11 Noise and Vibration

11.1 Introduction

This chapter of the EIS assesses the noise and vibration impact of the proposed M7 Osberstown Interchange and R407 Sallins Bypass Scheme. The assessment has been undertaken in accordance with the relevant guidelines and standards relating to environmental noise and vibration and those specifically dealing with road traffic in Ireland. The chapter sets out the methodology to be followed (Section 11.2), describes the existing environment (Section 11.3), reviews predicted impacts (Section 11.4), sets out mitigation measures proposed (Section 11.5) and describes anticipated residual impacts (Section 11.6).

11.2 Methodology

11.2.1 Baseline Environment

The first stage is to assess and quantify the existing noise environment in the vicinity of sensitive receptors that may be affected by the proposed road development. In the case of a road scheme, the selected noise sensitive receptors assessed are those likely to be affected by the construction and operational phase of the scheme.

11.2.2 Assessment Criteria

The impact of the proposed scheme is determined through prediction of future noise levels associated with the scheme using established calculation techniques. Road traffic noise levels have been assessed in accordance with the National Roads Authority's (NRA) guidance document *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* (2004 Noise Document) 2004. The calculation methodology used in this instance is the UK's Department of Transport *Calculation of Road Traffic Noise* (CRTN) 1988.

Construction impacts have been assessed in accordance with the NRA's 2004 Noise Document. Indicative construction noise calculations have been undertaken using the methodology set out in BS 5228 *Code of Practice for noise and vibration control of construction and open sites* - Part 1: Noise 2009.

11.2.2.1 Operational Phase

For new roads in Ireland, the most commonly applied standard is that issued by the NRA within the 2004 Noise Document. This document specifies that it is considered appropriate to set the design goal for new national road schemes in Ireland as a day-evening-night value of 60dB $L_{den.}$ This is a free field façade criterion, i.e. does not take account of reflections from building facades.

This criterion applies to new national roads and sets the following criteria with respect to determining when mitigation measures are deemed necessary. The following three conditions must be satisfied under the NRA guidelines in order for noise mitigation to be provided:

a) The combined expected maximum traffic noise level, i.e. the relevant noise level, from the proposed road scheme together with other traffic in the vicinity is greater than the design goal of 60dB L_{den}.

b) The relevant noise level is at least 1dB more than the expected traffic noise level without the proposed road scheme in place.

c) The contribution to the increase in the relevant noise level from the proposed road scheme is at least 1dB.

The proposed scheme under consideration here comprises elements of a national road (i.e. The M7 Osberstown Interchange) in addition to a new regional road (R407 Sallins Bypass, Side Roads and Link Roads). In this instance, given the nature of the works, i.e. the development of a new road in greenfield land in additional to an interchange on a national road, it is considered appropriate to use the design goal set out in the NRA guidelines for the assessment of noise impacts of the proposed scheme.

These conditions will ensure that mitigation measures arising out of this process are based upon the degree of impact of the proposed scheme under consideration. It should be noted that the design Goal is applicable to new road schemes only. In addition, the design goal is applied to existing receptors in respect of both the year of opening and the design year, typically 15 years after projected year of opening. In the case of this proposed scheme a commencement year of 2015 and a future design year of 2030 have been assessed.

11.2.2.2 Construction Phase

The NRA guidance document specifies noise levels that it typically deems acceptable in terms of construction noise. These limits are set out in Table 11.1.

Table 11.1: Maximum Permissible Noise Levels at the Façade of Nearby Dwellings during Construction

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

Note 1: Construction activity at these times, other than that required in respect of emergency works, will normally require the explicit permission of the relevant authority.

It should be noted that the noise criteria quoted in the table above are specific to construction activities only (i.e. these levels are not cumulative with the existing noise environment from road traffic and other surrounding sources).

11.3 Existing Environment

In accordance with the guidelines set out in the NRA 2004 Noise Document, the baseline noise environment is characterised along the length of the proposed scheme in order to provide a context of the range of noise levels and the main contributors to the existing noise levels at the closest noise sensitive locations.

A series of baseline noise surveys were undertaken at selected residential properties along the length of the proposed scheme. Attended noise levels were measured at a total of 11 locations, 2 locations were also selected as unattended monitoring positions.

11.3.1 Survey Periods

Attended measurements were conducted at a total of 11 locations between 10:00hrs to 17:10hrs on 20 June 2013. Unattended measurements were conducted at two locations over the course of the following periods:

- Location S02-a (see **Figure 11.1 V3**): 12:20hrs on 9 July to 12:25 on 10 July 2013.
- Location S02-f (see **Figure 11.1 V3**): 13:08hrs on 9 July and 13:08 on 10 July 2013.

11.3.2 Measurement Locations

The measurement location coordinates and location descriptions are presented in Table 11.2 and illustrated in **Figure 11.1 V3**.

Table 11.2: Description of Noise Survey Positions

Survey Location	Survey Area	Coordinates	
		Easting	Northing
S01-a	Side garden of property along Osberstown Road (North of Mill Road Lane)	288,585	221,829
S01-b	Rear garden of property along Osberstown Road (North of Mill Road Lane)	288,504	222,095
S01-c	Entrance gate of property along Canal Road, close to railway overbridge	288,395	222,225
S01-d	Entrance gate of property along Osberstown Road	288,310	222,107
S01-e	Front garden of property along Osberstown Road.	288,099	221,930
S01-f	Entrance gate of property along Osberstown Road	287,697	221,663
S02-a	Rear garden of property within Castlesize Drive	288,675	223,278
S02-b	Green area to front of properties within Castlesize Park Road	288,475	223,514
S02-c	Front garden of Easkey House - Clane Road	288,784	224,322
S02-d	Entrance gate of property along Grand Canal	288,770	223,109
S02-e	Front garden of property within Millbank estate, Sallins	287,992	222,581
S02-f	Osberstown House – balcony of second floor – garden side.	288,066	221,725

11.3.3 Instrumentation and Procedure

The shortened measurements were performed using Brüel & Kjær Type 2260 Sound Level Meters.

