

Volume 2: Chapter 15 - Noise and Vibration

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15. NOISE AND VIBRATION

15.1 Introduction

15.1.1 This Chapter considers the potential effects, including cumulative effects, of the Proposed Development on Noise and Vibration during construction and operation. The methodology focuses on the assessment of effects on permanent noise sensitive receptors (NSRs) in the study area. Where likely significant effects are predicted, appropriate mitigation measures are proposed, and the significance of predicted residual effects are assessed. This Chapter (and its associated appendices) is not intended to be read as a standalone assessment and reference should also be made to the following chapters of this Environmental Impact Assessment Report (EIAR):

- **Volume 1, Chapter 3: Project Description** for full details of the Proposed Development;
- **Volume 2, Chapter 8: Forestry;**
- **Volume 2, Chapter 14: Traffic and Transport;** and
- **Volume 2, Chapter 16: Cumulative Effects.**

15.1.2 The objectives of this Chapter are to:

- describe the assessment methodology and significance criteria used in the assessment;
- identify the residential and non-residential NSRs in the vicinity of the Proposed Development;
- describe and define the baseline noise environment;
- identify the dominant sound sources associated with the construction and operation of the Proposed Development;
- predict the likely impacts and residual effects on NSRs; and
- indicate any requirements for mitigation measures, if applicable, to provide sufficient levels of protection for all NSRs.

15.1.3 The construction and operational noise assessment was undertaken by Wood plc as discussed in **Volume 5, Appendix 5.1: The EIA Team.**

15.1.4 Noise is defined as unwanted sound. Human ears are able to respond to sound in the frequency range 20 Hz (hertz) (deep bass) to 20,000 Hz (high treble) and over the audible range of 0 dB (decibel) (the threshold of perception) to 140 dB (the threshold of pain). The ear does not respond equally to different frequencies of the same magnitude, but is more responsive to mid-frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates the response of the human ear, a weighting mechanism is used. This reduces the importance of lower and higher frequencies, in a similar manner to the human ear.

15.1.5 Furthermore, the perception of noise may be determined by a number of other factors, which may not necessarily be acoustic. In general, the impact of noise depends upon its level, the margin by which it exceeds the background level, its character and its variation over a given period of time. In some cases, the time of day and other acoustic features such as tonality or impulsiveness can increase the potential for adverse impacts on sensitive receptors. Any assessment of noise should give due consideration to all of these factors when assessing the significance of a noise source on an NSR.

15.1.6 The most widely used weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or LAeq, LA90 etc., according to the parameter being measured.

15.1.7 The decibel scale is logarithmic rather than linear, and hence a 3 dB increase in sound level represents a doubling of the sound energy present, however, this is generally regarded as the minimum difference needed for the human ear to perceive a change under normal listening conditions. Judgement of sound is subjective, but as a general guide a 10 dB(A) increase can be taken to represent a doubling of perceived loudness.

15.1.8 The following acoustic terminology is referred to throughout this Chapter:

Terminology	Definition
dB (decibel)	A unit of the noise level derived from the logarithm of the ratio between the value of a quantity and a reference value and the scale on which sound pressure level is expressed. Sound pressure level is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure (2×10^{-5} Pa).

Terminology	Definition
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (ie 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
$L_{Aeq,T}$	L_{Aeq} is defined as the notional steady sound level which, over a stated period of time (T), would contain the same amount of acoustical energy as the A-weighted fluctuating sound measured over that period.
L_{A10} & L_{A90}	If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The L_n indices are used for this purpose, and the term refers to the level exceeded for n% of the time of the measurement. Hence L_{A10} is the A-weighted level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L_{A90} is the 'average minimum level' and is often used to describe the background noise. It is common practice to use the L_{A10} index to describe traffic noise.
Free-field Level	A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other reflective surfaces. Generally as measured outside and away from buildings.
Ambient Noise Level	The all encompassing noise level measured in $L_{Aeq,T}$. The Ambient Noise Level incorporates background sounds as well as the source noise under consideration.
Residual Noise Level	The Ambient Noise Level in the absence of the source noise under consideration, measured in $L_{Aeq,T}$.
Specific Noise Level	The noise level measured in $L_{Aeq,T}$ attributed to the industrial noise source under consideration alone.
Background Noise Level	The noise level in the absence of the source noise under consideration, measured in L_{A90} .
Noise Sensitive Receptor (NSR)	Any property where the presence of noise could significantly impact the occupants' well-being, activities, or health. These receptors typically include places such as residences, schools, hospitals, offices and other commercial properties.

- 15.1.9 An energised overhead line (OHL) can be the source of an audible phenomenon known as 'corona discharge'. This is a limited electrical breakdown of the air in the vicinity of the OHL conductors. While OHL conductors are designed and constructed to minimise corona discharge, surface irregularities such as damage, attached raindrops, insects and other types of contamination can increase local electric field strength beyond the inception level for local corona discharge at these sites. Such corona discharge can be the source of audible noise, a crackling sound accompanied sometimes by a low frequency hum.
- 15.1.10 The highest noise levels generated by an OHL usually occur during light rain when water droplets, collecting on the surface of the conductor, can initiate corona discharge. The number of droplets that collect, and hence the amount of noise, depends on the rate of rainfall. Mist or fog can also cause corona discharge from droplets condensing on and attaching to the conductor surface. Sometimes, after a prolonged spell of dry weather, conductors can become contaminated with accumulated dust particles and other materials on which corona discharge can occur and audible noise can be generated. Later rain showers have the effect of washing the conductors clean of such debris.
- 15.1.11 An OHL may also produce 'aeolian noise'. Aeolian noise is caused by wind blowing over a structure resulting in vibration that matches that the natural frequency of the structure, or vortex shedding on the surface of a structure. It is difficult to assess aeolian noise and there is currently not a standardised method to predict this type of noise. This type of noise is usually infrequent and depends on wind velocity and direction. Embedded mitigation in **paragraph 15.5.4** details how these potential effects can be reduced.

15.2 Scope of the Assessment

Effects Scoped Out

15.2.1 On the basis of the desk-based assessment undertaken, the professional judgement of the Environmental Impact Assessment (EIA) team, experience from other relevant projects and policy guidance or standards, and feedback received from consultees, the following effects have been ‘scoped out’ of detailed assessment, as proposed in the EIA Scoping Report (**Volume 5, Appendix 6.1: Scoping Report**) and confirmed in the Scoping Opinion (**Volume 5, Appendix 6.2: Scoping Opinion**):

- There are no sources of operational vibration associated with the Proposed Development at nearby NSRs. Therefore, vibration due to operation is not expected to be perceptible or adversely impact receptors and has not been assessed further.
- Any operational maintenance works required will be short-term and intermittent and are not expected to give rise to significant effects relating to noise and vibration. Therefore, noise from operational maintenance is not expected to adversely impact receptors and has not been assessed further.

15.2.2 The Kintore to Tealing 275 kV OHL and Craigiebuckler to Tarland 132 kV OHLs are **Negligible** due to the low noise conductor type, therefore operational noise is scoped out where NSRs are within 500 m of these two routes and more than 500 m away from the 400 kV OHL.

Effects Assessed in Full

15.2.3 The scope of this assessment is to quantify the noise and vibration impacts on NSRs that are predicted from the construction and operational phases (including cumulative effects) of the Proposed Development and to evaluate the significance of the effects following mitigation.

15.2.4 The EIA Scoping process, baseline conditions and professional judgement has identified the following effects for detailed assessment:

- effects during construction of Noise and Vibration;
- effects during operation of Noise;
- cumulative effects during construction of Noise and Vibration; and
- cumulative effects during operation of Noise.

15.2.5 The assessment scenarios used for this topic are during construction and for the fully operational development.

Study Area

15.2.6 The study area for the assessment of noise and vibration encompasses the area over which all desk-based and field data were gathered to inform the assessment presented in this Chapter. The study area comprises 522 nearby NSRs in proximity to the Proposed Development. NSRs were compiled from AddressBase data¹, detailed maps, and aerial photographs of the area surrounding the Proposed Development. These NSRs are all within 500 m of the nearest point to the Proposed Development. 500 m was chosen based on the EIA Team’s experience ensuring all potentially impacted NSRs are be considered in the assessment. Beyond this distance, operational effects are negligible and construction effects are addressed by NSRs within the 500 m.

15.3 Assessment Methodology

15.3.1 The following section provides an overview of the legislation, policy, and guidance that inform the assessment methodology. This is then followed by a description of the sensitivity of receptors, determining the magnitude of impact and the effect significance.

15.3.2 The assessment of construction noise has complied with the following standards and guidance.

Legislation

15.3.3 This assessment was carried out in accordance with the principles contained within the following legislation:

¹ Emapsite, n.d. UK Mapping and Data. [Online] Available at: <https://www.emapsite.com/>.

- *The Control of Pollution Act, 1974 (COPA) (UK Government, 1974).*

15.3.4 Section 60 of the Act enables Local Authority officers to serve a notice in respect of noise nuisance from construction works, instructing the contractor to minimise nuisance to neighbouring properties through specific conditions. Section 61 of this Act provides a method by which a contractor can apply to the Local Authority for prior consent to undertake construction works in advance of their commencement. If consent is given, the application is exempt from any enforcement action under Section 60 of the same Act.

Policy

15.3.5 The following policies of relevance to the assessment have been considered:

Scottish Government Planning Advice Note (PAN) 1/2011: 'Planning and Noise'².

- 15.3.6 Published in March 2011, this document provides advice on the role of the planning system in helping to prevent and limit adverse effects of noise. Information and advice on noise assessment methods are provided in the accompanying Technical Advice Note (TAN): Assessment of Noise. Included within the PAN document and the accompanying TAN are details of the legislation, technical standards, and codes of practice for specific noise issues.
- 15.3.7 Neither PAN 1/2011 nor the associated TAN provides specific guidance on the assessment of noise from fixed plant, but the TAN includes an example assessment scenario for 'New noisy development (including commercial and recreation) affecting a noise sensitive building', which is based on British Standard (BS) 4142:1997: Method for rating industrial noise affecting mixed residential and industrial areas. This BS has been replaced with BS 4142:2014: Methods for rating and assessing industrial and commercial sound.

Guidance

15.3.8 This assessment is carried out in accordance with the principles contained within the following documents:

BS 5228-1/2:2009 +A1:2014 (BS 5228), Code of Practice for Noise and Vibration Control on Construction and Open Sites³.

- 15.3.9 Guidance on the prediction and assessment of noise and vibration from construction sites is provided in BS 5228 2009 +A1:2014 *Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1: Noise*. BS 5228-1 provides recommended limits for noise from construction sites.
- 15.3.10 The construction noise impact assessment (CNIA) has been carried out according to the ABC method specified in Table E.1 of BS 5228-1, in which NSRs are classified in categories A, B or C according to their measured or estimated background noise level (the threshold values and categories are shown in **Table 15.1: Construction Noise Impact Assessment Criteria**). If the site noise level exceeds the threshold value of the appropriate category, then a potential significant effect is indicated.
- 15.3.11 The noise criteria provided for the ABC method detailed in BS 5228-1 are shown in **Table 15.1: Construction Noise Impact Assessment Criteria**. NSRs are classified in categories A, B or C according to their measured or estimated background noise level. If the site noise level exceeds the threshold value of the appropriate category, then a potential significant effect is indicated.

² The Scottish Government, 2011. Planning Advice Note: Planning and noise (PAN 1/2011).

³ UK Government, 2009. British Standard 5228: *Code of practice for noise and vibration control on construction and open sites* (BS 5228), BSI, 2009, Amended 2014.

