference between the Rating Level (LAr,Tr) of noise from the development and the existing background noise (LA90,T), with the Rating Level being the Specific Noise level (LAeq,T), corrected for presence of any acoustic features (e.g. tonality, impulsivity) that could increase noise impact. This being the approach defined in BS 4142.

17.5.42 The magnitude of impacts, based on the above approaches and as defined in the TAN and BS 4142:2014, are summarised in **Table 17.6: Magnitude of Noise Impacts.**

Table 17.6: Magnitude of Noise Impacts

Change in noise level (TAN)		BS 4142 Assessment Level and Commentary	
LAeq,T dB	Magnitude of Impact	LAr,Tr – LA90,Tr (dB)	Magnitude of Impact
>= 5	Major	>= 10	Significant adverse impact
3 to 4.9	Moderate	>= 5	Adverse impact
1 to 2.9	Minor	< 5	Minor adverse impact
0.1 to 0.9	Negligible	0	Low adverse impact
0	No Change	< 0	Further lowering of impact

17.5.43 However, within the latest 2014 version of BS 4142, emphasis is put on considering the context of the noise, before coming to any conclusion about the overall impact of the noise.

17.5.44 BS 4142 advises that when making assessments and arriving at decisions it is essential to place the sound in 'context' so in each case, the context in which the sound is placed must be considered and the initial estimate of impact should be modified accordingly. For example, it 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 level exceeds the background. This is especially true at night.' At night, the noise is assessed in relation to intrusion into sensitive premises and the potential disturbance to sleep.

17.5.45 When evaluating noise impacts from existing noise sources, on new residential developments, the Standard considered appropriate is BS*8233:2014 Guidance on sound insulation and noise reduction for buildings*. This does provide some context to a BS 4142 assessment, although in this particular instance, all the receptors exist already or in the case of NSR 5, have residential planning consent.

17.5.46 Within BS 8233, Internal noise criteria are advised within dwellings relating to sources of external noise '"without a specific character". Noise has a specific character if it contains features such as a distinguishable, discrete and continuous tone, is irregular enough to attract attention, or has strong low-frequency content, in which case the Standard advises that lower noise limits might be

appropriate'. The criteria advised are shown in **Table 17.7: BS8233 Indoor Ambient Noise Criteria for Dwellings for 'Noise without Character'.**

Table 17.7: BS8233 Indoor Ambient Noise Criteria for Dwellings for 'Noise without Character'

Activity	Location	Daytime 07:00-23:00	Nightime 23:00-07:00
Resting	Living room	35 dB LAeq,16 hour	-
Dining	Dining room/area	40 dB LAeq,16 hour	-
Sleeping (daytime resting)	Bedroom	35 dB LAeq,16 hour	30 dB LAeq,8 hour

17.5.47 Whilst modern dwellings will have double glazed windows which will generally be particularly good at preventing the transmission of external noise into internal areas, a worst-case assumption of having a window partly open for ventilation purposes will mean in practice that the level may be only 12-15 dB below the external level (Annex G.1 para 4 of the Standard). With partly open windows, levels outside bedroom at night should accordingly not exceed 42-45 dB. If the noise includes the elements described above such as distinguishable tones, irregularity such as would attract attention, or strong low frequency content then limits should be lower than this.

Operational Noise Criteria - Assumptions and limitations

17.5.48 It is difficult to anticipate the level of audibility of any tone from the operating plant. Pump-turbines do have the potential to generate tones, however these will not be audible if the level of noise at receptors is very low. In determining the rating level (Lar) in accordance with BS 4142, a correction of +5dB is assumed to allow for the noise to contain audible tonality.

17.6 Baseline Conditions

Existing Baseline

17.6.0 In order to assess noise from the Proposed Development, the noise emission needs to be compared with the existing ambient noise environment at the nearest sensitive residential locations to the site.

17.6.1 As part of the noise assessment process, existing ambient noise levels therefore need to be established, in order to determine any change to these levels due to the specific noise contribution from the Proposed Development.

Noise Sensitive Receptor Positions (NSRs)

17.6.2 A description of the NSRs, chosen for the noise impact assessment, is provided in **Table 17.8: Description of Noise Sensitive Receptor Positions**. These positions were chosen as being representative of the nearest properties both to the Proposed Development and to the associated construction activities. The locations of NSR 1-4 were proposed to, and approved by, THC. NSR 5 was later added as a location where planning consent has recently been granted for a new residential dwelling.

17.6.3 Noise measurements for the purpose of describing the current ambient noise environment were recorded in the vicinity of each receptor position. Where these deviate significantly from each NSR, they are identified as Noise Monitoring Locations (NML). There are two such locations, NML 1 and NML 3 which are representative of the noise environment at NSR 1 and NSR 3 respectively. A mean value of the results at NML 1 and NSR 2 is used to establish the baseline of noise at NSR 5 and is considered adequate for an assessment to be made at NSR 5.

Table 17.8: Description of Noise Sensitive Receptor Positions

Position	OS Grid Ref.	Description
NSR 1: Home Farm **NML 1:** Proxy measurement position at waterfront track	243108E 816495N 242829E 816268N	Home Farm is located on the NW side of Loch Ness in wooded parkland between the loch and the A82. Access to this property would have been through a security gate and so baseline measurements were made at NML 1 nearby on the track leading down to the Loch at the mouth of the River Moriston.
NSR 2: Alltsigh Cottages	245580E, 818956N	These properties are set back 20 m north of, and on high ground, overlooking the A82 on the NW side of Loch Ness in the small community at Alltsigh. The measurement position was close to the southern corner of the dwelling.
NSR 3: Dell House **NML 3**: Proxy measurement position at Dell Lodge	248580E 816281N 248824E 816268N	Dell House and the nearby proxy measurement position at Dell Lodge are located to the west of the River Fechlin and accessed off the B862 in Whitebridge.
NSR 4: Braeholm	247942E 814627N	Braeholm is in Easter Drummond and accessed from the B862 1 km west of the centre of the village of Whitebridge. The property is 85 m from an existing track which is the main access point to the Site.
NSR 5: Location of consented dwelling	244625E 817598N	This is the location for a single residential property which has recently been granted planning consent (Ref 21/04932/FUL, 'Land 1680M NE Of Creag-Nan-Eun, Invermoriston'. 21 Oct 2022)

17.6.4 A plan showing the Proposed Development and NSRs/NMLs is illustrated in **Volume 2, Figure 17.1: Noise Sensitive Receptors (NSRs) and Noise Monitoring Locations (NMLs)**. An additional sensitive receptor is shown (NSR 3a – Dell Farm), which is of relevance to the Associated Works of a proposed Switching Station, but at which baseline noise measurements were not made, as data obtained at NSR 3 was considered adequately representative.

17.6.5 Photos of the noise measurement positions at each NSR are included in **Photos 17.1 – 17.4** below.

Photo 17.1: View of noise monitoring position NML 1 waterfront track; proxy position for NSR 1 Home Farm

Photo 17.2: View of noise monitoring position at NSR 2 Alltsigh Cottages

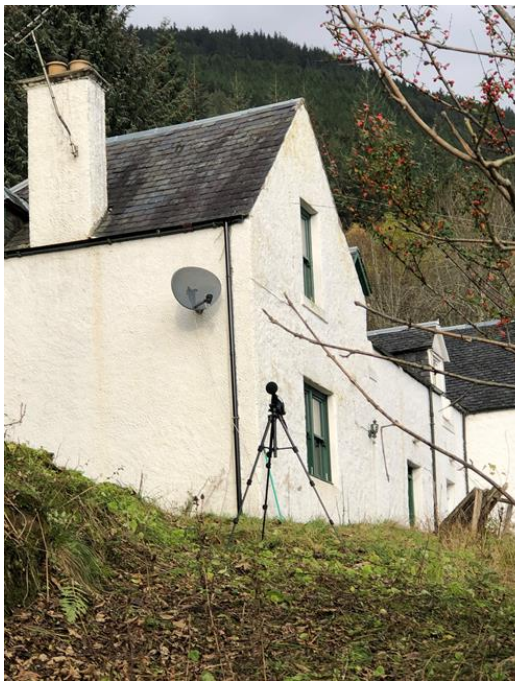


Photo 17.3: View of noise monitoring position at NML 3 Dell Lodge; proxy position for NSR 3 Dell House

Photo 17.4: View of noise monitoring position at NSR 4 Braeholm

Noise Survey Procedure and Instrumentation

17.6.6 Instrumentation used to measure noise levels at each receptor position included the following items. All equipment is calibrated in accordance with manufacturers requirements, using equipment referenced to the British Calibration Service and the National Physical Laboratory:

- NSR/NML 1 and 4: Bruel & Kjaer Type 2250 (No.5) Sound Level Analyser (s/n 3010945), with type 4952 Microphone (s/n 3010648); and
- NSR/NML 2 and 3: Bruel & Kjaer Type 2250 (No.6) Sound Level Analyser (s/n 3010857), with type 4952 Microphone (s/n 3060877).

Other equipment included:

- Bruel & Kjaer Type 4231 Acoustic calibrator (s/n 3010648).

17.6.7 The methodology proposed to establish the baseline noise levels along with the proposed measurement positions were approved by the Environmental Health Department (see **Table 17.1: Consultation Responses**).

17.6.8 The baseline noise survey programme agreed with THC covered a period of 2 days and nights and consisted of sampled periods of measurement made at each receptor. The survey covered the period from 14th to 16th November 2022. Noise samples were typically of 15-minute duration which was deemed sufficient to provide information on prevailing ambient noise levels over the nighttime assessment period defined in BS 4142:2014.

17.6.9 The final date for carrying out the survey was set once the short-term weather forecast confirmed conditions consistent with gathering good quality ambient noise data. Weather conditions during the survey were negligible to low wind speeds, with occasional light rain.

17.6.10 Noise samples were recorded, in terms of the following parameters:

- LAeq,T (equivalent continuous sound level), and
- LA90,T (90% percentile level).

17.6.11 LAeq,T, the equivalent continuous sound level is used as the measure of total ambient noise, or noise from a specific source. LA90,T is defined in BS 4142, as the measure for background noise, when it is applied to the residual noise level (the noise in the absence of the specific noise (i.e. noise from the Proposed Development) being assessed).

Noise Survey Results

17.6.12 The raw noise data is included in **Volume 4, Appendix 17.1: Baseline Noise Data** in tabular form, for each NSR/NML.

17.6.13 The arithmetic mean of the qualifying LAeq,15min and LA90,15min measurement samples best describes the current noise environment at each of the receptor positions. Accordingly, **Table 17.9: Mean Ambient LAeq,T and Background LA90,T Noise Levels at each NSR Position** presents these values, applicable to the daytime (07:00-19:00), evening (19:00-23:00) and nighttime (23:00-07:00) periods. Measurements were not taken specifically covering weekends or bank holidays as whilst there can sometimes be differences during the evening period, levels during the day and night are typically found to be similar. Those values in parenthesis are indicative values reflecting a small

sample of data. They apply at some receptors and only to levels at night after 23:00 and are stated as being typically similar to levels in the late evening period 21:00-23:00.

