9 AIR - NOISE AND VIBRATION

9.1 INTRODUCTION

1 This chapter evaluates the noise and vibration impacts arising from the proposed 400 kV overhead line (OHL) and associated development including the extension of Woodland Substation as set out in Chapter 6, **Volume 3B** of the Environmental Impact Statement (EIS). That chapter describes the full nature and extent of the proposed development, including elements of the OHL design and the towers. It provides a factual description, on a section by section basis, of the entire line route, including that portion within the Meath Study Area (MSA). The proposed line route is described in that chapter using townlands and tower numbers as a reference. The principal construction works proposed as part of the proposed development are set out in Chapter 7, **Volume 3B** of the EIS.

2 The information contained within this chapter is concerned with noise and vibration in the MSA as defined in Chapter 5, **Volume 3B** of the EIS. This evaluation deals with 'audible' noise and vibration.

3 This evaluation considers an area in excess of 100m either side of the proposed alignment. The evaluation focuses on the construction, operation and decommissioning aspects of the proposed development.

4 This evaluation was prepared in accordance with the Environmental Protection Agency's (EPA) *Guidelines on the information to be contained in Environmental Impact Statements (*March 2002) and *Advice Notes on Current Practice in the preparation of EIS* (September 2003).

5 This chapter should be read in conjunction with Chapter 7, **Volume 3B** of the EIS and **Chapter 13** in this volume of the EIS.

9.2 METHODOLOGY

6 This section of the EIS has been prepared in accordance with relevant EU and Irish Legislation and guidance, including the requirements of Annex IV of the Environmental Impact Assessment (EIA) Directive and in accordance with Schedule 6 of the *Planning and Development Regulations 2001* (as amended) and conforms to the relevant requirements as specified therein. The scope of the evaluation is based on a review of legislation, guidance documents, other EISs, feedback from public consultation, consultation with prescribed bodies, consultation with An Bord Pleanála (the Board) and on a consideration of the likelihood for significant impacts arising, having regard to the nature of the receiving environment and the nature and extent of the proposed development.

7 The scoping opinion received from the Board (refer to Appendix 1.3, **Volume 3B Appendices** of the EIS) identified the following issues as being relevant to this chapter of the EIS:

- Description and assessment of the noise environment at construction and operational phases, clearly measurable against the existing ambient noise environment.

8 A number of factors can influence the potential for noise impact from any proposed development such as the duration of the works, noise characteristics and perception. The impact and its effects is a subjective consideration. In order to minimise the impact on sensitive receptors, the potential for noise and vibration impact has been evaluated, and a range of mitigating measures, which will ensure that acceptable noise limits are met, have been provided.

9 Extensive background noise measurements were recorded in 2013 at 17 locations along the proposed line route, during daytime and night time. The locations of the noise monitoring surveys on the line route are shown in Figures 9.1 - 9.4, **Volume 3D Figures** of the EIS. The locations chosen are receptor locations near to the towers and OHLs along the proposed route to represent the quiet rural area. The results from the 2013 background noise survey are presented in **Tables 9.2** and **9.3**. In addition, baseline noise measurements taken in 2013 under the existing 400 kV OHL at Bogganstown, County Meath and at the existing Woodland Substation, being the southern end of the proposed development are provided in **Tables 9.4** and **9.5**.

10 All measurements were recorded in suitably calm conditions using appropriately calibrated Type 1 instrumentation which is in line with current appropriate standards and methodology (i.e. the British Standard BS4142 *Method of Rating Industrial Noise Affecting Mixed Residential and Industrial Areas* (1997)). The sound level meter and the acoustic calibrator were at the time of measurement calibrated to the appropriate standards. No significant drift was noted during the field calibration process.

11 Potential for noise and vibration impact in both the construction and operational phases of the proposed development have been evaluated and specific noise and vibration mitigation measures have been presented (refer to **Section 9.6**).

12 Various standards and guideline documents covering the impact of external noise sources and the introduction of industrial and construction noise have been used in this evaluation. The standards and guidelines appropriate for this appraisal are the World Health Organisation's (WHO) *Guidelines for Community Noise* 1999, BS5228 *Code of Practice for Noise and Vibration Control on Construction and Open Sites* – Part 1: Noise (2009), and BS4142 *Method of Rating Industrial Noise Affecting Mixed Residential and Industrial Areas* (1997).

9.3 CHARACTERISTICS OF THE PROPOSED DEVELOPMENT

13 The characteristics of the proposed development as relating to the potential for noise and vibration impacts to sensitive receptors will occur in the construction and operational phases of the proposed development. These potential impacts are considered in detail below (see **Section 9.5**). A description of the proposed development and how it will be constructed is presented in Chapters 6 and 7**, Volume 3B** of the EIS

9.4 EXISTING ENVIRONMENT

14 The proposed development is located in a predominantly rural area. **Tables 9.2** and **9.3** quantify the typical noise levels encountered in the ambient environment. The values in **Tables 9.2** and **9.3** can be used to compare the predicted and measured noise levels presented in this chapter. Ambient noise levels at the properties located close to the majority of the route are characterised by rural environmental noise (i.e. wind in trees, agricultural activities and livestock) and transportation noise on the local supply roads. However, there are sections of the proposed route, near to busier roads, where transportation noise becomes the predominant noise source.

9.4.1 Baseline Noise Survey

15 The measurement locations along the proposed line route represent individual properties or clusters of residential properties along the route. The dB L_{A90} noise levels presented in **Tables 9.2** and **9.3** represent the existing 'background' noise levels within the area. The levels presented in terms of 'dB L_{A90}' are defined as the background noise level at a location according to BS4142 (*Method of Rating Industrial Noise Affecting Mixed Residential and Industrial Areas*, British Standards Institute (1997)). A typical guide to environmental noise levels is presented in **Table 9.1**.

16 The baseline noise evaluation surveys were carried out along the proposed line route and at the existing 400 kV Woodland Substation in order to establish expected noise levels for the operational phase. Baseline noise surveys were also carried out under the existing 400 kV OHL at Bogganstown County Meath. The locations of the noise monitoring surveys on the line route are shown in Figures 9.1-9.4, **Volume 3D Figures** of the EIS.

17 Attended measurements were recorded during daytime and during night time at each noise monitoring location. The measurements taken were deemed to be representative of typical noise levels in the vicinity of the noise monitoring locations. The equipment used during this survey was a Bruel and Kjaer, 2250, Type 1 sound level meter.

