Table of Contents

List of Figures and Tables

List of Appendices

9 Noise and Vibration

9.1 Introduction

This chapter of the EIAR assesses the impacts of noise and vibration associated with the proposed Glenamuck District Roads Scheme. A full description of the development can be found in Section 5 of this EIAR.

The noise and vibration assessment has been prepared by Dr. Aoife Kelly (Acoustic Consultant) who holds a BSc (Hons) in Environmental Health, a Diploma in Acoustics and Noise Control and a PhD in Occupational Noise. Aoife has specialised in acoustics since 2014 and has extensive knowledge in the field of occupational noise risk assessments, environmental noise and vibration impact assessment and inward impact assessments. She has extensive experience in environmental and occupational noise surveying and environmental acoustics.

The assessment takes the worst-case scenario, assuming high traffic growth for future opening and design years.

The assessment of direct, indirect and cumulative noise and vibration impacts on the surrounding environment have been considered as part of the assessment. The assessment of potential impacts presented in this chapter considers the relevant aspects of the *Environmental Protection Agency's Guidelines on the Information to be contained in Environmental Impact Assessment Reports Draft, August 2017* and *Advice Notes for preparing Environmental Impact Statements Draft September 2015.*

Note that Appendix 9.1 presents an overview of the basic fundamentals of acoustics to assist in understanding of this part of the EIAR.

9.2 Methodology

In order to assess the noise impact of any proposed road scheme, the following methodology is normally adopted:

- 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 development. In the case of a road scheme, the selected noise-sensitive locations are likely to be those in closest proximity to the proposed road.
- The noise levels resulting from both the construction and operational phases are then calculated using established prediction techniques.
- The noise levels associated with the operational phase of the proposed development are predicted in accordance with guidance set out in UK's Calculation of Road Traffic Noise (CRTN), giving results in the form of $L_{A10(18hour)}$ values. These are then converted to L_{den} values in accordance with the procedures detailed in the NRA guidance. The derived values for L_{den} should be rounded to the nearest whole number, with 0.5 being rounded up.
- The results of the predicted assessment are compared against the most appropriate criteria for both construction and operational phases. Where predicted noise levels are in excess of the adopted criteria, mitigation measures are proposed.

Further details of each phase of the assessment are set out in the individual sections of the chapter.

9.2.1 Assessment Criteria

Operational Phase

There are no statutory guidelines or standards for noise mitigation in Ireland applicable for Street or Road Schemes. The Department for Transport, Tourism and Sports *Design Manual for Urban Roads and Streets* (DMRUS) (2013) offers approaches for the design of urban streets, including the acoustic benefits to designing boulevards to separate vehicular traffic from pedestrians. Nevertheless, the DMURS document does not detail noise assessment criteria for residential receivers.

For new national roads in Ireland, it is standard practice to adopt the traffic noise design goal contained within the TII document *Guidelines for the Treatment of Noise and Vibration in National Road Schemes 2004* and Guidance contained within the TII's *Good Practice Guide for the Treatment of Noise during the Planning on National Road Schemes* (2014). Both documents note the use of a traffic noise design goal of 60dB L_{den} (free field residential façade criterion) for new national roads.

The following three conditions must be satisfied under the TII guidelines in order for noise mitigation to be provided:

- 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};
- the relevant noise level is at least 1dB more than the expected traffic noise level without the proposed road scheme in place, and;
- the contribution to the increase in the relevant noise level from the proposed road scheme is at least 1dB.

It should be noted that the Design Goal is applicable to new national road schemes. In the case of this scheme the proposed distributor road does not fall under the strict requirements for noise design goals set within the TII's guidance document. It is therefore acknowledged that it may not always be sustainable or possible to achieve the 60dB L_{den} design goal at existing or future developments in the area.

This design goal is to be 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 this case, an opening year of 2020 and a design year of 2035 have been assessed.

The 2014 Good Practice Guide recognises that "in some cases the attainment of the design goal may not be possible by sustainable means". The guidance also notes that the benefit gained by the insertion of a barrier is limited and notes that for caution should be exercised specifying substantial screening where small benefits (<3dB) are only achieved, given a change of 3dB(A) is the smallest change that would give a reliable difference in public response.

Due to very low levels of vibration generated by road traffic on well-maintained and smooth road surfaces, ground borne vibration from this development is unlikely to cause perceptible levels of

vibration to building occupants. Similarly, the operational phase is not expected to generate any form of cosmetic damage to buildings located in proximity to the alignment. As such, the impacts of operational vibration have not been addressed further in this chapter.

Construction Phase

The TII guidance document specifies noise levels that it typically deems acceptable in terms of construction noise. These limits are set out in Table 9-1.

Table 9-1: Maximum Permissible Noise Levels at the Façade of Nearby Dwellings at Construction

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

It should be noted that the noise criteria quoted in the table 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).

9.3 Baseline Environment

An environmental noise survey was conducted in the vicinity of the proposed road realignment in the Glenamuck area. These locations have been chosen in order to quantify the existing noise environment in the vicinity of the noise-sensitive locations that may be affected by the proposed works.

A survey of vibration along the proposed route corridor was not undertaken, as levels associated with existing roads would not be expected to be of a magnitude sufficient to cause disturbance to people or structural damage to property. Furthermore, vibration was not perceptible at any of the noise survey locations.

9.3.1 Survey Periods

Unattended noise surveys were conducted at two locations:

- UN 1, between 09:00hrs on 19 April to 09:00hrs on 20 April 2018, and;
- UN 2, between 10:00hrs on 19 April to 10:00hrs on 20 April 2018.

Attended monitoring was conducted at 5 locations, AN1 to AN5, on 19 April between 10:00 and 17:00 hours.

9.3.2 Measurement Locations

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 development. In the case of a road development, the selected noise-sensitive locations are those in closest proximity to the proposed road. Both the

construction and operational phases of the proposed road development should be reviewed when selecting appropriate measurement locations.

The measurement location descriptions are presented below and illustrated in Figure 9-1.

Table 9-2: Baseline Noise Monitoring Locations

Survey Location	Description	Grid Reference (ITM)	
		E	N
AN1	Outside residential property along Glenamuck Road, near Enniskerry Road junction	720,436	722,582
AN2	Proxy location in line with residential property 140m from Glenamuck Road, positioned on roadside near Wayside Celtic FC.	720,830	722,780
AN3	Grass verge along roadside on Enniskerry Road.	720,209	723,105
AN4	Outside residential property along Ballycorus Road.	720,835	722,131
AN5	Outside residential property along Barnaslingan Lane.	720,973	721,801
UN1	Outside residential property along Glenamuck Road. Chosen due to proximity to existing road.	721,107	723,307
UN2	Outside residential property along Glenamuck Road. Chosen due to proximity to proposed road.	720,735	723,050

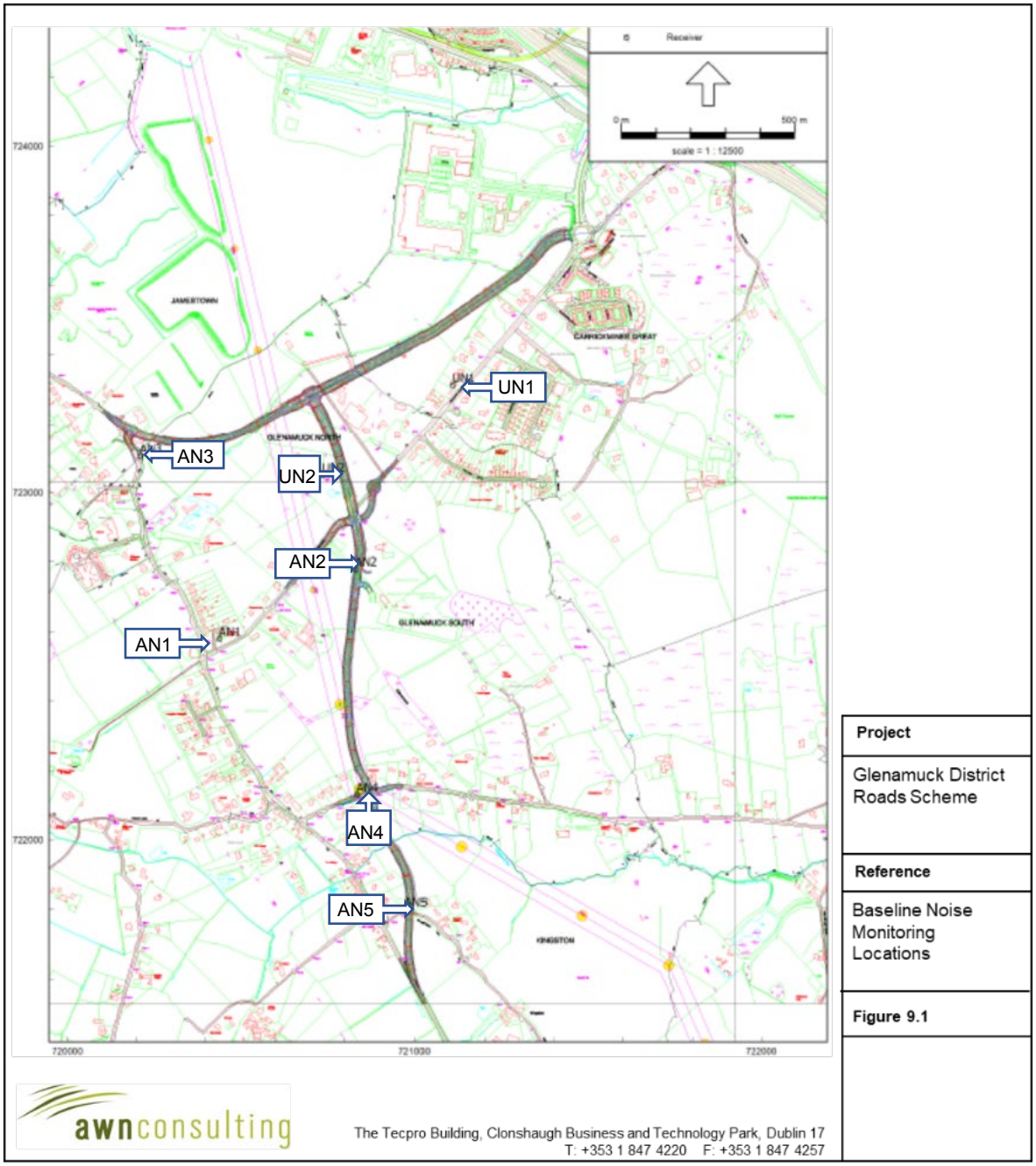

Figure 9-1 Baseline Noise Monitoring Locations

9.3.3 Instrumentation

The attended measurements were performed using a Brüel & Kjær Type 2250 Sound Level Meter. The unattended measurements were performed using Brüel & Kjær Type 3592 Environmental Kits with Brüel & Kjær Type 2238 Sound Level Meter. Before and after the survey the measurement apparatus was check calibrated using a Brüel & Kjær Type 4231 Sound Level Calibrator.

