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N24 CARRICK ROAD IMPROVEMENT SCHEME

NOISE AND VIBRATION IMPACT ASSESSMENT

Technical Report Prepared For

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EXECUTIVE SUMMARY

AWN Consulting Ltd. was commissioned to investigate the potential noise impacts associated with the proposed N24 Carrick Road Improvement Scheme. The potential impacts and the outcome of the assessment are summarised below.

A baseline noise survey was undertaken to measure existing traffic noise levels at the closest properties within the study area. A total of 6 locations were surveyed: one unattended and 5 attended. The results of the baseline survey confirm that properties along the existing road network experience traffic noise levels above 60 dB L_{den}. Calculated L_{den} values at the attended survey locations ranged from 76 to 79 dB L_{den}. The measured L_{den} value at the unattended survey location was 67 dB L_{den}. Traffic noise from the existing N24 was the primary noise contributor.

To determine the potential noise impact of the proposed road alignment, a 3D noise model of the existing adjacent road network and the proposed road alignment was developed for the future traffic years of 2024 (the opening year) and 2039 (the design year). Road traffic noise levels were predicted at 25 properties within the study area using the projected traffic flows for the two assessment years. It was determined that mitigation is required to reduce traffic noise levels at one location, R018b.

Noise mitigation in the form of a noise barrier along the road edge closest to this property has been proposed and modelled to reduce traffic noise levels to below the TII design goal of 60 dB $L_{den.}$ With the proposed mitigation in place, it may be concluded that the project complies with the appropriate guidance in relation to noise, hence the associated impact is considered acceptable.

The magnitude of traffic noise change has been determined for the assessment locations using guidance from the UK's Design Manual for Roads and Bridges (DMRB) Noise and Vibration 2020 document. The assessment has determined that once operational, the noise impact associated with the new road alignment will result in a negligible to moderate negative impact during the long term period at some assessment locations. A number of locations experience a major positive noise impact as the proposed road scheme is at a greater distance than the existing road.

Indicative calculations have been made to estimate the range of likely noise levels during the construction phase of the project. The application of noise limits, controlled hours of operation, along with implementation of appropriate noise control measures, have indicated that the construction noise impact will be short-term moderate to major impact.

1.0 INTRODUCTION

This report assesses the potential noise impacts associated with the construction and operational phases relating to the proposed N24 Carrick Road Improvement Scheme in Co. Kilkenny. An assessment is made of the requirements and opportunities for noise mitigation.

The scheme covers a length of approximately 2 km and realigns the N24 in the area between Mooncoin and the Grange Road junction.

2.0 METHODOLOGY

In order to assess the noise impact of the proposed road development, the following methodology has been adopted:

- Baseline noise monitoring has been undertaken in the vicinity of the proposed road development in order to characterise the existing noise environment;
- A review of the most applicable standards and guidelines has been carried out in order to set a range of acceptable noise criteria for the construction and operational phases of the proposed road development;
- Predictive calculations relating to construction phase impacts have been undertaken at the nearest sensitive locations to the development site in accordance with British Standard BS5228 Code of Practice for Noise and Vibration Control on Construction and Open Sites. Part 1 – Noise (2009 +A1 2014);
- Operational noise levels at the closest noise sensitive locations to the proposed road development during the opening and future assessment years have been predicted in accordance with guidance set out in Calculation of Road Traffic Noise (CRTN) and the relevant conversion methodologies prescribed by TII for calculating road traffic in terms of the L_{den} parameter;
- Noise levels associated with the construction and operational phases have been reviewed against relevant standards and guidelines for noise to determine the potential impacts of both phases;
- A schedule of mitigation measures is proposed, where required or practicable, to reduce the identified potential noise impacts associated with the proposed development.

3.0 ASSESSMENT CRITERIA

3.1 Operational Phase

3.1.1 Kilkenny County Council Noise Action Plan (2019 - 2023)

The Kilkenny County Council Noise Action Plan (NAP) 2019 – 2023 relates to the management of environmental noise in accordance with the Environmental Noise Directive (END) (2002/49/EC). The purpose of the NAP is to manage and reduce, where necessary, environmental noise through the adoption of the action plans. It is important to note that Kilkenny's only major noise source for the purpose of this plan is major roads.

The NAP does not include any local guidelines relating to noise criteria from new road developments. Section 3.1.4 of the plan refers to the *Transport Infrastructure Ireland (TII) Guidelines for the Treatment of Noise and Vibration in National Road Schemes.*

In Section 7, *Identification of Areas to be subject to Noise Management Activities,* the action plan summarises the onset assessment levels relating to road traffic which are prescribed by the EPA. The proposed onset levels for assessment of noise mitigation measures are as follows:

- 57 dB L_{night}
- 70 dB L_{den}

For assessment of noise level preservation where the existing levels are good, the levels are set as:

- 45 dB L_{night}
- 55 dB L_{den}

Where locations are identified to be exposed to traffic noise levels above these thresholds during the noise mapping process, they will form part of a priority decision support matrix which takes into account factors such as the noise exposure level, type of noise receptor, the type of noise source and the number of people affected. It enables a number of different factors to be examined and facilitates the assessment of the relative importance of each. Noise mitigation or management is then considered where necessary, feasible and cost effective.

3.1.2 Criteria for National Road Projects

There are no statutory guidelines or standards for noise in Ireland applicable for new or existing road schemes. As referred to with the Kilkenny County Council NAP, 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 60 dB L_{den} (free field residential façade criterion i.e. without the influence of building reflections).

The following three conditions must be satisfied under the TII 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 60 dB L_{den};
(b) the relevant noise level is at least 1 dB more than the expected traffic noise level without the proposed road scheme in place, and;
(c) the contribution to the increase in the relevant noise level from the proposed road scheme is at least 1 dB.

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 caution should be exercised specifying substantial screening where small benefits (<3 dB) are only achieved, given a change of 3 dB(A) "*is the smallest change that would give a reliable difference in public response".*

Similarly, it may not always be practicable to achieve the design goal of 60 dB L_{den} due to a variety of constraints, particularly for properties along existing trafficked roads, where access to properties is required directly onto roads, and/or where the alignment is in close proximity to residential buildings which bound the upgraded sections of existing regional roads.