Table 9.1: Guidance Note for Noise in relation to Scheduled activities, 2nd Edition, EPA 2006

Typical noise levels in our Environment	
Sound levels in decibels dB	**Description of Activity**
0	Absolute silence
25	Very quiet room
35	Rural night time setting with no wind
55	Day time, busy roadway 0.5km away
70	Busy restaurant
85	Very busy pub, voice has to be raised to be heard
100	Disco or rock concert
120	Uncomfortably loud, conversation impossible
140	Noise causes pain in ears

18 All measurements were carried out in accordance with the International Organization for Standardization's (ISO) ISO 1996: *Acoustics - Description and Measurement of Environmental Noise.* Measurements were made placing the microphone at a height of 1.5m above ground level, were free field and were measured >2m from reflecting surfaces.

19 Before and after surveys the measurement apparatus was checked and calibrated using a calibrator to an accuracy of +/- 0.3dB. Weather conditions during all surveys conducted for the purposes of this evaluation were in line with the conditions described within ISO 1996, *Acoustics Description and Measurements of Environmental Noise* and the Environmental Protection Agency 2003, *Environmental Noise Guidance Document,* as follows:

- An average wind speed of less than 5m / sec; and
- No precipitation was present during survey periods.

20 The measurement results were logged onto survey record sheets immediately following each measurement and also stored in the instrument's internal memory for subsequent analysis. Notes were taken in relation to the primary contributors to audible noise at each monitoring location.

21 The environmental noise parameters measured are defined below:

- L_{Aeq} is the A-weighted equivalent continuous steady sound level during the measurement period and effectively represents an average ambient noise value;
- L_{Amax} is the maximum A-weighted sound level measured during the measurement period;
- L_{Amin} is the minimum A-weighted sound level measured during the measurement period;

- L_{A10} is the A-weighted sound level that is exceeded for 10% of the measurement period and is used to quantify road traffic noise;
- L_{A50} is the A-weighted sound level that is exceeded for 50% of the measurement period and in this evaluation is used to quantify noise from OHLs; and
- L_{A90} is the A-weighted sound level that is exceeded for 90% of the measurement period and is used to quantify background noise level.

22 A-weighting is the process by which noise levels are corrected to account for the non-linearity of human hearing. All noise levels quoted are relative to a sound pressure of $2x10^{-5}$ Pa.

23 No tangible vibration was observed at any of the noise survey locations evaluated as part of the proposed development.

9.4.2 Noise Survey Results

24 The 2013 baseline noise levels recorded for both daytime and night time at each of the 17 locations are presented in **Tables 9.2** and **9.3,** with noise monitoring locations shown in Figures 9.1-9. 4, **Volume 3D Figures** of the EIS. These are the same locations as were monitored in the 2009 planning application (Reference PL02 VA0006, subsequently withdrawn). The results of the 2009 survey are presented in **Appendix 9.1, Volume 3D Appendices**. The results of noise monitoring at the existing Woodland Substation in 2013 are detailed in **Table 9.4**.

Table 9.2: 2013 Baseline Noise Levels Daytime

Baseline Noise Survey Results Daytime							
Location	**Date**	**Duration**	**L_{Aeq}**	**L_{Amax}**	**L_{Amin}**	**L_{A10}**	**L_{A90}**
N1	12/08/2013 12:31	15:00	47.0	68.3	35.6	48.6	38.8
N2	10/09/2013 12:28	15:00	46.6	72.2	33.0	43.9	35.3
N3	12/08/2013 13:00	15:00	60.1	85.2	39.1	57.1	42.9
N4	10/09/2013 12:54	15:00	57.1	78.8	33.9	53.4	37.0
N5	12/08/2013 13:28	15:00	67.5	84.1	34.6	70.5	37.4
N6	10/09/2013 13:15	15:00	47.4	71.8	30.4	47.7	38.0
N7	12/08/2013 14:07	15:00	41.7	73.8	30.0	43.5	32.2
N8	10/09/2013 13:43	15:00	68.0	86.4	33.6	67.8	37.0
N9	12/08/2013 14:34	15:00	63.1	83.7	42.3	60.2	45.8
N10	10/09/2013 14:08	15:00	67.2	86.7	40.8	67.2	46.3
N11	12/08/2013 15:01	15:00	76.7	88.8	45.8	80.9	55.5
N12	10/09/2013 14:34	15:00	62.9	85.6	38.5	60.9	42.1
N13	12/08/2013 15:34	15:00	76.0	91.8	39.1	80.8	45.9
N14	10/09/2013 15:06	15:00	40.8	57.4	31.1	44.1	33.8

Baseline Noise Survey Results Daytime							
Location	Date	Duration	L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}
N15	12/08/2013 16:05	15:00	59.3	81.7	39.4	54.6	42.3
N16	10/09/2013 15:31	15:00	65.5	88.6	32.2	63.0	35.5
N17	12/08/2013 16:33	15:00	68.8	92.6	35.0	65.1	38.8

Table 9.3: 2013 Baseline Noise Levels Night Time

Baseline Noise Survey Results Night time							
Location	Date	Duration	L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}
N1	20/08/2013 22:27	10:00	46.8	61.6	40.3	49.8	42.6
N2	10/09/2013 22:06	10:00	56.3	80.5	21.5	42.3	24.8
N3	20/08/2013 22:56	10:00	47.9	69.0	38.0	48.4	40.5
N4	10/09/2013 23:31	10:00	52.3	75.1	20.7	40.9	23.8
N5	20/08/2013 23:17	10:00	43.9	50.4	37.4	46.4	40.7
N6	10/09/2013 23:52	10:00	49.4	72.7	20.0	48.7	23.2
N7	20/08/2013 23:38	10:00	40.3	48.9	33.4	43.0	35.7
N8	11/09/2013 00:21	10:00	55.6	81.7	18.2	39.6	21.3
N9	20/08/2013 23:59	10:00	39.9	49.0	33.5	42.6	35.9
N10	11/09/2013 00:47	10:00	36.5	53.3	21.5	40.1	25.0
N11	21/08/2013 00:35	10:00	42.9	57.0	31.5	47.2	34.6
N12	11/09/2013 01:16	10:00	29.1	50.8	26.7	29.4	27.7
N13	21/08/2013 00:59	10:00	43.7	59.8	33.2	45.2	35.1
N14	11/09/2013 01:47	10:00	42.8	63.9	20.8	38.1	25.6
N15	21/08/2013 01:35	10:00	50.2	60.7	39.1	54.0	41.8
N16	11/09/2013 02:10	10:00	35.1	56.1	26.9	37.9	30.3
N17	21/08/2013 01:57	10:00	47.8	57.3	44.7	49.2	46.1

25 **Noise Monitoring Location N1:** This location is situated on the townland boundaries of Moorlagh and Boherlea. The main noise sources at this location were birdsong and foliage noise. Infrequent passing traffic and distant traffic noise was occasionally audible.

