

14. NOISE AND VIBRATION

14.1 INTRODUCTION

This chapter of the EIS assesses the predicted impacts of the proposed M28 Road Project in terms of its impact from noise on the surrounding environment and the potential for generation of vibration.

14.1.1 Noise Assessment Criteria

Noise is regarded as a form of manmade pollution and under the *Environmental Protection Agency Act, (1992)* the definition of ‘environmental pollution’ includes ‘noise... which is a nuisance or would endanger human health or damage property or harm the environment’.

Sound levels are expressed in decibels (dB) on a logarithmic scale. In terms of sound pressure levels, audible sound ranges from 0 dB (i.e. the threshold of hearing) to the threshold of pain at 120dB. A doubling/halving of pressure equates to a 3 dB increase/decrease in decibel level. Typically, under normal circumstances, a 3 dB change in environmental noise level is the smallest noticeable to the human ear. A 10 dB increase/decrease in sound level normally equates to a subjective doubling/halving of noise.

The frequency of sound is the rate at which a sound wave oscillates, and is expressed in Hertz (Hz). The sensitivity of the human ear to different frequencies in the audible range is not uniform. For example, hearing sensitivity decreases markedly as frequency falls below 250 Hz. A mechanism known as "A-weighting" has been adopted in order to account for this non-linearity of the human ear. Sound levels expressed using "A-weighting" are typically denoted dB(A). An indication of the level of common sounds on the dB(A) scale is presented in **Figure 14.1**.

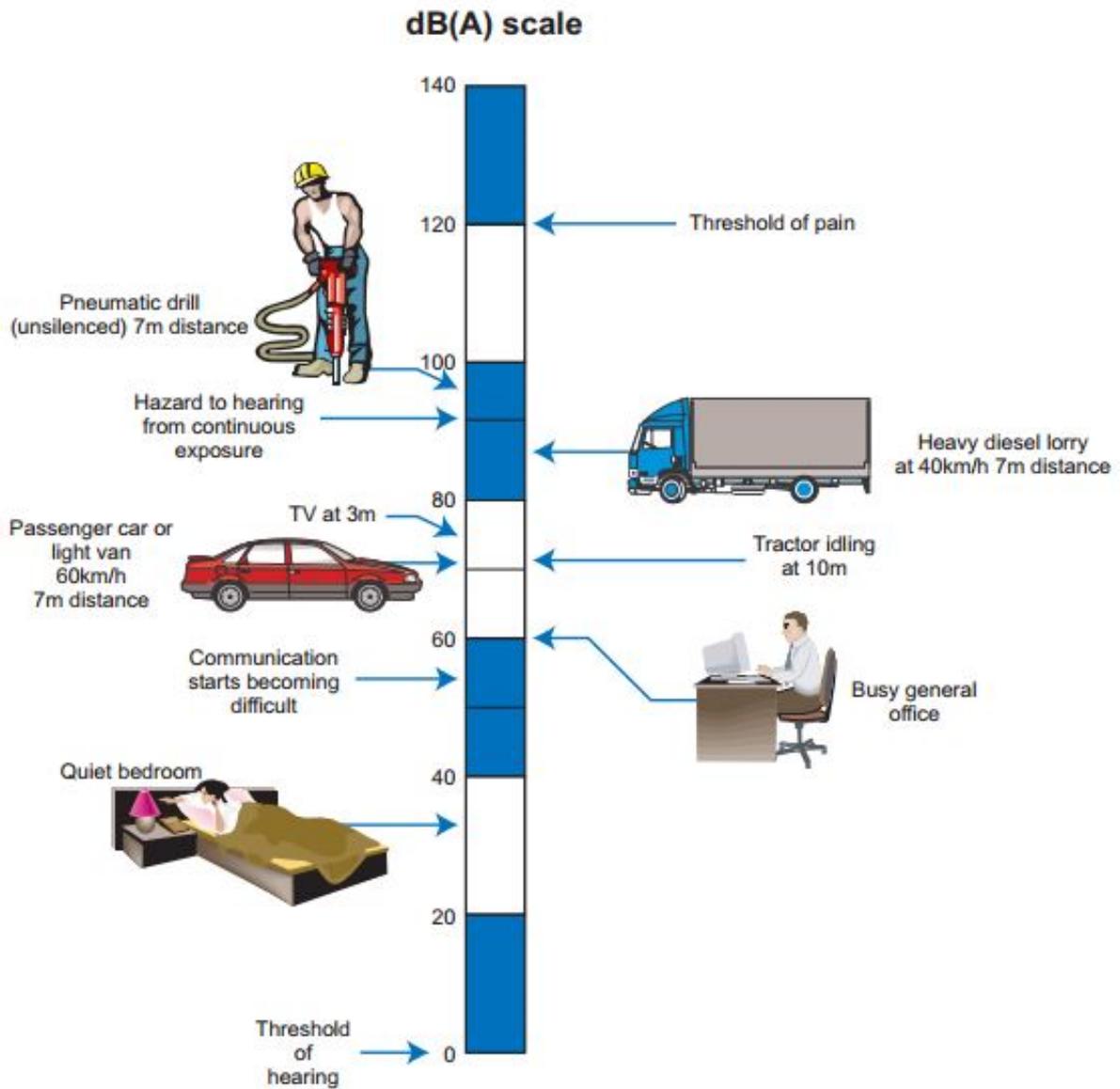
The parameter most commonly used for the assessment of noise impact is L_{Aeq} , which is defined as being the A-weighted equivalent continuous steady sound level during the sample period and effectively represents an average value. In other words the L_{Aeq} is a good measure of the average ambient noise level. The L_{A10} index is considered a good indication of road traffic noise, while the L_{A90} index is considered a good indication of the background noise level. A glossary of noise level indices terms is given below:-

- $L_{Aeq,T}$ The continuous equivalent A-weighted sound pressure level. This is an “average” of the sound pressure level over a period of time (T).
- $L_{Amax,T}$ is the maximum A-weighted sound level measured during a period of time (T).
- $L_{Amin,T}$ is the minimum A-weighted sound level measured during a period of time (T).
- $L_{A90,T}$ The A-weighted noise level exceeded for 90% of the measurement over a period of time (T). This is normally used to indicate background noise.
- $L_{A10,T}$ The noise level exceeded for 10% of the measurement over a period of time (T). This is normally used as a measure of road traffic noise.
- L_A Denotes, measurements were made using the A-weighting network. The A-weighting represents the response of human ear to sound.

Road traffic noise is considered in Directive 2002/49/EC of the European Parliament and of the Council of 25th June 2002 (transposed in Ireland by the Environmental Noise Regulations S.I. 140 of 2006) relating to the assessment and management of environmental noise. The Regulations require Local Authorities to prepare Noise Action Plans for their area. These Regulations use the L_{den} and L_{night} noise indicators for road traffic noise in Ireland. L_{den} and L_{night} are based on L_{Aeq} with adjustments for the evening and night periods.

Figure 14.1: The Level of Typical Common Sounds on the dB(A) Scale

(Based on Guidance taken from: Design Manual for Roads and Bridges, Volume 11 Consolidation Edition, 1993)



14.2 METHODOLOGY

14.2.1 Design Criteria

The NRA (now TII)'s *Guidelines for the Treatment of Noise and Vibration in National Road Schemes*, as revised by the National Roads Authority in October 2004, are based on the Authority's phased approach to road scheme planning and development.

The current design goal is that all new national road schemes should be designed, where feasible, to meet a day-evening-night sound level of 60 dB L_{den} (free-field residential façade criterion), to be met both in the year of opening and in the design year.

The Guidelines acknowledge that it may not always be sustainable to provide adequate mitigation in order to achieve the design goal.

The assessment has been carried out having regard to the following guidelines:-

- Design Manual for Roads and Bridges Volume II Environmental Assessment, Section 2 Environmental Impact Assessment;
- Guidelines for the Treatment of Noise and Vibration in National Road Schemes Revision 1 (2004) – National Roads Authority;
- Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes (2014) – National Roads Authority;
- Cork Agglomeration Noise Action Plan (2013-2018);
- Major Roads Cork County Noise Action Plan (2013-2018);
- BS 5228-1:2009+A1:2014 Noise and Vibration Control on Construction and Open Sites: Part 1 Noise;
- BS 5228-1:2009+A1:2014 Noise and Vibration Control on Construction and Open Sites: Part 2 Vibration;
- BS6472-1:2008 Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting;
- BS6472-2:2008 Guide to evaluation of human exposure to vibration in buildings. Blast-induced vibration;
- BS7385-2 1993: Evaluation and measurement for vibration in buildings. Guide to damage levels from ground borne vibration;
- ISO1996-1_2016 Acoustics – Description, measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedure;
- UK's Department of Transport (Welsh Office) "*Calculation of Road Traffic Noise' Document*", 1988;
- Guidelines on the information to be contained in Environmental Impact Statements, EPA (2002);
- Advice Notes on Current Practice in the Preparation of Environmental Impact Statements, EPA (2003);
- Revised Guidelines on Information to be Contained in Environmental Impact Statements, EPA (Draft September 2015);

- Advice Notes from Preparing Environmental Impact Statements, EPA (Draft September 2015).
- EPA Guidance Note for Noise Action Planning For the first round of the Environmental Noise Regulations 2006 (July 2009); and
- Environmental Protection Agency Office of Environmental Enforcement (OEE), Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) January 2016.

14.2.2 Construction Noise Criteria

With regard to the construction stage the NRA Guidance document ‘*Guidelines for the treatment of Noise and Vibration on National Road Schemes*’ has published Irish guidance relating to the permissible noise level that may be generated during construction (see **Table 14.1**). These limits have been considered to represent a reasonable compromise between the practical limitations in a construction project, and the need to ensure an acceptable ambient noise level for nearby residents.

Table 14.1: Recommended Maximum Permissible Noise Levels at the Façade of Dwellings During Construction (Normal Construction Activities)

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

(Source: NRA Guidelines for the Treatment of Noise and Vibration on National Road Schemes, 2004)

The TII Guidelines do not provide guidance for night time working. Weekend and night time working will be necessary for critical works involving road closures i.e. for the bridge works at Maryborough Hill. In addition to this, it is likely there will be need for other works to be carried out at night time and weekends.

Construction activity on Monday to Friday evenings, on Sundays and on Bank Holidays, and work outside the times indicated above, will require the explicit permission of the relevant local authority in accordance with the limits set out in **Table 14.2** below. Any explicit permission for night or weekend working will give consideration to the potential disruptive effects there may be on nearby residences and restrictions on noise and other adverse environmental emissions may be conditioned to any approval granted.

Annex E of BS 5228-1:2009 + A1:2014 “Code of practice for noise and vibration control on construction and open sites – Part 1” presents various methods of determining the significance of noise effects due to construction works. In this assessment, the ABC method detailed in Annex E.3.2 has been used.

The time periods have been adjusted to correspond with the TII periods outlined in **Table 14.1**, i.e., night time has been brought forward to commence at 22:00 and extend to 08:00 on weekends and bank holidays. Using the ABC method, the measured ambient noise level is rounded to the nearest 5 dB for the appropriate period (night, evening/ weekends or day). This is then compared with the estimated construction noise level. If the construction noise level exceeds the appropriate category

value, then there is potential for a significant effect to occur. The example threshold for significant effects at dwellings is shown below in **Table 14.2**.

Table 14.2: Recommended Maximum Permissible Noise Levels at the Façade of Dwellings During Construction (Exceptional Circumstances)

Threshold value period (L_{Aeq})	Threshold value (dB)		
	Category A	Category B	Category C
Night time (22:00-07:00 weekdays) and (22:00-08:00 weekends and bank holidays)	45	50	55
Evenings (19:00-22:00 weekdays) and Weekends (13:00-22:00 Saturdays) and (08:00-19:00 Sundays)	55	60	65
Daytime (07:00-19:00 weekdays) and Saturdays (08:00-16:30)	65	70	75

(Based on: BS 5228 -1:2009 + A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise time periods modified as outlined in the text)

The values in Category A, B and C are the threshold values to be used to determine the potential for significance at a noise sensitive receptor, based on ambient noise levels rounded to the nearest 5 dB. A receptor is categorised by comparing its rounded ambient noise level with the values assigned to Category A for the relevant time period, and is then categorised depending on whether the rounded ambient noise levels are less than, equal to, or higher than the values in Category A column, respectively. For example, if the rounded daytime ambient noise level is below 65 dB(A), then it is a Category A receptor and the threshold for potential significance is 65 dB(A). If the rounded daytime ambient noise level is equal to 65 dB(A), then the receptor is assigned to Category B and the threshold level is 70 dB(A).

Some blasting activity will be required during the earthworks phase for rock removal. Air overpressure from any required blasting shall not exceed 125 dB(linear) max peak, with a 95% confidence limit when measured at the nearest noise sensitive location. No individual air overpressure value shall exceed the limit value by more than 5 dB(Linear).

