

5.10 Air - Noise and Vibration

5.10.1 Introduction

This Chapter of the EIAR has been prepared by AWN to assess the noise and vibration impact of the proposed development in the context of current relevant standards and guidance. This assessment has been prepared by Leo Williams BA BAI MAI AMIOA, Acoustic Consultant at AWN Consulting who has over 3 years' experience as an environmental consultant specialising in Acoustic Impact Assessment.

This Chapter includes a description of the receiving ambient noise climate in the vicinity of the subject site and an assessment of the potential noise and vibration impacts associated with the proposed development during both the short-term demolition and construction phase and the long term operational phase on its surrounding environment. The assessment of direct, indirect and cumulative noise and vibration impacts on the surrounding environment have been considered as part of the assessment.

Mitigation measures are included, where relevant, to ensure the proposed development is constructed and operated in an environmentally sustainable manner in order to ensure minimal impact on the receiving environment.

The assessment has been undertaken with reference to the most appropriate guidance documents relating to environmental noise and vibration which are set out within the relevant sections of this Chapter and included in the references section. In addition to specific noise guidance documents, the following guidelines were considered and consulted for the purposes of this Chapter:

- EPA Guidelines on the Information to be contained in Environmental Impact Statements, (EPA, 2002);
- EPA Advice Notes on Current Practice (in the preparation of Environmental Impact Statements), (EPA, 2003);
- EPA Guidelines on the Information to be contained in Environmental Impact Assessment Reports, (Draft August 2017), and;
- EPA Advice Notes for Preparing Environmental Impact Statements, (Draft, September 2015).

5.10.2 Methodology

This assessment has been undertaken using the following methodology:

- Detailed baseline noise monitoring has been undertaken in the vicinity of the nearest noise sensitive locations to determine the range of noise levels in the existing environment;
- A review of the most applicable standards and guidelines has been conducted in order to set a range of acceptable noise and vibration criteria for the construction and operational phases of the proposed development, this is summarised in the following sections, and;
- Where necessary, a schedule of mitigation measures has been proposed to control the noise and vibration emissions associated with both the construction and operational phases of the proposed development.

5.10.2.1 Demolition and Construction Phase - Noise

5.10.2.1.1 Residential and Commercial Noise Sensitive Receivers

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 the absence of specific noise limits, appropriate criteria relating to permissible construction noise levels for a development of this scale may be found in the British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.

BS5228-1:2009+A1 gives several examples of acceptable limits for construction or demolition noise, the most simplistic being based upon the exceedance of fixed noise limits. 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”.

Note that a typical planning condition in relation to construction noise issued by Dublin City Council (DCC) refer also to compliance with BS 5228 Part 1 as a means of controlling impacts to the surrounding environment.

BS 5228, has therefore been used to inform the assessment approach for construction noise in line with DCC practice.

For residential properties it is considered appropriate to adopt the 70dB(A) criterion while for non-residential locations it is considered appropriate to adopt the higher category values of 75dB(A) during the day. The non-residential properties are only considered to be noise sensitive during office hours.

5.10.2.1.2 Clinical Receivers - Rotunda Hospital

There is specific guidance on appropriate noise levels within hospitals contained within the NHS document Health Technical Memorandum 08-01: Acoustics. The recommended internal noise levels due to external noise sources within various areas of a hospital are listed below:

Table 5.10.1: Internal Noise Criteria for Clinical Spaces

Room Type	Example	Criteria for noise intrusion from external sources (dB)
Ward – single person	Single-bed wards, recovery rooms, on-call rooms etc	40 $L_{Aeq,1hr}$ daytime 35 $L_{Aeq,1hr}$ night 45 $L_{Amax,f}$ night
Ward – multi-bed	Multi-bed wards and recovery areas	45 $L_{Aeq,1hr}$ daytime 35 $L_{Aeq,1hr}$ night 45 $L_{Amax,f}$ night
Operating Theatres	Operating Theatres	40 $L_{Aeq,1hr}$ 50 $L_{Amax,f}$

However, the values above are recommended to be applied to the noise intrusion from long terms sources of external noise. The issue of construction noise is discussed only briefly in HTM 08-01 where it is recommended that each project will have different requirements and that a strategy should be prepared to control noise and

vibration impacts in accordance with the guidance in BS5228. No criteria are presented for construction noise impacts on existing clinical areas however a relaxation on the HTM-08-01 criteria for long term noise sources is appropriate.

Based on the above discussion it is recommended that noise intrusion due to construction in the nearby hospital buildings is limited to 65dB $L_{Aeq,1hr}$, externally during the daytime period.

5.10.2.2 Demolition and Construction Phase - Vibration

Vibration standards come in two varieties: those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. For the purpose of this scheme, the range of relevant criteria used for surface construction works for both building protection and human comfort are expressed in terms of Peak Particle Velocity (PPV) in mm/s. There are no vibration sources associated with the development once the buildings become operational.

5.10.2.2.1 Building Damage

Guidance relevant to acceptable vibration in order to avoid damage to buildings is contained within BS 7385-2 (1993). The guidance values contained within BS 7385 are reproduced also in British Standard BS 5228-2 (2009).

These standards differentiate between transient and continuous vibration. Surface construction activities are considered to be transient in nature as they occur for a limited period of time at a given location. The standards note that the risk of cosmetic damage to residential buildings starts at a Peak Particle Velocity (PPV) of 15mm/s at 4Hz. The standard also notes that below 12.5 mm/s PPV the risk of damage tends to zero. Both standards note that important buildings that are difficult to repair might require special consideration on a case by case basis but building of historical importance should not (unless it is structurally unsound) be assumed to be more sensitive. If a building is in a very 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 most significant sources of transient vibration during the construction phase of the cultural quarter development are likely to be from the following activities:

- Piling of secant walls and foundations, and;

- Rock breaking during excavation works.