26 **Noise Monitoring Location N2:** N2 is in the townland of Aghamore, north-east of Kilmainhamwood. Farm machinery at work in adjacent fields during the daytime, passing local traffic and foliage noise were the main noise sources at this location. Passing local traffic and foliage noise were the main noise sources at night.

27 **Noise Monitoring Location N3:** N3 is located close to the townland boundaries of Altmush and Boynagh. Passing road traffic and cattle in the adjacent field were audible at this location. Distant agricultural machinery at work was also audible in the daytime.

28 **Noise Monitoring Location N4:** N4 is located in the townland of Rahood, at the cross roads. Passing local traffic, agricultural traffic in the daytime and cattle in the field were the main noise sources at this location. At night local traffic and cattle in the field were the main noise sources.

29 **Noise Monitoring Location N5**: This location is in the townland of Clooney, near Raffin Cross on the N52. Road traffic noise on the N52 was dominant at location N5. Foliage noise was audible in traffic lulls.

30 **Noise Monitoring Location N6:** Monitoring location N6 is situated in the townland of Drakerath. A tractor at work at this location in the daytime, in association with road traffic were the main noise sources at N6. Aircraft passing overhead were also audible. Distant road traffic was the main noise source at night.

31 **Noise Monitoring Location N7:** Noise monitoring location N7 is located in the townland of Cluain na Ghaill (Clongill). Distant agricultural machinery was audible at this location in the daytime as were cattle in the adjacent field. At night distant road traffic and cattle in the fields were the dominant noise sources.

32 **Noise Monitoring Location N8**: N8 is located at Gibstown Cross / Crasulthan Cross on the R163 in the townland of Baile Órthaí (Oristown). Passing road traffic, birdsong and foliage noise were the main noise sources at this location. A barking dog was also audible during the night time survey.

33 **Noise Monitoring Location N9:** N9 is located on the Castlemartin Road, in the townland of Castlemartin, approximately 200m from the N3 road. N3 road traffic and local passing road traffic dominated the noise at this location.

34 **Noise Monitoring Location N10**: N10 is located west of Ardbraccan Village on the Bohermeen Road in the townland of Neillstown. Passing traffic, aircraft over head and a lawnmower in use in the distance were the main noise sources at this location. The lawn mower was not present at night.

35 **Noise Monitoring Location N11:** Halltown crossroads on the N51 road is the site of location N11 on the boundary of the townlands of Halltown and Irishtown. Road traffic on the N51 and local passing traffic were the dominant noise sources at this location.

36 **Noise Monitoring Location N12**: N12 is located on Oak Drive outside the village of Dunderry in Philpotstown townland. Passing road traffic and agricultural machinery at work during the daytime in the distance were the main noise sources at this location. Passing road traffic was dominant at night.

37 **Noise Monitoring Location N13:** On the R161 Road near Bective, in the townland of Rathnally is the location of N13. Traffic on the R161, local passing traffic, including agricultural traffic during the daytime, were the dominant noise sources at this location. Traffic on the R161 and local passing traffic were dominant at night. A barking dog was also audible throughout the surveys.

38 **Noise Monitoring Location N14:** N14 is located in Marshallstown off the R154. This is close to the intersection of the townlands of Creroge, Finlaghtown Little and Ardbraccan. Infrequent passing traffic and distant traffic noise were the main noise sources at this location. A shot gun in use in the distance was audible during daytime.

39 **Noise Monitoring Location N15**: N15 is located in the townland of Martinstown on a local road. Passing local traffic and distant road traffic noise were the main noise sources at N15, foliage noise was audible in traffic lulls.

40 **Noise Monitoring Location N16**: N16 is located in the townland of Derrypatrick on a local road. Passing local traffic, foliage noise and birdsong were the main noise sources audible at N16.

41 **Noise Monitoring Location N17**: N17 is located between Woodtown and Curraghtown on the R125 road. Passing local traffic including agricultural traffic were the main noise sources at this location. Distant road traffic noise was audible at night.

42 There is some minor variation in background noise levels compared to 2009 levels (shown in **Appendix 9.1, Volume 3D Appendices** of the EIS) as these were recorded in June 2009 and more recent noise levels were recorded in August and September 2013. The background noise levels recorded most recently in 2013 are considered to be similar to but marginally lower than those measured previously. However, these recent measurements show no significant changes in the dominant noise sources in the existing noise environment. Background noise levels are influenced mainly by constant traffic flows, agricultural activity, and weather conditions.

9.4.2.1 Woodland Substation

43 In addition to the 17 No. noise surveys, a baseline evaluation was carried out in November 2013 at Woodland Substation, County Meath. Baseline noise monitoring was also taken under the existing 400 kV line, at Bogganstown County Meath, close to where it enters the substation site. The results of this survey are presented in **Tables 9.4** and **9.5.**

Table 9.4: Baseline Monitoring at Woodland Substation

Locations	Date	Time	Duration	L_{Aeq}	L_{AMin}	L_{AMax}	L_{A10}	L_{A90}
Woodland Substation	07/11/2013	14:18	15:00	43.1	35.1	104.5	44.6	38.3

Table 9.5: Baseline Monitoring directly under Existing 400 kV Line at Bogganstown near Woodland Substation

Locations	Date	Time	Duration	L_{Aeq}	L_{AMin}	L_{AMax}	L_{A10}	L_{A50}	L_{A90}
Under 400kV Line at Bogganstown	07/11/2013	14:51	5:00	47.6	38.1	99.4	50.6	44.3	39.8
Under 400 kV Line at Bogganstown	07/11/2013	14:56	5:00	45.0	37.9	96.1	47.1	43.6	40.6
Under 400 kV Line at Bogganstown	07/11/2013	15:01	5:00	42.9	36.4	89.5	45.7	41.2	38.5
Average				45.1	37.5	95.0	47.8	43.0	39.6

44 As can be seen from the levels recorded at Woodland Substation in **Table 9.4**, there is no significant noise emission from the existing substation. The substation was not the dominant noise source in the area during the surveys. During the survey, the dominant noise sources were local traffic and foliage noise, while a faint broadband hum from the substation was also audible. There was no precipitation during the readings, and there was a light breeze of less than 5m/s. The noise levels shown in **Table 9.4** include all of these sources in addition to all of the existing power lines entering the substation, including the existing 400 kV line, multiple other power lines, transformers, line bays, bus bars and switch gear contained in the substation site. As such the modifications required to the substation to accommodate the connection of the proposed transmission line is not expected to have any significant noise impact to the local noise climate.