Table 15.1: Construction Noise Impact Assessment Criteria

Assessment category and threshold value period	Threshold value, LAeq (dB)		
	Category A	Category B	Category C
Night-time	45	50	55
Evenings and weekends	55	60	65
Daytime and Saturdays	65	70	75

- 15.3.12 To determine the threshold value and noise limit to which the construction noise is assessed against, the periods must be defined and categories identified.
- 15.3.13 Night-time is defined as between 23:00 and 07:00. This is also in line with the BS 4142 definition for night-time. Evenings and weekends are defined as 19:00 – 23:00 on weekdays, 13:00 – 23:00 on Saturdays and 07:00 – 23:00 on Sundays. Daytime is defined to be 07:00 – 19:00 on weekdays and 07:00 – 13:00 on Saturdays.
- 15.3.14 The NSR is defined as Category A if the ambient noise levels (rounded to the nearest 5 dB) are less than those stated for Category A. This is true for the Study Area given the rural setting and to ensure that the assessment is conservative, therefore the NSRs of the Proposed Development has been assessed to Category A thresholds.
- 15.3.15 As indicated by the Scoping Opinion, work is expected to take place seven days a week. It is likely that the majority of construction works will occur during daytime periods, however, may extend into evening periods and weekends. It is not known what activities within each phase will take place at what times, therefore, all activities within each phase are assumed to take place on Saturday afternoons or Sundays to present the worst-case scenario. Therefore, the 55 dB(A) limit has been adopted in this case to ensure a conservative assessment takes place.
- 15.3.16 While work is expected to take place between 7:00 and 18:00 every day during GMT (extended to 19:00 during BST), construction activity will take place within the hours of Daytime and Saturdays, therefore the noise is also assessed to a 65 dB limit in the case that noisier work is prioritised then rather than Saturday afternoons or Sundays.
- 15.3.17 In line with best practice (BS 5228-1), a Construction Noise Management Plan (CNMP) will be developed by the Principal Contractors prior to starting construction works. The details of the CNMP will be agreed with the Local Authority and is expected to be secured by an appropriately worded consent condition.
- 15.3.18 To calculate the potential construction noise levels from the work sites for the Proposed Development, information about the proposed construction activities is needed. The Principal Contractors will be responsible for developing the detailed construction methodology and associated plant requirements following contract award, however, **Volume 5, Appendix 15.2: Construction Activity** shows plant activities, assumed plant items, their assumed quantities, their assumed utilisation, and associated noise levels at a distance of 10 m, taken from BS 5228, which have been adopted for the assessment reported in this chapter. By combining the items' noise levels ($L_{A,eq}$ at 10 m (dB)) with the amount of time each will be running (utilisation) and their quantity, the total equivalent noise can be calculated for each row. These were then logarithmically summed to give a total value for the construction noise at 10 m. To ensure a worst-case assessment, it has been assumed that all works within the phases will take place simultaneously for the indicated percentage of the working hours. The noise due to predicted levels of vehicle movements on access tracks (including deliveries of materials and plant) has also been considered. Based on information from the Principal Contractors, the average number of heavy goods vehicles (HGVs) on access tracks is conservatively estimated to be 10 per hour. The Principal Contractors are also responsible for implementing a traffic management plan, especially in the case this average changes.
- 15.3.19 The total equivalent noise level at 10 m for each activity can be used in a propagation calculation to find the specific noise at each receptor. The average activity over the working period will be at the geometric centre of the construction area which is the tower itself, so noise is calculated for each phase as if it takes place at the tower.
- 15.3.20 As noise propagates across the ground, some sound will be absorbed by the surface, resulting in attenuation. This attenuation of noise due to distance and ground conditions has been calculated over mixed hard and soft ground to the F.2.3.2 method in BS 5228. Given the dominance of soft ground in the area surrounding the Proposed Development, this is slightly conservative. The effects of barriers or topographical screening have not been considered as a conservative approach.

15.3.21 Part 2: Vibration. BS 5228-2 provides recommended limits for vibration from construction sites. The construction vibration impact assessment (CVIA) has been carried out against the guidance on effects of vibration levels specified in Table B.1 of BS 5228-2. The level of vibration ranging from 0.14 mm.s⁻¹ to 10 mm.s⁻¹ indicates where vibration may be perceptible, acceptable, or intolerable.

15.3.22 Potential of HGV vibration on receptors along haul roads will be predicted using the procedures in Transport and Road Research Laboratory (TRL) Research Report 246 – Traffic Induced Vibrations in Buildings⁴. The predictive method in Section 3.4.4 of TRL 246 is used. The expected value of maximum vertical peak particle velocity (PPV) at a building foundation can be calculated as:

$$PPV = 0.028 a \left(\frac{v}{48} \right) t p \left(\frac{r}{6} \right)^x$$

15.3.23 Where a = maximum height or depth of the surface defect in mm, v = expected speed of HGV in km/h and t = ground scaling factor (Table 7 of TRL 246). If the surface defect occurs in one wheel path only, then $p = 0.75$, otherwise, $p = 1$, r = distance of foundation from the defect in metres, and x = power factor obtained from Table 7 from TRL 246 for most appropriate soil type. Chalk rock has been selected for this assessment. The ground scaling factor is 0.1 and power factor is -1.08.

Design Manual for Roads and Bridges LA 111 Noise and Vibration⁵

15.3.24 The *Design Manual for Roads and Bridges (DMRB) LA 111 Noise and Vibration* document provides guidelines for the assessment and management of noise and vibration impacts associated with road projects. The guidance sets out the requirements for assessing noise and vibration impacts from road schemes, ensuring that these impacts are identified, quantified, and managed appropriately.

15.3.25 The *DMRB LA 111* guidance provides a method of assessing the noise and vibration due to construction traffic on existing roads. The magnitude of impact caused by construction traffic is determined by the increase in noise level from the calculated existing baseline noise levels. Vibration levels are assessed to absolute limits. This has been used to assess the HGV movements on roads.

15.3.26 During any time period, the significance of the effect is defined by the lowest observable adverse effect level (LOAEL) and significant observable adverse effect level (SOAEL).

TGN(E)322 – Operational Audible Noise Assessment Process for Overhead Lines

15.3.27 National Grid Electricity Transmission (NGET)⁶ has derived a procedure which is followed by Transmission Network Operators, including SSEN Transmission, to assess the impact of OHL noise in both dry and rainy conditions – TGN (E) 322 – *Operational Audible Noise Assessment Process for Overhead Lines*⁷. The guidance of BS 4142: 2014 can also be used to assess the impact of the noise from a specific industrial source at NSRs.

15.3.28 The NSRs in this chapter are building premises classified as **Medium** sensitivity according to TGN(E)322.

15.3.29 The procedure requires that a series of assessments are conducted in tiers. Tier 3 requires that the background noise (BGN) at NSRs within a set distance from Proposed Development be measured during quiet night times and in dry conditions with little wind. The nature of the ground surface around the sensitive receptors is noted so that the contribution to background noise of the surface noise attributable to the rainfall can be derived from empirically derived curves (Miller curves). The logarithmic sum of the measured BGN and the empirically derived contribution for rainfall is adopted as the BGN level, in rainy conditions, against which to compare the predicted received noise from the OHL. Using the parameters provided in TGN(E)322 the likelihood of an adverse impact can be assessed.

15.3.30 The assessment procedure follows TGN(E)322, and has been conducted in the following stages:

- the outcome of the Tier 1 assessment determines whether the ‘worst case’ wet noise impact is predicted to be acceptable, or whether further assessment is required. Only the wet noise is assessed to a certain limit (34 dB(A);
- the outcome of the Tier 2 assessment determines whether the combined wet and dry noise impact is acceptable, or whether further assessment is required. Historical rain data in the region is used to calculate the mean annual wet hours

⁴ Transport and Road Research Laboratory, Research Report 246, Traffic Induced Vibrations in Buildings.

⁵ Transport Scotland, 2019. Design Manual for Roads and Bridges (DMRB), LA 111 Noise and Vibration.

⁶ The Transmission Operator in England and Wales.

⁷ Technical Guidance Note TGN(E)322, 2021, Operational Audible Noise Assessment Process for Overhead Lines, National Grid.

and new criteria for a 'combined' wet and dry noise level. The mean annual wet hours are used to find the percentage of wet weather, which will determine how often wet noise occurs and conversely, the percentage of dry noise. Using the formula for combined wet and dry noise criteria in Appendix D of TGN(E)322, this results in a range for adverse impacts of 36.7 dB(A) to 46.7 dB(A). Where the combined wet/dry noise falls below 36.7 dB(A), the NSR will be assessed to experience 'No Adverse Impacts' and OHL noise is deemed acceptable, and no further action is necessary. Where the combined wet/dry noise is within this range, the NSRs falls into the Adverse Impacts category. TGN(E)322 suggests that NSRs in this category should be considered to proceed to Tier 3 given the scale and cost of noise mitigation associated with minimising the noise. If the combined wet/dry noise is above 46.7 dB(A), then the NSR falls into the Significant Adverse Impact category and must proceed to Tier 3;

- the outcome of the Tier 3 assessment determines whether the noise impact is acceptable, whether the noise needs to be mitigated and minimised or whether the noise is unacceptable;
- the Tier 3 assessment takes account of existing background sound levels in the area and noise levels due to rainfall;
- the attended collection of night-time background noise levels at NSRs, or groups of such NSRs, within approximately 500 m of the centreline of the OHL during suitable dry weather conditions, before construction;
- allowance for the effects of rainfall on BGN (TGN(E)322 considers fog – an atypical condition – to produce lower noise levels than in rain but is still referred to as 'wet noise');
- prediction of contribution from conductors; and
- determination of total excess at the most likely rain rate.

15.3.31 In Tier 3, a 6 dB tonal penalty is added to the wet noise predicted in Tier 1 to determine a rating level. The excess wet figure is derived by comparing the total noise with penalty (rating) to the background noise level for the appropriate Miller Curve rating at each receptor at a rain rate of 1 mm/hr. Miller curve descriptions are provided in **Table 15.2: Miller Curve Description**. This rating level is then compared to the background noise level measured which must be adjusted for rainfall.

15.3.32 A dry noise rating is also determined by adding a tonal penalty of 3 dB to the dry noise level. The excess dry figure is compared to a background noise level in dry conditions.

Table 15.2: Miller Curve Description

Miller Curve	Description
R-1	Essentially bare, porous ground (that is ploughed field or snow-covered ground), no standing puddles or water. Relatively small-leafed ground cover vegetation, such as grass lawn, meadow, hayfield shortly after mowing, field of small-leaf plants.
R-2	Non-porous, hard, bare ground or pavement, falling raindrops splash on thin layers of puddles of collected water; or in or beside wooded area of deciduous trees without leaves or with only small leaves; or in or beside wooded area of coniferous trees or evergreens having needles rather than leaves; or thin-leafed ground cover of crop, such as hay, clover, or grain.
R-3	A few small, fully leafed deciduous trees 15 to 30 m or a few large, fully leafed trees 30 to 90 m distance.
R-4	Large area of fully leafed trees or large-leafed crops or vegetation, such as corn starting 15 to 30 m distance.
R-5	Large area of fully leafed trees or large-leafed crops or vegetation surrounding the area of interest.

15.3.33 While foggy conditions are associated with a low background noise level, the TGN(E)322 guidance defines noise in these conditions as 'wet noise'. If the Tier 1 or Tier 2 assessment screens out NSRs that are not affected by the wet noise, then the background noise level does not need to be considered in the assessment.

15.3.34 The excesses and magnitudes of impact are explained in the following section describing BS 4142.

*BS 4142:2014+A1:2019: Methods for rating and assessing industrial and commercial sound (BS 4142)*⁸

15.3.35 BS 4142 describes methods for rating and assessing the following:

⁸ UK Government, 2014. British Standard 4142: *Methods for rating and assessing industrial and commercial sound (BS 4142)*, BSI, 2014, Amended 2019.

- sound from industrial and manufacturing processes;
- sound from fixed installations which comprise mechanical and electrical plant and equipment;
- sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and
- sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train movements on or around an industrial and/or commercial site.

15.3.36 The methods use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

15.3.37 In accordance with the assessment methodology, the specific sound level ($LA_{eq,T}$) of the noise source being assessed is corrected, by the application corrections for acoustic features, such as tonal qualities and/or distinct impulses, to give a "rating level" ($LA_{r,Tr}$). The BS effectively compares and rates the difference between the rating level and the typical background sound level ($LA_{90,T}$) in the absence of the noise source being assessed.

15.3.38 BS 4142 advises that the time interval ('T') of the background sound measurement should be sufficient to obtain a representative or typical value of the background sound level at the time(s) when the noise source in question is likely to operate or is proposed to operate in the future.

