13 NOISE & VIBRATION

13 NOISE & VIBRATION

13.1 Introduction

13.1.1 This chapter presents the Noise Impact Assessment undertaken following guidelines set out in the IEMA publication “Guidelines for Environmental Impact Assessment”, relevant British Standards and planning guidance. The chapter sets out the baseline conditions including an appraisal of the background noise levels of the site and surrounding area, noise sensitive receptors and existing vibration levels.

13.1.2 This chapter will set out the potential noise effect during both the construction, operational and decommissioning phases of the Development. The proposed scope of assessment has been discussed and agreed with the local Environmental Health Department.

13.1.3 The different components of the site and the likely construction phases for the Development are outlined in this chapter. Activities which may produce noise effects include blasting, drilling, tunnel boring, crushing, and general surface plant operation.

Summary of 2012 Environmental Statement Chapter

13.1.4 Potential effects included noise and vibration, specifically blasting, from the construction phase of the approved scheme. During the operational phase, potential effects include operation of turbines and generators, electrical equipment, the workshop and pumping station.

13.1.5 With the implementation of mitigation measures, residual effects during construction are predicted to range from moderate/major adverse to negligible, and during operation, from minor adverse to negligible.

Scope of 2015 Environmental Statement Chapter

13.1.6 This chapter has been updated as follows:

- The planning policy has been updated to include the National Policy Statements and also the update to the British Standards (Section 12.2);
- Additional noise surveys have been undertaken in April 2015 to update the baseline conditions;
- Updated assessment of potential effects (section 13.7) of the proposed changes to the approved scheme, namely the installation of more powerful turbines increasing generating the output from 49.9MW to 99.9MW, information provided post-submission of the 2012 ES on tonal noise and also assessment against the updated British Standards; and
- Additional consideration has been provided with reference to low frequency noise (LFN) following concerns raised through consultation post-submission of the 2012 ES.

13.2 Legislation and Policy Framework

National Policy Statements

13.2.1 Noise and vibration is addressed in Section 5.11 of the Overarching National Policy Statement for Energy (EN-1) and Section 2.9 of National Policy Statement for Electricity Networks Infrastructure (EN-5).

13.2.2 In particular, Section 5.11 of EN-1 presents guidance on noise and vibration effects of development. This has been adopted as the basis for the assessments presented in this ES.

13.2.3 Section 5.11.4 of EN-1 states:

"Where noise impacts are likely to arise from the proposed development, the applicant should include the following in the noise assessment:

- *a description of the noise generating aspects of the development proposal leading to noise impacts, including the identification of any distinctive tonal, impulsive or low frequency characteristics of the noise;*
- *identification of noise sensitive premises and noise sensitive areas that may be affected;*
- *the characteristics of the existing noise environment;*

- *a prediction of how the noise environment will change with the proposed development;*
- *in the shorter term such as during the construction period;*
- *in the longer term during the operating life of the infrastructure; at particular times of the day, evening and night as appropriate;*
- *an assessment of the effect of predicted changes in the noise environment on any noise sensitive premises and noise sensitive areas;*
- *measures to be employed in mitigating noise; and*
- *the nature and extent of the noise assessment should be proportionate to the likely noise impact."*

13.2.4 Section 5.11.9 of EN-1 states:

"The IPC should not grant development consent unless it is satisfied that the proposals will meet the following aims:

- *avoid significant adverse impacts on health and quality of life from noise;*
- *mitigate and minimise other adverse impacts on health and quality of life from noise; and*
- *where possible, contribute to improvements to health and quality of life through the effective management and control of noise."*

National Planning Policy

Planning Policy Wales

13.2.5 Section 13.13 within Planning Policy Wales (PPW) (Edition 7, July 2014) identifies that:

"Noise levels provide an indicator of local environment quality. The objective of a policy for noise is to minimise emissions and reduce ambient noise levels to an acceptable standard."

13.2.6 PPW suggests that development plan policies:

"...should also be designed to ensure, as far as possible, that potentially noisy developments are located in areas where noise will not be such an important consideration or where its effect can be minimised. Local planning

authorities should adopt policies to prevent potentially noisy developments in areas which have remained relatively undisturbed by noise."

13.2.7 Noise Action Plans that aim to protect specific areas within Wales do not extend to the Development site.

Technical Advice Note (TAN) 11: Noise (1997)

13.2.8 TAN 11 provides advice on how the planning system can be used to minimise the adverse impact of noise without placing unreasonable restrictions on development or adding unduly to the costs and administrative burdens of business. It outlines some of the main considerations which local planning authorities should take into account in drawing-up development plan policies and when determining planning applications for development which will either generate noise or be exposed to existing noise sources.TAN11 offers guidance to local authorities on the assessment of noise and its potential effect on noise-sensitive dwellings. TAN 11 also "*provides advice on how the planning system can be used to minimise the adverse effect of noise without placing unreasonable restrictions on development or adding unduly to the costs and administrative burdens of business."*

13.2.9 Where the information with TAN11 references British Standards that have since been superseded, the current version of these standards will be used within this assessment. This include BS4142:2014, BS 5228-1:2008+A1 and BS 5228-2:2009+A1:2014

13.2.10 The likelihood of complaints about noise from industrial development can be assessed, where the Standard is appropriate, using guidance in BS 4142: 2014. Tonal or impulsive characteristics of the noise are likely to increase the scope for complaints and this is taken into account by the "rating sound level" defined in BS 4142.

13.2.11 Detailed guidance on assessing noise from construction sites can be found in BS 5228:2009+A1:2014. In particular, “Part 1 Noise" describes a method for predicting noise from construction sites as well as giving general advice.

Technical Advice Note (TAN) 8: Renewable Energy (2005)

13.2.12 TAN 8 addresses renewable energy policy within Wales, including hydroelectric schemes. The minimal noise advice within TAN 8 that is relevant to the development states the following: "The noise of the turbine will generally be well contained within the turbine house and it would rarely be an issue."

13.2.13 Following the publication of TAN 8 policy and legislative changes have occurred. Annex A of the 'Chief Planning Officers (CPOs) – publication of planning policy Wales edition 4, February 2011' sets out these changes, however, with reference to noise and vibration there are no discernible changes.

A Noise Action Plan for Wales 2013-2018 (NAP)

13.2.14 The NAP explains how different sources of noise are being managed across Wales and by whom, and provides summaries of evidence to support noise policy, it gives examples of positive initiatives that have taken place in Wales.

13.2.15 Regarding industrial noise, Section 6.1 of the NAP states that:

"There is a danger that if the acceptability of a new industrial noise source is assessed relative to the background sound level from all the existing noise sources, this may lead to an ever-increasing noise level where each new source to be added is allowed to be louder than the previous one, known as 'creeping background'. This is clearly inappropriate, because the total noise level has potential to cause harm to health and wellbeing regardless of whether individual components are noticeable."

13.2.16 Noise Action Plans that aim to protect specific areas within Wales do not extend to the Development area.

Control of Pollution Act (COPA) 1974

13.2.17 The provisions of Sections 60 and 61 of the Control of Pollution Act 1974 offer protection to those living in the vicinity of construction sites.

13.2.18 Section 60 enables a local authority to serve a notice specifying its noise control requirements which may include:

- plant or machinery that is or is not to be used;
- hours of working; and,
- levels of noise or vibration that can be emitted.

13.2.19 Section 61 relates to prior consent, and is for situations where a contractor or developer takes the initiative and approaches the local authority before work starts to obtain approval for the methods to be used and any noise and vibration control techniques that may be required.

13.2.20 The term 'Best Practicable Means' (BPM) is defined in Section 72 of the Control of Pollution Act 1974, where 'practicable' means reasonably practicable having regard among other things to local conditions and circumstances, to the current state of technical knowledge and to the financial implications.

Local Planning Policy

13.2.21 Planning policy for Gwynedd Council is contained within the Gwynedd UDP 2001-2016. There are no noise policies to address this specific type of Development, however Policy B33 provides general guidance for with respect to development that has the potential to create pollution or nuisance.

Policy B33 - Development That Creates Pollution or Nuisance

13.2.22 “Proposals that will cause significant harm to the quality of public health, safety or amenities, or to the quality of the built or natural environment as a result of higher levels of air, water, noise, or soil pollution will be refused unless adequate controls can be attained by means of planning conditions and powers of regulatory bodies, and that arrangements can be made to monitor discharges.”

13.2.23 Appendix 6 of the UDP provides a definition of a Noise Effect Assessment

“A Noise Effect Assessment should be submitted with the planning application when the Development is likely to create an unacceptable level of noise. Planning authorities' consideration of planning applications that raise significant noise issues will be greatly assisted by a Noise Effect Assessment. These can be used to show whether a noise problem is likely

to occur, demonstrate its implications and help identify measures for its effective control or mitigation. A Noise Effect Assessment may be included within an EIA."

Chapter Specific Legislation

13.2.24 The following documents have been referred to as part of this assessment. Further details about the documents can be found in the assessment section.

- BS 4142:2014 Method for Rating and Assessing Industrial and Commercial Sound;
- BS 5228:2009+A1:2014 Noise and Vibration Control on Construction and Open Sites Parts 1 and 2 (with amendments, 2014);
- BS 6472-1: 2008. 'Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting';
- BS 6472-2: 2008. 'Guide to evaluation of human exposure to vibration in buildings. Blast-induced vibration';
- Minerals Planning Guidance (MPG) 11: "The control of noise at surface mineral workings"; and
- Design Manual for Roads and Bridges Volume 11 Section 3 Part 7 HD 213/11 (revision 1) 'Noise and Vibration'.

13.3 Scope of Assessment

13.3.1 The baseline study includes an appraisal of background noise levels, identifying the acoustic character of the surrounding area.

13.3.2 An acoustic assessment will be made as to how the Development will affect noise sensitive receptors as well as the wider area.

13.3.3 Baseline studies will be used to inform the acoustic assessment. Mitigation measures will be developed to minimise potential adverse noise effects.

13.3.4 Decommissioning will involve the drainage of water through the reservoirs to Llyn Padarn and the removal of above ground structures. No blasting or crushing will be required and it is considered that the effects will be negligible. Therefore it is not considered further.

13.4 Consultation

13.4.1 The following presents details of the consultation as part of the 2012 ES Chapter for noise and vibration as well as the consultation undertaken in 2015 regarding the additional noise surveys.

13.4.2 In the Gwynedd Council response to the approved scheme's Scoping Report, noise issues were raised under the heading of "Public Protection". Comments were provided stating that the ES should identify all receptors that are potentially vulnerable to the effects of noise, dust, vibration and heavy haulage. The authority's Public Protection Department would monitor the site for environmental effects. It is advisable that a local liaison group be set up to discuss matters relating to noise, dust and vibration with representatives of the developers and a delegation of local councillors and residents.

13.4.3 As requested within the 2012 Scoping Response, consultation has been conducted with an Environmental Health Officer (EHO) with Gwynedd Council regarding the noise assessment for the approved scheme.

13.4.4 In consultation with Gwynedd Council, agreement was made on six residential receptor locations for the monitoring of existing ambient and background noise levels.

13.4.5 It was agreed that 24 hour monitoring would be conducted and that additional short term attended measurements during the night period would supplement the unattended measurements.

13.4.6 Gwynedd Council recommended that operational noise from the Development would need to be assessed in accordance with BS 4142:1997. It was communicated that as specific information on the power generating plant to be used for the Development would be unavailable, that an operational noise assessment of the Development would be excluded from this assessment. However, as requested by Gwynedd Council, operational noise limits would be established and noise emissions from underground power generating plant would incur a 5 dB penalty due to low frequency noise. Accordingly, an allowance for this 5 dB low frequency penalty has been included when determining the noise limits for the Development.

13.4.7 BS 5228 (Part 1 and Part 2) was agreed to be used to assess noise and vibration effects from construction activities.

13.4.8 The preference of Gwynedd Council with regard to construction noise limits was to use the guidance provided within Minerals Planning Guidance (MPG) 11: The Control of Noise at Surface Mineral Workings.

13.4.9 The EHO of Gwynedd Council emphasised that the assessment should look at ways to minimise noise effects from construction, including but not limited to:

- no blasting at night, weekends or bank holidays, and
- planning noisy activities at the start of the week (so delays would not continue into the weekend).

13.4.10 The EHO of Gwynedd Council indicted that if blasting, piling, or other works were to occur outside normal construction hours, the Council would require the work to be undertaken with a COPA Section 61 agreement.

13.4.11 Following the initial 2012 consultation, the 2014 version of BS 4142 came into effect on 31 October 2014 and has superseded the previous 1997 version of BS 4142. However, in terms of assessment methodologies, there are in practice no differences between the 2014 and 1997 standards. The 2014 version still assesses impacts by comparing the ‘Rating sound level’ of the new sound source with the existing ‘Background sound level’.

13.4.12 Additional clarification was provided post-submission of the 2012 ES in July 2013 and this information has been incorporated into this chapter for completeness. This has also included the additional information related to tonal noise which was provided post-submission of the 2012 ES.

13.4.13 Following the submission of the Scoping Report (January 2015), further consultation was undertaken in March 2015 with Gwynedd Council to agree on the methodology for the additional 2015 baseline noise surveys.

13.4.14 An initial noise survey plan was submitted for review to Gwynedd Council on the 23rd March 2015. Gwynedd Council was satisfied with the survey locations and methodology, but recommended unattended noise monitoring

for a minimum period of 24 hours at each location rather than the short term attended monitoring approach initially proposed by AECOM.

13.4.15 It is noted that unattended 24-hour monitoring was not proposed at the caravan park location or the Surf Lines location. This was because the caravan park is currently under construction and therefore the noise environment at this location would not be representative of the baseline noise environment. A daytime only survey is appropriate for the Surf Lines locations since amenity use is limited to daytime hours only. It was agreed that the finalised survey plan comprises minimum 24-hour measurements, where practicable and/or appropriate, at each location supplemented by attended 'spot check' measurements during daytime and night time periods to make observations on the dominant noise sources in the area.

13.4.16 Following the baseline survey in April 2015, a technical note summarising the 2015 baseline survey (see Appendix 13.2) was sent to Gwynedd Council for review on the 18th June 2015. Due to road works on the A4086 during the daytime periods short term attended monitoring was undertaken at Locations 3 and 6. Following a review of the noise survey report, Mr Alun Evans responding on the 24th July 2015 stating that consideration should have been given to returning to the locations affected by the road construction works at a later date once the construction works had been completed to measure the noise levels. As a precautionary approach, the results from the attended 2012 surveys have been used at these locations to determine the construction and operational noise limits.

13.4.17 Gwynedd Council also queried why noise monitoring equipment not was left during the evening and night- time periods at Locations 3 and 6. .Rather than long-term unattended measurements, short-term attended measurements were instead carried out at these locations in order to obtain observations of the noise climate and readily exclude any influence of construction works noise on the measurements, as it was not known what time the construction works would commence in the morning or cease in the evening.