45 The noise levels shown in **Table 9.5** include all ambient noise sources in addition to the existing 400 kV line. These readings were taken directly under the existing 400 kV line. These include foliage noise, distant road traffic noise, birdsong and occasional passing traffic. There was no precipitation during the readings, and there was a light breeze of less than 5m/s.

46 With regard to tonality a 1/3 Octave frequency band analysis was carried out on the survey recorded at Woodland Substation. The results of this analysis are presented in **Figure 9.1**.

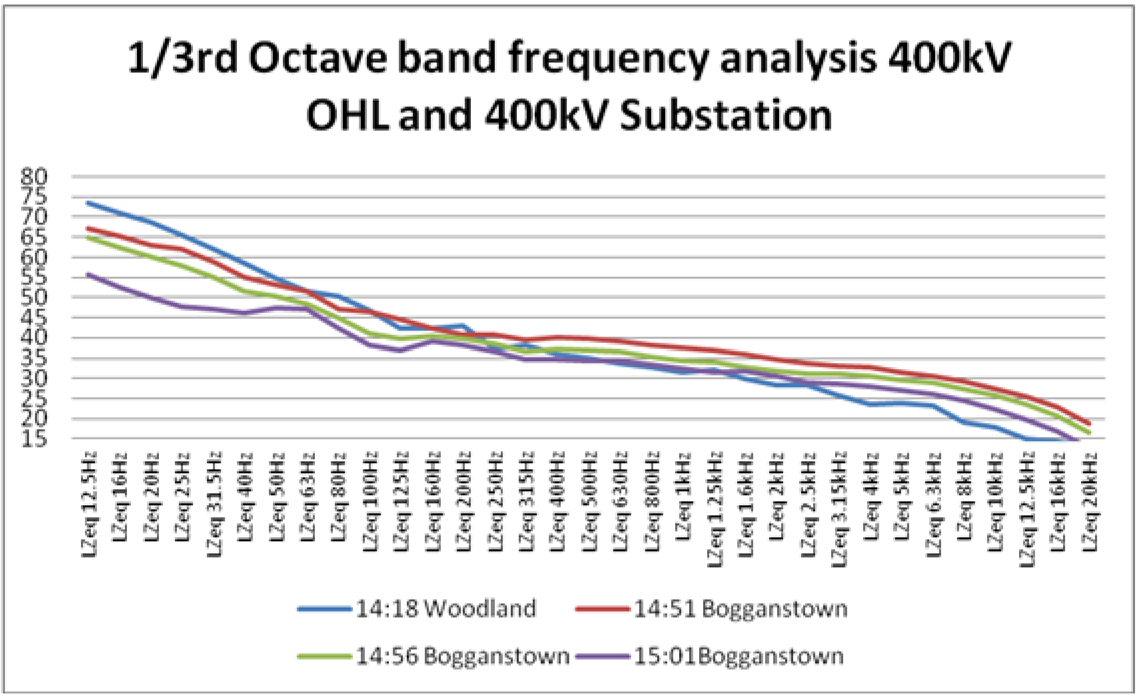

Figure 9.1: Frequency Analysis at Existing 400 kV OHL and at Woodland Substation

47 As can be seen from the frequency analysis, there was no tonal component to any of the noise sources recorded at Bogganstown or at Woodland Substation.

9.5 POTENTIAL IMPACTS

48 During the preparation of this EIS, an extensive evaluation of the likely significant effects of all aspects of the proposed development has been undertaken.

49 The noise and vibration characteristics of the proposed development will be divided between the construction and the operational phases of the development. The majority of impacts will occur during the construction phase of the development.

50 The construction phase will involve excavation, piling (if required) and general construction activities and is discussed further below. The construction details for the proposed development are set out in Chapter 7, **Volume 3B** of the EIS. The operational phase will not have any vibration impacts and will only have the potential for minimal noise impact, as described later in this chapter.

9.5.1 Do Nothing

51 In the ‘Do Nothing’ Scenario the proposed development will not proceed. In this scenario the baseline noise and vibration climate, save for the potential for general development outside of the scope of this proposed development will remain unchanged.

9.5.2 Construction Phase

52 The construction phase of the proposed development has the potential to temporarily increase noise levels at noise sensitive locations surrounding the proposed alignment i.e. at the construction phase of the towers and during the extension of the existing 400 kV substation at Woodland. The nearest noise sensitive receptors are located at least 50m from proposed tower locations.

53 Noise sensitive locations as referred to in this evaluation are comprised of houses, schools, hospitals, places of worship, heritage buildings, special habitats, amenity areas in common use and designated quiet areas. There are none of these sensitive receptors located within 50m of a proposed tower location.

54 Impact from the construction phase will depend on the number and types of equipment used during the construction of the proposed development. Construction noise sources will result in a temporary impact on the noise climate in the area. The temporary and transient nature of the construction phase on this type of development should not give rise to excessive construction noise levels. The list of machinery as detailed in **Table 9.6** will form the plant which will be in operation during the construction phase.

Table 9.6: Construction Phase Plant Noise Levels

CONSTRUCTION PHASE			
BS5228 Calculations	**Estimated Construction noise levels at varying distances $L_{Aeq\ 1\ hour}$**		
Machinery	**50m**	**75m**	**100m**
Wheeled loader	65	60	57
Winch	56	51	48
Line tensioner	56	51	48
Road lorry pulling up	49	44	41
Tracked excavator	65	60	57
Vibratory hammer	61	56	53
Tracked crane moving	66	61	58
Support crane moving	57	52	49
Lorry unloading	63	58	55
Diesel generator	54	49	46
Continuous flight auger	56	51	48
Combined Level LAeq 1hour	**71dB**	**67dB**	**64dB**

55 Predicted noise levels have been estimated using the methodology described in *BS: 5228: Noise and control on construction and open sites*, (1997). Predictions are based on typical equipment used during various construction phases of the proposed development. Predictions are based on a $L_{Aeq1hour}$ value with all machinery listed in **Table 9.6** operating for a continuous period of 1 hour.

56 This may be considered a worst case scenario as this machinery will not operate simultaneously. Additionally, calculations are based on minimum distances between site activities and the nearest noise sensitive locations, with no allowance for screening of hedgerows, trees or buildings in between.

57 In Ireland, there are no statutory guidelines relating to noise limits for construction activities. These are generally controlled by local authorities and commonly refer to limiting working hours to prevent a noise nuisance. The National Roads Authority (NRA) *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* (2004) outlines recommended noise levels for construction noise during the construction of national road schemes.