The continuous measurements were performed using Larson Davis 812 and 824 Sound Level Meters. Before and after the survey the measurement apparatus was check calibrated using a Brüel & Kjær Type 4231 Sound Level Calibrator.

11.3.3.1 Unattended Noise Measurements

Unattended continuous measurements were performed over a 24-hour period at two locations. Sample periods were 1-hour long and the results were saved to the instrument memory for later analysis. L_{den} values are derived directly from the measured L_{Aeq} data using the following equation:

$$L_{den} = 10 \times \log_{10} (12 \times 10^{Lday/10} + 4 \times 10^{(5+Levening)/10} + 8 \times 10^{(10+Lnight)/10}) \text{ dB (A)} \quad \text{(Eq.1)}$$

11.3.3.2 Attended Noise Measurements (Derived Value)

Shortened measurements were conducted at 11 survey locations surrounding each unattended 24 hour location. Surveys were conducted on a cyclical basis with sample periods of 15 minutes. The results were noted onto a Survey Record Sheet immediately following each sample, and were also saved to the instrument memory for later analysis where appropriate. Survey personnel noted all primary noise sources contributing to noise build-up. The survey work was conducted in accordance with the shortened measurement procedure as laid down in the NRA guidance document.

When surveying traffic noise, the acoustical parameters of interest are $L_{A10\,(T)}$ and $L_{A10\,(18hour)}$, which are expressed in terms of decibels (dB) relative to 2×10^{-5}Pa. The value of $L_{A10\,(T)}$ is the noise level exceeded for just 10% of the time over the assessment period $L_{A10\,(18hour)}$ is the arithmetic average of the values of $L_{A10\,(T)}$ for each of the one hour periods between 06:00 and 24:00hrs.

The shortened measurement procedure involves a method whereby $L_{A10\,(18hour)}$ values are obtained through a combination of measurement and calculation as follows:

- Noise level measurements are undertaken at the chosen location over three consecutive hours between 10:00 and 17:00hrs.
- The duration of the sample period during each hour is selected to encompass sufficient traffic flows to ensure reliable results.
- The $L_{A10\,(18hour)}$ for the location is derived by subtracting 1dB from the arithmetic average of the three hourly sample values, i.e.:

$$L_{A10(18hour)} = ((\Sigma L_{A10(1hour)}) / 3) - 1 \text{ dB}. \quad \text{(Eq.2)}$$

The L_{den} for the location is then derived from the calculated $L_{A10(18hour)}$ value using the following equation:

$$L_{den} = 0.86\, L_{A10(18hour)} + 9.86 \text{ dB}. \quad \text{(Eq.3)}$$

11.3.4 Survey Results

Table 11.3 presents the results of the measured noise levels for each of the attended survey locations and the calculated L_{den} values for the unattended monitoring locations. Tables A11.1 to A11.2 in Appendix A11.1 V4 present the results of the unattended survey results at the 24 hour locations.

The results of the survey have indicated that baseline noise levels at all locations assessed are dominated by local passing traffic, traffic from the M7 Motorway, birdsong and occasional passing trains, where applicable.

Derived L_{den} values were calculated to be in the range of 47 to 62dB L_{den} with lower values being recorded within residential areas set back from local roads. The higher values were recorded at monitoring locations in close proximity to road edges. The range of noise levels is typical of the environment under assessment, i.e. a semi-rural environment in proximity to local roads.

Table 11.3: Results of Noise Surveys

Survey Location	Survey Time	Measured Noise Levels (dB re.2x10-5Pa)			dB L_{den}		Notes
		L_{Aeq}	L_{A10}	L_{A90}	Derived (attended)	Measured (unattended)	
S01-a	10:00 – 10:15	58	58	55	57	n/a	Distant traffic from M7 and local surrounding roads were the main source of noise. Birdsong also noted.
	11:08 – 11:23	55	56	51			
	12:15 – 12:30	53	55	50			
S01-b	10:25 – 10:40	47	49	43	51	n/a	Traffic along Osberstown Road main background source, bird song and faint leaf rustle, M7 Motorway audible in distance.
	11:35 – 11:48	48	50	39			
	12:34 – 12:49	46	48	39			
S01-c	10:47 – 11:02	61	56	50	57	n/a	Passing road traffic dominates at this measurement location, monitoring position c.10m from property façade. 1 no. train during first and second measurement.
	11:55 – 12:10	60	56	48			
	12:54 – 13:11	61	56	47			
S01-d	13:15 – 13:30	57	50	57	55	n/a	Traffic passing along Osberstown Road. Train passing during second measurement and aircraft and HGV passing during third measurement period.
	14:31- 14:46	57	55	41			
	16:13 – 16:28	58	57	41			
S01-e	13:37 – 13:52	50	53	42	56	n/a	Road traffic along Osberstown Road, distant traffic audible at low level from M7 Motorway. Dog barking during second measurement period.
	15:07- 15:42	54	56	45			
	16:32 – 16:47	53	56	47			
S01-f	14:11 – 14:26	64	61	43	62	n/a	Road traffic along Osberstown Road main noise source. Access gate of property opening and closing. HGV passing during third measurement.
	15:54 – 16:09	63	58	42			
	16:55 – 17:10	67	66	46			