9.3.4 Procedure

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 data.

At UN1 a 4m tripod was used to obtain representative noise levels at first floor level of the receptor. At UN2 a 1.5m tripod was used to obtain representative noise levels at ground floor level of the receptor.

Attended Noise Measurements (Derived Value)

Attended measurements were conducted at 5 survey locations. 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 TII guidance document.

In all cases, measurements were performed free-field at least 3m from any reflecting wall or structure.

When surveying traffic noise, the acoustical parameters of interest are $L_{A10\ (1hour)}$ and $L_{A10\ (18hour)}$, expressed in terms of decibels (dB) relative to 2×10^{-5}Pa. The value of $L_{A10\ (1hour)}$ is the noise level exceeded for just 10% of the time over the period of one hour. $L_{A10\ (18hour)}$ is the arithmetic average of the values of $L_{A10\ (1hour)}$ 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. $L_{A10(18hour)} = ((\Sigma L_{A10(1hour)}) / 3) - 1dB$.

- The L_{den} for the location is then derived from the calculated $L_{A10(18hour)}$ value,

  i.e. $L_{den} = 0.86\ L_{A10(18hour)} + 9.86dB$.

9.3.5 Results of Noise Surveys

Table 9-3 presents the results of the attended measured noise levels for each of the five survey locations. Tables A1 and A2 in Appendix 9-2 presents the results of the unattended survey results at UN1 and UN2.

The results of the survey have indicated that baseline noise levels at all locations assessed are dominated by existing traffic flows along the roads within the Glenamuck area.

Measured noise levels were above 60dB L_{den} at the majority of monitoring locations in close proximity to the existing road edges. Marginally lower noise levels were recorded at properties set back from road traffic.

Table 9-3: Baseline Noise Monitoring Results

Survey Location	Start time	Measured Noise Levels (dB re.2x10^{-5}Pa)			dB L_{den}		Notes
		L_{Aeq}	L_{A10}	L_{A90}	Derived (Short term)	Measured (long term)	
AN1	10:00	52	55	44	57	n/a	Road traffic dominant source
	11:00	56	57	44			
	12:00	54	56	47			
AN2	10:19	54	51	42	53	n/a	Road traffic dominant source
	11:19	47	50	41			
	12:19	49	52	42			
AN3	10:42	68	73	45	72	n/a	Road traffic dominant source. Positioned 5m from Enniskerry Road.
	11:39	69	73	50			
	12:39	68	73	49			
AN4	13:24	67	69	36	69	n/a	Road traffic dominant source with additional noise from overhead cables.
	14:10	68	71	40			
	15:00	68	70	40			
AN5	13:45	58	53	36	53	n/a	Passing road traffic along Enniskerry Road dominates
	14:32	48	47	37			
	15:23	51	53	37			
UN1	09:00	L_{day}	$L_{evening}$	L_{night}	n/a	60	Road traffic dominant source.
		58	57	52			
UN2	10:00	L_{day}	$L_{evening}$	L_{night}	n/a	51	Road traffic dominant source with local car movements around property.
		50	47	43			

The baseline environment in the vicinity of the proposed road development has been characterised through a noise survey. The noise climate was observed to vary considerably across the proposed road development although for the most part, the baseline environment can be regarded as typical of quasi urban/rural locations in close proximity to local or regional roads.

The primary land use across the extent of the proposed road development is agricultural and includes greenfield areas of land.

The majority of noise sensitive receptors in the vicinity of the proposed road are comprised of residential dwellings although a small number of a number of recreational receptors are also located along the proposed route.

For all attended locations the measured ambient noise levels ranged from 47 to 69 dB L_{Aeq} whilst the calculated L_{den} ranged from 53 to 72 dB.

For the unattended locations the measured ambient noise levels ranged from 50 to 58dB $L_{day,}$, 47 to 57dB $L_{evening}$ and 43 to 52dB L_{night}. The calculated L_{den} value for the unattended survey locations ranged from 51 to 60dB.

The higher attended values were measured at locations along the existing road edge on the Enniskerry Road and Ballychorus Road. The higher unattended value at UN1 (60dB L_{den}) was measured along the existing Glenamuck Road East, which had a direct line of sight to the road. The lower unattended value at UN2 (51dB L_{den}) was measured at a property that was at a greater distance to the existing Glenamuck Road (no direct line of sight) but was chosen due to its proximity to the proposed road.

In the majority of cases, for both the attended and unattended survey locations, the ambient noise levels were influenced primarily by road traffic noise although other sources of noise such as birdsong, wind generated noise and barking dogs were also contributory sources.

9.4 Predicted Impacts

9.4.1 Assessment of Operational Noise

Noise Model

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.

Bruel and Kjaer 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. The calculation module of Predictor allows the calculation of L_{den} by converting predicted L_{A10} values using the "end corrections" derived by the UK Transport Research Laboratory (TRL) and subsequently verified and adopted by TII.

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, and;
- the hardness of the ground between the source and receiver.

Prediction of Traffic Noise

Noise emissions during the operational phase of the project have been modelled using *Predictor* in accordance with CRTN and with the application of the relevant TRL conversion factors as detailed in the TII 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, and;

- combine the contributions from all segments to give the predicted noise level at the receiver location for the whole road scheme.

Note that all calculations are performed to one decimal place. For the purposes of comparison with the design goal of 60dB L_{den}, the relevant noise level is to be rounded to the nearest whole number.

Input to the Noise Model

The noise model was prepared using the following data:

- Up to date Ordnance Survey mapping, and alignment data of the new road supplied by DBFL Consulting Engineers,
- Review of the Dun Laoghaire-Rathdown planning website carried out to include closest receivers for all developments granted planning permission before October 10th 2018 and disregard receivers outlined in the OS mapping, which have been/will be demolished; and,
- Traffic flows and speeds data as supplied by DBFL Consulting Engineers for all existing and proposed roads within the proposed road development for the opening year 2020 and design year 2035. Data was provided for the Do Nothing and Do Something scenarios.

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

Table 9-4 summarises the traffic flow volumes used for the design year impact assessment.

Table 9-4: Traffic Volumes used for Noise Impact Assessment

Ref.	Link	Do Nothing 2035		Do Something 2035	
		AADT	%HGV	AADT	%HGV
A	R117 Enniskerry Road (N) Junct. Glebe Rd	14,600	4.0%	5,800	3.2%
B	R117 Enniskerry Road (S)	16,900	6.2%	2,050	1.5%
C	Barnaslingan Lane	800	1.1%	800	1.5%
D	R116 Ballycorus Road	7,100	3.3%	11,600	2.9%
E	Glenamuck Road (E)	17,800	7.6%	5,000	1.8%
F	Glenamuck Road (W)	13,900	4.8%	5,750	3.2%
G	GDDR (W)	--	--	14,250	6.0%
H	GDDR Junct. GLDR	--	--	26,450	8.7%
I	GLDR (N)	--	--	21,600	5.4%
J	GLDR Junct. Glenamuck Road	--	--	20,450	4.7%
K	GLDR Junct. R117 (S)	--	--	18,450	4.3%
L	GDDR (E)	--	--	26,600	8.6%
M	R117 Enniskerry Road (N) Junct. GDDR	14,500	5.1%	16,250	4.4%
O	R117 Enniskerry Road (S) Junct. Ballybetagh Road	20,800	6.0%	6,200	3.3%
P	GLDR Junct. Barnaslingan Lane	--	--	16,800	4.8%

Key: GDDR – Glenamuck District Distributor Road; GLDR – Glenamuck Link Distributor Road

Traffic flows provided by DBFL Consulting Engineers indicate that traffic volumes are expected to reduce substantially between the Do Minimum or Do Something scenarios on the existing R117 (N and

S) and Glenamuck Road (E and W). The addition of the GDDR and GLDR will redirect the difference in traffic along these new link roads. The speed limit along the length of scheme is 50km/hr. Junctions will be signalised and minor arm approaches are likely to be on red lights the majority of the time, reducing the speed limit to 30km/hr along the Ballycorus Road and Barnaslingan Lane in particular.

A standard road surface type, such as hot rolled asphalt (HRA) has been assumed for all existing roads. A PSMA road surface type has been assumed for all new roads, with a 1dB reduction applied compared to the standard HRA road surface.

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 dB L_{den}.

Calibration

The purpose of noise model validation 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 validation 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 is to compare the output of a Predictor model scenario, using the AADT traffic flows for the existing road network in 2017, with the measured L_{den} value at unattended survey location UN01, which was in the vicinity of the existing road network (Glenamuck Road). The reason for choosing this survey location for the purposes of calibration is to ensure that the noise environment was dominated by road traffic noise during the survey period.

Traffic data for the year 2017 was provided by DBFL Consulting Engineers. The AADT value used for the existing roads is outlined in Table 9-5 below.

Table 9-5: Traffic Volumes used for Calibration of Noise Model

Ref.	Link	Baseline Traffic 2017	
		AADT	%HGV
M	R117 Enniskerry Road (N)	7,650	3.7%
B	R117 Enniskerry Road (S)	8,350	4.6%
C	Barnaslingan Lane	350	1.6%
D	R116 Ballycorus Road	2,200	2.7%
E	Glenamuck Road (E)	12,300	4.4%
F	Glenamuck Road (W)	9,000	2.7%

The results of the calibration are presented in Table 9-6. The difference between the measured and predicted results is 0 dB(A), which demonstrates a strong correlation and confirms that the model is correctly interpreting the input data.