58 Although these NRA's guidelines refer to road projects, they have been developed in line with typical construction noise limits on construction projects used previously in Ireland. The limits outlined represent a reasonable compromise between the practical limitations during a construction project and the need to ensure an acceptable ambient noise level for local residents. As a result, these limits have become the most acceptable standard for construction noise limits for EIS assessments in Ireland to date. The NRA does note however, that where pre-existing noise levels are particularly low, more stringent levels may be more appropriate. **Table 9.7** details these recommended limits.

59 The predicted values are a worst case evaluation and as such the impact is likely to be moderate, with regard to the nearest noise sensitive locations. The evaluation is considered worst case as the temporary nature of the construction period and the variety of machinery used should ensure that no construction activity is operational for long periods. Similarly, all the plant listed in **Table 9.6**, will not be in use at the same stage of construction, as it is a phased process. Hence, the noise impact to be expected at the nearest noise sensitive receptor would be significantly less than the worst case scenario described in **Table 9.6**. The construction phase will therefore result in a moderate temporary, transient noise impact.

60 There is a possibility that a small amount of localised rock breaking may be required if rock is encountered close to the surface during tower construction. In the unlikely event, that the need for rock breaking arises the process will be carried out so as to achieve adherence to the guideline noise limits as presented in **Table 9.7**. If required, temporary noise barriers as outlined in **Section 9.6.2** will be used to achieve these guideline noise level values.

Table 9.7: Typical Maximum Permissible Noise Levels at the Façade of Dwellings during Construction Activities

Day & Times	$L_{Aeq\ (1hr)}$ dB	L_{Amax} dB
Monday – Friday (07:00 to 19:00 hrs)	70	80
Monday – Friday (19:00 to 22:00 hrs)	60[1]	65[1]
Saturday (08:00 to 16:30 hrs)	65	75
Sundays and Bank Holidays (08:00 to 16:30 hrs)	60[1]	65[1]

[1] Construction activities at these times, other than that required in respect of emergency works, will normally require the explicit permission of the relevant local authority.

Source: NRA *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* 2004.

9.5.2.1 Construction Phase Traffic Noise Impact

61 The likely Heavy Goods Vehicles (HGV) noise impact due to the expected traffic flows has been calculated using the Haul Road Method detailed in BS5228 *Noise and Control on Construction and Open Sites*, (1997). Considering a standard tower construction site, as detailed in Chapter 7, **Volume 3B** of the EIS, a maximum frequency of 9 vehicle trips per hour (Q) and a minimum distance of at least 5m (v) from the haul road to any nearby property, and a speed of 30km/h (V) the calculated noise impact is as follows:

$$\text{Level} = \text{Average SWL} - 33 + 10 \log Q - 10 \log V - 10 \log d$$

$$+\ 98 - 33 + 10 \log 9 - 10 \log 30 - 10 \log 5$$

$$= 52.8\text{dB } L_{Aeq,\ 1h}$$

62 This is not predicted to cause any significant noise impact to the nearest sensitive receptor at a distance of 5m.

63 Considering an angle mast tower construction site, as detailed in Chapter 7, **Volume 3B** of the EIS, a maximum frequency of 12 vehicle trips per hour (Q) and a minimum distance of at least 5m (v) from the haul road to any nearby property, and a speed of 30km/h (V) the calculated noise impact is as follows:

$$\text{Level} = \text{Average SWL} - 33 + 10 \log Q - 10 \log V - 10 \log d$$

$$+\ 98 - 33 + 10 \log 12 - 10 \log 30 - 10 \log 5$$

$$= 54.0\text{dB } L_{Aeq,\ 1h}$$

64 This is not predicted to cause any significant noise impact to the nearest sensitive receptor at a distance of 5m. A distance of 5m has been assumed in these calculations and is presented as a practical assumption for distance from receptor to haul road.

9.5.2.2 Supply of Vehicle Movements

65 An increase of 3 dB (A) on existing traffic noise is required before it may be noticed by the public (example ref: UK Department for Transport *Guidance on the Methodology for Multi-Modal Studies* (DETR 2000), paragraph 4.3.5). With reference to the UK Department of Transport Welsh Office *Calculation of Road Traffic Noise* (CRTN 1988) and if all other factors remain equal, this would represent an increase in traffic flow of 100%.

66 The UK Highways Agency *Design Manual for Roads and Bridges* document (DMRB 2008) suggests that a 1dB increase in traffic might be perceptible although it acknowledges that other factors in visual perception and magnitude of traffic levels before increases are relevant. Again with reference to CRTN, a 1dB increase in noise level is approximately equivalent to a traffic number increase of 25%. It is unlikely that the introduction of a small number of additional vehicles on the local supply roads will be sufficient to present a 25% increase in traffic flows. As such this element of the proposed development is not expected to cause significant noise impact. In instances of tree felling for example where supply traffic would use local roads, this would be very short term and transient and would not be expected to cause any significant noise impact. Any such activity will be carried out in adherence to the requirements of the *Construction Environment Management Plan* (CEMP) (an outline of which is available in Appendix 7.1**, Volume 3B Appendices** of the EIS).

9.5.2.3 Construction Phase Vibration Impacts

67 There is potential for ground vibration due to the construction phase works, this will mainly be derived from excavation and from piling works (in the unlikely event that this is required). Vibration may be defined as regularly repeated movement of a physical object about a fixed point. The magnitude of vibration is expressed in terms of Peak Particle Velocity (PPV) expressed in millimetres per second (mm/s).

68 Common practice in Ireland has been to use guidance from internationally recognised standards. Vibration standards come in two varieties, those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. In both instances, the magnitude of vibration is expressed in terms of PPV in mm/s.

69 In order to ensure that there is no potential for vibration damage during construction, the NRA recommends that vibration from road construction activities be limited to the values set out in **Table 9.8**. These values have been derived through consideration of the various international standards, compliance with this guidance should ensure that there is little to no risk of even cosmetic damage to buildings.

70 These limits will be adhered to at all times during the construction phase of the proposed development. There is no vibration impact predicted for the operational phase of the proposed development.