Table 5.10.2 summarises the proposed vibration criteria below which there is no risk of damage to buildings. These limits apply to vibration frequencies below 15Hz where the most conservative limits are required. If there are any protected buildings near the works there is a greater potential for these to be more vulnerable than other adjacent modern structures. Therefore, on a precautionary basis, the guidance values for structurally sound buildings are reduced by 50% in line with the guidance documents referred to above. More detail of protected structures is provided in Chapter 5.3: Cultural Heritage - Architectural Heritage.

Table 5.10.2: Transient Vibration Impact Criteria for Buildings (conservative criteria below which there is no risk of cosmetic damage).

Category of Building	Threshold of potential significant effect (Peak Particle Velocity - PPV - at building foundation) for Transient Vibration
Structurally sound and non-protected buildings	12 mm/s
Protected and / or potentially vulnerable buildings	6 mm/s

5.10.2.2.2 Human Perception

It is acknowledged that humans are sensitive to vibration stimuli and that perception of vibration at high magnitudes may lead to concern. Vibration typically becomes perceptible at around 0.15 to 0.3 mm/s and may become disturbing or annoying at higher magnitudes. However, higher levels of vibration are typically tolerated for single events or events of short term duration, particularly during construction projects and when the origin of vibration is known. For example, piling can typically be tolerated at vibration levels up to 6 mm/s respectively if adequate public relations are in place. These values refer to the day and evening time periods only.

During surface construction works (piling, rock breaking etc.) the vibration limits set within Table 5.10.2 will be perceptible to building occupants and have the potential to cause subjective impacts. The level of impact is, however, greatly reduced when the origin and time frame of the works are known and limit values relating to structural integrity are adequately communicated. In this regard, the use of clear communication and information circulars relating to planned works, their duration and vibration monitoring can

significantly reduce vibration impacts to the neighbouring properties.

5.10.2.2.3 Clinical Buildings

Due to the proximity of the development to existing hospital and clinical services it is also considered appropriate to make reference to the UK Department of Health document Health Technical Memorandum 08-01: Acoustics. This document recommends a conservative approach for assessing the vibration impact on clinical areas using the frequency weighted acceleration. The frequency weighting, W_g , as described in the British Standard (withdrawn) BS 6841 Measurement and evaluation of human exposure to whole-body mechanical vibration and repeated shock, 1987 should be used.

The maximum frequency weighted accelerations for both continuous and intermittent sources should not exceed the values in Table 5.10.3 in order to avoid adverse comment.

Table 5.10.3: Allowable Vibration During Construction Phase for Clinical Buildings

Location	Frequency Weighted Acceleration
Operating theatres, precision laboratories, audiometric testing booths	0.005 m/s ²
Wards	0.01 m/s ²
General Laboratories, treatment areas	0.02 m/s ²

5.10.2.3 Operational Phase - Noise

5.10.2.3.1 Mechanical Plant Noise

Due consideration must be given to the nature of the primary noise sources when setting criteria. Criteria for noise from these sources, with the exception of additional vehicular traffic on public roads, will be set in terms of the $L_{Aeq,T}$ parameter (the equivalent continuous sound level).

Typical Dublin City Council Condition

In relation to day to day operational noise DCC would typically apply the following condition to a development of this nature:

“Noise levels from the proposed development shall not be so loud, so continuous, so repeated, of such duration or

pitch or occurring at such times as to give reasonable cause for annoyance to a person in any premises in the neighbourhood or to a person lawfully using any public place. In particular, the rated noise levels from the proposed development shall not constitute reasonable grounds for complaint as provided for in B.S. 4142. Method for rating industrial noise affecting mixed residential and industrial areas.

Reason: In order to ensure a satisfactory standard of development, in the interests of residential amenity."

This wording is most relevant to the noise emissions from mechanical plant serving the development and careful consideration will be given to this issue as part of the detailed assessment.

Guidance from DCC on noise emissions from mechanical plant items typically makes reference to the British Standard BS 4142: 2014: Methods for Rating and Assessing Industrial and Commercial Sound. This document is the industry standard method for analysing building services plant noise emissions to residential receptors and is the document typically used by DCC in their standard planning conditions and also in complaint investigations.

BS 4142 describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

For an appropriate BS 4142 assessment it is necessary to compare the measured external background noise level (i.e. the $L_{A90,T}$ level measured in the absence of plant items) to the rating level ($L_{Ar,T}$) of the various plant items, when operational. Where noise emissions are found to be tonal, impulsive in nature or irregular enough to attract attention, BS 4142 also advises that a penalty be applied to the specific level to arrive at the rating level.

The subjective method for applying a penalty for tonal noise characteristics outlined in BS 4142 recommends the application of a 2dB penalty for a tone which is just perceptible at the noise receptor, 4dB where it is clearly perceptible, and 6dB where it is highly perceptible.