13.5 Methodology

13.5.1 In order to aid the reading of the methodology section, please note the following definitions of principal terms as follows (as found in BS4142):

- ambient sound - the totally encompassing sound in a given situation at a given time usually composed of sound from many sources near and far;
- specific sound $L_{Aeq, T}$ - the sound source under consideration;
- rating sound level – L_{ArTr} is the specific noise level corrected to allow for certain distinctive acoustic features;
- residual sound L_{Aeq} - the ambient sound remaining when the specific sound is sufficiently suppressed so as not to contribute to the ambient sound level; and,
- background sound $L_{A90,T}$ - the measured $L_{A90,T}$ level of the residual sound.

BS 5228-1:2009 Code of practice for noise and vibration control on construction and open sites. Part 1: Noise (with 2014 amendment)

13.5.2 Noise levels generated by demolition and construction activities are subject to Local Authority control under the Control of Pollution Act 1974. Supplementary advice is provided by British Standard BS 5228-1:2009 'Code of Practice for Noise and Vibration Control on Construction and Open Sites' with respect to noise assessment and mitigation.

13.5.3 BS 5228-1:2009 contains a noise emission database for individual construction plant, their associated activities, and methods of working. Unless noise level data is available from manufacturers, the BS 5228-1:2009 database is used when predicting noise levels associated with various construction activities.

13.5.4 Construction noise levels are considered to result in an adverse effect when the adopted criterion is exceeded. Where noise levels fall below the adopted criterion a negligible noise effect would be concluded.

13.5.5 For the purposes of the construction assessment, the equipment, locations and timings have been modelled based on our best knowledge to date.

13.5.6 The outcome of the construction assessment will be to inform the use of Best Practicable Means (BPM) to mitigate noise during construction, as recommended by the Control of Pollution Act 1974.

BS 5228-2:2009 Code of practice for noise and vibration control on construction and open sites. Part 2: Vibration (with 2014 amendments)

13.5.7 BS 5228-2:2009 addresses the need for the protection against vibration for persons living in the vicinity of construction sites and recommends procedures for vibration control. BS 5228-2:2009 recommends that:*'.... it is considered more appropriate to provide guidance in terms of the PPV (Peak Particle Velocity), since this parameter is likely to be more routinely measured based upon the more usual concern over potential building damage'.*

13.5.8 BS 5228-2:2009 provides empirical formulae relating resultant PPV for vibratory compaction, percussive and vibratory piling, dynamic compaction, the vibration of stone columns and tunnel boring operations.

13.5.9 Table 13-1 is taken from BS 5228-2:2009, and provides guidance on the effects of vibration in relation to human perception and disturbance.

Table 13-1 Guidance on Effects of Vibration Levels

PPV (mm/s)	Effect
0.14	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3	Vibration might be just perceptible in residential environments.
1.0	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation is given to residents.
10	Vibration is unlikely to be tolerable for any more than a very brief exposure to this level.

BS 6472-2: 2008. 'Guide to evaluation of human exposure to vibration in buildings. Part 2: Blast-induced vibration

13.5.10 BS 6472-2 provides guidance on human exposure in buildings to blast-induced vibration and air overblasts. It is primarily applicable to blasting associated with mineral extraction but can also be applicable to explosives used within civil engineering and demolition.

13.5.11 BS 6472-2 advises that to predict the likely vibration magnitude from a controlled blast, a series of measurements at several locations should be taken from one or more trial blasts. Using the formula provided in BS 6472-2 and extrapolation of the trial blast results, the likely vibration magnitudes at a given distance (for a given maximum instantaneous charge) can be predicted.

13.5.12 The standard suggests that accredited blasting contractors will appropriately design blasts to minimise effects at Noise Sensitive Receptors (NSRs).

13.5.13 For blast vibration occurring up to three times per day the generally accepted maximum satisfactory magnitude for residential premises is a peak particle velocity (PPV) of between 6.0 mm/s• and 10.0 mm/s.

13.5.14 Should more than three blasts be required per day, BS 6472-2 provides information on the acceptable vibration limits.

13.5.15 BS 6472-2 states that "*Accurate prediction of air overpressure (from blasting) is almost impossible due to the variable effects of the prevailing weather conditions and the large distances often involved."*

13.5.16 Whilst not providing any specific air overblast limit, BS 6472-2 provides the following information on acceptable overblast pressures: 'Windows are generally the weakest parts of a structure exposed to air overpressure. Research by the United States Bureau of Mines has shown that a poorly mounted window that is pre-stressed can crack at around 150 dB(lin), with most windows cracking at around 170 dB(lin). Structural damage would not be expected at air overpressure levels below 180 dB(lin).'

13.5.17 The air overpressure levels measured at properties near quarries in the United Kingdom are generally around 120 dB(lin), which is 30 dB(lin) below, or only 3% of, the limit for cracking pre-stressed poorly mounted windows.

BS 7385: Part 2: 1993 "Evaluation and measurement for vibration in buildings. Part 2 Guide to damage levels from groundborne vibration"

13.5.18 BS 7385-2:1993 provides guidance on the levels of groundborne vibration above which the building structures could be damaged. This is particularly relevant for the Development due to the possible use of a tunnel boring machine (TMB) to construct the penstock.

13.5.19 For the purposes of BS 7385-2:1993, damage is classified as cosmetic (formation of hairline cracks), minor (formation of large cracks) or major (damage to structural elements). Guide values given in BS 7385-2:1993 are associated with the threshold of cosmetic damage only, usually in wall and/or ceiling lining materials.

13.5.20 BS 7385 provides a frequency-based vibration criterion for transient vibration induced cosmetic damage, which is reproduced in Table 13-2.

Table 13-2 Transient vibration guide values for cosmetic damage

Type of building		**Peak component particle velocity in frequency range of predominant pulse**	
		4 Hz to 15 Hz	***15 Hz and above***
1	Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Un-reinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
NOTE 1. Values referred to are at the base of the building NOTE 2. For line 2, at frequencies below 4 Hz, a maximum displacement of 0.6mm (zero to peak) should not be exceeded.			

13.5.21 When considering continuous vibrations, even taking the precautionary approach of halving the guideline vibration values for transient vibration induced minor cosmetic damage to buildings (from BS 7385), the resulting guidelines are still orders of magnitude above the threshold of perception and substantially higher than equivalent values likely to provoke complaint.

13.5.22 The guidance on acceptable vibration levels in structures provided in BS 5228-2: 2009 recommends adopting the building damage vibration guidelines from BS 7385.

Minerals Planning Guidance (MPG) 11: The control of noise at surface mineral workings

13.5.23 Although the Development does not involve the extraction of minerals, the preference of Gwynedd Council EHO was to use the guidance provided within MPG 11 with regard to NSRs construction noise limits due to the similar nature of construction activity.

13.5.24 Paragraphs 31-43 of MPG 11 describe a recommended method for setting noise limit values. The recommendation is that daytime free-field noise limits should not be higher than $L_{Aeq,1h}$ 55 dB, and night time limits shall be set at $L_{Aeq,1h}$ 42 dB.

13.5.25 In quieter rural areas a lower daytime limit may be appropriate when a limit of $L_{Aeq,1h}$ 55 dB would exceed the existing background noise levels by more than 10 dB. In this case we propose a $L_{Aeq,1h}$ noise limit of background noise + 10 dB.

13.5.26 Where the daytime background noise level is below L_{A90} 35 dB(A), MPG 11 proposes a fixed lower criterion limit of $L_{Aeq,1h}$ 45 dB, to avoid "unduly restrictive" noise criteria being placed on the operator.

13.5.27 Within MPG 11, daytime working is defined as 0700-1900 hours and night-time as 1900-0700 hours.

13.5.28 Paragraph 61 of MPG 11 suggests that it may be necessary to increase the noise limit for an 8 week period (per year) that would allow potentially noisy activities to occur up to a level of $L_{Aeq,1h}$ 70 dB. This period may be required during the Development, at the start and end of the penstock and tailrace

tunnel construction, or for other noisy activities such as the construction of earth/spoil bunds to provide noise screening.

BS 4142:2014 - Method for Rating and Assessing Industrial and Commercial Sound

13.5.29 To assess the significance of noise effect at the nearest residential properties following the introduction of the Development, an operational noise effect assessment has been undertaken in accordance with BS 4142: 2014.

13.5.30 BS 4142:2014 provides guidance as to the likely community response to new fixed noise sources (e.g. building plant or services) affecting NSRs. Note that the 2014 version of BS 4142 came into effect on 31 October 2014 and has superseded the previous 1997 version of BS 4142.

13.5.31 BS 4142 describes methods for rating and assessing sound of an industrial and/or commercial nature. The method compares the rating level with the background level.

- The rating level is the specific noise level due to the noise source under investigation plus an adjustment for any features of the character of the noise that would be likely to increase its impact.
- The background level is the L_{A90} value (noise level exceeded for 90% of the time) measured at the receptor, in the absence of the specific noise.

13.5.32 The standard states that the appropriate reference time interval for daytime and night-time periods is 1 hour and 15 minutes, respectively.

13.5.33 The rating method detailed within this standard is widely accepted by Local Authorities as a means of assessing building plant noise. BS4142 requires separate analysis for day and night time periods. BS4142 states the following regarding the assessment of impacts, comparing the rating level of the new noise source with the existing background level:

a) “Typically, the greater this difference, the greater the magnitude of the impact.

b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.

c) A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.

13.5.34 The lower the rating sound level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating sound level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context."

13.5.35 Note that section 1.3 of BS 4142:2014 advises that 'the determination of noise amounting to a nuisance is beyond the scope of the standard', and that 'the standard is not intended to be applied to the derivation of indoor sound levels arising from sound levels outside, or the assessment of indoor sound levels'.

13.5.36 Background noise typically varies throughout the day and night. For plant that may operate on a 24-hour basis, it is appropriate to measure background noise levels during representative daytime and night-time periods at the nearest residential property and to use this value for comparison against the predicted rating sound level from the new plant.

13.5.37 Note that while the assessment methodology from BS 4142:2014 has similarities to that of MPG11 as detailed above, the BS 4142:2014 methodology is intended to apply to the operational phase of the development whereas the MPG11 methodology is intended to apply to the construction phase of the development.

Design Manual for Roads and Bridges (DMRB)

13.5.38 The DMRB sets out the requirements for undertaking noise and vibration assessments, as well as providing guidance on the methodology to be used when assessing the noise and vibration effects arising from all road projects.

13.5.39 The guidance provides advice on how a percentage change in vehicle movements relates to a decibel change in road traffic noise: *'A change in noise level of 1 dB $L_{A10,18h}$ is equivalent to a 25% increase or a 20% decrease in traffic flow, assuming other factors remain unchanged and a*

change in noise level of 3 dB $L_{A10,18h}$ is equivalent to a 100% increase or a 50% decrease in traffic flow.'

13.5.40 DMRB defines classifications of 'magnitude of noise effects' from road traffic. Construction traffic noise would typically be described as a short term effect (less than 15 years). The magnitude of effect tables from DMRB are reproduced in Table 13-3.

Table 13-3 Classification of Magnitude of Noise Effects in the Short Term

Noise Change $L_{A10,18h}$	Magnitude of Effect
0	No Change
0.1 - 0.9	Negligible
1 - 2.9	Minor
3 - 4.9	Moderate
5+	Major

Criteria for Sensitivity of Receptors

13.5.41 The adopted assessment of noise effects is based on the sensitivity of the noise receptor and the magnitude of the noise level exceedance of the relevant noise and vibration criteria.

13.5.42 The sensitivity of receptors to noise and vibration is based on their usage as defined in Table 13-4.

Table 13-4 Criteria Used to Define Sensitive Receptors

Sensitivity	Description	Examples of receptor usage
High	Receptors where people or operations are particularly susceptible to noise or vibration.	Residential. Quiet outdoor areas used for recreation. Conference facilities. Auditoria/studios. Schools in daytime. Hospitals/residential care homes.

Table 13-4 Criteria Used to Define Sensitive Receptors		
Sensitivity	**Description**	**Examples of receptor usage**
Medium	Receptors moderately sensitive to noise or vibration, where it may cause some distraction or disturbance	Offices. Restaurants. Sports grounds when spectator noise is not a normal part of the event and where quiet conditions are necessary (e.g. tennis, golf).
Low	Receptors where distraction or disturbance from noise or vibration is minimal	Residences and other buildings not occupied during working hours. Factories and working environments with existing high noise levels. Sports grounds when spectator noise is a normal part of the event.

Criteria for Industrial Noise Effects

13.5.43 With regard to industrial noise i.e. the operational phase of the Development, the classification of magnitude of effects is presented in Table 13-5 which is based upon the advice of BS 4142 (levels during the operational phase and then subtracting the measured background noise level from the rating sound level).

Table 13-5 Classification of Magnitude of Effect - Operational Phase	
Difference Between Rating and Background Levels	**Magnitude of Effect**
≤-10	Neutral
-9 to 0	Negligible
1 to +4	Minor
+5 to +9	Moderate
≥ +10	Major

Criteria for Construction Noise and Vibration Effects

13.5.44 Construction noise limits at the nearest sensitive receptors have been derived from MPG 11 for this assessment. Professional judgement has been used to derive magnitude of construction noise effects, which are presented in Table 13-6.

Table 13-6 Classification of Magnitude - Construction Noise

Magnitude of Effect	Criteria
Negligible	Generation of $L_{Aeq,1hr}$ daytime facade noise levels that are equal to or below the daytime criterion limit*. Generation of night time facade noise levels that are equal to or below $L_{Aeq,1hr}$ 42 dB
Minor	Generation of $L_{Aeq,1hr}$ daytime facade noise levels that are +1 to +4 dB above the criterion limit* Generation of night facade noise levels that are +1 to +4 dB above $L_{Aeq,1hr}$ 42 dB
Moderate	Generation of $L_{Aeq,1hr}$ daytime facade noise levels that are +5 to +9 dB above the criterion limit* Generation of night facade noise levels that are +5 to +9 dB above $L_{Aeq,1hr}$ 42 dB
Major	Generation of $L_{Aeq,1hr}$ daytime facade noise levels that equal to or are more than 10 dB above the criterion limit* Generation of night facade noise levels that are equal to or are more than 10 dB above$L_{Aeq,1hr}$ 42 dB

*The daytime $L_{Aeq,1hr}$ criterion limit is defined as the background noise level + 10 dB, or $L_{Aeq,1hr}$ 45 dB, whichever is the greater.

13.5.45 Construction vibration limits at the nearest sensitive receptors have been derived from BS 5228-2:2009 for this assessment. Professional judgement of the magnitude of construction vibration effects has been made to define the magnitude of construction vibration effects as shown in Table 13-7.