Table 9.8: Allowable Vibration during Road Construction in Order to Minimise the Risk of Building Damage

Allowable vibration velocity (Peak Particle Velocity) at the closest part of any sensitive property to the source of vibration, at a frequency of:		
Less than 10Hz	10 to 50Hz	50 to 100Hz and above
8mm/s	12.5mm/s	20mm/s

9.5.3 Operational Phase

71 There will be no significant operational phase vibration impacts associated with the proposed development. There will be occasional requirement in the operational phase for tree cutting / lopping to protect the OHL. This will be carried out during day time hours only. This will be localised, short term and temporary and is unlikely to cause any significant noise impact. Following construction the transmission line will be subject to an annual survey by helicopter patrol. Helicopter inspections will be announced in advance in local newspaper and the Famers Journal. This is not expected to cause any significant noise impact due to the short term and transient nature of the annual survey.

72 Operational phase noise from the proposed transmission line is characterised by the following types of noise:

- Corona Discharge Noise;
- Continuous Operational Noise;
- Aeolian Noise; and
- Gap Sparking.

73 These aspects are each evaluated in detail in the sections below.

9.5.3.1 Corona Discharge Noise

74 Corona noise is the predominant noise audible from OHLs and can occur on transmission lines carrying higher voltages. Most modern transmission lines and substations are designed to reduce the magnitude of the electric field surrounding the line conductors below the air breakdown value. Corona discharge typically occurs where a sharp point or edge is present,

either on the conductor or the tower coupling. Occasionally a small sharp point can be found on a line or on nearby hardware that will result in a corona discharge.

75 Such discharges are often more active during the increased humidity conditions provided by fog or light rain. Water drops impinging or collecting on the conductors produce a large number of corona discharges, each of them creating a burst of noise. In dry conditions, the conductors usually operate below the corona inception level, and much less corona sources are present.

76 Corona noise comprises two sound components; one is irregular (random noise) sound and the other is the pure sound (corona hum noise) of buzzing. The random sound has a wide frequency band because the impulsive sounds caused by corona discharge overlap randomly.

77 The corona hum noise results from the excitation of ion groups, which are generated from corona discharge, caused by the electric field surrounding the conductors. The predominant frequency of the corona hum noise is double the commercial frequency (100Hz is the frequency of the corona hum noise in this instance).

78 The level of operational noise from OHLs will vary depending upon the environmental conditions, the locality and a number of other factors including the distance to ground and voltage. The noise derived from this discharge is typically a short burst of random ‘crackling’.

79 However, **Figures 9.2** and **9.3** depict the noise in wet conditions at distances from 0m to 100m from the line. It may be the case, that under certain circumstances, the background level may be exceeded by more than +10 dB. However, due to the unpredictability of corona noise derived from OHLs and very short limited duration of such discharges (typically peak levels of a duration of less than 1 second) the overall impact when considered over an hour (reference BS4142 daytime reference time period) can be deemed minimal.

80 The Electric Power Research Institute’s (EPRI) *AC Transmission Line Reference Book – 200 kV and Above* (Third Edition, 2005) provides a method for predicting the noise level at varying distances from the line under varying climatic conditions. The document provides the noise level during rainfall in terms of dB L_{A50} which represents the A-weighted sound pressure level (in decibels, dB) obtained using ‘Fast’ time-weighting that is exceeded for 50% of the given time interval.

81 A noise prediction calculation has been carried out with reference to the proposed line for inclusion within this evaluation. The results of this calculation are presented in **Figures 9.2** and **9.3** which illustrate the noise level at varying distances from the line. The noise levels presented have been calculated using the Bonneville Power Administration Method (BPA) and represent the noise level during normal rainfall.

82 **Figures 9.2** and **9.3** and **Table 9.9** shows the predicted LA50 dBA level (A-weighted sound level that is exceeded for 50% of the measurement period) and LA10 dBA level (A-weighted sound level that is exceeded for 10% of the measurement period). These levels are predicted using the EPRI calculation methodology. The noise indicators represent the predicted corona noise levels as a function of lateral distance from the centre of the proposed line route during wet conditions.

83 Corona is rarely a problem at distances beyond 50m from the transmission line. The level of audible corona at any time is dependent on the prevailing weather conditions. The dielectric strength of air is lower in wet weather than in dry weather. Thus the voltage stress at a conductor surface does not have to reach such high levels in wet weather for corona noise to become audible.

84 Corona noise attains higher levels and may become audible in wet weather, when large numbers of corona sources form as water droplets on the conductors. However, on such occasions the background noise level of rainfall and wind tend to mask the noise from the line. People tend to find noise from a high voltage line to be more noticeable during periods of light rain, snow, or fog, when they are more likely to be outdoors or to have windows open, and when the background noise is generally lower. In fair weather, corona sources are sufficiently few in number that this noise is unlikely to cause complaint due to the very short term nature of the source (less than 1 second).