The following definitions as discussed in BS 4142 as summarised below:

- “ambient noise level, $L_{Aeq,T}$ ” is the noise level produced by all sources including the sources of concern, i.e. the residual noise level plus the specific noise of mechanical plant, in terms of the equivalent continuous A-weighted sound pressure level over the reference time interval [T].
- “residual noise level, $L_{Aeq,T}$ ” is the noise level produced by all sources excluding the sources of concern, i.e. the ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound, in terms of the equivalent continuous A-weighted sound pressure level over the reference time interval [T].
- “specific noise level, $L_{Aeq,T}$ ” is the sound level associated with the sources of concern, i.e. noise emissions solely from the mechanical plant, in terms of the equivalent continuous A-weighted sound pressure level over the reference time interval [T].
- “rating level, $L_{Ar,T}$ ” is the specific sound level plus any adjustments for the characteristic features of the sound (e.g. tonal, impulsive or irregular components);
- “background noise level, $L_{A90,T}$ ” is the sound pressure level of the residual noise that is exceeded for 90% of the time period T.

If the rated plant noise level is +10dB or more above the pre-existing background noise level then this indicates that complaints are likely to occur and that there will be a significant adverse impact. A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context.

The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the

rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact.

In this instance the existing prevailing background noise level measured during the noise survey ranges from 41 to 52dB LA90 during the most sensitive night-time period. Making the assumption that certain items of mechanical plant serving the development will operate 24/7 the mechanical plant noise emissions must be designed to achieve the BS4142 requirements during the night-time period.

Therefore, in order to limit the noise impact of mechanical plant serving the proposed development, during the detailed design of the development the specific plant noise levels will be designed to be equal or lower to the prevailing background noise level at the nearest off-site noise sensitive locations.

Due to the fact that there is the potential for short periods of noise to cause a greater disturbance at night-time, a shorter assessment time period (T) is adopted. Appropriate periods are 15min for daytime (07:00 to 23:00 hours) and 5 minutes for night-time (23:00 to 07:00 hours).

In summary, the following criteria apply at the façades of those residential properties closest to the proposed development:

- Daytime (07:00 to 23:00 hours) 40dB LAeq,15min
- Night-time (23:00 to 07:00 hours) 35dB LAeq,5min

5.10.2.3.2 Operational Phase - Traffic Noise

Typically, new developments attract visitors and require trips be made by staff once the development is operational. In the case of the proposed development, it is envisaged that the vast majority of trips will be made via public transport, by foot, or in private vehicles that travel only part of the way to the development. Table 5.10.4 offers guidance as to the likely impact associated with any particular change in traffic noise level (Source DMRB, 2011). It shows that small changes in noise levels are not normally noticeable, whereas an increase of 10dB would be described as a doubling of loudness. In summary the assessment looks at the impact with and without development at the nearest noise sensitive locations. The impact of this activity is discussed in the following sections.

Table 5.10.4: Significance in Change of Noise Level

Change in Sound Level (dB)	Subjective Reaction	Magnitude of Impact	EPA Glossary of Effects¹
0	None	No Change	Neutral
0.1 – 2.9	Imperceptible	Negligible	Imperceptible
3 – 4.9	Perceptible	Minor	Slight
5 – 9.9	Up to a doubling of loudness	Moderate	Moderate
10+	Over a doubling of loudness	Major	Significant

5.10.2.4 Operational Phase - Vibration

There are no sources of vibration expected during the operational phase of the proposed development and hence is not considered further with respect to the operational phase.

¹ EPA Guidelines on the Information to be contained in Environmental Impact Assessment Reports, (Draft August 2017)

² Environmental Protection Agency Act 1992 – Section 107

5.10.3 Receiving Environment (Baseline Situation)

The site under consideration is located off Parnell Square North, Dublin 1. The site is bounded to the south-east by Parnell Square, to the south-west by residential properties and hotel rooms on Granby Row, to the east by the Hugh Lane Gallery, and to the north by residential apartments on Bethesda Place.

5.10.3.1 Baseline Noise Survey

An environmental noise survey has been conducted at the site in order to quantify the existing noise environment. The survey was conducted in general accordance with ISO 1996: 2017: Acoustics – Description, measurement and assessment of environmental noise. Specific details are set out below.

Three measurement locations were selected as shown in Figure 5.10.1 and described below.

- Location A - was located on Granby Row to the west of the site in the vicinity of residential properties located in this area.
- Location B - was located at western end of Bethesda Place to the rear of the site. This location is next to the hotel and apartment complex in this area.
- Location C - was located on Frederick Lane to the east of the site in the vicinity of residential apartments.