Survey Location	Survey Time	Measured Noise Levels (dB re.2x10-5Pa)			dB L_{den}		Notes
		L_{Aeq}	L_{A10}	L_{A90}	Derived (attended)	Measured (unattended)	
S02-a	10:10 – 10:25	50	49	40	51	51[1]	Distant road traffic noise, birdsong, dogs barking. Dog barking during third measurement increased L_{Aeq} parameter.
	11:32 – 11:47	53	51	41			
	12:42 – 12:57	61	47	37			
S02-b	10:32 – 10:47	46	43	34	47	n/a	Birdsong, distant traffic, aircraft in distance.
	11:52 – 12:07	42	46	35			
	13:03 – 13:18	43	44	35			
S02-c	10:55 – 11:10	70	74	46	60[2]	n/a	First measurement made at entrance gate c.5mm from road. Remaining measurements made within garden set back from road. Traffic along Clane Road main noise source.
	12:16 – 12:31	56	59	46			
	13:22 – 13:37	56	59	46			
S02-d	14:21 – 14:36	57	57	39	56	n/a	Passing traffic, birdsong and distant traffic. Second measurement paused due to people talking near meter. Train x 1 passing during first measurement.
	15:09 – 15:24	60	55	40			
	16:01 – 16:16	56	52	38			
S02-e	14:41 – 14:56	43	45	38	50	n/a	Distant road traffic noise, birdsong, occasional estate activities.
	15:37 – 15:52	48	49	37			
	16:45 – 17:00	46	48	39			
S02-f						60[3]	Road traffic from M7 motorway main source. Other sources included bird song and leaf rustle.

Note 1: The L_{den} value at Location S02-a has excluded, where possible, outlier values in the monitored data which was noted to be due to barking dogs in the back garden.

Note 2: The derived L_{den} value at Location S02-c excludes the survey data measured during the first monitoring round measured adjacent to the road.

Note 3: The L_{den} value measured at Location S02-f was at c1.5m from the façade of the building on a balcony area. The measured value therefore is not free field

11.4 Predicted Impact on Noise and Vibration

11.4.1 Impact Assessment Construction Phase

11.4.1.1 Construction Plant

As per NRA guidance, noise levels associated with construction may be calculated in accordance with the methodology set out in BS 5228: Part 1. This standard sets out sound power levels for plant items normally encountered on construction sites, which in turn enables the prediction of noise levels at selected locations. The NRA guidance notes that definitive construction methods and number of plant items are not usually set out at the EIS stage and that the overriding requirement of the contractor will be to construct the proposed scheme to the final design with the constraints of the Construction Noise Criteria. These limits are set out in Table 11.1.

A variety of items of plant will be in use during the construction of the proposed scheme. These will include excavators, dump trucks, and generators in addition to general road surfacing and levelling equipment. In addition to the above, construction of overbridges, underbridges and the interchange will require structural works likely to involve piling, steel and concreting works. Reference to the soils and geology assessment confirms that rock removal (via breaking or blasting methods) is not likely to be required along the proposed scheme as there are no major excavations associated with the proposed road development in addition to the underlying rockhead being several meters below the overburden.

Due to the fact that the construction programme is not progressed to a detail level at this stage, it is not possible to calculate specific noise emissions to the local environment from different phases of works. However, the following tables present calculations of indicative noise levels for typical noise sources associated with road construction.

BS 5228: 2009 *Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1: Noise* sets out typical noise levels for items of construction plant. Tables 11.4 to 11.7 set out assumed plant items during the key phases of construction with the associated source reference from BS 5228. The closest properties to the existing road edge are typically between 50 and 100 m. A small number of properties are within 25 m of the proposed alignment (typically side and slip roads). Construction noise calculations have therefore been conducted at distances of 25 to 150 m from the works for each phase, representing the nearest properties to the works.

The calculations assume that plant items are operating for 66% of the time and that all plant items associated with the individual phases are operating simultaneously and at the same distance for any one scenario. Screening provided by site works, hoarding or boundary walls etc. have not been included in the calculated results.

Table 11.4: Indicative construction noise calculations during site preparation, and excavation works.

Site Clearance & Preparation	Calculated $L_{Aeq, T}$ at distance from road (m)			
	25 m	50 m	100 m	150 m
Wheeled loader (C2.26)	69	63	57	54
Tracked excavator (loading dump truck) (C1.10)	75	69	63	60
Dozer (C.2.10)	70	64	58	55
Dump Truck (C2.30)	69	63	57	54
Combined L_{Aeq} from all plant	78	72	66	62

Table 11.5: Indicative construction noise calculations during cut and fill works

Excavation and Fill Works	Calculated $L_{Aeq, T}$ at distance from road (m)			
	25 m	50 m	100 m	150 m
Tracked excavator (loading dump truck) (C1.10)	75	69	63	60
Articulated dump truck (dumping rubble) (C1.11)	70	64	58	55
Wheeled loader (C2.26)	69	63	57	54
Dozer C.2.10	70	64	58	55
Dump Truck Tipping fill (C2.30)	69	63	57	54
Combined L_{Aeq} from all plant	79	73	66	63

Table 11.6: Indicative construction noise calculations during road works

Road Works	Calculated $L_{Aeq, T}$ at distance from road (m)			
	25 m	50 m	100 m	150 m
Tracked excavator (C2.21)	61	55	49	46
Dump Truck (C2.30)	69	63	57	54
Vibration rollers (C5.20)	65	59	53	50
Asphalt Paver & Tipping Lorry (C.5.31)	67	61	55	52
Diesel Generator (C4.76)	51	45	39	36
Road Rollers (C5.19)	70	64	58	55
Combined L_{Aeq} from all plant	75	69	63	59