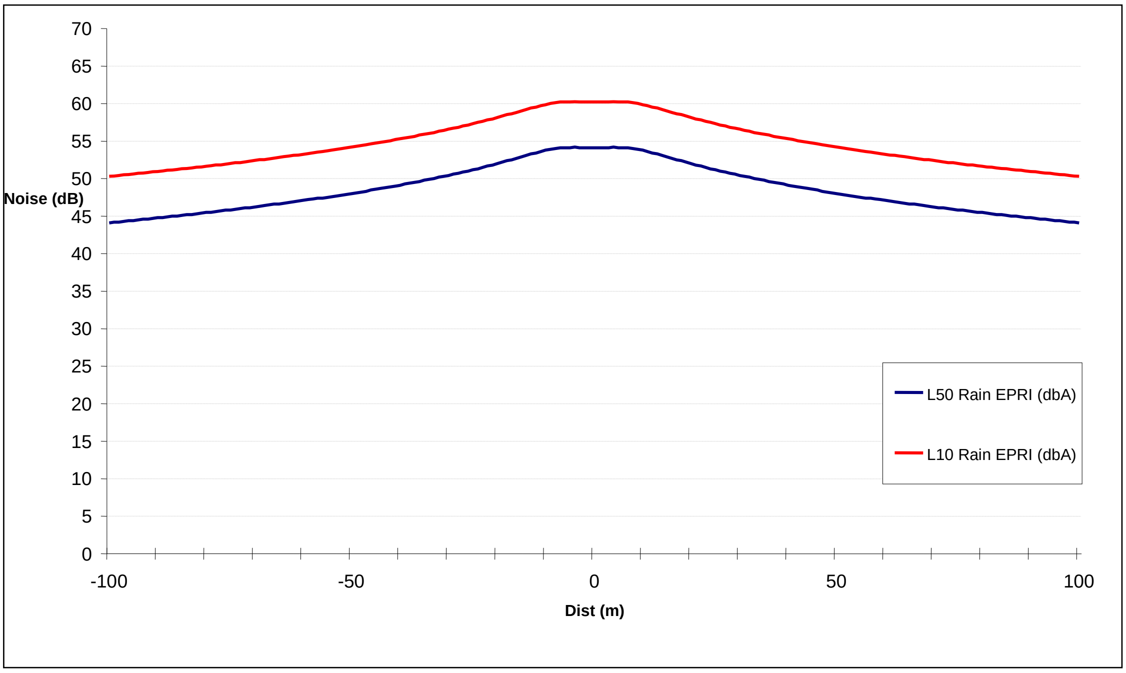

Figure 9.2: 400 kV Double Circuit Line Noise Levels in Wet Conditions

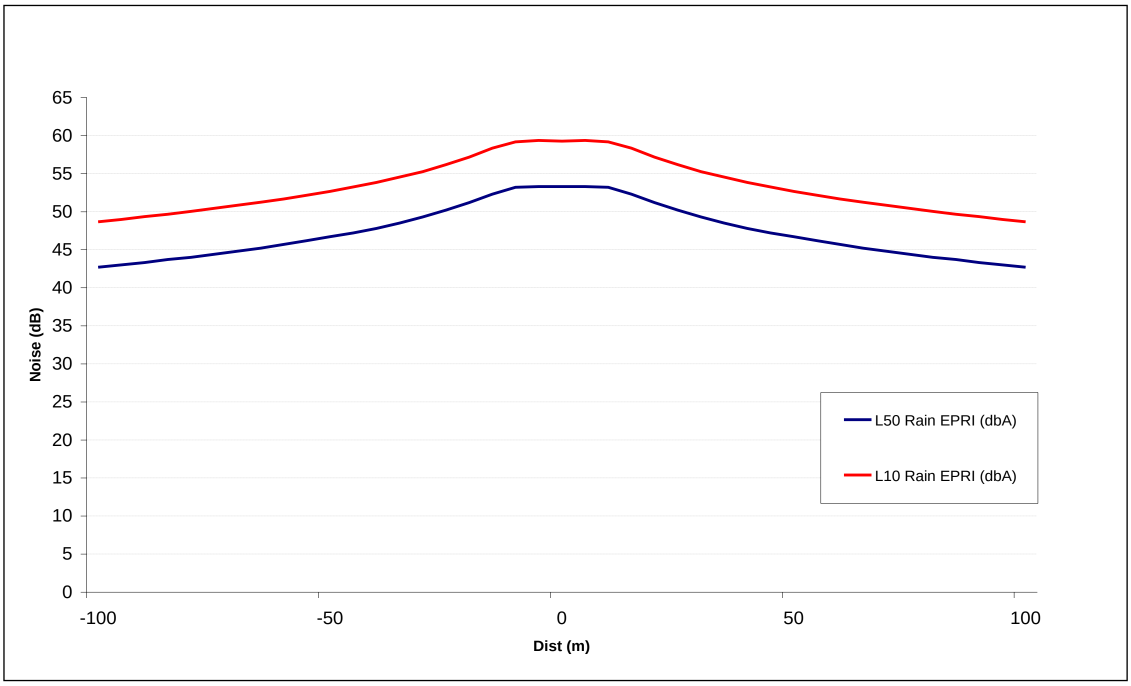

Figure 9.3: 400 kV Single Circuit Line Noise Levels in Wet Conditions

85 A useful guideline referring specifically to power lines is the New York Public Service Commission (NYPSC) following a public enquiry in 1978. This specified an L_{50} rain level limit of 52dB (A) at the edge of a right of way. This L_{50} noise level was based on an indoor maximum permitted noise level of 35dB (A). This was in the bedroom of a house at the edge of a right of way. It was assumed that the noise attenuation of a partly closed window was 17dB (A). An examination of the background noise measurements and the predicted corona noise levels are unlikely to cause annoyance. The predicted corona noise emitted from the proposed 400 kV transmission line (measured at 50m from the line) is presented in **Table 9.9.**

Table 9.9: Summary of Noise Values

Circuit Type	L_{50} Rain EPRI (dBA)	L_{10} Rain EPRI (dBA)	Fair Weather Range (dBA)	
400 kV Double Circuit	48.0	55.4	21.9	41.4
400 kV Single Circuit	46.7	52.7	20.9	40.2
Transposition Towers	46.7	52.7	20.9	40.2

86 As illustrated in **Table 9.9** the L_{50} value during rain for both the double and single circuit line, reaches a maximum of 48dB (A) L_{50} at 50m from the centre of the proposed line route. This is 4dB (A) below the 52dB (A) L_{50} NYPSC guideline limit for OHL noise in rainy conditions. The maximum fair weather value of 41.4dB (A) is significantly lower than the 52dB guideline limit value. Based on this comparison, the proposed 400 kV transmission line will not cause noise

annoyance to nearby residents as there are no residential receptors located within 50m of the proposed tower locations.

87 In the case of the southern end of the OHL where the line will meet the existing Oldstreet to Woodland 400 kV OHL there will be a section of double circuit 400 kV OHL that will continue to Woodland Substation. The proposed OHL will run on existing towers at this stage of the line. The closest sensitive receptors to these existing towers are located at approximately 27m distance. The noise impact from the double circuit line reaches a maximum of 51dB (A) L_{50} at approximately 27m from the centre of the proposed line route. This is 1dB (A) below the 52dB (A) L_{50} NYPSC guideline limit for OHL noise in rainy conditions. Based on this comparison, the proposed 400 kV transmission line will not cause noise annoyance to nearby residents.

9.5.3.2 Continuous Operational Noise

88 Due to the voltages associated with 400 kV OHLs, continuous operational noise may be audible but not dominant over the ambient noise levels. A noise survey at an existing 400 kV OHL has been conducted at Bogganstown near the existing Woodland Substation. This line runs to the west of Woodland Substation on a route south of the village of Summerhill, County Meath. A noise survey was also undertaken at the existing 400 kV substation at Woodland, County Meath. In these surveys, the substation / tower noise was audible but not dominant over the ambient noise levels.

89 The measurement results are presented in terms of 'dB L_{Aeq},' which is representative of an average of the energy associated with the noise at a location over a given time interval. The levels in terms of 'dB L_{A90}' are also presented and represent the level exceeded for 90% of the given time interval. The results are presented in **Table 9.5**.

90 The dB L_{A90} noise level represents the level exceeded for 90% of the given time interval. This is often considered as representative of the 'background' noise level at a location. This is inclusive of the noise from the active substation and the existing 400 kV OHL which enters the substation site. This noise level of 39.6dB L_{A90} is not considered significant and would not be expected to cause any significant noise impact to sensitive receptors. It is of note that this noise level is inclusive of all ambient noise sources in the area, such as foliage noise, distant road traffic etc., in addition to the OHL noise.