14.2.3 Operational Noise Criteria

14.2.3.1 General Considerations

Humans are considered in this assessment to be most sensitive to noise as species such as birds are acknowledged to have less sensitivity to noise. The following classifications can be regarded as conservative in their case. The significance of the changes in noise levels have been evaluated based on the assessment of changes in noise levels in terms of perceived change and loudness by humans and is shown in **Table 14.3**. The prediction of the perceived human impact of change in traffic noise level may result in a noise sensitive receiver being classified as potentially suffering from a 'neutral', 'imperceptible', 'slight', 'moderate', 'significant', 'very significant', or 'profound' subjective change in noise level. The thresholds outlined in the table are based on scientifically accepted norms, as published in Bies & Hansen Engineering Noise Control – Theory and Practice (2009) and Environmental Protection Agency Office of Environmental Enforcement (OEE), Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) January 2016.

Table 14.3: Significance of Changes in Noise Levels in Terms of Perceived Change in Loudness

Change in Noise Level	Impact Significance	Subjective Reaction
0	Neutral	Neutral
<1 dB	Imperceptible	Imperceptible
<3 dB	Not Significant	Rarely perceptible
<5 dB	Slight (Positive or Negative)	Just perceptible
5 to 10 dB	Moderate (Positive or Negative)	Clearly Perceptible
>10 dB	Significant (Positive or Negative)	>2 times change in loudness
>15 dB	Very Significant (Positive or Negative)	~3 times change in loudness
>20 dB	Profound (Negative only)	Much louder

14.2.3.2 TII Guidelines

The TII Guidelines acknowledge that it may be appropriate to adopt different design goals for diverse situations, e.g. design goals for existing situations may be different from new situations. They also acknowledge that it may not always be sustainable to provide adequate mitigation in order to achieve the design goal.

Traffic noise levels at the northern end of the proposed M28 Road Project are currently in excess of 70 dB L_{den} and are forecast to increase in the Do Minimum scenario. Scope to reduce noise levels using barriers and low noise surfaces is limited, and a reduction of over 10 dBA to achieve the TII Design Goal is not practicable.

Engineering solutions would require excessively high barriers which have structural, visual and safety issues making their implementation unsustainable. Possible design options including 4m and higher barriers and the use of high median barriers between carriageways were examined and found to have no significant acoustic benefits. Mitigation measures proposed in this EIS include 3m high barriers and low noise surfaces where their use will be effective.

The design goal specified in the NRA Guidance is an L_{den} value of 60 dB. This design goal applies to new road schemes only, which in the case of this proposed M28 Road Project is the section from Carr's Hill Interchange (Ch. 2200.0) south. The northern section (Ch. 0.0 to 2200.0) is on an existing alignment and online improvement and subject to criteria set out in **Section 14.2.3.3**. The on-line and off-line sections of the proposed M28 Road Project are illustrated on **Figure 14.2** contained in **Volume 5**.

The NRA Guidance also states that mitigation is required for new road schemes where the following three conditions arise at a noise sensitive location (NSL):-

- 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;*
- b) *The relevant noise level is at least 1 dB more than the expected traffic noise level without the proposed 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.*

14.2.3.3 Noise Plans

Noise Action Plans for the Cork area; *Cork Agglomeration Noise Action Plan* (2013-2018) and the *Major Roads Cork County Noise Action Plan* (2013-2018), have been prepared by Cork City and Cork County Councils. The Noise Action Plans identified and prioritised cluster areas which require further assessment and may require mitigation measures to be put in place. The Action Plans aim to minimise the population exposed to values of greater than 70 dB L_{den} through mitigation measures such as noise barriers, low noise surfacing etc. subject to budgets and available resources.

Existing noise levels at the northern end of the proposed road project have been measured consistently in excess of 70 dB(A). The proposed onset levels for assessment of noise mitigation for major roads in the Cork County area are as follows:-

- 70 dB L_{den} ; and
- 57 dB, L_{night}

Five high priority areas as identified in the Noise Action Plans fall within the vicinity of the proposed M28 Road Project. They are identified as; N40-8 along the N40 at Kiltteegan Park; N28-1 in the northern area of the N28 in the area of Newlyn Vale; N28-2 in the northern area of the N28 near Mount Oval; N28-3 south of Carr's Hill; and N28-4 at Hilltown.

The noise criteria assessment for the proposed road project has been divided between the northern (existing on-line improvement) and southern (new road) sections of the project. The criteria for the northern end of the road project, which represents an upgrade to the existing road alignment, are the onset levels for mitigation in the Cork Noise Action Plans (70 dB L_{den}). The criterion for the southern part of the road project, which consists of new road, is the TII/NRA design goal (60 dB L_{den}).

The on-line and off-line sections of the proposed M28 Road Project are illustrated on **Figure 14.2** contained in **Volume 5**.

14.2.4 Vibration Assessment Criteria

In respect of vibration, 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 ground of energy waves. These waves arise as a function of the size, shape and speed of the vehicle.

In the case of nominally continuous sources of vibration, such as traffic, vibration is perceptible at a peak particle velocity of 0.5mm/s or greater. The operational stages of the proposed road project will be assessed against this vibration level. Nelson et al. (1987) state that typical levels of traffic induced vibration velocity, 3.65m from the edge of a road, range from 0.06mm/s to 0.25mm/s in the frequency range of 20-30 Hz. The level of vibration arising through this pathway for modern road schemes at nearby residences is generally imperceptible.

There are various vibration guidelines to protect individuals and properties during operational and construction stages of a development. Common practice in Ireland has been to use guidance from these internationally recognised standards, which address vibration standards in two criteria, those

dealing with human comfort and those dealing with cosmetic or structural damage to buildings. The generally accepted criteria for vibration levels are:-

- Vibration levels that would be likely to lead to structural damage (BS7385-2 1993: Evaluation and measurement for vibration in buildings. Guide to damage levels from ground borne vibration); and
- Vibration that would be likely to lead to complaints (BS6472-1:2008 Guide to Evaluation of Human Exposure to Vibration in Building. Vibration sources other than blasting and BS 6472-2:2008 Guide to evaluation of human exposure to vibration in buildings. Blast-induced vibration).

During the construction stage of the proposed M28 Road Project, vibration levels are likely to be higher and associated with single events or events of short duration. For example, blasting or rock-breaking, which can be sources of vibration during construction are typically not significant at vibration levels up to 2.5mm/s for temporary nature/short works. Blast-induced vibration due to its infrequent nature is typically tolerated at much higher thresholds.

The NRA limits for protection of properties against cosmetic damage, which are given as a function of vibration frequency and are outlined in **Table 14.4**. These guidelines are in line with international best practice. The lowest international guideline for the protection of buildings with “particular sensitivity to vibration” and “of great intrinsic value” are set out in Deutsches Institut für Normung, “*Structural Vibration, Part 3: Effects of Vibration on Structures,*” DIN 4150-3 (Berlin: German Institute for Standardization, 1999): 1-11. The guideline set in this standard is 3mm/s at frequencies lower than 10 Hz and rising for higher frequencies.

Table 14.4: Allowable Vibration during Road Construction in Order to Minimise the Risk to Building Damage

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

(Source Reference: NRA Guidelines for the Treatment of Noise and Vibration on National Road Schemes)

14.3 NOISE MODELS FOR CONSTRUCTION AND OPERATION PHASES

Cadna noise modelling software was used to predict the impact of the proposed M28 Road Project on noise sensitive receptors. The Cadna software provides a three dimensional model for sound propagation and attenuation using a selection of appropriate calculation methods. Cadna has been validated in accordance with the German Standard: DIN 45687 "Acoustics - Software products for the calculation of the sound propagation outdoors - Quality requirements and test conditions" (German title: "Akustik - Software-Erzeugnisse zur Berechnung der Geräuschimmission im Freien - Qualitätsanforderungen und Prüfbestimmungen", issue date: 2006-05).

A construction stage model was generated using BS 5228-1:2009+A1:2014 “Code of Practice for Noise and Vibration Control on construction and open sites – Part 1: Noise” in order to predict likely construction noise levels during the construction stage of the proposed road project. This takes account of noise emissions from construction plant and machinery likely to be used during construction. The cumulative impact of traffic on the existing N28, other roads in the study area and the operation of the John A. Woods quarry at Raffeen were also taken in to account as part of the assessment.

Cadna noise modelling software was used to predict the impact of operational phase on the noise sensitive receptors. The software was used based on CRTN “Calculation of Road Traffic Noise”. CRTN dates from 1988 and updated advice on using CRTN recommended in the NRA *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes* (March 2014) have been included in the methodology.

In the model a three dimensional base map of the proposed road project including a 300m buffer zone is imported. The position of various buildings, receptor locations and distances are then inserted on the topography. Roads are imported in to the model and the traffic count data for each section is inserted. Distance losses, ground attenuation, and barrier/berm effects are applied as a result of the ground contour data inserted and the resulting noise levels are computed at the sensitive receptor locations. The noise model has the ability to show how the noise radiates from the sources and is affected by intervening structures and terrain.

The Cadna software includes detailed calculations for reflections from structures and allows for mitigation measures such as barriers and different road surfaces to be put in place within the model to assess their effectiveness in reducing the sound levels arising from the proposed M28 Road Project. ‘Standard’ road surface material is normal hot-rolled asphalt (HRA) with a surface layer depth of 50mm. Low noise road surface design is based on stone mastic asphalt with a surface layer depth of 30-50mm.

All calculations were based on the predicted traffic flows set out in **Chapter 5: Traffic and Transportation** and associated variables were inserted such as the speed of the various roads and the percentage of HGVs. All traffic flows were developed using project specific data in order to calculate L_{den} in accordance with Method A outlined in the TII Guidelines.

Noise models were generated for the following scenarios:-

- Existing Baseline Scenario;
- Construction Phase;
- Opening Year 2020 ‘Do-Minimum’ scenario;
- Design Year 2035 ‘Do-Minimum’ Scenario;
- Design Year 2035 ‘Do-Something’ Scenario; and
- Design Year 2035 ‘Do-Something’ with mitigation.

14.3.1 Noise Model Verification

The NRA Guidelines state that:-

“whilst there is no need for further validation of the established CRTN prediction methodology, the Authority considers that the noise models themselves should be validated in order to ensure that the roads, topography and other crucial features have been correctly represented and incorporated into the model. This could be done in a number of ways, for example, the survey results could be compared with the predicted results obtained using traffic data that are representative of the conditions during the period when the survey was conducted. The exact method of validation is left to the discretion of the Acoustic Engineer”

It is reasonable to consider that where the modelled noise levels are within +/- 2 dB of the measured noise levels for flat terrain and urban areas up to a distance of 2km, the model can be considered to be validated. Where the modelled and measured noise levels are within +/- 5 dB for hilly terrain the model can be considered to be validated. The complex terrain in which this project is located places the acceptable tolerance in the +/- 5 dB range.

This difference between the modelled and measured noise levels can be accounted for due to the fact that the noise levels in the model arise as a result of traffic noise only, whereas the monitored noise levels take in to account other noise sources in the surrounding area and are limited to the traffic volumes during the noise survey period. It must be borne in mind that the predicted levels are annual average levels. In general comparisons are made with short term measurements. Short term measurements can vary significantly.

The models used in this study were verified by ensuring the vertical alignment was transferred directly from the planning drawings; road sections were assigned correct road surface types and traffic flows and speeds were coordinated with the traffic section. The topography, buildings and receiver heights were checked for consistency.

The noise model for the baseline scenario was generated using baseline traffic count data and baseline noise levels were predicted at a number of receiver locations within the vicinity of the proposed works. The model was validated through two baseline noise measurement surveys carried out in February/March 2015 and in October 2016. The baseline surveys consisted of both 24 hour and short term measurements. A series of locations where the baseline noise model could be compared with measurements were identified. The noise levels measured at these locations were within an acceptable range of the predicted levels calculated in the Cadna model. Therefore the noise model can be considered to be validated. **Table 14.5** compared the measured values to those predicted in the Cadna model.

Table 14.5: Measured vs Modelled Noise Levels

Sample Location	Measured Ambient Noise Level L_{den} dB(A)	Predicted Noise Level L_{den} dB(A)
N1-1	70	70
N1-3	57	57
N1-4	67	63
N1-5	61	60
N1-6	83	78
N2-1	65	65
N2-6	68	64
N3-1	66	69
N3-3	68	66
N3-4	69	72
N3-6	71	68
N4-1	59	64
N4-2	63	64
N4-3	62	57
N4-4	65	61
N4-5	62	61
N4-7	70	66
N4-8	54	52
N4-9	80	75

14.4 RECEIVING ENVIRONMENT

14.4.1 Existing Sources and Receptors

A noise sensitive location (NSL) is defined in the EPA *Guidance Note for Noise: Licence Applications, Surveys and Assessments in relation to Scheduled Activities* (EPA NG4, January 2016) as “ – any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or other area of high amenity which for its proper enjoyment requires the absence of noise at nuisance levels..