Table 9-6: Noise Model Calibration

Location Reference	Measured L_{den} (dB)	Predicted L_{den} (dB)	Variation (dB)
UN01	60	60	0

Choice of Receiver Locations

Free-field traffic noise levels have been predicted at 64 existing properties and 2 properties granted planning permission but have yet to be built, in the vicinity of proposed and existing roads[1]. The locations of all receptors are shown in Figure 9-2 to Figure 9-5. The predicted relevant noise levels have been presented in Table 9-8.

For certain properties, receiver locations have been positioned at two or more locations around the building to assess noise levels associated with existing road traffic from existing roads and from the proposed future GDDR and GLDR road alignments (114 modelled locations). The properties were selected on the basis of proximity to the existing and proposed roads. All properties with the nearest proximity to the realigned road have been considered as per best practice.

[1] All receivers have been modelled at heights of 1.5 and 4.0m above ground which corresponds approximately to ground and first floor windows respectively. The relevant result for the worst case highest window has been presented in each case.

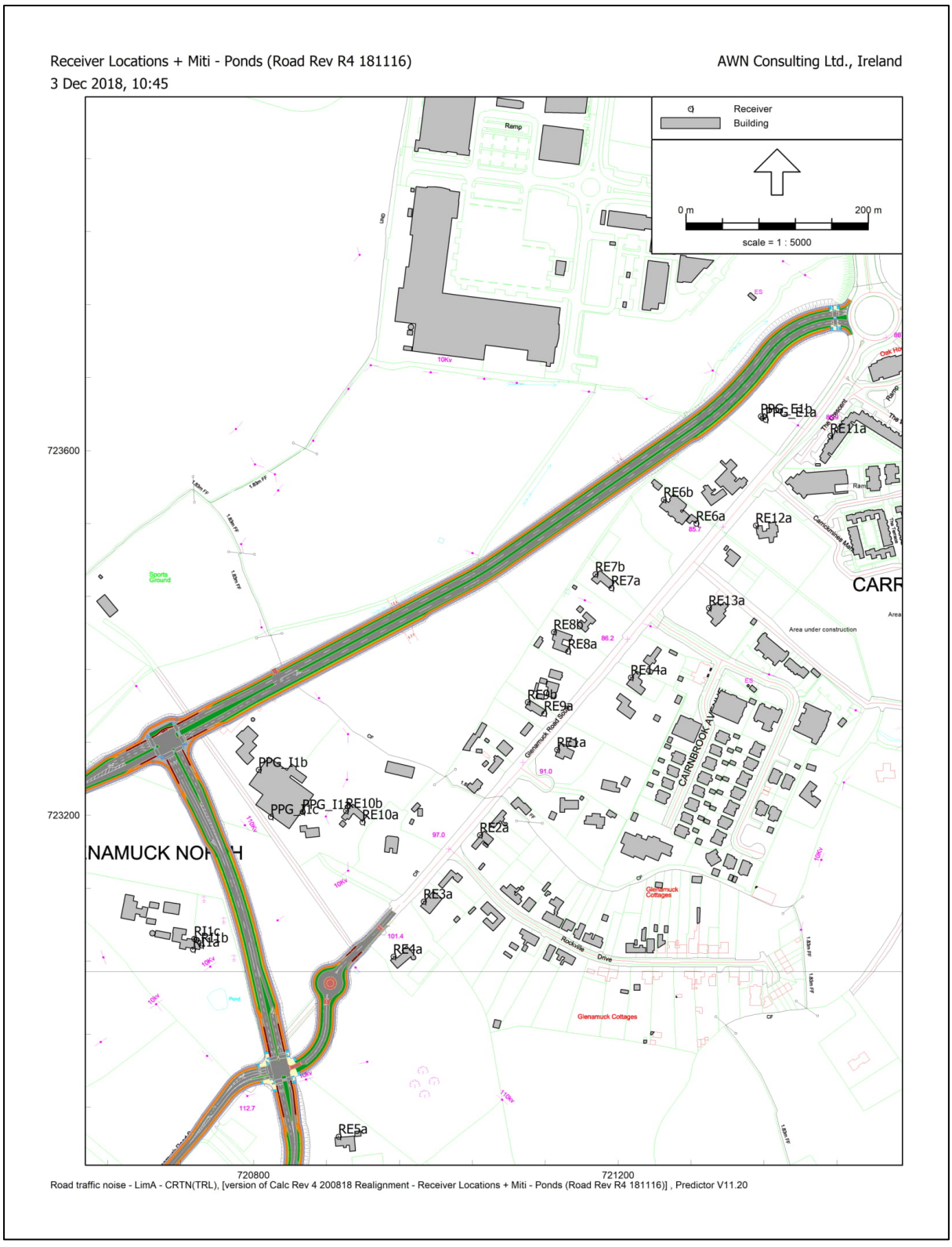

Figure 9-2: Receiver Locations to the North East.

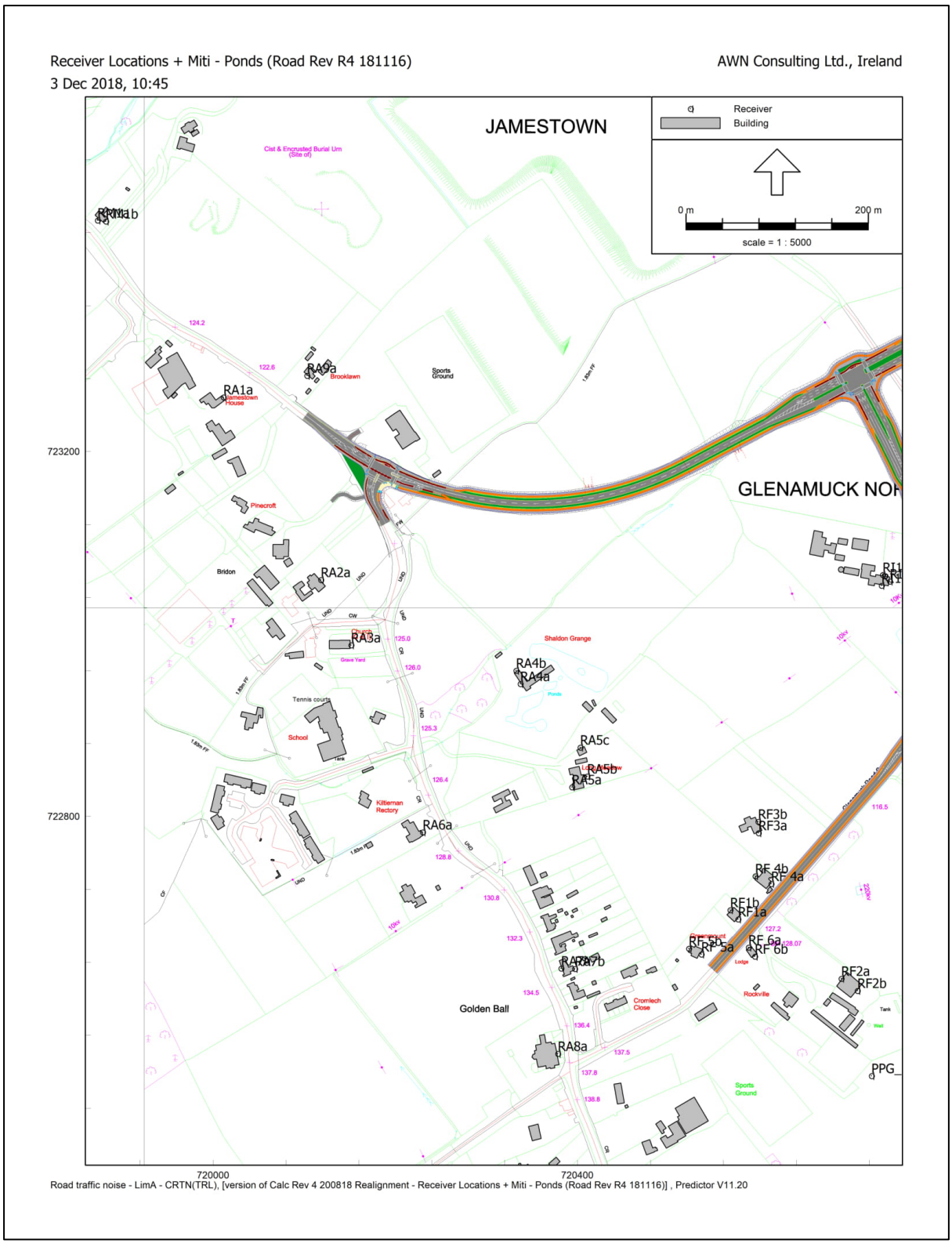

Figure 9-3: Receiver Location to the North West.

