Chapter 09
Noise & Vibration

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9 NOISE AND VIBRATION

9.1 Introduction

This Chapter of the Environmental Impact Assessment Report (EIAR) has considered the potential noise and vibration impacts associated with the Construction and Operational Phases of the BusConnects Galway: Dublin Road scheme (hereafter referred to as the Proposed Development).

During the Construction Phase, the potential noise and vibration impacts associated with the development of the Proposed Development are assessed. This included construction activities such as utility diversions, road resurfacing and road realignments as well as construction traffic along construction access routes.

During the Operational Phase, the potential noise and vibration impacts associated with altered traffic flows along the Proposed Development, realigned traffic lanes and displaced traffic flows are assessed.

The assessment is carried out according to best practice standard and guidelines relating to environmental noise and vibration.

The aim of the Proposed Development when operational is to provide enhanced walking, cycling and bus infrastructure on the eastern side of the city of Galway, which will enable and deliver efficient, safe, and integrated sustainable transport movement along the city. The objectives of the Proposed Development are described in Chapter 1 (Introduction) of this EIAR. The Proposed Development, which is described in Chapter 4 (Proposed Development Description) of this EIAR has been designed to meet these objectives.

9.2 Methodology

The assessment has been undertaken with reference to the most appropriate guidance documents relating to environmental noise and vibration which are set out in the following sections of this Chapter.

An overview of the methodology undertaken for this noise and vibration impact assessment is outlined below:

- A baseline noise study has been undertaken in order to characterise the baseline environment at areas most likely to be affected by noise associated with the Proposed Development. This has been undertaken through a review of available published data and site-specific noise monitoring at noise sensitive locations (NSLs) along the Proposed Development;
- A review of the most applicable standards and guidelines has been undertaken in order to set a range of acceptable noise and vibration criteria for the Construction and Operational Phases of the Proposed Development;
- Predictive calculations and impact assessments relating to the likely Construction Phase noise and vibration impacts have been undertaken at the NSLs closest to the construction work areas associated with the Proposed Development;
- Predictive calculations have been performed to assess the potential noise and vibration impacts associated with changes in predicted traffic associated with the operation of the Proposed Development at the most sensitive locations; and
- A schedule of mitigation measures has been incorporated to reduce, where necessary the identified potential significant noise and vibration impacts associate with the Proposed Development.

9.2.1 Study Area

The Proposed Development is located along the R338 Dublin Road, representing a west-east approximately 3.9 km long public transport corridor commencing east of the Moneenageisha Junction where it ties into the BusConnects Galway: Cross City Link proposals and extends to the junction with Doughiska Road, tying

into the Martin Junction Upgrade. Refer to Figure 1-1 (Chapter 1 Introduction) of this EIAR for the extents of the Proposed Development.

The Proposed Development has been split into two geographic areas for the purpose of the EIAR, defined as follows:

- Section 1: East of Moneenageisha Junction to Skerritt Junction; and
- Section 2: Skerritt Junction to Doughiska Road Junction.

For the full length of the Proposed Development, a dedicated bus lane, segregated cycle lanes and footpaths are proposed on both sides of the road. The Dublin Road will remain two-way for general traffic. All major junctions along the route, including the Skerrit Roundabout, are proposed to be upgraded to include for bus priority measures, signalised pedestrian crossings, and segregated cyclist facilities. This is to be achieved via a combination of carriageway widening, repurposing of existing traffic lanes, and setting back the existing footpath. Additional land will be required throughout the Proposed Development, the approximate area equates to 25,000m^2 (2.5 Hectares).

The existing land use in the vicinity of the R338 Dublin Road is a mixture of residential, commercial, and public service use properties, as well as recreational open green spaces. The existing land use across the proposed road development will stay largely the same with works designed to improve the existing road infrastructure to facilitate pedestrians, cyclists and buses moving along the R338 Dublin Road.

Full details of the Construction Phase activities are given in Chapter 5 (Construction) of this EIAR. The construction activities within Section 1 and Section 2 will comprise pavement reconstruction and resurfacing of the roads, footpaths, and cycle tracks, and new kerbs. Construction activities will also consist of relocation and reconstruction of boundary walls and boundary fences, additional signage, new road markings, new and amended traffic signal infrastructure, new street furniture and landscaping works.

It is proposed to demolish two single-story buildings located just inside the existing boundary wall in the Brothers of Charity. The wall will also be demolished either side of the main entrance and will be rebuilt at the new boundary location reusing the stone from the existing wall. The existing boundary wall outside the Connacht Hotel will also be demolished and the stone reused in the new boundary treatment.

Skerritt Junction is proposed to be replaced with the construction of a new “cyclops” (Cycle Optimised Protected Signals) junction. The new junction is designed to separate pedestrians and cyclists from traffic at the junction, reducing the possibility of collisions or conflict. The junction of Dublin Road with Rosshill Road will be signalised.

The study area for potential noise and vibration impacts during both Construction and Operational Phases relate to areas of potentially impacted NSLs, which include areas where people spend significant periods of time and where concentration, sleep and amenity are important considerations. Examples of these NSLs include residential dwellings, schools and other educational establishments, hospitals and nursing homes, hotels and other short-term accommodation buildings, buildings of religious sensitivity, recreational and noise sensitive amenity areas and offices. Vibration sensitive locations (VSLs) include buildings with vibration sensitive equipment (sensitive equipment within laboratories, highly sensitive medical equipment etc.) and structures that are structurally unsound.

For the Construction Phase, the assessment of the study area is focused on NSLs and VSLs adjacent to the works required to construct the Proposed Development, e.g., utility diversions, demolition, road widening works, road excavation works (where required), road reconfiguration and resurfacing works, and construction traffic access routes within the study area. The extent of the overall study area is typically up to 300m from a specific area of construction work with the key impacted study areas focused within 50m to 100m depending on the noise and vibration sources in question and the local area under consideration.

For the Operational Phase, the focus of the assessment is on NSLs and VSLs that bound the Proposed Development and those along diverted traffic routes. Potential noise impacts relate to alterations to traffic

patterns (e.g. introduction of a new bus lane), with particular attention focused on those areas where the Proposed Development will be encroaching closer to NSLs, specifically where bus or traffic lanes are moving closer to noise sensitive areas in addition to roads where traffic is displaced or diverted onto, resulting in potential increased traffic noise levels.

The key impacted study areas for the Operational Phase will be focused within 50m to 100m of the Proposed Development and roads affected by redistributed traffic which captures those locations where potential significant impacts can occur. Roads modelled as part of the Transport Impact Assessment (TIA) described in Chapter 6 (Traffic and Transport) of the Proposed Development have been included in the noise impact assessment study area for the Operational Phase assessment. This broadly extends out to approximately 5km from the Proposed Development boundary.

A summary of the closest noise or vibration sensitive buildings along the Proposed Development are summarised in **Error! Reference source not found.**.

Table 9-1 Description of Closest NSLs along Proposed Development

Geographic Section	Description of Study Area
Section 1 – East of Moneenageisha Junction to Skerritt Junction	The closest NSLs north of the Proposed Development in Section 1 are the residential dwellings at Sáilín apartments, Wellpark Grove, Glenina Heights, Belmont, the Connaught Hotel, Flannerys Hotel, and the Atlantic Technological University (ATU) The closest NSLs south of the Proposed Development are the Brothers of Charity Woodlands Campus, residential dwellings along the Dublin Road, Bon Secours Hospital Galway and Galway Hospice.
Section 2 – Skerritt Junction to Doughiska Road Junction	The closest NSLs north of the Proposed Development in Section 2 are the residential dwellings at Woodhaven and the Merlin Park University Hospital. The closest NSLs south of the Proposed Development are residential dwellings at Lurgan Park, Geata Na Mara, Líos an Uisce, and Durabhan and 7th day Adventist Church and Galway Crystal.

9.2.2 Relevant Guidelines, Policy and Legislation

Guidelines, policy and legislation specifically relevant to the noise and vibration impact assessment are outlined in Table 9-2.

Table 9-2 Standards and Guidelines Used for Impact Assessment

Guidance	Description	Relevance to Assessment
Environmental Protection Agency (EPA) Guidelines on the information to be contained in Environmental Impact Assessment Reports (hereafter referred to as the EPA Guidelines) (EPA 2022)	This document outlines EPA guidance for conducting Environmental Impact Assessments (EIAs) / EIARs and provides the fundamental requirements of the EIAR.	This guidance has been used to inform the significance of effect for all topics in the noise and vibration assessment.
British Standard Institute (BSI) British Standard (BS) 5228-1:2009 +A1 2014 Code of Practice for noise and vibration control of construction and open sites - Part 1: Noise.	A code of practice for assessing noise from construction sites	Informs construction noise limits and assessment

Guidance	Description	Relevance to Assessment
(hereafter referred to as BS 5228 – 1)		
BS 5228-2:2009+A1:2014 Code of Practice for noise and vibration control of construction and open sites - Part 2: Vibration (hereafter referred to as BS 5228 – 2)	Code of practice for assessing vibration from construction sites	Informs construction vibration limits and assessment
BS 7385-2: 1993 Evaluation and measurement for vibration in buildings Guide to damage levels from ground borne vibration (hereafter referred to as BS 7385 – 2)	Guide to assessing building damage from vibration	Informs vibration limits for buildings
BS 6472-1: 2008 Guide to evaluation of human exposure to vibration in buildings, Part 1 Vibration sources other than blasting (hereafter referred to as BS 6472 – 1)	Guide to assessing vibration with respect to the human response	Informs vibration limits for humans
United Kingdom Highways England (now National Highways) (UKHE) Design Manual for Roads and Bridges (DMRB) LA 111 Sustainability & Environmental Appraisal LA 111 Noise and Vibration Revision 2 (hereafter referred to as DMRB Noise and Vibration) (UKHE, 2020)	Guide to assessing noise and vibration from roads projects to nearby sensitive receptors	Informs noise and vibration assessment methodology
Draft Galway City Council Noise Action Plan 2024 – 2028 (Hereafter referred to as Draft Galway City NAP)	Noise action plan for Galway City Council for the years 2024 to 2028	Informs noise assessment
S.I. No. 663/2021 – European Communities (Environmental Noise) (Amendment) Regulations 2021	Guidance for implementing a common noise strategy across Europe, specifically for Ireland	Informs noise assessment methodology
S.I. No. 241/2006 - European Communities Noise Emission by Equipment for Use Outdoors (Amendment) Regulations 2006	Provides guidance for outdoor equipment noise	Informs noise assessment methodology
International Organization for Standardization (ISO) 9613-2:2024 Acoustics – Attenuation of sound during propagation outdoors - Part 2: General method of calculation	Guidance for how to calculate noise propagation outdoors	Used in noise assessment
ISO 1996-1:2016 Acoustics - Description, measurement, and assessment of environmental noise. Part 1: Basic quantities and assessment procedures	Guidance for undertaking noise measurements for environmental noise	Informs noise measurement methodology
ISO 1996-2:2017 - Description, measurement, and assessment of environmental noise - Part 2:	Guidance for undertaking noise measurements for environmental noise	Informs noise measurement methodology

Guidance	Description	Relevance to Assessment
Determination of sound pressure levels		
Transport Infrastructure Ireland (TII) (previously National Roads Authority (NRA)) Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes (hereafter referred to as the TII Noise Guidelines 2014) (NRA 2014)	Guidance for assessing road traffic noise in Ireland	Informs noise limits and assessment methodology
The UK Department of Transport Calculation of Road Traffic Noise (hereafter referred to as the CRTN) (UK Department of Transport 1998)	Guidance for the calculation of road traffic noise levels	Informs traffic noise calculation methodology
World Health Organization (WHO) Environmental Noise Guidelines for the European Region (2018)	Guidance for appropriate noise levels for human health	Informs noise assessment methodology
Institute of Acoustics (IOA) ProPG: Planning and Noise. Professional Practice Guidance on Planning and Noise. New Residential Development. 2017	Guidance for appropriate noise levels for residential properties	Informs noise assessment methodology

9.2.3 Data Collection and Collation

The baseline environment has been characterised through a desk study of publicly available published data sources and measured noise surveys. There are no sources of vibration in the surrounding environment that would give rise to any notable vibration levels to human or building response. Environmental vibration surveys are undertaken where there are known potential sources of vibration in the surrounding environment (e.g. rail line) which are absent from this study area. Reference has, however been made to vibration measurements made for the Bus Connects Dublin Infrastructure projects which focused on surveys along existing trafficked roads and roads with buses only which has measured low vibration magnitudes, as standard from road traffic. The results are summarised in the following sections.

9.2.3.1 Desk Study

The key sources of available baseline data comprise published noise mapping studies undertaken by Transport Infrastructure Ireland (TII). The modelled noise maps are published on the EPA Geo Portal and include existing sources of major road traffic noise within Galway City. The Round 4 road traffic noise maps have been used to review the prevailing noise environment. This information provides a useful strategic high-level overview of noise levels in the study area. The parameters presented in terms of the noise mapping are the L_{den} and L_{night} noise parameters which are both long-term noise indicators based on annual traffic and transport mode.

L_{den} is the 24-hour noise rating level determined by the averaging of the L_{day} with the $L_{evening}$ (plus a 5 dB penalty) and the L_{night} (plus a 10 dB penalty). L_{den} is calculated using the following formula, as defined within the Noise Regulations:

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

Where:

- L_{day} is the A-weighted long-term average sound level as defined in ISO 1996-2, determined over all the day periods of a year. The 12-hour daytime period is between 07:00hrs and 19:00hrs;
- $L_{evening}$ is the A-weighted long-term average sound level as defined in ISO 1996-2, determined over all the evening periods of a year. The four-hour evening period is between 19:00hrs and 23:00hrs; and
- L_{night} is the A-weighted long-term average sound level as defined in ISO 1996-2, determined over all the night periods of a year. The eight-hour night-time period is between 23:00hrs and 07:00hrs.

The range of noise sources within the published contour mapping associated with road traffic, are discussed in Section 9.3.1.

9.2.3.2 Baseline Noise Surveys

Baseline noise surveys have been conducted at locations representative of the nearest noise sensitive areas which have the potential to be impacted by construction works and / or those likely to be impacted during the Operational Phase of the Proposed Development. Baseline noise measurements were undertaken using both attended and unattended surveys to inform the assessment. Attended surveys (i.e. manned noise surveys in the field using noise meters that are moved for each survey position) were undertaken at a total of twelve locations along the length of the Proposed Development during May 2023. Unattended surveys (i.e. noise meters installed at a fixed location for a period of at least 72hrs in duration) were made at two locations also during May 2023.

The selection, number and type of surveys undertaken are in line with those prescribed in the TII Noise Guidelines 2014 (NRA 2014) survey methodology for linear (road) projects as far as practicable, taking account of the availability of secure locations along the length of the Proposed Development for equipment installation.

Full details of the baseline surveys, including methodologies, survey dates, terminology and glossary, and results are included in Appendix A9.1 in Volume 4 of this EIAR.

A summary of the baseline noise monitoring positions is provided in Section 9.2.3.2.1. Figure 9.1 in Volume 3 of this EIAR illustrates the baseline noise monitoring locations. Noise monitoring survey results are discussed in Section 9.3.2.

9.2.3.2.1 Noise Monitoring Positions

A total of 12 attended and two unattended noise monitoring locations were surveyed within the study area. The location reference and a description of survey positions are included in Table 9-3.

Table 9-3 Noise Monitoring Positions

Survey Type	Reference	Location
Attended	AT1	Attended position at residential properties along Wellpark Grove to the west of Kia Renmore, approximately 35m from the R338, OldDublin Road. Survey position represents baseline noise levels at residential properties in this estate closest to the Proposed Development and NSLs at similar distances from the Old Dublin Road.
Attended	AT2	Attended position at residential properties along Wellpark Grove to the east of Kia Renmore, approximately 40m from the R338 Old Dublin Road. Survey position represents baseline noise levels at residential properties in this estate closest to the Proposed Development and NSLs at similar distances from the Old Dublin Road.
Attended	AT3	Attended position at residential properties on the corner of Renmore Park and Old Dublin Road, approximately 10m from the R338 Old Dublin Road. Survey position represents baseline noise levels at

Survey Type	Reference	Location
		residential properties in this estate closest to the Proposed Development and NSLs at similar distances from the Old Dublin Road.
Attended	AT4	Car Park area within The Connacht, approximately 50m from the R338 Old Dublin Road. Survey position represents baseline noise levels at this hotel building and at NSLs at similar distance from the Proposed Development
Attended	AT5	Attended position at residential property along Old Dublin Road at the junction of Renmore Road, approximately 7m from the R338 Old Dublin Road.
Attended	AT6	Attended position at residential properties along Glenina Heights, approximately 15m from the R338 Old Dublin Road. Survey position represents baseline noise levels at residential properties in this estate closest to the Proposed Development and NSLs at similar distances from the Old Dublin Road.
Attended	AT7	Attended position at residential properties along Belmont. approximately 35m from the R338 Old Dublin Road. Survey position represents baseline noise levels at residential properties in this estate closest to the Proposed Development and NSLs at similar distances from the Old Dublin Road.
Attended	AT8	Attended position at GMIT Library, approximately 35m from the R338 Old Dublin Road. Survey position represents baseline noise levels at the closest building within the campus to the Proposed Development and at NSLs at similar distance from the R338 Old Dublin Road.
Attended	AT9	Attended position at residential properties at Woodhaven, approximately 20m from the R338 Old Dublin Road. Survey position represents baseline noise levels at residential properties in this estate closest to the Proposed Development and NSLs at similar distances from the Old Dublin Road.
Attended	AT10	Attended position at residential properties at Líos An Uísce, approximately 30m from the R338 Old Dublin Road. Survey position represents baseline noise levels at residential properties in this estate closest to the Proposed Development and NSLs at similar distances from the Old Dublin Road.
Attended	AT11	Attended position at Units 5&6 Merlin Park University Hospital, approximately 150m from the R338 Old Dublin Road. Survey position represents baseline noise levels at the closest buildings within the campus to the Proposed Development and at NSLs at similar distance from the R338 Old Dublin Road.
Attended	AT12	Attended position at residential properties at Durabhán, approximately 15m from the R338 Old Dublin Road. Survey position represents baseline noise levels at residential properties in this estate closest to the Proposed Development and NSLs at similar distances from the Old Dublin Road.
Unattended	UN1	Unattended position at Brothers of Charity Services Galway, approximately 35m from the R338 Old Dublin Road. Survey position represents baseline noise at NSLs along the Proposed Development over day, evening, and night-time periods.
Unattended	UN2	Unattended position at Irish Water land along R338 and Proposed Development route, approximately 25m from the R338 Old Dublin Road. Survey position represents baseline noise at NSLs along the Proposed Development over day, evening, and night-time periods.