9.5.3.3 Aeolian Noise

91 Aeolian noise also known as turbulent wind noise may be created due to high wind speeds affecting the towers and conductors. It refers to the audible sound of wind interaction with the towers and conductors. The amount of aeolian noise is directly linked to wind speed and

direction. This type of noise impact is normally not considered as significant with regard to noise impact to sensitive receptors, as the ambient noise levels are also higher due to wind noise, therefore masking any specific aeolian noise impact from the proposed development.

92 Aeolian noise is present in the environment as a natural noise source and occurs when wind blows through tree branches, fences and other such structures. Aeolian noise from the interconnector is not expected to cause significant noise impact to sensitive receptors.

9.5.3.4 Gap Sparking

93 Gap sparking can develop at any time on transmission lines at any voltage. It occurs at tiny electrical separations (gaps) that develop between mechanically connected metal parts. Combinations of factors like corrosion, vibration, wind and weather forces, mis-fabrication, poor design or insufficient maintenance contribute to gap formation. Gap sparking can give rise to electrical noise, i.e. it occurs at frequencies higher than those that are audible to humans and therefore can be omitted as a source of noise nuisance.

9.5.4 Decommissioning

94 The proposed development will become a permanent part of the transmission infrastructure. The expected lifespan of the development is in the region of 50 to 80 years. This will be achieved by routine maintenance and replacement of hardware as required. There are no plans for the decommissioning of the OHL. In the event that part of, or the entire proposed infrastructure is to be decommissioned, all towers, equipment and material to be decommissioned will be removed off site and the land reinstated. Impacts would be expected to be less than during the construction phase and would be of short term duration.

9.6 MITIGATION MEASURES

9.6.1 Construction Phase Mitigation

95 With regard to construction activities the contractor appointed will be required to ensure that all plant items used during the construction phase will comply with standards outlined in *European Communities (Construction Plant and Equipment) (Permissible Noise Levels) Regulations* (1990). The mitigation measures are outlined in BS5228: *Noise Control on Construction and Open Sites* (2009), which offers detailed guidance on the control of noise from construction activities. All such controls will be set out in the Construction Environmental Management Plan (CEMP) (an outline of which is available in Appendix 7.1**, Volume 3B Appendices** of the EIS).

96 It is proposed that various practices be adopted during construction, in conjunction with those presented in Chapter 7, **Volume 3B** of the EIS including:

- Night time working will typically not occur, but there is the unlikely possibility that there may be a necessity to continue to operate generator, pumps or other equivalent machinery at a number of locations, where the digging of foundations and erection of towers may cause activity to remain in one location for a longer period of time.

- On these infrequent occasions screening and enclosures can be utilised. Similar measures will apply should rock breaking be required along the OHL route, (although this will not occur at night). For maximum effectiveness, a screen should be positioned as close as possible to either the noise source or receiver. The screen should be constructed of material with a mass of > 7kg/m^2 and should have no gaps or joints in the barrier material. This can be used to limit noise impact to 45dB (A) L_{eq} (BS 5228 acceptable night time level) at any noise sensitive receptors, if required by agreement with the local authority.

- Appoint a site representative responsible for matters relating to noise and establish channels of communication between the contractor / developer, local authority and resident i.e. for notification of requirement of night works, should this be required.

97 Furthermore, it is envisaged that a variety of practicable noise control measures will be employed, these may include:

- Selection of plant with low inherent potential for generation of noise and / or vibration.

- Erection of temporary barriers around items such as generators or high duty compressors. For maximum effectiveness, a barrier should be positioned as close as possible to either the noise source or receiver. The barrier should be constructed of material with a mass of > 7kg/m^2 and should have no gaps or joints in the barrier material. An example is shown in **Figure 9.4.**

Figure 9.4: Example of a Section of Temporary Noise Barrier

- As a rough guide, the length of a barrier should be 5 times greater than its height. A shorter barrier should be bent around the noise source, to ensure no part of the noise source is visible from the receiving location.

- Positioning of noisy plant as far away from sensitive receptors, as permitted by site constraints.

9.6.1.1 Continuous Operational Noise

98 Any construction works that have the potential to cause vibration at sensitive receptors will be carried out in accordance with the limit values as set out in **Table 9.6**.

9.6.2 Operational Phase Noise Mitigation

99 As outlined in the previous sections it is not expected that noise arising from the proposed development will cause significant noise impact. Corona noise will only be audible under certain weather conditions and in close proximity to the line. Corona noise is caused predominantly by items of transmission line hardware, other than conductors, e.g. clamps and can be effectively mitigated by replacement of individual items of hardware. Aeolian noise very rarely occurs on 400 kV lines and is not expected to arise on the proposed development. Recommended mitigation measures for aeolian and corona noise, include the fitting of air flow spoilers on conductors and the fitting of composite insulators.

100 The OHL will be subject to an annual survey by helicopter patrol. The steady rise in noise level as the helicopter is approaching any given point (while following the line route) should minimise any surprise element to the onset of the helicopter noise. This is not expected to cause any significant noise impact, due to the short term and transient nature of the annual survey and the advance notice given to landowners.

9.7 RESIDUAL IMPACTS

101 Adherence to the mitigation measures will ensure there are no residual impacts associated with the proposed development.

9.8 INTERRELATIONSHIPS BETWEEN ENVIRONMENTAL FACTORS

102 During both the operational and the construction phase the noise and vibration impacts will be predominately associated with the road traffic impacts. This chapter should be read in conjunction with **Chapter 13** of this volume of the EIS, for a full understanding of the main interrelationships between these environmental topics.

103 The main impacts arise from the following interrelationships:

- **Chapter 2** - Human Beings – Population and Economic - There is the potential for noise impact to population in the form of impact to sensitive receptors such as private dwellings etc. in the construction phase and the operational phase. In the operational phase corona noise has the potential to cause noise impact during inclement weather conditions. These impacts are addressed in the EIS and are not deemed to be significant.

- **Chapter 13** - Material Assets – Traffic - In terms of traffic, during both the operational and the construction phase, the noise and vibration impacts will be predominantly associated with the road traffic impacts. No significant noise and vibration impacts are predicted.

9.9 CONCLUSION

104 An evaluation of the potential for noise and vibration impact to sensitive receptors from the proposed development has been carried out. It is predicted that the proposed development as designed, inclusive of the mitigation measures described in this evaluation, will not have a significant noise and vibration impact on sensitive receptors.