The route corridor runs between the Bloomfield Interchange of the N40 South Ring Road in the south of Cork City to the east of the village of Ringaskiddy on the Ringaskiddy Peninsula in County Cork. The upgrade is on-line through a densely populated area between Bloomfield and Carr’s Hill. South of Carr’s Hill the route runs on the eastern side of the existing N28 through open country to Shannonpark where it veers to an easterly direction, staying south of the existing road at Shanbally and Barnahely and joining the existing N28/L2545 east of Ringaskiddy.

There are various NSLs located along the proposed route including human and natural habitats. They vary in density and distance from the centreline of the proposed road project.

A total of 2983 properties were considered in the model, of which 225 are located within 50m of the existing N28 and proposed M28 Road Project including residential developments, schools, places of worship, commercial operations, etc. The most sensitive NSLs for the purpose of this document are residential dwellings where people are present for day, evening and night periods and thereby continuously exposed to road traffic noise. Residences, schools and places of worship are regarded as more sensitive than sporting grounds or commercial operations.

Other non-domestic NSLs considered in this document include schools, crèches/playschools, a health centre, residential care centre, B&Bs and a hotel. Amenity NSLs considered include a playground, football pitches, allotments, churches, graveyards and two golf courses. In addition to the residential and human NSLs, the Cork Harbour SPA, Lough Beg and Monkstown Creek pNHA are sensitive ecological NSLs that are located close to the route corridor of the proposed M28 Road Project at the northern and southern ends of the project. The noise levels at ecological NSLs are addressed in **Chapter 12: Terrestrial Ecology**.

Along some sections of the existing N28 (e.g. the section from Carr's Hill to the Rochestown Road Junction) the road verges consist of mature and semi mature trees and wooded area (i.e. Bloomfield Wood and Donnybrook Wood). Trees and shrubs may act as a visual screen but in accordance with the TII Publications and CRTN are not considered to provide any noise reduction in the modelling.

It is proposed that a Service Area will be located in the port area and will fulfil the needs of HGV traffic in the area. The nearest receptor to the site is the National Maritime College of Ireland which bounds the Service Area to the east. South of the Service Area is the Hammond Lane commercial operation which lies south of the L2545. The nearest residential properties to the service area include those at Martello Park to the south west of the site and north of the new alignment.

There are a number of existing noise sources along the existing and proposed road as follows;

- Road traffic on the national routes (including the existing N28 and the N40 at the northern boundary of the road project), the regional roads (R611 and R613 to Carrigaline from the N28, and the R610 and R609) and on the local road network generate significant noise levels along the road network;
- The quarry at Raffeen which has planning permission for blasting, rock processing and material storage. It is anticipated that the quarry will be in operation during the construction stage of the proposed road either for the purposes of supplying material for the road or other needs under its current planning condition (Reg. Ref. 06/10037 and PL. 04.225610). Condition 21 of the existing planning permission for this quarry limits noise emissions and Condition 24 controls blasting;
- The Port of Cork at Ringaskiddy operates on a 24-hour basis and includes shipping and shore based operations along with associated traffic. The traffic levels arising from port operations are included in **Chapter 5: Traffic and Transportation**;
- The noise arising from traffic using the port includes vehicles using the Ringaskiddy area for service calls and overnight parking of refrigerated trailers; and
- Wind turbines operate at three facilities in the wider Ringaskiddy area.

There are no facilities operating vibration sensitive equipment within 300m of the proposed road. The ruin at Castle Warren is a protected structure located approximately 50m from the proposed M28 Road Project. This structure was inspected in March 2017 and found to be in a stable condition with some vulnerability to vibration during the construction phase. In order to ensure this structure is protected during the construction phase specific vibration monitoring measures will be adopted.

14.4.2 Baseline Noise Survey

The existing ambient noise levels in the proposed M28 Road Project area were measured at a number of noise sensitive and receiver locations.

The baseline survey was carried out in accordance with the requirements of the NRA guidelines. Three 24 hour monitoring stations were set up in March 2015 (N1, N2 and N3). Six short-term measurement locations were also identified surrounding each of the 24 hour stations resulting in a total of 18 short-term monitoring locations. Measurements were taken at the short-term monitoring locations for a period of 15 minutes with three monitoring locations being sampled within a 1 hour period in accordance with the NRA guidelines. A description of the noise monitoring locations is presented in **Table 14.6** and their locations are shown on **Figure 14.3** contained in **Volume 5**.

Additional monitoring was also undertaken in October 2016 to revalidate the baseline measurements and collect data in the vicinity of Raffeen Quarry, as well as the proposed Service Area and provide a baseline model of the proposed M28 Road Project in its entirety. Nine locations were monitored and as with the previous short-term measurements monitoring was carried out for a period of 15 minutes with three monitoring locations being sampled within a 1 hour period.

The measurements were taken using a Type 1 Brüel and Kjaer Integrating Averaging Sound Level Meter with real time analysis. All measurements were carried out in accordance with the NRA Guidelines. Short-term measurements were made by placing the microphone at a height of 1.5m above ground level and positioned in the 'free field' at least 3m away from any reflecting surfaces. The 24 hour measurements were taken 'free field' at a height of 4m above ground level. Before and after the survey the measurement apparatus was checked and calibrated using a Brüel and Kjaer Type 4231 Sound Level Calibrator (94 dB at 1 kHz). Weather conditions during the surveys were in line with the conditions described within ISO 1996.

The noise measurements were noted onto survey record sheets immediately following each measurement and also stored in the instrument's internal memory for subsequent analysis, notes were taken in relation to the primary contributors to noise build-up at each location. A summary of the short time baseline noise monitoring results is presented in **Table 14.6**.

Table 14.6: Description of Noise Monitoring Locations and Noise Sources

Monitoring Location	Location of the Meter	Primary Noise Source	Secondary Noise Source
N1	This 24hr meter was mounted on a 4M pole and tripod on made ground / hardstanding within Raffeen Quarry, approximately 50m south of the N28. A low level wall was located approximately 2m to the east which formerly formed part of the quarry stockpiling activities.	Traffic from the N28	Some bird song from the quarry
N 1-1	The meter was located on a footpath to the west of the R610 and south of its junction with the L2470.	Traffic from the N28	Local traffic at junction of R610/L2470. Ground was wet for third recording.
N 1-2	The meter was located on a gravelled lay-by on the Ballinrea Rd, approx. 200m west of the Shannonpark Roundabout.	Local traffic dominant on L2473	Traffic from the N28, birdsong in the lull.
N 1-3	The meter was located at a gravel stockpiling area on the L6472 immediately east of Raffeen Quarry, approx. 60m north of an electricity pylon.	Traffic from the N28	Aeolian noise from overhead wires, aircraft and local traffic on L6472
N 1-4	Monitoring was undertaken at the entrance to Fernhill Golf And Country Club on the L2490, approximately 50m north of the ESB substation. The meter was located on a rough tarmacadam surface.	Local traffic on the L2490	N28 is audible, local traffic turning into Fernhill Golf and Country Club, electrical hum from substation
N 1-5	Monitoring took place on the Hilltown local road which connects the L2470 and L6469. The meter was located on the roadside at a field boundary. Linear residential properties were located to the north and south of N1-5 which is approx. 140m east of the N28.	Traffic from the N28	Local traffic on the Hilltown Road, dog barking and birdsong
N 1-6	The meter was located on the verge / rough grassland area immediately adjacent to the N28 at the entrance to an agricultural property. This entrance is located approximately 440m north west of the junction of the N28 with the L6477.	Traffic from the N28, very heavy for third recording	Agricultural property moving e.g. gates, cattle lowing, aircraft, wet ground for third recording
N2	This 24hr meter was attached to a 4m pole on a tripod and secured in the south western most corner of the National Vehicle Distribution property in Ringaskiddy village. The meter was located approximately 5m north of the L2545 and 40m east of the N28 where it enters the Port of Cork.	Traffic from the N28	Local traffic on the L2545, port-related traffic and vehicular movements within the National Vehicle Distribution
N 2-1	Monitoring was undertaken on the footpath outside Barnahely graveyard at the junction of the R613 and the private access road leading to Janssen Biologics.	Traffic on the R613 including trucks accelerating up a hill	Traffic on the N28, aircraft

Monitoring Location	Location of the Meter	Primary Noise Source	Secondary Noise Source
N 2-2	The meter was located on the roadside outside a residential property on the Ringaskiddy – Loughbeg road approx. 150m south of the junction with Ashgrove Terrace.	Local traffic on the L6518	Traffic collecting children from school, human voices, crows, chainsaw
N 2-3	Monitoring was undertaken on the footpath to the east of the junction of the N28 and the R613 approx. 50m south of the Port of Cork entrance.	Traffic from the N28	Trucks entering and exiting the Port of Cork facility onto the N28, Port related activities
N 2-4	The meter was located on a lay-by area outside the church walls immediately south of the junction of Church Rd (R613) and Rock Rd (L2490). This junction is located to the East of Carrigaline urban area.	Traffic on R613	Traffic from junction of R613 and L2490, birdsong
N 2-5	The meter was located outside residential properties at the east of the entrance to Coolmore estate at the junction of the R613 and the L2492.	Traffic on R613	Traffic from junction of R613 and L2492, crows from nearby rookery, human voices, lawnmower
N 2-6	Monitoring was undertaken on the L2492 outside a derelict property approximately 100m south of Shanbally School and immediately north of a private laneway servicing a number of properties to the west of the L2492.	Local traffic and electrical hum from nearby transformer	N28, birdsong, human voices
N3	This 24hr meter was attached to a 4m pole and secured to a tripod with the gardens of a the parochial house which is located approximately 40m east of St. Patrick's Church on the Rochestown Road. The meter was also approx. 85m east of the Rochestown / Douglas slip off ramp from the Bloomfield Interchange.	Traffic from the N28 / Bloomfield Interchange	Local traffic attending services in St. Patrick's Church and human voices.
N 3-1	Monitoring was undertaken on a grassed area on the Garryduff Rd outside a residential property at the junction of a minor local road which services 10 properties and loops back to the Garryduff Road again approx. 95m to the south.	Local traffic on Garryduff Road	Birdsong, buses accelerating uphill
N 3-2	The meter was located at a secondary vehicular access point to Douglas Golf Club on Maryborough Hill approx. 190m north east of the Maryborough overpass to the N28.	Traffic on Maryborough Hill	Grass cutting at the Douglas Golf Club, tree cutting / shredding
N 3-3	The meter was located in Moneygourney on a gravelled lay –by on the L6477, located approximately 360m south west of Garryduff playing pitches.	Traffic on the L6477	N28 audible, lambs bleating, some aircraft.

Monitoring Location	Location of the Meter	Primary Noise Source	Secondary Noise Source
N 3-4	Monitoring was undertaken in Wainsfort housing estate on the Rochestown Road, to the west of the Bloomfield interchange. The meter was located to the North of No. 11 Wainsfort.	Traffic from the N28 / Bloomfield Interchange	Dog barking, construction activity – perhaps an electric saw
N 3-5	The meter was located on the L2464 Douglas – Carrigaline Rd at an agricultural entrance opposite the junction of the L2464 with the Board of Works road which is located approx. 700m south west of the N28.	Traffic on the Ballinrea Road	Birdsong
N 3-6	Monitoring was undertaken on the R609 30m to the west of the N28 overpass at an agricultural access point north of the interchange.	Traffic from the N28 overhead	Local traffic on R609
N4	The 24hr meter attached to a 4m pole and secured to a lighting standard within the grounds of a Cork County Council area office to the south of the Rochestown Road roundabout and east of the N28.	Traffic from the N28 to the west.	Local traffic and voices from Cork County Council office and Mount Oval residences.
N 4-1	Monitoring was undertaken adjacent to the church grounds on an access road to serving a number of properties between the church and Bloomfield Interchange.	Traffic from the N28 to the north and west.	Local traffic in the churchyard, birdsong and occasional church bells.
N 4-2	The meter was set up in a cul-de-sac / turning and parking area located within Rochestown Rise housing estate, immediately west of the N28.	Traffic from the N28 to the east.	Local traffic in Rochestown Rise, birdsong and a water main / drain underground.
N 4-3	The meter was on a tripod at the edge of grassed public open space within Lisadell housing estate, between the internal roadway and the treeline forming a boundary with the N28.	Traffic from the N28 to the east and south.	Local traffic, occasional voices and construction noises such as hammering together scaffolding.
N 4-4	Monitoring was undertaken at The Fairways housing estate in an area of public open space adjacent to the internal road network and boundary with Lisadell housing estate.	Traffic from Maryborough Hill.	N28 to the south and east, lawnmower, voices.
N 4-5	The meter was recording sound at The Downs area of Broadale, at an area of open space overlooking the N28 to the west.	Traffic from the N28.	Local traffic on the internal estate road network, rubbish truck, occasional voices.
N 4-6	Noise monitoring was carried out in the Edgeworth area of Maryborough Ridge housing estate, at an area of open space to the north east of apartment blocks.	Local traffic within the Maryborough Ridge internal road network.	Voices, dogs barking, crows.
N 4-7	Monitoring was undertaken at the west of the junction between the L2545 and the eastern extent of Martello Park.	Traffic on the L2545	Voices, some construction work, truck idling in the National Vehicle Distribution Centre.