3.1.3 Evaluation of Impacts

In the absence of any Irish guidelines or standards relating to describing the effects associated with changes in road traffic noise levels, reference has been made to the UK's Design Manual for Roads and Bridges (2020) LA 111 Sustainability & Environmental Appraisal. Noise and Vibration Rev 2 (DMRB Noise and Vibration 2020 document). This document provides magnitude rating tables relating to changes in road traffic noise. The document suggests that during the year of opening (the short-term period), the magnitude of impacts between the Do-Minimum and the Do-Something scenarios are likely to be greater compared to the longer term period when people become more habituated to the change.

Table 1 summarises the classification of magnitude of impacts relating to traffic changes which are assessed against the "Short-term" period, i.e. the year of opening in accordance with within the DMRB guidance.

Change in Noise Level, dB	Short Term Magnitude of Impact
Less than 1.0	Negligible
1.0 to 2.9	Minor
3.0 to 4.9	Moderate
Greater than or equal to 5.0	Major

Table 1 Classification of Magnitude of Short-term Noise Impacts

Further consideration of the magnitude of change in noise levels are determined for the long-term period. For this assessment year (design year 2028), a 3 dB change is the smallest that is considered perceptible. Table 2 summarises the likely impact associated with defined changes in traffic noise level between the Do Minimum and Do Something scenarios during the long-term period.

Change in Noise Level, dB	Magnitude of Impact
Less than 3.0	Negligible
3.0 to 4.9	Minor
5.0 to 9.9	Moderate
Greater than or equal to 10.0	Major

Table 2 Classification of Magnitude of Long-term Noise Impacts

3.2 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 3.

Days & Times	$L_{Aeq\ (1hr)}$ dB	L_{Amax} dB(A)
Monday to Friday 07:00 to 19:00hrs	70	80
Monday to Friday 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

Table 3 Maximum Recommended Noise Levels at the Façade of Nearby Dwellings during Construction

With regards to construction vibration, the TII guidelines outline the following limits in respect of ensuring that no cosmetic damage occurs to buildings in the vicinity of construction works.

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

Table 4 Allowable vibration during road construction in order to minimise the risk of building damage

4.0 DESCRIPTION OF EXISTING CONDITIONS

The proposed road improvement scheme commences at the west end of Mooncoin, Co. Kilkenny and stays along the existing road alignment for approximately 350 m before turning offline in a north-westward direction. It continues with an orientation approximately parallel to the existing N24 for approximately 1.3 km before turning in a south-westward direction to tie back in with the existing N24.

4.1 Baseline Noise Survey

A baseline noise study has been undertaken within the study area in order to provide a context of the typical noise environment and to determine the main contributors to the existing environment. The surveying was completed in accordance with relevant guidance and standards including:

- Guidelines for the Treatment of Noise and Vibration in National Road Schemes (TII, 2004);
- Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes (TII, 2014);
- Calculation of Road Traffic Noise Shortened Measurement Procedure (CRTN 1988); and
- ISO 1996-2: 2017 Acoustics – Description, Measurement and Assessment of Environmental Noise – Part 2 Determination of sound pressure levels.

4.1.1 Survey Locations

Survey locations were chosen to represent noise levels at the closest noise sensitive locations to the proposed road improvement scheme. The survey comprised one unattended monitoring station and five attended monitoring locations along the relevant portion of the existing N24. The monitoring positions are described in Table 5 and illustrated in Figure 1.

Location	Survey Type	Description of Survey Location
UN01	Unattended	Within side garden of house on north side of existing N24
AT01	Attended	At entrance to driveway of house on south side of existing N24 at the west end of the scheme
AT02		At entrance to house on north side of existing N24 just east of Grange Road junction
AT03		In lay-by on north side of existing N24 near the centre of the scheme
AT04		At entrance to field, on north side of existing N24
AT05		At entrance to house on north side of existing N24 at east end of the scheme

Table 5 Noise Survey Locations

Figure 1 Baseline Noise Survey Locations

4.1.2 Survey Periods

Attended surveys were undertaken during the following periods:

- AT01 to AT05 on 25 February 2021 between 10:00 and 15:00hrs.

Unattended surveys were undertaken during the following period:

- UN01 between 10:00hrs on 25 February and 10:00hrs on 26 February 2021.

4.1.3 Unattended Noise Survey Procedure

The unattended noise survey (UN01) was conducted using a Rion NL-52 Sound Level Meter with Environmental Outdoor Kit. The measurement apparatus was calibrated before and after the survey using a Brüel & Kjær Type 4231 Sound Level Calibrator. The results were saved to the instrument memory for later analysis.

The L_{den} value from this monitoring data set is derived directly from the measured $L_{Aeq,}$ values and using the following formula:

$$L_{\text{den}} = 10log\left(\frac{1}{24}\right)\left(12 * \left(10^{\frac{Lday}{10}}\right) + 4 * \left(10^{\frac{Levening+5}{10}}\right) + 8 * \left(10^{\frac{Lnight+10}{10}}\right)\right)$$

Where:

- L_{day} is the A-weighted long-term average sound level as defined in ISO 1996 (2017) Description, measurement and assessment of environmental noise.

Part 2: Determination of sound pressure levels, determined over all of the day periods of a year. This is defined as the period between 07:00 and 19:00hrs;

- $L_{evening}$ is the A-weighted long-term average sound level as defined in ISO 1996-2, determined over all the evening periods of a year. This is defined as the period between 19:00 and 23:00hrs; and
- L_{night} is the A-weighted long-term average sound level as defined in ISO 1996-2:2017, determined over all the night periods of a year. This is defined as the period between 23:00 and 07:00 hrs.

The average sound levels are based on the L_{Aeq} parameter. This is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period (T). The time period, T, in this instance is 1 hour, i.e. $L_{Aeq,1\ hour}$.

4.1.4 Attended Noise Surveys

Attended measurements were performed using a Brüel & Kjær 2250L Sound Level Meter. Measurements were conducted at five survey locations on a cyclical basis. Sample periods were 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 short-term measurement procedure as specified in the TII noise guidance documents. When surveying traffic noise, the acoustical parameters of interest are the $L_{Aeq(T)}$, $L_{A10(T)}$ and $L_{A10(18hour)}$, expressed in terms of decibels (dB) relative to $2x10^{-5}$Pa.