9.2.3.3 Baseline Vibration

Attended baseline vibration surveys have been conducted by AWN Consulting as part of the overall Bus Connects Dublin – Core Bus Corridor Infrastructure Works at a number of locations adjacent to existing bus lanes within Dublin City. The surveys were undertaken to obtain typical baseline vibration levels along roads with both mixed vehicular traffic lanes and individual bus lanes. This information has been used to inform the operational vibration impact assessment for the Proposed Development and other Bus Connects Proposed Developments.

Surveys were also undertaken along an access road to the Harristown Bus Depot, Horizon Logistics Park, Swords, Co. Dublin, to obtain a measurement of vibration relating to specific bus drive bays in isolation at a controlled sampling location to characterise the specific vibration level associated with buses in the absence of other traffic.

Full details of the survey monitoring locations, methodologies, terminology and glossary, and results are included in Appendix A9.1 in Volume 4 of this EIAR.

9.2.4 Appraisal Method of the Assessment of Impacts

The significance of impacts has been assessed in accordance with the EPA Guidelines (EPA 2022). The relevant definitions relating to quality, significance and duration of impacts are defined as per the EPA Guidelines and are set out in Chapter 1 (Introduction) of this EIAR. These have been used to define the category of impacts throughout this chapter. The assessment of impacts is discussed in terms of a range of acoustic parameters. The key terms discussed in the following sections are summarised below.

- **$L_{Aeq,T}$** is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period (T). The time period T referred to in this section include the following:
  - $L_{Aeq,16hr}$: the daytime ambient noise level between 07:00hrs and 23:00hrs;
  - $L_{Aeq,18hr}$: the daytime ambient noise level between 06:00hrs and 00:00hrs; and
  - $L_{Aeq,12hr}$: the daytime ambient noise level between 07:00hrs and 19:00hrs, which is defined as the L_{day} parameter.
- **L_{ASmax}** is the maximum root mean squared (RMS) A-weighted sound pressure level occurring within a specified time period, measured using the 'Slow' time weighting;
- **L_{den}:** Definition included in Section 9.2.3.1;
- **Peak Particle Velocity (PPV)** is a measure of the velocity of vibration displacement in terms of millimetres per second (mm/s). It is defined as follows within BS 7385-2 (BSI 1993) as '*the maximum instantaneous velocity of a particle at a point during a given time interval*'; and
- **Vibration Dose Value (VDV)** is an evaluation of human exposure to vibration in buildings. It defines a relationship that yields a consistent assessment of continuous, intermittent, occasional and impulsive vibration and correlates well with subjective response. It is defined as follows within BS 6472-1 (BSI 2008), as:
  'The VDV is the fourth root of the integral of the fourth power of acceleration after it has been frequency-weighted (as defined in BS6472: 2008). The frequency-weighted acceleration is measured in m/s^2 and the time period over which the VDV is measured is in seconds. This yields VDVs in $m/s^{1.75}$.'

As the EPA Guidelines do not quantify the criteria for assessing impacts specifically for noise or vibration, reference has been made to relevant guidelines and standards relating to noise and vibration to further define significance ratings. These are discussed in the following sections.

9.2.4.1 Construction Phase Appraisal of Impacts

9.2.4.1.1 Criteria for Rating Construction Noise Impacts

There is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the Construction Phase of a project. Local authorities normally control construction activities by imposing limits on the hours of operation and consider noise limits at their discretion. In general, higher noise levels are tolerated during a Construction Phase of a project compared to its long-term Operational Phase, as construction works are temporary to short term and are varied over the course of the work duration.

In the absence of specific statutory guidance, reference has been made to the TII Noise Guidelines 2014 (NRA 2014) and BS 5228–1 (BSI 2014a) in order to review and set appropriate noise construction criteria.

9.2.4.1.2 TII Guidelines

The TII Noise Guidelines 2014 (NRA 2014) specify noise levels that are deemed acceptable in terms of construction noise for national road projects. These limits have been derived for the construction of new national road projects which predominately pass through rural environments with quieter ambient noise levels compared to those in urban settings. In this instance, these limits are typically lower than those typically used for urban infrastructural projects. These limits are set out in Table 9-4.

Table 9-4 TII Construction Noise Levels at the Façade of Dwellings during the Construction Phase

Days and Times	Noise Levels (dB re 2x 10^{-5} Pa)	
	L_{Aeq}	$L_{A\ Smax}$
Monday to Friday 07:00 to 19:00hrs	70	80
Monday to Friday 19:00 to 22:00hrs	60*	65*
Saturdays 08:00 to 16:30hrs	65	75
Sundays and Bank Holidays 08:00hrs to 16:30hrs	60*	65*

Note * Construction activity at these times, other than that required for emergency works, will normally require the explicit permission of the local authority.

9.2.4.1.3 British Standard BS5228 – 1:2009+A1:2014

Potential noise impacts during the construction stage of a project are often assessed in accordance with BS 5228–1 (BSI 2014a). Various mechanisms are presented as examples of recommended threshold values for determining if an impact is occurring, these are discussed in the following paragraphs.

Potential Significance Based on Noise Change – ABC Method

The approach adopted here calls for the designation of a noise sensitive location into a specific category (A, B or C) based on the existing ambient noise levels in the absence of construction noise. This then sets a threshold noise value that, if exceeded at this location, indicates a potential significant noise impact is associated with the construction activities, depending on context. Table 9-5 sets out the values which, when exceeded, signify a potential significant effect at the facades of residential receptors.

Table 9-5 BS5228-1 Example of Thresholds of Potential Significant Effect

Assessment Category and Threshold Value Period (L_{Aeq})	Threshold Value (dB)		
	Category A [A]	Category B [B]	Category C [C]
Night-time (23:00 to 07:00)	45	50	55

Assessment Category and Threshold Value Period (L_{Aeq})	Threshold Value (dB)		
	Category A [A]	Category B [B]	Category C [C]
Evenings and Weekends (19:00 – 23:00hrs weekdays) (13:00 – 23:00hrs Saturdays) (07:00 – 23:00hrs Sundays)	55	60	65
Daytime (07:00 – 19:00hrs) and Saturdays (07:00 – 13:00hrs)	65	70	75
Notes	Category A: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values	Category B: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values	Category C: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.

It should be noted that this assessment method is only valid for residential properties and if applied to commercial premises without consideration of other factors may result in an excessively onerous thresholds being set.

Potential Significance Based on Fixed Noise Limits

Section E.2 of BS 5228-1 (BSI 2014a) sets out recommended threshold levels using a fixed limit value set depending on the setting of the noise environment. For example, paragraph E.2 states: -

> *'Noise from construction and demolition sites should not exceed the level at which conversation in the nearest building would be difficult with the windows shut.'*

Paragraph E.2 goes on to state: -

> *Noise levels, between say 07.00 and 19.00 hours, outside the nearest window of the occupied room closest to the site boundary should not exceed: -*
>
> *70 decibels (dBA) in rural, suburban areas away from main road traffic and industrial noise;*
>
> *75 decibels (dBA) in urban areas near main roads in heavy industrial areas'.*

These limits apply to daytime working outside living rooms and offices. The document notes that where works occur outside other noise sensitive situations with daytime sensitivities, e.g. near hospitals and educational establishments or if works are occurring outside of normal daytime working hours, reduced construction noise levels may be more appropriate.

9.2.4.1.4 Proposed Threshold Noise Levels for Proposed Development

Taking into account the documents outlined above, the linear and transient nature of construction works associated with the Proposed Development, and making reference to the baseline noise environment, Table 9-6 sets out the Construction Noise Threshold (CNT) levels proposed for the Construction Phase of this development.

Table 9-6 Construction Noise Threshold (CNT) Levels for Proposed Development

Period Over Which Criterion Applies	Location	Construction Noise Threshold (CNT) (LAeq, Period)
Monday to Friday: Daytime (07:00 – 19:00hrs)	Residential properties and sensitive commercial buildings (e.g. offices) in urban areas near main roads in heavy industrial areas	75 dB
	Rural and suburban areas away from main roads	70 dB
Monday to Friday: Evening: (19:00 – 23:00hrs)	Residential Properties Urban and Suburban	65 dB
Monday to Friday: Night-time (23:00 – 07:00 hrs)	BS 5228-1: Category A locations	45 dB
	BS 5228-1: Category B Locations	50 dB
	BS 5228-1: Category C Locations	55 dB
Saturdays (08:00 – 16:30hrs)	Residential Properties Urban and Suburban	65 dB
Sundays and Bank Holidays (08:00 -13:00 hrs)	Residential Properties Urban and Suburban	60 dB

In order to assist with interpretation of CNTs, Table 9-7 includes guidance as to the likely magnitude of impact associated with construction activities, relative to the CNT. This guidance is derived from Table 3.16 of DMRB: Noise and Vibration (UKHA 2020) and adapted to include the relevant significance effects from the EPA Guidelines (EPA 2022).

In accordance with the DMRB: Noise and Vibration (UKHA 2020), construction noise and construction traffic noise impacts shall constitute a significant effect where it is determined that a major or moderate magnitude of impact will occur for a duration exceeding:

- Ten or more days or nights in any 15 consecutive days or nights; and
- A total number of days exceeding 40 in any six consecutive months.

Table 9-7 Construction Noise Significance Ratings

Guidelines for Noise Impact Assessment Significance (DMRB)	CNT Per Period	EPA EIAR Significance of Effect	Determination
Negligible	Below or equal to baseline noise level	Not Significant	Depending on CNT, duration, and baseline noise level
Minor	Above baseline noise level and below or equal to CNT	Slight to Moderate	
Moderate	Above CNT and below or equal to CNT +5 dB	Moderate to Significant	
Major	Above CNT +5 to +15 dB	Significant to Very Significant	
	Above CNT + 15 dB	Very Significant to Profound	

The adapted DMRB guidance outlined is used to assess the predicted construction noise levels at NSLs and comment on the likely impacts during the Construction Phase.

In order to determine the relevant construction noise significance ratings in line with Table 9-7, a daytime baseline noise level of 65 dB $L_{Aeq,T}$ has been used when describing construction noise significance ratings.

9.2.4.1.5 Criteria for Rating Construction Traffic Noise Impacts

In order to assist with the interpretation of construction traffic noise, Table 9-8 includes guidance as to the likely magnitude of impact associated with changes in traffic noise levels along an existing road. This is taken from Table 3.17 of the DMRB: Noise and Vibration (UKHA 2020).

Table 9-8 Magnitude of Impact Relating to Changes in Road Traffic Noise Level – Construction Phase

Magnitude of Impact	CNT Per Period	Duration	Initial Significance Rating
Major	Greater than or equal to 5.0	>10 days/nights over 15 consecutive days/nights; and >40 days over 6 consecutive months	Significant
Moderate	Greater than or equal to 3.0 and less than 5.0		Significant
Minor	Greater than or equal to 1.0 and less than 3.0		Not Significant
Negligible	Less than 1.0		Not Significant

The overall significance rating is determined taking account of the change in road traffic noise levels in addition to the specific absolute noise level. Further discussion relating to road traffic noise levels and overall significance rating tables are included in Section 9.2.4.2.2 dealing with operational traffic noise.

9.2.4.1.6 Criteria for Rating Vibration Impacts

Vibration standards come in two varieties: those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. In both instances, it is appropriate to consider the magnitude of vibration in terms of PPV for construction activities.

Building Response Criteria

BS 7385 - 2 (BSI 1993) gives guidance regarding acceptable vibration in order to avoid damage to buildings. BS 5228 – 2 (BSI 2014b) reproduces these same guidance values.

These standards differentiate between transient and continuous vibration. Surface construction activities are transient because they occur for a limited period of time at a given location. Both documents recommend that, for soundly constructed residential property and similar light framed structures that are generally in good repair, a threshold for minor or cosmetic damage (i.e. non-structural damage) should be taken as a PPV (in frequency range of predominant pulse) of 15mm/s at 4 Hertz (Hz) increasing to 20mm/s at 15Hz and 50mm/s at 40Hz and above. The standard also notes that below 12.5mm/s PPV the risk of damage tends to zero. Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in BS 5228 – 2 (BSI 2014b) Table B.2 might need to be reduced by up to 50%. On a cautious basis, therefore, continuous vibration limits are set as 50% of those for transient vibration across all frequency ranges. Historically important buildings that are difficult to repair might require special

consideration on a case-by-case basis, but buildings of historical importance should not be assumed to be more sensitive unless they are structurally unsound.

If a building is in an unstable state, then it will tend to be more vulnerable to the possibility of damage arising from vibration or any other ground borne disturbance. The vibration limit range for protected and historical buildings are equal to or up to 50% of those for light framed buildings, depending on their structural integrity. Where no structural defects are noted, the same limit to those for light framed buildings apply. For other structures and buildings that are determined to be potentially vulnerable to vibration due to significant structural defects, a further stringent criterion has been applied for transient vibration. It is assumed that known buildings and structures of this kind, will be subject to condition surveys well in advance of the works, and any defects identified repaired. The results of conditions surveys will determine whether a building or structure is classed as 'vulnerable.'

Table 9-9 sets out the limits as they apply to vibration frequencies at 4Hz where the most conservative limits are required. At higher frequencies, the relevant limit values for transient vibration within Table B.2 and Figure B.1 of BS5228-2 (BSI 2014b) will apply, with similar reductions applied for continuous vibration and those for protected structures. For line 2 of Figure B.1. at frequencies below 4Hz, a maximum displacement of 0.6mm (zero to peak) should not be exceeded. Taking the above into consideration the vibration criteria for building response is set out in Table 9-9.

Table 9-9 Recommended Construction Vibration Thresholds for Buildings

Vibration Limits for Buildings (PPV) at the Closest Part of the Building to the Source of Vibration, at a Frequency of 4Hz		
Building Type	**Transient Vibration**	**Continuous Vibration**
Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s	25 mm/s
Unreinforced or light framed structures. Residential or light commercial-type buildings.	15 mm/s	7.5 mm/s
Protected and Historic Buildings*Note 1	6 mm/s – 15 mm/s	3 mm/s – 7 mm/s
Identified Potentially Vulnerable Structures and Buildings with Low Vibration Threshold	3 mm/s	

Note 1: The relevant threshold value to be determined on a case-by-case basis. Where sufficient structural information is unavailable at the time of assessment, the lower values within the range will be used, depending on the specific vibration frequency.

Human Response Criteria

Humans are sensitive to vibration stimuli, and perception of vibration at high magnitudes may cause concern to building occupants. BS 5228–2 (BSI 2014b) notes that vibration typically becomes perceptible at around 0.15 to 0.3 mm/s and may become disturbing or annoying at higher magnitudes.

Table 9-10 presents the significance table relating to potential impacts to building occupants during construction based on guidance from BS 5228 – 2 (BSI 2014b), DMRB Noise and Vibration (UKHA 2020). and associated EPA significance ratings.

Table 9-10 Human Response Vibration Significance Ratings

Criteria	Likely Effect (DMRB)	Significance Rating
≥10 mm/s PPV	Major	Significant to Very Significant
≥1 to <10 mm/s PPV	Moderate	Moderate to Significant
≥0.3 to <1 mm/s PPV	Minor	Not Significant to Slight

Criteria	Likely Effect (DMRB)	Significance Rating
≥0.14 to 0.3mm/s PPV	Negligible	Imperceptible to Not Significant
Less than 0.14 mm/s PPV		Imperceptible

Disturbance of Particular Vibration Sensitive Equipment or Processes

There are no standard criteria for assessing the potential impact of vibration on sensitive equipment or processes. BS 5228–2 (BSI 2014b) provides a guide of vibration sensitivities of differing types of sensitive equipment from microscopes to microelectronic manufacturing equipment. However, these ranges are generic and relate to the sensitivity of the equipment as installed, not the external façade of the building. The most advisable approach for the control of potential vibration impacts at areas of vibration sensitive equipment or processes, was to review each location on its own merit in order to determine the site-specific vibration limits taking into account any building or machinery isolation already in place. In this instance, if a receptor was identified or made known within the study area for being potentially sensitive to vibration, this area would be highlighted as one for consideration. There is no identified sensitive equipment with potential for vibration impacts associated with the Proposed Development.

9.2.4.2 Operational Phase Appraisal of Impacts

9.2.4.2.1 Changes in Traffic Noise

The Proposed Development will be located along the existing road network which will be reconfigured and widened at specific locations to facilitate the Proposed Development. Once operational, the Proposed Development will include a realigned road corridor comprising dedicated footpaths, cycle lanes, bus lanes, and other vehicular lanes. Given that sections of the existing road network already carry traffic, it is appropriate to consider the change in traffic noise level that will arise as a result of changes in traffic flow (in terms of volume and fleet mix) and the realignment of traffic lanes, where relevant.