Table 17.9: Mean Ambient LAeq,T and Background LA90,T Noise Levels at each NSR Position.

Receptor Position	Mean LAeq,15 min			Mean LA90,15 min		
	Day	Evening	Night	Day	Evening	Night
NSR 1: Home Farm	53	48	48	40	41	38
NSR 2: Alltsigh Cottages	63	52	50	36	38	36
NSR 3: Dell House	47	41	(40)	33	30	(30)
NSR 4: Braeholm	43	42	(40)	32	35	(30)
NSR 5: Location of consented dwelling	58	50	49	38	39	37

17.6.14 The measurements show that the energy averaged Laeq values which will include the effects of passing road traffic, aircraft, etc are greater during the day than the evening and night. At NSR 1, 2 and 5 these values are controlled by road traffic noise on the A82 which is close to all 3 locations.

17.6.15 The background noise levels (La90) however are broadly the same day and night, which suggests that anthropomorphic sources of noise (from people, human activity including commercial sources) are not an influencing factor. Only natural sources prevail such as wind noise in trees/vegetation and river/stream noise. These are unchanging day and night.

Future Baseline

17.6.16 It is not considered necessary to evaluate noise impact against a future baseline of noise in this assessment. The major sources contributing to the existing baseline noise environment, especially the La90 background level, are natural sources such as streams, rivers and wind in trees and other vegetation. The levels from these sources are unlikely to change.

17.7 Mitigations by Design / Embedded Mitigation

17.7.0 During the construction phase, the most important noise mitigation will be from closely following the CNVPM procedures, which will have been developed during the detailed planning of the construction phases. This will use BS5228-1 and BS5228-2 as a starting point in considering noise and vibration matters respectively. Noise and vibration monitoring during early site trials will be important in determining the final mitigation.

17.7.1 Tunnelling and associated activity is required to continue overnight and particular attention will be paid to the mitigation to minimise noise generated at the work face and within the tunnel. Some acoustic screening or similar measures will be considered as required at some tunnel entrances, especially those associated with lower reservoir works on the edge of Loch Ness.

17.7.2 During operation, noise levels will be controlled by noise from the powerhouse building, transmitted through wall and roof elements and ventilation apertures. The wall and roof of the powerhouse are assumed to have a medium sound insulation performance of Rw = 34 dB, which will help contain the noise. At the detailed design stage, acoustic louvres and silencers will be considered for ventilation apertures to maintain the acoustic integrity of the powerhouse building.

17.8 Potential Significant Effects

17.8.0 This section considers the potential impacts and potential significant effects of the construction, and operation of the Proposed Development based on the typical activities described in **Chapter 3: Description of Development.**

- For the Proposed Development the following noise and vibration impacts have been identified for review and assessment:
- Temporary noise produced during construction of the Proposed Development (Construction Noise);
- Temporary vibration produced during construction of the Proposed Development (Construction Vibration);
- Temporary blast generated overpressure, during construction of the Proposed Development;
- Temporary noise from additional construction road traffic using public roads (Traffic Noise); and
- Permanent and continuous noise produced during operation of the Proposed Development (Operational Noise).

Construction Noise

17.8.1 Noise and vibration impacts from the construction phases of the project are considered to relate to:

- Access Tracks and Enabling Works;
- Underground Waterways, Powerhouse Works and Dam Construction; and
- Above ground Works and Waterways Completion.

17.8.2 For the purpose of this assessment, noise predictions have been completed for each of the above phases, at the NSRs identified in **Table 17.8: Description of Noise Sensitive Receptor Positions**, using appropriate procedures and construction.

17.8.3 Predictions for this computer model have been based on the BS 5228-1 plant sound power method, using the operating plant noise levels given in Annex C, with a +28 dB(A) correction applied to the LAeq,T values at 10 m distance. Whilst some plant would be mobile, this would be within a limited area work zone, so for the purpose of the predictions such plant would be classified as 'quasi-stationary'.

17.8.4 The method of prediction is a computation. This reflects the complexity of the terrain and the cumulation effect of simultaneous activities occurring at different parts of the site. It also takes particular account of the frequency content of the noise, which makes for a more accurate prediction.

17.8.5 The proprietary computer noise model, Softnoise Predictor V.2021.1 has been used to calculate noise propagation corrections, to procedures defined in ISO 9613-2. The model calculates noise levels around a site simultaneously and allows the reporting of the results visually through the construction of noise contours on an OS plan. This enhances the information provided by simple predictions made to specific receptor positions, as forecast noise levels can be reviewed across the complete region covered by the noise map.

17.8.6 The following set-up parameters have been used in the computer noise model:

- Ground Factor = 0.8 (mainly soft ground), 0 (for Loch Ness and Loch Kemp, which are reflective);
- Downwind conditions (C=0);
- Temperature = 10°C;
- Humidity = 60%;
- Receiver height = 1.5 m; and 4.0 m
- Noise source height: Varies depending upon particular source 2 m.

17.8.7 It may be noted that the noise model has been built onto a 1:10,000 scale OS map that includes land height contours, at 5 m distance intervals. Accordingly, the noise model takes full account of terrain screening.

17.8.8 For the purpose of the predictions, it has been assumed that all the plant items operating within a particular section of the Site, with associated numbers of each, could be operating together and continuously during the daytime period (07:00-19:00). For construction activity having to extend into the night period (19:00-07:00) that equipment will be assumed to be operating together and continuously. This therefore represents a worst-case scenario.

17.8.9 During the second phase of the work (Underground Waterways, Powerhouse Works and Dam Construction), tunnelling works with some ancillary external plant to support the tunnelling activity, will continue overnight.

17.8.10 Predictions made to ISO 9613 are applicable to the worst-case noise propagation condition, where all receptors are downwind from the noise source. Noise levels experienced under other wind directions are likely to be lower than those predicted for the downwind condition.

17.8.11 The basis for all the noise predictions is the noise data applicable to the items of construction plant and equipment that have been identified, at this stage, as typically being required for undertaking each of the planned work activities. The noise data applicable to the plant operation has been taken from the reference tables included in Annex C of BS 5228-1 but converted from 10 m Activity Sound Pressure Level LpA at 10 m, to Sound Power Level LwA, by adding 28 dB. The plant list with accompanying noise data is reproduced in **Table 17.10: Equipment and Plant Sound Power Level Data taken from BS 5228-1 Annex C.**

Table 17.10: Equipment and Plant Sound Power Level Data taken from BS 5228-1 Annex C

Construction Activity	Equipment / Plant Item	Value used in noise modelling (Quantity Range)	BS5228	L_{wA}	Octave Band Sound Pressure Levels dB(Lin)							
			Ref.	dB(A)	63	125	250	500	1k	2k	4k	8k
Access and Preparation Enabling Works												
	Bulldozer 153kW (21t)	6 (2-6)	C.5.15	111	111	109	104	105	110	98	93	86
	Excavator (35t)	3	C.5.18	108	104	107	103	103	104	101	98	93
	Excavator (20t)	6 (2-6)	C.2.19	105	123	112	107	101	98	96	92	85
	ADT dump truck CAT 745C	9 (4-11)	C.5.17	109	113	116	105	103	105	102	97	91
	CAT Grader 14m (193kW)	6 (4-6)	C 6.31	115	116	115	111	107	112	106	102	93
	Vibratory Compactor (12t)	2 (1-3)	C.5.22	109	120	111	103	107	105	98	95	89
	Crawler Crane (35t)	1	C.4.43	98	108	104	99	91	92	91	84	78
	Asphalt paver	1	C.5.31	105	100	105	102	100	99	98	95	88
	Rock drill	1	C.9.1	118	114	120	113	116	112	111	106	103
Underground Waterways and Powerhouse Works and Dams Construction												
	Bulldozer 153kW (21t)	10 (5-13)	C.5.15	111	109	104	105	110	98	93	86	85
	Excavator (35t)	4	C.5.18	108	107	103	103	104	101	98	93	90
	Excavator (20t)	16 (3-20)	C.2.19	105	112	107	101	98	96	92	85	83
	ADT dump truck CAT 745C	6	C.5.17	113	116	105	103	105	102	97	91	88
	CAT Grader 14m (193kW)	4 (2-6)	C 6.31	116	115	111	107	112	106	102	93	90
	Vibratory Compactor (12t)	4 (3-5)	C.5.22	109	111	103	107	105	98	95	89	87
	Crawler Crane (35t)	5 (1-4)	C.4.43	108	104	99	91	92	91	84	78	77
	Asphalt paver	1	C.5.31	100	105	102	100	99	98	95	88	86
	Concrete batching plant	2 (1-3)	D6-11	101	106	106	103	103	101	98	96	94
	Shotcrete plant	4 (2-5)	D.6.11	108	101	106	106	103	103	101	98	96
	Wheeled loader 60kW	6 (2-7)	C.4.13	99	111	100	98	97	93	92	85	77
	Wheeled loader 240kW	4	C.9.10	116	117	115	113	111	112	108	103	99
	Grout mixing and injection platform	5 (2-7)	D.6.13	108	112	112	104	103	104	101	96	90
	Wheeled drill/hammer	2	C.6.35	114	113	121	106	107	108	107	104	102
	Shotcrete Jumbo	5 (4-5)	C.9.2	121	122	123	118	119	115	113	108	101
	Rock drill	6 (2-7)	C.9.1	118	114	120	113	116	112	111	106	105
	Tracked excavator	2	C.6.4	108	114	118	106	102	103	98	90	88
	Crawler crane (50t)	3 (1-4)	C.4.46	95	106	97	95	92	90	85	77	68

Above ground Works and Waterways Completion	Permanent secant piling (rotary 110t)	1	C.3.14	112	112	120	109	108	106	104	96	89
	Excavation 50m depth for PH rock drill	2	C.9.1	118	114	120	113	116	112	111	106	105
	Top hammer drilling rig	2	C.6.35	114	113	121	106	107	108	107	104	102
	Crawler Crane Piling rig (50t)	2	C.3.29	98	109	105	97	95	90	88	89	79
	Vibratory rig for sheet piling (52t)	1	C.3.8	116	111	110	107	110	112	110	105	95
	Excavator (35t)	10 (9-12)	C.5.18	104	107	103	103	104	101	98	93	90
	ADT dump truck CAT 745C	9 (8-10)	C.5.17	113	116	105	103	105	102	97	91	90
	Bulldozer 153kW (21t)	11 (9-12)	C.5.15	111	109	104	105	110	98	93	86	85
	Concrete batching plant	5 (4-6)	D6-11	101	106	106	103	103	101	98	96	93
	Crawler crane (50t)	1	C.4.46	95	106	97	95	92	90	85	77	68
	Angle grinder	2	c.4.93	108	85	79	80	88	98	105	101	101
	Diesel generator	3 (2-4)	C.4.78	94	92	95	96	93	86	82	77	70

17.8.12 The noise maps, showing the predicted noise contours resulting from construction phase works follow. **Plate 17.1** shows output from the Predictor simulation of a 3D ground contour map view of Loch Ness, Loch Kemp and the study area. **Plates 17.2 – 17.5** show the noise contour maps for each of the construction stages.