The value of $L_{A10(T)}$ is the noise level exceeded for just 10% of the time over a representative time period within a sample hour 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. $L_{A10(18hour)}$ is the parameter typically used for the purposes of assessing traffic noise.

The shortened measurement procedure involves a method whereby $L_{A10(18hour)}$ and L_{den} 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 1 dB from the arithmetic average of the three hourly sample L_{A10} values, i.e.
- $L_{A10(18hour)} = ((\sum L_{A10(15\ minutes)}) \div 3) - 1$ dB; and
- The derived L_{den} value is calculated from the $L_{A10(18hour)}$ value, i.e.
- $L_{den} = 0.86 \times L_{A10(18hr)} + 9.86$ dB;

4.1.5 Survey Parameters

The survey results are presented in terms of the following parameters.

$L_{Aeq,T}$ is the A-weighted equivalent continuous steady sound level during the sample period and effectively represents an average value. T relates to the sample duration.

$L_{A10,T}$ is the A-weighted sound level that is exceeded for 10% of the sample period; this parameter gives an indication of the upper limit of fluctuating noise such as that from road traffic. T relates to the sample duration.

4.2 Results of Noise Surveys

Table 6 and Table 7 summarise the results of the baseline noise survey. Full survey results for the unattended survey conducted at Location UN01 are graphed in Appendix A.

The results of the attended surveys indicate noise levels in the range 76 to 79 dB L_{den}. The measured L_{den} value from the unattended survey at UN01 was 67 dB L_{den}.

Road traffic from the existing N24 was by far the primary noise contributor. Minor noise from a nearby site was a secondary contributor at Location AT03. The range of noise levels measured is considered typical of the environment under assessment.

Survey Location Reference	Start Time	Measured Noise Levels (dB re.2x10^{-5} Pa)		Calculated $L_{A10,18hr}$ dB	Calculated L_{den}, dB	Description of Noise Environment
		L_{Aeq}	L_{A10}			
AT01	10:00	74	79	79	78	Road traffic N24
	10:58	76	80			
	11:55	76	80			
AT02	10:17	75	79	79	78	Road traffic N24
	11:17	76	80			
	12:13	77	81			
AT03	10:40	74	77	77	76	Road traffic N24, occasional noise from nearby site (possibly cement mixer).
	11:36	74	79			
	12:33	74	78			
AT04	12:54	75	78	77	76	Road traffic N24
	13:29	74	78			
	14:04	74	77			
AT05	13:11	78	82	80	79	Road traffic N24
	13:46	77	81			
	14:21	76	81			

Table 6 Baseline Attended Noise Survey Results

Survey Location Reference	Date	Measured Noise Levels (dB re.2x10^{-5} Pa)			Measured L_{den}, dB	Description of Noise Environment
		L_{day}	$L_{evening}$	L_{night}		
UN01	25-26 February 2021	66	62	59	67	Road traffic along existing N24

Table 7 Baseline Unattended Noise Survey Results

5.0 NOISE IMPACT ASSESSMENT

5.1 Operational Phase

5.1.1 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 link road. 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 TII guidance.

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 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.

Input to the Noise Model

The noise model was prepared using 3D road alignment drawings, topographical data, Ordnance Survey mapping and traffic flow data. Table 8 summarises the traffic flow volumes used for the opening and design year impact assessments for the following scenarios.

- Year 2024 – Do Minimum Scenario – N24 Realignment not built;
- Year 2024 – Do Something Scenario – N24 Realignment;
- Year 2039 – Do Minimum Scenario – N24 Realignment not built, and;
- Year 2039 – Do Something Scenario – N24 Realignment.

The speed limit along the proposed N24 Realignment is modelled at 70 km/h for the first 450 m at the eastern end and 100 km/h for the remainder.

Road Link	2017 Baseline	Do Nothing 2024	Do Something 2024	Do Nothing 2039	Do Something 2039	DS 2039 % HGV
	AADT	AADT	AADT	AADT	AADT	
New N24 Section	7875	8642	8642	10051	10051	6.8%
Old N24 Carrick Road	7875	8642	8642	10051	10051	6.8%

Table 8 Traffic Volumes used for Noise Impact Assessment

The AADT values have been broken into 24 hourly periods using the TII standard diurnal profiles. The hourly noise predictions were conducted in accordance with Method A of the TII guidelines.

5.1.2 Impact Assessment Model

Free-field traffic noise levels have been predicted at 25 properties in the vicinity of the proposed road improvement. In certain cases, two receptors have been located at a single dwelling, for example at R013, where R013a is placed at the façade facing the existing road and R013b is placed at the rear of the house facing the proposed road. Figure 2 shows the receiver locations.

5.1.3 Model Results

The results of the traffic noise predictions are presented in Table 9 for the opening year (2024) and the design year (2039). The results are compared against the three TII criteria for determining the requirement for noise mitigation discussed in Section 3.1.2. These are re-iterated below for clarity:

(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 60 dB L_{den};
(b) the relevant noise level is at least 1 dB more than the expected traffic noise level without the proposed road scheme in place, and;
(c) the contribution to the increase in the relevant noise level from the proposed road scheme is at least 1 dB.

The associated magnitude of change in road traffic between the Do Minimum and Do Something scenarios are presented for the short-term period for the year of opening and for the long term period for the design year.