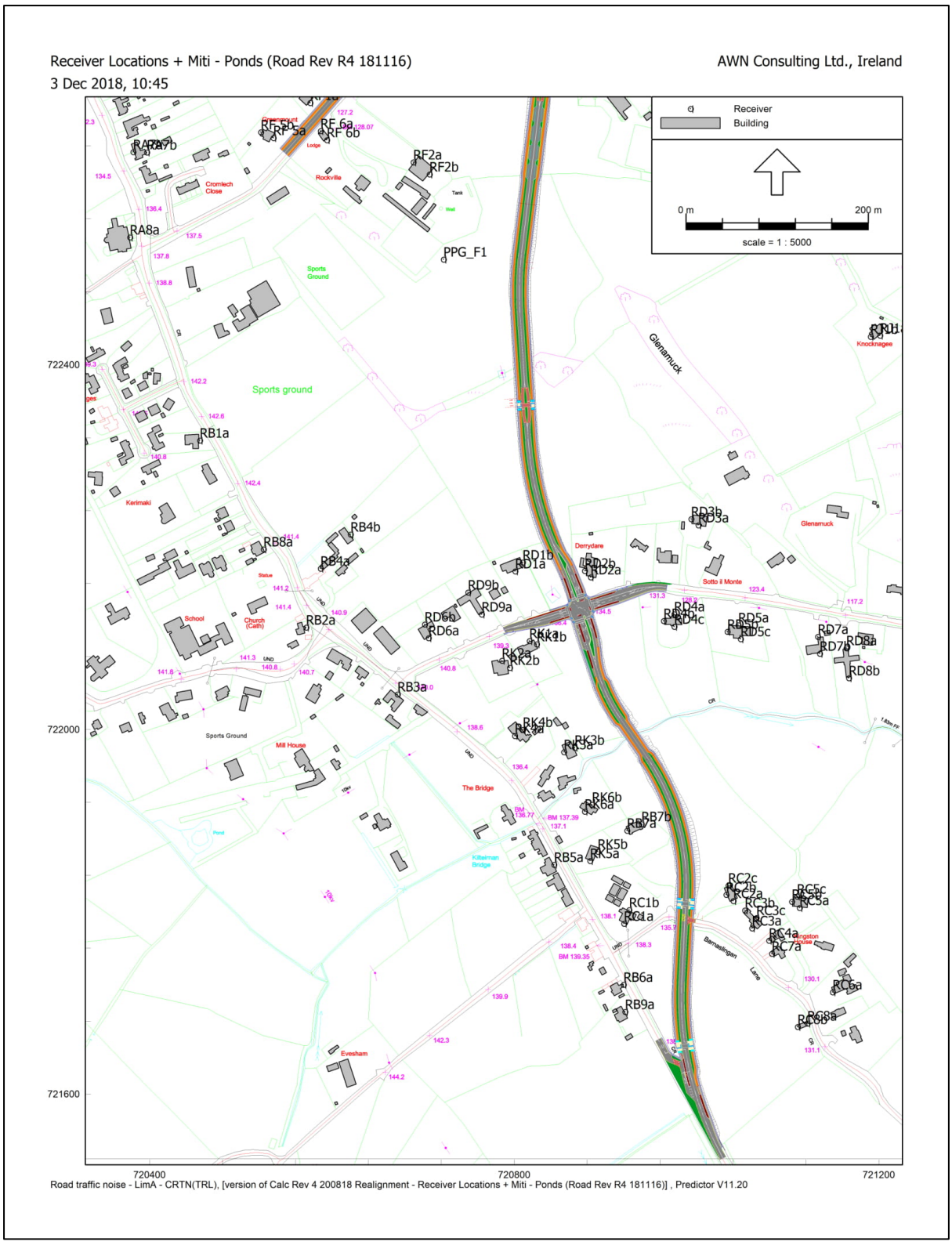

Figure 9-4: Receiver Location to the South West

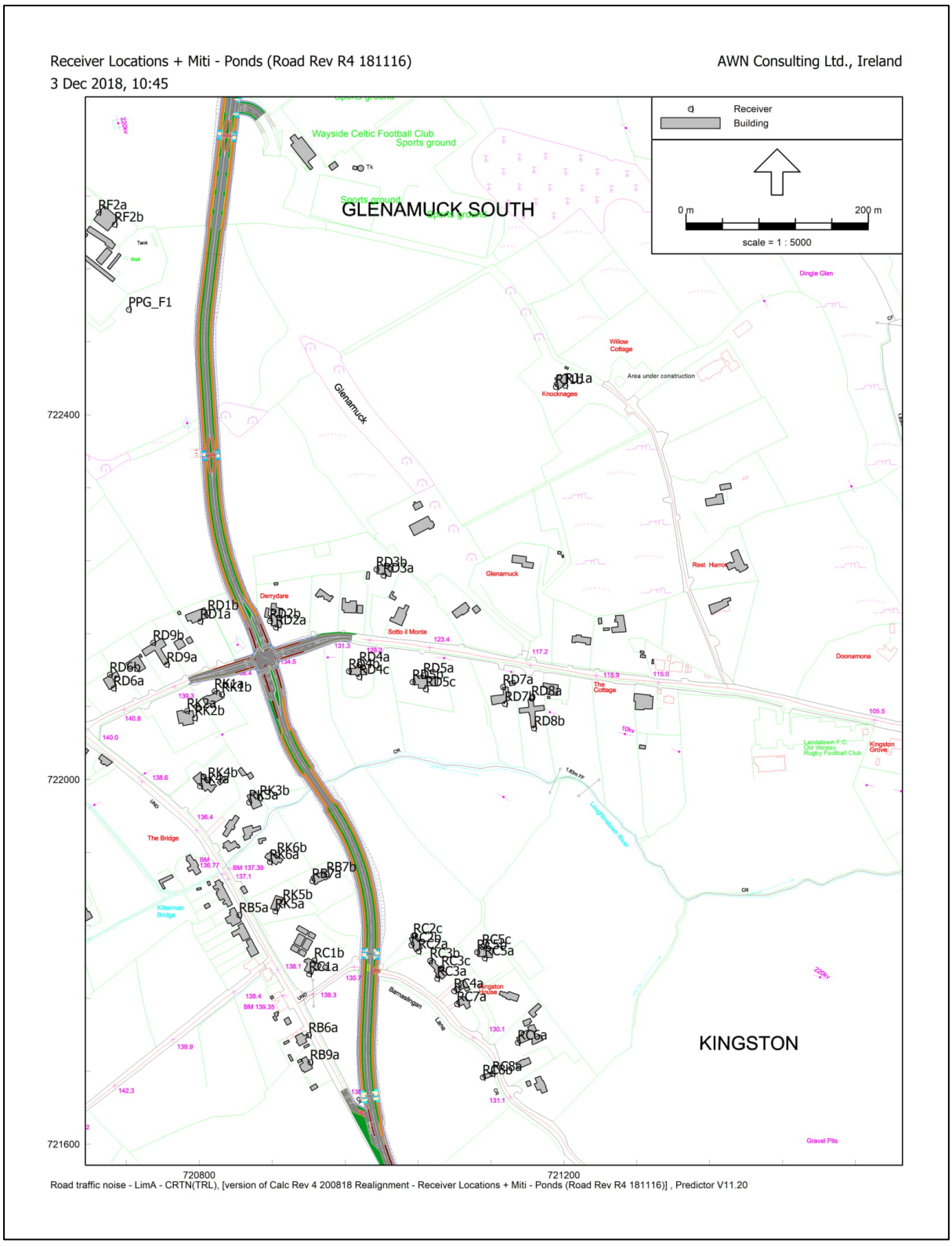

Figure 9-5: Receiver Locations to South East

Traffic Noise Predictions

Traffic noise predictions have been conducted for the operational phase of the scheme for two years, 2020, the proposed year of opening and 2035, the design year. A total of five scenarios have been considered as follows:

- Year 2020 – Do Nothing (i.e. proposed scheme is not built);
- Year 2020 – Do Something (i.e. proposed scheme is built);
- Year 2035 – Do Nothing (i.e. proposed scheme is not built);
- Year 2035 – Do Something (i.e. proposed scheme is built); and,
- Year 2035 – Do Something + Complementary Measures (i.e. proposed scheme is built).

In terms of the change in noise experienced at properties assessed, reference is made to the DMRB's Volume 11, Section 3 which prescribes a magnitude of impact relating to changes in road traffic noise.

Table 9-7 below summarises the classification of magnitude of impacts relating to traffic noise.

Table 9-7: Classification of Magnitude of Noise Impacts

Noise Change, dB	Magnitude of Impact
0	No Change
0.1 – 2.9	Negligible
3 – 4.9	Minor
5 – 9.9	Moderate
10+	Major

The results of the traffic noise predictions are presented in Table 9-8.

As the differences between the two Do Something 2035 noise predictions (with and without Complementary Measures) were less than 0.2dB, the prediction results without Complementary Measures are presented in the table i.e. worst case scenario.

Table 9-8: Predicted Noise Levels for Years 2020 and 2035 for "Do Nothing" and "Do Something" Scenarios

Receiver Location Reference	Opening Year 2020			Design Year 2035		
	Predicted Noise Level		Comment	Predicted Noise Level		Comment
	Do Nothing	Do Something		Do Nothing	Do Something	
	L_{den} (dB)	L_{den} (dB)		L_{den} (dB)	L_{den} (dB)	
RA1a	62	62	No Change	64	64	No Change
RA2a	57	56	Reduction[a]	59	58	Reduction[a]
RA3a	60	58	Reduction[a]	63	60	Reduction[a]
RA4a	53	50	Reduction[a]	55	51	Reduction[a]
RA4b	52	52	No Change[a]	54	54	No Change[a]
RA5a	53	50	Reduction[a]	55	52	Reduction[a]