Plate 17.1: 3-D Ground Contour Map of the site

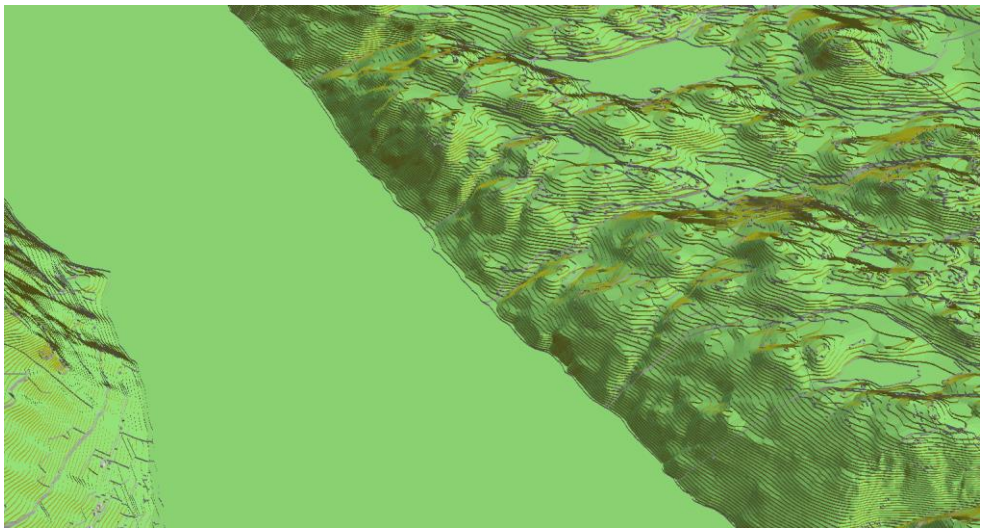


Plate 17.2: Access Tracks and Enabling Works

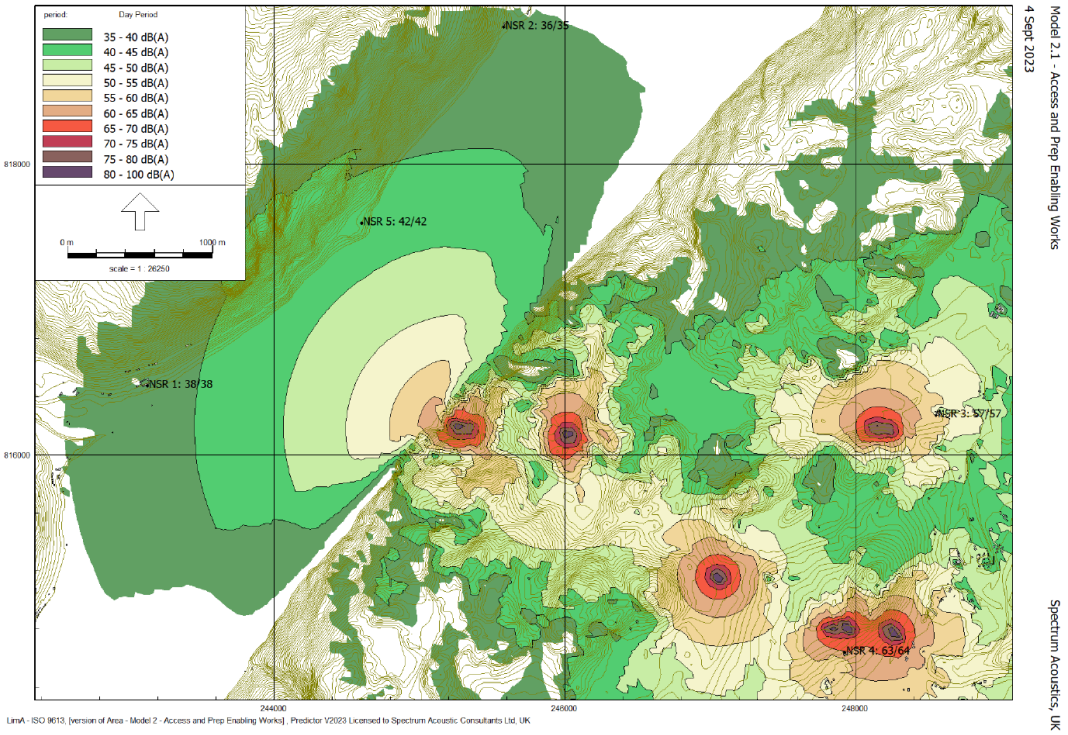


Plate 17.3: Underground Waterways, Powerhouse Works and Dam Construction – Day

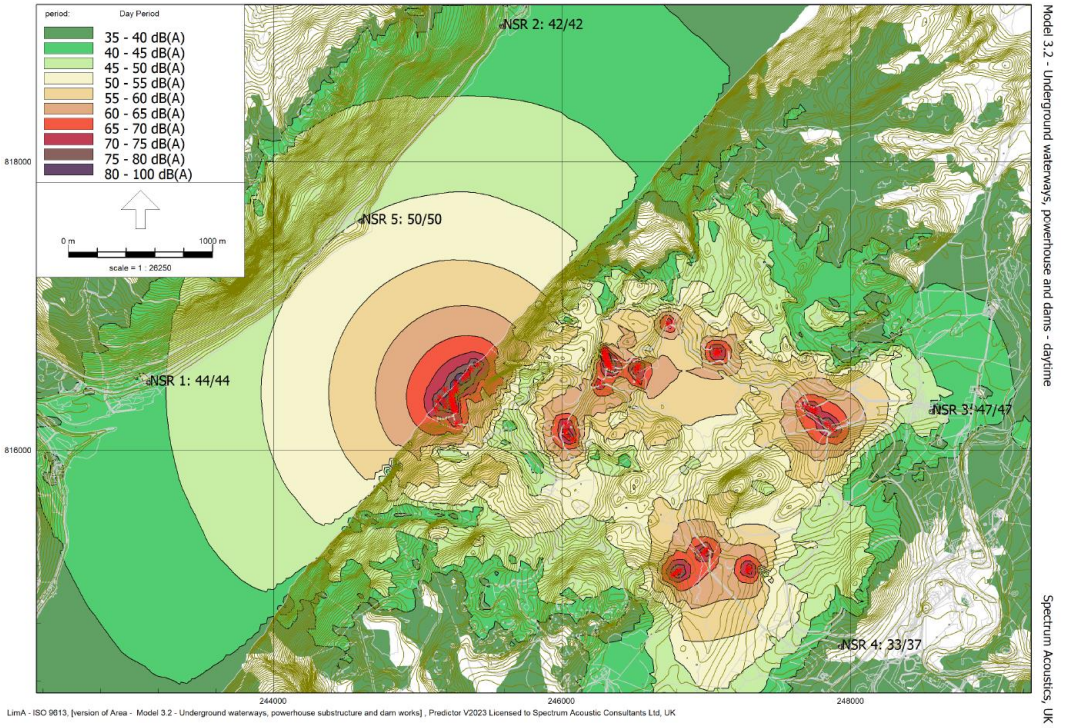


Plate 17.4: Underground Waterways, Powerhouse Works and Dam Construction – Night

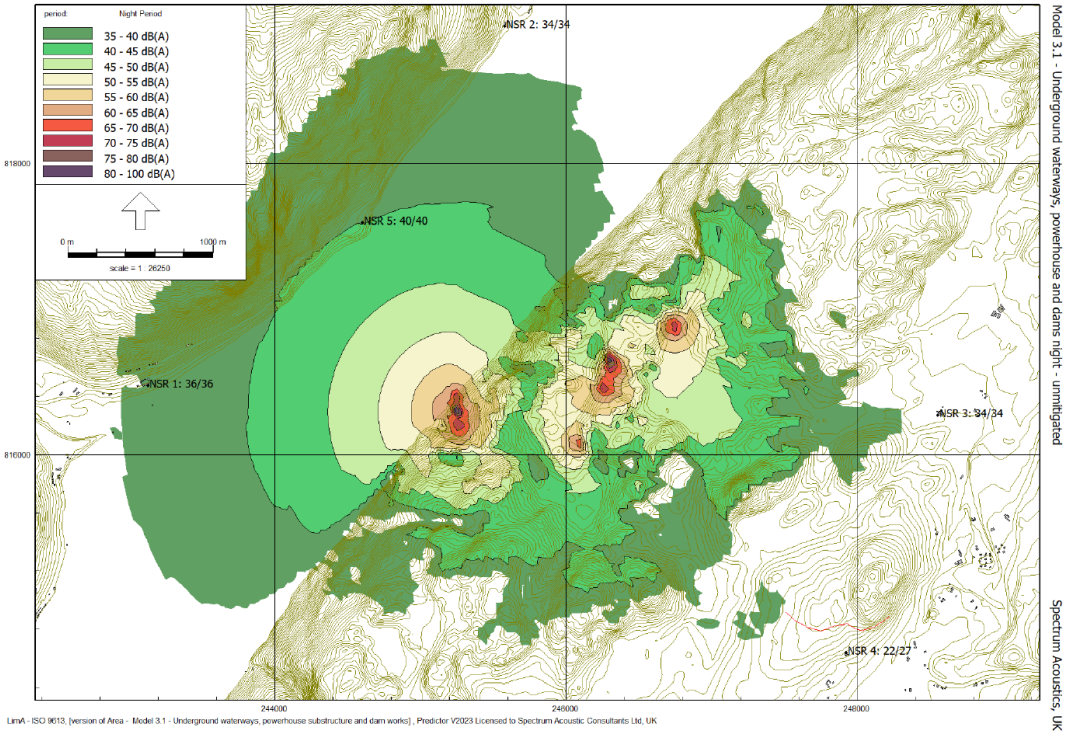
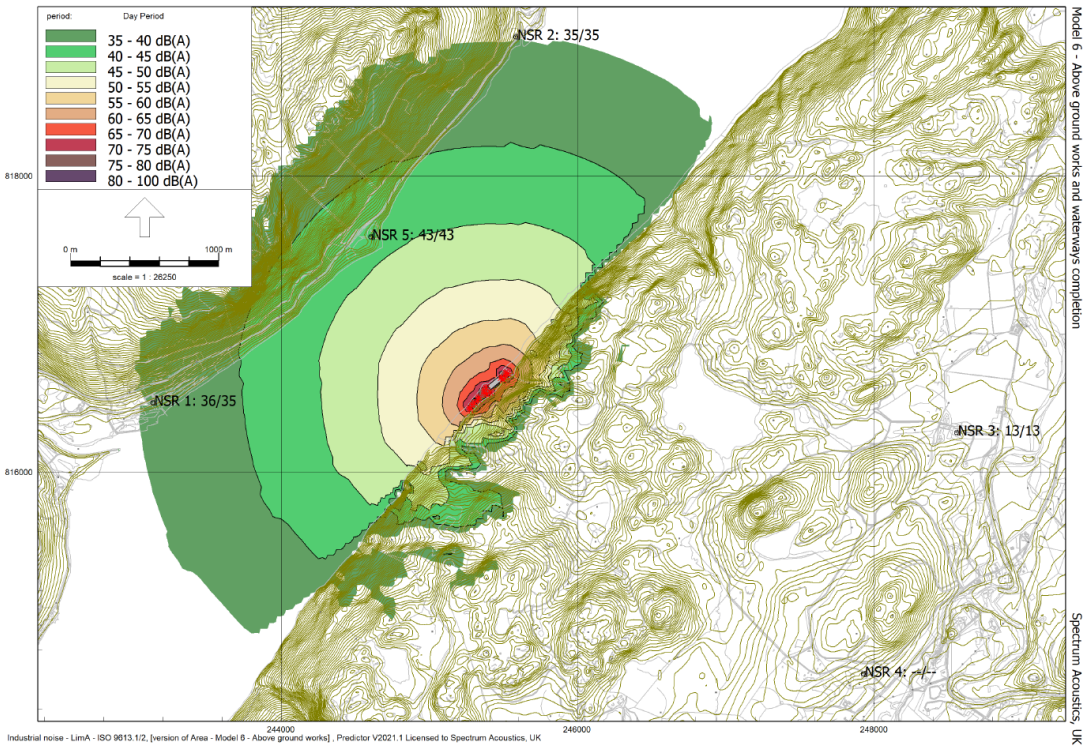