15.3.39 Comparing the rating level with the background sound level, BS 4142 states:

- *"Typically, the greater this difference, the greater the magnitude of impact."*
- *A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context."*
- *A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context."*
- *The lower the rating 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 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."*

BS 8233:2014⁹ and Noise Rating Curves

15.3.40 BS 8233:2014: Guidance on Sound Insulation and Noise Reduction for Buildings⁹ provides guidance for the control of noise in and around buildings. The methodology provided within the document is applicable to the design of new buildings, or refurbished buildings undergoing a change of use, but does not provide advice on assessing the effects of changes in the external noise levels to occupants of an existing building. It has been requested by the Aberdeenshire Council and Angus Council to consider indoor noise, hence the assessment to BS 8233:2014⁹.

15.3.41 The guidance provided includes appropriate internal and external noise level criteria which are applicable to dwellings exposed to steady-state external noise sources. It is stated in the BS that it is desirable for internal ambient noise level not to exceed the criteria set out in Table 15.3 **Table 15.3: Summary of Internal Ambient Noise Level Criteria for Dwellings from BS 8233:2014.**

Table 15.3: Summary of Internal Ambient Noise Level Criteria for Dwellings from BS 8233:2014

Activity	Location	07:00 to 23:00 Hours, ie Daytime	23:00 to 07:00 Hours, ie Night time
Resting	Living Room	35 dB $LA_{eq,16}$ hour	
Dining	Dining Room/Area	40 dB $LA_{eq,16}$ hour	
Sleeping (daytime resting)	Bedroom	35 dB $LA_{eq,16}$ hour	30 dB $LA_{eq,8}$ hour

15.3.42 Noise Rating (NR) curves were developed by the International Organization for Standardization (ISO) to determine the acceptable indoor environment for hearing preservation, speech communication and annoyance. The primary standards that reference NR curves include; ISO 1996-1:2016, ISO 717-1:2013, and BS 8233:2014.

⁹ UK Government, 2014. British Standard 8233: *Guidance on sound insulation and noise reduction for buildings* (BS 8233), BSI, 2014.

15.3.43 The NR curves for different sound pressure levels are plotted as acceptable sound pressure levels at different frequencies. Acceptable sound pressure level varies with the room and the use of it. Different curves are obtained for each type of use. Each curve is referenced by a NR number as set out in **Table 15.4: Noise Rating Descriptions**.

Table 15.4: Noise Rating Descriptions

Noise Rating	Application
NR 20	Quiet rural area for protection of amenity
NR 25	Concert halls, broadcasting and recording studios, churches
NR 30	Private dwellings, hospitals, theatres, cinemas, conference rooms
NR 35	Libraries, museums, court rooms, schools, hospitals operating theatres and wards, flats, hotels, executive offices
NR 40	Halls, corridors, cloakrooms, restaurants, night clubs, offices, shops
NR 45	Department stores, supermarkets, canteens, general offices
NR 50	Typing pools, offices with business machines
NR 60	Light engineering works
NR 70	Foundries, heavy engineering works

15.3.44 The NR curve NR20 equates to a similar total noise level of 30 dB(A) and therefore is an appropriate consideration in respect to indoor noise levels as specified in BS8233. NR 20 has been selected for this assessment as the majority of NSRs are in a quiet rural area,

15.3.45 The guidance documents described above help inform the following assessments:

- BS228-1/2 has been used to assess potential effects of construction noise and vibration due to static equipment.
- DMRB LA111 has been used to assess potential effects of construction noise due to traffic.
- TGN(E)322 has been used to assess potential effects of operational noise of the OHLs
- BS 4142 has been used in Tier 3 assessment of TGN(E)322
- BS 8233 has been used for the assessment of internal noise due to the operation of the Proposed Development

Consultation

15.3.46 In undertaking the assessment, consideration has been given to the scoping and pre-consultation responses which has been undertaken as detailed in Table 15.5 **Table 15.5: Summary of Consultation**. A full summary of consultation is provided in **Volume 1, Chapter 6: Scope and Consultation**.

Table 15.5: Summary of Consultation

Consultee and Date	Type of consultation	Response	How Issue has been Addressed
Energy Consents Unit 19 December 2024	Scoping Opinion	Construction noise and vibration is to be assessed. Operational noise to be assessed for corona discharge and aeolian noise. Internal noise levels are to be calculated due to a history of complaints of existing 400 kV lines. Indoor noise criteria of NR 25 daytime and NR 20 night-time should be applied.	The noise and vibration assessment of properties has been proposed in the Scoping Report and is being conducted in this Chapter. Construction noise and vibration is assessed to BS 5228-1 and BS 5228-2 respectively. Construction is proposed to take place from 07.00 to 19.00 during British Summer Time and 07.00 to 18.00 during Greenwich Mean Time seven days a week. Construction noise has been assessed to 55 dB limits to be in accordance with the Evening and Weekends limit, as per BS 5228-1. It has also been assessed to 65 dB limits to show impacts in the Daytime and Saturdays timeframe. Operational noise caused by corona discharge in wet conditions is assessed according to TGN(E)322. Aeolian noise has been addressed, considering the potential for its occurrence based on the likelihood of wind conditions

Consultee and Date	Type of consultation	Response	How Issue has been Addressed
			that will induce the aeolian noise and location of sensitive receptors relative to the Proposed Development. An indoor assessment has been conducted against NR curve criteria according to BS 8223, assuming a partially open window. Internal noise has been assessed at the closest receptor. A low impact magnitude at this receptor means that any receptors further from the line will also have a low impact.
Angus Council 17 June 2024	Proposed methodology and assessment approach.	General agreement on methodology. No comments were raised regarding the use of TGN(E)322, however expects some consideration of internal noise impacts.	Some properties initially identified were screened to be non-residential, and therefore have been removed from the assessment. A background noise measurement was conducted at the NSR progressed to Tier 3 TGN(E)322 operational noise assessment (Wester Durris). An indoor assessment has been conducted against NR curve criteria according to BS 8223, assuming a partially open window. Internal noise has been assessed at the closest receptor. A low impact magnitude at this receptor means that any receptors further from the line will also have a low impact.
Aberdeenshire Council 05 June 2024	Proposed methodology and assessment approach.	Generally content with the proposed methodology, however note that whilst previous assessments; North East 400 kV Reinforcement Works (January 2020) and East Coast 400 kV Upgrade (December 2020) have included NR Curves, there is no mention of this criteria in the proposed assessment.	An indoor assessment has been conducted against NR curve criteria, assuming a partially open window.

Desk Based Research and Data Sources

15.3.47 The following data sources have informed the assessment:

- AddressBase data¹, detailed maps, and aerial photographs of the area surrounding the Proposed Development were examined and nearby NSRs were identified for the purposes of the construction and operational noise impact assessments.

Sensitivity

15.3.48 The sensitivity of the NSR is estimated in its current state prior to any change implied by the Proposed Development. The level of sensitivity is determined according to existing regulations and guidance, societal value, and vulnerability for the change. These definitions of receptor sensitivity are outlined in TGN(E)322.

15.3.49 Prior to detailed assessment, all NSRs considered in this assessment are assumed to be residential in nature. Therefore, the sensitivity is assumed as **Medium** unless otherwise specified.

15.3.50 For noise considerations relating to Cultural Heritage refer to **Volume 2, Chapter 10: Cultural Heritage**.

Identification of Sensitive Receptors

15.3.51 Potential NSRs were processed from AddressBase data. All potential receptors from the AddressBase dataset that fall within 500 m of the centreline of the alignment are considered in the construction noise and vibration assessment and operational noise assessment. This resulted in the identification of 522 NSRs.

15.3.52 For the operational noise assessment, according to the Electrical Power Research Institute (EPRI)¹⁰ method, recommended by the TGN(E)322, an OHL passes a Tier 1 assessment of TGN(E)322 if the wet noise falls below 34 dB(A) at that receptor. It was calculated that the wet noise from the proposed conductor Triple Araucaria, is predicted to produce 34 dB(A) of wet noise up to a distance of 26 m. Adding a buffer of 10 m, for variances in property size, meant that addresses up to 36 m from the Proposed Development would fail at Tier 1 and progress to Tier 2.

15.3.53 The 522 NSRs are detailed in **Volume 5, Appendix 15.1 Noise Sensitive Receptors (NSRs)** and shown in **Volume 3, Figures 15.1.1 to 15.1.18: Noise Sensitive Receptors**.

Method of Assessing Noise and Vibration Impact Magnitudes

15.3.54 The magnitude of change has been assessed for both the construction noise and vibration in addition to the operational noise. These methods are described below.

Construction Noise

15.3.55 The following magnitude of impact at receptors can be determined from **Table 15.6: Construction Noise - Magnitude of Impact at Receptors** Table 15.6: Construction Noise - Magnitude of Impact at Receptors, which uses the threshold value periods described in **paragraph 15.3.11**.

Table 15.6: Construction Noise - Magnitude of Impact at Receptors

Magnitude of Impact	Predicted Construction Noise Level (dB(A))	
	Evenings and Weekends (55 dB Limit)	Daytime and Saturdays (65 dB Limit)
High	> 60	>70
Medium	56 to 60	66 to 70
Low	BGN to 55	BGN to 65
Negligible	< Background Noise Level	< BGN

15.3.56 Excess over the 55 dB criteria will result in **Medium** impact magnitude. Excess of 5 dB or more over the noise limit will result in **High** impact magnitude.

¹⁰ Electrical Power Research Institute, 2005. EPRI AC Transmission Line Reference Book – 200 kV and Above, Third Edition, Final Report, 2005, Electrical Power Research Institute.

15.3.57 The individual noise-generating activities are expected to be short term in nature according to the work schedule supplied by the Principal Contractor. These include but are not limited to the Mobilisation, Installation and Demobilisation in the Foundations phase, which are less than one month in duration.

15.3.58 Construction traffic movements for local haul roads and Site access are incorporated within the BS 5228-1 assessment, however additional criteria extend to construction traffic on highways. **Table 15.7: Construction Traffic Noise - Magnitude of Impact at Receptors** Table 15.7: Construction Traffic Noise - Magnitude of Impact at Receptors shows noise impact criteria for the assessment of changes to road traffic noise due to the addition of Proposed Development related construction traffic, with reference from Table 3.17 of DMRB, LA 111 Noise and Vibration.

Table 15.7: Construction Traffic Noise - Magnitude of Impact at Receptors

Magnitude of Change	Traffic Noise Level Change (dB(A))
Negligible	0.1 to 0.9
Low	1.0 to 2.9
Medium	3 to 4.9
High	> 5

15.3.59 According to LA 111, a change in construction traffic noise levels above 3 dB are considered to be a Major impact if occurring for more for a duration exceeding:

- 10 or more days or nights in any 15 consecutive days or nights; and/or
- a total number of days exceeding 40 in any six consecutive months.

Construction Vibration

15.3.60 Criteria for construction vibration due to access tracks and foundation works are taken from Table B.1 in BS 5228-2 and shown in **Table 15.8: Construction Vibration Impact Assessment Criteria**. Vibration is measured as peak particle velocity (PPV).

Table 15.8: Construction Vibration Impact Assessment Criteria

Impact Magnitude	Vibration Level, Peak Particle Velocity (PPV) $\text{mm}\cdot\text{s}^{-1}$	Impact
Negligible	<0.3	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.
Low	0.3 to 1.0	Vibration might be just perceptible in residential environments.
Medium	1.0 to 10	It is likely that vibration of this level in residential environments will cause complaints but can be tolerated if prior warning and explanation have been given to residents.
High	>10	Vibration is likely to be intolerable for any more than a very brief exposure to this level in most building environments.

15.3.61 Excess over the $10 \text{ mm}\cdot\text{s}^{-1}$ criteria will result in **High** impact magnitude. Construction vibration between the $1 \text{ mm}\cdot\text{s}^{-1}$ and $10 \text{ mm}\cdot\text{s}^{-1}$ threshold will result in **Medium** impact magnitude. Below $1 \text{ mm}\cdot\text{s}^{-1}$ will result in **Low** or **Negligible** impact magnitude.

Operational Noise

15.3.62 The impact of operational noise is approached as a tiered assessment in TGN(E)322.

15.3.63 The outcome of the Tier 1 assessment will determine whether the 'worst case' wet noise impact is predicted to be acceptable, or whether further assessment is required. Predicted free field wet noise levels at the external façade of the NSR are compared against the Tier 1 noise criteria outlined in **Table 15.9: Operational Noise – Tier 1**.