Table 11.7: Indicative construction noise calculations during structural works

Road Works	Calculated $L_{Aeq, T}$ at distance from road (m)			
	25 m	50 m	100 m	150 m
Crawler Mounted Rig (C3.22)	70	64	58	55
Tracked Excavator inserting metal cage, (C3.24)	64	58	52	49
Concrete Pump & Cement Mixer Truck (C4.24)	57	51	45	42
Diesel Generator (C4.76)	51	45	39	36
Angle Grinder (C4.93)	70	64	58	55
Combined L_{Aeq} from all plant	74	68	62	58

The results of the assessment has indicated that at distances of beyond 50 m from the works, the construction daytime noise limit of 70dB L_{Aeq} can typically be complied with for the scenarios assessed. At distances between 25 and 50 m from the works, the construction noise criteria has the potential to be exceeded, assuming the plant items assessed above. Note that these calculations are indicative only and are used for the purposes of comparison only with the adopted criteria and do not assume any mitigation measures. It will be a requirement of the works contractor to ensure that the various best practice working methods used to control noise and vibration are adopted during all works in order to comply with the relevant criteria. Further guidance is set out in Section 11.5.

11.4.1.2 Construction Traffic

Construction traffic volumes have been assessed along the main access routes to be used during the various work elements, in particular for the haulage of materials from quarry sites identified as part of the EIS. All works traffic will make use of existing roads namely the R407 Clane Road, the Western Distributor Road, Osberstown Road, the M7 Motorway and the existing M7 accommodation bridge initially.

The traffic assessment has determined the total number of haulage movements required over the duration of the proposed works and has calculated the typical daily movement along the identified roads. Traffic volumes for the following sections of work have been assessed, as set out in Chapter 4 *Description of Proposed Scheme*:

- Section 1: M7 Osberstown Interchange including the Distributor Link Road and the on (merge) and off (diverge) slip roads and auxiliary lanes from the M7 mainline.
- Section 2: R407 Sallins Bypass from motorway crossing (Ch. 0+000) to the railway crossing (Ch. 1+250), including the Osberstown Road realignment.
- Section 3: R407 Sallins Bypass from railway crossing (Ch. 1+250) to the Grand Canal crossing (Ch. 1+580).
- Section 4: R407 Sallins Bypass from Grand Canal crossing (Ch. 1+580) to the southern River Liffey crossing (Ch. 1+980) and including the construction of Sallins Link Road.

- Section 5: R407 Sallins Bypass from southern River Liffey crossing (Ch. 1+980) to northern River Liffey crossing (Ch. 3+050).
- Section 6: R407 Sallins Bypass from northern River Liffey crossing (Ch. 3+050) to existing R407 Clane Road (Ch. 3+650).

Table 11.8 presents a summary of the expected traffic volumes associated with each of these work sections and the additional traffic volumes expected along existing routes. The resultant increase in traffic noise has been calculated in accordance with the CRTN.

Table 11.8: Construction Traffic Noise Increase on Existing Routes

Section	Access Road	Existing AADT	Existing HGV's (AADT)	Additional HGV's (AADT)	Increase in traffic noise, dB(A)
1	M7 Mainline	56,400	6,204	221	0.1
Section 2 & 3	Western Distributor Road	10,900	545	106	0.5
Section 4, 5 & 6	R407 Clane Road	18,700	1,122	235	0.6

The expected increase in HGV traffic along the local road network is minor in comparison to the existing volume of traffic along the assessed routes. In terms of the contribution to noise levels, predicted noise levels are all below 1dB(A). An increase of this magnitude is not significant and will typically not be evident above the prevailing traffic noise environment.

11.4.2 Impact Assessment Operational Phase

Noise levels associated with the operational phase of the proposed scheme have been determined through the use of a 3D acoustic model in accordance with the calculation method set out in the NRA 2004 Noise Document. Details of the assessment procedure are set out in the following section.

11.4.2.1 Prediction of Traffic Noise Levels

A computer-based prediction model has been prepared in order to quantify the traffic noise level associated with the operational phase of the proposed scheme. This section discusses the methodology behind the noise modelling process and presents the results of the modelling exercise.

Brüel & Kjær Type 7810 Predictor

Proprietary noise calculation software was used for the purposes of this impact assessment. The selected software, Brüel & Kjær Type 7810 *Predictor*, calculates traffic noise levels in accordance with CRTN and NRA guidance.

Brüel & Kjær Type 7810 *Predictor* is a proprietary noise calculation package for computing noise levels in the vicinity of noise sources. Predictor predicts noise levels in different ways depending on the selected prediction standard. In general, however, the resultant noise level is calculated taking into account a range of factors affecting the propagation of sound, including:

- The magnitude of the noise source in terms of sound power or traffic flow and average velocity.
- The distance between the source and receiver.
- The presence of obstacles such as screens or barriers in the propagation path.
- The presence of reflecting surfaces.
- The hardness of the ground between the source and receiver.

Prediction of Traffic Noise

Noise emissions during the operational phase of the proposed scheme have been modelled using *Predictor* in accordance with CRTN and with the application of the relevant conversion factors as detailed in the NRA guidance. The CRTN method of predicting noise from a road scheme consists of the following five elements:

- Divide the road scheme into segments so that the variation of noise within this segment is small.
- Calculate the basic noise level at a reference distance of 10 metres from the nearside carriageway edge for each segment.
- Assess for each segment the noise level at the reception point taking into account distance attenuation and screening of the source line.
- Correct the noise level at the reception point to take account of site layout features including reflections from buildings and facades, and the size of source segment.
- Combine the contributions from all segments to give the predicted noise level at the receiver location for the whole road scheme.

