11 NOISE & VIBRATION

11.1 Introduction

This baseline noise and vibration section includes the baseline noise survey work completed for the proposed Carlingford Ferry and includes an outline of the vibration thresholds relevant to the proposed development.

The proposed development is for a ferry service between Greenore in the Republic of Ireland and Greencastle in Northern Ireland. The description of the proposed development is included in Chapter 3 Project Description.

The study area is rural and coastal and the existing noise environment is typical of such a rural coastal environment. There are a number of settlement areas in the general vicinity of the two crossing points, mostly notably Greencastle, Cranfield and Kilkeel on the Northern Ireland side of the crossing and Carlingford on the southern side of the crossing. There is an existing quay and associated buildings at Greenore Point.

The baseline noise surveys have focused on demonstrating the existing noise environment at a range of properties most likely to be impacted by the proposed development. Additional noise monitoring was completed along Greencastle Pier Road as the proposal includes for this road to be widened as part of the proposed works.

This section should be read in conjunction with Figures 11.1 and 11.2, which illustrate the noise monitoring locations and noise prediction locations included in the assessment.

11.2 Methodology

11.2.1 Relevant Noise Guidance Documents - United Kingdom

British Standard BS 5228:2009 Noise and Vibration Control on Construction and Open Sites

This British standard consists of two parts and covers the need for protection against noise and vibration of persons living and working in the vicinity of construction and open sites. The standard recommends procedures for noise and vibration control in respect of construction operations and aims to assist architects, contractors and site operatives, designers, developers, engineers, local authority environmental health officers and planners.

Part 1 of the standard provides a method of calculating noise from construction plant, including:

- Tables of source noise levels
- Methods for summing up contributions from intermittently operating plant
- A procedure for calculating noise propagation
- A method for calculating noise screening effects
- A way of predicting noise from mobile plant, such as haul roads.

The standard also provides guidance on legislative background, community relations, training, nuisance, project supervision and control of noise and vibration.

World Health Organisation (WHO) – Guidelines for Community Noise (1999)

In 1999, the World Health Organisation (WHO) proposed guidelines for community noise. In this guidance, a L_{Aeq} threshold daytime noise limit of 55 dB is suggested for outdoor living areas in order to protect the majority of people from being seriously annoyed. A second daytime limit of 50 dB is also given as a threshold limit for moderate annoyance.

The guidelines suggest that an internal L_{Aeq} not greater than 30 dB for continuous noise is needed to prevent negative effects on sleep. This is equivalent to a façade level of 45 dB L_{Aeq}, assuming open windows or a free-field level of about 42 dB L_{Aeq}. If the noise is not continuous, then the internal level required to prevent negative effects on sleep is an $L_{Amax,fast}$ of 45 dB. Therefore, for sleep disturbance, the continuous level as well as the number of noisy events should be considered.

British Standard 8233: 1999 Sound Insulation and Noise Reduction for Buildings – Code of Practice

BS8233:1999 provides guidance values for a range of ambient noise levels within residential properties as shown in Table 11.1 below.

Table 11.1: Internal Ambient Noise Levels for Bedrooms and Living Rooms

Citation	Typical Situation	Design Range dB $L_{Aeq,t}$	
		Good	Reasonable
Reasonable resting/ sleeping conditions	Living rooms	30	40
	Bedrooms	30	35

British Standard BS4142: 1997 – Method for rating industrial noise affecting mixed residential and industrial areas

BS4142: 1997 describes a method of determining the level of a noise of an industrial nature, together with procedures for assessing whether the noise in question is likely to give rise to complaints from persons living in the vicinity. In general, the likelihood of complaint in response to a noise depends on factors including the margin by which it exceeds the background noise level, its absolute level, time of day, change in noise environment etc., as well as local attitudes to the premises and the nature of the neighbourhood.

The standard will be used in this assessment in order to determine the likelihood that noise from the proposed ferry crossings will results in complaints at the nearest noise sensitive receptors.

The Design Manual for Roads & Bridges (DMRB)

The assessment of the new widened road on Greencastle Pier Road will be based on the guidance given in the *Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3, Part 7 (HA 213/08) Noise and Vibration*.

Under this guidance, the main stages of a noise and vibration assessment are clearly outlined in Section 3 – Procedures for Assessing Impacts. The four stages of any noise and vibration assessment are:

- Screening – determine whether the project has potential to cause change to the receiving environment which could result in noise and vibration impacts;
- Scoping – determine the likely extent of any assessment and to identify sensitive receptors;
- Simple – assessment of noise and vibration impact at dwellings and other sensitive receptors; and
- Detailed – assessment of noise and vibration impact at dwellings and other sensitive receptors.

These phases are intended to apply to various phases of planning design and execution of projects associated with the construction and maintenance of roads. It is also intended that each phase is followed in sequence.

The DMRB states that the magnitude of noise impact from a project should be classified into levels of impact in order to assist with the interpretation of the project. The DMRB example of classification of magnitude of impacts from traffic noise is included in Table 11.2 below.

Table 11.2: Classification of Magnitude of Noise Impacts

Noise Change, LA10,18-hr	Magnitude of Impact
0	No change
0.1 – 0.9	Negligible
1 – 2.9	Minor
3 – 4.9	Moderate
5+	Major

Calculation of Road Traffic Noise (CRTN)

Road traffic noise predictions will be undertaken using the methodology outlined in the Department of Transport (Welsh Office) guidance document *Calculation of Road Traffic Noise* (CRTN), 1988.

The CRTN requires that the noise levels due to road traffic (presented in terms of dB $L_{A10, 18\ hour}$) is predicted at the receiving position, 1m from the façade of a property under assessment. In order to undertake the predictions, carriageways have been broken down into appropriate segments and the following factors, which are specific to each road segment, have been taken into account:

- Number of vehicles using the road (18 hour Annual Average Daily Traffic Flows – AADT);
- Number of heavy goods vehicles (HGVs) as a percentage of the total number of vehicles using the road;
- Vehicle speed/road speed limit;
- Road gradient;
- Distance between the carriageway and receiving position;
- Relative heights of source and receiving positions;
- Barriers between carriageway and receiving position;
- Intervening ground cover (i.e. reflective or absorbent) between carriageway and receiving position;
- Angle of view of the road; and
- Reflections and facades.

Baseline noise monitoring was conducted in the vicinity of the proposed development site in order to characterise the existing noise environment around the proposed site. The noise monitoring survey was conducted in accordance with the 'Shortened Measurement Procedure' as described in paragraph 43 of the CRTN.

11.2.2 Relevant Noise Guidance Documents - Republic of Ireland

Environmental Protection Agency (EPA) Office of Environmental Enforcement (OEE) - Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)

NG4 is the most recent Irish guidance document in relation to noise survey and assessment and as such is the most relevant Irish guidance document for the purposes of this assessment. The document relates primarily to noise surveys and assessments for EPA licensed facilities but in the absence of any other directly applicable guidance documents, it also is pertinent for the purposes of noise surveys and assessments accompanying planning applications.