Receiver Location Reference	Opening Year 2020			Design Year 2035		
	Predicted Noise Level		Comment	Predicted Noise Level		Comment
	Do Nothing	Do Something		Do Nothing	Do Something	
	L_{den} (dB)	L_{den} (dB)		L_{den} (dB)	L_{den} (dB)	
RA5b	50	49	Reduction[a]	52	52	No Change[a]
RA5c	51	50	Reduction[a]	53	52	Reduction[a]
RA6a	63	59	Reduction[a]	65	60	Reduction[a]
RA7a	64	61	Reduction	66	62	Reduction
RA7b	46	43	Reduction[a]	48	46	Reduction[a]
RA8a	68	64	Reduction	70	65	Reduction
RA9a	60	61	Negligible	63	63	No Change
RB1a	68	63	Reduction	70	64	Reduction
RB2a	68	62	Reduction	70	64	Reduction
RB3a	70	63	Reduction	73	66	Reduction
RB4a	64	60	Reduction[a]	66	61	Reduction
RB4b	48	48	No Change[a]	51	51	No Change[a]
RB5a	69	57	Reduction[a]	72	61	Reduction
RB6a	70	61	Reduction	73	64	Reduction
RB7a	55	53	Reduction[a]	57	55	Reduction[a]
RB7b	47	62	Major	49	63	Major
RB8a	68	63	Reduction	71	64	Reduction
RB9a	65	60	Reduction[a]	68	62	Reduction
RC1a	64	58	Reduction[a]	66	60	Reduction[a]
RC1b	48	56	Moderate[a]	50	58	Moderate[a]
RC2a	49	53	Minor[a]	52	55	Minor[a]
RC2b	50	57	Moderate[a]	52	59	Moderate[a]
RC2c	46	56	Major[a]	48	58	Major[a]
RC3a	53	57	Minor[a]	55	59	Minor[a]
RC3b	52	56	Moderate[a]	54	58	Minor[a]
RC3c	44	52	Moderate[a]	46	54	Moderate[a]
RC4a	52	55	Minor[a]	55	57	Negligible[a]
RC5a	47	49	Negligible[a]	49	50	Negligible[a]
RC5b	48	53	Moderate[a]	50	55	Moderate[a]
RC5c	45	52	Moderate[a]	48	54	Moderate[a]
RC6a	50	51	Negligible[a]	52	53	Negligible[a]
RC7a	51	53	Negligible[a]	54	55	Negligible[a]
RC8a	50	51	Negligible[a]	53	54	Negligible[a]
RC8b	52	54	Negligible[a]	54	55	Negligible[a]
RD1a	53	57	Minor[a]	55	60	Moderate[a]
RD1b	50	60	Major[a]	52	63	Major
RD2a	60	64	Minor	62	67	Moderate

Receiver Location Reference	Opening Year 2020			Design Year 2035		
	Predicted Noise Level		Comment	Predicted Noise Level		Comment
	Do Nothing	Do Something		Do Nothing	Do Something	
	L_{den} (dB)	L_{den} (dB)		L_{den} (dB)	L_{den} (dB)	
RD2b	56	64	Moderate	58	67	Moderate
RD3a	51	53	Negligible[a]	54	56	Negligible[a]
RD3b	49	52	Minor[a]	51	55	Minor[a]
RD4a	59	61	Negligible	62	64	Negligible
RD4b	56	60	Minor[a]	58	63	Moderate
RD4c	51	56	Moderate[a]	53	58	Moderate[a]
RD5a	58	58	No Change[a]	61	62	Negligible
RD5b	55	56	Negligible[a]	57	59	Negligible[a]
RD5c	49	53	Minor[a]	52	55	Minor[a]
RD6a	62	59	Reduction[a]	65	63	Reduction
RD6b	50	48	Reduction[a]	52	51	Reduction[a]
RD7a	57	57	No Change[a]	60	61	Negligible
RD7b	46	49	Minor[a]	49	51	Minor[a]
RD8a	55	54	Reduction[a]	57	58	Negligible[a]
RD8b	45	49	Minor[a]	47	50	Minor[a]
RD9a	60	60	No Change[a]	63	63	No Change
RD9b	49	50	Negligible[a]	51	52	Negligible[a]
RE1a	68	60	Reduction[a]	70	63	Reduction
RE2a	69	60	Reduction[a]	71	63	Reduction
RE3a	68	60	Reduction[a]	70	63	Reduction
RE4a	64	58	Reduction[a]	65	60	Reduction[a]
RE5a	55	56	Negligible[a]	57	59	Negligible[a]
RE6a	66	58	Reduction[a]	67	61	Reduction
RE6b	49	61	Major	51	64	Major
RE7a	61	54	Reduction[a]	63	57	Reduction[a]
RE7b	45	58	Major[a]	47	62	Major
RE8a	62	54	Reduction[a]	64	57	Reduction[a]
RE8b	49	56	Moderate[a]	51	59	Moderate[a]
RE9a	67	59	Reduction[a]	69	62	Reduction
RE9b	49	53	Minor[a]	51	56	Moderate[a]
RE10a	56	52	Reduction[a]	58	55	Reduction[a]
RE10b	43	52	Moderate[a]	45	55	Major[a]
RE11a	65	59	Reduction[a]	67	62	Reduction
RE12a	66	58	Reduction[a]	67	61	Reduction
RE13a	61	55	Reduction[a]	63	58	Reduction[a]
RE14a	65	58	Reduction[a]	67	60	Reduction[a]
RF1a	65	58	Reduction[a]	67	64	Reduction

Receiver Location Reference	Opening Year 2020			Design Year 2035		
	Predicted Noise Level		Comment	Predicted Noise Level		Comment
	Do Nothing	Do Something		Do Nothing	Do Something	
	L_{den} (dB)	L_{den} (dB)		L_{den} (dB)	L_{den} (dB)	
RF1b	48	48	No Change	50	51	Negligible[a]
RF2a	55	51	Reduction[a]	57	54	Reduction[a]
RF2b	44	54	Major[a]	46	56	Major[a]
RF3a	57	53	Reduction[a]	59	56	Reduction[a]
RF3b	57	53	Reduction[a]	59	57	Reduction[a]
RF 4a	64	58	Reduction[a]	66	63	Reduction
RF 4b	52	49	Reduction[a]	54	52	Reduction[a]
RF 5a	64	57	Reduction[a]	65	62	Reduction
RF 5b	51	48	Reduction[a]	53	51	Reduction[a]
RF 6a	68	59	Reduction[a]	70	65	Reduction
RF 6b	58	52	Reduction[a]	59	56	Reduction[a]
RI1a	54	56	Negligible[a]	56	58	Negligible[a]
RI1b	55	59	Minor[a]	57	62	Moderate
RI1c	51	57	Moderate[a]	52	59	Moderate[a]
RJ1a	45	46	Negligible[a]	48	49	Negligible[a]
RJ1b	48	49	Negligible[a]	50	52	Negligible[a]
RK1a	59	61	Negligible	62	65	Minor
RK1b	56	60	Minor[a]	59	63	Minor
RK2a	58	58	No Change[a]	61	62	Negligible
RK2b	50	54	Minor[a]	52	56	Minor[a]
RK3a	54	47	Reduction[a]	56	49	Reduction[a]
RK3b	48	59	Major[a]	50	61	Major
RK4a	60	51	Reduction[a]	62	53	Reduction[a]
RK4b	47	51	Minor[a]	49	53	Minor[a]
RK5a	64	52	Reduction[a]	66	56	Reduction[a]
RK5b	56	54	Reduction[a]	58	56	Reduction[a]
RK6a	59	51	Reduction[a]	61	53	Reduction[a]
RK6b	47	56	Moderate[a]	49	58	Moderate[a]
RM1a	66	67	Negligible	68	69	Negligible
RM1b	62	63	Negligible	65	65	No Change
PPG_F1	50	56	Moderate[a]	52	59	Moderate[a]
PPG_I1a	51	52	Negligible[a]	53	55	Negligible[a]
PPG_ I1b	44	57	Major[a]	46	60	Major[a]
PPG_ I1c	52	58	Moderate[a]	54	61	Moderate

[a] Denotes predicted noise level is below design goal of 60dB Lden.

[b] Receiver satisfies the criteria for noise mitigation.

PPG denotes planning permission granted but development may not have commenced construction at time of survey.

The results of the traffic noise assessment have indicated that for two-thirds of assessment locations, road traffic noise levels are reduced, have no change or are negligible.

The majority of assessment locations above 60dB L_{den} are properties located in close proximity to the existing roads edge during both the Do Minimum and Do Something scenarios, as confirmed during the baseline noise surveys.

In many cases there is a reduction of traffic on the existing roads in Do Something scenario at the front facades of the properties but an increase in noise levels at the rear of the facades due to the orientation of the dwelling i.e. rear/side facades are closer to the proposed link roads.

During the opening year of 2020, the assessment has determined that a total of 3 receivers (4 modeled locations) satisfy the requirements for noise mitigation as described in Section 9.2.1.

During the design year of 2035, the assessment has determined that a total of 10 receivers (11 modelled locations) satisfy the requirements for noise mitigation as described in Section 9.2.1.

Noise mitigation is therefore discussed and outlined at the modelled locations identified (highlighted in red) in Table 9-8. The mitigation measures are included in Section 9.5.1.

9.4.2 Construction Phase

Impacts Assessment

As per TII guidance noise levels associated with construction may be calculated in accordance with the methodology set out in BS5228: 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. However, it is often not possible to conduct detailed prediction calculations for the construction phase of a project in support of the EIAR. This is due to the fact that the programme for construction works has not been established in detail. Under such circumstances, best practice involves the consideration of appropriate mitigation measures. The TII guidance document specifies noise levels that it typically deems acceptable in terms of construction noise. These limits are set out in Table 9-1

A variety of items of plant will be in use during the construction of the new road and road upgrade works. These will include excavators, dump trucks, compressors and generators in addition to general road surfacing and levelling equipment. Due to the nature of the activities undertaken on a road construction site, there is potential for generation of high levels of noise at nearby noise sensitive properties.

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.

BS5228:2009 + A1 2014 *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. Table 9-9 sets out assumed plant items during the key phases of construction with the associated source reference from BS5228– *Part 1 Noise*.

The closest properties to the proposed alignment are at distances of approximately 10m. Construction noise calculations have been conducted at distances of 10 to 80m from the works for different work phases, representing the nearest properties to the works.

The calculations assume that plant items are operating for 66%[2] 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.

[2] This estimate that assumes that the plant will operate a full 8-hour shift over the proposed 12 hour working period which equates to a 66% on time over a daytime period or 40 minutes over a 1-hour period. The dynamic nature of construction sites is such that this is deemed to be a conservative estimate.