Figure 2 Noise Model Receiver Locations

Location Ref.	Opening Year 2024		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?	Magnitude of Change Short term	Design Year 2039		TII Condition for Noise Mitigation Satisfied?			Mitigation Required ?	Magnitude of Change Long term
	Predicted Noise Level							Predicted Noise Level						
	Do Minimum	Do Something						Do Minimum	Do Something					
	L_{den} (dB)	L_{den} (dB)	(a)	(b)	(c)			L_{den} (dB)	L_{den} (dB)	(a)	(b)	(c)		
R001	61	61	Yes	No	Yes	No	Negligible	62	62	Yes	No	Yes	No	Negligible
R002	60	59	No	No	Yes	No	Minor Positive	61	60	No	No	Yes	No	Negligible
R003	62	61	Yes	No	Yes	No	Minor Positive	63	62	Yes	No	Yes	No	Negligible
R004	61	61	Yes	No	Yes	No	Negligible	62	62	Yes	No	Yes	No	Negligible
R005	58	59	No	No	Yes	No	Minor Negative	59	59	No	No	Yes	No	Negligible
R006	61	62	Yes	No	Yes	No	Minor Negative	62	63	Yes	No	Yes	No	Negligible
R007	64	65	Yes	No	Yes	No	Minor Negative	65	66	Yes	No	Yes	No	Negligible
R008	64	63	Yes	No	Yes	No	Minor Positive	65	64	Yes	No	Yes	No	Negligible
R009	73	69	Yes	No	Yes	No	Moderate Positive	74	70	Yes	No	Yes	No	Minor Positive
R010	68	66	Yes	No	Yes	No	Minor Positive	69	67	Yes	No	Yes	No	Negligible
R011	62	58	No	No	Yes	No	Moderate Positive	63	59	No	No	Yes	No	Minor Positive
R012	65	56	No	No	Yes	No	Major Positive	66	57	No	No	Yes	No	Moderate Positive
R013a	70	50	No	No	Yes	No	Major Positive	71	51	No	No	Yes	No	Major Positive
R013b	55	60	No	Yes	Yes	No	Major Negative	56	60	No	Yes	Yes	No	Minor Negative
R014a	62	49	No	No	Yes	No	Major Positive	63	49	No	No	Yes	No	Major Positive
R014b	54	59	No	Yes	Yes	No	Major Negative	55	60	No	Yes	Yes	No	Moderate Negative

Location Ref.	Opening Year 2024		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?	Magnitude of Change Short term	Design Year 2039		TII Condition for Noise Mitigation Satisfied?			Mitigation Required ?	Magnitude of Change Long term
	Predicted Noise Level							Predicted Noise Level						
	Do Minimum	Do Something						Do Minimum	Do Something					
	L_{den} (dB)	L_{den} (dB)	(a)	(b)	(c)			L_{den} (dB)	L_{den} (dB)	(a)	(b)	(c)		
R015a	67	47	No	No	Yes	No	Major Positive	68	47	No	No	Yes	No	Major Positive
R015b	48	57	No	Yes	Yes	No	Major Negative	49	58	No	Yes	Yes	No	Moderate Negative
R016a	69	47	No	No	Yes	No	Major Positive	70	47	No	No	Yes	No	Major Positive
R016b	55	55	No	No	Yes	No	Negligible	56	56	No	No	Yes	No	Negligible
R017	60	54	No	No	Yes	No	Major Positive	61	55	No	No	Yes	No	Moderate Positive
R018a	70	54	No	No	Yes	No	Major Positive	71	55	No	No	Yes	No	Major Positive
R018b	50	60	No	Yes	Yes	No	Major Negative	50	61	Yes	Yes	Yes	Yes	Major Negative
R019a	71	47	No	No	Yes	No	Major Positive	72	48	No	No	Yes	No	Major Positive
R019b	54	57	No	Yes	Yes	No	Moderate Negative	55	58	No	Yes	Yes	No	Minor Negative
R020a	69	46	No	No	Yes	No	Major Positive	70	47	No	No	Yes	No	Major Positive
R020b	56	59	No	Yes	Yes	No	Moderate Negative	57	60	No	Yes	Yes	No	Minor Negative
R021a	70	44	No	No	Yes	No	Major Positive	71	45	No	No	Yes	No	Major Positive
R021b	57	56	No	No	Yes	No	Minor Positive	58	56	No	No	Yes	No	Negligible
R022	67	61	Yes	No	Yes	No	Major Positive	68	62	Yes	No	Yes	No	Moderate Positive
R023	63	65	Yes	Yes	Yes	No [Note A]	Minor Negative	64	65	Yes	Yes	Yes	No [Note A]	Negligible
R024	63	65	Yes	Yes	Yes	No [Note A]	Minor Negative	64	66	Yes	Yes	Yes	No [Note A]	Negligible

Location Ref.	Opening Year 2024		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?	Magnitude of Change Short term	Design Year 2039		TII Condition for Noise Mitigation Satisfied?			Mitigation Required ?	Magnitude of Change Long term
	Predicted Noise Level							Predicted Noise Level						
	Do Minimum	Do Something						Do Minimum	Do Something					
	L_{den} (dB)	L_{den} (dB)	(a)	(b)	(c)			L_{den} (dB)	L_{den} (dB)	(a)	(b)	(c)		
R025	69	70	Yes	No	Yes	No	Minor Negative	70	71	Yes	No	Yes	No	Negligible

Table 9 Assessment of Traffic Noise Levels for Opening and Design Years

Note A See discussion to follow for these locations where a minor noise increase is noted.

The results of the assessment indicate that, during the opening year, a total of two locations (R023 and R024) satisfy the TII requirement for noise mitigation. However, both locations only experience a minor change in traffic noise <2 dB).

During the design year, a total of three assessment locations (R018b, R023 and R024) satisfy the TII requirement for noise mitigation. A total of one assessment location (R018b) is likely to experience a major change in noise level during the long term period (≥10 dB). The other locations (R023 and R024) experience a negligible change in traffic noise <3 dB).

Figure 3 presents an overview of the level of significance associated with the change in noise level at all locations.