The EPA published two earlier documents in relation to the survey, assessment and management of noise emissions from licensed facilities, namely the *Environmental Noise Survey Guidance Document* (commonly referred to as NG1) and *Guidance Note for Noise in Relation to Scheduled Activities - 2nd Edition* (commonly referred to as NG2). These two documents have been withdrawn with the publication of NG4.

NG4 provides detailed consideration of a range of noise related issues including basic background to noise issues, various noise assessment criteria and procedures, noise reduction measures, Best Available Techniques (BAT) and the detailed requirements for noise surveys.

Other EPA general EIA guidelines such as *Guidelines on the Information to be Contained in Environmental Impact Statements [2002]* and *Advice Notes on Current Practice (in the Preparation of Environmental Impact Statements) [2003]* have been considered in the preparation of this Noise and Vibration Chapter.

The National Roads Authority (NRA) Guidelines for the Treatment of Noise and Vibration in National Road Schemes (2004)

The NRA's guidance document *Guidelines for the Treatment of Noise and Vibration in National Road Schemes (2004)* is the recognised Irish guidance document for the assessment of road traffic noise. This document sets out the key items that should be included in a noise and vibration assessment for any significant road scheme. As a minimum, it stipulates that the following items should be included:

- A series of noise surveys to quantify the prevailing noise climate at sensitive receptors along the existing and proposed routes
- Preparation and calibration of a suitable noise prediction model;
- Prediction of Do Minimum and Do Something noise levels for opening and design years;

- Comparison of predicted Do Something noise levels with the design goal and three conditions that must be satisfied before mitigation measures are deemed necessary;
- Specification and assessment of road traffic mitigation measures, where required;
- Assessment and review of construction impacts and mitigation measures;
- Assessment and review of vibration.

This document has been referred to in the consideration of road traffic noise associated with the proposed development in the vicinity of Greenore. The document also presents maximum permissible noise levels at dwelling facades during construction activities (see Table 11.3 below). This provide a useful reference for assessing construction noise on the Greenore side of the proposed development.

Table 11.3: Maximum Permissible Noise Levels During Construction

Days & Times	$L_{Aeq\ (1hr)}$ dB	$L_{pA(max)slow}$ dB
Monday to Friday 07:00 to 19:00 hrs	70	80
Monday to Friday 19:00 to 22:00 hrs	60	65
Saturday 08:00 to 16:30 hrs	65	75
Sundays and Bank Holidays 08:00 to 16:30 hrs	60	65

11.2.3 Consultation

Consultation was undertaken with Newry and Mourne District Council and Louth County Council as part of the preparation of the Noise and Vibration Assessment for the proposed development.

11.2.4 Vibration

There is a very low likelihood of operational vibration impacts from the proposed development on account of the nature of the proposed plant/equipment and the nature of the design which will ensure that potential vibration effects are eradicated at the design stage. The most likely potential vibration effects associated with the proposed development would be associated with the construction phase. Vibration threshold values discussed below are presented in the context of potential vibration effects from the construction phase.

Limits of transient vibration, above which cosmetic damage could occur, are given numerically in Table 11.4 (Ref: BS5228-2:2009). Minor damage is possible at vibration magnitudes which are greater than twice those given in Table 11.4, and major damage to a building structure can occur at values greater than four times the tabulated values (definitions of the damage categories are presented in BS7385-1:1990).

Table 11.4: Transient Vibration Guide Values for Cosmetic Damage (Ref BS5228-2:2009)

Type of Building	**Peak Particle Velocity (PPV) (mm/s) in Frequency Range of Predominant Pulse**	
	4 Hz to 15 Hz	**15 Hz and above**
Reinforced or framed structures. Industrial and heavy commercial buildings.	50 mm/s at 4 Hz and above	50 mm/s at 4 Hz and above
Unreinforced or light framed structures. Residential or light commercial buildings.	15 mm/s at 4 Hz increasing to 20 mm/S at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above.

British Standard BS 7385 (1993) *Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration* indicates that cosmetic damage should not occur to property if transient vibration does not exceed 15mm/s at low frequencies rising to 20mm/s at 15Hz and 50mm/s at

40Hz. These guidelines refer to relatively modern buildings and therefore, these values should be reduced to 50% or less for more sensitive buildings.

The human body is an excellent detector of vibration, which can become perceptible at levels which are substantially lower than those required to cause building damage. The human body is most sensitive to vibration in the vertical direction (foot to head). The effect of vibration on humans is guided by British Standard 6472:1992. This standard does not give guidance on the limit of perceptibility, but it is generally accepted that vibration becomes perceptible at levels of approximately 0.15 to 0.3 mm/s.

BS 6472 defines base curves, in terms of root mean square (rms) acceleration, which are used to assess continuous vibration. Table 5 of the Standard states that in residential buildings, the base curve should be multiplied by 1.4 at night and by 2 to 4 during the daytime to provide magnitudes at which the probability of adverse comment is low.

In order to assess human exposure to vibration, ideally, measurements need to be undertaken at the point at which the vibration enters the body, i.e. measurements would need to be taken inside properties. However, various conversion factors have been established to convert vibration levels measured at a foundation to levels inside buildings, depending on the structure of the building.

Where vibration is intermittent or occurs as a series of events, the use of Vibration Dose Values (VDVs) is recommended in BS 6472 for the assessment of subjective response to vibration. The VDVs at which it is considered there will be a low probability of adverse comment are drawn from BS 6472 and presented in Table 11.5.

Table 11.5: Threshold Values for the Evaluation of Disturbance due to Vibration

Place	Daytime 16 Hour VDV ($ms^{-1.75}$)	Night-time 8 Hour VDV ($ms^{-1.75}$)
Critical working Area	0.11	0.09
Residential	0.22 – 0.43	0.13
Office	0.43	0.36[1]
Workshops	0.87	0.73

These VDV thresholds do not apply unless night-time work was a regular activity at these premises.

The NRA *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* (2004) also includes a discussion of vibration levels in relation to construction activities. While the document relates to national road schemes, the advice on construction vibration is relevant to all construction activities. Table 11.6 includes allowable vibration levels during construction activities which would minimise the risk of building damage. This is the reference to be applied to the assessment of vibration in the Republic of Ireland.

Table 11.6: Allowable Vibration During Construction in Order to Minimise the Risk of Building Damage

Allowable Vibration Velocity (Peak Particle Velocity) at the Closest Part of Any Sensitive Property tot eh Source of Vibration, at a Frequency of		
Less than 10Hz	10 to 50 Hz	50 to 100 Hz (and above)
8 mm/s	12.5 mm/s	20 mm/s

11.2.5 Methodology for Noise Monitoring

Noise monitoring was conducted in the vicinity of the proposed development site in order to characterise the noise environment around the site. Two types of noise monitoring survey were completed. Firstly, a general day and night-time survey at a range of the nearest noise sensitive properties to the proposed development was undertaken to determine existing background (i.e. L_{A90}) noise levels at these properties. In addition to this, a noise monitoring survey was completed in accordance with the CRTN Shortened Measurement Procedure in order to determine the existing noise levels at properties adjacent to the road to be widened.