Monitoring Location	Location of the Meter	Primary Noise Source	Secondary Noise Source
N 4-8	The meter was set up on the northern access road to Coolmore Close to the north of house No. 1.	Traffic on the L2492 Shanbally Mews / Marian Terrace road.	Crows, some construction noise and voices.
N 4-9	The meter was recording noise on the hardshoulder of the N28 to the east of a number of residences east of Shannonpark Roundabout.	Traffic from the N28 and Shannonpark Roundabout.	Voices at residences to the west, birdsong and ducks at a farm to the north.

14.4.3 Cork County Council Noise Monitoring

Cork County Council operates a permanent noise monitoring station at a facility in Mount Oval. This monitoring station has operated since 2014 and the latest year for which a full dataset is available is 2016.

The data from this station was downloaded and an annual L_{den} for 2016 was calculated for this location, the result of the calculation is compared with the modelling result for the baseline year in **Table 14.7:-**

Table 14.7: Measured v's Modelled Noise Level at Cork County Council Station

	Measured Ambient Noise Level	Predicted Modelled Noise Level
L_{den} dB(A)	69.2	68.6
L_{night} dB(A)	57.0	58.1

The modelled level is comparable to the calculated L_{den} level albeit slightly lower. This is normal for a traffic noise model as the model only includes traffic noise from the road, whereas the measured noise level includes noise from all sources. The night time predicted noise level is marginally higher than the measured value but within acceptable modelling tolerance.

The measured noise level indicates that noise levels at the northern end of the proposed road project are at or above the thresholds in the Noise Action Plans. Some properties are closer to the road than the measured location and others more exposed to road traffic noise, resulting in the need for mitigation measures to be introduced as part of the proposed M28 Road Project.

14.4.3.1 Baseline Noise Survey Results

The results of the short-term baseline measurement survey are shown in **Table 14.8.**

Table 14.8: Short-Term Baseline Measurement Results

Location	Measurement Date & Time	L _{A90}	L _{A10}	L _{Aeq}	Notes
N1-1	26/02/2015 14:01-14:17	54.4	69.9	66.3	Traffic from N28 and local traffic dominant source of noise. Measurement paused due to hail shower.
N1-1	26/02/2015 15:06-15:21	53.9	69.6	65.7	Traffic from N28 and local traffic dominant source of noise.
N1-1	26/02/2015 16:09-16:24	61.1	71.6	68.5	Traffic from N28 and local traffic dominant source of noise.
Derived Measurements					
Average L ₁₀			70.4		
L _{A10, 18 hour*}			69.4		
L _{den**}				69.5	
Location	Measurement Date & Time	L _{A90}	L _{A10}	L _{Aeq}	Notes
N1-2	26/02/2015 14:23-14:38	50.0	72.1	67.3	Local traffic dominant source of noise. Traffic from N28 audible. Birdsong.
N1-2	26/02/2015 15:26-15:41	47.2	68.8	65.0	Trucks passing intermittently.
N1-2	26/02/2015 16:32-16:47	48.5	71.3	66.6	Birdsong. Intermittent local traffic. Aircraft movement overhead.
Derived Measurements					
Average L ₁₀			70.7		
L _{A10, 18 hour*}			69.7		
L _{den**}				69.8	
Location	Measurement Date & Time	L _{A90}	L _{A10}	L _{Aeq}	Notes
N1-3	26/02/2015 14:46-15:01	48.1	55.1	52.7	Local traffic dominant source of noise. Traffic from N28 audible. Aircraft movement overhead. Birdsong.
N1-3	26/02/2015 15:47-16:02	47.2	55.6	54.0	Local traffic dominant source of noise. Traffic from N28 audible.
N1-3	26/02/2015 16:52-17:07	49.0	55.0	55.2	Local traffic dominant source of noise. Traffic from N28 audible.
Derived Measurements					
Average L ₁₀			55.2		
L _{A10, 18 hour*}			54.2		
L _{den**}				56.5	
Location	Measurement Date & Time	L _{A90}	L _{A10}	L _{Aeq}	Notes
N1-4	27/06/2015 10:00-10:15	43.3	67.4	64.4	Intermittent local traffic. Birdsong and distant traffic dominant source of noise.

N1-4	27/06/2015 11:06-11:21	41.3	67.4	64.4	Electrical hum from substation.
N1-4	27/06/2015 12:05-12:20	44.6	66.5	64.1	Aircraft movement overhead. Car horn. Dog barking. Noise from golf club audible. Wind through foliage.
Derived Measurements					
Average L ₁₀			67.1		
L _{A10, 18 hour*}			66.7		
L _{den**}				66.7	
Location	Measurement Date & Time	L_{A90}	L_{A10}	L_{Aeq}	Notes
N1-5	27/06/2015 10:22-10:37	51.1	58.3	56.4	Dog barking. Birdsong. Intermittent local traffic. Traffic on N28 audible.
N1-5	27/06/2015 11:27-11:42	52.9	58.8	57.0	Dog barking. Helicopter flying overhead.
N1-5	27/06/2015 12:26-12:41	56.7	62.4	60.8	Dog barking.
Derived Measurements					
Average L ₁₀			59.8		
L _{A10, 18 hour*}			58.8		
L _{den**}				60.5	
Location	Measurement Date & Time	L_{A90}	L_{A10}	L_{Aeq}	Notes
N1-6	27/06/2015 10:47-11:02	61.7	85.2	80.7	N28 dominant source of noise. Agricultural noise. Low flying aircraft movement overhead.
N1-6	27/06/2015 11:47-12:02	61.5	85.4	80.7	N28 dominant source of noise.
N1-6	27/06/2015 12:46-13:01	70.6	86.6	82.4	N28 dominant source of noise. Ground wet during measurement.
Derived Measurements					
Average L ₁₀			85.7		
L _{A10, 18 hour*}			84.7		
L _{den**}				82.7	
Location	Measurement Date & Time	L_{A90}	L_{A10}	L_{Aeq}	Notes
N2-1	10/03/2015 14:11-14:26	38.5	64.0	60.4	Local traffic. Truck passing. Aircraft movement overhead.
N2-1	10/03/2015 15:19-15:34	39.6	66.5	63.1	Local traffic dominant source of noise. N28 audible. Aircraft movements overhead.
N2-1	10/03/2015 16:17-16:32	44.2	65.7	60.7	Car engine running close to measurement location. Wind glider overhead.
Derived Measurements					
Average L ₁₀			65.4		

L _{A10} , 18 hour*			64.4		
L _{den} **				65.7	
Location	Measurement Date & Time	L _{A90}	L _{A10}	L _{Aeq}	Notes
N2-2	10/03/2015 14:42-14:57	41.7	56.9	54.7	Local traffic. N28 audible. Aircraft movement overhead. Noise from chainsaw and people at one point during the measurement.
N2-2	10/03/2015 15:39-15:54	37.1	47.3	50.8	Traffic from N28 dominant source of noise.
N2-2	10/03/2015 16:37-16:52	38.7	46.0	44.4	Dog barking.
Derived Measurements					
Average L ₁₀			40.1		
L _{A10} , 18 hour*			49.1		
L _{den} **				52.1	
Location	Measurement Date & Time	L _{A90}	L _{A10}	L _{Aeq}	Notes
N2-3	10/03/2015 15:01-15:16	54.2	76.1	71.9	Traffic noise from N28 dominant. Truck movements in and out of the adjacent facility.
N2-3	10/03/2015 15:59-16:14	56.8	78.1	73.6	Traffic noise from N28 dominant.
N2-3	10/03/2015 16:56-17:11	61.2	79.5	74.9	Traffic noise dominant. Road very busy.
Derived Measurements					
Average L ₁₀			77.9		
L _{A10} , 18 hour*			76.9		
L _{den} **				76.0	
Location	Measurement Date & Time	L _{A90}	L _{A10}	L _{Aeq}	Notes
N2-4	11/03/2015 13:46-14:01	47.5	73.6	69.5	Local traffic at junction. Birdsong.
N2-4	11/03/2015 14:53-15:08	51.2	72.8	68.3	Low flying aircraft movement overhead.
N2-4	11/03/2015 15:56-16:11	45.6	71.4	67.6	Car engine running nearby for period of measurement.
Derived Measurements					
Average L ₁₀			72.6		
L _{A10} , 18 hour*			71.6		
L _{den} **				71.4	
Location	Measurement Date & Time	L _{A90}	L _{A10}	L _{Aeq}	Notes
N2-5	11/03/2015 14:07-14:22	47.4	70.1	67.5	Traffic noise dominant. Bird noise from nearby rookery.

N2-5	11/03/2015 15:14-15:29	49.6	70.4	67.6	Lawn mower and music audible from across the road. Bus passing. Voices nearby.
N2-5	11/03/2015 16:18-16:33	54.7	76.1	71.8	Dog barking. Voices nearby. Road traffic noise. Road very busy.
Derived Measurements					
Average L ₁₀			72.2		
L _{A10, 18 hour*}			71.2		
L _{den**}				71.1	
Location	Measurement Date & Time	L_{A90}	L_{A10}	L_{Aeq}	Notes
N2-6	11/03/2015 14:29-14:44	42.9	68.5	64.3	Hum from transformer. Birdsong. School bell. N28 traffic noise audible. Local traffic noise.
N2-6	11/03/2015 15:33-15:48	42.5	67.6	64.3	Talking near microphone.
N2-6	11/03/2015 16:39-16:54	44.0	71.0	66.9	Cars queuing at roundabout. Birdsong. Aircraft movement overhead. Conservation.
Derived Measurements					
Average L ₁₀			69.0		
L _{A10, 18 hour*}			68.0		
L _{den**}				68.4	
Location	Measurement Date & Time	L_{A90}	L_{A10}	L_{Aeq}	Notes
N3-1	14/04/2015 09:45-10:00	38.9	65.6	63.8	Birdsong. Local traffic. Conversation.
N3-1	14/04/2015 10:55-11:10	38.0	66.2	62.1	Local traffic.
N3-1	14/04/2015 11:54-12:09	42.7	68.1	64.2	Local traffic.
Derived Measurements					
Average L ₁₀			66.6		
L _{A10, 18 hour*}			65.6		
L _{den**}				66.3	
Location	Measurement Date & Time	L_{A90}	L_{A10}	L_{Aeq}	Notes
N3-2	14/04/2015 10:07-10:22	50.4	77.1	72.4	N28 audible. Local traffic. Birdsong.
N3-2	14/04/2015 11:15-11:30	55.1	79.2	74.4	Grass cutting at golf course. Frequent local traffic.
N3-2	14/04/2015 12:13-12:28	53.5	78.7	73.9	Tree cutting/branch shredding.
Derived Measurements					
Average L ₁₀			78.3		
L _{A10, 18 hour*}			77.3		

L _{den} **				76.4	
Location	Measurement Date & Time	L _{A90}	L _{A10}	L _{Aeq}	Notes
N3-3	14/04/2015 10:34-10:49	36.4	69.4	68.1	Local traffic. Lambs bleating. Birdsong. Aircraft movement overhead.
N3-3	14/04/2015 11:34-11:49	36.1	69.6	67.2	Local traffic. Very quiet during periods of low traffic noise.
N3-3	14/04/2015 12:32-12:47	40.8	68.1	66.5	Wind through foliage.
Derived Measurements					
Average L ₁₀			69.0		
L _{A10} , 18 hour*			68.0		
L _{den} **				68.4	
Location	Measurement Date & Time	L _{A90}	L _{A10}	L _{Aeq}	Notes
N3-4	15/04/2015 13:46-14:01	64.2	70.3	69.1	N28 dominant source of noise. Dog barking.
N3-4	15/04/2015 14:56-15:11	63.0	69.2	67.5	Dog barking.
N3-4	15/04/2016 16:07-16:22	64.3	69.0	67.8	Dog barking. Construction noise – electric saw.
Derived Measurements					
Average L ₁₀			69.5		
L _{A10} , 18 hour*			68.5		
L _{den} **				68.8	
Location	Measurement Date & Time	L _{A90}	L _{A10}	L _{Aeq}	Notes
N3-5	15/04/2015 14:13-14:28	38.4	74.1	70.3	Intermittent local traffic. Birdsong.
N3-5	15/04/2015 15:23-15:38	42.0	73.8	69.3	Intermittent local traffic. Birdsong.
N3-5	15/04/2015 16:35-16:50	46.4	76.1	71.5	Intermittent local traffic. Birdsong.
Derived Measurements					
Average L ₁₀			74.7		
L _{A10} , 18 hour*			73.7		
L _{den} **				73.2	
Location	Measurement Date & Time	L _{A90}	L _{A10}	L _{Aeq}	Notes
N3-6	15/04/2015 14:34-14:49	49.5	73.5	71.7	Traffic from N28 overpass audible. Local traffic. Birdsong.
N3-6	15/04/2015 15:44-15:59	52.9	70.0	70.3	Traffic from N28 overpass audible. Local traffic. Birdsong.
N3-6	15/04/2015 16:56-17:12	56.0	73.7	72.2	Traffic from N28 overpass audible. Local traffic. Birdsong.