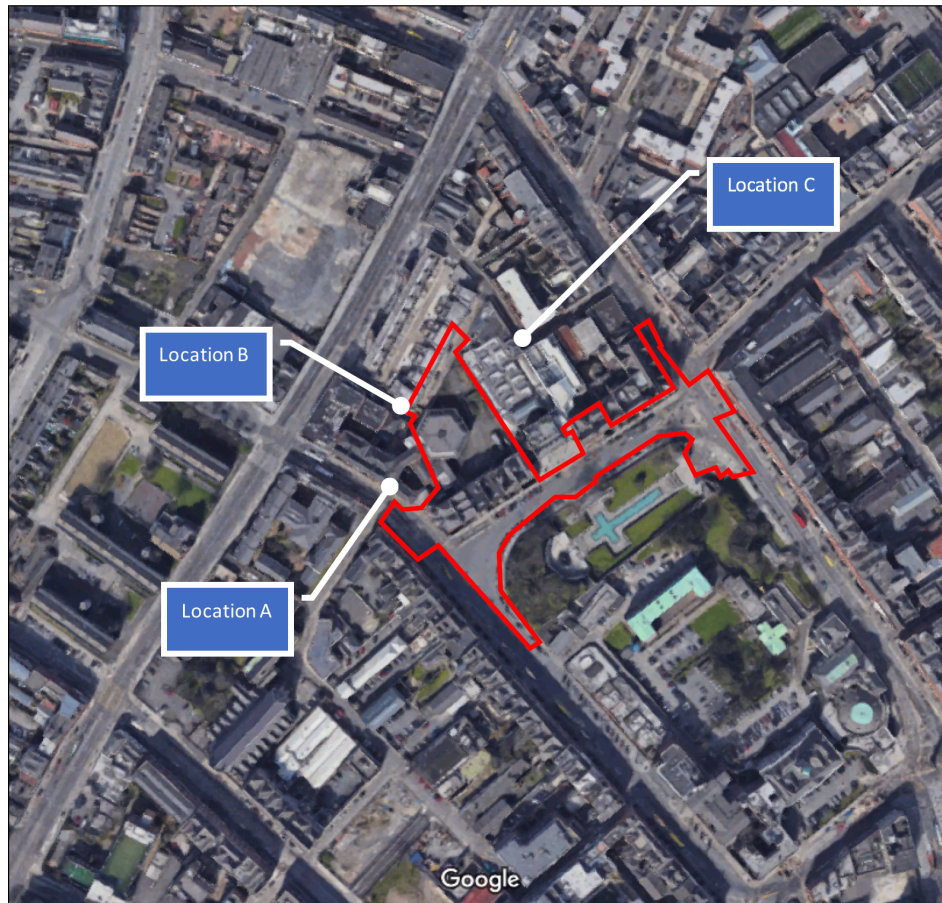


Figure 5.10.1: Site Context & Noise Monitoring Locations (Image Source: Google)

5.10.3.2 Survey Periods

The noise survey was conducted between the following periods:

- Daytime – 14:30hrs - 17:27hrs on 20 August 2015 and;
- Night-time – 23:04hrs on 20 August to 01:26hrs on 21 August 2015.

For the purpose of this assessment, daytime is taken to be between 07:00hrs and 23:00hrs, whilst night-time is between 23:00hrs and 07:00hrs. The daytime period is intended to account for normal daily activity at the site location as well the impact of increased traffic volumes at the end of the working day. The weather during the daytime survey period was dry and with wind speeds of less than 5m/s. Temperatures were in the range of 12 to 20°C. The weather during the night-time survey period was dry and calm with wind speeds less than 4m/s. Temperatures were of the order of 15°C (weather information from Met Éireann recording stations nearby).

5.10.3.3 Personnel and Instrumentation

Stephen Smyth and Leo Williams (AWN) performed the measurements during the survey periods. Measurements were made using an Brüel & Kjaer Type 2250 Sound Level Meter. Sample periods were 15-minutes for attended noise measurements.

Before and after the survey the measurement instruments were check calibrated using a Brüel & Kjær Type 4231 Sound Level Calibrator.

5.10.3.4 Measurement Parameters

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

- L_{Aeq}** 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.
- L_{A10}** is the sound level that is exceeded for 10% of the sample period. It is typically used as a descriptor for traffic noise.
- L_{A90}** is the sound level that is exceeded for 90% of the sample period. It is typically used as a descriptor for background noise.
- L_{AFmax}** is the instantaneous maximum sound level measured during the sample period using the 'F' time weighting.
- L_{AFmin}** is the instantaneous minimum sound level measured during the sample period using the 'F' time weighting.

The "A" suffix denotes the fact that the sound levels have been "A-weighted" in order to account for the non-linear nature of human hearing. All sound levels in this report are expressed in terms of decibels (dB) relative to 2×10^{-5} Pa.

5.10.3.5 Survey Results and Discussion

The results of the surveys at the three monitoring locations are summarised below.

5.10.3.5.1 Location A

Table 5.10.5: Summary of Results for Location A

Time		Measured Noise Levels (dB re. 2×10^{-5} Pa)				
		L _{Aeq}	L _{Amax}	L _{Amin}	L _{A10}	L _{A90}
Day	14:30 – 14:45	68	82	52	72	56
	15:35 – 15:50	69	92	52	73	58
	16:37 – 16:52	68	81	52	73	58
Night	23:04 – 23:19	67	83	42	72	52

	00:12 – 00:27	67	82	42	71	46
	00:51 – 01:06	68	84	43	72	41

During daytime monitoring periods the dominant source of noise at this location was road traffic on Granby Row. Pedestrian activity was also noted. Daytime ambient noise levels were in the range from 68 to 69dB $L_{Aeq,15min}$ and background noise levels in the range of 56 to 58dB $L_{A90,15min}$.

Road traffic was also the dominant noise source during the night-time survey period. Night time ambient noise levels were in the range of 67 to 68dB $L_{Aeq,15min}$ and background noise levels in the range of 41 to 52dB $L_{A90,15min}$.

5.10.3.5.2 Location B

Table 5.10.6: Summary of Results for Location B

Time		Measured Noise Levels (dB re. 2×10^{-5} Pa)				
		L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}
Day	14:53 – 15:08	56	78	46	59	50
	15:53 – 16:08	68	92	46	64	51
	16:55 – 17:10	55	65	46	59	49
Night	23:25 – 23:40	59	85	41	57	44

During daytime monitoring periods the dominant noise sources at this location were road traffic on Dorset St and activity within a carwash business nearby. During the second survey period there were also several sirens audible from passing emergency vehicles. Daytime ambient noise levels were in the range of 55 to 68dB $L_{Aeq,15min}$ and background noise levels in the range of 49 to 51dB $L_{A90,15min}$.

During night time monitoring periods the dominant source of noise at this location was from road traffic on Dorset St. Plant noise and dog barking was also audible. Night time ambient noise levels were of the order of 59dB $L_{Aeq,15min}$ and background noise levels in the range of 44 dB $L_{A90,15min}$.