Table 13-7 Classification of Magnitude - Construction Vibration		
Magnitude of Effect	**PPV (mm/s)**	**Effect**
Negligible	0.14	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
Minor	0.3	Vibration might be just perceptible in residential environments.
Moderate	1.0	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation is given to residents.
Major	10	Vibration is unlikely to be tolerable for any more than a very brief exposure to this level.

Significance of Effects

13.5.46 Based on the appropriate aforementioned derived magnitude of effects and the sensitivity of the receptor to noise, the significance of effects are as shown in Table 13-8.

Table 13-8 Significance of Effects			
Magnitude of Effect	**Sensitivity**		
	Low	**Medium**	**High**
Major	Moderate	Moderate	Major
Moderate	Minor	Moderate	Major
Minor	Minor	Minor	Moderate
Negligible	Negligible	Minor	Minor

13.5.47 Any significance levels of moderate and major are defined as significant effect.

13.6 Baseline Conditions

13.6.1 The following presents details of the methodology for determining the baseline conditions as part of the 2012 ES Chapter for noise and vibration, as well as additional the April 2015 baseline noise surveys.

13.6.2 The baseline assessment includes an appraisal of the background noise levels of the site and surrounding area where potentially adverse effects may occur. The study identifies the character of the surrounding area and provides a base for how the Development will affect individual receptors as well as the wider area.

13.6.3 For the July 2012 surveys, 24-hour unattended noise surveys have been carried out at locations surrounding the Development site. As agreed in 2012 consultation with the Gwynedd Council EHO these surveys were undertaken at a representative sample of NSRs surrounding the Development. Supplementary attended noise monitoring was conducted during night periods at the locations where unattended noise monitoring was conducted, as well as Location 4 (day and night), and Location 1/2 (night only), as shown on Volume 4 Figure 13.1.

13.6.4 For the April 2015 surveys, 24-hour unattended noise surveys have been carried out at locations surrounding the Development site. Supplementary attended noise monitoring was conducted during daytime, evening and night-time periods. Survey locations are presented in Volume 4 Figure 13.1. Noise monitoring has been repeated at the six monitoring locations from the 2012 survey and at two additional locations, a caravan park which is currently under construction and Surf Lines (commercial/ leisure premises).

13.6.5 The noise surveys measured a number of noise parameters including:

- L_{A90}, an indicator of background noise;
- L_{A10} the UK's adopted index for quantifying road traffic noise;
- L_{Amax}, an indicator of maximum noise level*s*; and,
- L_{Aeq}, the equivalent continuous noise level.

13.6.6 Measurements have been conducted in accordance with the principles of BS 7445-1:2003 'Description and Measurement of Environmental Noise Part 1: Guide to Quantities and Procedures' and BS 4142:2014.

Noise Sensitive Receptors

13.6.7 There are numerous NSRs surrounding the Development site. Due to the size of the project, residential properties are located at a large range of distances from various components of the Development.

13.6.8 Prior to the noise surveys being conducted, locations of representative NSR locations were agreed with the EHO at Gwynedd Council. It was also agreed that additional short term measurements would be conducted to supplement the 24 hour unattended noise surveys.

13.6.9 Once on site during the July 2012 survey, it was established that the owners of one of the locations (Warden Street) were on holiday, preventing the installation of noise equipment. Consequently, only attended noise measurements could be conducted at this location (Location 4).

13.6.10 During both 2012 and 2015 surveys, it was not possible to carry out night-time measurements due to access restrictions at Tan Hafotty (Location 1) and Ty Newydd (Location 2). Instead, attended night-time measurements were taken at a single representative location along Clegir Lane.(Location 1/2)

13.6.11 As previously mentioned in the consultation section, at some locations it was not practicable to carry out unattended 24-hour noise monitoring due to nearby construction works (Glan Llyn (Location 3) Lake View Hotel (Location 6) and Caravan Park (Location 7). Instead, attended measurements were carried out at these locations in order to readily exclude any influence of constructions works noise on the measurements.

Existing Ambient and Background Noise Levels

13.6.12 The environmental noise survey for the Development was undertaken to characterise and quantify the existing baseline ambient and background noise levels within the area.

13.6.13 Attended and unattended noise surveys were conducted at all of the locations as shown in Volume 4 Figure 13.1. Table 13-9 describes the noise measurement locations in more detail.

Table 12-9 Noise Measurement Locations

Location	NSR Name / Address	Description
1	Tan Hafotty	A single story 19th Century slate cottage located in a remote position at the end of a single track road off Ffordd Clegir to the north west of the former Glyn Rhonwy slate quarry. Grid Co-ordinates: X 256179, Y 361031
2	Ty Newydd, Clegir	A two story stone farm house located in a remote position on a single track road just off Ffordd Clegir to the north west of the former Glyn Rhonwy slate quarry. Grid Co-ordinates: X 256061, Y 360946
1 / 2 (night)	At the entrance to the private road to Loc. 1 & 2	Observations of night-time noise events were carried out at the gated entrance to measurement positions 1 (Tan Hafotty) and 2 (Ty Newydd, Clegir). This was used instead of directly accessing measurement positions 1 and 2 during the night time in order to prevent disturbance of residents within those properties. Grid Co-ordinates: X 256174, Y 361109
3	Glan Llyn	A two story residential dwelling fronting the A4086 to the east of former Glyn Rhonwy slate quarry. Grid Co-ordinates: X 257117, Y 360933
4	4 Warden Street	A two story end terrace located on Warden Street to the south east of the former Glyn Rhonwy slate quarry. Grid Co-ordinates: X 257528, Y 360431
5	Ty-Du/ Ael y Glyn	A derelict 17th Century stone cottage just off Ffordd Clegir to the south east of the former Glyn Rhonwy slate quarry. Grid Co-ordinates: X 256964, Y 360307

Table 12-9 Noise Measurement Locations		
Location	**NSR Name / Address**	**Description**
6	Lake View Hotel	A two story hotel and restaurant fronting the A4086 to the north of the former Glyn Rhonwy slate quarry. Grid Co-ordinates: X 256594, Y 361215
7 (2015 survey only)	Caravan Park (Consented, under construction)	Proposed Caravan Park which is located to the east of the site. At the time of the surveys this was under construction. Grid Co-ordinates: X 257242, Y 360758
8 (2015 survey only)	Surf Lines	Lakeside commercial/leisure facility. Not open during night-time periods. Grid Co-ordinates: X 257356, Y 360836

13.6.14 Due to access restrictions (as detailed in Table 12-9) observations of the night-time noise environment were carried out at Location 1/2 which was considered to be representative of the night-time environment at Locations 1 and 2.

13.6.15 As the Surf Lines receptor (Location 8) is for commercial/leisure purposes and is not open during night time periods, it was considered that night time monitoring is not required at this location.

13.6.16 The calibration of the equipment was checked before and after each set of measurements and found to be within specified limits. All staff involved with noise measurements were competent Members of the Institute of Acoustics.

13.6.17 At each measurement location the microphone was mounted on a tripod or pole, 1.5 metres above the ground in free-field conditions. The following equipment packages were used at each noise measurement location:

July 2012 - Survey Equipment

- Rion NL-32 Class 1 sound level meter s/n 00840885
- Rion NL-52 Class 1 sound level meter s/n 00410086
- GRAS Weatherproof microphone set s/n 55090

- Norsonic 140 Class 1 sound level meter s/n 8182225
- Norsonic 118 Class 1 sound level meter s/n 31509
- Rion NC-74 acoustic calibrator s/n 34672983
- Norsonic 1251 acoustic calibrator s/n 27485

April 2015 – Survey Equipment

- Rion NL-52 Class 1 sound level meter s/n 00840885
- Rion NL-52 Class 1 sound level meter s/n 743082
- Bruel & Kjaer 2250 Class 1 sound level meter s/n 2827275
- Bruel & Kjaer 2250 Class 1 sound level meter s/n 2827263
- Bruel & Kjaer 2238 Class 1 sound level meter s/n 2106193
- Bruel & Kjaer 4231 acoustic calibrator s/n 50541127

13.6.18 A number of details are provided within Tables 13-10 and 13-11 for each of the attended and unattended noise monitoring locations including:

- climatic conditions during the survey; and,
- measurement times and durations.

13.6.19 Weather conditions during the unattended monitoring periods were variable, ranging from heavy rain to dry conditions. Where rain has affected the unattended noise measurements, the data has been excluded from the assessment.

Table 13-10 Unattended Noise Measurement Details

Location	Survey Date	Time and Weather	
		Measurement Start	Measurement End
1	July 2012	05/07/2012 11:10 Approx. 16°C. No noticeable wind	06/07/2012 11:10 Raining. Forecast was for rain from 04:00. Approximately 16°C and no noticeable wind.

Table 13-10 Unattended Noise Measurement Details			
Location	**Survey Date**	**Time and Weather**	
		Measurement Start	**Measurement End**
2	July 2012	04/07/2012 13:52 Approx. 16°C. Very lightly raining with some puddles forming on the roads.	05/07/2012 13:52 Approx. 16°C. Rain stopped the previous afternoon and had remained dry for the remainder of the measurement period.
3	July 2012	04/07/2012 10:20 Approx. 16°C. Very lightly raining with some puddles forming on the roads.	05/07/2012 10:30 Approx. 16°C. Rain stopped the previous afternoon and remained dry for the remainder of the measurement period.
5	July 2012	05/07/2012 09:52 Approx. 16°C. Rain stopped the previous afternoon and remained dry for the remainder of the measurement period.	06:07/2012 10:26 Raining. Forecast was for rain from 04:00. Approximately 16°C
6	July 2012	04/07/2012 09:30 Approx. 16°C. Very lightly raining with some puddles forming on the roads.	05/07/2012 09:32 Approx. 16°C. Rain stopped the previous afternoon and remained dry for the remainder of the measurement period.
1	April 2015	14/04/2015 14:55 Dry. Approximately 15°C. No noticeable wind	15/04/2015 14:55 Dry. Approximately 15°C. No noticeable wind
2	April 2015	14/04/2015 13:54 Dry. Approximately 15°C. No noticeable wind	15/04/2015 13:54 Dry. Approximately 15°C. No noticeable wind
4	April 2015	14/04/2015 12:32 Dry. Approximately 15°C. No noticeable wind	15/04/2015 16:32 Dry. Approximately 15°C. No noticeable wind
5	April 2015	15/04/2015 14:14 Dry. Approximately 15°C. No noticeable wind	16/04/2015 14:14 Dry. Approximately 15°C. No noticeable wind

Table 13-11 Attended Noise Measurement Details			
Location	**Survey Date**	**Time and Weather**	
		Measurement Start	**Measurement End**
3	July 2012	06/07/2012 01:15 Dry. Approximately 12°C	06/07/2012 01:30 Dry. Approximately 12°C
4	July 2012	06/07/2012 00:55 Dry. Approximately 12°C	06/07/2012 01:10 Dry. Approximately 12°C
5	July 2012	06/07/2012 00:35 Dry. Approximately 12°C	06/07/2012 00:50 Dry. Approximately 12°C
6	July 2012	06/07/2012 01:35 Dry. Approximately 12°C	06/07/2012 01:50 Dry. Approximately 12°C
7	July 2012	06/07/2012 00:15 Dry. Approximately 12°C	06/07/2012 00:30 Dry. Approximately 12°C
1	April 2015	15/04/2015 12:31 Dry. Approximately 15°C. No noticeable wind	15/04/2015 13:31 Dry. Approximately 15°C. No noticeable wind
2	April 2015	15/04/2015 12:51 Dry. Approximately 15°C. No noticeable wind	15/04/2015 13:51 Dry. Approximately 15°C. No noticeable wind
1 and 2	April 2015	15/04/2015 00:53 Dry. Approximately 15°C. No noticeable wind	15/04/2015 01:33 Dry. Approximately 15°C. No noticeable wind
3	April 2015	16/04/2015 10:46 Dry. Approximately 15°C. No noticeable wind	16/04/2015 12:06 Dry. Approximately 15°C. No noticeable wind
3	April 2015	15/12/2015 20:01 Dry. Approximately 15°C. No noticeable wind	15/12/2015 20:31 Dry. Approximately 15°C. No noticeable wind
3	April 2015	16/04/2015 01:21 Dry. Approximately 15°C. No noticeable wind	16/04/2015 01:51 Dry. Approximately 15°C. No noticeable wind
4	April 2015	14/04/2015 15:27 Dry. Approximately 15°C. No noticeable wind	14/04/2015 16:17 Dry. Approximately 15°C. No noticeable wind
4	April 2015	15/04/2015 00:08 Dry. Approximately 15°C. No noticeable wind	15/04/2015 00:38 Dry. Approximately 15°C. No noticeable wind

Table 13-11 Attended Noise Measurement Details			
Location	**Survey Date**	**Time and Weather**	
5	April 2015	16/04/2015 12:25 Dry. Approximately 15°C. No noticeable wind	16/04/2015 13:25 Dry. Approximately 15°C. No noticeable wind
5	April 2015	16/04/2015 00:03 Dry. Approximately 15°C. No noticeable wind	16/04/2015 00:38 Dry. Approximately 15°C. No noticeable wind
6	April 2015	16/04/2015 11:05 Dry. Approximately 15°C. No noticeable wind	16/04/2015 12:05 Dry. Approximately 15°C. No noticeable wind
6	April 2015	15/12/2015 20:41 Dry. Approximately 15°C. No noticeable wind	15/12/2015 21:11 Dry. Approximately 15°C. No noticeable wind
6	April 2015	15/04/2015 01:45 Dry. Approximately 15°C. No noticeable wind	15/04/2015 02:15 Dry. Approximately 15°C. No noticeable wind
7	April 2015	15/04/2015 17:56 Dry. Approximately 15°C. No noticeable wind	15/04/2015 18:56 Dry. Approximately 15°C. No noticeable wind
7	April 2015	16/04/2015 00:45 Dry. Approximately 15°C. No noticeable wind	16/04/2015 01:15 Dry. Approximately 15°C. No noticeable wind
8	April 2015	16/04/2015 14:30 Dry. Approximately 15°C. No noticeable wind	16/04/2015 15:30 Dry. Approximately 15°C. No noticeable wind

13.6.20 Wind speeds observed during attended measurements were negligible and were well below the 5 m/s recommended within BS 4142 (when using a windshield to minimise turbulence noise at the microphone). No data has been excluded due to excessive wind speeds. The temperatures during the noise measurements were mild, ranging between 12°C and 20°C.

13.6.21 Observations noted during site visits of the noise climate at each location during the day and night are listed in Table 13-12.