Input to the Noise Model

The noise model was prepared using the following data:

- Ordnance Survey mapping, 3D topographical data and 3D alignment drawings of the proposed scheme supplied by the design team.
- Landscape mitigation berms as advised by the Landscape and Visual Consultants.
- Traffic flows, percentage HGV's and traffic speed data as supplied by the traffic consultants for the scheme.

Hourly noise predictions were conducted based on these traffic figures in accordance with Method A of the NRA guidelines. The hourly predictions were carried out using the diurnal traffic profiles provided in Appendix 1 of the NRA guidelines.

For the purpose of this assessment, traffic volumes in ADDT for a "medium growth" scenario for all years were used.

Output of the Noise Model

Predictor calculates noise levels for a set of receiver locations specified by the user. The results include an overall level in terms of the L_{den} parameter.

Model Calibration

The purpose of noise model calibration is to ensure that the software is correctly interpreting the input data and providing results that are valid for the scenario under consideration. It should be noted that the purpose of the model calibration is not to validate the prediction methodology in use as the CRTN prediction methodology has itself been previously validated.

The most appropriate mechanism for calibration would be to compare the output of a *Predictor* model scenario, using the AADT traffic flows for the existing road network in 2012, with the measured L_{den} value at the 24 hour survey locations S02-a, S02-f. The L_{den} values measured at these locations are directly taken from the full 24 hour profiles. The results of the calibration are presented in Table 11.9.

Table 11.9: Calibration Results

Location Reference	Measured L_{den} (dB)	Predicted L_{den} (dB)	Variation (dB)
S02-a	51	49	-2
S02-f	58[1]	59	-1

[1] A 2dB correction has been applied to this location to account for free field conditions.

The results of the calibration exercise have indicated that predicted noise levels at the two monitored locations are within 2dB of the measured noise levels. The model can be considered therefore to be interpreting the various input data correctly. It should be noted that calculated noise levels are based on the source of road traffic alone, whilst during baseline surveys, other surrounding factors contribute to the overall measured noise levels, namely dog barking, bird song (including early morning bird chorus, and leaf rustle). It should also be noted that on the survey date, the volume and speed of traffic is likely to vary compared to that used in the traffic noise predictions. Taking into account the above factors, the results of the calibration exercise confirms that the model is valid.

Choice of Receiver Locations

Free-field traffic noise levels have been predicted at 41 properties in the vicinity of the proposed and existing roads. For a small number of properties two receiver locations were assessed to evaluate noise levels at different exposed facades of the building. The coordinates of all locations are provided in Table 11.10. These receiver locations (Noise Assessment Locations) are detailed in **Figures 11.2 V3**.

Table 11.10: Noise Assessment Locations

Number	Location	Co-ordinates		Number	Location	Co-ordinates	
		Easting	Northing			Easting	Northing
1	Leinster Mills	288,692	221,605	20	Grand Canal	287,684	222,614
2	Obserstown Road	288,560	221,832	21	Sallins Wharf	288,702	222,799
3	Osberstown Road	288,716	221,940	22	Millbank	288,717	222,987
4	Osberstown Road	288,644	222,117	23	Millbank	288,761	223,083
5a	Osberstown Road	288,504	222,097	24	Millbank	288,770	223,113
5b	Osberstown Road	288,506	222,080	25	Millbank Crèche	288,817	223,111
6	Canal Road	288,397	222,233	26	Millbank	288,853	223,080
7	Canal Road	288,370	222,291	27	Millbank	288,896	223,101
8a	Osberstown Road	288,327	222,005	28	Millbank	288,908	223,099
8b	Osberstown Road	288,304	222,003	29	Millbank	288,968	223,082
9	Osberstown Road	288,092	221,928	31	Castlesize Drive	288,652	223,299
10a	Osberstown House (South East Facade)	288,060	221,712	32	Castlesize Drive	288,709	223,284
10b	Osberstown House (North East Facade)	288,065	221,748	33	Castlesize Drive	288,719	223,302
11	Osberstown Road Hill House	287,976	222,096	34	Castlesize Drive	288,613	223,336
12	Osberstown Road	287,833	221,860	35	Willow Grove	288,908	223,291
13	Osberstown Road	287,651	221,530	36	Main Street Sallins	289,131	222,820
14	Osberstown Road	287,611	221,500	37	Main Street Sallins - Link Road	289,163	223,095
15	Osberstown Road	287,563	221,138	38	Clane Road - South of Link Road	288,911	223,780
16	Osberstown Rd (West)	287,072	220,785	39	Easkey House - Clane Road	288,767	224,326
17	Osberstown Road (West)	287,017	220,668	40	Millbank Road - Off Clane Road	288,346	224,516
18	Grand Canal	288,293	222,569	41	Monread Road	289,262	221,846
19	Grand Canal	288,048	222,574				

11.4.2.2 Traffic Noise Predictions

Traffic noise predictions have been conducted for the operational phase of the proposed scheme for the proposed year of opening in 2015 and for the design year 2030. The following scenarios have been considered for each of the assessment years:

- Year 2015 – Do Minimum (DM), proposed scheme is not built. This scenario incorporates the M7 Naas to Newbridge By-Pass Upgrade Scheme.
- Year 2015 – Do Something (DS), M7 Osberstown Interchange, R407 Sallins Bypass, and associated side roads and link roads are developed.
- Year 2030 – DM (Incorporates M7 Naas to Newbridge By-Pass Upgrade Scheme).
- Year 2030 – DS (M7 Osberstown Interchange, R407 Sallins Bypass, and associated side roads and link roads are developed).