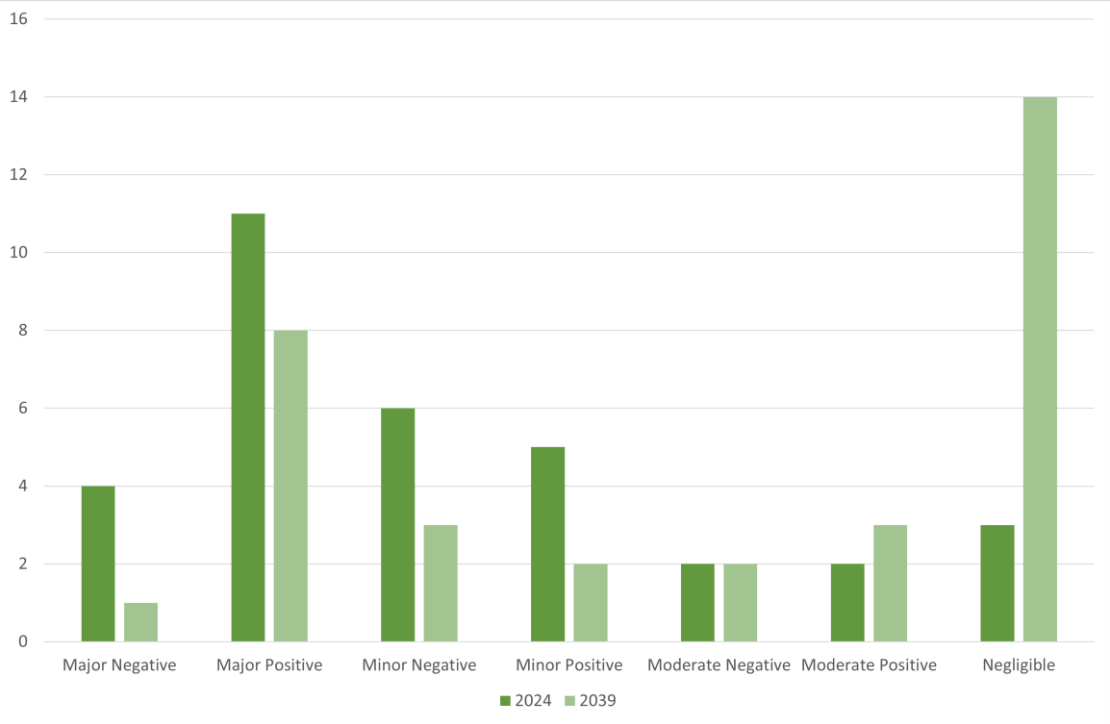


Figure 3 Level of Significance in Noise Level Change

There are a mix of impacts ranging from major positive and major negative to negligible. Mitigation is required to reduce the noise level at the properties identified previously in Table 9. Note that in accordance with the TII 2014 Good Practice Guide it is important to note that due to the very small change in noise level at locations R023 and R024 as a result of the scheme it would not be a sustainable solution to implement mitigation to reduce the noise levels by such a small margin, less than 2 dB in the design year. As a result mitigation is not considered necessary at these locations.

The mitigation measures proposed to reduce operational noise levels at those locations discussed above are set out in Section 6.1.

5.2 Construction Phase

Noise levels associated with construction may be calculated in accordance with methodology set out in BS5228 2009 + A1 2014: 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. It is often not possible, however, to conduct detailed prediction calculations for the construction phase of a project. 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 to ensure construction activities do not exceed the recommended noise criteria as set out in Table 3 in Section 3.2.

A variety of items of plant will be in use, such as excavators, loaders, dumper trucks, generators in addition to vehicular movements to and from the site that will make use of existing roads. Due to the nature of the activities undertaken on a road construction site, there is potential for generation of high levels of noise in close proximity to the works.

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 10 lists the sound power levels of the plant used for calculation of the expected noise level at various distances from the roadway. Construction noise calculations have been conducted at distances of 10 to 80m from the works for the main work phases. 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. A screening correction of 5 dB has been included in the calculations, assuming a partial screening from site hoarding along the site works.

Plant Item (BS5228 Ref.)	Sound Power Level, dB(A) re 10^{-12} W
Wheeled loader (C2.26)	107
Tracked excavator (loading dump truck) (C1.10)	113
Dozer (C.2.10)	108
Dump Truck Tipping fill (C2.30)	107
Articulated dump truck (dumping rubble) (C1-11)	108
Tracked excavator (C2.21)	99
vibration rollers (C5.20)	103
Asphalt Paver & Tipping Lorry (C.5.31)	105
Diesel Generator (C4.76)	89
Road Rollers (C5.19)	108

Table 10 Typical Construction Plant Sound Power Noise Levels

Table 11 to Table 13 set out the predicted noise levels during various phases of road construction at distances of 10 to 80m from the works.

Site Clearance & Preparation	Calculated $L_{Aeq,\,T}$ at distance from road (m)			
	10m	25m	50m	80m
Wheeled loader (C2.26)	72	64	58	54
Tracked excavator (loading dump truck) (C1.10)	78	70	64	60
Dozer (C.2.10)	73	65	59	55
Dump Truck (C2.30)	72	64	58	54
Combined L_{Aeq}	81	73	67	63

Table 11 Indicative Construction Noise Calculations during Site Clearance and Preparation

Excavation / Fill / Grading Works	Calculated $L_{Aeq,T}$ at distance from road (m)			
	10m	25m	50m	80m
Tracked excavator (loading dump truck) (C1.10)	78	70	64	60
Articulated dump truck (dumping rubble) (C1.11)	73	65	59	55
Wheeled loader (C2.26)	72	64	58	54
Dozer (C.2.10)	73	65	59	55
Dump Truck Tipping fill (C2.30)	72	64	58	54
Combined L_{Aeq}	81	74	68	63

Table 12 Indicative Construction Noise Calculations during Excavation and Fill Works

Road Works	Calculated $L_{Aeq,T}$ at distance from road (m)			
	10m	25m	50m	80m
Tracked excavator (C2.21)	64	56	50	45
Dump Truck (C2.30)	72	64	58	49
vibration rollers (C5.20)	68	60	54	42
Asphalt Paver & Tipping Lorry (C.5.31)	70	62	56	36
Diesel Generator (C4.76)	54	46	40	55
Road Rollers (C5.19)	73	65	59	57
Combined L_{Aeq}	76	72	71	70

Table 13 Indicative Construction Noise Calculations During Road Works

The results of the assessment have indicated that at distances of beyond 50m from the works, the construction daytime noise limit of 70 dB L_{Aeq} can typically be complied with for the scenarios assessed. At distances of up to 25m from the works, there is potential for the noise criterion to be exceeded in the absence of noise mitigation over and above the use of site hoarding. A small number of properties along the eastern end of the proposed road development are within 25m of the proposed works, hence the use of localised screening and the range of best practice mitigation measures set out in Section 6.2 will be employed to ensure the construction noise limits are not exceeded along the length of the scheme.

6.0 MITIGATION MEASURES

6.1 Operational Phase

In order to reduce operational noise levels at R018b it is proposed to introduce a noise barrier 1.25m high from chainage 1+040 to 1+100 on the northbound carriageway edge. See Figure 4 for extent relative to nearest receptors.