Table 13-12 Observations of Noise Climate at Measurement Positions			
Location	**Survey Date**	**Day / Night**	**Noise Sources During Measurements**
1	July 2012	Day	Maintenance work to the residential property was audible during the period of equipment installation. At no point during the installation of the equipment was road traffic noise from Ffordd Clegir audible. Bird song and noise due to wind passing through trees contributed to the overall noise level. Analysis of the data gathered by the unattended monitoring equipment shows an increase in the background noise level on 06/07/12 from 04:25 to 08:25, and then again from 09:15 to 11:10. This increase in noise level was due to persistent rainfall and has been excluded from the assessment.
2	July 2012	Day	Noise due to infrequent traffic movements on Ffordd Clegir was audible at Location 2. Sources of noise included bird song and wind passing through trees. Noise from a nearby stream was audible throughout, however it was not dominant.
3	July 2012	Day	Traffic on the A4086 was the most dominant noise source contributing to the ambient noise level. Other sources of noise include work processes taking place at the DMM factory, 100m south west from Location 3. A five minute traffic count of the A4086 was undertaken at approximately 10:30 when 0 HGVs, 35 cars and 1 coach was counted.
	July 2012	Night	Noise from the DMM factory contributed to noise levels measured at this position. The noises included intermittent, impulsive, and broadband noises with duration between 5 and 10 seconds. Intermittent vehicle movements on the A4086 also contributed to the overall noise levels. Noise from a small water feature in the garden of Glan Llyn was audible throughout, but was not dominant. Noise from a nearby fan to the east was audible but not dominant; however this noise source controlled the night time background noise levels

Table 13-12 Observations of Noise Climate at Measurement Positions			
Location	**Survey Date**	**Day / Night**	**Noise Sources During Measurements**
4	July 2012	Day	Distant road traffic noise was the most dominant noise source contributing to the ambient noise level. Traffic movements on Warden Road were infrequent and contributed to the L_{Aeq} noise level. Other sources of noise included children playing in the nearby playing fields, a helicopter flyover and the movements of pedestrians.
	July 2012	Night	Noise from water flowing through nearby drains was constant and dominated the ambient noise level. In the absence of noise from nearby drains, mechanical plant noise from Siemens factory (~400 m west) was audible.
5	July 2012	Day	Noise from the Siemens factory was constant and was the single largest contributor to the ambient and background noise levels. Noise sources at the Siemens factory included vehicle movements, fan noise, and the loading & unloading of vehicles. Other sources of noise included vehicles movements on Ffordd Clegir, bird song, and wind passing through trees.
	July 2012	Night	Fan noise from the Siemens factory was audible throughout the measurement period and was the single largest contributor to the ambient and background noise levels.
6	July 2012	Day	Vehicle movements on the A4086 were the dominant source of noise in the area. Other less dominant sources of noise included dogs barking and deliveries to the hotel. The hotel kitchen extraction fan was barely audible at the measurement location. A five minute traffic count was undertaken at approximately 09:45 when 1 HGV, 38 cars and 2 coaches were counted.
	July 2012	Night	Infrequent vehicle pass-bys contributed to the ambient noise level. Other sources of noise included wind passing through trees. An extract fan from either the hotel kitchen or one of the bedrooms was barely audible throughout.
1/2	July 2012	Night	Distant road traffic noise and noise from mechanical plant at the Siemens factory were the largest contributing factors to the ambient noise levels at this location

Table 13-12 Observations of Noise Climate at Measurement Positions			
Location	**Survey Date**	**Day / Night**	**Noise Sources During Measurements**
1	April 2015	Day	Dominant noise source road traffic along A4086. Other noise sources included wind in vegetation, birdsong and livestock (chickens) and streams.
2	April 2015	Day	Dominant noise source road traffic along A4086. Other noise sources included wind in vegetation, birdsong and streams.
1 and 2	April 2015	Night	Dominant noise source was from local streams running down the hill.
3	April 2015	Day	Dominant noise source road traffic along A4086 and construction noise from the roadworks on this road.
3	April 2015	Evening	Dominant noise source road traffic along A4086.
3	April 2015	Night	Dominant noise source was from local streams. Also occasional traffic on A4086 (although no steady flow of traffic).
4	April 2015	Day	Dominant noise source road traffic along A4086 and traffic and pedestrians on local roads (Warden Street, Gordon Street and others). Also noise from wind in vegetation and birdsong.
4	April 2015	Night	Dominant noise source from local streams. Also occasional traffic on A4086.
5	April 2015	Day	Dominant noise source was from the nearby Siemens factory, mostly vehicles but also some fan-like noises and occasional beeping noises.
5	April 2015	Night	Dominant noise source from Siemens factory. Persistent noise that sounded like a combination of electrical generator hum and whirring of fans.
6	April 2015	Day	Dominant noise source road traffic along A4086 and construction noise from the roadworks on this road.
6	April 2015	Evening	Dominant noise source road traffic along A4086.

Table 13-12 Observations of Noise Climate at Measurement Positions			
Location	**Survey Date**	**Day / Night**	**Noise Sources During Measurements**
6	April 2015	Night	Dominant noise source from local streams. Also some occasional cars using A4086.
7	April 2015	Day	Dominant noise source road traffic along A4086 and the road connecting the Siemens factory entrance to A4086.
7	April 2015	Night	Dominant noise source from local streams and some occasional cars using A4086.
8	April 2015	Day	Dominant noise source activity from Surf Lines customers, including cars, vans and noise from recreational activities taking place in the lake.

13.6.22 Daytime noise levels at each measurement location are presented in Table 13-13 for two time periods; 07:00-19:00 and 07:00-23:00. The L_{A90} noise levels for 07:00-23:00 will be used to determine the BS 4142 daytime limits for operational noise from the Development. The L_{A90} noise levels for 07:00-19:00 will be used to determine the daytime MPG 11 limits for construction noise from the Development.

13.6.23 Representative noise levels provided for Location 4 are from over three hours of attended measurements on 5th July, 2012, between 12:10 and 17:00, as shown on Table 13-13.

Table 13-13 Daytime Measured Noise Levels

Location	Daytime (07:00-19:00)			Daytime (07:00-23:00)		
	L_{Aeq*}	L_{AF90*}	L_{AFmax*}	L_{Aeq*}	L_{AF90*}	L_{AFmax*}
July 2012						
1	46	29	70	46	29	78
2	41	36	61	41	35	60
3	58	44	71	58	42*	70
4	50**	29**	80**	50**	29**	80**
5	49	47	63	47	44	51
6	51	41	65	51	37	67
April 2015						
1	61	34	86	62	35	86
2	49	31	68	49	31	68
3	52***	40***	74***	52	40	74
4	54	44	71	53	44	70
5	49	39	68	48	38	67
6	55***	35***	71***	55	35	71
7	44	37	68	44	37	68
8**	53	44	82	53	44	82

All values are in dB re 20µPa, Free-field, fast time-weighting.

*The daytime L_{A90} has been calculated using the 10th percentile of the $L_{A90,5min}$ noise levels during the respective time periods, which is representative of the lower range of background levels. Average $L_{Aeq,T}$ level determined from logarithmic average of continuous 5-minute samples. Typical highest L_{AFmax} level determined from 90th percentile of continuous 5-minute samples
** Taken from short term attended measurements

*** Used evening short term measurements as daytime noise levels dominated by road construction works

13.6.24 The updated version of BS 4142:2014 no longer uses the lowest background levels, and provides that a representative background should be used instead. The 'average' of the measured night time L_{A90} has been calculated using the 10th percentile of the $L_{A90,5min}$ noise levels during the night time period, which is representative of the lower range of background levels. The night time background noise levels at each measurement location are presented in Table 13-14. The L_{A90} noise levels will be used to determine the BS 4142 limits for operational night -time noise from the Development.

Table 13-14 Night Time Measured Noise Levels

Location	Measurement Duration hh:mm	$L_{Aeq,T}$	$L_{AF90,T}$	$L_{AFmax,T}$
July 2012 survey results				
1	08:00	34	30	49
2	08:00	39	34	54
3	08:00	49	42	69
4	00:15	26	24	43
5	08:00	45	44	51
6	08:00	44	33	60
April 2015 survey results				
1	08:00	56	35	81
2	08:00	44	32	64
3	00:30	41	41	80
4	08:00	51	45	62
5	08:00	46	36	64
6	00:30	41	34	69
7	00:30	37	36	69

All values are in dB re 20µPa, Free-field, fast time-weighting

The night time L_{A90} has been calculated using the 10th percentile of the $L_{A90,5min}$ noise levels during the respective time period, which is representative of the lower range of background levels. Average $L_{Aeq,T}$ level determined from logarithmic average of continuous 5-minute samples. Typical highest L_{AFmax} level determined from 90th percentile of continuous 5-minute samples

13.6.25 Graphical summaries of the noise levels measured at the five unattended locations in 2012 are presented in Volume 3 Appendix 13.1. Details of the 2015 surveys including graphical summaries of the noise levels measured at the unattended locations are presented in Volume 3 Appendix 13.2.

Existing Vibration Levels

13.6.26 There are currently no significant sources of vibration in the area. Consequently, ambient vibration monitoring has not been undertaken. It should be noted that annoyance due to vibration is not related to the comparison of pre and post-development vibration levels, and pre-development vibration levels are not usually necessary to assess the likelihood of vibration damage or annoyance from any new vibration sources likely to be introduced into the area.

13.7 Potential Effects - Construction Noise and Vibration

Surface Plant - Noise

13.7.1 Construction work of any type that involves heavy plant activity will generate noise, which may result in complaints if appropriate scheduling and control of works is not exercised. Noise levels generated by construction activities and experienced by NSRs, depends upon a number of variables, the most significant of which are:

- the level of noise generated by plant or equipment used on site, generally expressed as the sound power level;
- the periods of operation of the plant on the site, known as its 'on-time';
- the distance between the noise source and the NSR; and,
- the attenuation of sound due to ground absorption, air absorption and barrier effects.

13.7.2 To evaluate noise effects during the construction phases it is necessary to have knowledge of the variables listed above. Construction contractors may use different working methods and plant to achieve the same ends. An accurate construction noise and vibration effect assessment is not possible until after the appointment of an approved contractor with knowledge of the exact working routine and plant schedule to be implemented.

13.7.3 Until this is the case, assumptions on the required construction phases and durations are outlined in Chapter 4 Project Description and Table 13-15.

13.7.4 It must be emphasised that the information used within the assessment is unlikely to be adopted exactly by any contractor and therefore the outcomes of the construction assessment should be viewed in this context. AECOM has undertaken this construction noise assessment based on a 'worst-case' approach (e.g. plant working at its closest approach to nearby NSRs, all plant operating simultaneously) in order to identify the range of potential effects. In practice the worst-case nature of the assessment means that the actual levels are likely to be lower and, furthermore, these levels would not exist throughout the duration of a working day due to mobility of working meaning that plant is only likely to be at its closest approach to a particular dwelling for a short period.

13.7.5 The use of construction plant and the likely noise effect from its use is determined using the guidance detailed in BS 5228. Where necessary, mitigation methods may be required to attenuate noise to acceptable levels at NSRs. Should complaints be received from local residents, Gwynedd Council would determine whether BPM is being applied. Should this not be the case, action under the Control of Pollution Act 1974 may be taken.

13.7.6 Worst case noise levels will be assessed using the full schedule of plant working throughout the entire phase duration. In reality, the noise levels at receptors are likely to be lower as different activities with different plant/equipment will take place at different times, periods, combinations and sequences at different parts of the construction site.

13.7.7 Construction noise will occur throughout the predicted 4 years to complete the work. Table 13-15 shows indicative construction phases and their proposed duration. There may be some overlap of construction activities, however this will be finalised prior to construction works commencing. An indicative construction programme is shown in Table 4-2 of Chapter 4 Project Description.

Table 13-15 Proposed Construction Schedule	
Construction Activity	**Duration**
Q1 Headpond	18 Months
Q6 Powerhouse	36 months
Q6 Tailpond	15 months
Q6 Penstock and tailrace	18 months
Q6 Pumping Station / spillway	6 months

13.7.8 Construction compounds are proposed to the south of both Q1 and Q6. The proposed hours for construction are Monday to Friday 07:00 to 19:00 and 07:00 until 13:00 on Saturdays, although construction of the penstock and tailrace tunnel is likely to be a continuous 24 hour operation. The nature of 24 hour operations (either continuous or sporadic works) and the actual methods of working will be finalised prior to construction works commencing.

13.7.9 During construction, it is expected that the noisiest activities will be the drilling, blasting and grouting of Q1 and Q6, as well as the crushing of spoil and surface plant operation.

13.7.10 When the construction noise assessment was undertaken in 2012, it was thought the penstock will be likely constructed using a Tunnel Boring Machine (TBM) or alternative method such as drill and blast, which will be launched from Q6 towards the Q1 or vice versa. However it is now more likely that drill and blast method will be used due to more challenging and dense geology. The blasting will only take place within day time hours. Due the location of works underground it is considered likely that the impact from the drilling and blasting will be broadly similar to the TBM.

13.7.11 Material excavated by the tunnel excavation will be conveyed from the cutter head to temporary storage areas to be processed. Suitable excavated material will be utilised into the dam construction with any excess material to be transported to Q1 for placement in the excess slate mounds. Excess slate materials from Q6 will be transported internally within the penstock tunnel via conveyor to Q1.

13.7.12 At distances within close proximity to the tunnel excavation, airborne noise from this equipment is likely to be high. However for the majority of this tunnelling activity, the excavation will be underground and will therefore be screened from NSRs. Noise effects from ancillary plant to the TBM or drill and blast (exhaust fans and generators) have been considered within this assessment.

13.7.13 The generation of groundborne noise emission due to the penstock excavation will need to be considered. Groundborne noise is audible noise which occurs within buildings when vibration transmitted into the building causes the oscillation of floors, ceilings, or walls which radiate sound. Tunnel boring effects are discussed later in this chapter.

13.7.14 Construction noise will largely be controlled using various BPM (mitigation measures), as would the vibration effects due to the penstock excavation. Blasting effects are discussed later in this chapter.

13.7.15 Stabilisation works at Q1, and re-profiling at Q6 is likely to involve blasting which will be scheduled for daytime periods only.

13.7.16 Representative assessment locations have been assigned construction noise limits based on the measured daytime background noise levels at the eight locations, or provided with the lower noise criterion limit (of $L_{Aeq,1h}$ 45 dB) as suggested within MPG 11.

13.7.17 A comparison of the 2012 and 2015 noise survey results has been undertaken (Table 13.13). The noise limits have been based on long term (unattended measurements) between 07:00 and 19:00, and, as a conservative approach, the lower value from either the 2012 or 2015 survey has been used. At locations 7 and 8 data from the short term attended measurements undertaken in 2015 only have used.

Table 13-16 Representative Assessment Location Daytime Construction Criteria

Location	Daytime L_{AF90} (07:00-19:00) dB	Daytime L_{AF90} + 10 dB	Daytime Construction Criteria Used dB	Night time Construction Criteria Used dB
1	29*	39	45	42

Table 13-16 Representative Assessment Location Daytime Construction Criteria				
Location	**Daytime L_{AF90} (07:00-19:00) dB**	**Daytime L_{AF90} + 10 dB**	**Daytime Construction Criteria Used dB**	**Night time Construction Criteria Used dB**
2	31	42	45	
3	44	54	54	
4	44*	54	54	42
5	39	49	49	42
6	41	51	51	42
7	37	47	47	42
8	44	54	54	n/a

All values are in dB re 20µPa, Free-field, fast time-weighting

*The daytime L_{A90} has been calculated using the lowest 10th percentile of the $L_{A90,5min}$ noise levels during the respective time period.