The results of the traffic noise predictions for the year 2015 are presented in Table 11.11. The results of the DS are then assessed and tabulated. Making reference to Section 11.3 of this document, the noise mitigation measures are only required whenever all three of the conditions specified by the NRA are satisfied. Table 11.11 compares the results of the assessment against each of the three requirements in order to determine the requirement for noise mitigation.

Table 11.11: Predicted Noise Levels for Opening Year 2015 for DM, and DS Scenario

Receiver Location Reference	Opening Year 2015		NRA Condition for Noise Mitigation Satisfied?			Mitigation Required?
	Predicted Noise Level					
	DM	DS				
	L_{den} (dB)	L_{den} (dB)	(a)	(b)	(c)	
R1	60	60	No	No	No	No
R2	61	62	Yes	Yes	Yes	Yes
R3	63	63	Yes	No	No	No
R4	59	60	No	Yes	Yes	No
R5a	59	59	No	Yes	Yes	No
R5b	59	61	Yes	Yes	Yes	Yes
R6	55	58	No	Yes	Yes	No
R7	53	58	No	Yes	Yes	No
R8b	57	61	Yes	Yes	Yes	Yes
R8a	57	59	No	Yes	Yes	No
R9	60	59	No	No	No	No
R10a	60	61	Yes	Yes	Yes	Yes
R10b	59	61	Yes	Yes	Yes	Yes
R11	55	56	No	Yes	Yes	No
R12	62	61	Yes	No	Yes	No

Receiver Location Reference	Opening Year 2015 Predicted Noise Level		NRA Condition for Noise Mitigation Satisfied?			Mitigation Required?
	DM	DS				
	L_{den} (dB)	L_{den} (dB)	(a)	(b)	(c)	
R13	59	59	No	No	No	No
R14	59	59	No	No	No	No
R15	63	63	Yes	No	No	No
R16	59	58	No	No	No	No
R17	60	60	No	No	No	No
R18	52	57	No	Yes	Yes	No
R19	51	57	No	Yes	Yes	No
R20	49	52	No	Yes	Yes	No
R21	49	52	No	Yes	Yes	No
R22	53	54	No	Yes	Yes	No
R23	49	52	No	Yes	Yes	No
R24	49	54	No	Yes	Yes	No
R25	48	56	No	Yes	Yes	No
R26	49	53	No	Yes	Yes	No
R27	49	56	No	Yes	Yes	No
R28	52	55	No	Yes	Yes	No
R29	55	57	No	Yes	Yes	No
R30	49	56	No	Yes	Yes	No
R31	48	55	No	Yes	Yes	No
R32	51	55	No	Yes	Yes	No
R33	51	53	No	Yes	Yes	No
R34	48	53	No	Yes	Yes	No
R35	51	53	No	Yes	Yes	No
R36	73	71	Yes	No	No	No
R37	65	64	Yes	No	No	No
R38	70	68	Yes	No	No	No
R39	57	60	No	Yes	Yes	No
R40	44	49	No	Yes	No	No
R41	64	63	Yes	No	No	No

2015 Do Something (DS) Scenario.

The results of the assessment indicate that during the 2015 DS Scenario, five locations, R2, R5b, R8b, R10a and R10b satisfy the requirement for noise mitigation.

At all other properties, predicted noise levels associated with the DS Scenario are either below 60dB L_{den} or are less than or equal to the DM Scenario and hence do not satisfy the requirements for noise mitigation.

The results of the traffic noise predictions for the design year 2030 are presented in Table 11.12.

Table 11.12: Predicted Noise Levels for Design Year 2030 for the DM and DS Scenarios

Receiver Location Reference	Design Year 2030		NRA Condition for Noise Mitigation Satisfied?			Mitigation Required?
	Predicted Noise Level					
	DM	DS				
	L_{den} (dB)	L_{den} (dB)	(a)	(b)	(c)	
R1	61	60	No	No	No	No
R2	62	63	Yes	Yes	Yes	Yes
R3	63	63	Yes	No	No	No
R4	60	61	Yes	Yes	Yes	Yes
R5a	60	61	Yes	Yes	Yes	Yes
R5b	60	61	Yes	Yes	Yes	Yes
R6	56	59	No	Yes	Yes	No
R7	54	59	No	Yes	Yes	No
R8a	58	62	Yes	Yes	Yes	Yes
R8b	57	59	No	Yes	Yes	No
R9	61	60	No	No	No	No
R10a	60	62	Yes	Yes	Yes	Yes
R10b	60	61	Yes	Yes	Yes	Yes
R11	56	57	No	Yes	Yes	No
R12	63	62	Yes	No	No	No
R13	60	60	No	No	No	No
R14	60	60	No	No	No	No
R15	64	64	Yes	No	No	No
R16	59	59	No	No	No	No
R17	61	61	Yes	No	No	No
R18	52	58	No	Yes	Yes	No
R19	51	57	No	Yes	Yes	No
R20	50	52	No	Yes	Yes	No
R21	50	52	No	Yes	Yes	No
R22	53	55	No	Yes	Yes	No
R23	50	53	No	Yes	Yes	No
R24	49	54	No	Yes	Yes	No
R25	48	56	No	Yes	Yes	No