Figure 11.2 illustrates the position of all noise monitoring locations used in the noise monitoring survey. For the general noise monitoring survey, noise monitoring was undertaken for one hour at each location during

the day (10-minute logging) and for 20 minutes at each location during the night (5-minute logging). Subjective noisy events were recorded during each logging period.

Noise monitoring was carried out on-site using a Bruël & Kjær 2250 Hand Held Analyzer and a Bruël & Kjær Type 4231 Sound Level Calibrator. This instrumentation conforms to the requirements for integrating averaging sound level meters (Type 1) as specified in BS EN 60804. The sound level meter was accurately calibrated before use.

Measurements were made at a height of 1.2 – 1.5m above ground level. The weather conditions were in accordance with the requirements of BS7445: Description and Measurement of Environmental Noise.

The following parameters were recorded during each monitoring period:

L_{Aeq} The continuous equivalent A-weighted sound pressure level. This is an "average" of the sound pressure level.
L_{Amax} This is the maximum A-weighed sound level measured during the sample period.
L_{Amin} This is the minimum A-weighted sound level measured during the sample period.
L_{A10} This is the A-weighted sound level that is exceeded for noise for 10% of the sample period.
L_{A90} This is the A-weighted sound level that is exceeded for 90% of the sample period.

For the CRTN noise monitoring survey, measurements were made at six individual properties over three consecutive hours between 10:00 and 17:00 on 23/05/12. The L_{10} (3-hour) was calculated as the arithmetic mean of the three consecutive values of hourly L_{10}, from which the L_{10} (18-hour) could be calculated for comparative reasons.

11.3 Existing Environment

Noise monitoring was carried out at the proposed development site on 09/05/12, 21/05/12, 22/05/12 and 23/05/12. The noise monitoring locations are illustrated in Figure 11.2. The noise measurements attained during each monitoring period are displayed in Tables 11.7 - 11.9 below.

Table 11.7: Summary of General Daytime Noise Monitoring Survey - 09/05/12

Monitoring Time Period	Measured L_{Aeq} dB(A)	Measured L_{Amax} dB(A)	Measured L_{Amin} dB(A)	Measured L_{A10} dB(A)	Measured L_{A90} dB(A)
Location 1					
Measurement 1 - 12:07 - 12:17	51.4	73.8	35.6	54.2	41.9
Measurement 2 - 12:17 - 12:27	47.9	71.8	34.4	50.3	38.8
Measurement 3 - 12:27 - 12:37	49.5	73.0	35.3	52.2	40.7
Measurement 4 - 12:38- 12:49	54.2	76.3	34.2	57.0	39.9
Measurement 5 - 12:50 - 13:00	50.7	72.8	36.5	54.1	40.6
Measurement 6 - 13:00 - 13:10	53.4	77.9	36.2	57.1	40.3
Combined	**51.7**	**77.9**	**34.2**	**54.2**	**40.4**
Location 2					
Measurement 1 - 13:17 - 13:27	54.1	74.4	43.7	51.2	47.1
Measurement 2 - 13:28 - 13:38	54.4	71.5	46.1	53.7	48.4
Measurement 3 - 13:38 - 13:48	61.1	84.5	46.1	55.3	48.0
Measurement 4 - 13:48 - 13:58	54.1	74.0	45.8	51.9	48.2
Measurement 5 - 13:59 - 14:09	58.5	82.7	47.4	53.9	49.7
Measurement 6 - 14:09 - 14:19	67.5	84.6	49.0	68.3	50.6
Combined	**61.5**	**84.6**	**43.7**	**55.7**	**48.7**
Location 3					
Measurement 1 - 15:37 - 15:47	54.9	78.8	31.6	48.9	35.2
Measurement 2 - 15:47 - 15:57	55.7	80.8	32.5	43.5	35.3

Measurement 3 - 15:58 - 16:08	54.5	80.9	32.0	50.9	35.3
Measurement 4 - 16:09 - 16:19	51.6	74.8	32.5	47.1	35.2
Measurement 5 - 16:20 - 16:30	53.2	77.1	31.3	46.4	34.4
Measurement 6 - 16:30 - 16:40	56.6	78.4	30.9	53.7	34.4
Combined	**54.7**	**80.9**	**30.9**	**48.4**	**35.0**
Location 4					
Measurement 1 - 16:33 - 16:43	50.2	77.0	32.5	41.4	35.4
Measurement 2 - 16:44 - 16:54	37.7	51.5	32.2	39.9	34.3
Measurement 3 - 16:55 - 17:05	49.8	74.8	34.8	43.9	36.7
Measurement 4 - 17:06- 17:16	55.2	80.2	32.7	52.2	36.3
Measurement 5 - 17:17 - 17:27	57.7	82.1	31.9	57.8	35.3
Measurement 6 - 17:28 - 17:38	63.6	87.2	31.3	60.6	38.3
Combined	**57.6**	**87.2**	**31.3**	**49.3**	**36.1**

Table 11.8: Summary of General Night-time Noise Monitoring Survey - 21/05/12 - 22/05/12

Monitoring Time Period	Measured L_{Aeq} dB(A)	Measured L_{Amax} dB(A)	Measured L_{Amin} dB(A)	Measured L_{A10} dB(A)	Measured L_{A90} dB(A)
Location 1					
Measurement 1 - 23:28 - 23:33	34.1	58.4	26.7	32.3	28.0
Measurement 2 - 23:38 - 23:43	38.5	55.7	29.4	41.0	31.3
Measurement 3 - 23:44 - 23:49	39.2	53.0	32.2	39.5	34.5
Measurement 4 - 23:49 - 23:54	48.5	67.6	27.8	50.3	29.3
Combined	**43.5**	**67.6**	**26.7**	**40.8**	**30.8**
Location 2					
Measurement 1 - 00:02 - 00:07	37.2	55.3	30.7	38.5	33.3
Measurement 2 - 00:07 - 00:12	37.6	61.4	29.8	36.9	32.6
Measurement 3 - 00:13 - 00:18	36.3	62.5	30.1	36.1	32.0
Measurement 4 - 00:18 - 00:23	43.7	59.0	30.7	47.1	33.6
Combined	**39.9**	**62.5**	**29.8**	**39.7**	**32.9**
Location 3					
Measurement 1 - 01:55 - 02:00	38.5	68.9	28.6	34.6	30.8
Measurement 2 - 02:00 - 02:05	35.1	60.7	28.8	34.1	30.5
Measurement 3 - 02:06 - 02:11	37.8	68.2	28.5	33.7	30.4
Measurement 4 - 02:12 - 02:17	40.2	70.7	28.6	35.7	30.2
Combined	**38.3**	**70.7**	**28.5**	**34.5**	**30.5**
Location 4					
Measurement 1 - 01:30 - 01:35	41.5	72.7	30.7	35.5	32.2
Measurement 2 - 01:35 - 01:40	36.8	63.9	30.4	35.7	32.2
Measurement 3 - 01:41 - 01:46	36.0	64.2	30.3	35.0	31.6
Measurement 4 - 01:47 - 01:52	36.6	64.9	29.7	35.6	31.8
Combined	**38.4**	**72.7**	**29.7**	**35.5**	**32.0**

Subjective observations during the measurement periods revealed that the noise environment in the vicinity of the proposed facility was dominated by a mixture of road traffic noise, human activity noise, animal noises, birdsong.