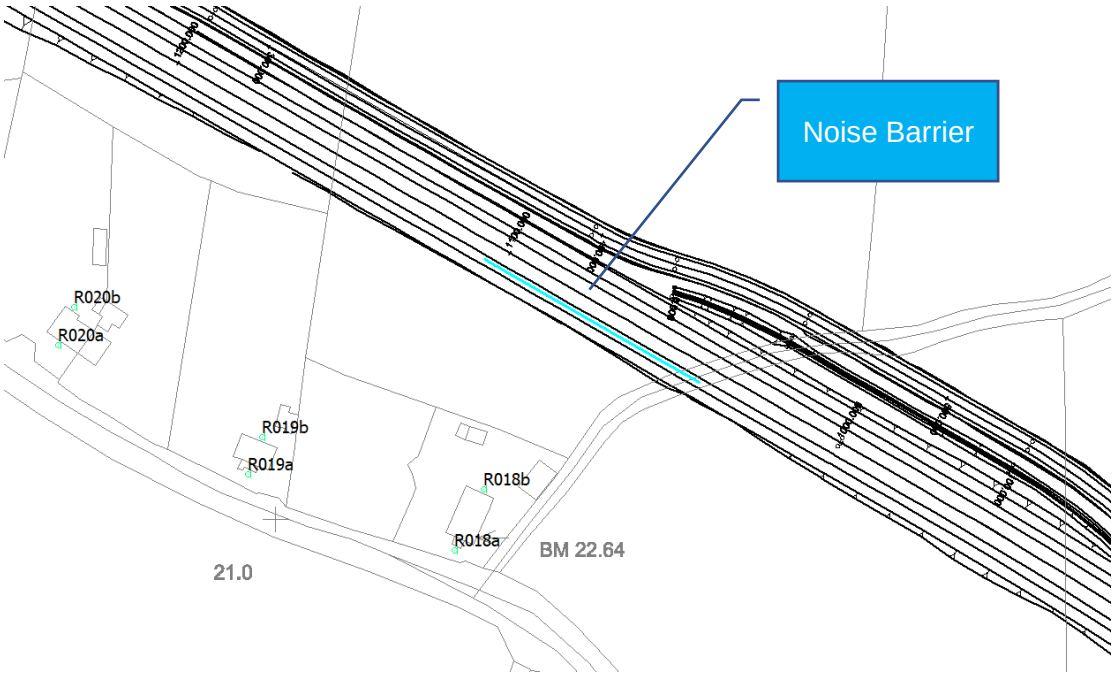


Figure 4 Noise Barrier Extent

The proposed mitigation measures consist of a noise barrier having a density of at least 10kg/m^2 and meeting category A3 in terms of absorptive characteristics as tested in accordance with BS EN 1793-1:2012 *Road Traffic Noise Reducing Devices. Test Method for Determining the Acoustic Performance Intrinsic Characteristics of Sound Absorption*.

6.2 Construction Phase

The contract documents will clearly specify the construction noise criteria included in this chapter which the construction works must operate within. The Contractor undertaking the construction of the works will be obliged to take specific noise abatement measures and comply with the recommendations of BS 5228-2009 +A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites, Parts 1 and 2 and the Noise and the European Communities (Noise Emission by Equipment for Use Outdoors) Regulations, 2001. These measures will ensure that:

- 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.

During the course of the construction programme, the contractor will be required to manage the works to comply with the limits detailed in Table 3 of this report. The following sections provide outline guidance on measures to control construction noise, in accordance with BS 5228 2009+A1 2014 Parts 1 and 2.

6.2.1 Selection of Quiet Plant

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 of plant will be selected wherever possible. Should a particular item of plant already on the site be found to generate high noise levels, the first action will be to identify whether or not said item can be replaced with a quieter alternative.

For static plant such as compressors and generators used at work areas such as construction compounds etc., the units will be supplied with manufacturers' proprietary acoustic enclosures where possible.

The contractor will evaluate the choice of excavation, breaking or other working method taking into account various ground conditions and site constraints. Where possible, where alternative lower noise generating equipment that would economically achieve, in the given ground conditions, equivalent structural/ excavation/ breaking results, these will be selected to minimise potential disturbance.

6.2.2 General Comments on Noise Control at Source

If replacing a noisy item of plant is not a viable or practical option, consideration will 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 or the best practice use of equipment and materials handling to reduce noise.

Proposed techniques will also be evaluated in light of their potential effect on occupational health and safety. The following outline guidance relates to practical noise control at source techniques which relate to specific site considerations:

- For mobile plant items such as cranes, dump trucks, excavators and loaders, the installation of an acoustic exhaust and/or maintaining enclosure panels closed during operation can reduce noise levels by up to 10 dB. Mobile plant will be switched off when not in use and not left idling;
- For percussive tools such as pneumatic concrete breakers, noise control measures include fitting a muffler or sound reducing equipment to the breaker 'tool' and ensuring any leaks in the air lines are sealed and erection of localised screens around breaker or drill bit when in operation in close proximity to noise sensitive boundaries or other suitable forms of noise reduction;
- For all materials handling, the contractor will ensure that best practice site noise control measures are implemented including ensuring that materials are not dropped from excessive heights;
- Where compressors, generators and pumps are located in areas in close proximity to noise sensitive properties/ areas and have potential to exceed noise criteria, these will be surrounded by acoustic lagging or enclosed within acoustic enclosures providing air ventilation;
- Resonance effects in panel work or cover plates can be reduced through stiffening or application of damping compounds; rattling and grinding noises can be controlled by fixing resilient materials in between the surfaces in contact;
- Demountable enclosures can also be used to screen operatives using hand tools and may be moved around site as necessary, and;

- All items of plant will be subject to regular maintenance. Such maintenance can prevent unnecessary increases in plant noise and can serve to prolong the effectiveness of noise control measures.

6.2.3 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 other forms of noise control. The effectiveness of a noise screen will depend on the height and length of the screen, its mass, 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 will be wrapped around the source.

BS 5228 -1:2009+A1 2014 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 will 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 10 kg/m^2 will give adequate sound insulation performance. As an example, the use of a standard 2.4m high construction site hoarding will provide a sufficient level of noise screening once it is installed at a suitable position between the source and receiver.