Plate 17.5: Above ground Works and Waterways Completion



17.8.13 Noise generated by HGVs travelling along the new site access track during the construction phase has the potential to affect NSR 4 which is set back around 160 m from the track, as shown in **Plate 17.6**. Initial noise modelling assuming use of the existing track 80 m from NSR4 showed higher levels of noise than now might be expected.

17.8.14 This noise is also calculated using the 'Method for mobile plant using a regular well-defined route (e.g. haul roads)' included within F.2.5 of BS 5228-1. The calculation is simple and takes only limited account of screening and frequency effects. **Table 17.11: Prediction Table for Temporary Haul Road Vehicle Movements According to BS5228-1, Section F.2.5** gives predicted values during the daytime at NSR 4. The duration of each HGV passing along a visible 500 m section of track (maximum passes per hour is 10) is taken as typically 100 seconds for which an on-time correction with respect to the assessment period of 1 hour, is made.

Table 17.11: Prediction Table for Temporary Haul Road Vehicle Movements According to BS5228-1, Section F.2.5.

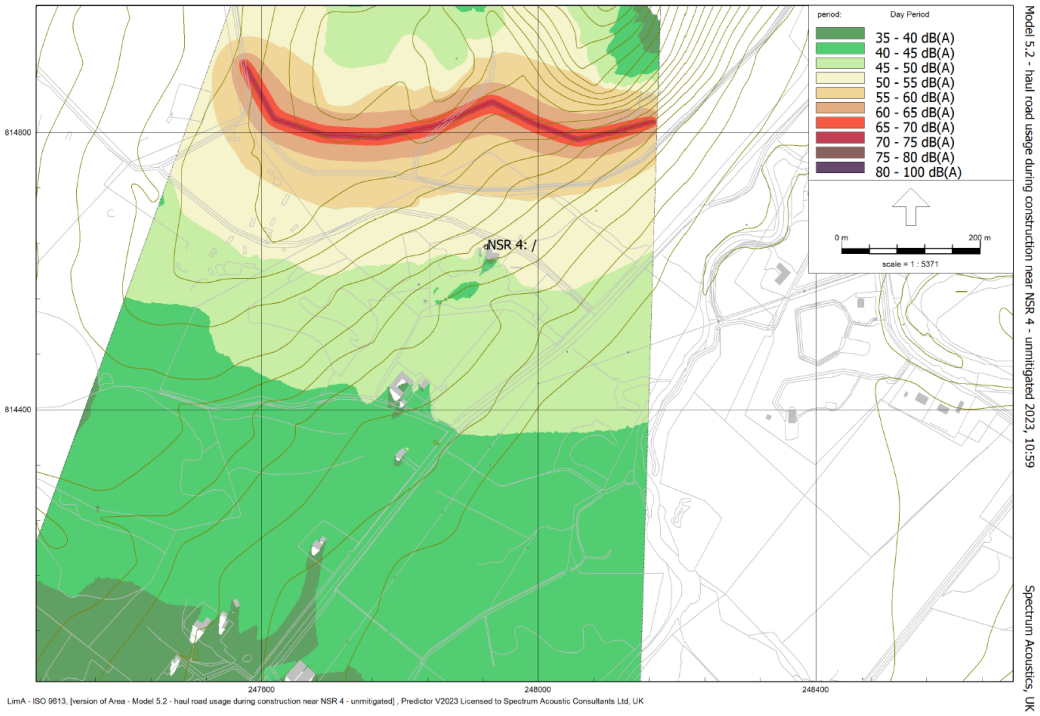
Receptor Position	L_{wA} dB	Q Veh./h	V Km/h	d Dist. (m)	View a_{v} º	Adjust (dB)	On- time (dB)	Result $L_{Aeq,T}$
NSR 4: Braeholm	112	7	18	200	120	1	-6	49

LAeq,T = LwA -33 + 10log Q – 10log V -10log d – 10 log (av,/180) + adjustments +ontime

17.8.15 **Plate 17.6** shows the same scenario but using the noise model local to NSR 4 and generating a noise contour map. The map shows values at the receptor of approximately Laeq,T 50 dB, which is similar

to the 49 dB shown in **Table 17.11: Prediction Table for Temporary Haul Road Vehicle Movements According to BS5228-1, Section F.2.5.**

Plate 17.6: Site access track traffic near NSR 4 – Braeholm



17.8.16 A summary of the predicted total noise levels for each of the construction phases at each NSR is shown in **Table 17.12: Summary of Predicted Construction Noise Levels LAeq,T.**

Table 17.12: Summary of Predicted Construction Noise Levels LAeq,T

Receptor Position	Access Tracks and Enabling Works - day	Underground Waterways and Powerhouse Works and Dams Construction - day	Underground Waterways and Powerhouse Works and Dams Construction - night	Above ground Works and Waterways Completion - day	Access Road Vehicle Movements- day
NSR 1 : Home Farm	38	44	36	36	-
NSR 2: Alltsigh Cottages	36	42	34	35	-
NSR 3: Dell House	57[1]	47	34	13	-
NSR 4: Braeholm	63[1]	33	27	<10	50[2]
NSR 5: Loc. of consented dwelling	42	50	40	43	-

Note 1: Upgrading the access and on-site tracks during enabling works generates some elevated noise at NSR 3 and NSR 4 for a few days as the works construction plant moves close by.

Note 2: The only receptor close to the access road is NSR 4 (160m).

17.8.17 The predictions indicate that the highest noise levels up to LAeq,T 63 dB and therefore the greater potential for adverse impact would result from the short-term works associated with the upgrade and construction of on-site roads/tracks. This is primarily influenced by the set-back distance between the track and an NSR. However, at the closest receptors NSR 3 and NSR 4, the high noise does not breach the BS 5228-1 short-term noise threshold of Laeq,T 75 dB. Nor would it be expected to exceed the requirement that such a level would need to be breached in 10 in 15 consecutive days. The expected duration is just 2-3 days when main track upgrading plant is nearest; after that, it will have passed by and noise levels will be much lower.

17.8.18 During the construction of the Underground Waterways, Powerhouse and the Dams, the levels range between LAeq,T 33-50 dB during the daytime and LAeq,T 27-40 dB at night when tunnelling is required to continue. This is lower than the BS 5228-1 advised thresholds of LAeq,T 55 dB during the day and Laeq,T 45 dB at night.

17.8.19 During the latter stages of construction, when completing the waterways and the above ground works, the daytime levels are predicted to be LAeq,T 10-43 dB. This also is comfortably within the Laeq,T 55 dB threshold.

17.8.20 The predicted daytime noise impact at NSR 4 from HGVs using the access road is LAeq,T 50 dB which is within the long-term construction noise significance threshold of LAeq,T 55 dB.

Construction Vibration

17.8.21 The level of ground-borne vibration arising from mechanised construction works, at a receptor position, is difficult to predict, as there are a number of factors that may influence the production and transmission of vibration in the ground, including:

- Local ground (or soil) conditions at the construction site;
- The distance between source and receiver;
- The ground geology between source and receptor (the transmission path); and
- Local ground conditions at the receptor position

17.8.22 Whilst BS 5228-2 (Annex E) provides empirical formulae, to allow prediction of resultant PPV values from mechanised construction works, the parameter range for input distance only extends to 110 m, which would tie in with the expectation that prediction of vibration to larger distances would have limited accuracy.

17.8.23 Annex D and E of BS 5228-2 provides historic case data on vibration levels produced by various piling operations, which would typically produce ground vibration through percussive, or vibratory modes of piling.

17.8.24 As would be expected, the majority of the presented data relates to vibration produced at distances up to 100 m, which are most representative of typical sensitivity range. However, relevant detail on larger distances includes a measurement of PPV 0.1 mms-1 at 130 m and 0.025 mms-1 at 250 m, both resulting from driving sheet piles using a diesel hammer rig.

17.8.25 The lower reservoir works on Loch Ness would include for use of mechanised equipment, such as rock drills and drilling rigs, which have potential for producing localised ground vibration. However, a qualitative assessment, including review of BS 5228-2 guidance, would indicate that, due to the large separation distance (1.1 km to the closest sensitive receptor position NSR 5), the resulting

vibration PPV levels would be well below 1 mms-1, and consequently the potential impact would be negligible.

17.8.26 The more likely cause of ground vibration and associated potential impact, would be from blasting completed mainly in connection with lower reservoir works, which may include:

- Blasting activities associated with construction of the inlet/outlet area; and
- Blasting activities associated with construction of tunnels, underground shafts and the powerhouse building.

17.8.27 There may also be some blasting required within the borrow pits.

17.8.28 The level of vibration resulting from blasting is dependent on site-specific factors, such as distance from the blast, explosive charge weight and ground geology between blast and receiver.

17.8.29 Whilst vibration levels due to blasting activities are likely to be low, due to the large distance separation between the blasting sites and closest receptor positions, this would be confirmed by undertaking vibration tests during either blasting trials, or during the early stages of blasting operations.

17.8.30 As outlined in section E.2 of BS 5228-2, for the purpose of predicting site-specific ground vibration resulting from blasting it is necessary to complete a series of concurrent vibration measurements at different distances from the blast site. These measurements are then used to produce a scaled-distance graph, which can be used to indicate likely vibration magnitudes at various distances and to establish maximum instantaneous charge size, to meet acceptable vibration PPV limits.