13.7.18 As shown in Table 13-16, the two monitoring positions (Locations 1 and 2) away from the A4086 and the built up area of Llanberis have the lower limit criterion of $L_{Aeq,1h}$ 45 dB applied. This lower limit criterion has been applied for representative assessment locations in areas where noise surveys were not carried out which are located away from the A4086 and the north-west area of Llanberis.

13.7.19 The assessment of the construction noise effects has been undertaken at 30 representative NSR locations around the Development site as shown in Volume 3 Appendix 13.1. The closest NSRs to Q1 are approximately 1500m to the west or 1000m to the north east. The closest NSRs to Q6 are approximately 200m to the north east. During the construction of the spillway between Q6 and Llyn Padarn, NSRs will be approximately 50m from construction areas.

13.7.20 Noise levels have been predicted using a 12 hour construction working day, based on 07:00 - 19:00. For assessment purposes, it is assumed that all the equipment listed for each activity would be operating during the same working

day. Therefore based upon the proposed working hours, $L_{Aeq,1h}$ noise levels have been predicted for a theoretical 'worst-case day' of works.

13.7.21 Noise levels have been predicted 1m in front of the facade of each representative NSR; however no façade correction has been added to the predicted noise levels. These predicted noise levels can then be easily compared with the noise limits used within MPG 11 which are free-field noise limits.

13.7.22 Volume 3 Appendix 13.1 provides a summary of the predicted $L_{Aeq,1h}$ noise levels at the representative NSRs based upon the above methodology and assumptions for separate works phases as well as a combined works scenario with all phases operating simultaneously.

13.7.23 Volume 4 Figures 13.2 to 13.7 show graphically the extent of the predicted noise level propagation for the preliminary assessment of the individual construction phases.

13.7.24 The assessment outcome of the separate work phases shows that the construction noise limit is predicted to be exceeded by up to 8 dB due to tailpond construction and up to 7 dB due to power house construction phases at a number of representative NSRs.

13.7.25 For the period where all phases of work may occur simultaneously, the construction noise limit is predicted to be exceeded:

- by 10 dB or more at three representative NSR locations;
- by between 5 dB and 9 dB at five representative NSR locations; and,
- by between 0 and 4 dB at three representative NSR locations.

13.7.26 For the night time penstock construction, the night time noise limit is predicted to be exceeded by between 0 and 5 dB at two representative NSR locations.

13.7.27 As only representative NSRs have been assessed, the number of actual NSRs with the potential to be adversely affected by construction noise will be more than the number identified above.

13.7.28 Table 13-17 shows the significance of effects for the daytime construction noise effects for a worst-case scenario whereby all works phases occur

simultaneously, based upon the predicted noise levels provided within Volume 3 Appendix 13.1 and the sensitivity of the NSRs (high).

Table 13-17 Combined Construction - Significance of Effects

Representative NSR *	Predicted Noise Limit Exceedance $L_{Aeq,1h}$ (dB)	Magnitude of Effect	Significance of Effects
10 Coed y Glyn, Llanberis	0	Negligible	Minor
1-2 Llwyn Dyrus, Llanberis	10	Major	Major
1-6 Olgra Terrace, Llanberis	1	Minor	Moderate
2-4 Frin Deg Terrace, Llanberis	-1	Negligible	Minor
Cae Grolan, Waunfawr	-10	Negligible	Minor
Cae'r Fran, Llanberis	-6	Negligible	Minor
Fuches Isaf, Fachwen	8	Moderate	Major
Gallt-y-glyn, Llanberis	-1	Negligible	Minor
Glan Llyn, Llanberis	-5	Negligible	Minor
Glyn Padarn, Llanberis	3	Minor	Moderate
Glyn Peris, Llanberis	-1	Negligible	Minor
Glyn Perris Cottage, Llanberis	4	Minor	Moderate
Hafod Oleu Uchaf, Waunfawr	-11	Negligible	Minor
Lake View Tan y Pant, Llanberis	-8	Negligible	Minor
Llys Elen, Llanberis	-6	Negligible	Minor
Muriau Gwynion, Fachwen	7	Moderate	Major
Pen y Bryn, Fachwen	10	Major	Major
Pendas Eithin, Waunfawr	-11	Negligible	Minor
Pendraw, Llanberis	-6	Negligible	Minor
Tan Hafotty, Llanberis	-3	Negligible	Minor
Tan y Bryn, Fachwen	9	Moderate	Major
Tan y Graig, Fachwen	11	Major	Major
Ty Mawr, Llanberis	-6	Negligible	Minor
Ty Newydd Clegir, Llanberis	-1	Negligible	Minor
Ty Newydd, Llanberis	9	Moderate	Major

Table 13-17 Combined Construction - Significance of Effects			
Representative NSR *	**Predicted Noise Limit Exceedance $L_{Aeq,1h}$ (dB)**	**Magnitude of Effect**	**Significance of Effects**
Ty Uchaf, Ceunant	-18	Negligible	Minor
Tyddyn Isaf, Fachwen	8	Moderate	Major
Ty'n y Ceunant, Waunfawr	-11	Negligible	Minor
Tyn y Mynydd, Groeslon	-16	Negligible	Minor
Ynys Wen, Llanberis	-2	Negligible	Minor

* All NSRs have been identified to be of 'high' sensitivity.

13.7.29 Due to the large scale construction works and the proximity of NSRs, there will be noise effects at NSRs during the construction programme. It is considered that the residential dwellings are high sensitivity NSRs and that these short term effects (less than 5 years) are no greater than **major adverse** magnitude at the worst affected NSRs (8 out of 30 NSRs) outlined in Table 13-17. The noise would dissipate over distance. The significance of effects would be a **localised, temporary, major adverse** effect at high sensitivity NSRs. These NSRs that are likely to be most exposed to construction noise effects are those located along the A4086, those above Ffordd Clegir, and those across Llyn Padarn (in Fachwen). As the Q1 and Q6 work phase's progress, and equipment moves down into the quarry, noise from construction will reduce at many NSRs due to screening.

Surface Plant - Vibration

13.7.30 General surface plant, such as cranes, compressors and generators, are not recognised as sources of high levels of environmental vibration. Reference to Figure C2 of 'Control of Vibration and Noise During Piling' (British Steel, 1998) confirms that peak particle velocities (PPVs) significantly less than 5mm/s are generated by such machinery, even at close distances of 10m.

13.7.31 For example, the indication is that a bulldozer would generate a PPV of approximately 0.6mm/s at a distance of 10m. This value is well below the level at which cosmetic building damage could occur.

13.7.32 It is unlikely that surface plant would generate levels of vibration at NSRs above which cosmetic damage would be expected to occur. This is especially true at distances of 200m or more, which is the case for Q6 activities, or 50m for construction of the spillway. It is predicted that the significance of vibration effects for surface plant would be **negligible** at the closest NSRs. Accordingly, the significance of effects is a **localised, temporary, minor adverse** effect for all **high sensitivity** NSRs.

13.7.33 Hydraulic hammers and breakers that are mounted on excavators will cause groundborne vibration from their impulsive percussive action. Typical safe working distances from this type of equipment are shown in Table 13-18. This table has been taken from the Australian document "Construction Noise Strategy (Rail Projects)" (NSW Transport Construction Authority) as indicative advice for safe working distance to comply with the vibration criterion levels published within BS 6472:1 and BS 7385.

Table 13-18 Recommended safe working distances for Hydraulic Hammers

Plant	Rating/Description	Safe Working Distance	
		Cosmetic Damage	Human Response
Small Hydraulic Hammer	(300kg – 5-12t excavator)	2m	7m
Medium Hydraulic Hammer	(900kg – 12-18t excavator)	7m	23m
Large Hydraulic Hammer	(1,600kg – 18-34t excavator)	22m	73m

13.7.34 NSRs are more than 200m from the Q1 and Q6 quarries where hydraulic hammer rock breaking will occur. As such, the values provided within Table 12-18, demonstrate that NSRs are unlikely to sustain cosmetic damage to their buildings or perceive the vibration from hydraulic hammer rock breaking. Accordingly, the magnitude of effect is predicted to be **negligible** and therefore the significance of effects is a **localised, temporary, minor adverse** effect for all **high sensitivity** NSRs.

Blasting – Noise and Vibration

13.7.35 It has been proposed that blasting will be required during stabilisation works at Q1, and re-profiling at Q6. Pre-split blasting would be used to maximise the quarry face stability, with bulk blasting to fragment the main rock mass. Excavated rock material from blasting would then be processed (crushed and screened) and then used as rockfill for the adjacent dam.

13.7.36 Blasting activities would be scheduled for daytime periods only, well inside the proposed Monday to Friday working hours of 07:00 - 19:00. It is not proposed to blast early morning or late afternoon, with the local community given advance notice. It is inevitable that air overblast and vibration effects will be produced from any controlled blasting.

13.7.37 The Welsh "Mineral Technical Note 2: Coal" (2009) provides the following information regarding the difference between human exposure vibration levels and those that cause structural damage to buildings: ‘Blasting is perceived at much lower levels, and people express concern over nuisance and possible damage. Although damage or the fear of damage is people's major concern, vibration levels rarely approach the levels that would induce hairline cracks. People are very sensitive to vibration and some people become aware of vibration as low as 0.5mm/s, but the human body is not capable of accurately quantifying its magnitude. Good practice is needed to minimise effects, maximise efficiency and to establish and maintain good public relations. Once the threshold of perception is exceeded, the likelihood of complaints is largely independent of vibration magnitude but greatly influenced by the relationship between an operator and the local community. It is important to have a consistent approach to management, regulation and enforcement and to use monitoring and recording of vibration-levels from blasting, to ensure an operator's compliance with blasting conditions.’

13.7.38 At this stage of the project, the detail of blasting (mass of charge, frequency of blasts, site location, hole spacing, detonation delay, etc.) is currently unknown.

13.7.39 BS 5228 Part 2 provides guidance on calculating first estimates of potential vibration levels from blasting (Annex E.2). Using Figure E.1 and the distances to the closest NSRs at Q1 and Q6 (approximately 1000m and 200m respectively),

a maximum instantaneous charge can be calculated for a 95% confidence PPV limit to be achieved.

13.7.40 For example, if a PPV of 6mm/s was targeted to achieve 95% confidence levels, then the maximum instantaneous charge that could be used for Q1 and Q6 is 2500kg and 100kg respectively. This is a first estimate of possible maximum instantaneous charges and purely demonstrates that through appropriate design, blasting can achieve imposed limits.

13.7.41 Note that BS 5228:2009 provides the following guidance regarding noise from blasting operations and the effects of screening and weather conditions:

- *"The attenuation effects due to the topography, either natural or manufactured, between the blast and the receiver are much greater on the audible component of the pressure wave, whereas the effects are relatively slight on the lower frequency concussive component. The energy transmitted in the audible part of the pressure wave is much smaller than that in the concussive part and therefore baffle mounds or other acoustic screening techniques do not significantly reduce the overall air overpressure intensity."*
- *"Meteorological conditions, over which an operator has no control, such as temperature, cloud cover, humidity, wind speed, turbulence and direction, all affect the intensity of air overpressure at any location and cannot be reliably predicted. These conditions vary in time and position and therefore the reduction in air overpressure values as the distance from the blast increases might be greater in some directions than others."*

13.7.42 As such it is very difficult to provide a quantitative prediction of absolute levels of air overpressure from blasting works. In lieu of this it is preferential to carry out blasting operations using the BPM available to ensure that the resultant noise, vibration and air overpressure are minimised.

13.7.43 With appropriate design by suitably qualified blasting contractors, the magnitude of effects due to blasting is predicted to be **negligible** and the significance of effects if predicted to be a **localised, temporary, minor adverse** for all **high sensitivity** NSRs.

Tunnelling - Vibration

13.7.44 BS 5228 Part 2 provides guidance on calculating first estimates of potential groundborne vibration and noise levels from tunnel boring (Annex E.1). The empirical formulae within Table E.1 used to calculate groundborne vibration and noise from tunnelling are limited to the distance range of 10m to 100m. The closest NSR to the penstock route is approximately 200m at Q6 entry/exit pit with a second NSR approximately 300m from the penstock length.

13.7.45 The formulae have been employed to gain an indication of the groundborne vibration and noise at a nominal distance of 100m. For an NSR at this distance, the groundborne vibration is predicted to be PPV 0.45mm/s and the room octave band sound pressure level is predicted to be 19dB.

13.7.46 These results indicate that for distances of 100m from penstock construction, that groundborne vibration and noise effects are expected to be negligible. For NSRs at distances greater than 100m, as is the case here although only up to 60m below ground level, it would be expected that groundborne vibration and noise effects would decrease with increasing distance. This is true of either tunnelling method.

13.7.47 While this may be true, the authors of the original document cited by BS 5228 "*Groundborne vibration caused by mechanised construction works*" (Traffic and Transport Research Laboratory) warn that due to the formulae being derived from TBM activities over a limited range of materials, it is possible that formulae may underestimate predicted values for tunnelling in stronger rock. They also caution against the extrapolation of the formulae for distance greater than 100m.

13.7.48 With consideration of this guidance, it is expected that the significance of groundborne vibration and noise effects due to the operation of the TBM or any other method will be **negligible** at all NSRs.

Construction Traffic - Noise

13.7.49 Preliminary estimated data for construction related traffic movements has been compiled and presented within Chapter 12 Traffic and Transport. Given the phasing of the construction activities and the duration of the programme, site

related construction vehicles and HGV movements will be spread across entire construction programme of for up to 48 months.

13.7.50 The construction traffic route to the Q1 is proposed to be via the A4085, through an unnamed road priority junction to the north of Croesywaun. The route would then pass through priority crossroads within the settlement of Groeslon before continuing on east to the Q1 access road.

13.7.51 The construction traffic route to the Q6 is proposed to be via A4086, with a right turn onto Glyn Rhonwy Road and a short distance to Q6 through existing Industrial Estate roads.

13.7.52 Tables 13-19 to 13-24 present the estimated additional traffic volume increases on affected roads due to construction vehicles.

13.7.53 The relative increase in traffic noise levels along each road link has been predicted. The magnitude of effect and the significance of effect have been assessed against the criteria in Table 13-3 and Table 13-8. Receptors with high sensitivity (e.g. residential dwellings) have been taken into consideration.