5.10.3.5.3 Location C

Table 5.10.7: Summary of Results for Location C

Time		Measured Noise Levels (dB re. 2×10^{-5} Pa)				
		L _{Aeq}	L _{Amax}	L _{Amin}	L _{A10}	L _{A90}
Day	15:14 – 15:29	57	74	48	59	50
	16:15 – 16:30	66	89	48	63	51
	17:12 – 17:27	57	73	48	60	50
Night	23:46 – 00:01	51	63	45	53	47
	00:32 – 00:47	51	71	45	53	47
	01:11 – 01:26	50	66	44	53	46

During daytime monitoring periods the dominant noise source was noted to be distant and local road traffic. Other sources included birdsong, intermittent noise from gates opening and closing and some plant noise. Note that during the second monitoring period there was significantly more local traffic resulting in higher noise levels. Daytime ambient noise levels were in the range of 57 to 66dB L_{Aeq,15min} and background noise levels in the range of 50 to 51dB L_{A90,15min}.

During night time monitoring periods the dominant noise source was also noted to be distant and infrequent local road traffic. Plant noise was also audible at this location. Night time ambient noise levels were in the range of 50 to 51dB L_{Aeq,15min} and background noise levels in the range of 46 to 47dB L_{A90,15min}.

5.10.3.5.4 Overview

The measured noise levels reflect typical city centre locations. At roadside positions traffic on the busy main road and pedestrian activity dominate while at positions further from main roads, individual vehicle movements and pedestrian activity dominate with constant distant traffic contributing to measured levels.

5.10.3.6 Do Nothing Scenario

In the absence of the proposed development being constructed, the noise environment at the nearest noise sensitive locations and within the development site will remain largely unchanged. The

noise levels recorded during the baseline noise environment are considered representative of the Do-Nothing scenario.

5.10.4 Characteristics of the Proposed Development

5.10.4.1 General Characteristics

The proposed development is described in detail in Chapter 3: Description of the Proposed Development. The aspects relevant to this chapter are described in the following sections.

5.10.4.1.1 Demolition and Construction Phase

The construction phase will involve the demolition of a number of existing buildings, excavation over the development site, the formation of the basement levels and the construction of the new buildings.

5.10.4.1.2 Operational Phase

The primary source of outward noise that are deemed long term are mechanical plant items that will serve the development. During the operational phase visitors and staff will make trips to and from the development.

5.10.5 Potential Impacts of the Proposed Development

When considering a development of this nature, the potential noise and vibration impact on the surroundings must be considered for each of three distinct stages:

- Construction phase;
- Operational phase; and,
- Do-nothing impact.

The construction phase will involve excavation over the development site as well as some demolition and the construction of new buildings.

The primary sources of outward noise in the operational context are deemed to be long term in duration and will involve, 1) Mechanical plant noise; and, 2) Traffic movements to site using the existing road network. These issues are discussed in detailed in the following sections.

Noise impacts will be assessed to the nearest noise sensitive locations to the development. These are identified in Figure 5.10.2 overleaf.

- NSL1** Hotel rooms located adjacent to the north-west boundary of the proposed site.
- NSL2** Residential apartments on Bethesda Place adjacent to the north boundary of the proposed site.
- NSL3** The existing public art gallery adjacent to the east boundary of the proposed site.
- NSL4** Residential house on Granby Row adjacent to the south-west boundary of the proposed site.
- NSL5** The IVF Clinic in the Rotunda Hospital located off Parnell Square East.

5.10.5.1 Demolition and Construction Phase

5.10.5.1.1 Noise

The construction programme will create typical construction activity related noise onsite. During the construction phase of the proposed development, a variety of items of plant will be in use, such as breakers, excavators, lifting equipment, dumper trucks, compressors and generators.

Due to the nature of daytime activities undertaken on a construction site of this nature, there is potential for generation of significant levels of noise. The flow of vehicular traffic to and from a construction site is also a potential source of relatively high noise levels. The potential for vibration at neighbouring sensitive locations during construction is typically limited to excavation and piling works and potentially from lorry movements on uneven road surfaces.

Due to the fact that the construction programme has been established in outline form only, it is difficult to calculate the actual magnitude of noise emissions to the local environment. However, it is possible to predict typical noise levels using guidance set out in BS 5228-1:2009+A1:2014. Table 5.10. outlines typical plant items and associated noise levels that are anticipated for various phases of the construction programme.