Table 15.9: Operational Noise – Tier 1

Use	No Adverse Impact - Screened Out	Tier 2 Assessment Required
Vulnerable subgroups	< 29 dB(A)	> 29 dB(A)
Residential	< 34 dB(A)	> 34 dB(A)
Schools and Hotels	< 39 dB(A)	> 39 dB(A)

15.3.64 Where the predicted wet noise levels fall into the ‘No Adverse Impact’ category in **Table 15.9: Operational Noise – Tier 1**, the noise from the OHL is acceptable. Receptors falling into this category are screened out of further assessment and no further action or assessment is necessary, impact can be considered **Negligible**.

15.3.65 A Tier 2 Assessment shall be carried out where predicted Wet Noise levels exceed the ‘No Adverse Impact’ Category. A tier 2 assessment considers the combined dry and wet noise contribution through logarithmic calculation to determine new noise criteria. The combined noise criteria are presented in **Table 15.10: Operational Noise – Tier 2**.

Table 15.10: Operational Noise – Tier 2

Use	No Adverse Impact	Adverse Impact	Significant Adverse Impact
Vulnerable subgroups	< 31.7 dB(A)	31.7 - 41.7 dB(A)	> 41.7 dB(A)
Residential	< 36.7 dB(A)	36.7 - 46.7 dB(A)	> 46.7 dB(A)
Schools and Hotels	< 41.7 dB(A)	41.7 - 51.7 dB(A)	> 51.7 dB(A)

15.3.66 Where the predicted combined wet/dry noise level falls into the ‘No Adverse Impact’ category in a Tier 2 assessment, impacts can be considered **Negligible**.

15.3.67 Where the predicted combined wet/dry noise level falls into the ‘Significant Adverse Impact’ category in a Tier 2 assessment, TGN(E)322 states a Tier 3 assessment will be necessary. Where the predicted noise levels fall into the ‘Adverse Impact’ category, mitigation should be considered or also considered to proceed to Tier 3.

15.3.68 The outcome of the Tier 3 assessment will determine whether the noise impact is acceptable, whether the noise needs to be mitigated and minimised or whether the noise is unacceptable. The Tier 3 assessment takes account of existing background sound levels in the area and noise levels due to rainfall. The Tier 3 Assessment requires the impact of Dry Noise and Wet Noise to be assessed separately using two different methods which are based on the principles of BS 4142. The two methods differ in that the Dry Noise assessment requires the determination of the existing baseline sound level, whilst for the Wet Noise assessment, it is necessary to predict the increase in background sound levels due to rainfall.

15.3.69 The magnitude of a predicted noise impact at a given receptor can be interpreted as the degree of alteration that is undergone by the receptor as a consequence of the impact. Magnitude criteria can be quantitative using standards such as BS 4142, which is determined by the outcome of a TGN(E)322 Tier 3 assessment. As reported **Table 15.11: BS 4142 Impact Magnitude** below, the impact magnitude is worked out on a case-by-case basis for each NSR and classified as **Negligible**, **Low**, **Medium**, or **High**.

15.3.70 Information from the rating level, the background sound level, and the stated impacts from a BS 4142 assessment have been converted into representative impact magnitudes, detailed in **Table 15.11: BS 4142 Impact Magnitude**.

Table 15.11: BS 4142 Impact Magnitude

Impact Magnitude	Definition	Tier 1 Criteria for Magnitude of Impact	Tier 2 Criteria for Magnitude of Impact	TGN(E)322 Tier 3 Criteria for Magnitude of Impact (Difference between OHL Rating Noise Level and Background Sound Level)
Negligible	Impact to the receptor is immeasurable, undetectable or within the range of normal natural background variation.	<34 dBA wet noise	<36.7 dBA combined wet and dry noise	Low Impact ≤ 0 dB
Low	The lower the rating level is relative to the measured	>34 dBA, further	>36.7 dBA, further	Minor Impact 0 to 4 dB

Impact Magnitude	Definition	Tier 1 Criteria for Magnitude of Impact	Tier 2 Criteria for Magnitude of Impact	TGN(E)322 Tier 3 Criteria for Magnitude of Impact (Difference between OHL Rating Noise Level and Background Sound Level)
	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 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	assessment required at Tier 2	assessment required at Tier 3	
Medium	A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.			Adverse Impact 5 to 9 dB
High	A difference of around +10 dB or more is likely to be an indication of a Significant adverse impact, depending on the context.			Significant Adverse Impact ≥ 10 dB

Significance

- 15.3.71 After assessing the sensitivity of the NSR in its baseline state, and then the impact magnitude of the noise likely to affect the NSR, an estimate of the effect significance can be derived by applying a calculation matrix.
- 15.3.72 The measure of significance is the key output of the impact assessment process and drives the requirement for mitigation measures to be applied during construction and operation to offset or reduce potential project generated effects.
- 15.3.73 The predicted significance of the effect was determined through a standard method of assessment outlined in **Volume 1, Chapter 5: EIA Process and Methodology** and based on professional judgement, considering both sensitivity and magnitude of change as detailed in **Table 15.12: Matrix for Determination of Significance of Effects** below. **Major** and **Moderate** effects are considered **Significant** in the context of the *EIA Regulations*.

Table 15.12: Matrix for Determination of Significance of Effects

		Sensitivity of NSR			
		High	Medium	Low	Negligible
Magnitude of Change	High	Major	Major	Moderate	Minor
	Medium	Major	Moderate	Minor	Negligible
	Low	Moderate	Minor	Minor	Negligible
	Negligible	Minor	Negligible	Negligible	Negligible

Assessment Assumptions and Limitations

- 15.3.74 The following assumptions have been made when undertaking the assessment of effects:
- 15.3.75 Two scenarios are assessed in this Chapter. The first is where the noise is assessed as if the Proposed Development is built as designed. The second is where the noise is assessed as if the towers proposed are moved a maximum of 55 m for suspension towers or 100 m for the tension towers (see **paragraph 15.3.83** below) to address potential future changes in tower positions as a result of micro-siting within the Limits of Deviation (LOD).
- 15.3.76 Estimated noise emissions from the Proposed Development's construction activities and plant items have been extracted from Annex C in BS 5228-1. Where equipment has been proposed that cannot be extracted from BS 5228-1, information of source noise levels is taken from projects of a similar nature. This assessment considers conservative assumptions with the aim to produce a worst-case assessment. The assumptions include a direct path from source to receiver with no screening or change in terrain level. The ground factor is assumed as a mix of both hard and soft terrain. The assessment assumes equipment is

producing the maximum sound power level for the entire time it is assumed as operational according to the proposed working hours. In practice, noise levels during construction would be expected to be lower than the assessment details.

- 15.3.77 There will be periods just after rainfall or during foggy conditions where there is some noise emission from the OHL, although these levels are less than those during rain according to TGN(E)322. These periods where background noise is less than those in during periods of rainfall are not accounted for in the assessment as there no standardised methodology or procedure. The number of droplets, and hence the noise level, will depend primarily on the rate of rainfall. Historical studies determined that hum inception typically occurs at a rainfall rate of approximately 1 mm/hr. Hum inception is the point at which during rainfall the low-frequency humming component of corona discharge noise becomes noticeable. This hum induces a tonal component of the noise, which is represented by a 6 dB tonal penalty at Tier 3 of a TGN(E)322 assessment.
- 15.3.78 There is a degree of uncertainty when conducting assessments on developments in the planning stage. These uncertainties occur in calculation, rounding, and baseline levels used. Assumptions include a flat terrain between OHL centreline and NSR. In Tier 1 and 2 of the TGN(E)322 assessment, no acoustic absorption due to the ground is included to ensure a worst-case assessment. The calculation for OHL conductor noise uses the EPRI method of calculation which assumes a moderately aged conductor, which is appropriate for the assessment of the Proposed Development for the lifetime of its operation.
- 15.3.79 The assessments are based on information available at the time of publication, any changes to design or specification of the Proposed Development that may lead to increased adverse effects would require re-assessment.
- 15.3.80 The perception and impact of noise is subjective. However, the standard methodologies aim to assess noise objectively.
- 15.3.81 Whilst some information is subject to change such as the construction activities, it is considered that there is sufficient information to enable an informed decision to be taken in relation to the identification and assessment of likely significant environmental effects on noise and vibration.

Limits of Deviation

- 15.3.82 The standard LOD around suspension towers is 100 m either side of the centreline. The full extent of the LOD could be used for construction works on a temporary basis however, the need for an Operational Corridor of 45 m within the LOD means that towers are limited to a permanent movement of 55 m from the current proposed position. The standard LOD around angle towers is 200 meters (circular area). The full extent of the LOD could be used for construction works on a temporary basis however, the towers are limited to a permanent movement of 100 m. Towers are also restricted to being no closer than 100 m from any NSR) in the vast majority of cases. At the Kintore to Tealing 275 kV OHL however, the temporary diversion is 74 m from NSR 451 Southside Cottage, which is predicted to experience negligible impact from the single Araucaria conductor used. The Kintore to Fetteresso 275 kV/400 kV OHL temporary diversion is 38 m from NSR 323 Wester Durris Farm.
- 15.3.83 For the construction assessment, the distance from NSRs (the AddressBase point) to towers (centre of the tower base) has been measured using QGIS, with 55 m subtracted for a worst-case assumption for suspension towers and 100 m subtracted for tension towers or restricted by the LOD. The closest the construction of the Proposed Development can be to any NSR is at the outer edge of the LOD, so the distance between the NSR and construction area will never be less than this. However, the average activity over the working period will be at the geometric centre of the construction area which is the tower itself, so noise is calculated for each phase as if it takes place at the tower.
- 15.3.84 For the purposes of the operational assessment, the distance will by default be the distance from NSR (the AddressBase point) to the alignment (centreline). A second scenario has been assessed where 55 m subtracted from the distance from NSR to the alignment for a worst-case movement for suspension towers and 100 m subtracted for the worst-case movement for angle towers. In special cases, if this distance is smaller than the distance to the outer edge of the LOD, then distance to the outer edge of the LOD will be used.

15.4 Baseline Conditions

Summary of Baseline

- 15.4.1 The Proposed Development concerns of the following overhead lines: the proposed Kintore to Tealing 400 kV OHL, the existing Kintore to Fetteresso 275 kV OHL, the existing Kintore to Tealing 275 kV OHL, and the existing Craigiebuckler to Tarland 132 kV OHL. Baseline noise monitoring was not required for the Kintore to Tealing 400 kV OHL due to the outcome of the desk-based operational noise impact assessment. Only NSRs that proceed to Tier 3 are required for a baseline noise survey. The operational

noise impact assessment of the temporary diversion of the existing Kintore to Fetteresso 275 kV (currently being uprated to 400 kV) OHL required a Tier 3 assessment at NSR 323 Wester Durris Farm.

- 15.4.2 The field survey consisted of free-field attended spot measurements at the NSR using a class-1 sound level meter. This was necessary to determine the existing noise environment and to obtain BGN levels at the necessary location. This background noise level was used as a baseline for the operational noise impact assessment for dry and wet conditions in a Tier 3 TGN(E)322 Assessment.
- 15.4.3 Measurements were conducted using Rion NL-52 sound level meters (serial number 01265434) which was spot calibrated with a Rion NC-74 calibrator (serial number 34178103), before and after the measurement campaign. Where the acoustic environment was stable with no transient noise sources, a 10-minute measurement was conducted as this was representative of the location during this period. If transient noise sources (a sudden, short burst of noise such as passing traffic or animals) were present the measurement was extended to 15-minutes as recommended by BS 4142.
- 15.4.4 Measured parameters include the following:
- LAeq (10-minutes);
 - LAeq (10-minutes) one-third octave band spectrum;
 - LA90 (10-minutes); and
 - LA90 (10-minutes) one-third octave band spectrum.
- 15.4.5 To determine the BGN a free-field attended spot measurement was conducted at the nearby NSR between 23:00 and 03:00 on the nights of 18 September 2024 and 19 September 2024.
- 15.4.6 In general, the BGN data is relatively low at night with slight noise from distant traffic. The results of baseline noise survey show that NSR 323 Wester Durris Farm has a noise environment quantified around 27.3 dB LA90 during night periods.
- 15.4.7 Using a Miller Curve of R-1 at this location, the background noise in wet conditions has been adjusted to 38.4 dBA.
- 15.4.8 This background noise data has been used in the TGN(E)322 Tier 3 operational noise impact assessment **Section 15.3.30**.
- 15.4.9 It is not expected that there will be a significant change to future baseline noise levels than those measured in this study (in absence of the Proposed Development).