Derived Measurements					
Average L ₁₀			72.4		
L _{A10, 18 hour*}			71.4		
L _{den**}				71.3	
Location	Measurement Date & Time	L _{A90}	L _{A10}	L _{Aeq}	Notes
N4-1	09:00-09:15	52.8	57.4	55.6	Local traffic dominant. Birdsong. M28 visible and audible.
N4-1	10:09-10:24	51.8	57.6	56.2	Church bells at one occasion. Car pulling in near measurement position. Car horn.
N4-1	11:13-11:28	51.6	58.2	55.7	Plane flying overhead. Car passing on laneway.
Derived Measurements					
Average L ₁₀			57.7		
L _{A10, 18 hour*}			56.7		
L _{den**}				58.7	
Location	Measurement Time	L _{A90}	L _{A10}	L _{Aeq}	Notes
N4-2	09:19-09:34	57.0	63.2	61.1	Local traffic dominant. Birdsong. M28 visible and audible. Watermain/drain audible.
N4-2	10:28-10:43	55.9	63.0	60.2	Conversation near microphone for a few minutes.
N4-2	11:32-11:47	55.7	62.8	60.1	
Derived Measurements					
Average L ₁₀			63.0		
L _{A10, 18 hour*}			62.0		
L _{den**}				63.2	
Location	Measurement Date & Time	L _{A90}	L _{A10}	L _{Aeq}	Notes
N4-3	09:45-10:00	54.6	62.0	59.6	Local traffic dominant. Birdsong. M28 visible and audible. Occasional cars passing measurement position.
N4-3	10:50-11:05	54.3	61.1	59.9	Occasional vans and cars passing.
N4-3	11:56-12:11	55.6	61.4	59.4	Hammering audible from nearby construction work. Car starting near measurement position on two occasions.
Derived Measurements					
Average L ₁₀			61.5		
L _{A10, 18 hour*}			60.5		
L _{den**}				61.9	
Location	Measurement Date & Time	L _{A90}	L _{A10}	L _{Aeq}	Notes
N4-4	14:44-14:59	52.5	59.8	57.3	Traffic on N28 audible. Traffic from Maryborough Hill also audible. Low flying plane overhead.

N4-4	15:44-15:59	51.0	58.7	56.2	Voices near microphone. Car door.
N4-4	16:42-16:57	55.6	75.4	71.2	Motorbike passing. Lawnmower audible.
Derived Measurements					
Average L ₁₀			64.6		
L _{A10} , 18 hour*			63.6		
L _{den} **				64.6	
Location	Measurement Date & Time	L_{A90}	L_{A10}	L_{Aeq}	Notes
N4-5	15:05-15:20	56.1	61.9	60.4	Traffic from N28 and Maryborough Hill dominant source of noise. Birdsong. Waste truck also noted on two occasions during the measurement.
N4-5	16:03-16:18	56.8	61.2	59.5	Voices nearby. Birds in nearby trees. Plane flying overhead.
N4-5	17:05-17:20	55.5	62.2	59.8	
Derived Measurements					
Average L ₁₀			61.8		
L _{A10} , 18 hour*			60.8		
L _{den} **				62.1	
Location	Measurement Date & Time	L_{A90}	L_{A10}	L_{Aeq}	Notes
N4-6	15:26-15:41	40.8	54.9	53.5	Birds overhead. N28 audible. Occasional noise from vehicles including waste truck.
N4-6	16:22-16:37	41.9	53.9	53.4	Dog barking. High pitch noise from car.
N4-6	17:24-17:39	42.0	58.5	54.9	
Derived Measurements					
Average L ₁₀			55.8		
L _{A10} , 18 hour*			54.8		
L _{den} **				57.0	
Location	Measurement Date & Time	L_{A90}	L_{A10}	L_{Aeq}	Notes
N4-7	09:12-09:27	51.7	71.5	67.4	Local traffic dominant. Engine running from nearby vehicle distribution centre. Birdsong. Voices from nearby residence. Bus and truck passing.
N4-7	10:25-10:40	42.6	70.4	68.0	Truck and empty trailer passing. Angle grinder audible.
N4-7	11:31-11:46	37.7	71.9	68.6	
Derived Measurements					
Average L ₁₀			71.3		
L _{A10} , 18 hour*			70.3		
L _{den} **				70.3	

Location	Measurement Date & Time	L _{A90}	L _{A10}	L _{Aeq}	Notes
N4-8	09:36-09:51	42.9	51.4	50.1	Quiet area. Occasional vehicles entering estate. Birdsong. N28 audible in the distance. Activity within estate.
N4-8	10:45-11:00	37.7	51.4	49.6	Generator running at grotto to the east of measurement position audible.
N4-8	11:52-12:07	38.4	54.6	51.3	Church bells at Shanbally noted at one period. Frequent passing of cars and trucks overhead to the north-east of Shannonpark roundabout. Voices nearby microphone at the end of the measurement.
Derived Measurements					
Average L ₁₀			52.5		
L _{A10, 18 hour*}			51.5		
L _{den**}				54.1	
Location	Measurement Date & Time	L _{A90}	L _{A10}	L _{Aeq}	Notes
N4-9	09:59-10:14	60.7	81.0	77.1	Traffic noise from N28 and Shannonpark dominant. Voices from construction work at nearby house audible.
N4-9	11:06-11:21	64.7	82.8	78.7	Chainsaw to the north of N28 audible.
N4-9	12:12-12:27	66.5	83.4	79.5	
Derived Measurements					
Average L ₁₀			82.4		
L _{A10, 18 hour*}			81.4		
L _{den**}				79.9	

*The L_{A10, 18 hour} level was derived from the short-term calculation $L_{A10, 18 \text{ hour}} = (\text{Average measured } L_{10} \text{ values})/3 - 1$ given in the NRA document "Guidelines for the treatment of Noise and Vibration in National Road Schemes".

**The L_{den} level was derived from the Method B calculation given in the NRA document "Guidelines for the treatment of Noise and Vibration in National Road Schemes" $L_{den} = 0.86 \times L_{A10, 18 \text{ hour}} + 9.86$.

The results of the baseline 24 hour noise surveys carried out at each 24 hour monitoring location are shown in **Table 14.9** to **Table 14.11**.

Table 14.9: Location N1 24 Hour Baseline Noise Survey Results

Hour End	L _{A90, 1 Hour}	L _{A10, 1 Hour}	L _{Aeq, 1 Hour}
14:30	56.9	66.5	63.7
15:30	56.6	66.9	63.9
16:30	60.0	67.0	64.5
17:30	60.1	66.7	64.3
18:30	59.5	66.6	64.1
19:30	58.9	66.2	63.7
20:30	52.7	64.7	61.5
21:30	47.1	61.9	58.2
22:30	43.2	60.6	56.0
23:30	40.9	59.0	54.4
00:30	40.0	58.3	53.3
01:30	38.6	56.2	51.9
02:30	37.6	51.0	49.6
03:30	37.3	50.9	48.7
04:30	37.4	49.3	47.9
05:30	38.3	52.5	49.3
06:30	42.2	62.6	57.7
07:30	58.6	67.7	65.3
08:30	61.8	67.3	65.3
09:30	57.9	66.9	64.4
10:30	53.8	64.4	61.1
11:30	52.7	63.9	60..5
12:30	56.0	64.1	61.3
13:30	57.7	64.4	62.0
Derived Measurements			
L _{den} *			63

*The L_{den} value was derived from the Method B calculation given in the NRA document "Guidelines for the treatment of Noise and Vibration in National Road Schemes" $L_{den} = 10 \times \log_{10} \left(\frac{12 \times 10^{L_{day}/10} + 4 \times 10^{(5+L_{evening})/10} + 8 \times 10^{(10+L_{night})/10}}{24} \right)$ dB(A).

Table 14.10: Location N2 24 Hour Baseline Noise Survey Results

Hour End	L _{A90, 1 Hour}	L _{A10, 1 Hour}	L _{Aeq, 1 Hour}
14:47	48.8	70.3	67.5
15:47	48.7	67.4	63.6
16:47	51.7	70.4	66.0
17:47	52.7	69.3	66.0
18:47	51.1	69.0	65.0
19:47	46.8	63.9	60.8
20:47	41.1	60.1	59.0
21:47	40.6	61.1	60.4
22:47	39.8	52.3	54.1
23:47	39.9	47.4	53.0
00:47	40.7	48.6	50.8
01:47	42.5	50.4	50.8
02:47	44.5	51.1	50.0
03:47	46.3	55.2	52.1
04:47	50.8	59.5	57.4
05:47	49.8	58.3	58.9
06:47	51.4	62.6	60.3
07:47	61.4	72.8	70.3
08:47	63.6	74.6	70.8
09:47	60.5	74.6	70.6
10:47	52.0	70.4	67.0
11:47	49.0	67.4	63.1
12:47	50.4	69.2	64.1
13:47	50.2	69.7	65.0
Derived Measurements			
L _{den} *			66

*The L_{den} value was derived from the Method B calculation given in the NRA document "Guidelines for the treatment of Noise and Vibration in National Road Schemes" $L_{den} = 10 \times 10 \log_{10} \left(\frac{1}{24} (12 \times 10^{L_{day}/10} + 4 \times 10^{(5+L_{evening})/10} + 8 \times 10^{(10+L_{night})/10}) \right)$ dB(A).

Table 14.11: Location N3 24 Hour Baseline Noise Survey Results

Hour End	L _{A90} , 1 Hour	L _{A10} , 1 Hour	L _{Aeq} , 1 Hour
14:25	56.3	61.2	60.0
15:25	57.0	61.7	59.8
16:25	58.0	62.5	60.6
17:25	59.3	63.1	61.5
18:25	59.8	63.5	61.9
19:25	58.4	62.9	61.1
20:25	54.7	59.9	57.9
21:25	52.3	58.3	55.9
22:25	50.9	57.7	55.2
23:25	48.0	56.5	53.6
00:25	44.9	55.2	52.0
01:25	38.6	52.1	48.3
02:25	33.9	50.1	45.9
03:25	34.0	49.7	45.7
04:25	35.7	50.8	47.1
05:25	41.6	53.9	50.4
06:25	51.1	59.0	56.0
07:25	58.8	63.2	61.4
08:25	59.7	63.3	61.8
09:25	59.3	63.1	61.7
10:25	56.1	61.1	59.2
11:25	55.3	60.2	58.2
12:25	54.8	59.8	57.9
13:25	56.1	61.6	59.8
Derived Measurements			
L _{den} *			61

*The L_{den} value was derived from the Method B calculation given in the NRA document "Guidelines for the treatment of Noise and Vibration in National Road Schemes" $L_{den} = 10 \times 10 \log_{10} \left(\frac{1}{24} (12 \times 10^{L_{day}/10} + 4 \times 10^{(5+L_{evening})/10} + 8 \times 10^{(10+L_{night})/10}) \right)$ dB(A).

14.5 POTENTIAL IMPACTS

The potential noise and vibration impacts of the proposed road project have been evaluated for both the construction and operational stages.

14.5.1 Construction Stage

The construction stage is a significant task and is expected to take 30-36 months to complete. Details of the construction programme are set out in **Chapter 3: Description of the Proposed Road Development** and comprises:-

- Pre Main Construction works comprising fencing, tree and hedgerow clearance, site investigation and utility diversions. These works will generally be localised in extent and temporary in duration;
- Main construction works will comprise the construction of 3 interchanges, 10 significant structures approximately 13km of mainline and single carriageways with significant local road upgrades and tie-ins;
- The construction of the Service Area in Ringaskiddy; and
- Approximately 1,150,000m³ of reusable material will be excavated along the mainline with the majority located between Ch. 4,670m and Ch. 6,000m. This rock will be extracted using drilling and blasting.

The main works to be carried out at the northern will require short-term traffic management measures which include local diversions. The principal works requiring traffic management measures include:-

- Widening of the westbound M28 to N40 South Ring Road merge;
- On-line widening between Bloomfield and Rochestown Road, including the construction of large retaining walls and a new overbridge over Rochestown Road;
- Proposed works on Rochestown Road;
- On-line widening between Rochestown Road and Maryborough Hill, including the construction of large retaining walls;
- Proposed new bridge replacement at Maryborough Hill;
- On-line widening between Maryborough Hill and Carr's Hill, including the construction of large retaining walls;
- Widening of Carr's Hill Underbridge; and
- Construction of a Service Area at Ringaskiddy.

The traffic management measures are outlined in Drawings TM001 to TM010 and described in **Chapter 5: Traffic and Transportation**.

14.5.1.1 Quarrying During Construction

The construction phase of this road project will require considerable 'cut and fill' operations where material is beneficially reused inside the site boundary. This reuse of material will reduce the

quantum of material having to be hauled to the site from external sources, considerably reducing the overall environmental impact of the proposed M28 Road Project. No useful material will be hauled off the site.

In order to reuse material extracted from 'cut' operations it needs to be processed on site for use as aggregate in the construction of the road. This will involve the use of crushing and screening plants at certain locations along the route. These locations include the Carr's Hill junction, the mainline north of Shannonpark and south of Ringaskiddy. Other locations may need some material processing for limited periods.