17.8.31 Potential adverse impact from ground vibration would therefore be avoided by employing good blast design, in particular to the use of the appropriate charge sizes, to meet vibration limits appropriate to both human response and to protect buildings from damage (see **Table 17.3: Effects of Vibration, taken from BS 5228-2**). The methodology for the vibration testing programme would be provided in the Final Construction Noise & Vibration Management Plan (CNVMP), when more detail on the design of the blasting activities are known. An outline CNVMP is included in **Volume 4, Appendix 17.3: Outline Construction Noise and Vibration Management Plan.**

Construction Blast Generated Overpressure

17.8.32 BS 5228-2 states that there is no known evidence of blast generated air overpressure causing structural damage to buildings, with adverse comment more likely to result from the air overpressure exciting secondary vibrations (such as in windows) at audible frequencies.

17.8.33 The Standard further notes that, due to uncertainties with meteorological conditions, it is not possible to predict the location of the maximum air overpressure from a blast. Given the additional consideration that windy conditions can mask the blast generated air overpressure levels it is not accepted practice to set specific limits for air overpressure.

17.8.34 The best practical approach for the control of air overpressure, as noted in BS 5228-2, is to take measures in the design of the blasting technique, to minimise its generation. Potential adverse impact resulting from air-overpressure produced by blasting operations would therefore be avoided by employing good blast design.

17.8.35 Additionally, monitoring of air-overpressure during blasting activities would be completed in conjunction with ground vibration measurements, using the same seismograph instrumentation.

Detail of the monitoring programme would be included in the CNVMP, when more detail on the design of the blasting programme is known.

Construction Road Traffic Noise

17.8.36 For the purpose of demonstrating potential impact from road traffic noise, a quantitative assessment, to include prediction of noise levels resulting from changes to traffic flows during the construction phase of the Proposed Development, has been completed.

17.8.37 For the purpose of assessing road traffic change, during the construction phase of the Proposed Development, projected daily 18-hour (0600-0000) average 'with and without' peak development traffic flows (assumed Year 2025, as included in **Chapter 16: Traffic, Access and Transport**), on roads that would be used to access the site, have been produced based on the 24 hour and 20 hour data. This information is shown in **Table 17.13: Traffic Flows (2025) baseline and Projected (during Construction) 18-hour Traffic Flows** and includes the survey location numbers used within the Transport Assessment.

17.8.38 It may be noted that it is necessary to use 18-hour (0600-0000) traffic flow data in order to calculate traffic noise in terms of the LA10, 18 hour index, as required by CRTN. The noise change in terms of LA10,18 hour is used (in DMRB) to classify the magnitude of noise impacts.

Table 17.13: Traffic Flows (2025) baseline and Projected (during Construction) 18-hour Traffic Flows

Road Section	2025 baseline		Development traffic 2025		Total 2025		% Increase (Impact)	
	All	HGV	All	HGV	All	HGV	All	HGV
B852 Bailebeag (loc. 3)	349	69	15	0	364	69	4	0
B862 at site access (loc. 6)	793	193	384	68	1177	261	48	35
B862 east of Fort Augustus (loc. 7)	873	234	97	0	970	234	11	0
A82 west of Aberchalder (loc. 13)	3,447	252	20	0	3,467	252	1	0
A82 south of Drumnadrochit (loc. 14)	4,501	819	40	0	4,541	819	1	0

17.8.39 The effect of changes in road traffic flows, upon resulting noise levels, only becomes discernible (and thereafter potentially significant) when levels rise by more than + 1dB, representing an increase in traffic flow of 25%. From **Table 17.13: Traffic Flows (2025) baseline and Projected (during Construction) 18-hour Traffic Flows**, the increase to overall traffic is in the range 3-11% at all but one road section. However, the increase at the site access point on the B862 is 48% which has the potential of being significant.

17.8.40 Detailed traffic noise predictions, relating to projected increased traffic during the construction phase of the Proposed Development, have been made in accordance with 'Calculation of Road Traffic Noise' (CRTN), issued by the Department of Transport Welsh Office.

17.8.41 Road traffic noise calculations are based on 18-hour traffic flows with the traffic noise projections covering the following circumstances:

- Scenario A: Baseline (2025) 18-hour mean traffic flow; and
- Scenario B: Baseline (2025) traffic, including projected (2025) construction traffic.

17.8.42 The effect of changes in traffic noise are evaluated along road sections where there are residential receptors. Whilst it is not practicable to predict the received noise level on an individual property basis, it is the relative increase in traffic noise which is most important to the assessment, so the precise prediction distance from the road is not critical.

17.8.43 Consequently, predictions have been provided (**Table 17.14: LA10,18hr Current and Projected (during Construction) Traffic Noise Calculations**) in terms of LA10,18 hour at a reference position 10 m from the edge of the nearside carriageway, 1.5 m above ground in the free-field. Average 18-hour traffic speeds on each road section have been taken from the traffic survey. The calculation output is shown in **Volume 4, Appendix 17.2: Road Traffic Noise Calculation**

Table 17.14: LA10,18hr Current and Projected (during Construction) Traffic Noise Calculations

Road Section	Scenario	Average 18hr daytime flow			$L_{A10,18\ hour}$
		All veh.	Heavy	% heavy	BNL (10m)[1]
B852 Bailebeag (loc. 3)	A	349	69	20	(56.2)
	B	364	69	19	(56.3)
	Change	+15	0		(0.1)
B862 at site access (loc. 6)	A	793	193	24	(60.4)
	B	1177	261	22	60.2
	Change	+384	+68		0
B862 east of Fort Augustus (loc. 7)	A	873	234	27	(61.2)
	B	970	234	24	(61.2)
	Change	+97	0		0
A82 west of Aberchalder (loc. 13)	A	3447	252	7	65.7
	B	3467	252	7	65.7
	Change	+20	0		0
A82 south of Drumnadrochit (loc. 14)	A	4,501	819	18	68.7
	B	4,541	819	18	68.7
	Change	+40	0		0

Notes 1) BNL is the basic noise level calculated at 10 m from the nearside carriageway edge, in the free-field

2) Where traffic flows on are less than 1000 vehicles/18-hour, in accordance with CRTN, the 'low-flow' correction is not applicable and the predicted noise levels are therefore unreliable, being therefore shown in brackets.

17.8.44 It may be noted that the prediction on the B862 at the point of site access (loc. 6) shows an apparent small reduction in noise in spite of an increase in traffic flow of 48%. The reason for this anomaly is that the development traffic takes the total flow just out of the 'low flow' scenario where the

algorithm used changes. There is more confidence in the prediction with development traffic. What needs to be acknowledged however is that the absolute noise levels remain very low.

17.8.45 As shown in **Table 17.14: LA10,18hr Current and Projected (during Construction) Traffic Noise Calculations** the additional traffic generated during the construction phase of the Proposed Development results in only a very small (<1 dB) increase in LA10, 18 hour noise level on the public road network providing access to the Site.

Operational Noise

17.8.46 Noise from the operation of the Proposed Development comprises sources located within the powerhouse building, including reversible pump-turbines, motor generators, transformers and other associated equipment. There would be other sources including ventilation apertures and plant associated with the powerhouse building.

17.8.47 The tailrace tunnels and two screened inlet/outlet structures would mean water entering and leaving Loch Ness below minimum water level. There would therefore be no risk of noise travelling along the tailrace from the pump-turbines and breaking out to atmosphere.

17.8.48 There would also be some noise associated with water flow from the surge shaft and also the headrace at Loch Kemp. However, these would be low levels of noise and these are at particularly large set back distances from NSRs.

17.8.49 Once operational, it is estimated that an average of 15 full time equivalent staff would be employed at the facility on a permanent basis, requiring daily access. Regular maintenance visits would be made to inspect and maintain structures and components of the Proposed Development. The vehicle movements generated by these activities would be low, and therefore the potential for adverse noise impact would again be negligible.

17.8.50 Using the same noise propagation computer model and terrain topography as used for the Construction Phase, the predicted noise levels during the operating phase have been determined and are shown in **Plate 17.7** and then in **Table 17.15: Summary of Predicted Operating Noise Levels LAeq,T.** The levels of noise during operation are considered likely to be the same during the daytime as nighttime.

17.8.51 Source noise levels of equipment during the operation phase are shown in **Volume 4, Appendix 17.4: Source Noise Data During Construction**.

Plate 17.7: Operations (day and night)

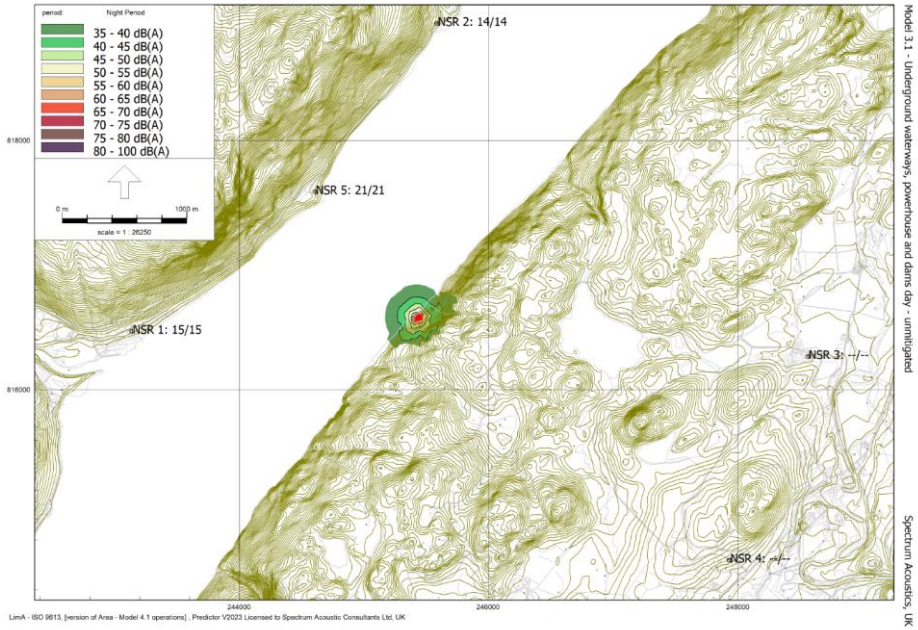


Table 17.15: Summary of Predicted Operating Noise Levels LAeq,T

Receptor Position	During Operating Phase, Leq,T
NSR 1 : Home Farm	16
NSR 2: Alltsigh Cottages	15
NSR 3: Dell House	1
NSR 4: Braeholm	<0
NSR 5: Location of consented dwelling	22

17.8.52 The predicted levels of noise are very low, with NSR 5 potentially experiencing the highest levels of noise. These are however only Laeq,T 22 dB. BS 4142:2014 requires that the context of the noise is taken account of in any assessment, and in this case both the background noise levels and the levels during potential development operation will be low, and therefore it is considered that absolute levels of noise may be more relevant.