15.5 Mitigation and Monitoring

Embedded Mitigation

- 15.5.1 Topic specific Embedded Mitigation (mitigation achieved through design) is outlined below. A comprehensive schedule of Embedded Mitigation is provided in **Volume 1, Chapter 4: Alternatives and the Routeing Process**.

Operational Noise

- 15.5.2 NV1 - The proposed conductor type, Triple Araucaria, has been selected for use on the Proposed Development, which is a low noise conductor.
- 15.5.3 NV2 - Permanent towers and conductors are not proposed to be located within 100 m of NSRs, beyond this distance, the conductor produces relatively low noise. The purpose and key driver of the routeing is to avoid proximity to NSRs such as residential properties.
- 15.5.4 NV3 - Aeolian noise is caused by wind blowing through the conductors and/or structures. This type of noise is usually infrequent and depends on wind velocity and direction. Wind must blow steadily and perpendicular to the lines to set up an aeolian vibration, which can produce resonance if the frequency of the vibration matches the natural frequency of the line. Design of the conductors will implement best practice. Dampers will be attached to the lines to minimise aeolian vibration and therefore aeolian noise. It must be ensured that no components are used that have a known history to produce high aeolian noise.

15.6 Assessment of Likely Significant Effects - Construction

- 15.6.1 The assessment of effects identified above is based on the project description as outlined in **Volume 1, Chapter 3: Project Description**. Unless otherwise stated, potential effects identified are considered to be adverse.

Predicted Construction Effects

Construction Noise

- 15.6.2 A desk-based construction noise appraisal has been prepared for the purpose of assessing the effects of the works on any nearby NSRs. This appraisal has been produced in line with BS 5228-1:2009 +A1:2014 (BS 5228), *Code of Practice for Noise and Vibration Control on Construction and Open Sites*.
- 15.6.3 Construction noise is assessed to a 55 dB limit in the case that work takes place during the Saturday afternoons or Sundays (defined as Evening and Weekends in **Section 15.3: Assessment Methodology**). Work will also take place in the during weekdays and Saturday mornings and therefore would be assessed to a 65 dB limit. Results have been included for both noise limits. The magnitude of change from each phase have been compared to the sensitivity of the NSRs and the resultant significance of effect has been evaluated. Where effects have been predicted to be significant, these are shown as detailed results shown in **Volume 5, Appendix 15.3: Construction Noise Impact Assessment**, a summary of results are presented in **Table 15.13: Summary of Construction Noise Results – Number of Predicted Receptors – Using Proposed Alignment for Distance to NSR** and **Table 15.14: Summary of Construction Noise Results – Number of Predicted Receptors – If Suspension Towers Move 55 m and Angle Towers Move 100 m**.
- 15.6.4 The proposed construction routes reported in **Volume 2, Chapter 14: Traffic and Transport** have been used as the basis for the assessment of haul routes using information obtained in March 2025. The traffic data is described as 'peak' traffic and therefore is conservative. Construction traffic noise calculations have followed guidance from BS 5228-1 Annex F.2.5 'Method for mobile plant using a regular well-defined route (eg haul roads) and noise levels incorporated into overall construction noise assessment.

Table 15.13: Summary of Construction Noise Results – Number of Predicted Receptors – Using Proposed Alignment for Distance to NSR

Phase	Using Proposed Alignment for Distances if assessed to 65 dB limit, work done in Daytime and Saturdays hours)		Using Proposed Alignment for Distances if assessed to 55 dB limit, work done in Evenings and Weekends hours)	
	Medium Impacts (65 dB Limit)	High Impacts (70 dB Limit)	Medium Impacts (55 dB Limit)	High Impacts (60 dB Limit)
Vegetation Clearance and Felling	84	15	170	260
Access and Enabling	27	38	137	118
Piling	2	1	261	111
Foundations	3	0	247	73
Tower Erection	0	0	8	1
Stringing	1	0	24	4
Downloads	0	0	2	0
Scaffold/Yard	1	0	9	3
Dismantling	3	0	32	6

- 15.6.5 For the vegetation clearance and felling phase, noise at 430 out of 522 NSRs are above the 55 dB noise limit with 260 NSRs rated as **High** impact. The distance is considered from the NSR (AddressBase property centre) to the nearest felling buffer. Felling activities will vary in time spent, with some areas expected to be very short-term. When the CNMP is created, the time expected to fell trees in each area should be specified to assess the severity of the construction noise.
- 15.6.6 Noise at 255 of 522 NSRs are above the 55 dB limit for the Access and Enabling phase, with 118 NSRs rated as **High** impact. The noise due to the excavators and the saws are dominant and have the potential to cause significant noise issues. This equipment must be controlled through the CNMP for running time during working hours.
- 15.6.7 For the Piling phase, it is predicted 372 of the 522 NSRs are above the 55 dB limit, with 111 NSRs rated as **High** impact and therefore **Significant** effects are predicted. The breaker and hammer rig are currently predicted to cause the highest impacts, therefore, careful management of running time during the working hours must be implemented in the CNMP.
- 15.6.8 For the Foundations phase, it is predicted 320 of the 522 NSRs are above the 55 dB limit, with 73 NSRs rated as **High** impact and therefore **Significant** effects are predicted. The breaker and excavators are currently predicted to cause the highest impacts, therefore, careful management of running time during the working hours must be implemented in the CNMP.
- 15.6.9 Tower erection is currently predicted to cause a breach of the 55 dB limit at 9 NSRs with 1 NSRs rated as **High** impact and therefore **No Significant** effects are predicted if activity is done during Daytime and Saturdays hours and There is careful management of running time during the working hours must be implemented in the CNMP.
- 15.6.10 Stringing is currently predicted to cause a breach of the 55 dB limit at 28 NSRs with 4 NSRs rated as **High** impact and therefore **Significant** effects are predicted. This is mostly due to the static vehicle activity such as telescopic handlers and tractors. Therefore, there must be careful management of running time during the working hours must be implemented in the CNMP
- 15.6.11 Downloads is currently predicted to cause only two breaches of the 55 dB limit and therefore no **Significant** effects are predicted if scheduling of noisy equipment is done to the Daytime and Saturdays threshold period.
- 15.6.12 Scaffold and yard work is currently predicted to cause a breach of the 55 dB limit at 12 NSRs with 3 NSRs rated as **High** impact and therefore **Significant** effects are predicted. This is mostly due to the telehandler activity. Therefore, there must be careful management of running time during the working hours must be implemented in the CNMP, however this phase is expected to be short term.
- 15.6.13 Dismantling is currently predicted to cause a breach of the 55 dB limit at 38 NSRs with 6 NSRs rated as **High** impact and therefore **Significant** effects are predicted. This is mostly due to the breaker activity. Therefore, there must be careful management of running time during the working hours must be implemented in the CNMP

15.6.14 Therefore, prior to the mitigation measures, construction noise is assessed as **High** impact, and therefore **Significant** due to the excess above 60 dB limit breaches at eight of the phases (all but downloads work).

Table 15.14: Summary of Construction Noise Results – Number of Predicted Receptors – If Suspension Towers Move 55 m and Angle Towers Move 100 m

Phase	Daytime and Saturdays (65 dB limit)		Evenings and Weekends (55 dB limit)	
	Medium Impacts (65 dB Limit)	High Impacts (70 dB Limit)	Medium Impacts (55 dB Limit)	High Impacts (60 dB Limit)
Vegetation Clearance and Felling	84	15	170	260
Access and Enabling	27	38	137	118
Piling	60	3	240	217
Foundations	36	1	245	176
Tower Erection	0	0	71	3
Stringing	1	2	101	23
Downleads	0	0	2	0
Scaffold/Yard	1	2	65	9
Dismantling	5	0	32	8

15.6.15 For activities in the Daytime and Saturdays hours (which are the majority) and therefore assessed to a 65 dB limit, as well as limiting the potential permanent movement of towers where possible within the LOD, then the number of NSRs in excess significantly reduces in all phases, as shown in **Table 15.13: Summary of Construction Noise Results – Number of Predicted Receptors – Using Proposed Alignment for Distance to NSR**.

15.6.16 Construction related traffic and transport impacts for main access routes have been assessed by calculating the relative increase in road traffic noise level adjacent to public roads used by construction traffic. The standard UK calculation method Calculation of Road Traffic Noise (CRTN) was used to calculate the noise level, at a nominal distance of 10 m from each road, using baseline traffic flows and also accounting for the addition of construction traffic as reported in **Volume 2, Chapter 14: Traffic and Transport**.

15.6.17 The average daily traffic flows reported in **Volume 2, Chapter 14: Traffic and Transport** have been converted to 18-hour traffic flows for the purposes of the noise calculation as is required by CRTN. Noise levels for the baseline 2026 and baseline + construction traffic scenarios are presented in **Volume 5, Appendix 15.3: Construction Noise Impact Assessment** for both cars and HGVs.

15.6.18 Assuming the values above, the following L10 18-hour noise levels are obtained and are fully presented in **Volume 5, Appendix 15.3: Construction Noise Impact Assessment**. The CRTN methodology requires a minimum of 1000 vehicle movements per day to enable reliable predictions.

15.6.19 Impacts on all of the routes are predicted as either **Low** or **Negligible** and therefore **Not Significant**. See **Volume 2, Chapter 14: Traffic and Transport** for description of Site References. According to the work schedule supplied by the Principal Contractors, the noise-generating activities associated with each phase (for example in the Foundations phase the Mobilisation, Installation and Demobilisation) do not last longer than a month and are therefore considered short-term in nature. These are therefore likely to be **Not Significant**. The following considers should the work extend beyond their planned schedule and the durations discussed in **paragraph 15.3.59**.

15.6.20 Impacts on the sections are predicted as either **Low** or **Negligible** and therefore **Not Significant**.

Construction Vibration

15.6.21 A desk-based construction vibration appraisal has been prepared for the purpose of assessing the effects of the works on any nearby residents. This appraisal has been produced in line with BS 5228-2:2009 +A1:2014 (BS 5228), *Code of Practice for Noise and Vibration Control on Construction and Open Sites*.

15.6.22 BS 5228-2 provides recommended limits for vibration from construction sites. The CVIA has been carried out against the guidance on effects of vibration levels specified in Table B.1 of BS 5228-2. The level of vibration ranging from 0.14 mm.s⁻¹ to 10 mm.s⁻¹ indicates where vibration may be perceptible however acceptable, or intolerable.

15.6.23 Construction activities that induce vibration are likely to be limited to potential piling activities where required at foundations. The formulae for the prediction of groundborne vibration due to piling is taken from Table E.1 in BS 5228-2.

15.6.24 Construction vibration activities and parameters associated with equipment specified in **Volume 5, Appendix 15.2:**

Construction Activity are largely unknown at time of writing, therefore, the worst-case parameters have been assumed for vibration due to foundation excavation and piling taking place at Tower 295R for the existing Kintore to Tealing 275 kV OHL Diversion. This tower is the closest to any NSR 451 Southside Cottage at 85 m from nearest Tower 259R. This distance is to the existing tower on the existing Kintore to Tealing 275 kV OHL. If the assessment passes at the closest receptor, it will pass at all others. The parameters that affect resultant vibration from piling, v_{res} , are shown in **Table 15.15: Groundborne Vibration Parameters from Mechanised Construction Works**.

Table 15.15: Groundborne Vibration Parameters from Mechanised Construction Works

Vibration Parameter	Range
Maximum amplitude of drum vibration, in millimetres (mm),	Between 0.4 and 1.72 mm
Pile toe depth, in metres (m),	Between 1 and 27 m
Vibrating roller drum width, in metres (m)	Between 0.75 and 2.2 m
Number of vibrating drums	1 or 2
Slope distance from the pile toe or tunnel crown, in metres (m)	Depends on distance between source and receiver and pile toe depth
Nominal hammer energy, in joules (J)	Between 1.5 and 85 kJ
Potential energy of a raised tamper, in joules (MJ)	Between 1 and 12 MJ
Distance measured along the ground surface, in m	84 m for closest NSR 451 Southside Cottage

15.6.25 **Table 15.16: Groundborne Vibration Results from Foundation Works at Tower 259R on NSR 451 Southside Cottage** shows the worst-case results of the groundborne vibration due to piling. Vibratory compaction, percussive piling, and vibratory piling have been calculated in the case these activities will take place.