In the absence of any Irish guidelines or standards describing the effects associated with changes in road traffic noise levels, reference has been made to the DMRB Noise and Vibration (UKHA 2020). The DMRB Noise and Vibration (UKHA 2020) document provides magnitude rating tables relating to changes in road traffic noise. The document suggests that during the year of opening the magnitude of impacts between the Do Minimum and the Do Something scenarios are likely to be greater compared to the longer-term period (fifteen years post opening) when people become more habituated to the noise level change.

For the Proposed Development, the initial significance criteria are used to describe the magnitude of change for the short- and medium-term period, (i.e. the year of opening up to 15 years post). For these assessment years, a 1 dB change between the Do Minimum and Do Something scenarios (Refer to Chapter 6 (Traffic and Transport) of this EIAR for a full description of these modelled traffic scenarios) is the smallest that is considered perceptible. Table 9-11 summarises the potential impact associated with defined changes in traffic noise level during the short to medium periods of the Proposed Development's operation.

Table 9-11 Significance of Change Criteria – Short to Medium Term

Change in Noise Level, dB	Short to Medium Term Magnitude (DMRB)	Initial Significance Rating (DMRB)
Greater than or equal to 5.0	Major	Significant
3.0 to 4.9	Moderate	Significant
1.0 to 2.9	Minor	Not Significant
Less than 1.0	Negligible	Not Significant

Where changes in traffic noise levels at NSLs along the Proposed Development in the short to medium term is less than 3 dB, the impact is deemed Not Significant. Where changes in traffic noise levels are greater than 3 dB, the impact is deemed to be Significant, depending on context and other factors including the absolute noise level. The approach is discussed in Section 9.2.4.2.2.

Further consideration of the magnitude of change in noise levels are determined for the long-term period (i.e. between the year of opening Do Minimum and the design year Do Something). For this assessment year (design year 2043), a 3 dB change is the smallest that is considered to pose any notable impact when considered over the life span of the project i.e. over a long term 15-year period between year of opening and design year in accordance with the DMRB Noise and Vibration (UKHA 2020) guidance document. Table 9-12 summarises the significance criteria associated with defined changes in traffic noise level between the Do Minimum and Do Something scenarios during the long-term period.

Table 9-12 Significance of Change Criteria – Long-Term

Change in Noise Level, dB	Long-Term Magnitude (DMRB)	Initial Significance Rating (DMRB)
Greater than or equal to 10.0	Major	Significant
5 to 9.9	Moderate	Significant
3.0 to 4.9	Minor	Not Significant
Less than 3.0	Negligible	Not Significant

Absolute Noise Levels

The absolute noise level is an important consideration when determining the response to noise levels along affected roads within the study area. This is particularly valid for locations where a 'moderate' or 'major' magnitude of change rating applies against comparably low absolute noise levels.

There are no statutory guidelines associated with road traffic noise levels in Ireland. There are no new roads associated with the Proposed Development and therefore application of a single road traffic noise design threshold is not appropriate in this instance. Notwithstanding, it is important to provide context for the range of traffic noise levels along the Proposed Development which includes the existing road network and associated road traffic noise.

WHO Environmental Noise Guidelines (WHO 2018)

The World Health Organisation (WHO) published Environmental Noise Guidelines for the European Region in October 2018. The objective of these guidelines is to provide recommendations for protecting human health from exposure to environmental noise from transportation (road traffic, railway, and aircraft), wind turbine noise and leisure noise. The guidelines set out recommended exposure levels for environmental noise in order to protect population health. The guidelines recommend L_{den} and L_{night} levels above which there is risk of adverse health risks for each source type.

The health-related effects for road traffic noise discussed within the WHO (2018) document relate to direct and indirect health effects such as increased risk of ischemic heart disease (IHD), high levels of annoyance and sleep disturbance. WHO (2018) found that a 5% relevant risk increase of the incidence of IHD occurs at a noise exposure level of 59.3 dB L_{den}. This value is closely aligned (within 0.7dB) with the TII Noise Guidelines of 60 dB L_{den}. WHO (2018) cites moderate quality evidence that there is an absolute risk of 10% of the population being 'Highly Annoyed' (HA) by road traffic noise at a level of 53.3 dB L_{den} and up to 54 dB L_{den}. With regards sleep disturbance, WHO (2018) notes there is a risk of 3% of the population being as 'Highly Sleep Disturbed' (HSD) by road traffic noise at a level of 45 dB L_{night}

The WHO Environmental Noise Guidelines (WHO 2018) guideline values are recommended to serve as the basis for a policy-making process, to allow public health orientated recommendations to control noise exposure within populations on a European and national level. Those guidelines are primarily considered in the context of national and local policy making to adopt and propose noise levels for use, should they deem feasible based on a range of factors which must be considered. In making these decisions, economic, physical (engineering), and social considerations all need to factor in. They are not however, intended to be noise limits for specific or individual properties. The WHO (2018) document states the following regarding the implementation of the guidelines:

> '*The WHO guideline values are evidence-based public health-oriented recommendations. As such, they are recommended to serve as the basis for a policy-making process in which policy options are considered. In the policy decisions on reference values, such as noise limits for a possible standard or legislation, additional considerations – such as feasibility, costs, preferences and so on – feature in and can influence the ultimate value chosen as a noise limit. WHO acknowledges that implementing the guideline recommendations will require coordinated effort from ministries, public and private sectors, and nongovernmental organizations, as well as possible input from international development and finance organizations.'*

These guidelines are to be considered therefore in the context of national policy making to adopt and/or propose alternative noise limits for use, should they be deemed feasible, based on a range of factors which must be considered. In making these decisions, economic, physical, and social considerations all need to be factored in. It is important, therefore, to highlight that the WHO Environmental Noise Guidelines (WHO 2018) should be considered across populations as a whole and used to review and manage health related noise exposure across national and European populations. They set a guideline as to what is desirable at a population level. They are not always achievable and are not intended to be applied at a level on an individual receptor or project basis.

It is important to put the WHO Environmental Noise Guidelines (WHO 2018) recommended traffic noise limits into context with respect to the existing noise levels within Galway City. For the existing road network within Galway City, the most recent noise NAP notes that the existing road network already contributes to road traffic noise above the recommended levels within the WHO Environmental Noise Guidelines (WHO 2018) for a large portion of the population.

An important part of the WHO Guidelines relates to the recommended interventions or mitigation measures to be considered with respect to controlling and reducing road traffic noise exposure across populations. These include:

- Changes in infrastructure;
- Reduction in road traffic flows;
- Pathway interventions (barriers); and
- Quieter road surfaces.

The Draft Galway City Noise Action Plan (NAP) (2024 to 2028) has set out the adopted approach to review population exposure to transport noise in line with WHO (2018) and the intervention or management options available to reduce traffic noise exposure across the population. These are discussed in the following section.

Draft Galway City Council Noise Action Plan 2024 - 2028

The Draft Galway City NAP (2024 to 2028) relates to the management of environmental noise in accordance with the Environmental Noise Directive (END) relating to the assessment and management of environmental noise, OJ L189/12-25, 18 July 2002. (2002/49/EC). The purpose of the Action Plan is to manage and reduce, where necessary, environmental noise through the adoption of the action plans.

The plan refers to the various EU, national, regional, and local guidelines, policies and standards relating to environmental noise and sets out an approach for managing transport related noise for the city and council. The parameters and thresholds couched in the plans relate to those in the WHO (2018) document.

TII as the designated noise mapping body for national roads, prepared strategic noise maps for major and non-major non-national roads carrying in excess of 3 million vehicles per annum within Galway City. The noise mapping was undertaken in 2021 and 2022 as part of the Round 4 Noise Mapping.

Article 6.2 of the Environmental Noise Directive (END) specifies the use of two noise level indicators when preparing environmental noise maps and action plans, the L_{den} and L_{night}.

- L_{den} – as defined above, is the noise indicator used for overall annoyance prescribed in the END and used in the NAP; and
- L_{night} – as defined above, is the noise indicator for sleep disturbance, prescribed in the END and used in the NAP.

The results of the strategic noise maps provide information on the predicted noise levels at all noise sensitive properties within the assessment area, with an estimate of the number of inhabitants. The outcome of the mapping within the NAP is to identify areas for focused review in terms of noise management and noise preservation relating to health-related transport noise impacts. The first area of focus in the Draft Galway City NAP (2024 to 2028) are Important Areas (IAs), where long term noise exposure to noise from infrastructure has potential to have adverse effects on the health of the exposed population. Following on from this, the Most Important Areas (MIAs), which are a subset of the IAs where the health effects are potentially the highest are determined. Once these areas are identified, a further subset of Priority Important Areas (PIAs) are identified and prioritized for which an assessment of noise mitigation measures will be undertaken within the life cycle of the Noise Action Plan.

The Draft Galway City NAP notes the following with respect to the IAs and MIAs

> *"It should be noted that the process of identifying the Important Areas and Most Important Areas is of a statistical nature and pertains to the entire population encompassed by the noise maps. The Most Important Areas should not be construed as a precise assessment of harmful effects for specific buildings, nor are the extents of the Most Important Areas definitive. The Most Important Areas are indicative for the identification of areas with a relatively high number of people who may be potentially highly annoyed due to road noise."*

A total of six PIAs have been selected for inclusion within the Draft Galway City NAP (2024 to 2028) which relate to locations with high levels of health impact due to both noise exposure and population density. These are located along the L1013 Western Distributor Road, R864 Newcastle Road, 2 locations along the R336 Bohermore Road, N6 Bóthar na dTreabh and N6 Bóthar na dTreabh at Briarhill. Details relating to the assessment approach and location of these areas are available in the Draft NAP 2024 to 2028. These areas are set back at considerable distances from the Proposed Development. The specific impacts in relation to changes in road traffic noise, will however be reviewed as part of the assessment within these areas.

The Draft Galway City NAP refers to the TII 2004 and 2014 Noise Guideline documents (listed in Table 9-2) which are recommended to achieve appropriate consistency with respect to the treatment of noise and vibration during the Environmental Impact Assessment and construction phases of road planning and development undertaken in accordance with TII's Project Management Guidelines (PMGs). The Draft Galway City NAP notes the current design goal for all national road schemes should be designed, where feasible, to meet 60 dB L_{den} (free-field residential façade criterion) at both the year of opening and in the design year. The Draft Galway City NAP includes further mitigation options to reduce traffic noise at exposed populations as part of the next 4-year plan/. These include national and regional level strategies for improved public transport and other intervention strategies include but are not limited to; traffic management and routing, speed controls, road surfacing, screening, and new road constructions.

The Draft Galway City NAP discusses the implementation of the proposals set out in the Galway Transport Strategy (2016 GTS) and the Galway City Centre Transport Management Plan as a means to improve public transport facilities and infrastructure and walking and cycling infrastructure. The modal shift to more sustainable modes of transport has potential to impact positively on road traffic noise levels.

The Proposed Development, therefore, forms a key part of implementing the noise mitigation strategies discussed within the Draft Galway City NAP which also align with the recommended interventions and overall policies of the WHO Environmental Noise Guidelines (WHO 2018) to reduce population exposure to road traffic noise.

9.2.4.2.2 Significance Ratings

Taking account the Draft Galway City NAP and other relevant guidance documents discussed above, the following overall significance ratings for the Operational Phase of the Proposed Development are applied taking account of both the calculated changes in road traffic noise levels (Table 9-11 and Table 9-12) and the noise level ranges.

Traffic noise levels at or below 50 dB L_{den} are deemed to be negligible and will not generate any significant impact in terms of annoyance or other health related impacts in line with the various guidance documents discussed above. Changes in traffic noise levels up to this level are therefore deemed Not Significant.

Traffic noise levels between 51 and 54 dB L_{den} are categorised as low. The percentage of the population deemed highly annoyed (HA) by road traffic in this range are 9 to 10% in line with the WHO Environmental Noise Guidelines (WHO 2018) community response studies. There are no significant health related noise effects at or below these levels. Changes in noise levels categorised as Moderate or Major in accordance with the DMRB magnitudes are categorised as Slight to recognise any potential small perceptible change.

Traffic noise levels between 55 and 60 dB L_{den} are categorised as medium. The percentage of the population deemed HA by road traffic in this range are 11 to 15% in line with the WHO Environmental Noise Guidelines (WHO 2018) community response studies. At 59.3 dB $L_{den,}$ the WHO Environmental Noise Guidelines quote a 5% relevant risk increase of the incidence of IHD, and hence traffic noise levels at or below this level are not considered to pose any significant physical health risk. 60 dB L_{den} is the design goal for new national road schemes in Ireland set by TII and referred to within the Draft Galway NAP. A moderate or major change in noise level up to this range of traffic noise level is categorised as a Moderate impact.

Traffic noise levels between 61 and 64 dB L_{den} are categorised as high. The percentage of the population deemed HA by road traffic in this range are 16 to 20% in line with the WHO Environmental Noise Guidelines (WHO 2018) community response studies. Noise levels in this range are also above the TII design goal for road traffic noise for new national road schemes. A minor change in noise level up to this range of traffic noise level is categorised as a Moderate to Significant. A moderate and major change in noise level up to this range of traffic noise level is categorised as a Significant impact.

Traffic noise levels at or above 65 dB L_{den} are categorised as very high. The percentage of the population deemed HA by road traffic in this range are >20% in line with the WHO Environmental Noise Guidelines (WHO 2018) community response studies and noise levels in this range are above the TII design goal for road traffic noise for new national road schemes. Smaller changes in traffic noise levels up to these ranges are categorised with higher impacts. A minor change in noise level up to this range of traffic noise level is categorised as significant. A moderate or major change in noise level up to this range of traffic is considered to be significant to very significant.

The overall significance ratings are shown in Table 9-13.

Table 9-13 Significance Ratings for Operational Phase Traffic Noise Impacts

Noise Level Range – dB L_{den}	Magnitude of Change in Noise Levels (Short Term and Long Term)				
	No Change / Reduction	Negligible	Minor	Moderate	Major
Negligible ≤50	Imperceptible / Positive	Not Significant	Not Significant	Not Significant	Not Significant
Low 51 – 54	Imperceptible / Positive	Not Significant	Not Significant	Slight	Slight
Medium 55 - 60	Imperceptible / Positive	Not Significant - Slight	Slight	Moderate	Moderate
High 61 - 64	Imperceptible / Positive	Not Significant - Slight	Moderate – Significant	Significant	Significant
Very High ≥65	Imperceptible / Positive	Not Significant - Slight	Significant	Significant	Very Significant

9.2.4.2.3 Vibration

Magnitudes of vibration associated with road traffic are orders of magnitude below those associated with building or structural response to vibration. Operational phase impacts are therefore limited to human response to vibration where much lower magnitudes of vibration apply.

In terms of human response, vibration associated with road traffic is negligible and generally do not result in perceptible levels of vibration within buildings along normal maintained roads with no significant defects. Notwithstanding, reference is made to BS 6472–1 (BSI 2008) which provides the following VDV ranges in Table 9-14 which result in various probabilities of adverse comment resulting from exposure to vibration within residential buildings. An adverse comment is an unfavourable human reaction or response to vibration in accordance with BS 6472–1 (BSI 2008).

Table 9-14 BS 6472 -1 VDV Ranges and Associated Impact Probabilities for Building Occupants (BSI 2008)

Place and Time	Low Probability of Adverse Comment $m \cdot s^{-1.75}$ (Note 1)	Adverse Comment Possible $m \cdot s^{-1.75}$	Adverse Comment Probable $m \cdot s^{-1.75}$ (Note 2)
Residential buildings 16-hour day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8-hour night	0.1 to 0.2	0.2 to 0.4	to 0.8

Note 1: Below these ranges adverse comment is not expected.
Note 2: Above these ranges adverse comment is very likely.

9.3 Baseline Environment

The baseline noise environment has been characterised through a desk study of publicly available published data sources and measured noise levels through field studies. The following sections summarise the data sources and the results of the baseline noise surveys. Full details of the baseline surveys, including methodologies, survey dates, terminology and glossary, and results are included in Appendix A9.1 in Volume 4 of this EIAR.

9.3.1 Desk Study of Published Noise Data

The key sources of publicly available baseline data comprise published noise mapping studies undertaken by TII. The available Round 4 noise mapping includes existing sources of major road noise sources within the Galway area. Table 9-15 presents a summary of the traffic noise levels relevant to the closest NSLs along the Proposed Development. The mapped Round 4 L_{den} noise levels are mapped on the EPA mapping site (Epa.ie/maps).

Table 9-15 Summary of Road Traffic Noise Levels from EPA Mapping

Geographical Section	Nearest NSL to Road Centre Line	Noise Contour Noise Levels at NSLs	
		dB L_{night}	dB L_{den}
Section 1 East of Moneenageisha Junction to Skerrit Junction	NSLs along Dublin Road 5-20m	55 - 60	65 - 70
	NSLs along Dublin Road 20-60m	45 - 55	55 - 65
Section 2 Skerrit Junction to Doughiska Road Junction	NSLs along Dublin Road 5-15m	55 - 60	65 - 70
	NSLs along Dublin Road 15-60m	45 - 65	55 - 65

The mapped road traffic noise levels for the geographical sections are discussed in the following sections.

The mapped road traffic noise levels for each of the geographical sections along the route are largely mapped to the same degree with section 2 being unmapped for approximately 400m. Mapped levels range from 55 to 70 dB L_{den} and 45 to 60 L_{ight} at varying distances from the road. Properties closest to the main carriageway of the R338 Dublin Road are mapped to have higher L_{den} and L_{night} parameters with levels decreasing the further set back from the carriageway.