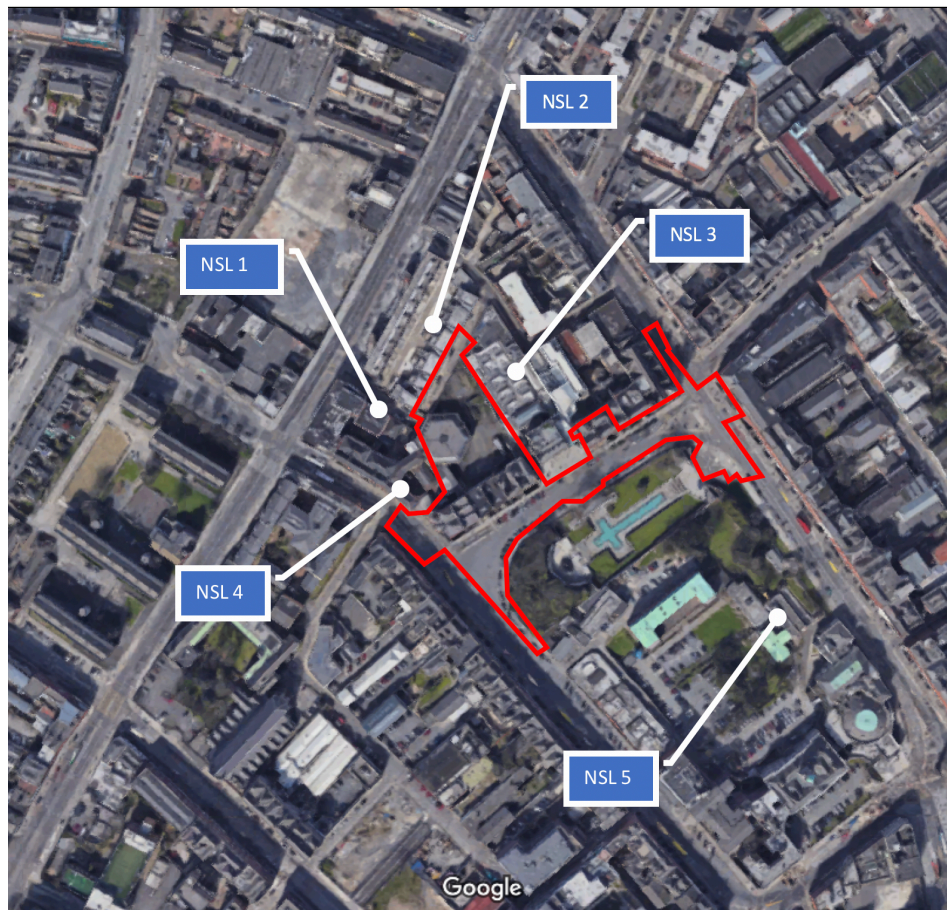


Figure 5.10.2: Site Context & Noise Sensitive Locations (Image Source: Google)

Table 5.10.8: Typical Noise Levels Associated with Construction Plant Items

Phase	Item of Plant (BS 5228-1:2009+A1:2014 Ref.)	Construction Noise Level at 10m Distance (dB LAeq(1hour))
Site Preparation	Wheeled Loader Lorry (D3 1)	75
	Track Excavator (C2 22)	72
	Dozer (C2.13)	78
	Dump Truck (C4.2)	78
Demolition	Pulveriser on Tracked Excavator (C1.5)	72
	Tracked Crusher (C1.14)	82
	Pulveriser on Tracked Excavator (C1.4)	76
	Dump Truck (C4.2)	78
Foundations	Tracked Excavator (C3.24)	74
	Concrete Pump (C3.25)	78
	Compressor (D7 6)	77
	Poker Vibrator (C4 33)	78
General Construction	Hand tools	81
	Tower Crane (C4.48)	76
	Pneumatic Circular Saw (D7.79)	75
	Internal fit – out	70
Landscaping	Dozer (C2.13)	78
	Dump Truck (C4.2)	78
	Surfacing (D8.25)	68

There are several residential and non-residential noise sensitive receivers in the vicinity of the site. As construction occurs in different areas of the site, the distance to the respective NSLs will vary, as will the noise level experienced at these receivers. The predicted noise levels for typical construction activities are presented below for increasing distances.

Table 5.10.9: Predicted Noise Levels Associated with Construction Plant Items

Distance to NSL	Phase	Predicted Construction Noise Level $L_{Aeq}(1hour)$ (dB)
10m	Site Preparation	74
10m	Demolition	77
10m	Foundations	75
10m	General Construction	75
10m	Landscaping	73
20m	Site Preparation	68
20m	Demolition	71
20m	Foundations	69
20m	General Construction	69
20m	Landscaping	67
30m	Site Preparation	65
30m	Demolition	67
30m	Foundations	65
30m	General Construction	66
30m	Landscaping	64
50m	Site Preparation	60
50m	Demolition	63
50m	Foundations	61
50m	General Construction	61
50m	Landscaping	59
80m	Site Preparation	56
80m	Demolition	59
80m	Foundations	57
80m	General Construction	57
80m	Landscaping	55
120m	Site Preparation	53
120m	Demolition	55
120m	Foundations	55
120m	General Construction	54
120m	Landscaping	52

There are noise sensitive residential units to the north west of the development site, approximately 10m from the site boundary. The predicted construction noise levels at this distance are above the 70dB(A) criteria and therefore it is expected that there will be a **negative, significant** and **short-term** impact at these receivers. Mitigation measures and recommended good practices have been outlined in Section 5.10.6 and detailed in Volume 2, Appendix 5.10.1.

The closest non-residential sensitive receiver is located to the east. There is an existing wall along the boundary of the site that will provide screening to this receiver and it is expected that construction noise levels will be within the non-residential noise criteria of 75dB(A). At greater distances predicted construction noise levels are within the relevant criteria.

There are Clinical buildings located within the Rotunda Hospital, some 120m from areas of works. Noise levels experienced at this location as a result of construction are projected to be approximately 52 – 55dB $L_{Aeq,1hr}$. The relevant construction noise criteria applied to the IVF Clinic is 65dB $L_{Aeq,1hr}$ externally. Therefore, the predicted construction noise levels are within the relevant criteria.

Construction Traffic

The noise levels associated with mobile plant items such as concrete mixer trucks, loaders etc. operational on site have been included as part of the construction noise assessment and calculated noise levels in Table 5.10.8. Consideration should also be given to the addition of construction traffic along the site access routes. Access to the development site for construction traffic will be via Parnell Square North and Frederick's Lane North/Bethesda

It is possible to calculate the noise levels associated with the passing vehicle using the following formula.

$$L_{Aeq,T} = L_{AX} + 10\log_{10}(N) - 10\log_{10}(T) + 20\log_{10}(r_1/r_2)\text{dB}$$

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);
- N is the number of events over the course of time period T;
- r_1 is the distance at which L_{AX} is expressed;
- r_2 is the distance to the assessment location.