Table 15.16: Groundborne Vibration Results from Foundation Works at Tower 259R on NSR 451 Southside Cottage

Vibration Operation	Resultant PPV (mms ⁻¹)	Magnitude of Impact
Vibratory Compaction (Steady State)	0.31	Low
Vibratory Compaction (Start Up and Run Down)	0.65	Low
Percussive Piling	0.14	Negligible
Vibratory Piling	0.29	Negligible

15.6.26 All impacts, except for the potential vibratory compaction (**Low**), for potential vibration works have been assessed as **Negligible**. In the worst case, the **Low** vibration activities might be just perceptible in residential environments, therefore, the significance of effect for construction vibration is **Minor** and **Not Significant**.

15.6.27 Construction vibration due to traffic is assessed based on absolute levels. As similar vibration levels on the existing roads will be generated by heavy vehicle traffic already, no change to absolute levels is predicted on these roads and impacts are predicted to be **Negligible**.

15.6.28 Vibration due to traffic on new access routes has been assessed using the same assessment method as construction noise due to HGVs on access tracks. It is estimated that there are 10 heavy goods vehicles passing by the NSRs per hour. The potential of HGV vibration on receptors along haul roads has been predicted using the procedures in Transport and Road Research Laboratory (TRL) Research Report 246 – *Traffic Induced Vibrations in Buildings*⁴. Groundborne vibration arises primarily from the interaction of vehicle tyres with irregularities in the road surface, such as potholes, cracks, or bumps. In this case, the road

defect is a 25 mm depression, which could amplify groundborne vibrations. However, it is important to consider the condition of the road surface, ground conditions, and vehicle characteristics when evaluating the magnitude of impact.

15.6.29 There are several NSRs along access tracks. In this case, with a vehicle traveling at an assumed maximum 60 km/h over a 25 mm road defect, at a distance of 15 m from any NSR over chalk rock, it is expected that the resultant PPV at the NSR is 0.7 mm.s^{-1} , indicating **Low** impact. Therefore, the significance of effect for construction traffic vibration is **Minor** and **Not Significant**.

15.6.30 Construction-related traffic vibrations are typically temporary and transient, depending on the frequency and volume of construction vehicle movements. LA 111⁵ provides criteria for determining significance based on the duration of the vibration impacts, which shall constitute a likely significant effect:

- 10 or more days or nights within any 15 consecutive days, or 40 or more days within any six consecutive months

Applied Mitigation

15.6.31 Due to the assessment being performed on assumed information at this stage, a detailed construction noise assessment with a CNMP, in accordance with the guidance and procedures outlined in BS 5228-1, will be conducted by the Principal Contractors. The CNMP is expected to be embedded within the Construction Environmental Management Plan (CEMP). Procedures could include where necessary and practicable:

- minimising the noise as much as is reasonably practicable at source;
- attenuation of noise propagation by the addition of acoustic absorptive screens or barriers within the Site;
- carrying out identified high noise level activities at a time when they are least likely to cause a nuisance to residents; and
- providing advance notice of unavoidable periods of high noise levels to residents.

15.6.32 In order to maintain low impact on the noise environment, consideration will be given to attenuation of construction noise at source by means of the following:

- giving due consideration to the effect of noise, in selection of construction methods;
- avoidance of vehicles waiting or queuing, particularly on public highways or in residential areas with their engines running;
- scheduling of deliveries to arrive during daytime hours only. Care should be taken to minimise noise while unloading delivery vehicles. Delivery vehicles will follow routes that minimise use of residential roads;
- ensure plant and equipment are regularly and properly maintained. All plant should be situated to sufficiently minimise noise impact at nearby properties;
- fit and maintain silencers to plant, machinery, and vehicles where appropriate and necessary;
- operate plant and equipment in modes of operation that minimise noise, and power down plant when not in use;
- use electrically powered plant rather than diesel or petrol driven, where this is practicable; and
- working typically not to take place outside of hours defined in the construction schedule.

15.6.33 Consideration will be given to the attenuation of construction noise in the transmission path by means of the following:

- locate plant and equipment liable to create noise as far from NSRs as is reasonably practicable or use natural land topography to reduce line of sight noise transmission;
- noise screens, hoardings and barriers will be erected where appropriate and necessary to shield high-noise level activities; and
- provide lined acoustic enclosures for equipment such as portable generators.

15.6.34 The updated, detailed CNIA, Traffic Management Plan (TMP) and CNMP will address any remaining predicted noise excess, and will be conducted prior to the commencement of any construction works.

Additional Mitigation

15.6.35 Where construction activities occur during Saturday afternoons and Sundays, and noise levels are assessed to reach 55 dB, mitigation measures outlined in **paragraphs 15.6.31 to 15.6.33** and the CNMP will be applied. The noisiest activities will be restricted to Daytime and Saturday working hours to allow assessment against the 65 dB threshold. These restrictions will be clearly defined in the CNMP.

- 15.6.36 For NSRs still assessed to be impacted, noise compliance measurements will be undertaken during peak activities to ensure emissions remain within permitted limits. Where exceedances are identified, further mitigation will be implemented.
- 15.6.37 During access/enabling, foundation, and piling phases, the active time of the noisiest equipment will be reduced to maintain worst-case levels at or below 65 dB at receptors. If noise levels exceed acceptable thresholds, Principal Contractors will be provided with site-specific mitigation requirements for inclusion in the CNMP. This may involve detailed scheduling of high-noise equipment such as saws, breakers, and piling rigs, particularly at locations identified in **Volume 5, Appendix 15.3: Construction Noise Impact Assessment**.
- 15.6.38 The simultaneous operation of the following equipment in conjunction with other noise-generating machinery will be managed to minimise noise impacts from each phase in the Daytime and Saturdays threshold period:
- Felling: wood chipper, chainsaw, and brushcutter.
 - Access: saw.
 - Foundations: breaker.
 - Piling: breaker and piling rig.
 - Dismantling: breaker.
- 15.6.39 Following the curtailment of this equipment, 96-97% of receptors no longer experience significant impacts.
- 15.6.40 At NSRs where moderate impacts remain, further detailed mitigation will be identified and incorporated into the CNMP. These NSRs are shown in **Volume 5, Appendix 15.3: Construction Noise Impact Assessment, Table 15.3.19**.
- 15.6.41 Additional mitigation measures during the construction period are outlined below in **Table 15.17: Additional Mitigation – Construction**.

Table 15.17: Additional Mitigation - Construction

Mitigation Measure	Rationale	Project Stage/ Timing	Responsibility
CNMP – Will set out proactive strategies to manage and minimise the noise and vibration impacts generated by construction. Mitigation measures such as the control of the noise source levels, controlling the noise transmission path via noise barriers, time management and managing operational times of equipment when not in use will be implemented where necessary. This will also include community engagement and stakeholder management plans to ensure legal compliance with <i>The Control of Pollution Act 1974</i> .	Potential Significant noise effects	Prior to and during construction	Principal Contractors
LOD Restriction - Construction noise is predicted to exceed 65 dB where towers may move the maximum distance from the Proposed Alignment within the LOD during piling and foundations (suspension towers could move up to 55 m closer to NSRs within the LOD and angle towers could move up to 100 m closer to NSRs within the LOD). However, the LOD has already been restricted at many locations (see Volume 1, Chapter 3: Project Description, Section 3.5: Limits of Deviation and Volume 3, Figures 3.3.1 to 3.3.29: Overview of the LOD Variations for details) and prior to any further changes being made to the Proposed Development within the LOD, a change control process would be undertaken to ensure that there is no unacceptable increase in adverse impacts as a result of the change. This process is managed via the Applicant's internal process 'Change Request Procedure for Project Design Parameters Controlled by Consent Limitations (PR-NET-ENV-503)' as detailed in Chapter 3: Project Description .	Potential Significant noise effects	Prior to and during construction	Applicant
Community Engagement - Communities would be informed of the programme of construction activities and a Community Liaison contact would be appointed to deal with any community queries or feedback. These would be detailed in the CNMP to be agreed with the relevant Local Authority.	Potential Significant noise effects	Prior to and during construction	Applicant
Equipment Curtailment – The elimination of concurrent use of the noisiest equipment in each phase will effectively eliminate the significant impacts of	Potential Significant	Prior to and during construction	Principal Contractors

Mitigation Measure	Rationale	Project Stage/ Timing	Responsibility
all but 3-4% of NSRs as detailed in paragraph 15.6.38 . This will be managed through the CNMP.	noise effects		
Duration of Works – The construction noise in general will be very short-term, maintaining this duration will ensure construction noise impacts are minimised.	Potential Significant noise effects	Prior to and during construction	Principal Contractors

Residual Construction Effects

15.6.42 The information used in this assessment is accurate at time of writing. It is recommended that this assessment is to be reviewed and updated as necessary by the Principal Contractors if significant changes in equipment take place. It is expected that with the implementation of a CNMP, where activity near locations of significant impacts can be microsituated in terms of active operational time of equipment and increased community engagement to detail the duration of works, any remaining impacts can be eliminated. Therefore, it is predicted that construction noise would result in **Minor** impact at worst and therefore is **Not Significant**.

15.7 Assessment of Likely Significant Effects - Operation

Predicted Operational Effects

- 15.7.1 There are differences in assessment methods for dry and wet conditions. Dry noise is assessed by indicating the excess of rating level over background. During wet conditions, the noise output from OHLs varies according to the number and size of rain droplets accumulated on the surface of the conductors. Therefore, there is a strong relationship between the rainfall rate and the noise output from an OHL. Background noise levels also increase with rainfall rate, such that during very heavy rain, OHL noise is generally inaudible. For these reasons, an alternative noise assessment method to deal with rain-induced noise is required. The external rain-induced noise levels are assessed using the methodology developed by National Grid and detailed in their Technical Guidance Note TGN(E)322.
- 15.7.2 The excess wet figure is derived by comparing the total noise to the background noise level for the appropriate Miller Curve rating at each receptor at a rain rate of 1 mm/hr.
- 15.7.3 The lower the rating 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.
- 15.7.4 Due to the lack of standardised quantitative prediction method for the assessment of potential aeolian noise impacts, a summary has been produced. While aeolian noise is possible under specific wind conditions, its occurrence is typically infrequent and it cannot be accurately assessed. Wind must be incident on the insulators or dampers of the OHL at certain direction and speed for the aeolian noise to be induced. If the wind is too low there will be no noise induced. If the wind is too high, then background noise is raised and aeolian noise impacts are less likely to be Significant. While aeolian noise may be audible several hundred metres from a tower, these specific conditions of wind conditions are not likely to be frequent enough to cause adverse noise impacts. Therefore, the focus is on anticipating and mitigating potential aeolian noise through appropriate design measures for the Proposed Development (NV3 in **paragraph 15.5.4**).
- 15.7.5 The corona-induced audible noise of the OHL in rainfall has been calculated using the EPRI method as recommended in TGN(E)322. Noise emissions at distances up to 500 m of the Triple Araucaria conductor have been calculated. The external rain-induced noise levels have been assessed using the TGN(E)322 methodology developed by National Grid.
- 15.7.6 In the TGN(E)322 method, previously mentioned in **paragraph 15.3.27**, the tiered system screens out receptors of low enough wet noise in Tier 1. If the wet noise is above 34 dB(A), Tier 2 assesses the combined wet and dry noise. This stage assesses the proportion of time the area is raining or is dry and calculates a 'combined' wet and dry noise. Dry noise is assumed to be 25 dB less than wet noise. Table 2 of TGN(E)322 provides criteria on various rainfall. Historical rain data in the region has been used to calculate the mean annual wet hours from the period of 01 June 2014 to 01 December 2024. 8822 wet hours of rain were recorded over a period of 70720 hours at Craibstone, resulting in a wet percentage of 12.5%. If combined noise is above 36.8 dBA, NSRs proceed to a Tier 3 assessment. If Tier 3 is required, the total noise is assessed at a worst-case rain rate of 1 mm/hr to provide the excess above the wet background noise.