9.3.1.1 Section 1 - East of Moneenageisha Junction to Skerritt Junction

From East of Moneenageisha at the start of the Proposed Development to Skerritt Junction, road traffic noise from the R338 Dublin Road is the dominant noise source in the area. In this area the L_{den} contours are mapped between 70 dB to 75 dB L_{den} along the road edge. Within a 25m distance from the R338 Dublin Road, the L_{den} contour is 65 dB to 70 dB L_{den}. Beyond this at distances between 25m to 40m the L_{den} contour is between 60 dB to 65 dB L_{den} reducing to between 55 dB to 60 dB L_{den} depending on road boundary treatments at distances greater than 40m.

During the night-time, road traffic remains the dominant noise source. The L_{night} contours are between 45 to 60 dB L_{night} along this section of the study area. At distances within 25m from the R338 Dublin Road the L_{night} contour is between 55 dB to 60 dB $L_{night,}$ with levels reducing from 45 to 55 dB L_{night} at distances beyond 25m.

9.3.1.2 Section 2 - Skerritt Junction to Doughiska Road Junction

Section 2 of the Proposed Development which runs from Skerritt Junction to Doughiska Road Junction is not fully mapped within the EPA Noise Maps with noise mapping only available along the stretch of the Proposed Development up until where the R338 Dublin Road turns onto R338 Coast Road. However, for the section of the Proposed Development that is mapped the road traffic noise from the R338 Dublin Road is the dominant noise source in the area.

The L_{den} contours in the immediate vicinity of the road are between 70 dB to 75 dB L_{den}. Within a 15m distance from the R338 Dublin Road, the L_{den} contour is 65 dB to 70 dB L_{den}. Beyond this at distances

between 15m to 40m the L_{den} contour is between 60 dB to 65 dB L_{den} reducing to between 55 dB to 60 dB L_{den} depending on road boundary treatments at distances greater than 40m.

During the night-time, road traffic remains the dominant noise source. The L_{night} contours are between 45 to 60 dB L_{night} along this section of the study area. At distances within 15m from the R338 Dublin Road the L_{night} contour is between 55 dB to 60 dB $L_{night,}$ with levels reducing from 45 to 55 dB L_{night} at distances beyond 15m.

9.3.2 Baseline Noise Surveys

The measured baseline noise survey results are summarised in the following sections. Full survey details and results are included in Appendix A9.1 in Volume 4 of this EIAR, while Figure 9.1 in Volume 3 of this EIAR illustrates the locations of noise monitoring surveys carried out for this assessment.

For unattended survey locations, results are presented for the 16-hour daytime period (07:00hrs to 23:00hrs) in terms of the L_{Aeq} parameter, and for the eight-hour night-time period (23:00hrs to 07:00hrs) in terms of the L_{Aeq} parameters (i.e. the L_{night}) and the derived L_{den}.

For attended surveys, the survey results are presented as the average daytime L_{Aeq} parameter, sampled over a three-hour daytime survey period and the calculated L_{den} parameter.

9.3.2.1 Attended Noise Monitoring Results

The attended baseline survey results within the study area are summarised in Table 9-16.

Table 9-16 Summary of Attended Baseline Surveys

Attended Location	Description	Average Daytime $L_{Aeq,T}$	Derived L_{den}
AT1	Attended position at residential properties along Wellpark Grove to the west of Kia Renmore.	52	56
AT2	Attended position at residential properties along Wellpark Grove to the east of Kia Renmore.	52	55
AT3	Attended position at residential properties on the corner of Renmore Park and Old Dublin Road.	68	70
AT4	Car Park area within The Connacht.	56	58
AT5	Attended position at residential property along Old Dublin Road at the joining of Renmore Road	65	66
AT6	Attended position at residential properties along Glenina Heights	65	67
AT7	Attended position at residential properties along Belmont	51	55
AT8	Attended position at GMIT Library Old Dublin Road	53	56
AT9	Attended position at residential properties at Woodhaven	57	60
AT10	Attended position at residential properties at Líos An Uísce	58	61
AT11	Attended position at Units 5&6 Merlin Park University Hospital	56	56

Attended Location	Description	Average Daytime $L_{Aeq,T}$	Derived L_{den}
AT12	Attended position at residential properties at Durabhán	57	57

The attended noise survey results within the study area are dominated by road traffic from the Old Dublin Road in addition to localised urban noise sources e.g. pedestrian conversation and vehicular movement on connecting roads.

Average daytime noise levels at the attended survey locations ranged between 51 and 68 dB $L_{Aeq,T}$, the higher values being recorded at monitoring locations closest to the Old Dublin Road.

L_{den} values calculated for the attended survey locations ranged between 55 and 70 dB $L_{den.}$ The calculated L_{den} noise levels align closely with those discussed in Section 9.2.3.1 at similar distances from the road edge.

9.3.2.2 Unattended Noise Monitoring Results

The unattended baseline survey results within the study area are summarised in Table 9-17.

Table 9-17 Summary of Unattended Baseline Surveys

Unattended Location	Description	Average $L_{Aeq,T}$		Derived L_{den}
UN1	Noise monitoring install within grounds of Brothers of Charity Services Galway	Day	57	61
		Evening	57	
		Night	53	
UN2	Noise monitoring install southeast of Merlin Meadows within Irish Water compound, along R338 and Proposed Development route	Day	59	62
		Evening	59	
		Night	54	

The unattended noise survey results within the study area are dominated by road traffic from the Old Dublin Road in addition to localised urban noise sources e.g. pedestrian conversation and vehicular movement on connecting roads.

Average daytime noise levels at the unattended survey locations ranged between 57 and 59 dB $L_{Aeq,\ 12hr.}$ L_{den} values calculated for the unattended survey locations ranged between 61 and 62 dB $L_{den.}$ The calculated L_{den} noise levels align closely with those discussed in Section 9.2.3.1 at similar distances from the road edge.

9.3.3 Baseline Vibration

As discussed in Section 9.2.3.3 a review of vibration studies previously undertaken by AWN Consulting as part of the overall Bus Connects Dublin – Core Bus Corridor Infrastructure Works have been reviewed for this Proposed Development.

The results of the surveys confirm vibration levels associated with a heavily trafficked urban – suburban road with a mix of fleet inclusive of dedicated bus lanes result in negligible vibration levels at the edge of the road both in terms of human perception and building response. The low vibration levels measured correspond with the subjective observations made during the surveys where vibration from passing vehicles was not perceptible. The volume and mix of traffic along the measured sections of road within the Dublin

Bus Connects studies are higher than those experienced along the section of the Proposed Development and hence baseline vibration levels will be no greater than those measured.

9.4 Potential Impacts

9.4.1 Do Nothing Scenario

The Do-Nothing Scenario assumes the Proposed Development does not proceed and assumes no other committed developments in the surrounding environment relating to traffic flow changes occur. Under this scenario there is no expected change in the prevailing baseline noise environment other than expected traffic growth in line with national forecasts.

9.4.2 Do Minimum Scenario

The Do Minimum Scenario is a defined scenario within the traffic modelling exercise in Chapter 6 (Traffic and Transport) of this EIAR. The output of this analysis has been used for traffic noise calculations. The Do Minimum scenario considers a range of committed developments and transport plans within the study area for the year of opening (2028) and the design year (2043). Refer to Chapter 6 (Traffic and Transport) of this EIAR for a full description of the assumptions included within the Do Minimum scenario forecast years.

Traffic flows associated with the Do Minimum scenario have been assessed as part of the operational traffic noise impact assessment. This is set out in Section 9.4.3.

9.4.3 Construction Phase

9.4.3.1 Construction Impact Assessment

The TII Noise Guidelines 2014 (NRA 2014) specifically note that there is limited information available on specific construction methods, numbers and types of plant before the appointment of a Contractor, which will normally happen after a scheme has been approved. The guidelines note that it is more appropriate to address the way in which potential construction impacts will be assessed and how they will be managed, including forms of mitigation and codes of practices that will be applied.

Whilst the phasing of works and location of activities and work sites have been progressed to detailed stages as part of the EIAR, the specifics in terms of plant items, plant numbers, their locations and operational duration will be subject to site conditions, work scheduling and contractor proposals. Notwithstanding, it is possible to determine indicative noise levels associated with typical construction activities associated with the various phases of works.

The TII Noise Guidelines 2014 (NRA 2014) note that, in the absence of an Irish or international standard relevant to construction noise, reference can be made to BS 5228 – 1 (BSI 2014a) and BS 5228 – 2 (BSI 2014b). These standards include recommended methodologies for calculating Construction Noise Levels (CNL) and include a range of best practice mitigation and management measures for the control of noise and vibration from construction sites.

In terms of calculation, BS 5228 – 1 (BSI 2014a) sets out sound pressure levels for a wide range of plant items normally encountered on construction sites, which in turn enables the prediction of indicative noise levels at distances from the works. BS 5228 – 2 (BSI 2014b) also includes empirical data on vibration levels measured at set distances from specific vibration generating activities in different ground and site conditions.

9.4.3.2 Construction Activity Noise

Due to the nature of the activities undertaken on a construction site, there is potential for generation of high levels of noise from some activities. The flow of vehicular traffic to and from a construction site is also a potential source of relatively high noise levels, the impact at nearby NSLs will depend upon a number of variables, the most notable of which are:

- The amount of noise generated by plant and equipment being used at any one time generally expressed as a sound power level;
- The periods of operation of the plant at the development site, known as the 'on-time';
- The distance between the noise source and the NSLs;
- The attenuation due to ground absorption or barrier screening effects; and
- Reflections of noise due to the presence of hard vertical faces such as walls.

Using the typical noise levels for items of construction plant set out in BS 5228 – 1 (BSI 2014a), CNLs at specific distances have been calculated to determine a range of potential noise levels representative of the key Construction Phases of the Proposed Development. The following sections set out the calculated CNL's associated with the key phases of construction representing the closest NSLs to the likely work phases.

Along the Proposed Development, the key Construction Phases of the project are:

- General road works, where existing road surfacing is showing signs of deterioration, and the existing cross section will be replaced;
- Road widening and road surface upgrade activities, where the quality of the existing road pavement is poor or where the existing road is being widened, full depth road foundation and pavement reconstruction will be carried out in line with new paving standards;
- Utility diversions;
- Boundary treatment works, where the relocation or rebuilding of replacement boundary walls is required;
- Retaining Walls and Principal Structures;
- Construction Compound, which will be used for storage of materials, plant and equipment, site offices, worker welfare facilities and limited car parking; and
- Landscaping works.

Items of plant and equipment that may be used during construction are identified in Chapter 5 (Construction) and typical operating on-times have been developed for the purposes of construction noise calculation. The plant items along with their associated sound pressure levels taken from BS 5228 – 1 (BSI 2014a) and percentage on-time of plant items used in the calculations are summarised in Table 9-18.

The calculations set out in the following sections do not include any attenuation from screening of site hoarding, buildings, or structures, hence relate only to distance attenuation over hard ground. NSLs located beyond the road edge which are screened by intervening buildings and solid boundary treatments, therefore, will experience lower construction noise emissions than those presented at the varying distances set out in the following sections.

Table 9-18 Indicative Plant Noise Levels and Predicted CNL at Varying Distances

Plant Item (BS 5228 Ref.)	**Plant Noise Level at 10m Distance**	**% Plant On-Time**	**Predicted CNL at Stated Distance from Edge of Works Based on % On-Time (dB $L_{Aeq,T}$)**						
			10m	**15m**	**20m**	**30m**	**50m**	**100m**	**150m**
Lorry (Table C2.34)	80	40	76	72	70	66	62	56	52
Backhoe Mounted Hydraulic Breaker (Table C5.1)	88	20	81	77	75	71	67	61	57
8t Excavator/Mini Digger (Table C4.17)	71	100	71	67	65	61	57	51	47
14t (Rubber Wheeled) Excavator (Table C4.56)	83	40	79	75	73	69	65	59	55
17t (Rubber Wheeled) Excavator (Table C5.11)	73	40	69	65	63	59	55	49	45

Plant Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance	% Plant On-Time	Predicted CNL at Stated Distance from Edge of Works Based on % On-Time (dB $L_{Aeq,T}$)						
			10m	15m	20m	30m	50m	100m	150m
Dumper (Table D3.98)	77	50	74	70	68	64	60	54	50
Road Planer (Table C5.7)	82	10	72	68	66	62	58	52	48
Road Sweeper (Table C4.90)	76	15	67	63	61	57	53	47	43
Asphalt Paver (Table C5.33)	75	15	66	62	60	56	52	46	42
Asphalt Roller (Table C5.20)	75	20	68	64	62	58	54	48	44
3t Roller (Table C5.27)	67	50	64	60	58	54	50	44	40
Vibratory Roller (Table D3.115)	74	50	73	70	65	61	57	51	40

As the Construction Phase progresses along the length of the Proposed Development, a variety of plant items will be required for the varying phases noted above (e.g. road works, road widening, etc.). When works are occurring immediately outside NSLs, they will be clearly audible and will generate high levels of construction noise. The specific noise level associated with individual items of plant at stated distances are included for reference in Table 9-18. The nature of the works associated with the Proposed Development are, however, transient in nature and each activity will occur for intermittent periods at any one time. For example, the use of breakers, excavators, and planers, some of the highest noise generating plant items will operate outside a NSL for a limited period as it progresses along the length of a working area.

For indicative calculation purposes, an average plant noise level has been calculated for each phase of work making reference to the plant list and on-times in Table 9-18. The average value is used to account for the mobile element of works assuming plant items associated with any activity are operating within a 50m linear work area at any one time. The average CNL for each phase of work has been used to assess construction noise levels at the closest NSLs. The following sections present a range of indicative construction noise calculations associated with the key construction activities associated with the Proposed Development.

The construction working hours will be time restricted in accordance with the Construction Contract. Normal construction working hours will be restricted to between 07:00 and 19:00 on weekdays and between 08:00hrs and 14:00hrs on Saturdays.

Night-time, Saturday, and Sunday working will be required during certain periods to minimise the impact on road traffic movements during the daytime, for example at busy road junctions and in commercial areas, and for such works as pavement / road surfacing. The planning of such works will take consideration of sensitive receptors, in particular any nearby residential areas and will require prior agreement with the county council.

9.4.3.2.1 General Road Works

This section assesses the indicative noise levels generated from general road works. As per Table 9-18, for construction plant typically associated with general road works, including lorries, dumpers, road planers, pavers and rollers etc., noise levels are typically in the range of 64 to 76 dB $L_{Aeq,T}$ at 10m taking account of their typical 'on-time' in a working area. Table 9-19 outlines the typical CNL per period associated road works activity, assuming six items of plant with a rounded average noise level each of 70 dB $L_{Aeq,T}$ at 10m. The average plant noise level has been calculated accounting for the fact that plant items will be operating at varying distances from a NSL at any one time.

Table 9-19 Indicative Road Works Construction Noise Calculations at Varying Distances

Predicted CNL at Stated Distance from Edge of Works Based on % Plant On-Time and Plant Items Operating Simultaneously (dB $L_{Aeq,T}$)								
10m	**15m**	**20m**	**30m**	**50m**	**75m**	**100m**	**150m**	**250m**
78	75	72	68	64	60	58	54	50

During normal road works the daytime CNT value of 75 dB $L_{Aeq,12hr}$ Monday through Friday (07:00 to 19:00hrs) is likely to be exceeded at distances of up to 15m from the works boundary in the absence of any noise mitigation. The weekend CNT of 65 dB $L_{Aeq,6hr}$ would be exceeded at distances of up to 50m in the absence of mitigation. The identified areas where this work will take place and calculated construction noise levels are presented in Table 9-20. The identified NSLs are those which bound the road edge and are not screened by intervening buildings. The identified NSL in Table 9-20 is not an exhaustive list of properties at varying distances.