The quarry at Raffeen has a 30 year planning permission (as of the 16th July 2008 under Reg. Ref. 06/10037 and PL. 04.225610) and it is proposed to utilise this resource for the construction of the proposed M28 Road Project to minimise the impact of hauling material on to the site from external sources.

Potential noise and vibration impacts from the cut and fill operations are included in the construction stage noise model.

14.5.1.2 Construction Stage Noise Impacts

The construction stage of a project on this scale will result in 'slight' to 'profound' negative impacts due to increases in noise levels. In the majority of cases the impact will be just perceptible or 'slight', but localised impacts, while of brief or temporary duration, could be profound. Mitigation measures will be required during construction to minimise noise and vibration impacts.

The works required for the construction of the proposed road project will include ground works for the excavation of cut and fill sections, road paving and the installation of services. The full extent of the proposed works is detailed in **Chapter 3: Description of the Proposed Road Development**. The construction stage will involve blasting and the use of a variety of equipment including excavators, rock breakers, generators, concrete mixers, lifting equipment, compressors, pumps, lighting, and dumper trucks. There will be vehicular movements to and from the site. All of these construction activities will generate noise and vibration.

In order to minimise the impact on nearby sensitive locations, it is common practice to limit the times of day during which it is permissible to carry out construction work that could create high levels of noise. It is proposed that normal working hours will be 07:00 and 19:00 Monday to Friday and 08:00 to 16:30 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 Local Authority.

Higher noise levels are generally accepted during the construction stage of this type of project than the operational stage, as these works are short-term in nature. The northern end of the project area is a sensitive residential area where significant civil engineering construction is required to be implemented. Off-peak and night working will be considered for works in critical locations. Any approval for night working will give consideration to the potential disruptive effects there may be on nearby residences and significant restrictions on noise and other adverse environmental emissions will be conditioned to any approval granted.

For the purpose of this requirement, night is defined as 22.00 to 07.00 hours.

This EIS sets out the control measures to be adopted for the proposed M28 Road Project. As part of the implementation of noise mitigation detailed noise control measures, for tasks arising during construction, detailed method statements for specific work elements will be developed. The Contractor will be obliged to comply with the noise limits set out in this chapter and apply Best Practicable Means, including the recommendations of BS 5228 *Code of practice for noise and vibration control on construction and open sites*, together with the specific requirements of any EIA Approval and the Construction Environmental Management Plan (CEMP) in the method statements. Any proposal for night time working will include a specific requirement for stakeholder engagement, including the Local Authority and the residential community.

Example of works that may be required outside the normal working hours include diversion of utilities, demolition and reconstruction of the bridge at Maryborough or working on existing roads outside of peak traffic periods to avoid or minimise traffic congestion.

Based on the likely construction methods required to complete the works, an indication of worst case noise levels at the nearest NSLs from the use of a range of equipment was calculated using data from BS 5228-1:2009+A1 - *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise* and the Cadna noise modelling software. Indicative construction activities and locations have been modelled and are shown in **Figure 14.4** contained in **Volume 5**. While these locations are indicative all works will be subject to noise control measures outlined in any EIA Approval.

BS 5228-1:2009+A1:2014 sets out a method of calculating the propagation of sound towards a receiver from the use of certain construction plant and machinery on a construction site. The standard describes single octave sound power level data for a range of standardised plant and machinery as would be expected to be the norm on construction sites.

Sound propagation calculations for a range of plant and machinery have been presented and are shown in **Table 14.12**.

Table 14.12: Sound Pressure Levels of Typical Machinery Used During Construction Stage

Item & BS5228-1:2009+A1:2014 Reference	Predicted Noise Levels at 10m
Pneumatic breaker (Ref D.2.11)	87
Backhoe Mounted Hydraulic Breaker (Ref C.5.1)	88
Concrete Mixer Truck (Ref D.6.35)	72
Wheeled Mobile Telescopic Crane (Ref C.4.38)	78
Vibratory Roller (Ref C.5.26)	77
Dumper (Ref C.4.9)	77
Articulated Dump Truck (Ref C.2.33)	81
Water Pump (Ref C.2.46)	66
Tracked semi-mobile crusher (Ref C.9.14)	90
Screen stockpile (Ref C.10.14)	81
Tracked Excavator (Ref C.2.14)	79
Bored piling/pile cast in place	87

Cars and vans travelling to and from the site compounds during the construction stage would be expected to peak during the morning (arrival of Contractors at the site) and evening (departure of Contractors from the site), and would not be a continuous source of noise emissions from the site during a typical working day. The delivery of construction materials by HGVs to the site has been included in the traffic figures.

Blasting works may be required to be carried out at a number of locations along the proposed road project, principally at the cut sections on the mainline north of Shannonpark and south of Ringaskiddy (as described in **Chapter 3: Description of the Proposed Road Development**). These blasting events will increase the noise levels within the vicinity of the blast. Noise from blasting will however be momentary in nature.

The potential noise impacts during the construction stage have been modelled at four specimen locations along the proposed M28 route using the Cadna software. These locations are shown on contained in **Volume 5**, which also shows the location of indicative crushing and screening operations modelled. The relevant noise sources listed in **Table 14.12** were included in the model at each location and all machinery modelled to operate simultaneously throughout the entirety of the day-time period. This represents a worst case condition. The reality will entail machinery being operated at different periods and at different locations throughout the proposed road project. **Figure 14.5** (refer to **Volume 5** of the EIS) shows the noise contour map results at each of the modelled locations. The results of the noise contours indicate that, under worst case conditions, noise levels may be above the limits set in **Table 14.1** or **Table 14.2**. In particular Edgewood, Maryborough Hill, Noise Action Plan Area N28-1, The Close and The View all indicated levels which, if uncontrolled, have the potential to exceed these noise limits. Mitigation in the form of construction phase acoustic screens is proposed for these areas in **Section 14.6.1**.

In the event that the Contractor's method statement for any proposed works indicates that the levels set out in **Table 14.1** or **Table 14.2** may be exceeded, permission for the works must be sought from the Planning Authority in advance of any works taking place. The application for such works will require a detailed noise control plan and follow up report to be prepared. This plan will include (i) a justification for the works, (ii) an assessment indicating what alternatives have been considered, (iii) a statement of the noise control measures from B.S. 5228 to be adopted and how Best Practicable Means will be used to control noise, (iv) an activity specific noise monitoring programme including contact details for persons with the authority to cease working if required by the Planning Authority. Each follow up report will include details of any complaints received and the action taken to address such complaints. The proposed mitigation measures for the construction period are detailed in **Section 14.6.1**.

In the event that material is used from the quarry for the purposes of the road noise levels from the quarry operation at Raffeen have been considered as part of the construction phase model. The predominant noise sources from the quarry will be from the various items of plant and machinery involved in the quarrying activities, as well as from blast events. It is likely that noise from blast events will be audible at some sensitive receptors. The nearest sensitive receptor is approximately 100m from the quarry. Noise from a quarry blast however will be intermittent and occur on average 4 times per month as set out under the existing planning permission – see Condition 24 of the permission. The quarry will not be operational on Sundays or Bank Holidays.

14.5.1.3 Construction Stage Vibration Impacts

The main sources of vibration during the construction works will arise as a result of blasting during the excavation works and to a lesser extent vehicles travelling on, to and from the construction sites. As discussed in **Section 14.2.4** the main issues of concern with regards to vibration are human sensitivity and potential structural damage to nearby buildings. Any works likely to cause vibration will be subject to vibration control measures set out in this document and in compliance with the limits set out in the NRA Guidelines.

The majority of dwellings within the vicinity of the proposed works will comply with modern building regulations standards and therefore will be tolerable to the vibration limits given in the NRA guidance (see **Table 14.4**). The NRA guidance limits also include a considerable factor of safety and therefore any older buildings or buildings that deviate from building regulations standards should still be tolerable to these vibration limits.

The Castle Warren site is considered to be sensitive to vibration during the construction phase. The nearest blasting activity will be over 1 kilometre from Castle Warren. The primary risk to the structure will arise from construction traffic during placement and compaction of materials during the construction of the elevated section of the road 50m from the structure. The largest dynamic compaction rollers have the capability of generating vibration levels of up to 3mm/s at a distance of 50m.

Vibration levels during construction will be maintained below the threshold of risk to the structure and a combination of structural and vibration monitoring will be carried out during the construction phase to protect the structure.

14.5.2 Operational Phase

14.5.2.1 Noise Impacts

The TII Guidelines require predictions to be reported for the Opening Year (2020), and for a Design Year (2035), 15 years after opening. Noise levels in the Design Year differ from those in the Opening Year by the same amount at all locations. This means that there will be no property that meets the requirements for mitigation in the Design Year that does not also meet them in the Opening Year.

TII Guidelines state it is only necessary to table the predictions for the Design Year and to report the (constant) difference between the Design and the Opening Year levels. This will reduce the volume of data presented in the noise report. It also avoids the need to consider mitigation for two different years, as any mitigation which is adequate for the Design Year will also meet the requirements of the Opening Year.

The main source of noise during the operational phase will arise from traffic on the proposed M28 Road Project. The traffic volumes and speeds are as set out in **Chapter 5: Traffic and Transportation**. For the purpose of noise modelling the 'high-growth' scenario has been chosen. The predicted impacts of the operational stage of the development on selected NSLs have been modelled for the design year. A 'Do-Minimum' (proposed road project is not carried out) and a 'Do-Something' (proposed road project is carried out without any mitigation) scenario has been modelled based on predicted traffic flows. The location of the NSLs is shown on **Figure 14.6** contained in **Volume 5**.

The predicted noise level at specific NSLs for the design year 2035 ‘Do-Minimum’ and ‘Do-Something’ scenario are given in **Table 14.13**. The Operational Noise Criteria set out in **Section 14.2.2** have been applied and the reasoning whether mitigation is required or not is also set out. The requirements of the Cork Noise Action Plans are referred to below under the Design Criteria Column of **Table 14.13** as Cork NAP. Where a number of properties in the same area have been examined, e.g., Belgard Downs, a range of values is presented.

The existing noise levels on the northern end (on-line section) of the proposed M28 Road Project are significantly higher than the TII Design Goal it is therefore not practicable to reduce these levels to achieve the TII Design Goal in a sustainable manner at all locations.

For this assessment the requirement for mitigation is triggered for the northern on-line section of the proposed road project where the onset levels for assessment of noise mitigation in the Cork Noise Action Plan are met. Where practicable on the northern section, mitigation will also be provided to reduce noise to the TII Design Goal. For the southern section, mitigation is provided where all three conditions requiring mitigation as set out in the NRA guidelines are met (refer to **Section 14.2.3.2**).

Table 14.13: Predicted Noise Levels Design Year 2035 ‘Do-Minimum’ v’s ‘Do-Something’

Noise Sensitive Location	Baseline L _{den} dB(A)	‘Do-Minimum’ L _{den} dB(A)	‘Do-Something’ L _{den} dB(A)	‘Do-Something’ L _{Night} dB(A)	Design Criteria	Mitigation Required (Yes/No)
All Saints Cemetery	55	56	58	48	South – NRA Conditions	No
Belgard Downs	63-69	63-69	63-69	53-59	North - NRA Conditions & Cork NAP	Yes
Bloomfield	42	44	63-64	50-51	South – NRA Conditions	Yes
Broadale Complex	59	75	69	62	North - NRA Conditions & Cork NAP	Yes
Carrigaline B&B	67	71	65	58	South – NRA Conditions	No
Carrigaline Road	59-67	60-68	63-69	53-60	North - NRA Conditions & Cork NAP	Yes
Carrigaline Rugby Club	56	55	57	47	South – NRA Conditions	No
Carr's Hill	67-73	67-72	66-69	55-61	South – NRA Conditions	No
Chestnut Lodge B&B	59	62	66	56	South – NRA Conditions	Yes
Church (Ringaskiddy)	63	64	62	55	South – NRA Conditions	No
Clarkes Hill	59-63	59-68	58-64	49-57	North - NRA Conditions & Cork NAP	No