17.8.53 The highest levels of noise predicted are Laeq,T 22 dB during the day and night, and this at NSR 5. The criterion for internal noise levels within dwellings based upon BS 8233, in **Table 17.8: Description of Noise Sensitive Receptor Positions** allow levels outside, if characterless noise and assuming partly open windows, of 42-45 dB. If the noise includes the elements described above such as distinguishable tones, limits should be lower than this.

17.8.54 Even assuming the potential for some tonality in the operating noise, levels of Laeq,T at 22dB outside dwellings are clearly well below the range of 42-45 dB considered as being acceptable at night as described in BS 8233. This would therefore be an indication of a low impact of noise at receptors.

17.8.55 Further consideration of the potential effects during operation, and a full BS 4142 assessment, is included within assessment of residual effects later in this chapter.

Cumulative Effects

17.8.56 There follows a list of the developments which have been taken account of in relation to a cumulative effects assessment of noise, vibration, and blasting. In most cases, the most notable element in relation to the potential for cumulative noise and vibration effects to arise, is the large distance between the developments, and consequently the selection of a different set of NSRs for each project. Where NSRs from the Proposed Development and other considered developments are substantial distances apart, the cumulative effect is highly likely to result in no change in the assessment conclusion of the Proposed Development at Loch Kemp.

17.8.57 The other developments considered within the cumulative effects assessment are:

- Corie Glas 1,500 MW Pumped Storage (Consented), located 26 km southwest of NSR 1;
- Red John 450 MW Pumped Storage Scheme (Consented), located 21 km northeast of NSR 1;
- Bhlaraidh Wind Farm Extension (Consented), located 4.5 km northwest of NSR 1;
- Loch Laith Wind Farm (Application), located 8 km northwest of NSR 1;
- Corriegarth 2 Wind Farm (Appeal), located 8 km east of NSR 3. Access would be taken from B862 via Corrie Garth Lodge to the north of Whitebridge village.
- Dell 2 Wind Farm (Scoping). Located 9 km south of NSR 3. Access from B862 south of Whitebridge village.
- 275 kV Switching Station for Kemp Pump Storage Project. Future application (Associated Works).

17.8.58 The two pumped storage schemes are consented but at 21-26 km distance from the Proposed Development, both are so far distant as not to be potentially contributory. The two wind farms that are consented or appeal schemes are Bhlaraidh Wind Farm Extension, 4.5 km northwest of Loch Kemp NSR 1, and Corriegarth 2 Wind Farm, 8 km east of Loch Kemp NSR 3. These schemes are close enough to the Proposed Development to be considered further.

17.8.59 The 275 kV Switching Station is considered as Associated Works to the Proposed Development(see **Section 3.7** in **Chapter 3: Description of Development** for further details). Its likely location is within the site boundary but outside the current Development Area, as illustrated on **Volume 4, Figure 3.1 Proposed Development**. A switching station generates relatively low levels of noise. **Volume 4, Appendix 17.5: Noise Modelling of Associated Works (275 kV Switching Station)** includes predictions of the switching station, once operating, on Dell House (NSR 3) 550 m SE of the proposed switching station location and Dell Farm (NSR 3a), further away and well shielded, at 590 m NE. At Dell House (NSR 3), the level from the proposed switching station is Laeq 19 dB and at Dell Farm (NSR 3a), Laeq 26dB. This assumes a worst-case high noise equipment whereas in practice, with the absence of any transformers in this type of station, the levels will likely be at least 5dB lower. However, using the predicted levels, at Dell House (NSR 3), the 19 dB added to the 1 dB from the Proposed Development in operation, will total 19 dB. These levels represent very low noise impacts and need not be considered further.

17.8.60 For Bhlaraidh Wind Farm Extension and Corriegarth 2 Wind Farm, construction noise and vibration assessments were scoped out of their respective EIA Reports, therefore no predictions at NSRs are available for these projects. However, this is because the predicted levels of construction noise

would likely have been substantially (at least 10 dB) below the relevant criteria. Operational noise assessments were however undertaken.

17.8.61 During operation of nearby wind farms, the accepted noise assessment methodology is not that detailed in BS 4142 but is a more complex approach which considers wind speeds and also uses the metric La90 to quantify noise impact. These are explained within ETSU-R-97 (The assessment and rating of noise from wind turbines, ETSU for the DTI, 1996) and 'A good practice guide to the application of ETSU-R-97 for the Assessment and rating of wind turbine noise (IOA, 2013) These set noise criteria for wind turbines operation at different wind speeds. However, there is a minimum value which applies at low wind speeds.

17.8.62 Section 10.2.2.3 of the noise chapter of the Corriegarth 2 EIA explains the relevant criteria for that wind farm application:

- A limit of 43 dB(A) is recommended at night at wind speeds or locations where the prevailing wind speed related night-time background noise level is lower than 38 dB(A). At other times, the limit of 5 dB above the prevailing wind speed-related background noise level applies.
- A 'simplified criterion' is also described which may be applicable where there are large separation distances between the proposed turbines and nearest noise-sensitive receptors. In such cases, a fixed limit of 35 dB, LA90,10min applies, without reference to background noise levels.

17.8.63 Figure 10.2 of the Corriegarth 2 EIA Report shows cumulative noise contours for wind farms in the area. These typically show the La90 35 dB contour typically 2 km from the nearest wind turbine. Conservative extrapolation to the Loch Kemp NSR 3, a further 6 km distant, is considered to be no greater than La90 20 dB.

17.8.64 Table 11.2 of the Bhlaraidh Wind Farm Extension EIA Report advises a cumulative predicted noise level at Achnaconeran, some 3 km from the nearest wind turbine, to be La90 26dB at 5 m/s wind speed. Considering the substantial intervening terrain and the lower elevation of the Proposed Development at NSR 1, typically on the west bank of Loch Ness, a further 2 km distant, the level of wind farm noise here is likely to be no greater than La90 20 dB.

17.8.65 The cumulative wind farm noise levels shown here are for wind speeds of 5 m/s. This represents the maximum speed at which baseline noise measurements for non-wind farm industrial developments can be undertaken. It is therefore a reasonable basis of cumulative assessment as above this speed, baseline noise levels rise significantly and a BS 4142 noise assessment cannot be undertaken.

17.8.66 With construction phase noise impact not being considered an issue and being scoped out of the Corriegarth 2 and Bhlaraidh Wind Farm Extension EIA Reports, the cumulative impacts of construction phase activities of the Proposed Development together with those from the two wind farm developments are considered to be the same as that for the Proposed Development alone.

17.8.67 During operation of the other developments, together with the Proposed Development, the cumulative impacts may be combined for a robust assessment approach. This is shown in **Table 17.16: Summary of Predicted Cumulative Operating Noise Levels LAeq,T.**

Table 17.16: Summary of Predicted Cumulative Operating Noise Levels LAeq,T

Receptor Position	The Proposed Development	Other Developments including Associated Development	Cumulative Noise Levels
NSR 1 : Home Farm	16	<20	<21
NSR 2: Alltsigh Cottages	15	<20	<21
NSR 3: Dell House	1	23	23
NSR 4: Braeholm	<0	<20	<20
NSR 5: Location of consented dwelling	22	<20	<24

17.8.68 The results in Table 17.16 show cumulative operating noise levels which are very low. These are assessed further in **paragraph 17.10.23**

17.9 Mitigation

Mitigation during Construction

17.9.0 Construction noise and vibration would primarily be managed through a CNVMP, which would be formally approved by THC, prior to construction work commencing.

17.9.1 Once clearer detail of the construction plant and processes are known, the appointed Principal Contractor would develop and submit, for approval by THC, the CNVMP, which would detail how noise and vibration emissions would be managed during construction works. The plan would detail control measures, such as hours of work, mitigation strategy, monitoring proposals and protocol for receiving and dealing with any complaints.

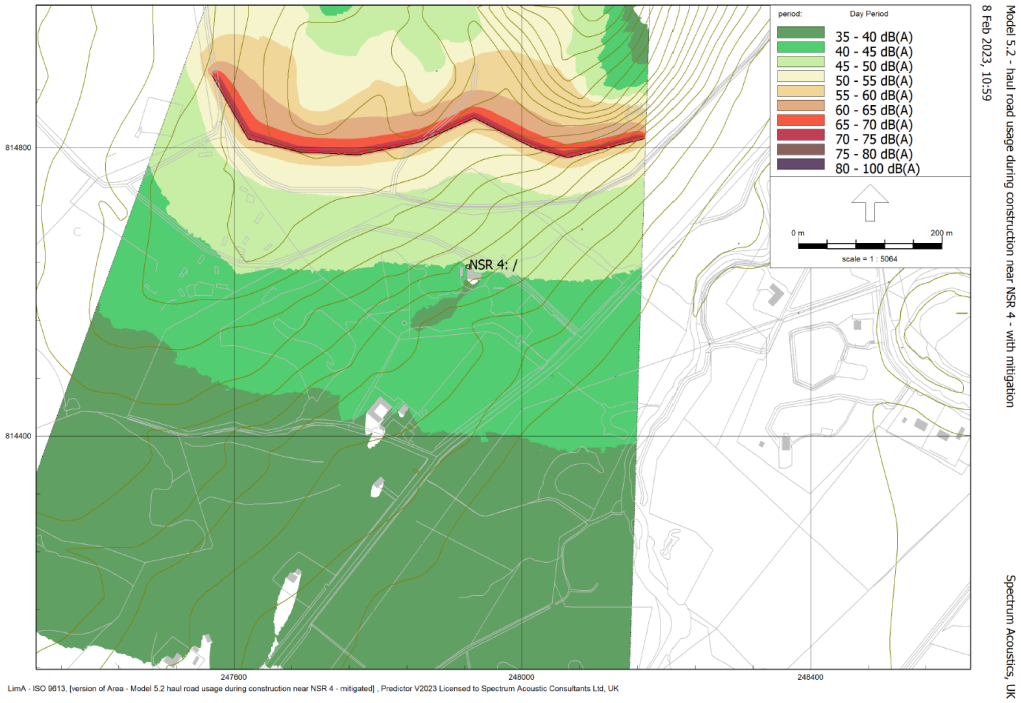
17.9.2 As a general principle, consideration would be given in the CNVMP for adopting the 'best practicable means' to noise and vibration control, with particular consideration given to the guidance provided in Section 8 (Control of Noise) of BS5228-1, for the purpose of minimising noise emission. For information, an outline of the typical detail provided in the CNVMP, is included in **Volume 4, Appendix 17.3: Outline Construction Noise and Vibration Management Plan.**

17.9.3 Traffic during the construction and operation of the Proposed Development would utilise existing public roads and forestry tracks, where possible. The Caledonian Canal System would also be used for the delivery of abnormal load components of Electrical and Mechanical (E&M) equipment associated with the lower reservoir works of the Proposed Development, removing a large number of potential Abnormal Indivisible Load (AIL) movements from the road network. The use of the canal for the delivery of further equipment and materials associated with the construction of the lower reservoir works would also be explored by the appointed Principal Contractor (in consultation with THC and other relevant stakeholders) but is not considered as part of this assessment, which considers a reasonable worst-case scenario where most deliveries reach the site by road. .