- 15.7.7 All receptors are of **Medium** sensitivity. As shown in **Volume 5, Appendix 15.4: Operational Noise Impact Assessment**, for the Tier 1 assessment, the wet noise at each location is predicted to be between 12.2 and 33.5 dB. Also detailed is the distance from the NSRs to the nearest point on the existing line, also shown in **Volume 5, Appendix 15.1: Noise Sensitive Receptors (NSRs)**.
- 15.7.8 NSRs that are more than 500 m from OHLs that are scoped in to the operational noise assessment are not considered (ie these NSRs are only within 500 m of the Kintore to Tealing 275 kV OHL or Craigiebuckler to Tarland 132 kV OHL).
- 15.7.9 Audible noise from the wet Proposed Development falls below 34 dB for all receptors and therefore no NSRs proceed to Tier 2 of the assessment. This results in **Negligible** magnitude of impact at the NSRs and therefore **Not Significant**.
- 15.7.10 The Triple Araucaria conductor for the Proposed Development was not required to be assessed to Tier 3 for wet noise during rainfall against background noise levels. Therefore, the noise induced by fog was not required to be assessed to a dry background noise level.
- 15.7.11 The Kintore to Fetteresso 275 kV OHL has been assessed as it is expected to be uprated to 400 kV Triple Upas conductor. The permanent realignment and temporary diversions have been assessed. Results are shown in **Volume 5, Appendix 15.4: Operational Noise Impact Assessment**. The results show for the permanent assessment that four NSRs proceed to a Tier 2 assessment, which then shows acceptable impacts at a Tier 2. The results also show for the temporary diversion that at a TGN(E)322 Tier 3 assessment at NSR 323 Wester Durris Farm, 14 dB of excess is predicted in wet conditions. This includes a tonal penalty of 6 dB. However, TGN(E)322 indicates that context must be considered. This diversion is short-term (approximately six months) and this impact will be a limited occurrence due to the 12.5% average annual wet hours. A dry noise assessment has also been conducted and results show an excess of -3 dB compared to dry background conditions. A tonal penalty of 3 dB has added, which is less severe than a wet noise tonal penalty due to there being less of an impact. The dry noise assessment shows a **Negligible** impact, which is predicted to occur 87.5% of the time. Considering the context of the likelihood of the wet noise, and the short-term nature of the temporary diversion, impacts are deemed to be **Minor**. Therefore, this is deemed as **Not Significant**. The permanent realignment is assessed as **Negligible** and **Not Significant**. The Applicant is encouraged to liaise and engage with the affected property (NSR 323) of the temporary effects likely to be experienced during wet conditions of the temporary diversion.

Internal noise assessment

- 15.7.12 According to Table 4 of BS8233, the indoor ambient noise levels in the night time should not exceed 30 dB $L_{Aeq,8hr}$. In addition, octave band levels should meet an NR20 rating for night time and NR25 rating for daytime.
- 15.7.13 The external noise levels and spectra have been considered at the closest receptor (NSR 153 Rosehill Timber), at a distance of 70 m from the centreline (assuming towers move a maximum within the LOD). An external to internal noise calculation has been performed on the basis of a partially open window for the nearest receptors. If NR limits are met at the closest receptors, then the limits will be met at all other receptors. The small element parameter level difference ($D_{n,e}$) has been assumed from NANR116: *Sound Insulation through Ventilated Domestic Windows*. The level difference values are taken from a window opening of 200k mm², see **Table 15.18: Level Difference Through a Partially Open Window NANR116**.

Table 15.18: Level Difference Through a Partially Open Window NANR116

Opening Size	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	$D_{n,e}$
200k (mm ²)	20	14	14	16	14	17	19	16

- 15.7.14 The results of the internal noise assessment for the Proposed Development at the nearest NSR to a point on the alignment (conductor) (NSR 153) are presented in **Table 15.19: Predicted Internal Noise Levels**.

Table 15.19: Predicted Internal Noise Levels

NSR	External Noise Level (dB(A))	Level (dB(Z))							Total (dB(A))
		63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	
NR 25	--	55	44	35	29	25	22	20	-

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NR 20	-	51	39	31	24	20	17	14	-
NSR 153 Rosehill Timber	29.2	-5.4	0.9	10.1	-4.3	-0.1	-0.7	-1.8	6.7

- 15.7.15 The results above show that for the Proposed Development, the internal noise level at the closest NSRs meet the 30 dB limit as well as falling below the NR 20 and NR 25 curves, therefore it is predicted that the internal noise level at all NSRs will fall below these levels. The internal noise levels at NSR 153 Rosehill Timber are assessed as **Minor** and **Not Significant** and therefore all other NSRs are assessed as **Minor** and **Not Significant**.

Additional Mitigation

- 15.7.16 The proposed additional mitigation measures during operation are set out in **Table 15.20: Committed Additional Mitigation – Operation**.

Table 15.20: Committed Additional Mitigation – Operation

Mitigation Measure	Rationale	Project Stage/Timing	Responsibility
Engagement with NSR 323 on the potential temporary effects during wet conditions of the temporary alignment.	Short-term temporary	Prior to construction	Applicant

Residual Operational Effects

- 15.7.17 No residual operational effects are predicted.

15.8 Assessment of Likely Significant Effects - Decommissioning

- 15.8.1 The noise and vibration impacts of decommissioning a tower of the Proposed Development will be comparable to the dismantling works phase (**Table 15.14: Summary of Construction Noise Results – Number of Predicted Receptors – If Suspension Towers Move 55 m and Angle Towers Move 100 m**) and is not likely to be any more significant. Therefore, if towers move a maximum distance from the design, the construction noise and vibration impacts are limited to 5 NSRs across the entire Proposed Development (shown in **Volume 5, Appendix 15.3 Construction Noise Impact Assessment**).

15.9 Assessment of Likely Cumulative Effects

Management Felling

- 15.9.1 As set out in **Chapter 8: Forestry**, the responsibility for management felling (defined as felling in commercial forests that has been undertaken before its current agreed phase to allow windfirm edges to be created following the removal of trees due to infrastructure felling) lies with the landowners. Consent for felling outwith the OC is therefore not being sought as part of this application and phasing and timescales are unknown. Management felling should however be considered in terms of the scheduling of wider felling and, if the felling is concurrent with the infrastructure felling and undertaken by the Applicant, then a Felling Noise Management Plan will be created to address potential cumulative effects at nearby NSRs. If the landowner undertakes the management felling separately at a later date, it is recommended that they produce a Felling Noise Management Plan. The management felling equipment is likely to be the same as the equipment that has been used for this assessment, however a chain saw will only be used if necessary, therefore noise emissions are likely to be reduced during management felling.

Predicted Intra (Associated) Developments Cumulative Effects

- 15.9.2 **Table 15.21: Cumulative Assessment: Intra Developments** provides a cumulative assessment of the Proposed Development with the Intra (Associated) Developments defined in **Volume 1, Chapter 5: EIA Process and Methodology**. These are the substation proposals at Emmock and Hurlie which would be directly connected with the Proposed Development.

Table 15.21: Cumulative Assessment: Intra Developments

OHL Section	Cumulative Development	Construction Noise	Construction Vibration	Operational Noise
A	Emmock 400 kV substation	It has been concluded that there will be No Significant adverse effects upon NSRs during the construction of the Proposed Development with the application of Applied Mitigation. The duration of the construction of OHLs are typically short compared to that of the substation. This associated SSEN Transmission Development, will be subject to its own CNMP which will mitigate any potential risks, therefore it is assumed that there is no potential for Significant cumulative effects at NSRs.	It has been concluded that the Proposed Development will have No Significant adverse effects upon sensitive receptors as a result of construction vibration.	The operational noise of Emmock substation is predicted to be below 5 dB excess above background noise in a BS 4142 assessment and therefore Low impact and Not Significant. Emmock Substation has assessed in dry conditions as a worst-case for lower background noise. The Proposed Development has been assessed in wet conditions, where the background noise is elevated. In these conditions, the background noise is raised due to rainfall. Therefore, in this scenario, operational noise from Emmock substation will be less prominent and likely to have a Negligible impact on NSRs when considered cumulatively with the operational noise from the Proposed Development. Any noise effects from Emmock substation are predicted to be Negligible in these conditions. The Proposed Development is assessed for worst-case noise in wet conditions. Receptors that are potentially impacted by both Emmock Substation and the Proposed Development are unlikely to exceed wet background noise with contributions from both Emmock substation and the Proposed Development. The worst-case noise effects of Emmock substation are assessed in dry conditions, where noise from the Proposed Development is Negligible. The worst-case noise effects from the Proposed Development are assessed in wet conditions where noise from Emmock Substation is no longer worst-case. Therefore, cumulative noise in dry and wet conditions is Not Significant. The noise levels due to the Proposed Development are of Negligible increase at NSRs and therefore unlikely that there will be Significant cumulative effects.

OHL Section	Cumulative Development	Construction Noise	Construction Vibration	Operational Noise
E	Hurlie 400 kV substation	It has been concluded that there will be No Significant effects upon NSRs during the construction of the Proposed Development with the application of Applied Mitigation. The duration of the construction of OHLs are typically short compared to that of the substation. This associated SSEN Transmission Development, will be subject to its own CNMP which will mitigate any potential risks, therefore it is assumed that there is no potential for Significant cumulative effects at NSRs.	It has been concluded that the Proposed Development will have No Significant effects upon sensitive receptors as a result of construction vibration.	The operational noise of Hurlie substation is predicted to be below background noise level in a BS 4142 assessment and therefore Negligible impact and Not Significant. Hurlie Substation has assessed in dry conditions as a worst-case for lower background noise. The highest noise levels generated by an OHL usually occur during rain when water droplets, collecting on the surface of the conductor, can initiate corona discharge. The number of droplets that collect, and hence the amount of noise, depends on the rate of rainfall. The Proposed Development has been assessed in wet conditions, where the background noise is elevated. Any noise effects from Hurlie substation are predicted to be Negligible in these conditions. The noise levels of the Proposed Development are Negligible at NSRs and therefore unlikely that there will be Significant cumulative effects.

Predicted Inter Developments Cumulative Effects

15.9.3 **Table 15.22: Cumulative Assessment: Inter Developments** provides a cumulative assessment of the Proposed Development and Intra (Associated) Developments together with cumulative effects predicted from other reasonably foreseeable SSEN Transmission and third party developments (collectively referred to as Inter Developments) as defined in **Volume 1, Chapter 5: EIA Process and Methodology** and **Volume 2, Chapter 16: Cumulative Effects**.

Table 15.22: Cumulative Assessment: Inter Developments

OHL Section	Cumulative Development	Construction Noise	Construction Vibration	Operational Noise
A	Tie-in of (existing (upgraded) Alyth to Tealing 275 kV OHL to Emmock substation ¹¹	It has been concluded that there will be No Significant effects upon NSRs during the construction of the Proposed Development with the application of Applied Mitigation. This associated SSEN Transmission Development, will be subject to its own	It has been concluded that the Proposed Development will have No Significant effects upon sensitive receptors as a result of construction vibration.	The noise from the proposed OHLs has been estimated at each NSR, and the total cumulative noise predicted from existing OHLs. The closest NSR (Dunian) to the tie-in is approximately 160 m from that proposed alignment and 252 m from the Proposed Development. At this distance, operational noise from the triple araucaria is Negligible, and any noise

¹¹ Note: The first three rows of this table are all part of the same Inter Development, the Emmock and Tealing Substation OHL Tie-in's and Tie-Backs project but the elements have been split for assessment purposes.