Table 13-19 Daily Vehicle Movements - Month 1-6

Road Link	2017 Baseline Total Vehicles	Construction Traffic - Cars	Construction Traffic - HGVs	With Development % Traffic Increase	Relative increase in traffic noise level dB	Magnitude of effect	Significance of effect (High sensitivity receptor)
Waunfawr Crossroads							
Green Road (east of crossroads)	305	43	2	15%	0.6	Negligible	Minor
Green Road (west of crossroads)	510	43	2	9%	0.4	Negligible	Minor
A4085 Waunfawr							
Green Road	701	43	2	6%	0.3	Negligible	Minor
A4085 (W)	3519	43	2	1%	0.1	Negligible	Minor
A4085 (E)	3139	0	0	0%	0.0	Neutral	-
A4086 / Glynn Rhonwy							
Glynn Rhonwy	830	47	15	7%	0.3	Negligible	Minor
A4086 (W)	6329	45	15	1%	0.0	Neutral	-
A4086 (E)	5847	3	0	0%	0.0	Neutral	-

Table 13-19 Daily Vehicle Movements - Month 1-6							
Road Link	**2017 Baseline Total Vehicles**	**Construction Traffic - Cars**	**Construction Traffic - HGVs**	**With Development % Traffic Increase**	**Relative increase in traffic noise level dB**	**Magnitude of effect**	**Significance of effect (High sensitivity receptor)**
A4086 / A422							
A4244	6956	0	18	0%	0.0	Neutral	-
A4086 (W)	6683	45	2	1%	0.0	Neutral	-
A4086 (E)	6721	45	15	1%	0.0	Neutral	-

Table 13-20 Daily Vehicle Movements - Month 7							
Road Link	**2017 Baseline Total Vehicles**	**Construction Traffic - Cars**	**Construction Traffic - HGVs**	**With Development % Traffic Increase**	**Relative increase in traffic noise level dB**	**Magnitude of effect**	**Significance of effect (High sensitivity receptor)**
Waunfawr Crossroads							
Green Road (east of crossroads)	305	181	51	76%	2.5	Minor	Moderate
Green Road (west of crossroads)	510	181	51	45%	1.6	Minor	Moderate
A4085 Waunfawr							
Green Road	701	181	51	33%	1.2	Minor	Moderate
A4085 (W)	3519	181	51	7%	0.3	Negligible	Minor
A4085 (E)	3139	0	0	0%	0.0	Neutral	-
A4086 / Glynn Rhonwy							
Glynn Rhonwy	830	252	41	35%	1.3	Minor	Moderate
A4086 (W)	6329	216	41	4%	0.2	Negligible	Minor
A4086 (E)	5847	42	0	1%	0.0	Neutral	-
A4086 / A422							
A4244	6956	0	92	1%	0.1	Negligible	Minor
A4086 (W)	6683	216	51	4%	0.2	Negligible	Minor
A4086 (E)	6721	216	41	4%	0.2	Negligible	Minor

Table 13-21 Daily Vehicle Movements - Month 8-28							
Road Link	**2017 Baseline Total Vehicles**	**Construction Traffic - Cars**	**Construction Traffic - HGVs**	**With Development % Traffic Increase**	**Relative increase in traffic noise level dB**	**Magnitude of effect**	**Significance of effect (High sensitivity receptor)**
Waunfawr Crossroads							
Green Road (east of crossroads)	305	153	19	56%	1.9	Minor	Moderate
Green Road (west of crossroads)	510	153	19	34%	1.3	Minor	Moderate
A4085 Waunfawr							
Green Road	701	153	19	25%	1.0	Minor	Moderate
A4085 (W)	3519	153	19	5%	0.2	Negligible	Minor
A4085 (E)	3139	0	0	0%	0.0	Neutral	-
A4086 / Glynn Rhonwy							
Glynn Rhonwy	830	187	26	26%	1.0	Minor	Moderate
A4086 (W)	6329	170	26	3%	0.1	Negligible	Minor
A4086 (E)	5847	24	0	0%	0.0	Neutral	-
A4086 / A422							
A4244	6956	0	45	1%	0.0	Neutral	-
A4086 (W)	6683	170	19	3%	0.1	Negligible	Minor
A4086 (E)	6721	170	26	3%	0.1	Negligible	Minor

Table 13-22 Daily Vehicle Movements - Month 29							
Road Link	**2017 Baseline Total Vehicles**	**Construction Traffic - Cars**	**Construction Traffic - HGVs**	**With Development % Traffic Increase**	**Relative increase in traffic noise level dB**	**Magnitude of effect**	**Significance of effect (High sensitivity receptor)**
Waunfawr Crossroads							
Green Road (east of crossroads)	305	178	71	82%	2.6	Minor	Moderate
Green Road (west of crossroads)	510	178	71	49%	1.7	Minor	Moderate
A4085 Waunfawr							
Green Road	701	178	71	36%	1.3	Minor	Moderate
A4085 (W)	3519	178	71	7%	0.3	Negligible	Minor

Table 13-22 Daily Vehicle Movements - Month 29							
Road Link	**2017 Baseline Total Vehicles**	**Construction Traffic - Cars**	**Construction Traffic - HGVs**	**With Development % Traffic Increase**	**Relative increase in traffic noise level dB**	**Magnitude of effect**	**Significance of effect (High sensitivity receptor)**
A4085 (E)	3139	0	0	0%	0.0	Neutral	-
A4086 / Glynn Rhonwy							
Glynn Rhonwy	830	220	46	32%	1.2	Minor	Moderate
A4086 (W)	6329	199	46	4%	0.2	Negligible	Minor
A4086 (E)	5847	28	0	0%	0.0	Neutral	-
A4086 / A422							
A4244	6956	0	118	2%	0.1	Negligible	Minor
A4086 (W)	6683	199	71	4%	0.2	Negligible	Minor
A4086 (E)	6721	199	46	4%	0.2	Negligible	Minor

Table 13-23 Daily Vehicle Movements - Month 30-36							
Road Link	**2017 Baseline Total Vehicles**	**Construction Traffic - Cars**	**Construction Traffic - HGVs**	**With Development % Traffic Increase**	**Relative increase in traffic noise level dB**	**Magnitude of effect**	**Significance of effect (High sensitivity receptor)**
Waunfawr Crossroads							
Green Road (east of crossroads)	305	53	0	17%	0.7	Negligible	Minor
Green Road (west of crossroads)	510	53	0	10%	0.4	Negligible	Minor
A4085 Waunfawr							
Green Road	701	53	0	8%	0.3	Negligible	Minor
A4085 (W)	3519	53	0	2%	0.1	Negligible	Minor
A4085 (E)	3139	0	0	0%	0.0	Neutral	-
A4086 / Glynn Rhonwy							
Glynn Rhonwy	830	63	24	10%	0.4	Negligible	Minor
A4086 (W)	6329	58	24	1%	0.1	Negligible	Minor
A4086 (E)	5847	5	0	0%	0.0	Neutral	-
A4086 / A422							
A4244	6956	0	24	0%	0.0	Neutral	-

Table 13-23 Daily Vehicle Movements - Month 30-36							
Road Link	**2017 Baseline Total Vehicles**	**Construction Traffic - Cars**	**Construction Traffic - HGVs**	**With Development % Traffic Increase**	**Relative increase in traffic noise level dB**	**Magnitude of effect**	**Significance of effect (High sensitivity receptor)**
A4086 (W)	6683	58	0	1%	0.0	Neutral	-
A4086 (E)	6721	58	24	1%	0.1	Negligible	Minor

Table 13-24 Daily Vehicle Movements - Month 37-48							
Road Link	**2017 Baseline Total Vehicles**	**Construction Traffic - Cars**	**Construction Traffic - HGVs**	**With Development % Traffic Increase**	**Relative increase in traffic noise level dB**	**Magnitude of effect**	**Significance of effect (High sensitivity receptor)**
Waunfawr Crossroads							
Green Road (east of crossroads)	305	14	0	5%	0.2	Negligible	Minor
Green Road (west of crossroads)	510	14	0	3%	0.1	Negligible	Minor
A4085 Waunfawr							
Green Road	701	14	0	2%	0.1	Negligible	Minor
A4085 (W)	3519	14	0	0%	0.0	Neutral	-
A4085 (E)	3139	0	0	0%	0.0	Neutral	-
A4086 / Glynn Rhonwy							
Glynn Rhonwy	830	21	23	5%	0.2	Negligible	Minor
A4086 (W)	6329	17	23	1%	0.0	Neutral	-
A4086 (E)	5847	3	0	0%	0.0	Neutral	-
A4086 / A422							
A4244	6956	0	23	0%	0.0	Neutral	-
A4086 (W)	6683	17	0	0%	0.0	Neutral	-
A4086 (E)	6721	17	23	1%	0.0	Neutral	-

13.7.54 During Months 7 to 29, construction traffic noise effects of up to **minor** magnitude have been predicted along: Waunfawr Crossroads - Green Road (east of crossroads) and Green Road (west of crossroads); A4085 Waunfawr - Green Road; and A4086 / Glynn Rhonwy – Glynn Rhonwy. For Months 1 to 6 and Months 30 to 48, effects are limited to **negligible** magnitude.

13.7.55 For all other road links, construction traffic noise effects are predicted to be limited to **negligible** magnitude throughout the works programme.

13.7.56 Accordingly, as a worst-case the significance of effects is a **localised, temporary, moderate adverse** effect for **high sensitivity** NSRs.

Construction Traffic - Vibration

13.7.57 Vibration is a low frequency disturbance that can produce physical movement in buildings and their occupants. Vibration can be transmitted through the air or through the ground. Airborne vibration from traffic can be produced by the engines or exhausts of road vehicles with dominant frequencies in the 50-100Hz range. Ground-borne vibration is more often in the 8-20Hz range and is produced by the interaction between rolling wheels and the road surface. Ground-borne vibration is usually measured in terms of PPV (mm/s).

13.7.58 Advice on vibration effects and annoyance cited within DMRB is referenced to the Transport and Road Research Laboratory document "Traffic Induced Vibrations in Buildings" (1990). A summary of findings from the document includes:

- Groundborne vibration levels depend on many factors and are difficult to predict.
- Research has shown that traffic induced ground borne vibrations do not cause significant damage to buildings.

13.7.59 The highest levels of traffic induced groundborne vibration are generated by irregularities in the road surface which can be avoided with appropriate maintenance.

13.7.60 Airborne vibration is more likely to cause disturbance than ground-borne vibration, but both sources of vibration will cause less disturbance than noise.

13.7.61 DMRB relates changes in traffic vibration annoyance to the change in the $L_{A10,18h}$ noise levels at NSRs. However, this method is based on survey data and noise level changes where road traffic was the dominant noise source of the area. Given the relatively small number of traffic volumes on roads other than the A4085 and A4086, this method may not necessarily be valid for these roads.

13.7.62 HGV construction vehicles have the potential to pass within 2m of existing residential properties within Groeslon when travelling along the access route to Q1. The existing width of the roads would likely require HGVs to manoeuvre at a lower speed than standard vehicles.

13.7.63 Given the expected increase in construction traffic volumes on Glyn Rhonwy Road, and also along the access roads to Q1, it is likely that NSRs fronting these roads/routes will be affected by groundborne vibration and/or airborne vibration caused by construction vehicles.

13.7.64 DMRB advises that if the level of vibration at a receptor is predicted to rise to above a level of 0.3mm/s, or an existing level above 0.3mm/s is predicted to increase, then this should be classed as a **temporary adverse** effect from vibration.

13.7.65 As there is no accurate method of predicting a magnitude of effect of construction traffic vibration therefore a level of **minor** magnitude has been assigned to construction traffic induced vibration. The significance of effects is **moderate adverse** for **high sensitivity** NSRs.

Unexploded Ordnance Storage and Disposal

13.7.66 It is proposed that within Works 3 or 4A or 4D there will be the creation and use of one temporary facility for the disposal of unexploded ordnance (UXO). Operations at the temporary facility are envisaged to comprise of storage and disposal of any discovered UXO during ground works.

13.7.67 This will include the installation and use of up to two temporary structures, insulating works to those structures which may include elements of bunding and other deposition of materials on and around the temporary structures, the

installation of security fencing, and the storage of waste materials from any use of the facility in line with the Ordnance Management Strategy.

13.7.68 The UXO disposal process is typically via a small charge which is used to detonate the UXO in a safe and controlled manner. However at this stage the exact location of the UXO storage and disposal facilities is yet to be determined. In addition, due to the unknown nature of UXO at the site it is not possible to pre-emptively determine the quantities and types of UXO that may need to be stored and/or disposed of. As such while there is the potential for noise effects during any on-site UXO disposal, these cannot be assessed at this stage.

13.7.69 The UXO facility location, disposal methodology and any associated noise effects will be finalised as part of the DCO agreements and will be managed in line procedures to be documented in the Ordnance Management Strategy.

13.8 Potential Effects - Operational Noise

13.8.1 Potential operational noise sources are limited to the power station site and include:

- Turbines & Generators;
- Transformers & Switchgear; and
- Workshop

13.8.2 The proposed location of the power house is south of Q6. The power house comprises a main plant hall building at surface level, and a deep shaft to house the pump/turbines.

Operational Noise Limits

13.8.3 Operational noise limits have been determined using the BS 4142 assessment methodology, based on the measured daytime and night time background noise level at the representative NSRs.

13.8.4 A difference of zero between the background and rating sound levels has been set as a target so as to achieve a magnitude of effects no greater than negligible (i.e. rating sound level equals the measured background noise level (as shown in Table 13-13 and Table 13-14)).

13.8.5 Note that as per BS 4142 guidance, the target rating sound level includes any potential character corrections (due to characteristics such as tonality, impulsivity and intermittency) to the specific sound level based on the aforementioned rating sound level targets. At this stage information on the characteristics of the sound sources (e.g. any tonal features) are yet to be determined, however these will be considered during detailed design.

13.8.6 Table 13-25 presents recommended operational limits for the power house (which includes any correction for characteristics such as tonality, impulsivity and intermittency), with recognition that the main noise generating equipment is beneath ground at depth. Although the recommended rating sound level limits have been determined using the measured background sound levels (as shown in Table 13-13 and Table 13-14), these can be refined during detailed design stage. The measured background sound levels from 2012 and 2015 for each location have been reviewed, as previously mentioned for the construction noise limits, the recommended limits have been selected from long term (unattended measurements) during the representative period. As a conservative approach, the lower value from the 2012 or 2015 survey has been used. At locations where only short term attended measurements have been undertaken, the measured L_{A90} levels have used.