Table 11.9: Summary of CRTN Noise Monitoring Survey (23/05/12)

Monitoring Time Period	Measured $L_{Aeq\ 1hr}$ dB(A)	Measured L_{Amax} dB(A)	Measured L_{Amin} dB(A)	Measured L_{A10} dB(A)	Measured L_{A90} dB(A)
Location 1					
10:05 – 10:20	56.1	76.6	27.7	52.2	32.3
11:05 - 11:20	56.6	84.4	29.9	58.8	32.1
12:05 - 12:20	71.6	83.0	54.2	74.6	56.0
$L_{A10\ 3hr}$				**61.9**	
$L_{A10\ 18hr}$				**60.9**	
Location 2					
10:25 – 10:40	71.4	99.8	25.6	58.0	32.0
11:25 - 11:40	61.0	89.0	25.8	49.6	28.5
12:25 - 12:40	53.3	87.1	23.8	47.4	26.9
$L_{A10\ 3hr}$				**51.7**	
$L_{A10\ 18hr}$				**50.7**	
Location 3					
10:45 – 11:00	57.4	79.2	24.1	54.8	28.7
11:45 - 12:00	63.5	92.7	27.6	49.8	30.6
12:45 - 13:00	62.7	87.0	29.1	58.0	33.0
$L_{A10\ 3hr}$				**54.2**	
$L_{A10\ 18hr}$				**53.2**	
Location 4					
13:05 – 13:20	55.1	79.3	30.5	49.6	33.4
14:05 - 14:20	61.2	89.4	26.7	48.5	32.0
15:05 - 15:20	65.3	92.4	24.1	59.3	33.4
$L_{A10\ 3hr}$				**52.5**	
$L_{A10\ 18hr}$				**51.5**	
Location 5					
13:25 – 13:40	59.0	90.7	28.4	55.9	34.5
14:25 - 14:40	63.9	89.2	28.5	56.5	32.8
15:25 - 15:40	63.9	89.7	30.7	60.7	35.0
$L_{A10\ 3hr}$				**57.7**	
$L_{A10\ 18hr}$				**56.7**	
Location 6					
13:45 – 14:00	63.0	87.8	31.2	56.4	33.5
14:45 - 15:00	63.8	91.2	30.6	59.6	33.2
15:45 - 16:00	64.6	85.6	29.6	58.8	32.4
$L_{A10\ 3hr}$				**58.3**	
$L_{A10\ 18hr}$				**57.3**	

11.4 Impact Assessment

11.4.1 Construction Phase - Northern Ireland

The construction phase on the Northern Ireland side of the proposed ferry crossing will involve two principle aspects: the construction of the ferry terminal on a site adjacent to Greencastle Pier Road, and the widening of the existing Greencastle Pier Road between the proposed ferry terminal site and Benagh Road. The construction phase is outlined in detail in Chapter 3 Project Description of the ES/EIS.

There is no requirement for the demolition of any significant structures on the Greencastle side of the proposed development. The key structures that will be constructed as part of the ferry terminal adjacent to Greencastle Pier Road will be:

- a concrete pier consisting of vertical steel tubular piles and a suspended concrete deck;
- a slipway consisting of vertical tubular piles supporting a suspended concrete deck;
- Approximately 12 tubular piles driven into the seabed on the southern side of the slipway with fenders mounted vertically on the berthing side;
- a portacabin for ticket sales and containing a toilet;
- a hardstanding area for off road queuing;
- a landscaped and planted area to shield the development from local views.

The construction activities at the ferry terminal site will last approximately 6 months as outlined in Section 4. The activities taking place at the site during this 6 month period will vary in terms of numbers of vehicles/plant operational at any one time, types of activities taking place and areas of work. Therefore, the noise levels emitted from the site will vary constantly.

Construction activity for the proposed development will generally operate between the hours of 08:00 and 18:00 on Monday to Fridays, between 08:00 and 13:00 on Saturdays and there will be no activity on Sundays or Bank Holidays.

In order to complete a worst-case noise impact assessment of the programme above, it is necessary to determine what the noisiest stages of the construction phase will be. The simplest and most robust means of ensuring a worst-case scenario is assessed is to assume all items of plant/equipment are active at the same time. To ensure the most conservative approach, the assessment will also assume that all items of plant/equipment are active at the nearest boundary of the proposed development site to the relevant noise sensitive receptor.

Table 11.10 contains typical noise levels from various construction plant that will be used during the construction phase. Table 11.11 contains typical combined construction noise levels for various construction phase activities as outlined in Chapter 3. This table also includes a combined noise level representing all activities being operational at the same location at the same time. This will be used for the purposes of the worst-case noise assessment of the proposed works.

Table 11.10: Noise Levels from Construction Plant (Ref: BS5228:2009)

Activity / Plant (Reference from Annex C & D, BS5228:2009)	Power Rating (kW)	Equipment Size, Weight (Mass), Capacity	Activity Equivalent Continuous Sound Pressure Level L_{Aeq} at 10m (dB)
Ground Excavation: Dozer (C2 - Ref 12)	142	20t	81
Ground Excavation: Tracked excavator (C2 - Ref 14)	226	40t	79
Ground Excavation: Wheeled loader (C2 - Ref 27)	193	-	80
Distribution of Material: Dump Truck (tipping fill) (C2 - Ref 30)	306	29t	79
Distribution of Material: Dump Truck (empty) (C2 - Ref 30)	306	29t	87
Rolling & Compaction: Roller (C2 - Ref 38)	145	18t	73
Tubular Steel Casting / pile cast in place (D4, Ref 19)	4t 1m drop		87
Pumping Water: Water pump (C2 - Ref 45)	20	6 in	65
Breaking Road Surface: Wheeled excavator/loader fitted with hydraulic rock breaker (D8, Ref 12)	52		78
Removing Broken Road Surface: Wheeled excavator/loader (D8, Ref 15)	57		75
Road Planing: Road planer (D8, Ref 17)	124		83
Road Surfacing: Asphalt Melter (D8, Ref 21)			75
Road Surfacing: Asphalt Spreader (D8, Ref 24)	90	13t	73
Road Surfacing: Road Roller/Lorry (D8, Ref 25)		10t/24t	68
Road Sweeping: Lorry Mounted Road Sweeper (D8, Ref 31)			73

Table 11.11: Combined Noise Levels from Various Construction Activities (Ref: BS5228:2009)

Activity	L_{Aeq} @ 10 m	L_{Aeq} @ 40 m	L_{Aeq} @ 80 m	L_{Aeq} @ 160 m	L_{Aeq} @ 320 m
Ground Excavation	85	73	67	61	55
Distribution of Materials	88	76	70	64	58
Rolling & Compaction	73	61	55	49	43
Piling	87	75	69	63	57
Pumping Water	65	53	47	41	35
Breaking Road Surface	78	66	60	54	48
Removing Broken Road Surface	75	63	57	51	45
Road Planing	83	71	65	59	53
Road Surfacing	78	66	60	54	48
Road Sweeping	73	61	55	49	43
Combined Total for All Activities	**93**	**81**	**75**	**69**	**63**

Based on the overall combined worst-case noise level from the proposed development site (i.e. 93dB[A] at 10m as per Table 11.11), noise predictions have been undertaken to determine the worst-case predicted noise levels from the proposed development at a range of the nearest noise sensitive receptors. Table 11.12 includes all worst-case predicted noise levels based on the distance from the nearest portion of the proposed site boundary to the relevant noise sensitive receptor. In order to ensure a worst-case scenario is assessed, distance attenuation has been predicted in Table 11.12 on the basis of hard ground attenuation between the source and receiver (i.e. it assumes ground surface reflects noise and no absorption takes place).