Table 9-9: Indicative Construction Noise Calculations at Closest Properties to Works

Construction Activities	Calculated Construction Noise Levels, dB $L_{Aeq,1hr}$				
	10m*	20m*	30m*	50m*	80m*
Site Clearance & Preparation					
Wheeled loader C2-26	69	66	63	58	54
Tracked excavator (loading dump truck) C1-10	75	72	69	64	60
Dozer C.2.10	70	67	64	59	55
Dump Truck (C2.30)	69	66	63	58	54
Combined L_{Aeq}	78	75	71	67	63
Fill works					
Tracked excavator (loading dump truck) C1-10	75	72	69	64	60
Articulated dump truck (dumping rubble) C1-11	70	67	64	59	55
Wheeled loader C2-26	69	66	63	58	54
Dozer C.2.10	70	67	64	59	55
Dump Truck Tipping fill (C2.30)	69	66	63	58	54
Combined L_{Aeq}	78	75	72	68	63
Piling Works					
Crawler Mounted Rig (C3.22)	70	67	64	59	55
Tracked Excavator inserting metal cage, (C3.24)	64	61	58	53	49
Concrete Pump & Cement Mixer Truck (C4.24)	57	54	51	46	42
Diesel Generator (C4.76)	51	48	45	40	36
Angle Grinder (C4.93)	70	67	64	59	55
Combined L_{Aeq}	74	71	67	63	59
Road Works					
Tracked excavator (C2.21)	61	58	55	50	46
Dump Truck (C2.30)	69	66	63	58	54
vibration rollers (C5.20)	65	62	59	54	50
Asphalt Paver & Tipping Lorry (C.5.31)	67	64	61	56	52
Diesel Generator (C4.76)	51	48	45	40	36
Road Rollers (C5.19)	70	67	64	59	55
Combined L_{Aeq}	74	72	68	64	60
Construction Compound Activities					
Tracked excavator (C2.21)	61	58	55	50	46
Dump Truck (C2.30)	69	66	63	58	54
Angle Grinder (C4.93)	70	67	64	59	55
Diesel Generator (C4.76)	51	48	45	40	36
Wheeled loader (C2-26)	69	66	63	58	54
Combined L_{Aeq}	74	72	68	64	59

Note: *Suitable 2.4m construction hoarding used as standard along all noise sensitive locations.

The reference values outlined in Table 9-1 indicate that at distances of up to 30m from the works, there is potential for the construction noise limit of 70dB L_{Aeq} to be exceeded from Monday through Friday (07:00 to 19:00hrs), depending on the number and type of equipment occurring at any one time. The calculations would also indicate that at distances of up to 50m from the works, there is potential for the construction noise limit of 65dB L_{Aeq} to be exceeded on Saturdays (between 08:00 and 16:30hrs), depending on the number and type of equipment occurring at any one time.

Please note the following:

- The 10m scenario applies only at two properties on the Ballycorus Road (RD2b and RK1a) and at four properties on the Glenamuck Road (W) (RF1a, RF4a, RF5a and RF6a).
- The 20m scenario applies only at two properties ; residential property West of the GLDR junction with Ballycorus Road (RD1b) and the De La Salle Palmerstown FC grounds located to the north of the GDDR(W) junction with Enniskerry Road (N).
- The 30m scenario applies at two properties, at the realigned junction on the Glenamuck Road East (RE3a) and at the GLDR junction with Barnaslingan Lane (RB7b).

At distances greater than 50m and beyond noise levels associated with construction plant items are further reduced and are typically within the daytime noise construction criteria.

It should be noted that the calculations set out in the above tables are indicative and are used for the purposes of comparison only with the adopted criteria. Where exceedance of the recommended criteria is expected, the use of noise mitigation measures will be used as part of the construction works. In this instance, where construction works are planned within 80m of noise sensitive properties, a schedule of noise mitigation measures will be required to ensure noise levels are minimised. Further details are set out in Section 9.5.2.

9.4.3 Vibration

Description of Existing Environment

A survey of vibration along the proposed scheme was not undertaken, as levels associated with existing roads would not be expected to be of a magnitude sufficient to cause disturbance to people or structural damage to property. Furthermore, vibration was not perceptible at any of the noise survey locations.

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 proposed new road are not expected to generate any perceptible vibration levels.

Potential Impacts – Construction Phase

The potential for vibration at neighbouring sensitive locations during construction is typically limited to limited forms of excavation works and lorry movements on uneven road surfaces. Where ground breaking is required, this would generate higher potential for vibration, depending on the methodologies used. Given the nature of the scheme and the limited extent of excavation works below ground, however, there are no significant ground or rock breaking activities anticipated. The vibration limits in Table 9-10: Maximum Allowable Vibration Levels During Construction Phasewill apply at the nearest sensitive building which are set in order to avoid any form of structural or cosmetic damage to light-weight buildings. The choice of plant will be selected and controlled to ensure these limit values are not exceeded at the closest sensitive buildings.

Table 9-10: 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

9.5 Mitigation Measures

9.5.1 Mitigation Measures Operational Phase

The results of the modelling exercise show that noise mitigation should be considered for 10 receivers (11 modelled locations) along the proposed route.

The following section details the possible mitigation measures deemed practicable to achieve the design goals previously defined in Section 10.2. For the purposes of this assessment a PSMA road surface has been assumed for all new roads.

The mitigation measures will be specified based on the predicted noise levels for the design year of 2035.

The mitigation measures detailed here may be constructed as earth bunds, proprietary noise barriers or a combination of both. The mitigation requirements for the proposed road development will be further progressed during the detailed design and construction phase of the project, should approval be granted, taking into account the available construction techniques and technologies at the time of development.

Details of the proposed mitigation measures are outlined in Table 9-11 in order to meet the noise threshold set out in the TII guidance document.

Table 9-11: Proposed Acoustic Barriers

Barrier Ref.	Road Ref	Road Link	Chainage Start (m)	Chainage End (m)	Height (m)	Alignment
NB-001	L	GDDR (E)	1+072	1+360	2.0	South
NB-002	I	GLDR (N)	0+050	0+160	2.0	East
NB-003			0+160	0+265	2.0	West
NB-004	J	GLDR Junct. Glenamuck Road	1+055	1+108*	2.0	West
NB-005			1+050	1+108*	2.5	East
NB-006	P	GLDR Junct. Ballycorus Road	1+118	1+325	2.0	West
NB-007			1+118	1+205	2.0	East
NB-008			1+360	1+480	2.5	West

* Barriers proposed to extend to rear of property boundary as shown in Figure 9.8

The extent and location of these barriers are shown in Figure 9-6 to Figure 9-8 overleaf.

The predicted post mitigation noise levels at receptors requiring mitigation has been presented in Table 9-12.

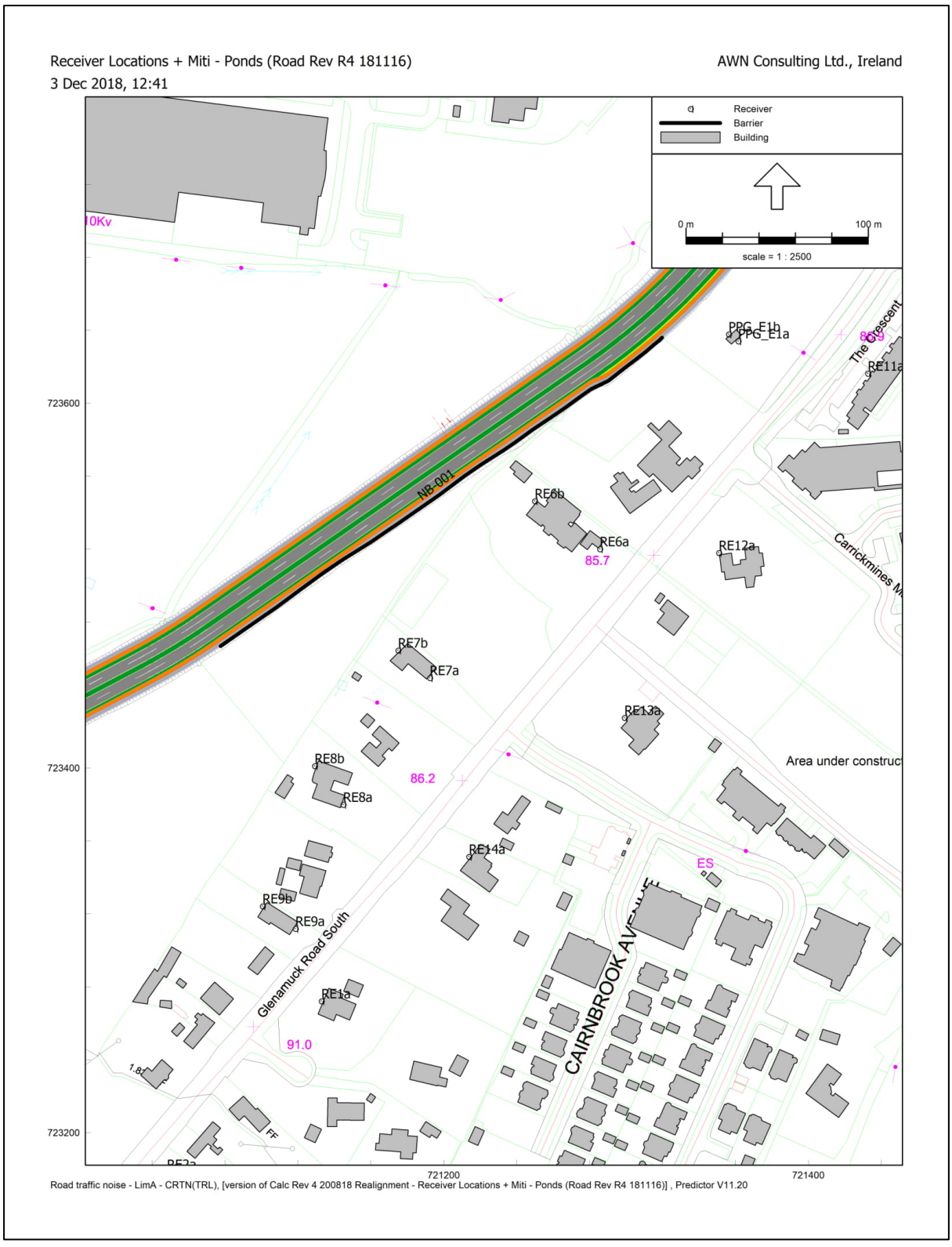

Figure 9-6: Barrier NB-001 to South of GDDR (E)