OHL Section	Cumulative Development	Construction Noise	Construction Vibration	Operational Noise
		CNMP which will mitigate any potential risks, therefore it is assumed that there is no potential for Significant cumulative effects at NSRs.		emitted will be entirely due to the tie in. Cumulative operational noise at all other NSRs predicts Negligible impact.
A	Tie-in of (existing, upgraded) Tealing to Westfield 275 kV OHL to Emmock substation	It has been concluded that there will be No Significant effects upon NSRs during the construction of the Proposed Development with the application of Applied Mitigation. This associated SSEN Transmission Development, will be subject to its own CNMP which will mitigate any potential risks, therefore it is assumed that there is no potential for Significant cumulative effects at NSRs.	It has been concluded that the Proposed Development will not No Significant effects upon sensitive receptors as a result of construction vibration.	The noise from the proposed OHLs has been estimated at each NSR, and the total cumulative noise predicted from existing OHLs. The closest NSR (Balkemback Farmhouse) to the tie-in is over 500 m from that proposed alignment. At this distance, operational noise from the Triple Oslo tie back is Negligible . Cumulative operational noise at all other NSRs predicts Negligible impact.
A	Emmock and Tealing Substation OHL Tie-Back's	Cumulative construction noise as above.	Cumulative construction vibration as above.	The closest NSRs to the tie-backs and the Proposed Development are over 500 m away. At this distance, operational noise from all lines is Negligible . Cumulative operational noise at all other NSRs predicts Negligible impact.
A	Alyth to Tealing 275 kV OHL Upgrade (to 400 kV)	See text on the Alyth to Tealing 275 kV OHL to Emmock substation Tie-in above.	See text on the Alyth to Tealing 275 kV OHL to Emmock substation Tie-in above.	See text on the Alyth to Tealing 275 kV OHL to Emmock substation Tie-in above.
A	Tealing to Westfield 275 kV OHL Upgrade (to 400 kV)	See text on the Tealing to Westfield 275 kV OHL to Emmock substation Tie-in above.	See text on the Tealing to Westfield 275 kV OHL to Emmock substation Tie-in above.	See text on the Tealing to Westfield 275 kV OHL to Emmock substation Tie-in above.
D	Glendye Wind Farm Grid Connection	Cumulative construction noise as above.	Cumulative construction vibration as above.	Cumulative operational noise as above.
D	Network Rail Drumlithie	Cumulative construction noise as above.	Cumulative construction vibration as above.	Operational noise of the additional transformers is assessed in different (dry) weather conditions to OHLs. Cumulative operational noise is predicted to be Negligible and Not Significant .
D	Fiddes 132 kV Grid replacement	Cumulative construction noise as above.	Cumulative construction vibration as above.	132 kV OHLs produce Negligible noise. Cumulative operational noise is predicted to be Not Significant .

OHL Section	Cumulative Development	Construction Noise	Construction Vibration	Operational Noise
E	SSEN Transmission offshore grids project	Cumulative construction noise as above.	Cumulative construction vibration as above.	Operational noise of the additional transformers and other substation equipment is assessed in different (dry) weather conditions to OHLs. Cumulative operational noise is predicted to be Negligible and Not Significant . Cumulative operational noise is predicted to be Not Significant .
D	Fetteresso Wind Farm Grid Connection and Access Corridor	Cumulative construction noise as above.	Cumulative construction vibration as above.	Operational noise of the additional transformers and other substation equipment is assessed in different (dry) weather conditions to OHLs. Cumulative operational noise is predicted to be Negligible and Not Significant . 132 kV OHLs produce Negligible noise. Cumulative operational noise is predicted to be Not Significant . Cumulative operational noise is predicted to be Not Significant .
E	Craigneil Wind Farm Future Connection.	Cumulative construction noise as above.	Cumulative construction vibration as above.	Cumulative operational noise as above.
F	Kintore to Craigiebuckler 132 kV OHL (existing) realignment (undergrounding)	Cumulative construction noise as above.	Cumulative construction vibration as above.	132 kV OHLs produce Negligible noise. Cumulative operational noise is predicted to be Not Significant .
A	Fithie Energy Park	The construction of the BESS site has the potential to have a cumulative noise impact due to the equipment and increased traffic. If the construction works are coincidental, once a contractor has been appointed, a detailed CNMP must be updated to include working times, activities and a schedule. There is the potential for activities that are associated with the construction of the BESS site that take place concurrently to raise the noise above either the 65 dB daytime noise limit or the 55 dB evening and weekend limit at the Proposed Development NSRs.	Cumulative construction vibration as above.	The battery storage containers will be fitted with air conditioning units and the operation of the facility create noise. Other noise-producing equipment includes transformers and inverters. While recognising there are other noise generating uses in the vicinity of the Site, there are a small number of properties which may be adversely affected by noise from the development. Worst-case results from the proposed BESS site will occur in dry conditions, which is where the OHL noise is at a minimum. In wet conditions, the OHL noise is elevated. In these conditions, the background noise is increased due to the rainfall, which would make the effects of the cumulative developments such as the

OHL Section	Cumulative Development	Construction Noise	Construction Vibration	Operational Noise
		Therefore, it is possible for cumulative construction noise to result in Major effect which is Significant . Cumulative construction noise is required to be controlled through an updated assessment by the Principal Contractors, and a CNMP. Therefore, with the appropriate mitigation, residual effects are likely to be Minor and Not Significant .		BESS development less likely to have an impact on the relevant receptors. The site is approximately 1 km from the Proposed Development, where NSRs relevant to the BESS site will have Negligible impacts from the Proposed Development. Therefore, cumulative impacts due to the BESS would be low and considered to have Negligible impact.
A	Balnuith BESS	Cumulative construction noise as above.	Cumulative construction vibration as above.	Cumulative operational noise from BESS sites as above. The NSRs relevant to the Proposed Development are over 500 m from the BESS site and will have Negligible cumulative impacts from the Proposed Development. Therefore, cumulative impacts due to the BESS would be Low and considered to have Negligible impact.
A	Myreton BESS	Cumulative construction noise as above.	Cumulative construction vibration as above.	Cumulative operational noise from BESS sites as above. The NSRs relevant to the Proposed Development are over 1.5 km from the BESS site and will have Negligible cumulative impacts from the Proposed Development. Therefore, cumulative impacts due to the BESS would be Low and considered to have Negligible impact.
A	Ark Hill Wind Farm Extension	Cumulative construction noise as above.	Cumulative construction vibration as above.	The Ark Hill Wind Farm Extension is over 1.5 km from the nearest Proposed Development NSR and deemed to have Negligible impact over the distance noise will propagate (assuming this development meets its own noise limit criteria). Therefore, No Significant cumulative effects are predicted.
A/B	Cossans Solar & BESS	Cumulative construction noise as above.	Cumulative construction vibration as above.	Cumulative operational noise from BESS sites as above. The NSRs relevant to the Proposed Development are over 1.5 km from the BESS site and will have Negligible cumulative impacts from the Proposed Development. Therefore, cumulative impacts due to the BESS would be Low and considered to have Negligible impact.

OHL Section	Cumulative Development	Construction Noise	Construction Vibration	Operational Noise
C	Glendye Wind Farm	Cumulative construction noise as above.	Cumulative construction vibration as above.	The operational noise impacts of windfarms are assessed in different conditions to OHL noise. Windfarm noise is increased in high winds, where the background noise also increases. This reduces the impact of the operational noise of the Proposed Development to a Negligible level, due to the increase in background noise when windfarm noise may be Significant . Therefore, No Significant cumulative effects are predicted from the Glendye Windfarm. The windfarm is over 8 km from the Proposed Development.
C	Laurencekirk Residential Development	Cumulative construction noise as above.	Cumulative construction vibration as above.	No cumulative operational noise effects are predicted.
D	Glenbervie BESS	Cumulative construction noise as above.	Cumulative construction vibration as above.	Cumulative operational noise from BESS sites as above. The NSRs relevant to the Proposed Development are adjacent to BESS site however will have Negligible cumulative impacts from the Proposed Development due to the conditions required for worst-case noise impacts. Therefore, cumulative impacts due to the BESS would be low and considered to have Negligible impact despite the site being approximately 100 m from the Proposed Development.
D	Quithel BESS	Cumulative construction noise as above.	Cumulative construction vibration as above.	Cumulative operational noise from BESS sites as above. The NSRs relevant to the Proposed Development are adjacent to BESS site however will have Negligible cumulative impacts from the Proposed Development due to the conditions required for worst-case noise impacts. Therefore, cumulative impacts due to the BESS would be Low and considered to have Negligible impact. The site is approximately 300 m from the Proposed Development.
D/E	Bowdun Offshore Wind Farm Onshore Cable Connection	Cumulative construction noise as above.	Cumulative construction vibration as above.	The cables also tie in to Hurlie Substation however there are no operational noise effects due to the undergrounding. Cumulative operational effects are Negligible .

OHL Section	Cumulative Development	Construction Noise	Construction Vibration	Operational Noise
E	Craigneil Wind Farm	Cumulative construction noise as above.	Cumulative construction vibration as above.	The operational noise impacts of windfarms are assessed in different conditions to OHL noise. Windfarm noise is increased in high winds, where the background noise also increases. This reduces the impact of the operational noise of the OHL to a Negligible level, due to the increase in background noise when windfarm noise may be Significant. Therefore, no Significant cumulative effects are predicted from the Craigneil Windfarm. The windfarm is approximately 300 m from the Proposed Development.
F	Hill of Fare Wind Farm	Cumulative construction noise as above.	Cumulative construction vibration as above.	The operational noise impacts of windfarms are assessed in different conditions to OHL noise. Windfarm noise is increased in high winds, where the background noise also increases. This reduces the impact of the operational noise of the OHL to a Negligible level, due to the increase in background noise when windfarm noise may be Significant. Therefore, no Significant cumulative effects are predicted from the Hill of Fare Windfarm. Hill of Fare Wind Farm is approximately 1.5 km from the Proposed Development.
F	South Leylodge Farm BESS	Cumulative construction noise as above.	Cumulative construction vibration as above.	Cumulative operational noise from BESS sites as above. The NSRs relevant to the Proposed Development are over 1.5 km from the BESS site and will have Negligible cumulative impacts from the Proposed Development. Therefore, cumulative impacts due to the BESS would be Low and considered to have Negligible impact.
F	Kintore Substation BESS	Cumulative construction noise as above.	Cumulative construction vibration as above.	Cumulative operational noise from BESS sites as above. The NSRs relevant to the Proposed Development are over 1.5 km from the BESS site and will have Negligible cumulative impacts from the Proposed Development. Therefore, cumulative impacts due to the BESS would be Low and considered to have Negligible impact.

OHL Section	Cumulative Development	Construction Noise	Construction Vibration	Operational Noise
F	Kintore Hydrogen Production Facility	Cumulative construction noise as above.	Cumulative construction vibration as above.	The Noise and Vibration chapter of the Kintore Hydrogen Production Facility concluded that there is likely to be Minor effects which are Not Significant . The electrolysis works are most impactful when background noise is low and in dry conditions. The OHL noise is Negligible in these conditions. Cumulative operational noise is predicted to be Not Significant .
F	Kintore South Solar Array and BESS	Cumulative construction noise as above.	Cumulative construction vibration as above.	Cumulative operational noise from BESS sites as above. The NSRs relevant to the Proposed Development are over 1.5 km from the BESS site and will have Negligible cumulative impacts from the Proposed Development. Therefore, cumulative impacts due to the BESS would be Low and considered to have Negligible impact.
F	Womblehill Farm BESS	Cumulative construction noise as above.	Cumulative construction vibration as above.	Cumulative operational noise from BESS sites as above. The NSRs relevant to the Proposed Development are over 1.5 km from the BESS site and will have Negligible cumulative impacts from the Proposed Development. Therefore, cumulative impacts due to the BESS would be Low and considered to have Negligible impact.

15.10 Summary of Significant Effects

15.10.1 **Table 15.23: Summary of Significant Effects** below summarises the predicted residual effects of the Proposed Development on Noise and Vibration prior to and following the application of additional mitigation.

Table 15.23: Summary of Significant Effects

Predicted Effects	Significance Prior to Additional Mitigation	Mitigation	Significance of Residual Effects Following Additional Mitigation
Construction	Significant	Equipment curtailment to reduce cumulative machinery noise within each phase will reduce impacts at 96% of receptors. The CNMP will ensure best practice so that noise levels are minimised and will consider NSRs predicted to experience significant impacts in more detail (Volume 5, Appendix 15.3: Construction Noise Impact Assessment, Table 15.3.19). This will include measures to reduce active time of noisiest equipment over the working hours, reduce quantity of simultaneous equipment, prioritise noisiest activity in daytime, and increase community engagement.	Not Significant
Operation	Not Significant	Not required	Not Significant
Cumulative	Significant	Equipment curtailment to reduce cumulative machinery noise within each phase will reduce impacts at 96% of receptors. The CNMP will ensure best practice so that noise levels are minimised and will consider NSRs predicted to experience significant impacts in more detail (Volume 5, Appendix 15.3: Construction Noise Impact Assessment, Table 15.3.19). This will include measures to reduce active time of noisiest equipment over the working hours, reduce quantity of simultaneous equipment, prioritise noisiest activity in daytime, and increase community engagement. Awareness of simultaneous operations of cumulative developments so manage traffic effects.	Not Significant