Table 9-20 Indicative Road Works Construction Noise Calculations at Nearest NSLs

Construction Section Reference	**Chainage Reference**		**Nearest NSL to Edge of Works**	**Potential Total CNL at Stated Distance (dB $L_{Aeq,T}$)**	**Predicted EPA Significance Impact**	
	Start	**End**			**Weekday**	**Weekend**
Section 1 Proposed Development Start to Renmore Park	0+000	0+390	Apartments North of Proposed Development (15m)	75	Slight to Moderate	Significant to Very Significant
Section 1 Proposed Development Start to Renmore Park	0+000	0+390	Brothers of Charity South of the Proposed Development (30m)	68	Slight to Moderate	Moderate to Significant
Section 1Renmore Park to Renmore Road	0+390	0+600	The Connacht Hotel North of Proposed Development (40m)	66	Slight to Moderate	Moderate to Significant
Section 1 Renmore Park to Renmore Road	0+390	0+600	Properties along Old Dublin Road South of the Proposed Development (<10m)	78	Moderate to Significant	Significant to Very Significant
Section 1Renmore Road to Galway Hospice Foundation	0+600	0+800	Properties along Old Dublin Road North of the Proposed Development (15m)	75	Slight to Moderate	Significant to Very Significant
Section 1 Renmore Road to Galway Hospice Foundation	0+600	0+800	Bon Secours Hospital South of the Proposed Development (40m)	66	Slight to Moderate	Moderate to Significant
Section 1 Galway Hospice Foundation	0+800	1+130	Properties along Glenina Heights Northeast of the	78	Moderate to Significant	Significant to Very Significant

Construction Section Reference	Chainage Reference		Nearest NSL to Edge of Works	Potential Total CNL at Stated Distance (dB $L_{Aeq,T}$)	Predicted EPA Significance Impact	
	Start	End			Weekday	Weekend
to Ballyloughane Road			Proposed Development (10m)			
Section 1 Galway Hospice Foundation to Ballyloughane Road	0+800	1+130	Properties along Old Dublin Road South of the Proposed Development (10m)	78	Moderate to Significant	Significant to Very Significant
Section 1 Ballyloughane Road to Skerritt Junction	1+130	1+500	Properties along Belmont Northeast of the Proposed Development (10m)	78	Moderate to Significant	Significant to Very Significant
Section 1 Ballyloughane Road to Skerritt Junction	1+130	1+500	Garda Station along Old Dublin Road to South of the Proposed Development (10m)	78	Moderate to Significant	Significant to Very Significant
Skerritt Junction	1+480	1+550	GMT Library Old Dublin Road Northwest of Proposed Development (50m)	64	Not Significant	Slight to Moderate
Skerritt Junction	1+480	1+550	Properties along Ballybane Road Northeast of the Proposed Development (25m)	70	Slight to Moderate	Moderate to Significant
Skerritt Junction	1+480	1+550	Properties along Gleann Rua Southeast of the Proposed Development (25m)	70	Slight to Moderate	Moderate to Significant
Section 2 Skerritt Junction to Entrance to Merlin Park	1+480	1+550	Properties along Old Dublin Road North of the Proposed Development (20m)	72	Slight to Moderate	Significant to Very Significant
Section 2 Skerritt Junction to Entrance to Merlin Park	1+480	1+550	Properties along Old Dublin Road South of the Proposed Development (10m)	78	Moderate to Significant	Significant to Very Significant
Section 2 Entrance to Merlin Park to turning for Coast Road R338	1+830	3+290	Merlin Park University Hospital North of the Proposed Development (150m)	54	Not Significant	Not Significant
Section 2 Entrance to Merlin Park to	1+830	3+290	Properties along Old Dublin Road	66	Slight to Moderate	Moderate to Significant

Construction Section Reference	Chainage Reference		Nearest NSL to Edge of Works	Potential Total CNL at Stated Distance (dB $L_{Aeq,T}$)	Predicted EPA Significance Impact	
	Start	End			Weekday	Weekend
turning for Coast Road R338			South of the Proposed Development (40m)			
Section 2 Turning for Coast Road R338 to End of Proposed Development	3+290	3+810	Property Northeast of the Proposed Development along Doughíshka Road (65m)	62	Not Significant	Slight to Moderate
Section 2 Turning for Coast Road R338 to End of Proposed Development	3+290	3+810	Property Southeast of the Proposed Development along Doughíshka Road (10m)	78	Moderate to Significant	Significant to Very Significant

As summarised in Table 9-20, in the geographical sections of the Proposed Development, general road works including junction realignments are within 10m to 150m of the nearest NSLs. The predicted cumulative noise levels for these works at the closest NSL façades are between 54 to 78 dB $L_{Aeq,T}$ in the absence of noise mitigation. Making reference to the CNLs in Table 9-20 the potential noise impacts at the closest NSLs range between negative, not significant to moderate to significant and temporary during weekday periods in the absence of noise mitigation. During Saturday morning periods, impacts are negative, slight to moderate to very significant and temporary at the closest NSLs in the absence of noise mitigation.

Reference to Table 9-18, indicates that highest noise levels will occur when road planers are operating at the closest distance to NSLs. During specific periods when these activities are operating outside NSLs, higher noise levels will occur compared to those discussed in Table 9-20. These activities will occur, however, for intermittent periods of time at any one location over the course of a working day.

In the event road works are scheduled to occur outside of normal working hours, these will require permission from the county council. Information relating to the location, duration and activities proposed will be provided in advance of these activities, should they be deemed necessary. Where required, they will be subject to the same construction noise criteria outlined in Table 9-6.

9.4.3.2.2 Road Widening, Road Upgrade and Utility Diversion Construction Works

This section assesses the indicative noise levels generated from road widening and utility diversion activities, where the quality of the existing road pavement is poor or where the existing road is being widened, full depth road foundation and pavement reconstruction will be carried out. This section also included for activities associated with utility diversions where road widening works have taken place and for urban realm and pavement upgrade works. Construction plant typically associated with road widening, reconstruction and utility diversion works include lorries, breakers, excavators, dumpers, road planers, sweepers, pavers, and rollers etc which will operate as required depending on the specific activity taking place at any one time. As per Table 9-18, noise levels associated with these activities are typically in the range of 64 to 82 dB $L_{Aeq,T}$ at 10m taking account of their typical 'on-time' in a working area. Table 9-21 outlines the typical CNL associated with the proposed works for this element of the construction phase, assuming six items of plant with a rounded average noise level each of 75 dB $L_{Aeq,T}$ at 10m are operating simultaneously.

Table 9-21 Indicative Road Widening and Utility Diversion Construction Work Noise Calculations at Varying Distances

Predicted CNL at Stated Distance from Edge of Works Based on % Plant On-Time and Plant Items Operating Simultaneously (dB $L_{Aeq,T}$)								
10m	**15m**	**20m**	**30m**	**50m**	**75m**	**100m**	**150m**	**250m**
83	80	77	73	69	65	63	59	55

During road widening, reconstruction and utility diversion works, the daytime CNT value of 75 dB $L_{Aeq,12hr}$ Monday through Friday (07:00 to 19:00hrs) is likely to be exceeded at distances of up to 25m from the works boundary in the absence of noise mitigation. The Saturday morning CNT of 65 dB $L_{Aeq,6hr}$ is likely to be exceeded at distances of up to 75m in the absence of mitigation. The identified areas where this work will take place and calculated construction noise levels are presented in Table 9-22.

Table 9-22 Road Widening, Reconstruction, Road Upgrade and Utility Diversion Construction Noise Calculations at Nearest NSLs

Construction Section Reference	**Chainage Reference**		**Nearest NSL to Edge of Works**	**Potential Total CNL at Stated Distance from Edge of Works (Db $L_{Aeq,T}$)**	**Predicted EPA Significance Impact**	
	Start	**End**			**Weekdays**	**Weekend**
Section 1 Proposed Development Start to Renmore Park	0+000	0+390	Apartments North of Proposed Development along Sáilín (18m)	78	Moderate to Significant	Significant to Very Significant
Section 1 Proposed Development Start to Renmore Park	0+000	0+390	Brothers of Charity South of the Proposed Development (15m)	80	Moderate to Significant	Significant to Very Significant
Section 1 Renmore Park to Renmore Road	0+390	0+600	The Connacht Hotel North of Proposed Development (40m)	71	Slight to Moderate	Significant to Very Significant
Section 1 Renmore Road to Galway Hospice Foundation	0+390	0+600	Properties along Glenina Heights (15m)	80	Moderate to Significant	Significant to Very Significant
Section 1 Renmore Road to Galway Hospice Foundation	0+600	0+800	Bon Secours Hospital South of the Proposed	71	Slight to Moderate	Significant to Very Significant

Construction Section Reference	Chainage Reference		Nearest NSL to Edge of Works	Potential Total CNL at Stated Distance from Edge of Works (Db $L_{Aeq,T}$)	Predicted EPA Significance Impact	
	Start	End			Weekdays	Weekend
			Development (40m)			
Section 1 Galway Hospice Foundation to Ballyloughane Road	0+600	0+800	Properties along Glenina Heights Northeast of the Proposed Development (15m)	80	Moderate to Significant	Significant to Very Significant
Section 1 Galway Hospice Foundation to Ballyloughane Road	0+600	0+800	Flannerys Hotel Galway North of Proposed Development (20m)	77	Moderate to Significant	Significant to Very Significant
Section 1 Ballyloughane Road to Skerritt Junction	1+130	1+500	Properties along Belmont Northeast of the Proposed Development (10 -20m)	77 - 83	Significant to Very Significant	Significant to Very Significant
Skerritt Junction	1+480	1+550	GMT Library Old Dublin Road Northwest of Proposed Development (50m)	69	Slight to Moderate	Moderate to Significant
Skerritt Junction	1+480	1+550	Properties along Ballybane Road Northeast of the Proposed Development (25m)	75	Slight to Moderate	Significant to Very Significant
Skerritt Junction	1+480	1+550	Properties along Gleann Rua Southeast of the Proposed Development (25m)	75	Slight to Moderate	Significant to Very Significant
Section 2 Skerritt Junction to Entrance to Merlin Park	1+480	1+550	Properties along Old Dublin Road North of the Proposed	77	Moderate to Significant	Significant to Very Significant

Construction Section Reference	Chainage Reference		Nearest NSL to Edge of Works	Potential Total CNL at Stated Distance from Edge of Works (Db $L_{Aeq,T}$)	Predicted EPA Significance Impact	
	Start	End			Weekdays	Weekend
			Development (20m)			
Section 2 Skerritt Junction to Entrance to Merlin Park	1+480	1+550	Properties along Old Dublin Road South of the Proposed Development (10m)	83	Significant to Very Significant	Profound
Section 2 Entrance to Merlin Park to turning for R338	1+830	3+290	Merlin Park University Hospital North of the Proposed Development (150m)	59	Not Significant	Not Significant
Section 2 Entrance to Merlin Park to turning for R338	1+830	3+290	Properties along Old Dublin Road South of the Proposed Development (40m)	71	Slight to Moderate	Significant to Very Significant
Section 2 Turning for R338 to End of Proposed Development	3+290	3+810	Property Northeast of the Proposed Development along Doughíshka Road (75m)	65	Not Significant	Slight to Moderate
Section 2 Turning for R338 to End of Proposed Development	3+290	3+810	Property South of the Proposed Development along Duírling (150m)	59	Not Significant	Not Significant

As summarised in Table 9-22 above, in the geographical sections of the Proposed Development, road widening works are within 10m to 150m of the nearest NSLs. The highest predicted cumulative CNL for these works at the closest NSL façades are between 59 to 83 dB $L_{Aeq,T}$ in the absence of any noise mitigation. Making reference to the CNLs in Table 9-22 the potential noise impacts at the closest NSLs range between negative, not significant to very significant and temporary in the absence of mitigation during weekday periods. During Saturday morning periods, impacts are negative, not significant to very significant or profound and temporary at the closest NSLs in the absence of noise mitigation.

The calculations are based on six plant items with an average noise level of 75 dB $L_{Aeq,T}$ at 10m operating simultaneously, in the absence of any noise mitigation, along a given section of road. The average plant noise level has been calculated on the basis that plant will be operating at varying distances from a NSL at

any one time. Reference to Table 9-18 indicates that highest noise levels will occur when breaking, excavators and road planers are operating at the closest distance to NSLs. Highest noise levels are calculated at properties south of the Section 2 within 10m of the works. These activities will occur, however, for intermittent periods of time at any one location over the course of a working day.

In the event road works are scheduled to occur outside of normal working hours, these will require permission from the county council. Information relating to the location, duration and activities proposed will be provided in advance of these activities, should they be deemed necessary. Where required, they will be subject to the same construction noise criteria outlined in Table 9-6.

9.4.3.2.3 Boundary Treatments

This section assesses the indicative noise levels generated from boundary treatment works, where the relocation or rebuilding of replacement boundary walls is required. For boundary treatment works, where road widening and reconstruction works have already taken place and involved removal of boundaries with excavators, dumpers etc, the rebuilding works will require plant items such as excavation of new foundations, cement mixing and block laying. Table 9-23 outlines the typical CNL associated with the proposed works for this element of the construction, assuming three items of plant with a rounded average noise level each of 75 dB L_{Aeq} at 10m.

Table 9-23 Indicative Boundary Wall Noise Calculations at Varying Distances

Predicted CNL at Stated Distance from Edge of Works Based on % Plant On-Time and Plant Items Operating Simultaneously (dB $L_{Aeq,T}$)								
10m	**15m**	**20m**	**30m**	**50m**	**75m**	**100m**	**150m**	**250m**
80	77	74	70	66	62	60	56	49

During boundary wall construction work with cumulative site works up to 80 dB L_{Aeq} at 10m, the daytime CNT value of 75 dB $L_{Aeq,12hr}$ Monday through Friday (07:00 to 19:00hrs) is likely to be exceeded at distances within 20m from the works boundary in the absence of any noise mitigation. The weekend CNT of 65 dB $L_{Aeq,6hr}$ would be exceeded at distances of up to 50m in the absence of mitigation.

The identified areas where this work will take place and calculated construction noise levels are presented in Table 9-24. For properties where boundary wall works are less than 10m from the property façade, the calculated noise level outlined in Table 9-24 is considered a valid representation of likely noise levels given the number of plant likely to operate simultaneously within this small working area will be limited at any one time.

Table 9-24 Boundary Walls Noise Calculations at Nearest NSL's

Construction Section Reference	**Chainage Reference**		**Nearest NSL to Edge of Works**	**Potential Total CNL at Stated Distance (dB $L_{Aeq,T}$)**	**Predicted EPA Significance Impact**	
	Start	**End**			**Weekday**	**Weekend**
Section 1 Proposed Development Start to Renmore Park	0+000	0+100	Lakeview School and Brothers of Charity Services Galway (25m)	72	Slight to Moderate	Significant to Very Significant
Section 1 Proposed	0+250	0+450	Residential receptors to the	72	Slight to Moderate	Significant to Very Significant

Construction Section Reference	Chainage Reference		Nearest NSL to Edge of Works	Potential Total CNL at Stated Distance (dB $L_{Aeq,T}$)	Predicted EPA Significance Impact	
	Start	End			Weekday	Weekend
Development Start to Renmore Park			North and South of the Proposed Development (25m)			
Section 1 Renmore Park to Renmore Road	0+520	0+610	Residential receptors to the North and South of the Proposed Development (10m)	80	Moderate to Significant	Significant to Very Significant
Section 1 Renmore Road to Galway Hospice Foundation	0+750	0+790	Bon Secours Hospital Galway (15m)	77	Moderate to Significant	Significant to Very Significant
Section 1 Galway Hospice Foundation to Ballyloughane Road	0+900	0+980	Residential NSL's to the north of the Proposed Development at Glenina Heights and Glaswegians RFC (30-35m)	70	Slight to Moderate	Moderate to Significant
Section 2 Galway Hospice Foundation to Ballyloughane Road	1+000	1+450	Technological University Galway to the north of the Proposed Development and Garda Station to the south of the Scheme (5 - 10m)	80	Moderate to Significant	Significant to Very Significant
Section 2 Skerritt Junction to Merlin Park	1+630	1+800	Residential Receptors within Woodhaven (20m)	74	Slight to Moderate	Significant to Very Significant
Section 2 Skerritt Junction to Merlin Park	1+810	1+830	Residential Receptors to the southeast of the Proposed Development (40m)	68	Slight to Moderate	Moderate to Significant
Section 2 Entrance to Merlin Park to turning for R338	1+850	2+580	Residential NSL's to the south of the Proposed Development and Merlin Park University Hospital to the North of the Proposed Development (40 – 150m)	56 - 68	Not Significant / Slight to Moderate	Not Significant / Moderate to Significant
Section 2	3+280	3+810	Residential NSL's to the south of the	68	Slight to Moderate	Moderate to Significant

Construction Section Reference	Chainage Reference		Nearest NSL to Edge of Works	Potential Total CNL at Stated Distance (dB $L_{Aeq,T}$)	Predicted EPA Significance Impact	
	Start	End			Weekday	Weekend
Turning for R338 to End of Proposed Development			Proposed Development (40m)			

During boundary wall treatment works in the specific geographical sections, the nearest NSLs are within <10m to 150m of the proposed works. The highest predicted cumulative noise levels for these works at the closest NSL façades are between 56 to 80 dB L_{Aeq} in the absence of any noise mitigation. Making reference to the CNLs in Table 9-24 the potential noise impacts at the closest NSLs range between negative, not significant to significant, and temporary during weekday periods in the absence of noise mitigation. During Saturday morning periods, impacts are negative, not significant to very significant and temporary at the closest NSLs in the absence of noise mitigation.

9.4.3.2.4 Structural Work

Retaining walls are proposed at one location (approximately 2m in height) along the Proposed Development and two storm water holding tanks are proposed at low points in Section 2. Works involve ground clearance, excavation, form, steelwork, and concreting. As per Table 9-18, for plant typically associated with these structures including excavators and dumpers etc. noise levels are typically in the range of 74 to 79 dB $L_{Aeq,T}$ at 10m taking account of their typical 'on-time' in a working area. Table 9-25 outlines the typical CNL associated with the proposed works for this element of the construction, assuming three items of plant with a rounded average noise level each of 75 dB $L_{Aeq,T}$ at 10m.

Table 9-25 Indicative Structural Work Noise Calculations at Varying Distances

Predicted CNL at Stated Distance from Edge of Works Based on % Plant On-Time and Six Plant Items Operating Simultaneously (dB $L_{Aeq,T}$)								
10m	15m	20m	30m	50m	75m	100m	150m	250m
80	77	74	70	66	62	60	56	52

During structural works, the daytime CNT value of 75 dB $L_{Aeq,12hr}$ Monday through Friday (07:00 to 19:00hrs) is likely to be exceeded at distances within 20m from the works boundary in the absence of any noise mitigation. The weekend CNT of 65 dB $L_{Aeq,6hr}$ would be exceeded at distances of up to 50m in the absence of mitigation. The identified area where this work will take place and calculated construction noise levels are presented in Table 9-26.