Receiver Location Reference	Design Year 2030		NRA Condition for Noise Mitigation Satisfied?			Mitigation Required?
	Predicted Noise Level					
	DM	DS				
	L_{den} (dB)	L_{den} (dB)	(a)	(b)	(c)	
R26	49	53	No	Yes	Yes	No
R27	50	57	No	Yes	Yes	No
R28	53	55	No	Yes	Yes	No
R29	55	57	No	Yes	Yes	No
R30	50	57	No	Yes	Yes	No
R31	49	55	No	Yes	Yes	No
R32	51	56	No	Yes	Yes	No
R33	51	53	No	Yes	Yes	No
R34	49	54	No	Yes	Yes	No
R35	51	53	No	Yes	Yes	No
R36	74	71	Yes	No	No	No
R37	66	64	Yes	No	No	No
R38	70	68	Yes	No	No	No
R39	57	61	Yes	Yes	Yes	Yes
R40	45	50	No	Yes	No	No
R41	64	64	Yes	No	No	No

2030 DS Scenario

The results of the assessment indicate that during the 2030 DS Scenario, eight locations i.e. R2, R4, R5a, R5b, R8a, R10a, R10b, and R39 all satisfy the requirement for noise mitigation.

At all other properties, predicted noise levels associated with the DS Scenario are either below 60dB L_{den} or are lower than or equal to the DM Scenario and hence do not satisfy the requirements for noise mitigation.

11.5 Mitigation Measures

11.5.1 Construction Phase

The following section describes typical measures to minimise the potential for noise disturbance to the surrounding area which will be employed by the contractor to ensure the construction noise criteria are not exceeded.

The Contractor will take specific noise abatement measures and comply with the recommendations of BS 5228: Part 1 (2009) and the European Communities (*Noise Emission by Equipment for Use Outdoors*) Regulations, 2001.

BS 5228 includes guidance on several aspects of construction site practices, including, but not limited to:

- Selection of quiet plant.
- Control of noise sources.
- Screening.
- Hours of work.
- Liaison with the public.
- Monitoring.

Detailed comment is offered on these items in the following paragraphs. Noise control measures that will be considered include the selection of quiet plant, enclosures and screens around noise sources, limiting the hours of work and noise monitoring. The contractor will be required to conduct construction noise predictions and put in place the most appropriate noise control measures depending on the level of noise reduction required at any one location.

Selection of Quiet Plant

This practice is recommended in relation to sites with static plant such as compressors and generators. It is recommended that these units be supplied with manufacturers' proprietary acoustic enclosures where possible. The potential for any item of plant to generate noise will be assessed prior to the item being brought onto the site. The least noisy item should be selected wherever possible. Should a particular item of plant already on the site be found to generate high noise levels, the first action should be to identify whether or not said item can be replaced with a quieter alternative.

General Comments on Noise Control at Source

If replacing a noisy item of plant is not a viable or practical option, consideration should be given to noise control "at source". This refers to the modification of an item of plant or the application of improved sound reduction methods in consultation with the supplier. For example, resonance effects in panel work or cover plates can be reduced through stiffening or application of damping compounds; rattling and grinding noises can often be controlled by fixing resilient materials in between the surfaces in contact.

BS 5228 states that "as far as reasonably practicable sources of significant noise should be enclosed". In applying this guidance, constraints such as mobility, ventilation, access and safety must be taken into account. Items suitable for enclosure include pumps and generators. Demountable enclosures will also be used to screen operatives using hand tools and will be moved around site as necessary.

Screening

Typically screening is an effective method of reducing the noise level at a receiver location and can be used successfully as an additional measure to all other forms of noise control. The effectiveness of a noise screen will depend on the height and length of the screen and its position relative to both the source and receiver.

The length of the screen should in practice be at least five times the height, however, if shorter sections are necessary then the ends of the screen should be wrapped around the source. The height of any screen should be such that there is no direct line of sight between the source and the receiver.

BS 5228 states that on level sites the screen should be placed as close as possible to either the source or the receiver. The construction of the barrier should be such that there are no gaps or openings at joints in the screen material. In most practical situations the effectiveness of the screen is limited by the sound transmission over the top of the barrier rather than the transmission through the barrier itself. In practice screens constructed of materials with a mass per unit of surface area greater than 7 kg/m^2 will give adequate sound insulation performance.

In addition, careful planning of the site layout should also be considered. The placement of site buildings such as offices and stores and in some instances materials such as topsoil or aggregate can provide a degree of noise screening if placed between the source and the receiver.

Liaison with the Public

A designated noise liaison officer should be appointed to site during construction works. All noise complaints should be logged and followed up in a prompt fashion by the liaison officer.

Monitoring

During the construction phase consideration may be given to noise monitoring at the nearest sensitive locations. Noise monitoring will be conducted in accordance with the International Standard ISO 1996: 2007: *Acoustics – Description, measurement and assessment of environmental noise*.

Working Hours

Works other than the pumping out of excavations, security, emergency works and works during night-time possessions of the rail line will not be undertaken outside of normal working hours without the written permission of the Kildare County Council. This permission, if granted, can be withdrawn at any time should the working regulations be breached.

Emergency Work

The emergency work referred to above may include the replacement of warning lights, signs and other safety items on public roads, the repair of damaged fences, repair of water supplies and other services which have been interrupted, repair to any damaged temporary works and all repairs associated with working on public roads.

11.5.2 Operational Phase

Options for the reduction in traffic noise levels can take the form of a low noise road surface (LNRS), the use of barriers and or bunds or a combination of both. A LNRS surface is assumed to achieve a minimum noise reduction of -2dB when compared to Hot Rolled Asphalt (HRA). Mitigation measures have been considered for the proposed scheme under assessment.