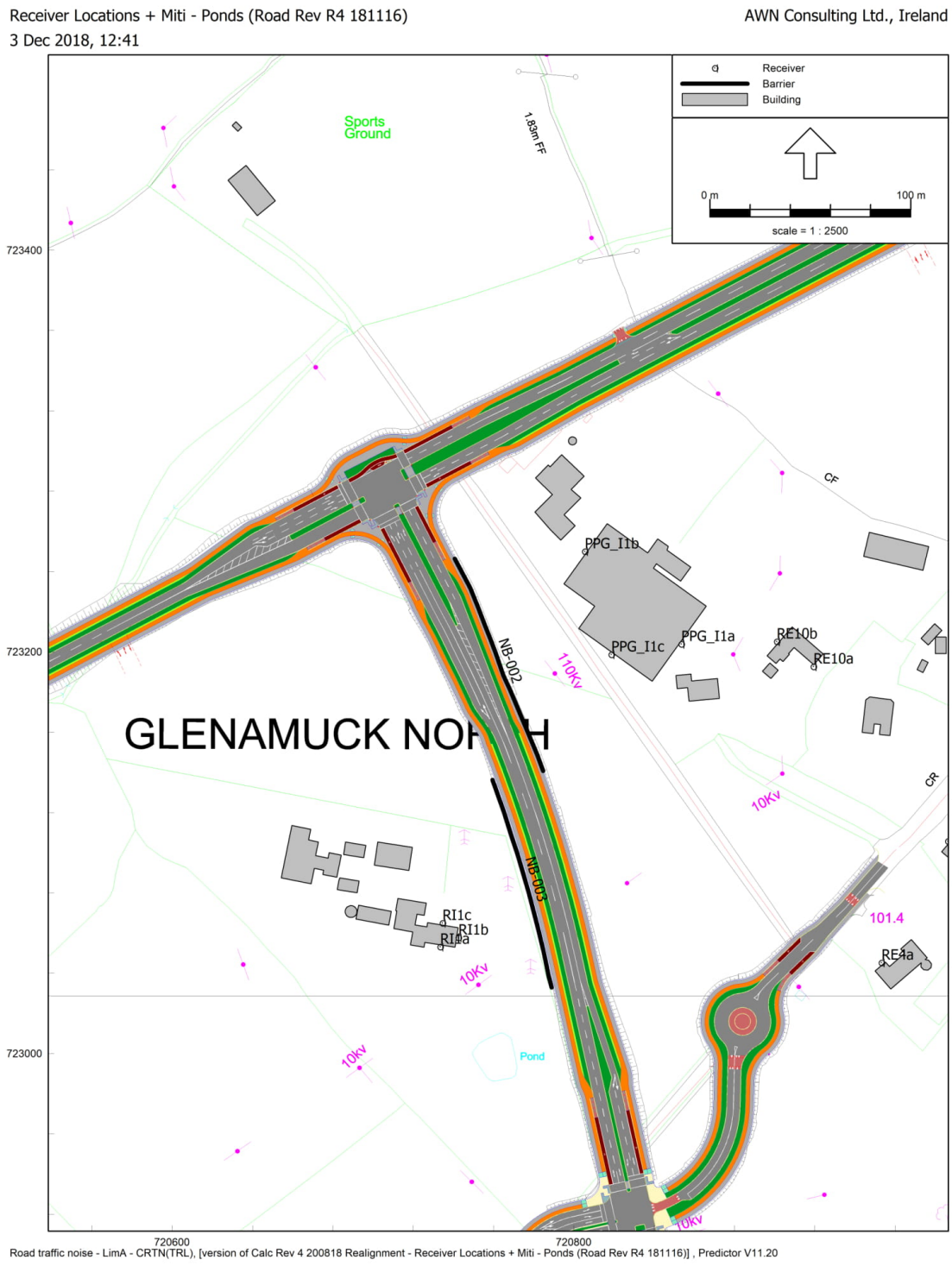

Figure 9-7: Barriers NB-002/NB-003 to West and East of GLDR (N)

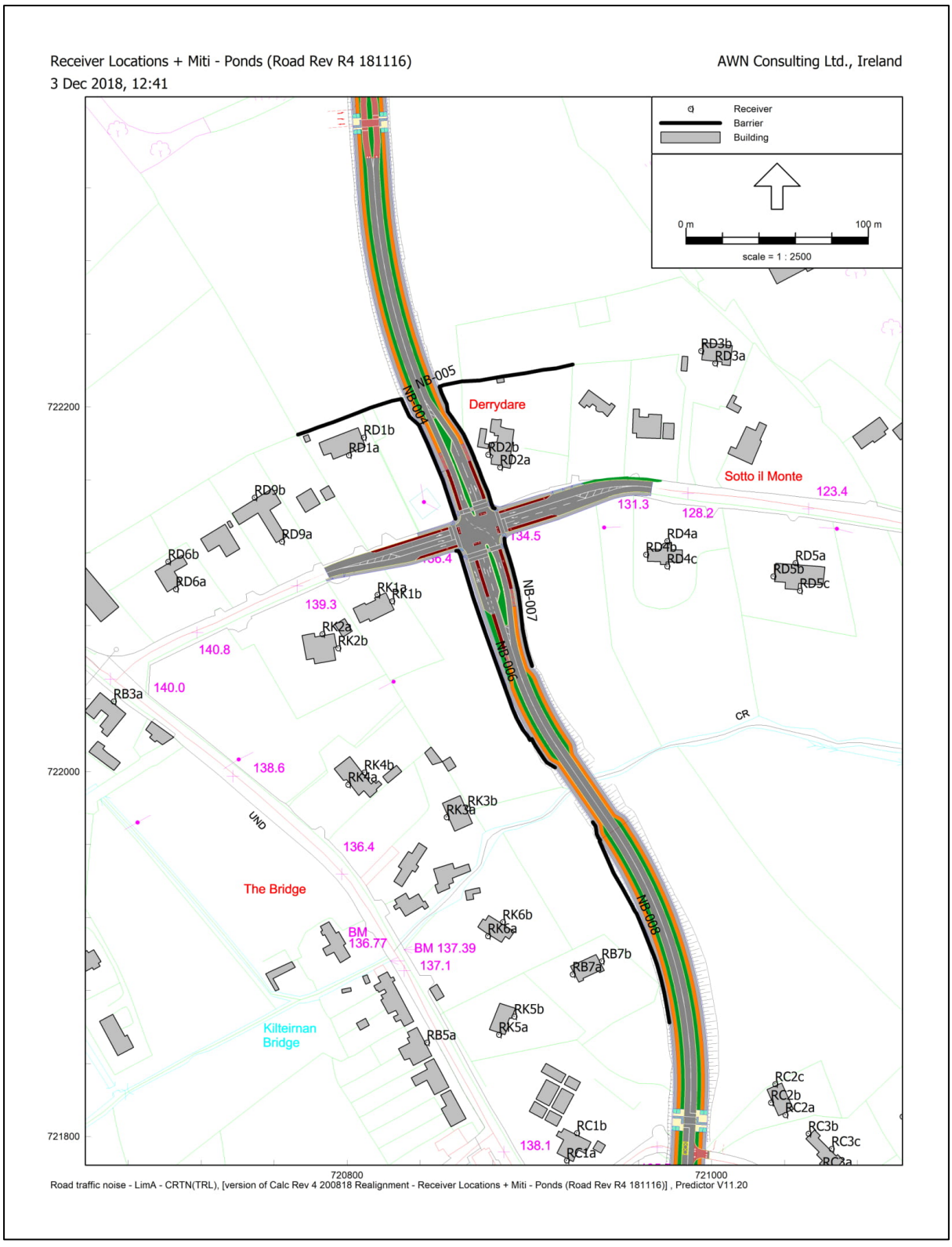

Figure 9-8: Barriers NB-004 to NB-008 West/East of GLDR (S)

Table 9-12: Predicted Post Mitigation Noise Levels at Receptors Requiring Mitigation

Receiver Location Reference	Design Year 2035 L_{den} (dB)		
	Unmitigated		Mitigated
	Do Minimum	Do Something	Do Something
RB7b	49	63	61
RD1b	52	63	60
RD2a	62	67	65
RD2b	58	67	65
RD4b	58	63	62
RE6b	51	64	61
RE7b	47	62	59
RI1b	57	62	61
RK1b	59	63	61
RK3b	50	61	59
PPG_I1c	54	61	60

In relation to 8 no. receivers (RB7b, RD1b, RE7b, RE7b, RI1b, RK1b, RK3b and PPG_1c) the proposed barriers are sufficient to reduce the variation in noise levels between the design goal of 60dB L_{den} and the mitigated Do Something Scenarios by equal or less than 1dB.

At 2 no. receivers (RD2a/b and RD4b), immediately to the East of the Ballycorus Road, the inclusion of a barrier along a section of the new road reduces the Mitigated Do Something to between 62dB to 65dB L_{den} respectively. It is important to note that the existing road contributes 58dB to 62dB L_{den} in the Do Minimum Scenario.

The guidance notes that the benefit gained by the insertion of a barrier is limited and notes that caution should be exercised specifying substantial screening where small benefits (<3dB) are only achieved, given a change of 3dB(A) is the smallest change that would give a reliable difference in public response.

It may also be prudent to consider if the benefit of the barriers in terms of noise reduction is proportionate to the potential visual intrusion and associated costs of such measures.

The most recent guidance from the TII in relation to Noise and Vibration has been published in the form of the *Good Practice Guide for the Treatment of Noise during the Planning of National Road Schemes (March 2014*). The TII/NRA GPG presents a discussion on the issue of "proportionality" and acknowledges that *"in some cases the attainment of the design goal may not be possible by sustainable means".*

In the context of the proposed mitigation measures, the above comments must be considered in the context of other issues relating to potential visual impacts and costs.

In terms of the change in noise experienced at properties assessed, reference is made to the DMRB's Volume 11, Section 3 which summarises the magnitude of impact relating to changes in road traffic noise, as previously outlined in Table 9-7.