6.2.4 Working Hours

Normal working times will be 07:00 to 19:00hrs Monday to Friday and 08:00 to 13:00hrs on 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. This permission, if granted, can be withdrawn at any time should the working regulations be breached.

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

7.0 RESIDUAL IMPACT

7.1 Operational Phase

The residual impacts of the proposed scheme have been assessed taking into account the recommended noise mitigation measures set out in Section 6.1. Table 14 presents the residual noise impacts taking into account the proposed mitigation measures for noise.

Location Ref.	Opening Year 2024		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?	Magnitude of Change Short term	Design Year 2039		TII Condition for Noise Mitigation Satisfied?			Mitigation Required ?	Magnitude of Change Long term
	Predicted Noise Level							Predicted Noise Level						
	Do Minimum	Do Something						Do Minimum	Do Something					
	L_{den} (dB)	L_{den} (dB)	(a)	(b)	(c)			L_{den} (dB)	L_{den} (dB)	(a)	(b)	(c)		
R001	61	61	Yes	No	Yes	No	Negligible	62	62	Yes	No	Yes	No	Negligible
R002	60	59	No	No	Yes	No	Minor Positive	61	60	No	No	Yes	No	Negligible
R003	62	62	Yes	No	Yes	No	Negligible	63	63	Yes	No	Yes	No	Negligible
R004	61	61	Yes	No	Yes	No	Negligible	62	62	Yes	No	Yes	No	Negligible
R005	58	59	No	No	Yes	No	Minor Negative	59	60	No	No	Yes	No	Negligible
R006	61	62	Yes	No	Yes	No	Minor Negative	62	63	Yes	No	Yes	No	Negligible
R007	64	65	Yes	No	Yes	No	Minor Negative	65	66	Yes	No	Yes	No	Negligible
R008	64	63	Yes	No	Yes	No	Minor Positive	65	64	Yes	No	Yes	No	Negligible
R009	73	69	Yes	No	Yes	No	Moderate Positive	74	70	Yes	No	Yes	No	Minor Positive
R010	68	66	Yes	No	Yes	No	Minor Positive	69	67	Yes	No	Yes	No	Negligible
R011	62	58	No	No	Yes	No	Moderate Positive	63	59	No	No	Yes	No	Minor Positive
R012	65	56	No	No	Yes	No	Major Positive	66	57	No	No	Yes	No	Moderate Positive
R013a	70	50	No	No	Yes	No	Major Positive	71	51	No	No	Yes	No	Major Positive
R013b	55	60	No	Yes	Yes	No	Major Negative	56	60	No	Yes	Yes	No	Minor Negative
R014a	62	49	No	No	Yes	No	Major Positive	63	49	No	No	Yes	No	Major Positive
R014b	54	59	No	Yes	Yes	No	Major Negative	55	60	No	Yes	Yes	No	Moderate Negative

Location Ref.	Opening Year 2024		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?	Magnitude of Change Short term	Design Year 2039		TII Condition for Noise Mitigation Satisfied?			Mitigation Required ?	Magnitude of Change Long term
	Predicted Noise Level							Predicted Noise Level						
	Do Minimum	Do Something						Do Minimum	Do Something					
	L_{den} (dB)	L_{den} (dB)	(a)	(b)	(c)			L_{den} (dB)	L_{den} (dB)	(a)	(b)	(c)		
R015a	67	47	No	No	Yes	No	Major Positive	68	47	No	No	Yes	No	Major Positive
R015b	48	57	No	Yes	Yes	No	Major Negative	49	58	No	Yes	Yes	No	Moderate Negative
R016a	69	47	No	No	Yes	No	Major Positive	70	48	No	No	Yes	No	Major Positive
R016b	55	55	No	No	Yes	No	Negligible	56	56	No	No	Yes	No	Negligible
R017	60	54	No	No	Yes	No	Major Positive	61	55	No	No	Yes	No	Moderate Positive
R018a	70	54	No	No	Yes	No	Major Positive	71	55	No	No	Yes	No	Major Positive
R018b	50	58	No	Yes	Yes	No	Major Negative	50	59	No	Yes	Yes	No	Moderate Negative
R019a	71	47	No	No	Yes	No	Major Positive	72	48	No	No	Yes	No	Major Positive
R019b	54	57	No	Yes	Yes	No	Moderate Negative	55	58	No	Yes	Yes	No	Minor Negative
R020a	69	46	No	No	Yes	No	Major Positive	70	47	No	No	Yes	No	Major Positive
R020b	56	59	No	Yes	Yes	No	Moderate Negative	57	60	No	Yes	Yes	No	Minor Negative
R021a	70	44	No	No	Yes	No	Major Positive	71	45	No	No	Yes	No	Major Positive
R021b	57	55	No	No	Yes	No	Minor Positive	58	56	No	No	Yes	No	Negligible
R022	67	61	Yes	No	Yes	No	Major Positive	68	62	Yes	No	Yes	No	Moderate Positive
R023	63	65	Yes	Yes	Yes	No [Note A]	Minor Negative	64	65	Yes	Yes	Yes	No [Note A]	Negligible
R024	63	65	Yes	Yes	Yes	No [Note A]	Minor Negative	64	66	Yes	Yes	Yes	No [Note A]	Negligible

Location Ref.	Opening Year 2024		TII Condition for Noise Mitigation Satisfied?			Mitigation Required?	Magnitude of Change Short term	Design Year 2039		TII Condition for Noise Mitigation Satisfied?			Mitigation Required ?	Magnitude of Change Long term
	Predicted Noise Level							Predicted Noise Level						
	Do Minimum	Do Something						Do Minimum	Do Something					
	L_{den} (dB)	L_{den} (dB)	(a)	(b)	(c)			L_{den} (dB)	L_{den} (dB)	(a)	(b)	(c)		
R025	69	70	Yes	No	Yes	No	Minor Negative	70	71	Yes	No	Yes	No	Negligible

Table 14 Assessment of Traffic Noise Levels for Opening and Design Years with Mitigation

Note A See discussion to follow for these locations where a minor noise increase is noted.