The following summarises the noise mitigation for the following scenario:

DS Scenario – Development of M7 Osberstown Interchange, R407 Sallins Bypass and associated Side Roads and Link Roads

On review of the various options available and the predicted noise levels associated with each, the most appropriate mitigation measures have been determined to be a combination of a LNRS and road side barriers in order to effectively reduce road traffic noise levels to within the relevant design goal at the affected properties.

Table 11.13 presents the likely required extent of noise barriers assuming an LNRS is used along the following developed roads, refer to **Figure 11.3 V3**:

- M7 Osberstown Interchange.
- R407 Sallins Bypass.

Table 11.13: Likely Extent of Noise Mitigation Required for DS Scenario

Mitigating Receiver No.	Road Link	Barrier Chainage	Side of Road	Barrier Height (m)	Location
R2 & R10[1]	M7 Osberstown Interchange	Eastbound Merge Slip Ch.0+300 – Osberstown Road crossing (ca. 500m)	North	2	Edge of carriageway
R5	R407 Sallins Bypass	Ch.0+920 – Ch.1+050	East	2.5	Top of cutting/ embankment
R8	R407 Sallins Bypass	Ch.0+920 – Ch.1+050	West	2	Top of cutting/ embankment

11.6 Residual Impact

11.6.1 Construction Phase

The assessment has indicated that construction activities can, for the majority of activities operate within the adopted noise limits for daytime periods at the nearest properties to the works. A small number of potential exceedance are predicted at properties facing directly to site works. Given the linear nature of the works, however, noise emissions related to construction works will be of short term impact at any one area as the works progress along the length of the proposed scheme. The application of the proposed noise limits and restricted hours of operation, along with implementation of appropriate noise control measures, will ensure that noise impact is kept to within acceptable standards.

11.6.2 Operational Phase

The residual noise levels during the operational phase have been calculated taking into account the proposed mitigation measures outlined in Section 11.5. 2.

The calculated residual noise levels are presented in Table 11.14 for those locations where mitigation has been provided. The calculated results are presented for the two assessment years, 2015 and 2030.

Table 11.14: Calculated Residual Noise with Levels with Mitigation

Receiver Location Reference	Opening Year 2015 Predicted Noise Level		NRA Condition for Noise Mitigation Satisfied?			Mitigation Required?	Opening Year 2030 Predicted Noise Level		NRA Condition for Noise Mitigation Satisfied?			Mitigation Required?
	DM	DS					DM	DS				
	L_{den} (dB)	L_{den} (dB)	(a)	(b)	(c)		L_{den} (dB)	L_{den} (dB)	(a)	(b)	(c)	
R2	61	59	No	No	No	No	62	59	No	No	No	No
R4	59	59	No	No	No	No	60	60	No	No	No	No
R5a	59	58	No	No	No	No	60	59	No	No	No	No
R5b	59	59	No	No	No	No	60	60	No	No	Yes	No
R8a	57	59	No	Yes	Yes	No	58	59	No	Yes	Yes	No
R8b	57	58	No	Yes	Yes	No	57	59	No	Yes	Yes	No
R10a	60	60	No	No	No	No	60	60	No	No	No	No
R10b	59	59	No	No	No	No	60	60	No	No	No	No
R39	57	59	No	Yes	Yes	No	57	60	No	Yes	Yes	No

11.7 Vibration

11.7.1 Potential Impacts – Operational Phase

As a vehicle travels along a road, vibration can be generated in the road and subsequently propagate towards nearby buildings. Such vibration is generated by the interaction of a vehicle's wheels and the road surface and by direct transmission through the air of energy waves. Some of these waves arise as a function of the size, shape and speed of the vehicle, and others from pressure fluctuations due to engine, exhaust and other noises generated by the vehicle.

It has been found that ground vibrations produced by road traffic are unlikely to cause perceptible structural vibration in properties located near to well-maintained and smooth road surfaces. Problems attributable to road traffic vibration can therefore be largely avoided by maintenance of the road surface. Given that the existing road Scheme does not generate any significant vibration levels at present, vibration levels associated with the upgrade works are not expected to generate any perceptible vibration levels.

11.7.2 Potential Impacts – Construction Phase

The potential for vibration at neighbouring sensitive locations during construction is typically limited to excavation works, piling and lorry movements on uneven road surfaces. The more significant of these is the potential vibration from piling operations; the method of which will be selected and controlled to ensure there is no likelihood of structural or even cosmetic damage to existing neighbouring dwellings.

11.7.3 Mitigation Measures and Residual Impacts

The NRA Guidelines recommend that in order to ensure that there is no potential for vibration damage during construction, vibration from construction activities should not exceed the values set out in Table 11.15 as set out in the NRA 2004 Noise Document.

Table 11.15: Maximum Allowable Vibration Levels during Construction Phase

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)
8 mm/s	12.5 mm/s	20 mm/s

11.8 References

BS 5228 (2009) *Code of Practice for noise and vibration control of construction and open sites - Part 1: Noise*

BS 5228 (2009) *Code of Practice for noise and vibration control of construction and open sites - Part 2: Vibration*

BS 5228: Part 1 (2009) and the European Communities *Noise Emission by Equipment for Use Outdoors) Regulations*, 2001.

International Standard ISO 1996: 2007: *Acoustics – Description, measurement and assessment of environmental noise*.

NRA (2004) *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* (2004 Noise Document)

UK`s Department of Transport (1988) *Calculation of Road Traffic Noise* (CRTN).