Table 9-26 Structural Works Noise Calculations at Nearest NSL's

Construction Section Reference	Structure Reference	Chainage Reference		Nearest NSL to Edge of Works	Potential Total CNL at Stated Distance (dB $L_{Aeq,T}$)	Predicted EPA Significance Impact	
		Start	End			Weekday	Weekend
Section 2 Skerritt	STR_RW_01	1+560	1+610	Residential receptors to the north of	68	Slight to Moderate	Moderate to Significant

Construction Section Reference	Structure Reference	Chainage Reference		Nearest NSL to Edge of Works	Potential Total CNL at Stated Distance (dB $L_{Aeq,T}$)	Predicted EPA Significance Impact	
		Start	End			Weekday	Weekend
Roundabout to Woodhaven				the Proposed Development at Woodhaven (40m)			
Section 2	STR_TK_02	2+200		Church to south (30m)	70	Slight to Moderate	Moderate to Significant
Section 2	STR_TK_02	3+200		Merlin Park Hospital to North (>200m)	50	Not Significant	Not Significant

As summarised above, the provision of structures are proposed in Section 2 of the Proposed Development. The indicative predicted noise levels for these works at the closest NSL facades are in the region of 50 to 70 dB $L_{Aeq,T}$ in the absence of any noise mitigation. The predicted noise impacts at the closest NSLs are determined to be negative, not significant to slight to moderate and temporary during weekday periods in the absence of noise mitigation. During Saturday morning periods, potential impacts are negative, not significant to significant and temporary at the closest NSLs in the absence of noise mitigation.

9.4.3.2.5 Construction Site Compound

One Construction Compound is proposed which will be used for storage, offices and material handling, generators etc, a total CNL of 78 dB $L_{Aeq,T}$ at 10m has been used for the purposes of indicative calculations. This would include, for example plant typically with noise levels in the range of 70 to 75 dB L_{Aeq} at 10m. Table 9-27 outlines the typical CNL associated with typical noise levels from this area.

Given the variations of on-site activities and noise levels over any one day, and considering that all activities will not operate simultaneously, the values noted above are considered robust for the purposes of assessing potential construction impacts.

Table 9-27 Indicative Construction Compound Construction Noise Calculations at Varying Distances

Predicted CNL at Stated Distance from Edge of Works Based on % Plant On-Time and Plant Items Operating Simultaneously (dB $L_{Aeq,T}$)								
10m	**15m**	**20m**	**30m**	**50m**	**75m**	**100m**	**150m**	**250m**
78	75	72	68	64	60	58	54	50

The predicted values outlined in Table 9-27 indicate the daytime CNT value of 75 dB $L_{Aeq,\ 12hr}$ Monday through Friday (07:00 to 19:00hrs) is likely to be exceeded at distances of up to 15m from the works boundary in the absence of any noise mitigation. The weekend CNT of 65 dB $L_{Aeq,6hr}$ would be exceeded at distances of up to 50m in the absence of mitigation.

There is one site identified as a potential site compound on the Proposed Development. The Construction Compound is listed in Table 9-28 with approximate distance to NSLs and general comments on potential noise impacts included.

Table 9-28 Construction Site Compound Noise Calculations at Nearest NSL's

Construction Section Reference	Nearest NSL to Edge of Works	Potential Total CNL at Stated Distance from Edge of Works (dB $L_{Aeq,T}$)	Predicted EPA Significance Impact	
			Weekday	Weekend
Section 1North of the Proposed Development in Fields to the West of The Connacht Hotel	The Connacht Hotel to the East of the Compound (20m)	72	Slight to Moderate	Significant

The Construction Compound for the Proposed Development is within 20m of the adjacent hotel. The highest predicted cumulative noise level is of the order of 72 dB $L_{Aeq,\ T}$ in the absence of any noise mitigation assuming this compound includes ongoing material handing activities. Making reference to the CNL in Table 9-28, the potential noise impacts at the closest NSL is negative, slight to moderate, and short-term during the weekday periods in the absence of noise mitigation. During Saturday morning periods, impacts are negative, significant, and short-term at the closest NSL in the absence of noise mitigation.

9.4.3.2.6 Emergency Work

Emergency work may include the replacement of warning lights, signs and other safety items on public roads, the repair of water supplies and other services which have been interrupted, repair to any damaged temporary works and all repairs associated with working on public roads. These activities may be required to work outside of normal working hours. Where required, they will be subject to the same construction noise criteria outlined in Table 9-6.

9.4.3.3 Construction Vibration

The potential for elevated levels of vibration at sensitive locations during construction activities associated with the Proposed Development is typically associated with surface breaking activities used for road widening and utility diversions.

During surface breaking activities, there is potential for vibration to be generated through the ground. Empirical data for this activity is not provided in BS 5228–2 (BSI 2014b), however the likely levels of vibration from this activity will be significantly below the vibration criteria for building damage based on monitoring data and experience from other sites. AWN Consulting has previously conducted vibration measurements under controlled conditions, during trial construction works on a sample site where concrete slab breaking was carried out. The trial construction works consisted of the use of the following plant and equipment when measured at various distances:

- 3 tonne hydraulic breaker on small CAT tracked excavator; and
- 6 tonne hydraulic breaker on large Liebherr tracked excavator.

Vibration measurements were conducted during various staged activities and at various distances.

Peak vibration levels during staged activities using the 3-tonne breaker ranged from 0.48 to 0.25 PPV (mm/s) at distances of 10m to 50m respectively from the breaking activities. Using a 6-tonne breaker, measured vibration levels ranged between 1.49 to 0.24 PPV (mm/s) at distances of 10m to 50m, respectively.

Whilst these measurements relate to a solid concrete slab, the range of values recorded provides some context in relation to typical ranges of vibration generated by construction breaking activity.

Widening and upgrading of existing footpaths and kerbs will involve careful deconstruction using controlled techniques. Vibration levels associated with this activity will be of similar or lower magnitude to breaking activities discussed above.

Referring to the vibration magnitudes above and Table 9-10, vibration impacts during groundbreaking activities using heavy breakers have the potential to generate a negative, slight to moderate, temporary effects at distances of 10m from the activity. Beyond 50m from this type of activity, impacts are reduced to not significant to slight and temporary. For all other works, vibration impacts will be below those associated with perceptible vibration and will be imperceptible to not significant and temporary. All construction works are orders of magnitude below limits values associated with any form of cosmetic or structural damage for structurally sound or protected or historical buildings or structures referred to in Table 9-9.

No vibration sensitive processes have been identified along the Proposed Development that would be affected by the proposed works.

9.4.3.4 Construction Traffic

During construction works, it is planned to maintain the roads and streets along the Proposed Development open to general traffic. Two-way traffic will generally be maintained, however in circumstances where there is not sufficient width to permit two-way traffic, single lane traffic controlled by stop/ go system will be implemented.

Traffic flows associated with the Construction Phase represent the busiest period over the two-year construction period and includes for the required traffic management measures associated with the works. Further information relating to construction traffic, construction sections and the construction working sequences is set out in Chapter 5 (Construction) and Chapter 6 (Traffic and Transport).

Given the assessed traffic flows represent a 'worst case' peak scenario over the overall two-year construction period for the Proposed Development, the duration over which the calculated impacts are described will be less than 1 year and are categorised as temporary.

Calculation Methodology

The approach adopted for construction noise traffic analysis involves calculation of noise emission levels associated with the Do Minimum and Do Something traffic scenarios and determining the related increase in noise level because of the additional traffic on the road network. Calculations have been undertaken for each of the roads modelled within a traffic impact assessment zone using a breakdown of the fleet types along each i.e., buses, cars, LGVs and HGVs. The calculated noise levels are then summed to obtain a total L_{den} value along each road within the study area.

Noise levels associated with a passing event such as road traffic may be expressed in terms of its Sound Exposure Level (L_{AX}). The Sound Exposure Level can be used to calculate the contribution of an event or series of events to the overall noise level in a given period using the following formulae:

$$L_{Aeq,T} = L_{AX} + 10\log_{10}(N) - 10\log_{10}(T)\ dB$$

where:

- $L_{Aeq,T}$ is the equivalent continuous sound level over the time period T (in seconds);
- L_{AX} is the "A-weighted" Sound Exposure Level of the event considered (dB); and
- N is the number of events over the course of time period T.

The following Sound Exposure Level (L_{AX}) reference values have been used for the assessment. The specific data has been obtained from specific source measurements undertaken for the Proposed

Development EIAR and from AWN's in-house data base of road vehicle sound exposure levels measured under controlled conditions for other applications. The L_{AX} values relate to vehicles traveling at a low to moderate speed in an urban environment. The reference noise values are also comparable with those within the Common Noise Assessment Methods in Europe - CNOSSOS-EU (EU 2012) document for road traffic noise for light, medium and heavy vehicles at urban speeds. Speeds corrections for road links of speeds of 75km and above are made in line with the CRTN (1988) methodology.

Table 9-29 Reference Sound Exposure Levels for Noise Calculations

Vehicle Type	LAX at 5m from Road Edge, dB
Car	72
LGV	75
Bus	78
HGV	85

The Annual Average Daily Traffic (AADT) for each vehicle category is used to calculate a total $L_{Aeq,24hr}$ value along each road within the study area at a reference distance of 5m. The $L_{Aeq,24hr}$ is converted to an L_{den} value using the correction values from the research paper *Conversion between noise exposure indicators L_{eq24hr}, L_{Day}, $L_{Evening}$, L_{night}, L_{dn}, and L_{den}; Principles and practical guidance.*

The conversion factors have been tested for a range of sample road sections in the study area using the AADT profiles and are confirmed to provide a comparative result to those measured during baseline surveys and those calculated using the CRTN Basic Noise Level (BNL) output and $L_{Aeq,1hr}$ conversion methodologies from the Transport Research Laboratories (TRL) from L_{A10} to L_{Aeq} and the calculated results are all within and less than 1dB.

The approach used above has been used in Lieu of the Basic Noise Level Calculation (BNL) from the CRTN (1988) in order to calculate a direct L_{Aeq} value per period. In addition, the approach above allows for a sensitive analysis relating to different classification of vehicle, where required.

Traffic Noise Assessment – Construction Phase

The assessment of potential traffic noise impacts has been undertaken using the following approach:

- Traffic noise levels have been calculated along the modelled roads provided by the traffic consultants;
- Noise levels have been calculated for the Do Minimum (DM) scenario for the assessed construction year, 2026;
- Noise levels have been calculated for the Do Something (DS) scenario for the assessed construction year, 2026; and
- The change in traffic noise levels between the Do Minimum and Do Something scenarios for the year 2026 has been calculated and the associated magnitude of change and noise level range defined.

For the majority of the study area, traffic noise impacts are determined to be positive, imperceptible, and temporary impact to negative, not significant to slight and temporary impact due to the negligible to low volume of additional traffic along the road network during the Construction Phase scenario.

There are a small number of roads in the overall study area where there are potential for significant impacts as a result of traffic redistribution onto the surrounding road network due to temporary traffic management measures. These are defined as roads with a traffic noise level above a daytime noise level of 54 dB L_{den} and an increase in noise level greater than 1 dB.

Further analysis of these road was undertaken as follows:

- For each identified road above the potential significance thresholds, the location or presence of NSLs was identified and distance from the road confirmed;
- The corrected traffic noise level at the closest NSL façade was calculated, where required; and

- The overall significance rating was determined taking account of the change in noise level during the short-term period and the noise level range, taking account of any distance corrections.

The specific construction noise impacts for these roads are summarised in Table 9-30.

Table 9-30 Summary of Potential Construction Phase Traffic Impacts – Year 2024

Road	Potential Increase above DM Scenario, dB	DMRB Short-term Magnitude of Impact	Potential DS Road Traffic Noise at Closest NSL	Noise Level Rating	Overall Significance Rating	Potential Impact
Water Macken Road	+1	Minor	59	Medium	Slight	Negative, Slight, Temporary
Renmore Park	+1.2	Minor	58	Medium	Slight	Negative, Slight, Temporary
Doughiska Road	+1.4	Minor	57	Medium	Slight	Negative, Slight, Temporary
Doughiska Road	+1.1	Minor	63	High	Moderate to Significant	Negative, Moderate - Significant, Temporary
Rosshill Road	+6	Major	59 - 61	Medium to High	Moderate to Significant	Negative, Moderate to Significant, Temporary

Traffic flow changes along the roads in Table 9-30 are a result of traffic management measures required as part of the Construction Phase which result in an element of traffic diversions onto surrounding roads off the Proposed Development.

During the assessed construction year, the highest potential noise impacts are calculated along a section of Rosshill Road as a result of traffic management measures and related redistributed traffic temporarily onto this road. The change in traffic noise is defined as major with traffic noise level calculated at the closest NSLs along this section of road categorised as medium to high. The overall impact is determined to be negative, moderate to significant and temporary.

Along Doughiska Road, the combination of changes in traffic noise level and the absolute noise level calculated at the nearest NSLs result in a negative, moderate to significant and temporary noise impact at the closest NSLs reducing to negative, slight, and temporary at NSLs set back further from the road edge.

For all other roads across the study area, a positive, imperceptible, and temporary impact, to negative, not significant to slight and temporary impact is calculated at the closest NSLs.

The overall construction traffic noise impacts across the full study area are presented in Figure 9.2 in Volume 3 of this EIAR.

9.4.3.5 Summary of Potential Construction Noise Impacts

It should be noted that the calculations set out Section 9.4.3.4 are indicative and are used for the purposes of comparison only with the adopted criteria. Where exceedance of the recommended criteria is expected, the use of noise mitigation measures will be used as part of the construction works. Further details of the noise mitigation measures are set out in Section 9.5.

The pre-mitigation construction noise significance ratings across the Proposed Development are summarised in line with Table 9-7 which take account of the prevailing baseline noise environment and the calculated CNL. The specific duration of construction activities at a NSL also influences the overall significance determination. In accordance with the DMRB Noise and Vibration (UKHA 2020), a significant effect occurs where a moderate or major magnitude of impact occurs for periods equal to or greater than 10 or more days in any 15 consecutive days or for a total number of days exceeding 40 in any 6 consecutive months. Given this level of detail cannot be accurately determined at EIAR Stage for construction activities at any one location, the pre-mitigation construction noise significance ratings discussed in Table 9-31 relate to activities which occur over periods equal to or greater than the durations discussed above. In line with the proposed construction working hours, only daytime works are expected to be undertaken as standard.

For ease of reference, where activities have comparable average plant noise levels (e.g. general road works and construction compounds), their impacts are discussed under one heading to reflect that the range of noise levels are comparable at the same distances.

Table 9-31 Summary of Potential Construction Phase Noise Impacts

Assessment Topic	Period over which criterion Applies	Potential Impacts
General Road Works Construction Compound	Monday to Friday: Daytime (07:00 – 19:00hrs)	▪ Negative, moderate to significant and temporary at NSLs within 15m distance from the proposed works. ▪ Negative, slight to moderate and temporary at NSLs at distances between 15m to 45m from the proposed works. ▪ Negative, not significant and temporary at NSLs at distances greater than 45m from the proposed works. All impacts noted above are in the absence of noise mitigation. Refer to Section 9.5 for the range of noise mitigation measures which will be adopted at specific working areas to reduce noise impacts at NSLs. Particular emphasis is given to localised screening around high noise level plant items.
	Saturdays (08:00 to 14:00hrs)	▪ Negative, significant to very significant and temporary at NSLs within 30m from the proposed works. ▪ Negative, moderate to significant and temporary at NSLs at distances between 30m to 45m from the proposed works. ▪ Negative, slight to moderate and temporary at NSLs at distances between 45m and 70m from the proposed works. ▪ Negative, not significant and Temporary at NSLs at distances greater than 70m from the proposed works. All impacts noted above are in the absence of noise mitigation.

Assessment Topic	Period over which criterion Applies	Potential Impacts
		Refer to Section 9.5 for the range of noise mitigation measures which will be adopted at specific working areas to reduce noise impacts at NSLs
Road Widening	Monday to Friday: Daytime (07:00 – 19:00hrs)	▪ Negative, significant to very significant and temporary at NSLs within 15m distance from the proposed works. ▪ Negative, moderate to significant and temporary at NSLs at distances between 15m to 25m from the proposed works. ▪ Negative, slight to moderate and temporary at NSLs at distances between 25m and 75m from the proposed works. ▪ Negative, not significant and temporary at NSLs at distances greater than 75m from the proposed works. All impacts noted above are in the absence of noise mitigation. Refer to Section 9.5 for the range of noise mitigation measures which will be adopted at specific working areas to reduce noise impacts at NSLs. Particular emphasis is given to localised screening around high noise level plant items.
	Saturdays (08:00 to 14:00hrs)	▪ Negative, profound and temporary at NSLs within 15m distance from the proposed works. ▪ Negative, significant to very significant and temporary at NSLs between 15 and 40m distance from the proposed works. ▪ Moderate to significant and temporary at NSLs at distances between 40m and 75m from the proposed works. ▪ Slight to Moderate and temporary at NSLs at distances between 75m and 120m from the proposed works. ▪ Not significant at NSLs at distances greater than 120m from the proposed works. All impacts noted above are in the absence of noise mitigation.
Boundary Walls Structures	Monday to Friday: Daytime (07:00 – 19:00hrs)	▪ Negative, moderate to significant and temporary at NSLs within 20m distance from the proposed works. ▪ Negative, slight to moderate and temporary at NSLs at distances between 20m to 60m from the proposed works. ▪ Negative, not significant and temporary at NSLs at distances

Assessment Topic	Period over which criterion Applies	Potential Impacts
		greater than 60m from the proposed works. All impacts noted above are in the absence of noise mitigation. Refer to Section 9.5 for the range of noise mitigation measures which will be adopted at specific working areas to reduce noise impacts at NSLs. Particular emphasis is given to localised screening around high noise level plant items.
	Saturdays (08:00 to 14:00hrs)	▪ Negative, significant to very significant and temporary at NSLs within 30m from the proposed works. ▪ Negative, moderate to significant and temporary at NSLs at distances between 30m to 60m from the proposed works. ▪ Negative, slight to moderate and temporary at NSLs at distances between 60m and 80m from the proposed works. ▪ Negative, not significant and Temporary at NSLs at distances greater than 80m from the proposed works. All impacts noted above are in the absence of noise mitigation.
Construction Vibration from general road works and construction activities	All construction work periods	▪ Negative, imperceptible to not significant and temporary
Construction Vibration from groundbreaking activities within 10m of residential buildings	Ground breaking during utility and road widening works	▪ Negative, slight to moderate and temporary
Construction Traffic	Peak construction traffic periods	Positive, imperceptible, and temporary impact to negative moderate to significant and temporary

9.4.4 Operational Phase Noise

9.4.4.1 Calculation of Road Traffic Noise Levels

The key principle of the operational noise impact assessment associated with the Proposed Development is to determine and categorise potential changes in road traffic noise between the Do Minimum and Do Something Scenarios.