A calculation distance of 5m from the road has been used to assess noise levels at the closest buildings along the construction routes. The mean value of Sound Exposure Level for truck moving at low to moderate speeds (i.e. 15 to 45km/hr) is of the order of 82dB L_{AX} at a distance of 5 metres from the vehicle. This figure is based on a series of measurements conducted under controlled conditions. Construction vehicle numbers have been provided by AECOM for peak hours associated with each key phase. Table 5.10.10 below

summarises the calculated noise level associated with passing haul vehicles during each phase, assuming the peak hour flows per day.

Table 5.10.10: Calculated Construction Traffic Noise Levels at Edge of Road

Construction Phase	No. of trucks/peak hour	Calculated Noise level at edge of road (5m), dB $L_{Aeq,1hr}$
Demolition	3	55
Excavation	10	61
Concrete Frame Works	8	60
General Building Materials	2	54
General Waste	1	51

The calculated noise levels associated with the various phases are in the range of 51 to 61dB $L_{Aeq,1hr}$. The calculated noise levels are below the construction noise criterion of 70dB. In addition, it should be noted that, in order to assess a worst-case scenario, a large proportion of the daily vehicle numbers have been assumed to arrive/depart over an hour long period.

5.10.5.1.2 Vibration

The main potential source of vibration during the construction programme is associated with piling and ground-breaking activities.

For the purposes of this assessment the expected vibration levels during piling have been determined through reference to published empirical data. The British Standard BS 5228 – Part 2: Vibration, publishes the measured magnitude of vibration of rotary bored piling using a 600mm pile diameter for bored piling into soft ground over rock, (Table D.6, Ref. No. 106):

- 0.54mm/s at a distance of 5m, for auguring;
- 0.22mm/s at a distance of 5m, for twisting in casing;
- 0.42mm/s at a distance of 5m, for spinning off, and;
- 0.43mm/s at a distance of 5m, for boring with rock auger.

Considering the low vibration levels at very close distances to the piling rigs, vibration levels at the adjoining buildings are not expected to pose any significance in terms of cosmetic or structural damage to any of the protected structures in proximity to the development works or any of the other adjacent buildings. In addition, the range of vibration levels is typically below a level which would cause any disturbance to occupants of adjacent buildings.

During any rock breaking within the site, there is also potential for vibration to be generated through the ground. Empirical data for this activity is not provided in the BS 5228-2 standard, however the likely levels of vibration from this activity is expected to be significantly below the lower adopted criteria for building damage on experience from other sites.

Vibration levels at Clinical Buildings in the Rotunda Hospital are expected to be below the relevant criteria considering the large distances between areas of works and sensitive building identified.

Notwithstanding the above, any construction activities undertaken on the site will be required to operate below the recommended vibration criteria set out in Table 5.10.2.

5.10.5.2 Operational Phase

There are two primary potential sources of noise associated with the development once operational. These are:

- Mechanical plant noise; and,
- Additional vehicular traffic on public roads.

Each of these primary noise sources is addressed in turn in the following sections.

Note that there is no significant source of vibration associated with the operational phase of the proposed development.

5.10.5.2.1 Mechanical Plant

During the operational phase of the buildings life, there will be a variety of mechanical and electrical plant that will be required to service the development, some of which will have the possibility of emitting noise to the surroundings. Noise emission levels from the development will be linked to the hours of occupancy of the building meaning that noise emissions will reduce to minimal levels during the most sensitive periods (i.e. at night time). However, some plant will need to operate on a 24 hour basis to maintain environmental conditions and this plant will be located and attenuated as necessary so as not to increase existing background noise levels in the surrounding area. The design of the Services installation will be in line with the information set out within the EPA Act;

“Noise levels from the proposed development should not be so loud, so continuous, so repeated, of such duration or pitch or occurring at such times as to give reasonable cause for

annoyance to a person in any premises in the neighbourhood or to a person lawfully using any public place.”²

Appropriate external limits have been derived based on the internal criteria noted in Section 5.10.2.

5.10.5.2.2 Additional Traffic on Adjacent Roads

While the development will attract visitors and require staff to travel to it, no dedicated staff or visitor car parking is proposed.

Section 7.5 of the Traffic and Transportation Assessment, prepared by AECOM which accompanies the planning application states that the proposed development will generate additional two-way traffic volumes of 9 movements and 16 vehicle movements during the AM and PM peak hours respectively.

The existing AM and PM peak hour movements in the absence of the development are 714 and 1,013 respectively.

The change in noise level corresponding to the predicted increase in traffic is less than 1dB. Therefore, it is expected that the noise impact associated with vehicles travelling to and from the development is **neutral, imperceptible and long-term.**

5.10.6 Mitigation Measures

5.10.6.1 Demolition and Construction Phase

Noise

The impact assessment conducted for the construction activity during the construction phase has highlighted that the predicted construction noise levels are above the adopted criterion at distances of 10m or less, and that a negative impact on nearby receivers will occur.

The following mitigation measures should be considered during certain construction activities in order to reduce the noise and vibration impact to nearby noise sensitive areas.