Table 13-25 Recommended Operational Noise Limits *

Location	Daytime 07:00 – 23:00		Night-time 23:00 – 07:00	
	Representative Background sound level dB $L_{A90,T}$	Operational Limit (Rating sound level) dB ($L_{Ar,1\ h}$)	Representative Background sound level dB $L_{A90,T}$	Operational Limit (Rating sound level) dB ($L_{Ar,15\ min}$)
1	29	29	30	30
2	31	31	32	32
3	42	42	42	42
4	44	44	45	45
5	38	38	36	36
6	37	37	33	33
7	37	37	36	36
8	44	44	n/a**	n/a**

** All values are in dB re 20µPa, Free-field, fast time-weighting. L_{A90} has been calculated using the 10th percentile of the $L_{A90,5min}$ noise levels during the respective time periods, which is representative of the lower range of background levels** Not open at night- commercial/leisure premises*

Turbines & Generators

13.8.7 The nominal turbine type used in the preliminary design of the Development has a generating capacity below 100MW and the design allows for a maximum of two units to be installed in parallel. The maximum output of the development as a whole shall not exceed 99.9MW even where both turbines are operating.

13.8.8 The turbine will be partially encased in a concrete jacket cast into the shaft for structural support and to help absorb operational vibration.

13.8.9 The turbines and generators will be approximately located within the turbine hall which is 80m below ground level, housed within the shaft, enclosed and insulated within their own level, and separated from the main plant hall building which is located on the surface.

13.8.10 The sound power levels of the turbines, generators and associated equipment are not yet known. However typically such industrial type machinery would be likely to have sound power levels of approximately 100dB.

13.8.11 The turbine hall is approximately 80 m below ground level and so it will need some form of ventilation to the ground surface. Any necessary noise control design measures for the turbine hall ventilation shaft will be finalised during detailed design to ensure appropriate operational noise limits are achieved, therefore **negligible** magnitude of effects expected. The significance of effect on **high** sensitive NSRs (i.e. residential properties) is a **localised, minor adverse** effect.

13.8.12 Specifically with regard to low frequency noise (LFN), BS4142:2014 makes reference to the University of Salford ‘Procedure for the assessment of low frequency noise complaints - NANR45’ (2005) for the assessment of LFN.

13.8.13 LFN can be very difficult to predict with a high level of certainty and similarly hard to identify and resolve if present. This is because it can be generated by the unexpected interactions between system components and can be amplified by the geometry of the site and receptor buildings. However there are several risk factors that are known to make the generation of LFN more likely. The

potential issue of LFN will be considered throughout the detailed design for the Development and mitigated through design.

Transformers & Switchgear

13.8.14 To the front of the power station main hall, an internal switchgear annex is proposed. External transformer compounds are proposed for three main power transformers, located immediately in front of the power house main hall.

13.8.15 Modern gas insulated switchgear equipment emits very low noise levels during operation. As such, the noise levels emitted by the switchgear are expected to be easily mitigated by the building fabric and mechanical ventilation design, which can be determined at any future detailed design stage of the Development. Consequently, the magnitude and effect of noise effect from switchgear is predicted to be **negligible** and the significance of effects is a **localised, temporary, minor adverse** effect.

13.8.16 Transformers are proposed to be located externally to the building. The sound power level of the transformers is currently unknown at this early stage of the project.

13.8.17 The assessment of potential transformer noise at NSRs has been undertaken assuming that the three transformers can be considered point sources with a combined sound power level of 85dB(A). Given the proposed location of the transformer enclosure, the nearest NSRs (fronting the A4086) are at least 400m away (Location 3 and Location 6). The resultant sound level at a distance of 400 m due to distance attenuation only, would be 25dB(A).

13.8.18 At this stage, no detailed information is available regarding the acoustic character of sound from the proposed transformers. However, to allow for the potential of the specific sound level featuring characteristics that are otherwise readily distinctive against the residual noise environment, a correction of +6dB has been applied to the rating sound level as per the guidance in Section 9.2 ‘Rating sound level – Subjective method’ of BS 4142. Applying a character correction of +6dB(A) to account for any tonal features. Therefore a BS 4142 rating sound level of 31 dB(A) at the nearest NSR is predicted.

13.8.19 Table 13-26 presents an assessment of the predicted rating sound level against the background sound levels at NSR locations 3 and 6.

Table 13-26 Transformer Operational Noise Assessment

Location	Daytime 07:00 – 23:00			Night-time 23:00 – 07:00		
	Background sound level dB $L_{A90,T}$	Predicted Rating sound level dB ($L_{Ar,1\ h}$)	Difference dB	Background sound level dB $L_{A90,T}$	Predicted Rating sound level dB ($L_{Ar,15\ min}$)	Difference dB
3	42	31	-11	42	31	-11
6	37	31	-6	33	31	-2

13.8.20 During daytime periods at Location 3, the rating sound level is predicted to be 11 dB below the background sound level. The magnitude of effect is therefore predicted to be neutral, and the significance of effects is also **neutral**.

13.8.21 9 During night-time periods at Location 3, the rating sound level is predicted to be 11 dB below the background sound level. The magnitude of effect is therefore predicted to be neutral, and the significance of effects is also **neutral**.

13.8.22 During daytime periods at Location 6, the rating sound level is predicted to be 6 dB below the background sound level. The magnitude of effect is therefore predicted to be **negligible**, and the significance of effects is a **localised, temporary, minor adverse** effect.

13.8.23 During night-time periods at Location 6, the rating sound level is predicted to be 2 dB below the background sound level. The magnitude of effect is therefore predicted to be **negligible**, and the significance of effects is a **localised, temporary, minor adverse** effect.

Workshop

13.8.24 A workshop and loading area are included at one side of the power house. General offices and a control room are proposed for the other side of the power house.

13.8.25 It is currently unknown what sound power levels will be emitted by maintenance equipment within the workshop, albeit this is anticipated to occur infrequently, in

response to maintenance requirements. Excluding emergency situations, workshop noise will be generated during the day only.

13.8.26 Noise levels emitted by the workshop are expected to be easily mitigated by the building fabric and mechanical ventilation design.

13.8.27 The magnitude and significance of noise effect from the workshop is predicted to be **negligible**.

Pumping Station

13.8.28 The pumping station at Llyn Padarn, will contain equipment to pump water from Llyn Padarn to Q6 for initial filling and top up. Equipment will be located below ground within a sealed concrete chamber.

13.8.29 Access to the underground chamber will be via access panels which will be made from thick galvanised steel which will be suitable attenuate noise from within the chamber.

13.8.30 It is expected that selected pumping equipment will meet the requirements set out in the EU Machinery Directive. Typically, such equipment is not inherently noisy.

13.8.31 The pumping station is expected to operate on an intermittent basis, allowing for the initial filling of Q6 and subsequent 'topping up' as required. As such, noise effects are only expected for short durations on an operational basis. Actual noise levels are expected to be adequately mitigated through the design of the pumping station (chamber, access panels, etc.)

13.8.32 The closest NSR to the pumping station is more than 200m away. Infrequent noise emitted by the pumping station is expected to be easily mitigated by the design of the underground chamber and distance attenuation. As such, magnitude and significance of pumping station noise effects are considered to be **negligible** at NSRs.

13.9 Mitigation, Compensation and Enhancement Measures

Construction Noise and Vibration

<u>Surface Plant – Noise and Vibration</u>

13.9.1 With regard to construction activities, agreement on operational hours and working methods will be sought from Gwynedd Council as part of the CoCP to minimise noise effects at NSRs. Working hours will be subject to agreement between the Contractor, Gwynedd Council and NRW as part of the DCO. In addition, adherence to working hours will be contractually implemented within the DCO and any subsequent enforcement to be regulated by Gwynedd Council and NRW.

13.9.2 Moreover, during consultation with the EHO at Gwynedd Council, a Section 61 prior consent under the Control of Pollution Act 1974 was recommended for any construction works that would fall outside of typical construction hours. As TBM/ Drilling works are expected to be required on a continuous 24 hour per day basis, a Section 61 agreement may be required to limit the potential effect from the construction works.

13.9.3 Section 61 consent places the responsibility for controlling construction noise onto the PC via restricting types of construction, methodologies, and timescales.

13.9.4 The responsibility for seeking final approval for noise control will lie with the PC, with final approval itself resting with the Environmental Health Officer, to be established prior to the commencement of works.

13.9.5 Based on the construction assumptions presented within the assessment section, the results from the combined work phases (where all phases of work may occur simultaneously) shows that the construction noise limit is predicted to be exceeded by:

- by 10 dB or more at three representative NSR locations;
- by between 4 dB and 9 dB at five representative NSR locations; and,
- by between 1 and 4 dB at three representative NSR locations.

13.9.6 For the night time penstock construction, the night time noise limit is predicted to be exceeded by between 0 and 4dB at two representative locations.

13.9.7 As only representative NSRs have been assessed, the actual total number of NSRs with the potential to be adversely affected by construction noise may be greater than those identified above.

13.9.8 The construction noise assessment reveals that based on the sound power levels and location placement of the individual plant items, certain plant has greater contributions to the NSR predicted noise levels than others.

13.9.9 Where particular plant items have been modelled at terrain heights lower than typical surface heights (i.e. within quarries), screening provides considerable attenuation to NSRs.

13.9.10 During the Q6 tailpond construction, a crusher unit, graders and excavators at unscreened locations provide the greatest contribution to the predicted NSR noise levels.

13.9.11 During the power house construction, a crusher unit, and a Drill Rig (blast) at unscreened locations provide the greatest contribution to the predicted NSR noise levels.

13.9.12 Subsequent to the Scoping Opinion for the Development provided by Gwynedd Council regarding noise and vibration, a local liaison group will be set up to discuss matters relating to noise and vibration effects from the Development's construction, with representatives from relevant stakeholders.

13.9.13 Plant that is not required to be mobile (such as a crusher unit or batching plant) will be located and oriented with a localised barrier to provide attenuation to NSRs. Localised barriers that effectively decrease the noise path to NSRs and can attenuate noise levels by 10dB or more.

13.9.14 Mobile plant is more difficult to attenuate by one particular method and these may require a combination of methods to reduce noise levels at NSRs.

13.9.15 As suggested by the EHO, noisy construction activities will be planned for the beginning of the week where possible so that any delays in the construction works do not result in the particularly noisy activities being conducted on Saturdays.

13.9.16 BS 5228 gives detailed advice on methods of minimising nuisance from construction noise. This can take the form of reducing source noise levels, control of noise spread and, in areas of very high noise levels, insulation at receptors. It is likely to be a requirement of any construction contract that any constructors at the site comply with the recommendations in BS 5228.

13.9.17 Mitigation measures to achieve BPM (as required by the Control of Pollution Act 1974) may include the following provisions:

- ensure all processes are in place to minimise noise before works begin and should ensure BPM are being achieved throughout the construction programme;
- the appropriate use of plant with respect to minimising noise emissions and regular maintenance. All vehicles and mechanical plant used for the purpose of the works would be fitted with effective exhaust silencers and would be maintained in good efficient working order;
- ensure that modern plant is used, complying with the latest EC noise emission requirements;
- selection of inherently quiet plant where appropriate. Use of electrical items of plant instead of diesel plant; especially in sensitive locations. All major compressors should be 'sound-reduced' models fitted with properly lined and sealed acoustic covers which would be kept closed whenever the machines are in use and all ancillary pneumatic percussive tools would be fitted with mufflers or silencers of the type recommended by the manufacturers;
- machines in intermittent use would be shut down in the intervening periods between work or throttled down to a minimum;
- all ancillary plant such as generators, compressors and pumps would be positioned so as to cause minimum noise disturbance. If necessary, acoustic barriers or enclosures will be provided;
- loading/unloading sites should be located away from residential properties and shielded from those properties where practicable;
- arrange the site operations and vehicle routes to minimise the need for reversing movements, and to take advantage of rises in natural terrain to screen NSRs;
- no employees, subcontractors and persons employed on the site should cause unnecessary noise from their activities e.g. excessive 'revving' of vehicle engines, music from radios, shouting and general behaviour etc. All

staff inductions at the site should include information on minimising noise and reminding them to be considerate of the nearby residents;

- where possible, the hours of noisy operations should be planned considering the effects of noise upon nearby NSR, taking into account the duration of work and the potential consequence of any lengthening of periods of noisy work;
- where possible, the items of plant should be located furthest from the nearby NSR buildings or in locations where acoustic screening is provided by site cabins, buildings, or barriers. Plant known to emit noise strongly in one direction should, when possible, should be orientated so that the noise is directed away from the nearest NSR;
- materials should be lowered whenever practicable and not dropped. Any chutes and skips should be lined with sound attenuating material to reduce effect noise; and
- care should be taken when loading / unloading vehicles and dismantling scaffold.

13.9.18 The appointed Contractor will identify potential effects of works noise and vibration once precise working methods (including underground works) and required plant have been confirmed, and in turn appropriate mitigation measures will be implemented.

13.9.19 Working hours will be subject to agreement between the Contractor, Gwynedd Council and NRW as part of the CoCP under the DCO. In addition, adherence to working hours will be contractually implemented within the DCO and any subsequent enforcement to be regulated by Gwynedd Council and NRW.

13.9.20 Method Statements regarding construction management, traffic management, overall site management, and resident management, prepared in accordance with good practice and relevant British Standards, can help to minimise effects of construction works. These will be contained within a Noise Management Plan (NMP) within the Code of Construction Practise (CoCP). This should include consideration of the construction phasing of the Development. Construction of appropriately located earth/spoil bunds during the early phase of the

construction programme would help to increase the acoustic screening of construction noise.

13.9.21 Consultation and communication with the local community throughout the construction period also serves to publicise the works schedule, giving warning to residents regarding periods when higher levels of noise may occur during specific operations, and providing them with lines of communication where complaints can be addressed. Dissemination of such information is likely to encourage the community to be more tolerant of any disturbance considering the perceived long term benefits of the Development.

13.9.22 A CoCP will also be prepared and put in place to ensure BPM are adopted with regards to each phase of the proposals. This will help to ensure that the noise effects relating to construction activities are minimised.

Blasting - Vibration

13.9.23 The air overblast and vibration effects of blasting can be reduced through good blast design, although this may come at the expense of higher drilling and detonator costs. Smaller, more frequent blasts lead to smaller but more frequent effects, and the balance between these factors will need to be discussed with Gwynedd Council.

13.9.24 Methods employed to control air overpressure and vibration from blasting operations will need to be agreed with Gwynedd Council prior to any blasting, as well as the frequency of blasting and a 95% confidence limit for blast PPV values at NSRs. The PPV blasting vibration limit should follow the guidance provided within BS 6472-2, of between 6.0 - 10.0mm/s.

13.9.25 An air overblast limit at NSRs should follow the guidance provided within BS 6472-2 (120 - 150 dB (LIN)) and be agreed upon with Gwynedd Council.

13.9.26 It is recommended that a blast monitoring scheme for air overpressure and vibration be implemented. Any scheme should include details on the location of monitoring points and vibration sensitive properties, and the equipment to be used.

13.9.27 All blasts at the site should be monitored and records maintained so that the historical peak particle velocity from blasts can be produced as required.

13.9.28 A close working relationship between the construction/blasting operator and the local planning authority will be required for the exchange of information regarding blasting events.

13.9.29 Blasting should be carried out using the BPM available to ensure that the resultant noise, vibration and air overpressure are minimised in accordance with current British Standards and Mineral Guidelines.