Table 11.12: Worst-Case Predicted Noise Levels from Construction Plant at Nearest Noise Sensitive Properties

Nearest Sensitive Receptor (See Fig 11.1)		Worst-Case L_{Aeq} @ 10m (dBA)	Distance from Construction Boundary (m)	Distance Attenuation (dBA)	Predicted Worst-Case Construction Noise (dBA)
1	6 The Lightkeepers Green	93	210	-26	67
2	117 Greencastle Pier Road	93	207	-26	67
3	113 Greencastle Pier Road	93	141	-23	70
4	103 Greencastle Pier Road	93	113	-21	72
5	97 Greencastle Pier Road	93	52	-14	79
6	93 Greencastle Pier Road	93	18	-5	88
7	92 Greencastle Pier Road	93	<10	+	93+
8	91 Greencastle Pier Road	93	15	-4	89
9	88 Greencastle Pier Road	93	<10	+	93+
9a	90 Greencastle Pier Road	93	<10	+	93+
10	80 Greencastle Pier Road	93	24	-8	85
11	74 Greencastle Pier Road	93	48	-14	79
12	68 Greencastle Pier Road	93	<10	+	93+
13	60 Greencastle Pier Road	93	<10	+	93+
14	57 Greencastle Pier Road	93	<10	+	93+
15	52 Greencastle Pier Road	93	30	-10	83
16	51 Greencastle Pier Road	93	30	-10	83
17	45 Greencastle Pier Road	93	<10	+	93+
18	44 Greencastle Pier Road	93	<10	+	93+
19	41 Greencastle Pier Road	93	21	-6	87
20	20 Greencastle Pier Road	93	17	-5	88
21	17 Greencastle Pier Road	93	<10	+	93+
22	11 Greencastle Pier Road	93	45	-13	80
23	9 Greencastle Pier Road	93	26	-8	85
24	1 Greencastle Pier Road	93	175	-25	68
25	24 Benagh Road	93	192	-26	67
26	49 Benagh Road	93	311	-30	63
27	44 Benagh Road	93	397	-32	61
28	18 Grange Road	93	332	-30	63
29	19 a Fair Road	93	315	-30	63

Table 11.10 above illustrates that there is potential for worst-case construction noise levels of >90 dB(A) at numerous properties in the vicinity of the proposed development if measures are not put in place to control construction noise levels. It must be borne in mind that the above predicted noise levels are very much worst-case scenario and assume all activities are taking place simultaneously at the nearest point of the construction phase boundary to the relevant residential receptor. It is clear from these predictions that there will be a requirement for extensive mitigation measures to reduce noise levels from construction activities to the lowest possible levels. Mitigation measures aimed at reducing construction noise levels are outlined in Section 11.5.

11.4.2 Construction Phase - Republic of Ireland

The construction phase on the Republic of Ireland side of the proposed ferry crossing will involve only one aspect, namely the construction of the ferry terminal at Greenore. There will be no road widening construction activities on this side of the proposed ferry crossing. The construction phase is outlined in detail in Chapter 3 Project Description of the ES/EIS.

There will be a requirement for the demolition of a number of structures on the Greenore side of the proposed development. The key structures that will be constructed as part of the ferry terminal at Greenore will be:

- a concrete slipway bounded on three sides by a sheet piled wall;
- Approximately 7 tubular piles driven into the seabed on the southern side of the slipway with fenders mounted vertically on the berthing side;
- a portacabin for ticket sales and containing a toilet;
- a hardstanding area for off road queuing;

The construction activities at the ferry terminal site will last approximately 6 months as outlined in Chapter 3. The activities taking place at the site during this 6 month period will vary in terms of numbers of vehicles/plant operational at any one time, types of activities taking place and areas of work. Therefore, the noise levels emitted from the site will vary constantly.

Construction activity for the proposed development will generally operate between the hours of 08:00 and 18:00 on Monday to Fridays, between 08:00 and 13:00 on Saturdays and there will be no activity on Sundays or Bank Holidays.

In order to complete a worst-case noise impact assessment of the programme above, it is necessary to determine what the noisiest stages of the construction phase will be. The simplest and most robust means of ensuring a worst-case scenario is assessed is to assume all items of plant/equipment are active at the same time. To ensure the most conservative approach, the assessment will also assume that all items of plant/equipment are active at the nearest boundary of the proposed development site to the relevant noise sensitive receptor.

Table 11.13 contains typical noise levels from various construction plant that will be used during the construction phase. Table 11.14 contains typical combined construction noise levels for various construction phase activities as outlined in Section 4. This table also includes a combined noise level representing all activities being operational at the same location at the same time. This will be used for the purposes of the worst-case noise assessment of the proposed works.

Table 11.13: Noise Levels from Construction Plant (Ref: BS5228:2009)

Activity / Plant (Reference from Annex C & D, BS5228:2009)	Power Rating (kW)	Equipment Size, Weight (Mass), Capacity	Activity Equivalent Continuous Sound Pressure Level L_{Aeq} at 10m (dB)
Demolition: Breaking up concrete - pulverizer mounted on excavator (C1 - Ref 3)			80
Demolition: Dumping brick rubble - tracked excavator loading dump truck (C1 - Ref10)	228	44t	85
Clearing Site: Dozer (C2 - Ref 1)	142	20t	75
Clearing Site: Tracked excavator (C2 - Ref 3)	102	22t	78
Clearing Site: Wheeled backhoe loader (C2 - Ref 8)	62	8t	68
Distribution of Material: Dump Truck (tipping fill) (C2 - Ref 30)	306	29t	79
Distribution of Material: Dump Truck (empty) (C2 - Ref 30)	306	29t	87
Rolling & Compaction: Roller (C2 - Ref 38)	145	18t	73
Piling: Sheet Steel Piling - Vibratory (C3 - Ref 8)		52t, 14m length	88
Tubular Steel Casting / pile cast in place (D4, Ref 19)	4t 1m drop		87
Pumping Water: Water pump (C2 - Ref 45)	20	6 in	65
General: Road Sweeper (C4 Ref - 90)	70		76

Table 11.14: Combined Noise Levels from Various Construction Activities (Ref: BS5228:2009)

Activity	L_{Aeq} @ 10 m	L_{Aeq} @ 40 m	L_{Aeq} @ 80 m	L_{Aeq} @ 160 m	L_{Aeq} @ 320 m
Demolition	86	74	68	62	56
Clearing Site	80	68	62	56	50
Distribution of Materials	88	76	70	64	58
Rolling & Compaction	73	61	55	49	43
Piling	91	79	73	67	61
Pumping Water	65	53	47	41	35
Road Sweeping	76	64	58	52	46
Combined Total for All Activities	**94**	**82**	**76**	**70**	**64**

Based on the overall combined worst-case noise level from the proposed development site (i.e. 94dB[A] at 10m as per Table 11.14), noise predictions have been undertaken to determine the worst-case predicted noise levels from the proposed development at a range of the nearest noise sensitive receptors. Table 11.15 includes all worst-case predicted noise levels based on the distance from the nearest portion of the proposed site boundary to the relevant noise sensitive receptor. In order to ensure a worst-case scenario is assessed, distance attenuation has been predicted in Table 11.15 on the basis of hard ground attenuation between the source and receiver (i.e. it assumes ground surface reflects noise and no absorption takes place).