Traffic flows have been modelled over an extensive study area across Galway City as part of the traffic assessment for the Proposed Development. The output of the traffic modelling has been used to undertake a detailed analysis of traffic noise levels changes. The noise impact assessment has focused on all modelled roads along the Proposed Development and roads affected by diverted traffic flows.

There are two key assessment zones within the study area, the Proposed Development and the surrounding road network extending out from the Proposed Development. In both instances, changes in traffic volumes and changes in fleet composition (i.e. car, bus, LGV, HGV etc) is a key consideration when determining the change to the traffic noise environment.

9.4.4.1.1 Traffic Flow Data

Detailed traffic data have been provided for each modelled road within the study area for the Proposed Development. For each road, traffic flows are provided in terms of Annual Average Daily Traffic (AADT) with a percentage breakdown of cars, buses, LGVs and HGVs for each road.

Traffic flow data was provided for the year of opening, 2028 and the design year of 2043.

9.4.4.1.2 Potential Noise Impacts Along the Proposed Development

Along the Proposed Development the key changes affecting the noise environment relate to:

- Increased bus usage and an associated reduction in private traffic;
- Alterations to the cross section of the road to include footpaths, cycle and bus lanes where none presently exist; and
- Addition or relocation of bus stops.

9.4.4.1.3 Potential Noise Impacts Along the Proposed Development

Along the surrounding road network, potential changes to traffic noise associated with traffic redistribution onto local roads due to the introduction of bus priority measures and new restricted turning movements. Redistributed traffic onto the surrounding road network is determined from traffic modelling to occur during daytime periods only.

9.4.4.1.4 Traffic Noise Levels

Traffic noise levels associated with the Operational Phase are calculated in line with the methodology described in 9.4.3.4.

The approach adopted for both study areas involve calculation of noise emission levels associated with the key fleet composition types along the road i.e., buses, cars, LGVs and HGVs. The calculated noise levels relate to the Lden parameter. This calculation approach is as described in Section 9.4.3.4.

The L_{AX} values relate to fleet with internal combustion engines (ICEs). The source noise levels therefore take account of the combustion noise associated with the vehicle engine noise and rolling noise from the tyre and road interface, both of which make up the total noise associated with road traffic vehicles. At speeds of up to approximately 30 km/hr, noise from light ICE vehicles is dominated by engine noise. The contribution from engine noise for light ICE vehicles reduces above this speed and rolling noise becomes the dominant contributor to overall noise levels. For heavy vehicles including buses, the contribution of the engine noise remains a significant contributor to overall noise levels at speeds typically encountered in an urban environment (between 30 to 60 km/hr).

For the operational years of the Proposed Development, it is understood that the number of ICEs in the vehicle fleet (both light vehicles and heavier vehicles such as buses) will reduce, and therefore the calculated noise levels included within this study are worst case and reflect a full fleet of ICE vehicles. Refer to Chapter 8 (Climate) of this EIAR for further details of the future project's vehicle types. Due to the absence of reliable published sound emission data relating to EVs and HEVs, the approach for this EIAR is to assume a full fleet of ICE. Given the same fleet type is assumed for both the Do Minimum and Do Something scenarios, the relative change in noise levels between these scenarios will remain unchanged irrespective of the fleet type used. Further comment on specific noise levels is discussed in Section 9.4.4.2.3.

9.4.4.1.5 Proposed Development

Using the calculation approach discussed above, the L_{den} traffic noise level was calculated along each road modelled as part of the traffic impact assessment refer to Chapter 6 (Traffic and Transport) of this EIAR within the Proposed Development boundary for the Do Minimum and Do Something scenarios. All calculations are made at a reference distance of 5m from the road edge. Where relevant, the calculations have taken account of changes to the alignment of bus lanes and general traffic lanes during the Do Something scenario, specifically where these were identified to be located closer to NSLs compared to the existing cross section (i.e. the Do Minimum scenario). In these identified scenarios, the reference distance of the traffic source is accounted for in the calculations. The calculations also account for potential speed increase of buses using the dedicated bus lanes, consistent with the traffic model.

9.4.4.1.6 Surrounding Road Network

For each modelled road within the surrounding road network outside of the Proposed Development, the associated L_{den} traffic noise level was calculated for the Do Minimum and Do Something scenarios. For all roads, calculations are made at a reference distance of 5m from the road edge. No changes to the alignment cross section occurs outside of the Proposed Development boundary.

9.4.4.2 Traffic Noise Impacts

9.4.4.2.1 Opening Year 2028

For the purposes of assessing and describing potential noise impacts, opening year traffic is assumed to be representative from the year of opening to the design year (i.e. for a 15-year period). The 'short-term' magnitude of change ratings from the DMRB (UKHA 2020) (Table 9-11) are therefore used to assess potential noise impacts associated with the opening year (2028) up to the design year (2043). In this instance, these impacts are described as short to medium term in duration in accordance the EPA Guidelines (EPA 2022).

The assessment of potential traffic noise impacts has been undertaken using the following approach:

- Traffic noise levels have been calculated along each road within the study area of the Proposed Development;
- Noise levels have been calculated for the Do Minimum (DM) scenario for the opening year, 2028;
- Noise levels have been calculated for the Do Something (DS) scenario for the opening year, 2028; and
- The change in traffic noise levels between the DM and DS scenarios for the year 2028 has been calculated and the associated magnitude of change and noise level range have been determined.

There are no significant noise impacts calculated along the Proposed Development due to an overall reduction in traffic volumes from the incorporation of bus priority signals and junctions, restricted turning movements for private vehicles and the incorporation of dedicated bus lanes, cycle lanes and footpaths.

Along the Proposed Development, lowest impacts are categorised as direct, positive, imperceptible to slight and short to medium term. Highest impacts are categorised as direct, negative, not significant to slight and short to medium term. (Reference to Table 9-13).

Along the roads off the Proposed Development, there are a small number of roads in the overall study area that have triggered the criteria for potential significant impacts. These are defined as roads with a traffic noise level above a daytime noise level of 54 dB L_{den} and an increase in noise level greater than 1 dB. The specific operational noise impacts for these roads are summarised in Table 9-32.

Table 9-32 Summary of Potential Operational Phase Traffic Impacts – Year 2028

Road	Potential Increase above DM Scenario, dB	DMRB Short-term Magnitude of Impact	Potential DS Road Traffic Noise at Closest NSL	Noise Level Rating	Overall Significance Rating	Potential Impact
Walter Macken Road	+1.8	Minor	58	Medium	Slight	Negative, Slight, Short to Medium Term
Renmore Road	+1.4	Minor	59 - 60	Medium	Slight	Negative, Slight, Short to Medium Term
Rosshill Road	+1.2	Minor	59	Medium	Slight	Negative, Slight, Short to Medium Term

Along the three roads presented above, the change in traffic noise is defined as minor and the traffic noise level calculated at the closest NSLs categorised as medium. The overall impact is determined to be indirect, negative, slight, and short to medium term.

Along all other roads outside of the Proposed Development boundary, impacts are determined to be indirect, positive, imperceptible to slight, and short to medium term to negative, slight, and short to medium term once the Proposed Development becomes operational.

The specific operational noise impacts during the daytime period for these roads are summarised in Figure 9.3 in Volume 3 Figures of this EIAR.

9.4.4.2.2 Design Year (2043)

For the Design Year (2043), the assessment of potential traffic noise impacts has been undertaken using the following approach:

- Traffic noise levels have been calculated along each road across the study area;
- Noise levels have been calculated for the Do Minimum scenario for the Opening Year (2043);
- Noise levels have been calculated for the Do Something scenario for the Design Year (2043); and
- The change in traffic noise level between the Do Minimum and the Do Something scenarios for the Design Year (2043) has been assessed to determine any increase in traffic noise as a result of the Proposed Development.

There are no roads in the overall study area where there are potential significant impacts, i.e. there are no roads with a traffic noise level increase above 3 dB during the design year.

Highest impacts are calculated outside of the Proposed Development boundary along Lakeshore Drive, Lough Atalia Avenue, Woodlands Avenue and Renmore Park where a minor change in noise level is calculated (3 dB increase) and the traffic noise level at the closest NSLs is categorised as medium (58 to 59 dB L_{den}) resulting in an indirect, negative, slight and long-term impact.

Along all other roads outside of the Proposed Development boundary, lowest impacts are categorised as indirect, positive, imperceptible to slight and long-term. Highest impacts are categorised as indirect, negative, not significant to slight, and long-term due to the low volume of additional traffic added once the Proposed Development becomes operational.

Along the Proposed Development, the lowest impacts are calculated as direct, positive, imperceptible to slight and long-term. The highest impacts are calculated as direct, negative, not significant to slight, and long-term.

The overall operational noise impacts across the full study area for the design year, 2043, are presented in Figure 9.5 in Volume 3 of this EIAR.

9.4.4.2.3 Comment on Future EV Fleet

For the roads outside of the Proposed Development along the surrounding road network, the majority of the fleet type is comprised of cars and light goods vehicles. Given the same power type (ICE) has been assumed for both the Do Minimum and Do Something scenarios, the relative change in traffic noise remains the same for these roads, irrespective of the vehicle power.

The range of traffic noise levels calculated along these roads have the potential to be lower during the future year scenarios as a result of the conversion from ICE to EVs and HEVs, particularly along residential roads with speeds at or lower than 30km/hr. In addition, an overall reduction in engine noise will occur at junctions and roundabouts. The calculated traffic noise level for these roads is therefore considered a robust analysis and to be worst-case.

Along the Proposed Development the fleet type is a mixture of buses, cars, LGVs with a portion of HGVs. The change in noise levels is determined to be imperceptible to slight negative along the Proposed Development for both the Opening Year (2028) and the Design Year (2043) due to reduced overall traffic volumes. Given the same fleet type (ICE) has been assumed for both the Do Minimum and Do Something scenarios, the relative change in traffic noise remains the same for these roads irrespective of the vehicle power type.

Notwithstanding, it is likely that a further reduction in overall noise level will occur along the Proposed Development due to the transition towards a full EV and HEV bus fleet. This reduction will occur irrespective of the Proposed Development. An overall reduction in engine noise from buses will occur at junctions, roundabouts, and bus stops. The calculated traffic noise level assuming ICEs for all fleet is therefore considered a robust analysis and to be worst-case.

9.4.4.3 Operational Phase Vibration

Once operational, buses will use the dedicated bus lanes for the Proposed Development. Analysis of traffic data for the Proposed Development, however, indicates a reduction in overall AADT traffic flows along the Proposed Development.

Vibration monitoring results for other bus connects projects undertaken along the road edge, confirm that vibration levels associated with passing buses and other vehicular traffic at distances of 2.5m to 10m from the road edge are negligible in terms of human perception and building response. Vibration levels associated with a passing bus were recorded at 0.1mm/s PPV or less under the monitored scenarios. These values are below the normal range of perceptible human response to vibration and would not pose any significant impact. (Refer to Appendix 9.1 for vibration source data).

A review of the traffic data for the Proposed Development indicates that the maximum number of buses travelling in-bound or outbound is 322 over the 16-hour daytime period. Using this number and the highest VDV event measured during a bus pass at a reference distance of 5m from the road edge (0.0033 $m/s^{1.75}$), the daytime $VDV_{,b,day}$ value is calculated as $0.014 m/s^{1.75}$. Reference to Table 9-14 confirms this value is orders of magnitude below those associated with a low probability of adverse comment. The overall impact is Neutral, Imperceptible and Long Term.

9.4.4.4 Bus Stops

Noise sources associated with bus stops relate to idling engines, acceleration and deceleration from the stop and air brakes. At close distances to a stop, these activities are perceptible over normal passing road

traffic. However, the level of perceptibility is masked to a greater extent along heavily trafficked routes with higher road traffic noise levels.

The majority of bus stops will be retained in their current position as part of the Proposed Development or will be reconfigured and upgraded as part of the overall Proposed Development works with no change in noise environment as a result.

Five new bus stop locations are proposed along the Proposed Development. The location of these stops are adjacent to commercial/ office or green areas set back from NSLs and have lower noise sensitive ratings. The location of the new bus stops are all along the Proposed Development where the prevailing noise environment is dominated by road traffic from cars, buses and light and heavy good vehicles. The prevailing environment is mapped in the range of 70 to 75 dB L_{den} at the bus stop locations and hence the inclusion of a bus stop into the existing noise environment will be masked by the prevailing traffic noise.

As discussed in Section 9.4.4.2.3, it is likely that a further reduction in overall noise level will occur along the Proposed Development due to the transition towards a full EV and HEV bus fleet. The operation of electric and hybrid buses eliminates ICE noise from buses accelerating, decelerating, and idling at bus stops which is one of the dominant noise sources. In addition, the characteristic of noise from electric vehicles is subjectively less intrusive compared to those with ICE's and is masked to a much greater extent by surrounding road traffic.

The overall impact is determined to be long-term and not significant.

9.4.4.5 Road Maintenance

The Proposed Development is expected to have an operational life span of 60 years. Once operational, the Proposed Development will be subject to the same maintenance programme as the existing road infrastructure. This will involve upgrade and / or replacement of road surfaces over the life span of the project. These activities will occur along sections of the Proposed Development as required. Noise impacts associated with these activities will be of similar magnitude to those described in Section 9.4.3.2.

9.4.4.6 Summary of Potential Impacts

The Operational Phase noise impacts associated with the Proposed Development are summarised in Table 9-33.

Table 9-33 Summary of Potential Operational Phase Impacts

Assessment Topic	Potential Impact
Opening Year (2028) traffic noise – Proposed Development	Direct, positive, imperceptible to slight, short to medium term impact, to negative, not significant to slight, and short to medium term impact
Opening Year (2028) traffic noise – Surrounding road network	Indirect, positive, imperceptible to slight, short to medium term impact, to negative, slight, and short to medium term impact
Design Year (2043) traffic noise – Proposed Development	Direct, positive, imperceptible to slight, long-term impact, to negative, not significant to slight, and long-term impact
Design Year (2043) traffic noise – Surrounding road network	Indirect, positive, imperceptible to slight, long-term impact to negative, slight and long-term impact
Operational Phase Vibration	Neutral, imperceptible, long-term
New Bus stops	Negative, not significant, long-term

9.5 Mitigation and Monitoring Measures

9.5.1 Construction Phase

9.5.1.1 Noise

The appointed contractor will be required to take specific noise abatement measures to the extent required and comply with the recommendations of BS 5228–1:2009 +A1 2014 Code of Practice for noise and vibration control of construction and open sites - Part 1: Noise and S.I. No. 241/2006 - European Communities (Noise Emissions by Equipment for Use Outdoors) (Amendment) Regulations 2006. The mitigation measures outlined below for the Construction Phase have also been included in the Construction and Environmental Management Plan (CEMP) in Appendix A5.1 in Volume 4 of this EIAR.

These measures will ensure that:

- During the Construction Phase, the appointed contractor will be required to manage the works to comply with the limits detailed in Section 9.2.4.1.1 using methods outlined in BS 5228–1:2009 +A1 2014 Code of Practice for noise and vibration control of construction and open sites - Part 1: Noise; and
- The best means practicable, including proper maintenance of plant and equipment, will be employed to minimise the noise produced by on-site operations.

BS 5228–1 includes guidance on several aspects of construction site practices, which include, but are not limited to:

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

The appointed contractor will put in place the most appropriate noise control measures depending on the level of noise reduction required at individual working areas (i.e. based on the construction threshold values for noise and vibration set out in Table 9-6 and Table 9-9) . Reference to Table 9-31 indicates that intrusive works occurring within 50m of NSLs will need specific noise control measures to reduce impacts depending on the time period over which they will occur.

9.5.1.1.1 Selection of Quiet Plant

The potential for any item of plant to result in exceedance of construction noise thresholds will be assessed prior to the item being brought onto the site. The least noisy item of plant will be selected wherever practicable (e.g. plant items with sound attenuation incorporated). Should a particular item of plant already on the site be found to exceed the construction noise thresholds, the first action will be to identify whether the item can be replaced with a quieter alternative.

The appointed contractor will evaluate the choice of excavation, breaking or other working method considering various ground conditions and site constraints. Where alternative lower noise generating equipment are available that will provide equivalent structural / excavation / breaking results, these will be selected to control noise within the relevant thresholds, where it is practicable to do so.

The decision regarding the type of excavation technique or other construction activity to be used on a site will normally be governed by a range of engineering and environmental constraints. In these instances, it may not be possible for technical reasons to replace an item of plant with a quieter alternative. In some instances, the adoption of a quieter method may prolong the overall process, with the net result being that the overall disturbance to the community will not necessarily be reduced.