Noise Sensitive Location	Baseline L _{den} dB(A)	'Do-Minimum' L _{den} dB(A)	'Do-Something' L _{den} dB(A)	'Do-Something' L _{Night} dB(A)	Design Criteria	Mitigation Required (Yes/No)
Coolmore Close	48-54	53-59	63-65	52-55	South – NRA Conditions	Yes
Delfern Groove	60-64	62-66	66-70	55-59	North - NRA Conditions & Cork NAP	Yes
Edgewood	60-61	63-64	63-66	53-56	North - NRA Conditions & Cork NAP	Yes
Ferryview Student Accommodation	39	42	54	40	South – NRA Conditions	No
Footprints Montessori and Daycare	67	69	67	58	South – NRA Conditions	No
Health Centre (Shanbally)	50	54	61	52	South – NRA Conditions	Yes
Hibernian AFC	46	50	65	54	South – NRA Conditions	Yes
Kilteggan Park (N40 - 8)	66-73	66-73	66-73	56-64	North - NRA Conditions & Cork NAP	Yes
Lissadell	60	62	65	55	North - NRA Conditions & Cork NAP	Yes
Manor Avenue	58	60	65	54	North - NRA Conditions & Cork NAP	Yes
Marian Terrace	42-61	47-65	58-65	46-54	South – NRA Conditions	Yes
Martello Park	49-59	50-61	57-60	43-48	South – NRA Conditions	No
Maryborough Heights	65-68	66-70	69-71	59-61	North - NRA Conditions & Cork NAP	Yes
Maryborough Hill	60-70	62-71	63-69	53-59	North - NRA Conditions & Cork NAP	Yes
Maryborough Hotel	58	59	59	49	North - NRA Conditions & Cork NAP	No
Maryborough Nursing Home	58	59	59	49	North - NRA Conditions & Cork NAP	No
Mount Oval Village	50	53	53	44	North - NRA Conditions & Cork NAP	No
National Maritime College	44-47	47-48	49-56	38-42	South – NRA Conditions	No

Noise Sensitive Location	Baseline L _{den} dB(A)	'Do-Minimum' L _{den} dB(A)	'Do-Something' L _{den} dB(A)	'Do-Something' L _{Night} dB(A)	Design Criteria	Mitigation Required (Yes/No)
Noise Action Plan N28-1	66-72	66-73	66-71	56-62	North - NRA Conditions & Cork NAP	Yes
Noise Action Plan N28-2	67-75	69-76	68-74	58-66	North - NRA Conditions & Cork NAP	Yes
Noise Action Plan N28-3	59-72	59-71	65-69	55-61	South – NRA Conditions	Yes
Noise Action Plan N28 4	59-63	60-64	57-61	47-51	South – NRA Conditions	No
Old Post Office Road	51-53	51-53	64-65	50-51	South – NRA Conditions	Yes
Playground	65	65	63	55	South – NRA Conditions	No
Raffeen	51-66	51-67	59-65	47-55	South – NRA Conditions	Yes
Raffeen Lodge B&B	66	67	65	55	South – NRA Conditions	No
Ringaskiddy	53	54	63	48	South – NRA Conditions	Yes
Ringaskiddy Community Centre	57	56	54	43	South – NRA Conditions	No
Ringaskiddy Lower Harbour National School	55	58	62	55	South – NRA Conditions	Yes
Rochestown Park Hotel	70	70	70	60	North - NRA Conditions & Cork NAP	Yes
Rochestown Rd	65-70	66-71	65-70	56-63	North - NRA Conditions & Cork NAP	Yes
Rochestown Rise	61-68	63-69	65-69	55-61	North - NRA Conditions & Cork NAP	Yes
Rochestown Rise B&B	61	63	67	56	North - NRA Conditions & Cork NAP	Yes
Rowan Hill	61-63	62-65	64-67	53-57	North - NRA Conditions & Cork NAP	Yes
Rowan Hill (8m)	65	66	70	60	North - NRA Conditions & Cork NAP	Yes
Shamrock Place	46-53	48-62	60-65	47-55	South – NRA Conditions	Yes

Noise Sensitive Location	Baseline L _{den} dB(A)	'Do-Minimum' L _{den} dB(A)	'Do-Something' L _{den} dB(A)	'Do-Something' L _{Night} dB(A)	Design Criteria	Mitigation Required (Yes/No)
Shamrocks GAA Club	47	50	60	48	South – NRA Conditions	No
Shanbally	46-50	50-53	58-60	47-48	South – NRA Conditions	No
Shanbally Catholic Church	52	57	55	44	South – NRA Conditions	No
Shanbally Mews	53-65	57-69	62-68	53-60	South – NRA Conditions	Yes
Shanbally National School	48	53	56	44	South – NRA Conditions	No
Shannonpark	45-61	46-64	53-68	42-58	South – NRA Conditions	Yes
Shannonpark House B&B	65	64	65	56	South – NRA Conditions	No
SP Housing Development	46-69	48-69	55-70	43-62	South – NRA Conditions	Yes
St Carthege Place	41	44	61	47	South – NRA Conditions	Yes
St. Patrick's Church (RC)	63	65	63	56	North - NRA Conditions & Cork NAP	No
Suite Cottages	48	49	54	43	South – NRA Conditions	No
The Close	56-62	57-63	61-68	51-57	North - NRA Conditions & Cork NAP	Yes
The Downs	61	63	65	55	North - NRA Conditions & Cork NAP	Yes
The Fairways	70	71	68	57	North - NRA Conditions & Cork NAP	Yes
The Ferryboat Inn and Accommodation	67	68	65	58	South – NRA Conditions	No
The Oaks	51-52	53	53-56	43-46	North - NRA Conditions & Cork NAP	No
The View	65-71	68-72	68-74	60-64	North - NRA Conditions & Cork NAP	Yes
Warren's Court	43	46	59	46	South – NRA Conditions	No
Wishing Well Centre	48	49	54	43	South – NRA Conditions	No

The proposed Service Area in Ringaskiddy has been modelled on the basis that 10% of the traffic going to the port at Ringaskiddy will stop at the service station. This figure was obtained based on the assumption made in the *Cork Port Heavy Goods Vehicle Rest Area Study* carried out by AECOM. The Service Area comprises 45 HGV spaces and includes a 500m² facility building with a forecourt. Six fuel pump stations will be constructed at the Service Area. For the truck parking spaces a worst case scenario was taken with the trucks being modelled as all containing refrigeration units, and all parking spaces being occupied at the one time. The other parking spaces were modelled using the Cadna parking lot source option and is based on the German Standard RLS-90.

As part of the planning permission for the house under construction just east of Raffeen Quarry a planning condition for that site requires that a 2.4m high barrier be constructed on the site. A 2.4m high barrier has been modelled along the south and western boundary of this site in to the Do-Nothing noise model.

Noise contour maps generated for the ‘Do-Minimum’ L_{den} and the ‘Do-Minimum’ L_{night} are shown on Figure 14.7 and Figure 14.8 contained in Volume 5.

14.5.2.2 Vibration Impacts

The NRA Document *“Guidelines for the Treatment of Noise and Vibration on National Road Schemes”* states that *“ground vibrations produced by road traffic is unlikely to cause perceptible structural vibration in properties located near to well-maintained and smooth road surfaces. This aspect does not require further consideration unless there are unusual circumstances under which higher than normal traffic vibration levels may be expected”*. It is not expected that there will be an unusual level of vibration from the proposed M28 Road Project and therefore it is not expected that any vibrational impacts will arise during the operational phase of the project.

The Castle Warren site is a kilometre from the nearest blasting and 50m from the nearest construction activity required for the project. These separation zones ensure that the potential vibration levels are below the most conservative international vibration level guidelines at Castle Warren. In order to protect this site, emphasis will focus on prevention of vibration at source and monitoring and reporting of vibration levels during the construction phase.

14.6 MITIGATION MEASURES

14.6.1 Construction Phase

14.6.1.1 Construction Phase Noise & Vibration Mitigation Measures

The following mitigation measures will be implemented during the construction works:-

- Temporary acoustic barriers will be installed at the locations adjacent to the Maryborough overpass shown in Drawing TM0010 (barriers 3m high).
- The Contractor will be required to install additional screening at the piling machine at Maryborough Hill that will be capable of providing a reduction of 10dB(A) at the nearby noise sensitive locations.

- The existing wall and fence (2m high) shown on Drawing No. TM0001 will be maintained to provide an acoustic screen for the construction phase, prior to the installation of AB01 and RW01 barriers.
- Acoustic noise barriers AB01 to AB04, RW01 to RW05, AB06 to AB08, AB10 to 14 and AB26, AB27 and AB28 will be constructed as early as possible during the construction phase. The Contractor will be required to set out an acoustic barrier construction schedule to maximise acoustic screening for the construction phase.
- Construction will be phased to minimise the duration of activities in each area.
- All Contractors will employ the Best Practicable Means to minimise noise emissions and will be obliged to comply with the general recommendations of BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*. And BS 5228-2:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Part2: Vibration* (together referred to as B.S. 5228).
 - “Best Practicable Means” include:-
 - Limiting the hours during which site activities likely to create high levels of vibration are permitted; any work outside normal working hours shall only take place with the written permission of the local authority; and
 - Establishing channels of communication between the Contractor/developer, Local Authority and residents.
- Where works need to be completed outside normal working hours or the Contractor’s method statement for any proposed works indicates that the levels set out in **Table 14.1** may be exceeded, permission for these works must be sought from the Planning Authority in advance of any works taking place. The application for such works will require a detailed noise control plan and follow up report to be prepared. This plan will include (i) a justification for the works being carried out in the manner proposed, (ii) an assessment indicating what alternatives have been considered, (iii) a statement of the noise control measures from B.S. 5228 to be adopted and how Best Practicable Means will be used to control noise, (iv) an activity specific noise monitoring programme including contact details for persons with the authority to cease working if required by the Planning Authority. Each follow up report will include details of any complaints received and the action taken to address such complaints.
- A noise and vibration monitoring programme will be implemented for the duration of the construction phase. Monitoring will assess compliance of the construction works with the noise limits set out in **Table 14.1** and **Table 14.2**.
- A vibration monitoring programme will be implemented around the Castle Warren site. In the event that vibration levels approach 3mm/s at frequencies below 10 Hz additional vibration control measures will be implemented to protect the structure.
- Full details of the Contractor’s provision for noise and vibration monitoring and procedures in relation to public notice will be made available to the Planning Authority.
- Blasting will only be permitted between 0900 and 1800 hrs Monday to Friday inclusive. Blasting will not be permitted on Weekends or Bank Holidays.
- In the advance of any blasting operation the Contractor will inform occupants of all dwellings within 500m of the blast that blasting will take place and the duration of blasting operations.
- Air overpressure from any blast will not exceed 125 dB (linear) max peak, with a 95% confidence limit when measured at the nearest air overpressure sensitive location. No individual air overpressure value shall exceed the limit value by more than 5 dB (Lin).
- As part of the implementation of mitigation, the CEMP will include the following measures:-
 - Channels of communication between the Contractor/developer, the council and residents will be established;

- Records of any noise complaints relating to the construction operations will be and investigated as soon as possible and reported to the Local Authority’
- Plant such as pumps and generators used on or near sensitive locations will be contained within an acoustic enclosure and comply with the noise levels in **Table 14.1** and **Table 14.2**;
- Plant and machinery used on-site will comply with the EC (Construction Plant and Equipment) Permissible, Noise Levels Regulations, 1988 (S.I. No. 320 of 1988);
- All noise producing equipment will comply with S.I. No 632 of 2001 European Communities (Noise Emission by Equipment for Use Outdoors) Regulations 2001; and
- Measures outlined in “*Environmental Good Practice Site Guide*” 2005 compiled by CIRIA and the UK Environmental Agency and the “*London Good Practice Guide: Noise & Vibration Control for Demolition and Construction*” 2016 These guidelines provide useful and practical information regarding the control of noise emissions at construction sites.

14.6.2 Operational Phase

It is proposed to use a low noise surface along the entire mainline of proposed M28 Road Project. A low road noise surface provides a minimum reduction in noise levels of 2.5 dB(A) and will provide mitigation for all properties situated in the vicinity of the road project. A low road noise surface is proposed for the R611 Cork Road from the proposed new roundabout at Shannonpark to the roundabout at Heron’s Wood. It is also proposed to install a low road noise surface along a portion of a side road named Ballinrea Road at Shannonpark off the R611. **Table 14.14** outlines the extent of low noise surfacing proposed.

Table 14.14: Proposed Mitigation Measures (Road surfacing)

Location	Type of Mitigation	Length (m)
All surfaces inside LMA boundary including East and west of M28 mainline on Maryborough Hill	Low Noise Road Surface	Full Length of proposed road (approx. 13km)
Existing N28 at Priority area N28-3	Low Noise Road Surface	1436
East and west of M28 mainline on Rochestown Road	Low Noise Road Surface	629
Shannonpark Road*	Low Noise Road Surface	524
Ringaskiddy Harbour National School	Low Noise Road Surface	813

Using a low noise surface in the model resulted in a number of NSLs requiring further mitigation, in accordance with the guidelines listed in **Section 14.2.3**. It is proposed to install noise reducing measures (walls/acoustic barriers) at the remaining locations requiring mitigation. The height and length of the barrier proposed is detailed in **Table 14.15**. The table refers to ‘Noise Barriers’, this may take the form of walls, earthen berms and other landscaping features providing the required acoustic screening and meeting all other technical specifications. The locations of noise reducing measures are shown on **Figure 14.9** contained in **Volume 5**.