17.9.4 Furthermore, the connection between the lower reservoir works area and the upper reservoir and dams, provides an opportunity to supplement rock quarried within the upper reservoir, with suitable tunnel spoil from the underground works, for dam construction.

17.9.5 A 2 m high temporary timber acoustic barrier set along the south side of the access track, extending around 500 m in length and configured to reduce the impact of noise to NSR 4 is recommended to benefit the resident in the property at NSR 4 and other residents in Easter Drummond during construction. **Plate 17.8** shows the noise contour map from HGV use of the access road, with the acoustic barrier in place.

Plate 17.8: Site access track traffic near NSR 4 – Braeholm – with mitigation



17.9.6 The predicted Laeq,T value for daytime HGV noise at NSR 4 after mitigation is 45 dB, compared with 50 dB without mitigation.

17.9.7 More detail regarding the options for the transportation and re-use of spoil is described in **Volume 4, Appendix 3.4: Outline Spoil Management Plan**

17.9.8 Monitoring of noise during construction works would be covered in a section included in the CNVMP **(Volume 4, Appendix 17.3: Outline Construction Noise and Vibration Management Plan)**. It is expected that monitoring of noise would only be carried out in response to a specific complaint.

17.9.9 Vibration and air-overpressure monitoring would be carried out, either during trials, or during the early stages of blasting operations, for the purpose of predicting site-specific ground vibration and air-overpressure resulting from these operations. Detail of the monitoring programme would be included in the CNVMP, when more detail on the design of the blasting programme is known.

17.9.10 Noise and vibration impact during de-commissioning is considered to be similar or less than during construction and therefore similar mitigation may be considered for that phase of work to that being incorporated during construction.

Mitigation during Operation

17.9.11 In the case of operational noise, mitigation is integral to the design of the powerhouse building walls and roof. Reversible pump-turbines, motor generators, and other associated equipment would be located below ground level within the building. Main transformers are located within the powerhouse building.

17.9.12 The roof and walls of the powerhouse building are assumed to have sound insulation values of Rw >34 dB. In addition, there are likely to be acoustic louvres or in line silencers fitted to ventilation apertures so as not to degrade the overall acoustic integrity of the powerhouse building. These will be considered further at the detailed design stage.

17.10 Residual Effects

17.10.0 This section considers the potential residual impacts and potential significance of residual effects of the construction and operation of the Proposed Development, following the implementation of the mitigation measures proposed in **Section 17.9.**

Construction Noise Residual Effects

17.10.1 As described in **Chapter 3: Description of Development**, normal construction shifts would generally apply for the surface works, subject to some variation to suit the work in hand and weather conditions, to be agreed with THC.

17.10.2 For the purpose of assessing noise impact, the predicted noise levels from each of the construction activities have been used to establish the produced ambient noise change, taken over the BS 5228-1 daytime assessment period, defined as 07:00-19:00 Monday to Saturday and 07:00-15:00 on Sundays.

17.10.3 Tunnelling work along with the use of ancillary equipment associated with tunnelling will continue on a 24 hour basis.

17.10.4 Any surface works outside these normal daytime construction hours would be subject to agreement with THC and, where requested by the Council, to a separate assessment of noise covering the specific activity proposed and the proposed time of this activity. **Table 17.17: Summary of Construction Noise Levels and Produced Ambient Noise (LAeq,T) Change** provides a summary of the predicted daytime construction noise levels, together with the resulting ambient noise change.

Table 17.17: Summary of Construction Noise Levels and Produced Ambient Noise (LAeq,T) Change

Receptor Position	Access Tracks and Enabling Works				Underground Waterways and Powerhouse Works and Dams Construction - DAY				Underground Waterways and Powerhouse Works and Dams Construction - NIGHT				Above ground Works and Waterways Completion				Haul Road Vehicle Movements			
	CNL	EAN	TAN	ANC	CNL	EAN	TAN	ANC	CNL	EAN	TAN	ANC	CNL	EAN	TAN	ANC	CNL	EAN	TAN	ANC
NSR 1: Home Farm	38	53	53.1	0.1	44	53	53.6	0.6	36	48	48.2	0.2	36	53	53.1	0.1	-	-	-	-
NSR 2: Alltsigh Cottages	36	63	63.0	0	42	63	63.1	0.1	34	50	50.1	0.1	35	63	63.0	0	-	-	-	-
NSR 3: Dell House	57	47	57.4	10.4	47	47	50.0	3.0	34	40	41.0	1.0	13	47	47.0	0	-	-	-	-
NSR 4: Braeholm	63	43	63.0	20.0	33	43	43.4	0.4	27	40	40.2	0.2	<10	43	43.0	0	45	43	47.1	4.1
NSR 5: Loc. of consented dwelling	42	58	58.1	0.1	50	58	58.6	0.6	40	49	49.5	0.5	43	58	58.1	0.1	-	-	-	-

Key to table:

CNL: Construction Noise Level. LAeq,T

EAN: Existing Ambient Noise. LAeq,T

TAN Total Ambient Noise (construction noise + existing ambient noise). LAeq,T

ANC: Ambient Noise Change (total ambient noise – existing ambient noise). LAeq,T

17.10.5 In accordance with the **Table 17.2: Magnitude of construction noise impacts, including 5228-1 defined threshold of potential significant effects for long-term activities in excess of 6 months** impact classification, **Table 17.18: Magnitude of Noise Impacts for Each Construction Phase** defines the impact magnitude for each construction activity at each NSR position, but assuming a different threshold for short-term daytime noise (75 dB), normal term daytime noise (65 dB) or long-term noise i.e. over 6 months (55 dB). Where noise impact is classified as High (noise change >=5 dB and CNL >threshold) this is highlighted in red font, where noise impact is classified as Medium (noise change >=5 dB and CNL is below threshold), this is highlighted in amber font and where noise impact has been classed as low (noise change <5 dB) this is highlighted in green font. Very low is also green (noise change <1 dB). At night the threshold reduces to 45 dB.

Table 17.18: Magnitude of Noise Impacts for Each Construction Phase.

Pos.n	Access Tracks and Enabling Works (normal term noise 65 dB or 75dB short-term noise threshold)		Underground Waterways and Powerhouse Works and Dams Construction – DAY (long-term noise 55 dB threshold)		Underground Waterways and Powerhouse Works and Dams Construction – NIGHT (long-term noise 45 dB threshold)		Above ground Works and Waterways Completion (long-term noise 55 dB threshold)		Access Road Vehicle Movements (long-term noise 55 dB threshold)	
	ANC	Impact	ANC	Impact	ANC	Impact	ANC	Impact	ANC	Impact
NSR 1	0.1	Very low	0.6	Very low	0.2	Very Low	0.1	Very Low	-	No Change
NSR 2	0	No Change	0.1	Very low	0.1	Very Low	0	No Change	-	No Change
NSR 3	10.4[1]	Medium[1]	3.0	Low	1.0	Very Low	0	No Change	-	No Change
NSR 4	20[1]	Medium[1]	0.4	Very low	0.2	Very Low	0	No Change	7.7[2]	Medium[2]
NSR 5	0.1	Very low	0.5	Very low	0.4	Very Low	0.1	Very Low	-	No Change

17.10.6 Most of the daytime and nighttime noise impacts of construction phases to NSRs are either low, very low or no change. There are no High impacts predicted. As all NSRs are high sensitivity only high or major impacts will result in a significant effect or a large significance of effect. Medium or moderate impacts are not considered likely to result in a potentially significant effect, having only a

[1] *These levels arise over a very short period whilst road/track building equipment is intensely working close to NSRs. Threshold is 75 Laeq,T for short-term noise*

[2] *Value without mitigation. With 2m acoustic barrier reducing level at NSR 4 from Laeq,T 50 dB to 45 dB, ANC is reduced to 4.1dB and impact is Low*

moderate significance of effect. Low and very low impacts also would not result in a significant effect having only slight significance of effect.

17.10.7 Nevertheless, although no phases of construction will give rise to a significant effect, the few days of tracks/road works passing NSRs 3 and 4 are noticeable, but very short-term periods.

17.10.8 However, for the bulk of the construction period, NSR 4 is subjected to noticeable HGV and perhaps other road traffic noise from the access road activity. In this case, some noise mitigation, including the acoustic barrier detailed in **Section 17.9**, is shown as being practical at reducing noise levels by 5 dBA and reducing the magnitude of impact from medium to low.

Construction Vibration Residual Effects

17.10.9 A qualitative assessment of potential vibration produced by construction activities has indicated that, due to the large separation distances to the closest NSR positions, the resulting ground vibration levels would be below 1 mms-1 PPV. Consequently, the potential vibration impact would be low, with the residual effect being slight, which is not significant.

17.10.10 Providing the mitigation and monitoring proposals outlined in **Section 17.9** are adopted and incorporated into the CNVMP, to be agreed with THC, potential major adverse impacts from ground vibration and air-overpressure resulting from blasting activities would be avoided, resulting in the residual impacts being moderate or minor and the residual effect being slight, which is not significant.

Construction Road Traffic Noise Residual Effects

17.10.11 As shown in **Table 17.14: LA10,18hr Current and Projected (during Construction) Traffic Noise Calculations** the additional traffic generated during the construction phase of the Proposed Development results in only a very small (<1 dB) increase in LA10, 18 hour noise level on the public road network providing access to the Site.

17.10.12 **Table 17.4: LA10,18hr Current and Projected (during Construction) Traffic Noise Calculations** shows that an increase of <1 dB is a negligible noise impact and is associated with a significance of effect which is only slight and therefore not significant.

Operational Noise Residual Effects

17.10.13 Most potentially significant operating noise sources are located within the powerhouse, which incorporates design noise control mitigation in the form of acoustically rated walls and roof, with provision being made for acoustic louvres or in-line silencers for ventilation apertures.

17.10.14 The predicted levels of operating noise at NSRs is shown to be low, and BS 4142 allows for consideration of absolute noise levels and values included for internal dwelling spaces as indicated within BS 8233. The highest levels of operating noise predicted are Laeq,T 21 dB during the day and night, at NSR 5. The criterion for internal noise levels within dwellings, based upon BS 8233, allow levels outside, if characterless noise and assuming partly open windows, of 42-45 dB. If the noise includes the elements described above such as distinguishable tones, limits should be lower than this. The predicted level of operating noise at Laeq,T 22dB is clearly well within this limit, and the impact is therefore likely to be very low with the **significance of effect, only slight and therefore not significant.**

17.10.15 Although BS 4142 is not relied upon because of the low predicted levels of operating noise, an assessment using this method does however provide some further context.