13.9.30 Fly rock requirements will be controlled through Health and Safety legislation.

Tunnelling - Vibration

13.9.31 It is expected that groundborne vibration and noise due to the underground operation of the TBM or drill and blast method will be negligible, therefore no mitigation is proposed.

Construction Traffic - Noise

13.9.32 Construction traffic movements will occur throughout the construction phases. Consideration and planning of the construction traffic routes have been provided within Chapter 12 - Traffic and Transport, to minimise the effects related to construction traffic. A Construction Traffic Management Plan will be prepared and incorporated into the overall CoCP.

13.9.33 Noise effects from construction traffic along roads other than the A4085 and the A4086 are expected to be minor (< $L_{A10,18h}$ 1dB). Given the small existing traffic volumes and the large percentage increase in expected HGV movements, construction traffic noise effects will need to be managed to minimise these effects.

13.9.34 Management methods include a speed limit for construction vehicles and the planning of deliveries throughout the day.

13.9.35 A smooth road surface is required to be maintained on access routes to Q1 and Q6. Consultation between the applicant and Gwynedd Council should be undertaken to facilitate a process that will ensure that road irregularities do not exceed a 20mm change in the road profile.

13.9.36 In general, PPVs increase with increasing speed of vehicles. Data presented within the Transport and Road Research Laboratory document "Traffic Induced

Vibrations in Buildings", suggests that a speed reduction from 80km/h to 48km/h can decrease PPV levels by 40%.

Construction Traffic - Vibration

13.9.37 Given the close proximity of NSRs to the Q1 access route, groundborne vibration at NSR locations has been identified as a potential issue. Measurements of vibration at the foundations of buildings considered to be at high risk should be taken to establish whether construction traffic vibration levels would be likely to exceed the threshold values or increase PPV levels to more than 0.3 mm/s. Vibration measurements of existing traffic along these particular routes should also be undertaken to determine the existing vibration levels. As noted in paragraph 13.9.35, a smooth road surface is required to be maintained on access routes to minimise the levels of groundborne vibration at NSRs.

Unexploded Ordnance Storage and Disposal

13.9.38 Mitigation measures to control noise effects associated with the UXO facility will be documented in the Ordnance Management Strategy. This will be finalised as part of the DCO agreements once the location of the UXO facilities and the potential requirements of UXO disposal are determined.

Operational Noise

Power House Operational Noise

13.9.39 Noise from the power station's turbines, generators and associated equipment will be contained below ground level by significant structural components (concrete slabs, air lock doors, etc.). It is expected that airborne noise flanking between this equipment (at depth) and ground level will be suitably mitigated by design to achieve appropriate operational noise limits at NSRs.

13.9.40 As stated previously, the turbine hall is approximately 80m below ground level and so it will need some form of ventilation to the ground surface. The actual design of noise control to meet appropriate operational noise limits will need to be finalised during detailed design; these will likely comprise measures such as orientation away from NSRs, vent attenuators, acoustic lining within the vent shaft, and acoustic louvres at intake and extract terminals. The design

measures of noise control for the turbine hall ventilation shaft will be finalised during detailed design to ensure appropriate operational noise limits are achieved.

13.9.41 Where any other means of ventilation is required to the depth of the shaft to facilitate safe working conditions for personnel, it is expected that appropriate mechanical plant design can be easily implemented considering the extent of the shaft depth. Attenuation of any turbine or generator noise can be adequately attenuated prior to surface discharge, via standard mechanical ventilation design (lined ducts, attenuators, etc.).

13.9.42 The noise emission of the transformers will be confirmed during detailed design. Should the combined noise emission of the transformers be higher than a sound power level of 85dB(A), appropriate mitigation in the form of an enclosure, attenuators, and ventilation outlets will be required so that the rating sound level of the transformer noise at NSR locations does not exceed the background sound level at NSRs.

13.9.43 Modern gas insulated switchgear equipment emits very low noise levels during operation. Noise levels emitted by the switchgear can be easily mitigated by the building fabric and mechanical ventilation design, and distance attenuation to NSRs.

13.9.44 Noise levels emitted by the workshop are expected to be mitigated by the building fabric and mechanical ventilation design within the Main Hall, and distance attenuation to NSRs.

13.9.45 Noise control and mitigation measures will be finalised during detailed design in order to ensure that airborne noise emissions from operational plant will achieve suitable operational limits following guidance from BS 4142. The rating levels of the noise emissions will be determined following guidance from BS 4142, and will include consideration for any acoustic features such as tonality, impulsivity and intermittency.

13.9.46 However, the NANR45 assessment methodology is based on a comprehensive measurement procedure at a receptor position rather than a prediction procedure. Ultimately it is difficult to carry out a preliminary prediction at this

stage and therefore a reliable evaluation of LFN emissions from items of plant as source levels of LFN cannot be accurately measured until the plant is in situ.

13.9.47 NANR45 provides a methodology for measuring and assessing LFN, including a criterion curve of 1/3 octave sound pressure levels. It is recommended that should any valid complaints of LFN due to the proposed installations be received by Gwynedd Council, the Operator shall undertake an assessment of LFN affecting these receptors following guidance from NANR45.

13.9.48 A further assessment of low frequency noise (LFN) will be carried out by the Operator and requirements for mitigation measures and noise control will be determined once the detailed design is finalised. Careful selection of equipment, use of mitigation measures such as vibration isolation, mufflers, attenuators, etc. will be considered during the design phases.

13.10 Residual Effects

Construction Works Noise and Vibration

Surface Plant - Noise

13.10.1 Due to the large scale construction works and the proximity of NSRs, there will be noise effects at NSRs during the construction programme. However, construction work mitigated through BPM and careful management, would be anticipated to result in short term effects (less than 5 years) that are no greater than moderate adverse magnitude at the worst affected NSRs. The significance of effects would be major at high sensitivity NSRs.

13.10.2 Construction noise impacts would not be constant throughout the 5 years, as the nature of construction work means that the worst-case situation with all plant operating simultaneously and/or working at closest approach may only exist for only a matter of days or even hours and there would be regular periods, even during the course of a single day, when the assumed noisy plant would not be in operation during breaks or changes of working routine. However, until the actual (rather than assumed) method of working is specified, detailed recommendations to reduce the predicted worst-case construction noise to the closest residential and other noise sensitive buildings cannot be undertaken.

13.10.3 The NSRs that are likely to be most exposed to construction noise effects are those located along the A4086, those above Ffordd Clegir, and those across Llyn Padarn (in Fachwen). As the Q1 and Q6 work phase's progress, and equipment moves down into the quarry, noise from construction will reduce at many NSRs due to screening.

13.10.4 However, due to the local topography, there will be a limit to the amount of attenuation that can be provided to some NSRs through screening. Some NSRs in Fachwen are located at elevations that are greater than proposed construction activities at Q6, with little scope to implement screening barriers for the majority of activities.

13.10.5 Once specific construction methods, proposed plant and scheduling are specified by the appointed PC, an assessment should be undertaken to more accurately assess construction noise impacts and if necessary, specify mitigation measures to reduce the overall residual effect where practicable. This would be implemented through the NMP which will be finalised by the appointed PC.

Surface Plant - Vibration

13.10.6 With the implementation of a NMP within the CoCP which will control the timing of noisy construction activities, screening and general management of noisy machinery and plant, it is proposed that the significance of effects is a **localised, temporary, minor adverse** effects for all **high sensitivity** NSRs, and therefore is not significant.

Blasting - Vibration

13.10.7 Air overpressure and vibration effects from blasting are inevitable. Methods to control air overpressure and vibration from blasting operations will be agreed with Gwynedd Council prior to any blasting.

13.10.8 Blasting will be carried out using the BPM available to ensure that the resultant noise, vibration and air overpressure are minimised in accordance with current British Standards and Mineral Guidelines, as required by the Control of Pollution Act 1974.

13.10.9 However they will be temporary in nature and a liaison group will be set-up to notify the local community in advance of works. Therefore the residual effect remains to be a **localised, temporary, minor adverse effect** and is therefore not significant.

Tunnelling - Vibration

13.10.10 Due to the depth of the tunnelling operations, it is expected that the effects will remain negligible. Discussions with the Gwynedd Council EHO have recommended that a Section 61 consent is sought for any 24 hour operations.

Construction Traffic - Noise

13.10.11 Construction traffic effects mitigated through management methods, road maintenance and ongoing monitoring, would be anticipated to result in short term effects (less than 5 years) that are no greater than minor adverse at the worst affected NSRs. With the implementation of a CTMP and NMP within the CoCP, the construction traffic vibration is to have a residual **localised temporary minor** effect at all high sensitivity NSRs, and therefore is not significant.

Construction Traffic - Vibration

13.10.12 The requirement for vibration monitoring in potentially affected houses will be assessed should the measures outlined in the CTMP and NMP not be effective or not adequately address the concerns of potentially affected residential dwellings. With these mitigation measures in place, it is proposed that there will be a **localised, temporary, minor** effect, and therefore is not significant.

Operation

13.10.13 The depths of the turbines will mitigate any operational effects. Therefore these are considered to be **negligible** and not significant.

13.10.14 The building design of the transformers, switchgear, workshop and pumping station will have appropriate noise attenuation measures which will mitigate any effects to **negligible** and therefore is considered to be not significant.

13.11 Evaluation of Significance

13.11.1 A summary of the significance of effects from the various noise and vibration effects contained within this chapter have been summarised in Table 13-27.

Table 13-27 Summary of Noise and Vibration Assessment

Description of Receptor		Description of Potential Effect					Description of Residual Effect			Change from 2012 Chapter
Receptor	Sensitivity	Effect	Nature of Effect	Duration	Magnitude	Potential Significance	Summary of Mitigation	Residual Effect	Residual Significance	
Construction										
Residential Dwellings (those located along the A4086, those above Ffordd Clegir, and those across Llyn Padarn (in Fachwen))	High	Surface Plant - Noise	Adverse	Temporary	Moderate	Major Adverse	Implementation of NMP and BPM	Implementation of BPM and the completion and implementation of the NMP by the PC will mean that no greater than major adverse effects will be potentially experienced at 8 locations out of 30 which have been monitored. Noise will decrease over distance and as the works enter the quarries at depth.	Localised, Temporary, Major Adverse	No change
		Surface Plant - Vibration	Adverse	Temporary	Negligible	Minor Adverse	Implementation of NMP	Vibration effects from surface plant will be localised to the quarries. The effects on NSRs will be temporary and will reduce with natural screening and as the works progress into the quarries.	Localised, Temporary, Minor Adverse	No change
		Blasting - Vibration	Adverse	Temporary	Negligible	Minor Adverse	Implementation of NMP and notification given through the Development liaison group	Blasting will be undertaken intermittently and at the start of the construction phase of each quarry. Local residents will be notified through the ECOW / liaison group, and works undertaken with BPM and COPA.	Localised, Temporary, Minor Adverse	No change
		Tunnelling - Vibration	Adverse	Temporary	Neutral	Negligible	None proposed	Underground tunnelling method	Negligible	No change
		Construction Traffic - Noise	Adverse	Temporary	Minor	Moderate Adverse	Implementation of CTMP and NMP mitigation measures	Implementation of the mitigation measures outlined in the CTMP and NMP including road management and maintenance and ongoing monitoring	Localised, Temporary. Minor Adverse	No change

Table 13-27 Summary of Noise and Vibration Assessment

Description of Receptor		Description of Potential Effect					Description of Residual Effect			Change from 2012 Chapter
Receptor	Sensitivity	Effect	Nature of Effect	Duration	Magnitude	Potential Significance	Summary of Mitigation	Residual Effect	Residual Significance	
		Construction Traffic - Vibration	Adverse	Temporary	Minor	Moderate Adverse	Implementation of CTMP and NMP mitigation measures	Implementation of vibration monitoring will be assessed as necessary in the potential affected properties	Localised, Temporary, Minor Adverse	No change
		Unexploded Ordnance Storage and Disposal – Noise	Adverse	Temporary	N/A	N/A	Implementation of Ordnance Management Strategy mitigation measures	Implementation of necessary mitigation and management procedures will be assessed as necessary at any potential affected properties	Localised, Temporary, Minor Adverse	Not considered in 2012 Chapter
Operation										
Residential Dwellings (those located along the A4086, those above Ffordd Clegir, and those across Llyn Padarn (in Fachwen)).	High	Turbines and Generators -	Disturbance to nearby residential dwellings from operational noise	Permanent	Negligible	Minor Adverse	Depth of turbine hall plus appropriate building design	Attenuation of tonal and operational noise within the building and engineering design, combined with the depth of the turbine hall, will mitigation any adverse effects	Negligible	No change
		Transformers		Permanent	Negligible	Minor Adverse	Appropriate building design	Attenuation of tonal and operational noise within the building and engineering design will mitigation any adverse effects		No change
		Switchgear		Permanent	Neutral	Negligible				No change
		Workshop		Permanent	Neutral	Negligible				No change
		Pumping Station		Permanent	Neutral	Negligible				No change

13.12 Summary and Conclusions

13.12.1 This chapter has presented the assessment of potential noise and vibration effects from the Development's operational and construction phases. Where necessary, outline recommendations for mitigation measures have been provided.

13.12.2 A baseline environmental noise survey has been undertaken to establish the existing noise climate at locations around the Development.

13.12.3 With regards to operational noise effects at the power house and pumping station, the Development is predicted to result in effects of **negligible** at NSRs, and therefore is considered not significant. Noise control and mitigation measures will be finalised during detailed design in order to ensure that airborne noise emissions from operational plant will achieve suitable operational limits following guidance from BS 4142. The rating levels of the noise emissions will be determined following guidance from BS 4142, and will include consideration for any acoustic features such as tonality, impulsivity and intermittency.

13.12.4 Based upon a preliminary assessment of potential noise from surface plant during the construction phase, it is considered that effects of up to **major adverse** could arise without mitigation. Such effects should be minimised where possible by adopting BPM, a CoCP and a Noise Management Plan (NMP), and the setup of a local liaison group, to specifically identify potential effects and appropriate mitigation based upon site specific information as the project progresses. Once specific and exact construction methods are known by a contractor, an assessment should be undertaken to determine a more accurate noise assessment.

13.12.5 Surface plant, tunnel drilling and blasting/ boring, and blasting working practices are unlikely to generate levels of vibration at local receptors above which cosmetic damage to structures would be expected. However, exact effects will be dependent upon the working methods employed and further consideration of potential vibration effects will need to be considered once a contractor is appointed.

13.12.6 Significance of construction traffic noise and vibration effects has been considered for representative NSRs. Construction traffic effects can be mitigated through management methods, road maintenance and ongoing monitoring and would be anticipated to result in short term effects (less than 5 years). This would result in effects that are no greater than **minor adverse** at the worst affected NSRs and therefore is considered **not significant**.

13.13 References

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