9.5.1.1.2 Noise Control at Source

The following measures will be implemented, if required, by the appointed contractor to control noise at source in order to remain below the threshold values for noise set out in Table 9-6, which relate to specific site considerations:

- For mobile plant items such as dump trucks, planers, excavators and loaders, the installation of an acoustic exhaust, utilising an acoustic canopy to replace the normal engine cover and maintaining enclosure panels closed during operation can reduce noise levels by up to 10 dB;
- For percussive tools such as pneumatic concrete breakers and tools, a number of noise control measures include fitting a muffler or sound reducing equipment to the breaker 'tool' and ensuring any leaks in the air lines are sealed;
- A strict noise control policy relating to materials handling will be applied at the proposed Construction Compound. Noisy items of plant will be sited away from noise sensitive boundaries;
- Where compressors, generators and pumps are located in proximity to NSLs and have the potential to exceed the construction noise thresholds, these will be surrounded by acoustic lagging or enclosed within acoustic enclosures providing air ventilation; and
- Resonance effects in panel work or cover plates can be reduced through stiffening or the application of damping compounds, while other noise nuisance can be controlled by fixing resilient materials in between the surfaces in contact.

9.5.1.1.3 Screening

Screening is an effective method of reducing CNLs at a receiver location and can be used successfully as an additional measure to other forms of noise control. The effectiveness of a noise screen will depend on the height and length of the screen, its mass, and its position relative to both the source and receiver. BS 5228–1 (BSI 2014a) states that on level sites the screen should be placed as close as possible to either the source or the receiver. The construction of the barrier will be such that there are no gaps or openings at joints in the screen material.

Erection of localised demountable enclosures or screens will be used around breakers or drill bits, as required, when in operation in proximity to NSL boundaries with the potential to exceed the construction noise thresholds. Annex B of BS 5228–1: 2009+A1:2014 (Figures B1, B2 and B3) provide typical details for temporary and mobile acoustic screens, sheds and enclosures that can be constructed on-site from standard materials. A well placed and designed mobile temporary screen around a breaker or excavation can effectively reduce noise emissions by 10 dB(A).

The appointed contractor will provide a site hoarding of 2.4m height along noise sensitive boundaries, at a minimum, at the Construction Compound. The length of the screen should in practice be at least five times the height. However, if shorter sections are necessary, then the ends of the screen will be wrapped around the source.

In most practical situations the effectiveness of the screen is limited by the sound transmission over the top of the barrier rather than the transmission through the barrier itself. In practice, screens constructed of materials with a mass per unit of surface area greater than 10kg/m2 (kilogrammes per metre squared) will give adequate sound insulation performance. The use of a standard 2.4m high construction site hoarding will provide a sufficient level of noise screening once it is installed at a suitable position between the source and receiver.

In addition, careful planning of the construction site layout will also be considered. Within the Construction Compound, the placement of site buildings such as offices and stores between the site and sensitive locations can provide a good level of noise screening. The location of sensitive locations where localised screening is required are those with significant effects in Section 9.4.3.2.

9.5.1.1.4 Hours of Work

It is envisaged that generally construction working hours will be between 07:00hrs and 19:00hrs on weekdays and between 08:00hrs and 14:00hrs on Saturdays. Night-time and Sunday working may be required during certain periods to facilitate street works that cannot be undertaken under daytime / evening time conditions. The planning of such works will take consideration of sensitive receptors, in particular any nearby residential areas into account.

Construction activities / plant items will be considered with respect to their potential to exceed construction noise thresholds at NSLs and will be scheduled according to their noise level, proximity to sensitive locations and possible options for noise control. In situations where an activity with potential for exceedance of construction noise thresholds is scheduled (e.g. road widening and utility diversions or activities with similar noise levels identified in Table 9-31), other construction activities will be scheduled at different times to not result in significant cumulative noise levels.

9.5.1.1.5 Liaison with the Public

For the Proposed Development, the major sources of noise are essentially mobile, and the noise received at any NSL will therefore vary from day to day as the work proceeds. The duration of excavation, breaking and other high noise or vibration activities is usually short in relation to the length of construction work as a whole, and the amount of time spent working near to sensitive areas can represent only a part of the overall period.

Galway City Council (GCC) will establish clear forms of communication that will involve the appointed contractor and NSLs in proximity to the works, so that residents or building occupants are aware of the likely duration of activities likely and timing to generate noise or vibration that are potentially significant, as set out in Table 9-6 and Table 9-9.

9.5.1.1.6 Monitoring

During the Construction Phase the appointed contractor will carry out noise monitoring at representative NSLs to evaluate and inform the requirement and / or implementation of noise management measures. Noise monitoring will be conducted in accordance with ISO 1996–1 (ISO 2016) and ISO 1996–2 (ISO 2017). The selection of monitoring locations will be based on the nearest representative NSLs to the working area which will progress along the length of the Proposed Development.

9.5.1.2 Vibration

On review of the likely vibration levels associated with construction activities, construction activities along the Proposed Development are not expected to give rise to vibration that is either significantly intrusive or capable of giving rise to structural or cosmetic damage to the range of buildings in the study area.

Vibration from construction activities will be limited to the values set out in Table 9-9 to avoid any form of potential cosmetic damage to buildings and structures. Monitoring will be undertaken at identified sensitive buildings, in the event that proposed works have the potential to be at or exceed the vibration limit values in Table 9-9. Given the proposed works associated with the Proposed Development, this is not envisioned to be required.

In the case of potentially vulnerable buildings, precondition surveys shall be carried out before any works commence.

In the case of vibration levels giving rise to human discomfort, in order to minimise such impacts, the following measures shall be implemented during the Construction Phase:

- A clear communication programme will be established by GCC to inform adjacent building occupants in advance of any potentially intrusive works which may give rise to vibration levels likely to result in

significant effects as per Table 9-10. In so far as possible the timing of such work will be scheduled to cause minimal disruption;

- Activities capable of generating significant vibration effects with respect to human response (as per Table 9-10) will be restricted to daytime hours only, as far as practicable; and
- Appropriate vibration isolation shall be applied to plant (such as resilient mounts to pumps and generators), where required and where feasible.

9.5.1.3 Summary of Impacts

A reduction of 10 dB has been applied to construction noise calculations to account for the level of noise reduction available by applying the various noise mitigation measures outlined above.

Table 9-34 presents the predicted Construction Phase impacts following the implementation of mitigation and monitoring measures and assumes that the construction activities are occurring for periods equal to or greater than 10 or more days in any 15 consecutive days, or for a total number of days exceeding 40 in any six consecutive months at impacted NSLs.

The results are summarised based on the distance of a NSL to a working area. The closest identified NSL to the edge of the works, unscreened by intervening buildings are identified in the relevant impact tables in Section 9.4.3.2.

Table 9-34 Summary of Potential Construction Phase Noise Impacts

Assessment Topic	Period over which criterion Applies	Potential Impacts (Pre-Mitigation and Monitoring)	Potential Impacts (Post Mitigation and Monitoring)
General Road Works Construction Compound	Monday to Friday: Daytime (07:00 – 19:00hrs)	▪ Negative, moderate to significant and temporary at NSLs within 15m distance from the proposed works. ▪ Negative, slight to moderate and temporary at NSLs at distances between 15m to 45m from the proposed works. ▪ Negative, not significant and temporary at NSLs at distances greater than 45m from the proposed works.	▪ Negative, slight to moderate and temporary at NSLs at distances up to 15m of proposed works. ▪ Negative, not significant and temporary at NSLs at distances of 15m and greater than from the proposed works.
	Saturdays (08:00 to 14:00hrs)	▪ Negative, significant to very significant and temporary at NSLs within 30m from the proposed works. ▪ Negative, moderate to significant and temporary at NSLs at distances between 30m to 45m from the proposed works. ▪ Negative, slight to moderate and temporary at NSLs at distances between 45m and 70m from the proposed works. ▪ Negative, not significant and Temporary at NSLs at distances greater than 70m from the proposed works.	▪ Negative, moderate to significant and temporary at NSLs at distances of up to 15m of proposed works. ▪ Negative, slight to moderate and temporary at NSLs at distances between 15m and 25m of proposed works. ▪ Negative, not significant and temporary at NSLs at distances greater

Assessment Topic	Period over which criterion Applies	Potential Impacts (Pre-Mitigation and Monitoring)	Potential Impacts (Post Mitigation and Monitoring)
			than 25m from the proposed works.
Road Widening	Monday to Friday: Daytime (07:00 – 19:00hrs)	▪ Negative, significant to very significant and temporary at NSLs within 15m from the proposed works. ▪ Negative, moderate to significant and temporary at NSLs at distances between 15m to 25m from the proposed works. ▪ Negative, slight to moderate and temporary at NSLs at distances between 25m and 75m from the proposed works. ▪ Negative, not significant and temporary at NSLs at distances at or greater than 75m from the proposed works.	▪ Negative, slight to moderate and temporary at NSLs within 25m of proposed works. ▪ Negative, not significant and temporary at NSLs at distances at or greater than 25m of proposed works.
	Saturdays (08:00 to 14:00hrs)	▪ Negative, profound and temporary at NSLs within 15m distance from the proposed works. ▪ Negative, significant to very significant and temporary at NSLs between 15 and 40m distance from the proposed works. ▪ Negative, moderate to significant and temporary at NSLs at distances between 40m and 75m from the proposed works. ▪ Negative, slight to Moderate and temporary at NSLs at distances between 75m and 120m from the proposed works. ▪ Negative, not significant and temporary at NSLs at distances greater than 120m from the proposed works.	▪ Negative, significant to very significant and temporary at NSLs within 15m of proposed works. ▪ Negative, moderate to significant and temporary at NSLs at distances between 15m and 25m of proposed works. ▪ Negative, slight to moderate and temporary at NSLs between 25 and 40m from the proposed works. ▪ Negative, not significant and temporary at NSLs at distances of 40m and greater from the proposed works.
Boundary Walls Structures	Monday to Friday: Daytime (07:00 – 19:00hrs)	▪ Negative, moderate to significant and temporary at NSLs within 20m distance from the proposed works. ▪ Negative, slight to moderate and temporary at NSLs at distances between 20m to 60m from the proposed works.	▪ Negative, slight to moderate and temporary at NSLs at distances within 20m of proposed works. ▪ Negative, not significant and temporary at NSLs at distances of 20m

Assessment Topic	Period over which criterion Applies	Potential Impacts (Pre-Mitigation and Monitoring)	Potential Impacts (Post Mitigation and Monitoring)
		▪ Negative, not significant and temporary at NSLs at distances greater than 60m from the proposed works.	and greater from the proposed works
	Saturdays (08:00 to 14:00hrs)	▪ Negative, significant to very significant and temporary at NSLs within 30m from the proposed works. ▪ Negative, moderate to significant and temporary at NSLs at distances between 30m to 60m from the proposed works. ▪ Negative, slight to moderate and temporary at NSLs at distances between 60m and 80m from the proposed works. ▪ Negative, not significant and temporary at NSLs at distances greater than 80m from the proposed works.	▪ Negative, moderate to significant and temporary at NSLs at distances within 20m of proposed works. ▪ Negative, slight to moderate and temporary at NSLs between 20m and 30m from proposed works. ▪ Negative, not significant and temporary at NSLs at distances of 30m and greater from the proposed works
Construction Vibration from general road works and construction activities	All construction work periods	▪ Negative, imperceptible to not significant and temporary	▪ Negative, imperceptible to not significant and temporary
Construction Vibration from ground breaking activities within 10m of residential buildings	Ground breaking during utility and road widening works	▪ Negative, slight to moderate and temporary	▪ Negative, slight and temporary
Construction Traffic	Peak construction traffic periods	▪ Positive, imperceptible, and temporary impact to negative, not significant to moderate to significant and temporary	▪ Positive, imperceptible, and temporary impact to negative, not significant to moderate to significant and temporary

9.5.2 Operational Phase

9.5.2.1 Change in Road Traffic Noise

The impact assessment has determined that traffic noise impacts across the study area for the Proposed Development results in a positive to neutral imperceptible short and long-term direct impacts along the Proposed Development and negative imperceptible to slight short- and long-term indirect impacts along the surrounding road network. The range of noise level changes and overall noise levels calculated do not require any specific noise mitigation measures to be incorporated into the Proposed Development.

9.5.2.2 Bus Stops

The impact assessment has determined that noise impacts associated with the provision of relocated or new bus stop locations will be negative, not significant and long-term taking account of their location away from noise sensitive buildings and the expected transition to electric and hybrid bus fleet. No noise mitigation measures are proposed.

9.5.2.3 Road Maintenance

Impacts associated with this activity will be controlled in line with best practice measures in line with regular road maintenance works across Galway City and County.

9.5.2.4 Impact Overview

The predicted Operational Phase impacts associated within the Proposed Development are summarised in Table 9-35.

Table 9-35 Summary of Predicted Operational Phase Impacts Following the Implementation of Mitigation and Monitoring Measures

Assessment Topic	Potential Impact (Pre-Mitigation and Monitoring)	Predicted Impact (Post Mitigation and Monitoring)
Opening year (2028) traffic noise – Proposed Development	Direct, positive, imperceptible to slight, short to medium term impact, to negative, not significant to slight, and short to medium term impact	Direct, Positive, Imperceptible to Slight, Short to Medium Term Impact, to Negative, Not Significant to Slight, Short to Medium Term
Opening year (2028) traffic noise – Surrounding road network	Indirect, positive, imperceptible to slight, short to medium term impact, to negative, slight, and short to medium term impact	Indirect, Positive, Imperceptible to Slight, Short to Medium Term Impact, to Negative, Slight, and Short to Medium Term Impact
Design year (2043) traffic noise – Proposed Development	Direct, positive, imperceptible to slight, long-term impact, to negative, not significant to slight, and long-term impact	Direct, Positive, Imperceptible to slight, Long-Term Impact to Negative, Not Significant to Slight, and Long-term
Design year (2043) traffic noise – Surrounding road network	Indirect, positive, imperceptible to slight, long-term impact to negative, slight and long-term impact	Indirect, Positive, Imperceptible to slight, Long-Term to Negative, Not Significant to Slight, long-term
Operational Vibration	Neutral, Imperceptible, Long-term	Neutral, Imperceptible, Long-term
Bus stops – new locations	Neutral, Imperceptible, Long-term	Neutral, Imperceptible, Long-term

9.6 Residual Impacts

9.6.1 Construction Phase

Given the linear nature of the works, noise emissions related to construction works will be of temporary impact at any one area as the works progress along the length of the Proposed Development. The application of the proposed noise thresholds and restricted hours of operation, along with the implementation of appropriate noise control measures, will ensure that noise impact is controlled within acceptable limit values.

During the Construction Phase of the Proposed Development, noise levels at properties closest to working areas will be temporarily increased. The most appropriate noise mitigation measures for each work area will be determined taking account of the various control measures included within 9.5.1 and the CEMP in

Appendix A5.1 in Volume 4 of the EIAR. The various mitigation measures will be selected in order to control CNLs to within the limit values included in Table 9-6 as far as practicable.

Once the various mitigation measures are put in place, noise impacts associated with the Construction Phase will be of Negative, Not Significant to Moderate, and Temporary impact during all key construction phases during daytime periods.

As per DMRB Noise and Vibration (UKHA 2020) in cases of moderate magnitude of impacts, the duration of works determines the overall significance rating. As part of the mitigation measures, the durations advised in the DMRB Noise and Vibration will be followed, where feasible, to reduce overall significant effects (i.e. scheduling works to occur for periods of less than 10 days / nights over 15 consecutive day / night periods and less than 40 days over six consecutive months where significant effects are identified). Once the CNL and duration of works is considered in line with the DMRB Noise and Vibration, all key Construction Phase residual noise levels will be Not Significant, whilst meeting the Proposed Development objectives set out in Chapter 1 (Introduction) of this EIAR.

The assessment has indicated that the use of standard construction activities can operate comfortably within the recommended vibration limits for standard residential and other light-framed buildings. With the adoption of best practice methodologies, vibration impacts at the most sensitive premises can be adequately mitigated to within acceptable levels relating to disturbance, whilst meeting the Proposed Development objectives set out in Chapter 1 (Introduction) of this EIAR.

9.6.2 Operational Phase

Once operational, there will be a direct positive and slight negative impact along the Proposed Development due to a reduction in traffic volumes during both the Opening Year (2028) and the Design Year (2043).

During the Opening Year (2028), an indirect, positive, imperceptible to slight, short to medium term impact to, negative, slight, short to medium term impact is determined along the surrounding road network outside of the Proposed Development.

During the Design Year (2043), an indirect, positive, imperceptible to slight, long-term impact to negative, slight, long-term impact is determined along the surrounding road network outside of the Proposed Development.

The Proposed Development aligns with the policy objectives of the Galway City NAP to reduce traffic noise exposure to populations across the city through the incorporation of improved public transport. The results of the noise assessment for the Operational Phase confirms that, with the introduction of the various measures included as part of the Proposed Development, a reduction in traffic noise can be achieved along the Proposed Development. The various design measures associated with the Proposed Development also align with the various intervention measures recommended within the WHO Environmental Noise Guidelines (WHO 2018) to reduce traffic noise exposure across populations. There are no direct or indirect noise impacts to the identified PIAs from the Draft Galway NAP as a result of the Proposed Development.

There are no significant residual Operational Phase noise or vibration impacts associated with the Proposed Development, whilst meeting the Proposed Development objectives set out in Chapter 1 (Introduction) of this EIAR.

9.7 References

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S.I. No. 663/2021 – European Communities (Environmental Noise) (Amendment) Regulations 2021

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