The assessment has determined that, with the inclusion of the recommended noise mitigation measures, traffic noise levels associated with the proposed road are sufficiently reduced at location N018b such that the TII conditions for noise mitigation are not triggered at the noise assessment location during either of the assessment years.

It may be concluded that the project complies with the appropriate guidance in relation to noise, hence the associated impact is considered acceptable.

7.2 Construction Phase

During the construction phase of the project there will be short term moderate to major impacts on nearby residential properties due to noise emissions from site traffic and other activities. The application of noise limits, restricted hours of operation, along with implementation of appropriate noise control measures, will be designed in order to control noise emissions to within the noise limits for this phase.

8.0 CONCLUSION

AWN Consulting Ltd. (AWN) has been commissioned to conduct a noise impact assessment of the proposed N24 Carrick Road Improvement Scheme.

A baseline noise survey was undertaken to measure existing traffic noise levels at the closest properties within the study area. The results of the baseline survey confirm that properties along the existing road network experience traffic noise levels above 60 dB L_{den}. Calculated L_{den} values at the attended survey locations ranged from 76 to 79 dB L_{den}. The measured L_{den} value at the unattended survey location was 67 dB L_{den}. Traffic noise from the existing N24 was the primary noise contributor.

Road traffic noise levels were predicted at 25 properties within the study area using the projected traffic flows for the two assessment years. It was determined that mitigation is required to reduce traffic noise levels at one location, R018b.

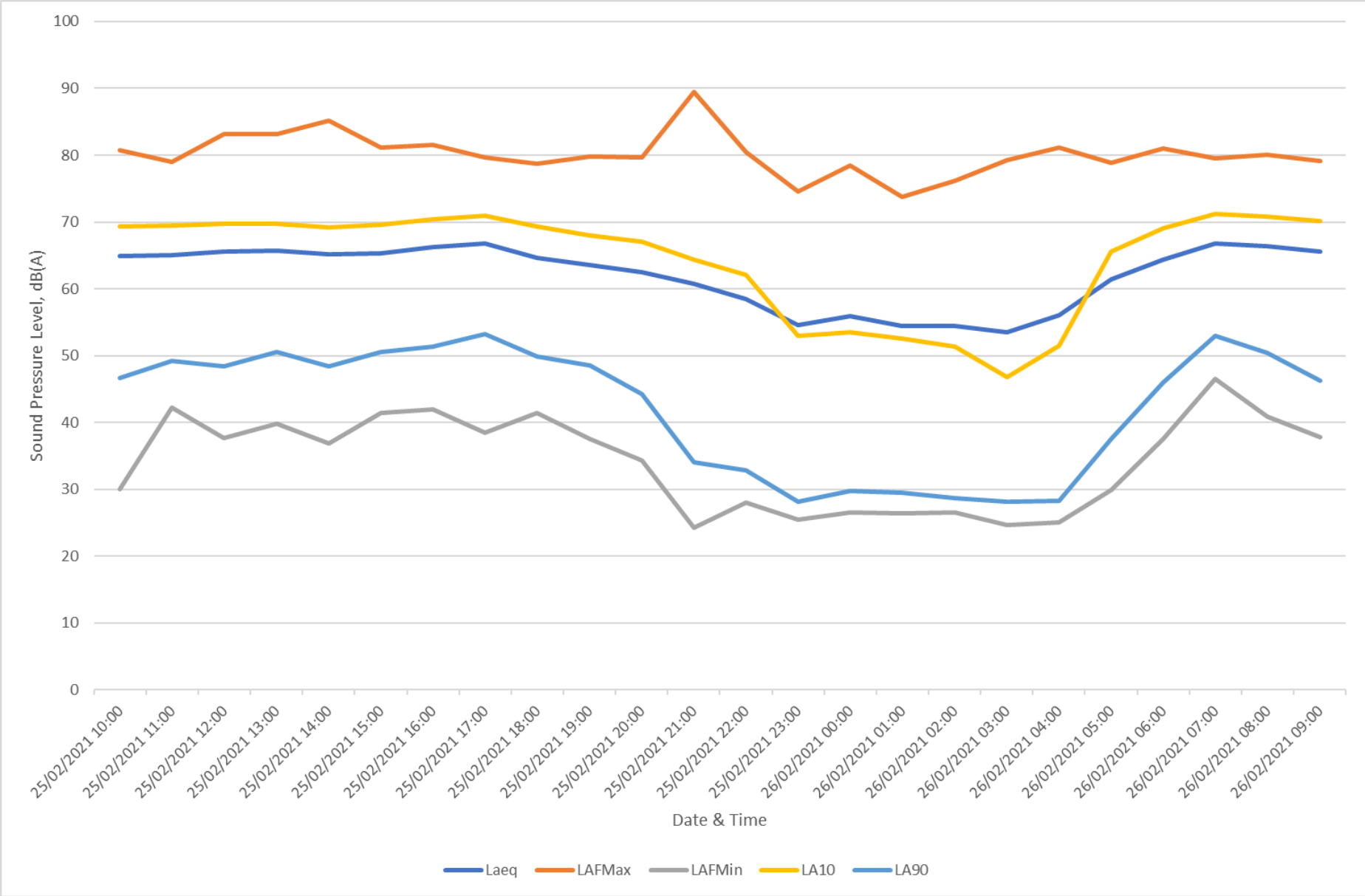
Noise mitigation in the form of a noise barrier along the road edge closest to this property has been proposed and modelled to reduce traffic noise levels to below the TII design goal of 60 dB $L_{den.}$ With the proposed mitigation in place, it may be concluded that the project complies with the appropriate guidance in relation to noise, hence the associated impact is considered acceptable.

The assessment has determined that, once operational, the noise impact associated with the new road alignment will result in a negligible to moderate negative impact during the long term period at some assessment locations. A number of locations experience a major positive noise impact as the proposed road scheme is at a greater distance than the existing road.

Indicative calculations have been made to estimate the range of likely noise levels during the construction phase of the project. The application of noise limits, restricted hours of operation, along with implementation of appropriate noise control measures, have indicated that the construction noise impact will be a short-term moderate to major impact.

APPENDIX A

UNATTENDED NOISE SURVEY RESULTS


100
90
80
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40
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Sound Pressure Level, dB(A)
25/02/2021 10:00
25/02/2021 11:00
25/02/2021 12:00
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