17.10.16 Generally, the greater the difference by which the Rating Level exceeds the Background Sound Level, the greater the magnitude of initially established potential impact. BS 4142 states that 'a difference of around +10 dB or more is likely to be an indication of a significant adverse impact […]. A difference of around +5 dB is likely to be an indication of an adverse impact […]. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact.' However, BS 4142 also advises that ' when making assessments and arriving at decisions […] it is essential to place the sound in context' so in each case, the context in which the sound is placed must be considered and the initial estimate of impact should be modified accordingly.

17.10.17 **Table 17.19: BS 4142 Initial Assessment of Operation Noise Impact from Proposed Development** shows a formal BS 4142 assessment for operating noise at each of the NSRs.

Table 17.19: BS 4142 Initial Assessment of Operation Noise Impact from Proposed Development

Noise Sensitive Receptor	Specific sound level, Ls (dB)	Rating level, LAr,Tr (dB)	Background sound level LA90 (dB)	Difference or Rating minus Background levels(dB)	Initial Impact defined within BS 4142
Daytime					
NSR 1	15	15	40	(-25)	Low
NSR 2	14	14	36	(-22)	Low
NSR 3	0	0	33	(-33)	Low
NSR 4	0	0	32	(-32)	Low
NSR 5	21	21	38	(-17)	Low
Nightime					
NSR 1	15	15	38	(-23)	Low
NSR 2	14	14	36	(-22)	Low
NSR 3	0	0	30	(-30)	Low
NSR 4	0	0	30	(-30)	Low
NSR 5	21	21	37	(-16)	Low

17.10.18 The results in **Table 17.19: BS 4142 Initial Assessment of Operation Noise Impact from Proposed Development** show the Rating Levels are all substantially lower than the Background Sound Level. The initial impact before consideration of context, is a low impact during day and night operations of the Proposed Development. It may be noted that the impact at the closest NSR which is NSR 5 could be 15 dBA higher, and the impact would still be low.

17.10.19 After considering context and the low absolute levels of noise, the significance of effect at the nearest receptor NSR 5 would be slight or neutral and therefore **not significant**.

Cumulative Residual Effects

Construction

17.10.20 When considering how contributions from two separate noise sources add together, to produce a cumulative total noise, it is important to have some understanding of the principals of noise level addition.

17.10.21 The addition of sound levels (or more correctly sound pressure levels), is sometimes referred to as 'decibel addition', or 'logarithmic addition'. In arithmetic addition, the sum of 50+50 is 100, but in decibel addition, 50dB + 50dB = 53dB. As the difference between noise levels becomes greater the total value (or cumulative total) becomes closer to the higher value. For example, where two sources produce sound levels of 50 dB and 45 dB, respectively, the total, or cumulative, sound level is 51.2 dB, representing a small 1.2 dB increase to the higher of the two sound levels. When the difference between the sound levels is 10 dB, e.g. 50 dB + 40 dB, then the total is only 50.4 dB, so more or less an insignificant increase.

17.10.22 The way sound levels add together means that where a sound level from a new source is below the current ambient sound level by 10 dB, or greater, there is no significant change to the current ambient sound level.

17.10.23 In a similar way, if there are two new sound sources (from two separate new developments), the contribution from each source would have to be relatively close and at least within 5 dB of each other at the same receptor position, in order for the cumulative effect of the two sources to produce a perceptible increase (above 1 dB). In practice, cumulative effects of noise are therefore unlikely, unless developments are closely aligned in terms of having equal sound emission and similar distance to receptors.

17.10.24 During the construction phase of the Proposed Development, if this coincides with the construction phase of other projects considered in **paragraph 17.8.57**, the large distances of these other developments from the Proposed Development site (4.5-26 km) alone means that all these sites are too distant to contribute to construction noise impacts at Loch Kemp NSRs.

17.10.25 In addition, the nearest two developments considered are both wind farm developments and construction noise from these developments was scoped out of their EIA Reports, as it was accepted by THC that this aspect would not be a potential issue.

17.10.26 It is therefore concluded that the cumulative impacts of construction noise of all developments considered together, will be the same as the predicted impacts from the Loch Kemp proposed development alone.

17.10.27 Whilst the various development sites are separated by large distances, the construction vehicles, including HGVs, associated with each development, do share the public road network, therefore a cumulative evaluation of the effects of this is now considered.

17.20: Traffic Flows (2025) Baseline with Cumulative from Proposed Kemp Development and Consented Developments (during Construction) 18-Hour Traffic Flows

Road Section	2025 baseline		Total baseline and Kemp development and consented developments 2025		% Increase (Impact)	
	All	HGV	All	HGV	All	HGV
B852 Bailebeag (loc. 3)	349	69	1184	255	239	269
B862 at site access (loc. 6)	793	193	1231	297	54	54
B862 east of Fort Augustus (loc. 7)	873	234	1,024	270	21	22
A82 west of Aberchalder (loc. 13)	3,447	252	3,750	487	93	93
A82 south of Drumnadrochit (loc. 14)	4,501	819	4,847	1,050	10	30

17.10.28 The percentage increase in road traffic during the construction phases of the potential developments should they be carried out simultaneously with the other consented developments, in most instances only rises slightly, however the impact is greatest at the B852 at Bailebeag (loc. 3). Here, with only the Loch Kemp potential development the total road traffic increases by 4%, however with all the consented schemes being constructed at the same time, this becomes a 239% increase, albeit from a very low baseline.

17.10.29 The change in noise level in the cumulative assessment of construction road traffic is shown in **Table 17.21: LA10,18hr Current and Projected Cumulative (during Construction) Traffic Noise Calculations.**

Table 17.21: LA10,18hr Current and Projected Cumulative (during Construction) Traffic Noise Calculations

Road Section	Scenario	Average 18hr daytime flow			$L_{A10,18\ hour}$
		All veh.	Heavy	% heavy	BNL (10m)[1]
B852 Bailebeag (loc. 3)	A	349	69	20	(56.2)
	B	1,184	255	22	60.2
	Change	+835	+186		(4.0)
B862 at site access (loc. 6)	A	793	193	24	(60.4)
	B	975	297	24	60.8
	Change	+182	+104		(0.4)
B862 east of Fort Augustus (loc. 7)	A	873	234	27	(61.2)
	B	1054	270	26	59.7
	Change	+181	+36		(-1.5)
A82 west of Aberchalder (loc. 13)	A	3,477	252	7	65.7
	B	3,857	487	13	67.2
	Change	+380	+235		1.5
A82 south of Drumnadrochit (loc. 14)	A	4,501	819	18	68.7
	B	4,935	1050	22	69.5
	Change	+434	+231		0.8

17.10.30 The change in noise level does remain broadly <1 dB at some locations, but no longer all locations now other projects are considered simultaneously. At the A82 west of Aberchalder (loc. 13) the change is +1.5B, which is a negligible impact and a slight significance of effect. However, at B852 Bailebeag (loc. 3) the change is +4.0 dB but in this case the 10 m noise level (BNL) remains low in absolute terms, at 60.2 dB. It should be noted that one consented project (the Red John Hydro Pumped Storage Hydro Scheme) dominates the cumulative impact here, as it contributes 10 x the number of vehicles of the Proposed Development. Furthermore, the Red John Pumped Storage Hydro Scheme would generate a large number of HGV traffic on this section of the B852, whereas the Proposed Development would generate no HGV traffic on this section of road, only cars and

LGVs. On this basis, the cumulative impact assessment of the Red John Hydro Pumped Storage Hydro Scheme including the Proposed Development's construction traffic, will be essentially no different to the assessment solely of the Red John Pumped Storage Hydro project. However, in the noise chapter[3] of the EIA Report for the Red John Pumped Storage Hydro Scheme, an assessment of construction road traffic was scoped out by agreement with THC, so no formal conclusion was drawn as to its effect.

17.10.31 Under these circumstances, when Red John and other consented developments, along with the Proposed Development's construction traffic, the change in noise level at B852 Bailebeag (loc. 3) is +4.1 dB. The dominance of the Red John Pumped Storage Hydro Scheme's construction traffic means that the cumulative magnitude of impact is potentially moderate, and therefore the **significance of effect is also moderate** and therefore **significant.**

17.10.32 The dominance of the Red John Pumped Storage Hydro Scheme project over the Proposed Development in terms of construction vehicle noise impact on the B852 (loc. 3) by a factor of 10 x, and the absence of any HGV traffic associated with the Proposed Development on this road section, should be noted. In addition, should the construction phases overlap there exists further scope, in more detailed traffic plans, to minimise overall impacts.

Operation

17.10.33 During operational phase of the Proposed Development, the cumulative impact of this development and other consented developments are shown in **Table 17.16: Summary of Predicted Cumulative Operating Noise Levels LAeq,T** to be Laeq,T 24 dB at the nearest sensitive receptor (NSR 5) and lower at the other receptors. The switching station development (Associated Works) has been modelled as a worst case at LAeq,T 26dB at Receptor NSR 3a (Dell Farm) although in practice even standard equipment is more likely to generate no more than LAeq,T 21 dB. This is a level of noise that is substantially below the existing background noise levels both during the day and night. The magnitude of impact is predicted to be low and the **significance of effect, slight** and therefore **not significant**. The cumulative noise during the operational phase of the Proposed Development will therefore be substantially below the level of a significant effect.

17.11 Conclusion

17.11.0 A noise impact assessment (NIA), to include either a qualitative, or quantitative, assessment appropriate to each identified potential impact, has been completed for the purpose of describing the likely effects on the receptors identified as being most sensitive to noise produced by the Proposed Development during construction and operation.

17.11.1 The following key mitigating measures have been identified for the purpose of controlling noise and vibration levels produced by the construction and operation of the Proposed Development:

- Construction noise and vibration would primarily be managed through a CNVMP, which would be formally agreed THC, prior to construction work commencing. As a general principal, consideration would be given in the CNVMP for adopting the 'best practicable means' to noise and vibration control;

[3] *Red John Pumped Storage Hydro Scheme EIA. Chapter 16:Noise and Vibration, AECOM, November 2018*

- A 2 m high timber acoustic barrier is recommended to be installed on the south side of the access track, along a section of around 500 m in length, to reduce the noise impact during the construction phase, to Braeholm (NSR 4) and other residents in Easter Drummond. This would be removed once the Proposed Development is in operation.
- The Caledonian Canal System would be used for the delivery of abnormal load components of E&M equipment associated with the lower reservoir works of the Proposed Development, removing a large number of potential AIL movements from the road network. Furthermore, the creation of a track to connect the lower reservoir works area to the upper reservoir and dams, provides an opportunity to supplement rock quarried within the upper reservoir, with suitable tunnel spoil from the underground works, for dam construction; and
- The control of operational noise would be integral to the acoustic design of the powerhouse and its ventilation apertures, as all the main items of generation equipment would be contained within it.

17.11.2 With the implementation of these mitigation measures, no significant residual effects are predicted. Similarly, no significant cumulative residual effects are predicted.