Table 11.15: Worst-Case Predicted Noise Levels from Construction Plant at Nearest Noise Sensitive Properties

Nearest Sensitive Receptor (See Fig 11.1)		Worst-Case L_{Aeq} @ 10m (dBA)	Distance from Construction Boundary (m)	Distance Attenuation (dBA)	Predicted Worst-Case Construction Noise (dBA)
30	Euston Street	94	180	-25	69
31	Euston Street	94	210	-26	68
32	Euston Street	94	240	-28	66
33	Andlesey Terrace	94	260	-28	66
34	Andlesey Terrace	94	277	-29	65
35	Euston Street	94	245	-28	66
36	Euston Street	94	206	-26	68
37	Euston Street	94	284	-29	65
38	Euston Street	94	288	-29	65
39	Andlesey Terrace	94	334	-30	64
40	Mourne View, Euston Street	94	299	-30	64
41	Sea View, Euston Street	94	347	-31	63
42	Four Winds, R175	94	425	-33	61
43	The Pines, R175	94	479	-34	60
44	Greenore Golf Club	94	441	-33	61

Table 11.15 above illustrates that there is potential for worst-case construction noise levels of in the high 60s dB(A) at numerous properties if measures are not put in place to control construction noise levels on the Greenore side of the proposed development. It must be borne in mind that the above predicted noise levels are very much worst-case scenario and assume all activities are taking place simultaneously at the nearest point of the construction phase boundary to the relevant residential receptor.

The worst-case predicted noise levels in Table11.15 are all just within the maximum permissible construction noise levels outlined in Table 11.3. However, all possible measure for reducing noise levels associated with these construction activities should be applied where feasible. Mitigation measures aimed at reducing construction noise levels are outlined in Section 11.5.

11.4.3 Operational Phase - Road Traffic Noise Assessment

In order to determine the potential for road traffic noise impacts associated with the operation of the proposed ferry crossing, an assessment of traffic flows on both sides of the ferry crossing was undertaken. Road traffic flows (18hr and 24-hour annual average daily traffic [AADT] flows), percentage heavy goods vehicles (%HGV) and road design speeds were retrieved from the traffic consultants in order to undertake the road traffic noise assessment. The road traffic noise assessment for all relevant roads in the study area is presented below under separate heading for the two jurisdictions.

In terms of interpreting the associated between road traffic flows and road traffic noise, it takes an increase in road traffic flows of 25% to result in a 1dB(A) increase in road traffic noise (Ref: UK Design Manual for Roads and Bridges [DMRB], Volume 11, Section 3, Part 7). It is also generally accepted that it takes an approximate 3dB(A) increase in noise levels for the average person to perceive a change in noise levels (Ref: UK Planning Policy Guidance Note 24 [PPG24] - Planning & Noise).

Northern Ireland

Table 11.16 presents the road traffic noise increases on all relevant roads in the study area in Northern Ireland. The table illustrates the percentage increase in road traffic levels along these routes and the equivalent noise level increase associated with such an increase in traffic levels.

Table 11.16: Traffic Noise Level Increases as a Result of the Proposed Development - Northern Ireland

Road	Year of Opening (2015)		Year of Opening + 15 Years (2030)	
	% Increase in Traffic as a result of Proposed Development	Increase in Noise Levels as a Result of Proposed Development - dB(A)	% Increase in Traffic as a result of Proposed Development	Increase in Noise Levels as a Result of Proposed Development - dB(A)
Killowen Road	3%	<1dB	2%	<1dB
Newry Road	<1%	<1dB	<1%	<1dB
Benagh Road (Newry Rd to Lurganconary Rd 1)	9%	<1dB	7%	<1dB
Benagh Road (Newry Rd to Lurganconary Rd 2)	10%	<1dB	8%	<1dB
Benagh Road (from Greencastle Pier Rd)	4%	<1dB	4%	<1dB
Lurganconary Road	13%	<1dB	12%	<1dB
Greencastle Pier Road - to site access	103%	+2.8dB	88%	+2.7dB
Greencastle Pier Road - after site access	No change	0dB	No change	0dB

The traffic noise increases on all roads other than Greencastle Pier Road between Benagh Road and the site access are less than 1dB(A) and will be imperceptible to sensitive receptors adjacent to these routes. The Greencastle Pier Road between Benagh Road and the proposed site access will experience an increase in traffic noise levels of 2.8dB in 2015 and 2.7dB in 2030. This noise level increase must be considered in the context that the existing traffic flows are very low on this road and the proposed development will approximately double the traffic flows along the road. While this increase in noise levels will be perceived by people along this road, the noise levels from traffic flow will still be considerably lower the design speed outlined in the Noise Insulation regulations (NI) 1995 for new roads in Northern Ireland (i.e. 69dB $L_{A10\ 18hr}$).

Republic of Ireland

Table 11.17 presents the road traffic noise increases on all relevant roads in the study area in the Republic of Ireland. The table illustrates the percentage increase in road traffic levels along these routes and the equivalent noise level increase associated with such an increase in traffic levels.

Table 11.17: Traffic Noise Level Increases as a Result of the Proposed Development - Republic of Ireland

Road	Year of Opening (2015)		Year of Opening + 15 Years (2030)	
	% Increase in Traffic as a result of Proposed Development	Increase in Noise Levels as a Result of Proposed Development - dB(A)	% Increase in Traffic as a result of Proposed Development	Increase in Noise Levels as a Result of Proposed Development - dB(A)
R175 from Grange	9%	<1dB	8%	<1dB
R176 to Carlingford	9%	<1dB	8%	<1dB
R175 (R176 to Euston Street 1)	43%	+1.6dB	37%	+1.4dB
R175 (R176 to Euston Street 2)	43%	+1.6dB	36%	+1.3dB
Euston Street	16%	<1dB	13%	<1dB
R175 (Euston Street to Site Entrance)	78%	+2.5dB	67%	+2.2dB
R175 (Site Entrance to Greenore Port)	No Change	0dB	No Change	0dB

Table 11.17 illustrates that traffic noise level increases of greater than 1dB will only be experienced on the R175 road between the junction with the R176 and the proposed site access. The traffic noise level increase along the section of the R175 from the junction with the R176 to the junction with Euston Street (i.e. maximum increase of 1.6dB in 2015) will not be perceived by the majority of people. The traffic noise level increase on the R175 between the Euston Street junction and the proposed site entrance (i.e. 2.5dB in 2015) may be perceived by some of the people that live adjacent to this road.