Referring to the predicted impacts sets out in Table 9-8 and based on the classification of noise impacts outlined in Table 9-7, the following comments are made in relation to opening year 2020;

- Traffic noise level reductions or no changes were calculated between the Do Minimum and Do Something scenarios for the opening year at 47 receivers (59 modelled locations). These receivers were located on the existing roads e.g. North and South on the Enniskerry Road, the front facades of receivers East and West on the Glenamuck Road and the front facades of receivers to the West on Ballycorus Road.

- Traffic noise level increases of between 0.1 and 4.9dB L_{den} are calculated between the Do Minimum and Do Something scenarios for the opening year at 25 receivers (34 modelled locations). The magnitude of change in noise levels is deemed to be negligible to minor. The overall noise levels are, however, calculated to be below/meet the TII design goal for national roads of 60dB L_{den} for the majority of the receivers, with the exception of some properties along the R117 Enniskerry Road (N) Junct. To GDDR, Ballycorus Road and GLDR Link Junct. with R117 (S) link road.

- Traffic noise level increases of between 5 and 9.9dB L_{den} are calculated between the Do Minimum and Do Something scenarios for the opening year at 12 receivers (13 modelled locations). The magnitude of change in noise levels is deemed to be moderate. The overall noise levels are, however, calculated to be below/meet the TII design goal for national roads of 60dB L_{den} for the majority of the receivers, including the receiver (PPG_F1) granted planning permission (planning ref: DA18A/0566) to West of GLDR Junct. Glenamuck Road. The rear façade of RD2b, located on the Ballycorus Road is the only locations whereby the TII design goal is exceeded (64 dB L_{den}).

- Traffic noise level increases of above 10dB L_{den} are calculated between the Do Minimum and Do Something scenarios for the opening year at 8 receivers. The magnitude of change in noise levels is deemed to be major. The overall noise levels are calculated to be below/meet the TII design goal of 60dB L_{den} for the majority of the receivers, including the receiver (PPG_I) granted planning permission (planning ref: DA09A/0316) to West of GLDR (N) GLDR Road. There are two locations whereby the TII design goal is exceeded, namely the rear façade of RB7b, located on the GLDR Junct. Barnaslingan Lane (62 dB L_{den}) and the rear façade of RE6b, located on Glenamuck Road (E) (61 dB L_{den}).

On analysis of the Do Something Scenario 2020, a total of 3 receivers (4 modelled locations) met the TII criteria for noise mitigation i.e. RB7b, RD2a/b and RE6b. The suitable mitigation, as outlined inTable 9-8 enables the noise threshold set out in the TII guidance document to be met at all 3 receivers. The provision and type of barrier used will be determined in conjunction with relevant landowners at accommodation works stage.

Based on the classification of noise impacts outlined in Table 9-7, the following comments are made in relation to design year 2035;

- Traffic noise level reductions or no changes were calculated between the Do Minimum and Do Something scenarios for the opening year at 45 receivers (57 modelled locations). These receivers were located on the existing roads e.g. North and South on the Enniskerry Road, and the front facades of receivers East and West on the Glenamuck Road.

- A negligible increase in traffic noise (0.1 – 2.9dB increase) is calculated at 17 of the receivers (21 modelled locations). The overall noise levels are, however, calculated to be below/meet the TII

design goal for national roads of 60dB L_{den} for the majority of the receivers, with the exception of some front facades of properties along the R117 Enniskerry Road (N) Junct. To GDDR and the Ballycorus Road.

- A minor increase in traffic noise (3 – 4.9dB increase) is calculated at 9 of the receivers (11 modelled locations). The overall noise levels are calculated to be below/meet the TII design goal of 60dB L_{den} for 8 of the receivers. The front and rear façade of RK1a/b, located 45m to the West of the GLDR Junction with Ballycorus Road, is the only receiver whereby the TII design goal is exceeded (63 dB and 65dB respectively).

- A moderate increase in traffic noise (5 – 9.9dB increase) is calculated at 12 of the receivers (16 modelled locations). The overall noise levels are calculated to be above the TII design goal of 60dB L_{den} for 5 receivers, namely the properties immediately to the East of the Ballycorus Road (RD2a/b and RD4b), the closest façade to the GLDR (N) Road (RI1b) and the rear façade of the receiver (PPG_Ic) at the site granted planning permission (planning ref: DA09A/0316) to East of GLDR (N) Road.

- A major increase in traffic noise (+10dB increase) is calculated at 9 of the receivers. The overall noise levels are calculated to be below/meet the TII design goal of 60dB L_{den} at four of the receivers, with the major increase in traffic noise particularly along the rear facade of properties located on the Glenamuck Road (RE6b, RE7b) and at those properties closest to the GLDR link road (RB7b, RD1b, and RK3b).

As the "Do Something" noise level at 10 no. receivers (11 modelled locations) is above 60dB L_{den} and is increased by 1dB or more as a direct result of the proposed road development, the criteria is met for mitigation at these locations based on the TII/NRA criteria for noise mitigation measures. Suitable mitigation, as outlined in Table 9-11 previously, enables the noise threshold set out in the TII guidance document to be met at 8 no. receivers, as illustrated in Table 9-12. The provision and type of barrier used will be determined in conjunction with relevant landowners at accommodation works stage.

Two receivers (RD2a/b and RD4b) have predicted L_{den} values between 3dB to 7dB above the TII design goal of 60dB L_{den}. The benefits gained by a 2.5m barrier is minimal (<3dB) due to the existing contribution of noise from the existing Ballycorus Road, however privacy from new road layout to rear of properties may be an important factor considered by the landowners at these locations. As per the TII guidance in relation to "proportionality" it may not be possible to attain the design goal of 60dB L_{den} at these two receivers through sustainable means. The mitigation benefits gained increasing the barrier height in these two locations greater than 2.5m is disproportionate to the potential visual intrusion of the barriers. Again, the provision and type of barrier used will be determined in conjunction with relevant landowners at accommodation works stage.

9.5.2 Construction Noise Mitigation Measures

The contract documents will clearly specify that the Contractor undertaking the construction of the works will be obliged to take specific noise abatement measures and comply with the recommendations of BS5228-1 2009 +A1 2014. These measures will typically include:

- No plant used on site will be permitted to cause an ongoing public nuisance due to noise.

- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.
- Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.
- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.
- Any plant, such as generators or pumps, which is required to operate before 07:00hrs or after 19:00hrs will be surrounded by an acoustic enclosure or portable screen.
- During the course of the construction programme, supervision of the works will include ensuring compliance with the limits detailed in Table 9-1 using methods outlined in BS5228:2009 *Part 1.*
- Erecting portable screens around noisy items of plant in noise sensitive areas, where required.

Working Hours

Normal working times will be 07:00 to 19:00hrs Monday to Saturday. Works other than the pumping out of excavations, security and emergency works will not be undertaken outside these working hours without the written permission of the Contracting Authority.

Works other than the pumping out of excavations, security and emergency works will not be undertaken at night and on Sundays without the written permission of the Contracting Authority.

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.

9.6 Residual Impacts

9.6.1 Construction Phase

During the construction phase of the project there is potential for some temporary moderate to major impacts on a limited number of properties between 10m to 50m distance from construction works. The application of binding noise limits and hours of operation, along with implementation of appropriate noise control measures, will ensure that noise impact is controlled to within the relevant criteria.

The probability of effects from construction noise are considered and a description of the effects are summarised in Table 9-13.

Table 9-13: Description of Construction Phase Effects

Quality	Significance	Duration
Negative	Moderate/Major	Short-term

9.6.3 Operational Phase

For two thirds of the modelled locations in the vicinity of the proposed development, residual noise levels will result in reduced, no change or negligible noise impacts. At 19 no. receivers where the residual impacts result in minor to major noise impacts, the operational noise levels at these properties are calculated to be below or within 1dB of the traffic noise design goal set for national road schemes of 60dB L_{den}.

During the course of the assessment, it was shown that the predicted noise levels at 10 receivers meet the specified TII Noise Mitigation Criteria. In this instance, mitigation measures have been specified for the design year 2035. Once such measures are implemented, it was shown that at 9 receivers comply with the adopted criterion. The probability of effects from the operational phase of the proposed road are likely and a description of effects are summarised in Table 9-14.

Table 9-14: Description of Operational Phase Effects at 9 no. Receivers Meeting TII Mitigation Criteria

Quality	Significance	Duration
Negative	Negligible	Long-Term

One receiver (RD2a/b) along the Ballycorus road does not comply with the 60dB L_{den} criteria without the use of dipropionate height barriers. The TII's *Good Practice Guidance to the Treatment of Noise during the Planning of National Road Proposed Road Schemes* (2014) provides guidance that *"above a height of 3m, a structure becomes a significant structure, requiring engineering to be considered. This does not rule out the use of higher barriers, but it may be necessary to use professional judgement to compare."* In this instance, the use of proportionality with respect to engineering and other environmental considerations should be carefully considered when assessing the justification for noise barriers with limited acoustic benefit.

The probability of effects from the operational phase of the proposed road on the receiver at RD2a/b are likely and a description of effects are summarised in Table 9-15.

Table 9-15: Description of Operational Phase Effects at 1 no. Receiver Meeting TII Mitigation Criteria

Quality	Significance	Duration
Negative	Moderate	Long-Term

It may be concluded that the project complies with the appropriate guidance in relation to noise, hence the associated impact in the Operational Phase is Negligible, with the exception of one receiver on the Ballycorus Road.

Difficulties Encountered

No difficulties noted.

References

- British Standards (2009a) BS 5228 – 1: 2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise.*
- British Standards (2009b) BS 5228-2:2009+A1 2014: *Code of practice for noise and vibration control on construction and open sites – Vibration.*
- Department for Transport, Tourism and Sports (2013) *Design Manual for Urban Roads and Streets* (DMRUS).
- Environmental Protection Agency (EPA) (Draft August 2017) *Guidelines on the Information to be contained in Environmental Impact Assessment Reports.*
- EPA (Draft, September 2015) *Advice Notes for Preparing Environmental Impact Statements.*
- National Roads Authority/TII (2004) *Guidelines for the Treatment of Noise and Vibration in National Road Schemes*
- National Roads Authority/TII (2014) *Good Practice Guide for the Treatment of Noise during the Planning on National Road Schemes*.