Table 14.15: Proposed Mitigation Structures

Barrier Reference	Type of Mitigation	Height (m)	Length (m)
AB01	Noise Barrier	3.0	1242
AB02	Noise Barrier	3.0	149
AB03	Noise Barrier	3.0	71
AB04	Noise Barrier	2.0	108
AB05	Noise Barrier	3.0	625
AB06	Noise Barrier	3.0	216
AB07	Noise Barrier	3.0	137
AB08	Noise Barrier	3.0	150
AB09	Noise Barrier	3.0	205
AB10	Noise Barrier	3.0	52
AB11	Noise Barrier	2.0	61
AB12	Noise Barrier	2.5	395
AB13	Noise Barrier	3.0	82
AB14	Noise Barrier	3.0	1049
AB15	Noise Barrier	2.0	514
AB16	Noise Barrier	2.0	421
AB17	Noise Barrier	3.0	272
AB18	Noise Barrier	3.0	278
AB19	Noise Barrier	2.5	242
AB20	Noise Barrier	2.0	287
AB21	Noise Barrier	2.0	142
AB22	Noise Barrier	2.0	120
AB23	Noise Barrier	2.0	301
AB24	Noise Barrier	2.0	507
AB25	Noise Barrier	2.0	182
AB26	Noise Barrier	3.0	559
AB27	Noise Barrier	3.0	220
AB28	Noise Barrier	2.0	165
RW-01	Wall	3.0	253
RW-02	Wall	3.0	246
RW-03	Wall	1.2	255
RW-04	Wall	1.2	302
RW-05	Wall	1.2	171
RW-08	Wall	3.0	101
RW-09	Wall	3.0	39
Existing Wall to be Extended	Wall	3.0	119
Wall/Acoustic Barrier	Wall	2.0	53

Acoustic mitigation measures will be installed in accordance with the relevant standards and where proprietary barriers are used they will be required to have a design life of 30 years with no gaps or leaks in the structure. The visual impact of the acoustic mitigation measures is addressed in **Chapter 16: Landscape and Visual**.

Table 14.6 shows the results at the NSLs following mitigation. The significance of the impact in accordance with **Table 14.2** is also included.

Table 14.16: Results at Noise Sensitive Locations with Mitigation

Noise Sensitive Location	'Do-Minimum' L _{den} dB(A)	'Do-Something with Mitigation' L _{den} dB(A)	'Do-Something with Mitigation' L _{Night} dB(A)	Design Criteria	Impact Significance
All Saints Cemetery	56	56	46	South – NRA Conditions	Imperceptible
Belgard Downs	63-69	58-61	49-51	North - NRA Conditions & Cork NAP	Slight Positive – Moderate Positive
Bloomfield	44	52-55	39-42	South – NRA Conditions	Moderate Negative – Significant Negative
Broadale Complex	75	69	62	North - NRA Conditions & Cork NAP	Moderate Positive
Carrigaline B&B	71	65	58	South – NRA Conditions	Moderate Positive
Carrigaline Road	60-68	60-62	50-53	North - NRA Conditions & Cork NAP	Imperceptible – Moderate Positive
Carrigaline Rugby Club	55	54	44	South – NRA Conditions	Not Significant
Carr's Hill	67-72	60-65	50-58	South – NRA Conditions	Moderate Positive
Chestnut Lodge B&B	62	61	51	South – NRA Conditions	Imperceptible
Church (Ringaskiddy)	64	62	55	South – NRA Conditions	Not Significant
Clarkes Hill	59-68	58-64	48-57	North - NRA Conditions & Cork NAP	Not Significant - Slight Positive
Coolmore Close	53-59	58-60	49-52	South – NRA Conditions	Imperceptible – Moderate Negative
Delfern Groove	62-66	61-66	51-56	North - NRA Conditions & Cork NAP	Imperceptible
Edgewood	63-64	61-63	51-53	North - NRA Conditions & Cork NAP	Not Significant

Noise Sensitive Location	'Do-Minimum' L _{den} dB(A)	'Do-Something with Mitigation' L _{den} dB(A)	'Do-Something with Mitigation' L _{Night} dB(A)	Design Criteria	Impact Significance
Ferryview Student Accommodation	42	50	37	South – NRA Conditions	Moderate Negative
Footprints Montessori and Daycare	69	66	58	South – NRA Conditions	Not Significant
Health Centre (Shanbally)	54	56	47	South – NRA Conditions	Not Significant
Hibernian AFC	50	61	50	South – NRA Conditions	Not Significant
Kilteggan Park (N40 - 8)	66-73	61-68	51-59	North - NRA Conditions & Cork NAP	Moderate - Positive
Lissadell	62	63	52	North - NRA Conditions & Cork NAP	Imperceptible
Manor Avenue	60	58	48	North - NRA Conditions & Cork NAP	Not Significant
Marian Terrace	47-65	55-61	44-51	South – NRA Conditions	Not Significant – Significant Negative
Martello Park	50-61	54-57	40-46	South – NRA Conditions	Slight Positive – Slight Negative
Maryborough Heights	66-70	65-67	55-56	North - NRA Conditions & Cork NAP	Imperceptible - Moderate Positive
Maryborough Hill	62-71	60-65	50-57	North - NRA Conditions & Cork NAP	Not Significant – Moderate Positive
Maryborough Hotel	59	58	48	North - NRA Conditions & Cork NAP	Imperceptible
Maryborough Nursing Home	59	59	49	North - NRA Conditions & Cork NAP	Imperceptible
Mount Oval Village	53	53	43	North - NRA Conditions & Cork NAP	Imperceptible
National Maritime College	47-48	49-55	38-42	South – NRA Conditions	Imperceptible – Moderate Negative
Noise Action Plan N28-1	66-73	60-65	50-57	North - NRA Conditions & Cork NAP	Moderate Positive

Noise Sensitive Location	'Do-Minimum' L _{den} dB(A)	'Do-Something with Mitigation' L _{den} dB(A)	'Do-Something with Mitigation' L _{Night} dB(A)	Design Criteria	Impact Significance
Noise Action Plan N28-2	69-76	65-69	55-62	North - NRA Conditions & Cork NAP	Slight Positive – Moderate Positive
Noise Action Plan N28-3	59-71	59-66	49-59	South – NRA Conditions	Imperceptible – Moderate Positive
Noise Action Plan N28 4	60-6	56-60	46-50	South – NRA Conditions	Slight Positive
Old Post Office Road	51-53	52-58	39-45	South – NRA Conditions	Imperceptible – Slight Negative
Playground	65	63	55	South – NRA Conditions	Not Significant
Raffeen	51-67	56-65	44-55	South – NRA Conditions	Slight Positive – Slight Negative
Raffeen Lodge B&B	67	65	55	South – NRA Conditions	Not Significant
Ringaskiddy	54	57	43	South – NRA Conditions	Not Significant
Ringaskiddy Community Centre	56	53	42	South – NRA Conditions	Not Significant
Ringaskiddy Lower Harbour National School	58	60	54	South – NRA Conditions	Not Significant
Rochestown Park Hotel	70	62	52	North - NRA Conditions & Cork NAP	Moderate Positive
Rochestown Rd	66-71	62-69	51-62	North - NRA Conditions & Cork NAP	Not Significant – Moderate Positive
Rochestown Rise	63-69	58-67	48-59	North - NRA Conditions & Cork NAP	Not Significant – Moderate Positive
Rochestown Rise B&B	63	59	49	North - NRA Conditions & Cork NAP	Slight Positive
Rowan Hill	62-65	60-65	50-55	North - NRA Conditions & Cork NAP	Imperceptible – Not Significant
Rowan Hill (8m)	66	68	57	North - NRA Conditions & Cork NAP	Not Significant
Shamrock Place	48-62	59-60	45-53	South – NRA Conditions	Not Significant – Significant Negative

Noise Sensitive Location	'Do-Minimum' L _{den} dB(A)	'Do-Something with Mitigation' L _{den} dB(A)	'Do-Something with Mitigation' L _{Night} dB(A)	Design Criteria	Impact Significance
Shamrocks GAA Club	50	58	46	South – NRA Conditions	Moderate Negative
Shanbally	50-53	56-58	44-46	South – NRA Conditions	Not Significant – Moderate Negative
Shanbally Catholic Church	57	54	43	South – NRA Conditions	Slight Positive
Shanbally Mews	57-69	57-67	47-60	South – NRA Conditions	Imperceptible – Moderate Positive
Shanbally National School	53	54	43	South – NRA Conditions	Imperceptible
Shannonpark	46-64	51-65	40-56	South – NRA Conditions	Imperceptible – Slight Negative
Shannonpark House B&B	64	63	53	South – NRA Conditions	Not Significant
SP Housing Development	48-69	51-68	40-61	South – NRA Conditions	Slight Negative – Moderate Positive
St Carthege Place	44	56	43	South – NRA Conditions	Significant Negative
St. Patrick's Church (RC)	65	61	54	North - NRA Conditions & Cork NAP	Slight Positive
Suite Cottages	49	52	41	South – NRA Conditions	Not Significant
The Close	57-63	56-61	45-50	North - NRA Conditions & Cork NAP	Not Significant
The Downs	63	63	53	North - NRA Conditions & Cork NAP	Imperceptible
The Fairways	71	61	50	North - NRA Conditions & Cork NAP	Moderate Positive
The Ferryboat Inn and Accommodation	68	65	58	South – NRA Conditions	Not Significant
The Oaks	53	52-54	42-43	North - NRA Conditions & Cork NAP	Imperceptible – Not Significant
The View	68-72	66-68	58-60	North - NRA Conditions & Cork NAP	Imperceptible – Slight Positive
Warren's Court	46	56	43	South – NRA Conditions	Moderate Negative
Wishing Well Centre	49	52	41	South – NRA Conditions	Not Significant

Noise contour maps generated for the ‘Do-Minimum’ L_{den} and the ‘Do-Minimum’ L_{night} are shown on **Figure 14.10** and **Figure 14.11** contained in **Volume 5**.

14.7 RESIDUAL IMPACTS

The vast majority of NSLs will either have reduced noise levels or be in line with either the TII design goal (southern section) or the Cork Noise Plans (northern section) requirements for mitigation during the operational phase. However, a limited number of properties will experience a residual noise impact as a result of the proposed project.

A total of approximately 2983 residential properties were considered during the noise modelling carried out as part of this EIS. A summary of the Do Minimum and the Do Something (with the proposed mitigation measures) is outlined in **Tables 14.17** and **14.18** below.

Table 14.17: Design Year L_{den} Levels

Noise Level Range dB(A)	Do Minimum	Do Something
<55	1196	1374
55-60	835	916
60-65	721	542
65-70	207	143
70-75	23	7

The number of properties in the study area predicted to experience L_{den} levels in excess of 70 dB(A) reduces from 23 to 7. These 7 properties are located more than 300m from the M28 mainline and the noise level at those locations is not attributable to M28 traffic. All properties which are and would exceed the Cork Noise Plan threshold of 70 dB(A) have noise levels reduced to below 70 dB(A) in the Do Something scenario.

The overall number of properties predicted to experience noise levels between 60 and 70 dB(A) reduces from 928 to 685. This results in an additional 243 properties which would have exceeded the TII design goal in the Do Minimum scenario now below the 60 dB(A) threshold. The number of properties predicted to experience noise levels below 60 dB(A) will also experience noise reductions if the proposed road project goes ahead. A small number of properties at the southern section will experience moderate or significant negative impacts but from an overall perspective noise levels will reduce as a result of the proposed road project.

Table 14.18: Design Year L_{night} Levels

Noise Level Range - dB(A)	Do Minimum	Do Something
<45	1197	1382
45-50	770	837
50-55	593	478
55-60	353	251
60-65	69	34

Similarly over 300 properties will experience a reduction in predicted noise levels at night.

The residual impact at the High Priority Areas identified in the Cork County *Noise Action Plan* and the *Cork Agglomeration Area Noise Action Plan* are summarised in **Table 14.19**. At the northern end of the proposed M28 Road Project the residual noise level will remain above the TII Design Goal but meet the Cork County Noise Plan 70 dB L_{den} .

Table 14.19: Residual Impacts at Noise Action Plan Priority Areas

Location	Residual Impact
N40-1	Residual noise levels are above the TII design goal of 60 dB L_{den} . However noise levels are decreasing from the 'Do-minimum' scenario and meet the Cork County Noise Plan 70 dB L_{den} .
N28-1	Residual noise levels are above the TII design goal of 60 dB L_{den} . However noise levels are decreasing from the 'Do-minimum' scenario and meet the Cork County Noise Plan 70 dB L_{den} .
N28-2	Residual noise levels are above the TII design goal of 60 dB L_{den} . However noise levels are not increasing from the 'Do-minimum' scenario by more than 1 dB(A) and meet the Cork County Noise Plan 70 dB L_{den} .
N28-3	Residual noise levels are above the TII design goal of 60 dB L_{den} . However noise levels are decreasing from the 'Do-minimum' scenario and meet the Cork County Noise Plan 70 dB L_{den} .
N28-4	Residual noise levels are below the TII design goal of 60 dB L_{den} .

In summary a small number of properties will experience a residual increase in noise levels. The impact as a result of the increase in noise levels will range from 'Not-Significant' to 'Major'. 243 properties will experience a reduction in noise levels ranging from 'Not-Significant' to 'Major'. The overall result will be a net decrease in the impact of road traffic noise on properties after the construction of the proposed M28 Road Project.