This noise level increases outlined above must be considered in the context that the existing traffic flows are very low on this road. While this increase in noise levels may be perceived by some people adjacent to this road, the noise levels from traffic flows will still be considerably lower the design speed outlined in the NRA *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* (2004) for new roads in Ireland (i.e. 60dB L_{den}).

11.4.4 Operational Phase - Ferry Noise Impact

It is not know what make or model of ferry boat will be used for the proposed ferry crossing at this stage. On account of the significant variation in noise emitted by ferry boats of different types and sizes, it is difficult to present an accurate assessment of operational phase noise associated with the proposed development. The approach taken in this assessment has been to define a relatively noisy ferry boat activity which then can be used as a reference point for the assessment the known ferry boat when this has been defined at the detailed design stage.

The major source of noise from ferries operating at full power is from engine noise and water propulsion (or wake noise). There is limited information available in standard sources relating to the noise level produced by ferries during standard activities. A literature search completed for the purposes of this assessment revealed a noise report completed in relation to a proposed development in Glen Cove Ferry Terminal and Boat Basin in the City of Glen Cover, New York. This noise report contains detailed noise measurement survey results relating to ferry arrivals and departures at the existing terminal.

A reference measurement based on a ferry arrival, idling and departure sequence lasting approximately 5 minutes was taken and used in this report for the purposes of the assessment of the proposed changes to the existing terminal. This reference measurement was an L_{Aeq} of 76.3 dB at a distance of 55ft (i.e. 16m) over approximately 5 minutes. Using this as an approximate reference, this assessment will use a reference noise level (L_{Aeq}) of 80dB at 10m for a period of 5 minutes to equate to a standard arrival, idle and departure at both Greenore and Greencastle terminal sites. This equates to an L_{Aeq} of 67dB at 10m over a period of one hour.

In order to assess the potential for noise impacts associated with the proposed development, the methodology outlined in BS4142:1997 has been used (See section 11.2). This methodology allows for the noise from the proposed source to be assess in reference to the background noise level (i.e. L_{A90}) at the nearest noise sensitive receptors. If the noise from the proposed source (i.e. the specific noise level) is 10dB above the background noise level at the noise sensitive receptor, the assessment methodology would indicate that complaints are likely. A difference of 5dB above the background noise level would indicate that results of the assessment are marginal. An additional 5dB penalty is applied to any noise source which has tonal characteristics, which is applied in this instance on account of the ferry engine noise.

The BS4142:1997 assessment has been completed for daytime hours only as all ferry crossing will take place during daytime hours only (i.e. 07:00 - 23:00).

Northern Ireland

The two nearest receptors on the Greencastle side of the proposed ferry terminal will be the properties on either side of the proposed terminal site, 80 and 88 Greencastle Pier Road (i.e. prediction locations 10 and 9 in Figure 11.1). 80 Greencastle Pier Road is approximately 174m from the nearest landing point of the proposed ferry slipway while 88 Greencastle Pier Road is approximately 105m away.

Using the reference noise level of 67dB(A) $L_{Aeq\ 1hr}$ as discussed above and applying distance attenuation in accordance with hard ground propagation (i.e. worst-case, see equation F1, Annex F, BS5228:2009), the predicted noise level at 80 and 88 Greencastle Pier Road is 42dB and 47dB respectively. If we apply a 5dB penalty, this will be 47dB and 52dB respectively. As the daytime recorded background noise levels (i.e. L_{A90}) at each of these properties is 35dB and 36.1dB respectively (see Table 11.7), the specific noise level is 12dB and 16dB above the background noise level in each, which is likely to result in complaint.

While the specific details of the proposed ferry is not known at this stage, the above assessment using a reference ferry noise level illustrates that there is potential for noise impacts from the ferry operation at the nearest receptors on the Greencastle side of the proposed development. Mitigation measures are discussed in Section 11.5 with a view to addressing the potential noise impacts associated with the proposed ferry activities on the Greencastle side of the ferry crossing.

Republic of Ireland

The nearest receptor on the Greenore side of the proposed ferry slipway is prediction location 30 as included in Figure 11.1, which is approximately 230m from the proposed ferry slipway. Using the same reference noise level and distance attenuation parameters as discussed above, the predicted noise level at this location will be 40dB, or 45dB if we assume the 5dB penalty for tonal noise. The background noise level (i.e. L_{A90}) recorded at this location was 40.4dB(A), which gives a marginal result to this assessment.

The above assessment would indicate that using the reference measurements for a ferry as described in this report, there will be a marginal likelihood of complaint associated with the proposed ferry crossings. Mitigation measures are discussed in Section 11.5 which also apply to the Greenore side of the ferry crossing.

11.4.5 Vibration

There is potential for vibration impacts during the construction phase on account of the proximity of general construction activities to some of the nearest sensitive receptors (especially 80, 88 & 90 Greencastle Pier Road) and on account of the fact the piling will be required as part of the construction works. The potential for vibration impacts on the Republic of Ireland side is limited as the nearest sensitive receptor is approximately 200m from any construction or piling activities.

Section 11.2.4 outlines permissible vibration levels below which there is no likelihood of structural damage from vibration levels associated with the construction of the proposed development. During the detailed

design stage, it will be necessary to consider the potential vibration impact associated with the construction phase activities at the nearest sensitive receptors. This will incorporate two separate aspects, namely:

- the completion of a detailed Construction Environmental Management Plan (CEMP) controlling the use of specific vibration generating plant in the vicinity of the site boundary closest to the nearest sensitive receptors;
- the completion of test piles to determine if the piling activities associated with the construction phase will result in any significant vibration impact at the nearest noise sensitive receptors.

While the above measures are most relevant to the Northern Ireland side of the proposed development, they should be considered on both sides of the development until it is clear as part of the detailed design work that there will be no vibration impact at the nearest sensitive receptors.

11.5 Mitigation Measures

11.5.1 Construction Phase

Construction activity for the proposed development will generally operate between the hours of 08:00 and 18:00 on Monday to Fridays, between 08:00 and 13:00 on Saturdays and there will be no activity on Sundays or Bank Holidays.

As outlined in Section 11.4.1, there is potential for significant construction phase noise impacts at the nearest sensitive properties on the Greencastle side of the proposed development. The worst-case predictions of construction noise illustrates that there is potential for construction noise levels in excess of 90dB(A) at numerous properties as a result of the construction phase activities if mitigation measures are not put in place. While noise levels of greater than 90dB(A) are likely to be experienced for only a short period of time in the worst-case scenario, it is necessary for mitigation measures to be put in place to reduce worst-case construction noise to as low a level as feasible.

The worst-case construction phase noise impacts on the Greenore side of the proposed development are outlined in Section 11.4.2. As presented in Table 11.15, there is potential for worst-case noise levels in the high 60s dB(A) at the nearest noise sensitive properties. While these predicted noise levels are not as severe as those predicted on the Greencastle side of the proposed development, there will still be a requirement for mitigation measures to reduce these worst-case construction noise levels to the lowest possible level.

On the Greencastle side of the proposed development, a temporary noise barrier (approximately 3m height) must be placed on the site boundary on all three land-based boundaries of the proposed site. If properly installed, such a barrier can achieve between 10-15dB(A) attenuation. In addition to this, a detailed Construction Environmental Management Plan (CEMP) should be prepared prior to the construction phase outlining all measures undertaken to reduce construction noise levels emanating from the proposed site. This plan should detail a range of measures aimed at controlling construction activities at the boundary of the site adjacent to the nearest noise sensitive properties and additional general measures aimed at reducing noise levels from the proposed site (see below).

On the Greenore side of the proposed development, a 3m temporary noise barrier should be placed along the southern boundary of the proposed development site. The CEMP Plan mentioned above should also include all measures proposed to reduce the noise levels at the nearest noise sensitive receptors to the proposed development in Greenore.

British Standard *BS5228:2009 – Noise and vibration control on construction and open sites* outlines a range of measures that can be used to reduce the impact of construction phase noise on the nearest noise sensitive receptors. These are best practice measures and examples of some of these measures are included below:

- ensuring that mechanical plant and equipment used for the purpose of the works are fitted with effective exhaust silencers and are maintained in good working order;

- careful selection of quiet plant and machinery to undertake the required work where available;

- all major compressors should be ‘sound reduced’ models fitted with properly lined and sealed acoustic covers which should be kept closed whenever the machines are in use;

- any ancillary pneumatic percussive tools should be fitted with mufflers or silencers of the type recommended by the manufacturers;

- machines in intermittent use should be shut down in the intervening periods between work;

- ancillary plant such as generators, compressors and pumps should be placed behind existing physical barriers, and the direction of noise emissions from plant including exhausts or engines should be placed away from sensitive locations, in order to cause minimum noise disturbance. Where possible, in potentially sensitive areas, acoustic barriers of enclosures should be utilised around noisy plant and equipment.

- Handling of all materials should take place in a manner which minimises noise emissions;

- Audible warning systems should be switched to the minimum setting required by the Health & Safety Executive or the Health & Safety Authority;

- The Contractor should adhere to the codes and practices for minimising noise emissions from construction and piling works, including those provided in BS5228:2009.

In order to minimise the likelihood of complaints, Newry and Mourne District Council, Louth County Council and affected residents should be kept informed of the works to be carried out and of any proposals for work outside normal hours. A complaints procedure should be operated by the Contractor throughout the construction phase, as part of the CEMP.

It is recommended that on-site monitoring of noise levels and construction activities be undertaken in order to verify the predicted worst-case noise levels and also to ensure that all available and appropriate measures are implemented to minimise the potential impact upon local sensitive receptors. This is especially required for the nearest noise sensitive receptors on the Greencastle side of the proposed development.

11.5.2 Operational Phase

Section 11.4.4 includes an assessment of ferry noise from the proposed development in accordance with British Standard BS4142:1997, which aims to determine the likelihood of complaint associated with a noise source by comparing the noise produced by the plant/activity with the background noise level (i.e. L_{A90}) at the nearest noise sensitive properties.

As it is difficult to determine an appropriate reference noise level from the proposed development on account of the make and model of ferry has not been defined, the assessment was competed using a standard reference noise level from a typical ferry. The assessment concluded the there is potential for noise impacts and complaint at the nearest noise sensitive receptors on the Greencastle side of the proposed ferry crossing. The likelihood of complaint is marginal on the Greenore side of the ferry crossing.

Whenever the make and model of ferry boat is known, a detailed noise assessment must be completed on this specific model and compared against the reference noise assessment included in this assessment. The requirement for mitigation measures will depend on the actual ferry boat used and the specific noise specification for this boat. If the ferry boat has a lower noise specification than the reference used in this assessment, a detailed noise assessment may illustrate that no further noise mitigation measures will be required at the nearest noise sensitive receptors at Greencastle or Greenore.

If the noise specification is similar or greater than the reference noise level used in this assessment, there will be a requirement for mitigation measures at Greencastle and possibly Greenore. The exact specification for any noise mitigation measures will depend on the outcome of the detailed noise assessment of the ferry boat noise specification to be used in the ferry crossing. At Greencastle, the most obvious mitigation measure would be to erect noise barriers at the side and sea boundary at the nearest receptors.

Great care should go into the choice of ferry and noise performance should be considered as a critical element to the selection of the proposed ferry boat. The reduction of noise at source (i.e. the noise from the ferry boat) is the easiest means of reducing the noise impact at the nearest noise sensitive properties.

11.5.3 Vibration

There will be a requirement for piling as part of the construction activities for the proposed development and this will be the case on both sides of the proposed ferry crossing. During the detailed design stage or as part of the initial on-site construction stage, a test pile survey and assessment must be completed to ensure that there will be no significant vibration impact from the proposed piling at the nearest vibration sensitive properties.

Any such assessment will include the requirement to undertake pile testing to determine the likely transmission of vibration levels to the nearest sensitive properties. The detailed requirements for pile testing must be included in the CEMP completed for the construction phase activities. This document will outline detailed procedures for undertaking the work, assign responsibility for the work and will outline detailed procedures for notification of local residents and dealing with complaints. The plan will also include for detailed vibration monitoring to be undertaken during any such work.

The intention throughout any construction programme should be to minimise the effects of site vibration whilst having due regard to the practicability and economic implications of any proposed control or mitigation measures. Excessive vibration levels can be avoided by giving careful consideration to the design of the proposed project, the processes and equipment implied by the design and the phasing of operations.

Elements of the works preparation that may contribute to reducing the vibration impact include:

- Arranging the project design such that the number of operations likely to be particularly disturbing is kept to a minimum;
- When a number of site operators will be working on one site, overall site operations should be coordinated with access traffic being routes placed away from sensitive receptors;
- The most appropriate plant must be selected in order that limits are not exceeded. The contractor must be aware of the extent of control measures that will be necessary so that appropriate cost allowances can be made;

In terms of control of vibration, the most general means of control are substituting plant with less intrusive plant and relocating or isolating stationary plant using resilient mountings. Other potential solutions to control vibration include the provision of cut-off trenches, the reduction of energy to the machine generating the vibration and excavations under support fluid.

11.6 Residual Impact

There is the potential for significant noise impacts during the construction phase of the proposed development. Mitigation measures are included in this report to reduce this impact to the lowest possible levels.

During the operation of the proposed development, the increase in traffic noise will be insignificant and the majority of roads in the study area. There may be a noticeable increase in traffic noise along a number of roads (most notably Greencastle Pier Road and the R175) but the overall traffic noise level will still be low and well below the relevant noise thresholds.

The operation of the proposed ferry will introduce a regular (albeit short) noise source at noise sensitive receptors in the vicinity of the two proposed terminal points, however if the appropriate mitigation measures are in place, this impact will be minor and will become part of the ambient noise environment.