As part of these mitigation measures it is recommended that the Contractor should compile a Noise and Vibration Management Plan (NVMP) which will deal specifically with management processes and strategic mitigation measures to remove or reduce significant noise

and vibration impacts, and cumulative noise and vibration impacts from the construction works. The Plan will also define noise and vibration monitoring and reporting. The NVMP will also include method statements for each phase of the works, the associated specific measures to minimise noise and vibration in so far as is reasonably practicable for the specific works covered by each plan and a detailed appraisal of the resultant construction noise and vibration generated.

The contractor will provide proactive community relations and will notify the public and vibration sensitive premises before the commencement of any works forecast to generate appreciable levels of noise or vibration, explaining the nature and duration of the works.

The contractor will distribute information circulars informing people of the progress of works and any likely periods of significant noise and vibration.

With regard to potential mitigation measures during construction activities, the standard planning condition typically issued by Dublin City Council states:

“During the construction and demolition phases, the proposal development shall comply with British Standard 5228 “Noise Control on Construction and open sites Part 1. Code of practice for basic information and procedures for noise control.”

BS5228 includes guidance on several aspects of construction site mitigation measures, including, but not limited to:

- selection of quiet plant;
- control of noise sources;
- screening;
- hours of work, and;
- liaison with the public.

Detailed comment is offered on these items in Volume 2, Appendix 5.10.1 Noise control measures that will be considered include the selection of quiet plant, enclosures and screens around noise sources, limiting the hours of work.

Vibration

Any construction activities undertaken on the site will be required to operate below the recommended vibration criteria set out in Table 5.10.2.

5.10.6.2 Operational Phase - Noise

5.10.6.2.1 Mechanical Plant

The potential for noise impact associated with mechanical plant items has been taken into consideration at this stage of the design process. Engineers will work to conceal noise emitting plant from direct line of sight of nearby noise sensitive receivers in order to provide passive attenuation measures to mitigate noise levels within existing site boundaries. This shielding, through use of the building, is supplemented by acoustic attenuation where required to equipment such as air handling units to keep noise levels within existing background levels for surrounding residences and spaces.

Careful design has been carried out to ensure that the locations of external noise emitting plant will be screened off by vertical elements that will ensure that any noise emission will spread vertically mitigating hemispherical noise spread to adjacent properties. In addition, acoustic attenuation will be provided where required to keep within existing background noise levels in occupied, and in particular residential, surrounding areas.

The plant proposed has been designed and selected to run at low speeds to minimise noise emissions whilst maximising energy efficiency.

The limit values for plant noise emissions have been derived from the baseline noise levels during the more sensitive night-time period. In order to ensure that there will be no increase to the background noise levels due to plant noise emissions the following limits should be adhered to:

- Daytime (07:00 to 23:00 hours) 40dB LAeq,15min
- Night-time (23:00 to 07:00 hours) 35dB LAeq,5min

5.10.6.2.2 Additional Traffic on Adjacent Roads

No measures are required with respect to traffic on adjacent roads.

5.10.7 Predicted Impact of the Proposed Development

5.10.7.1 Demolition and Construction Phase

Noise

The implementation of the mitigation measures outlined in Section 5.10.6, and detailed in Volume 2, Appendix 5.10.1, will aim to minimise impact of construction noise experienced at nearby residential and non-residential receivers. Due to the nature of construction noise and the proximity of noise sensitive receivers, it is predicted construction noise levels will be above the relevant criteria while works are within 10m, and that there will be a **negative, significant** and **short term** impact on these sensitive receivers. As works move further away, to within 20-80m the predicted noise levels are within the relevant noise criteria, and there will be a **negative, moderate** and **short term** noise impact during the construction phase. The descriptor "short-term" corresponds to a period of 1 – 7 years.

Vibration

No predicted significant adverse impact arising from vibration during construction provided works are carried out so as to fall under the relevant vibration criteria.

5.10.7.2 Operational Phase

Noise

The external plant items will be designed and located so that emissions will be within the noise criteria set for day and night-time periods and the impact at any noise sensitive locations will be **neutral, long term** and **imperceptible**.

No other substantial noise sources are anticipated during the operational phase of the development.

Vibration

No vibration impact is expected in association with the operational phase.

5.10.8 Monitoring

Should the construction noise and vibration risk assessment identify the need for monitoring the following actions are recommended during demolition and construction.

Noise Monitoring Terminals (NMT), number and locations to be agreed, to be installed with the following specifications (or similar approved):

- Logging of two concurrent periods, e.g. 15-minute & hourly;
- Daily CIC automated calibrations;
- E-mail alert on threshold exceedance;
- E-mail alert on low battery and low memory;
- Remote access to measured data, and;
- Live display of noise levels.

Vibration monitoring stations should continually log vibration levels using the Peak Particle Velocity parameter (PPV, mm/s) in the X, Y and Z directions, in accordance with BS ISO 4866: 2010: Mechanical vibration and shock – Vibration of fixed structures – Guidelines for the measurement of vibrations and evaluation of their effects on structures.

The mounting of the transducer to the vibrating structure will need to comply with BS ISO 5348: 1998: Mechanical vibration and shock – Mechanical mounting of accelerometers. In summary, the following ideal mounting conditions apply:

- The transducer and its mountings should be as rigid as possible;
- The mounting surfaces should be as clean and flat as possible;
- Simple symmetric mountings are best, and;
- The mass of the mounting should be small in comparison to that of the structure under test.

In addition, it is recommended that spot check noise & vibration measurements are conducted on a monthly basis. These spot checks can be organized to coincide with works that have potential to generate high levels of noise or vibration on site in order to confirm the potential extent of impact.

A monthly noise & vibration monitoring report should be prepared by the contractor. Reports should identify any exceedances above nominal limit values and attempts to clarify the causes etc. Where remedial measures are required and identifiable these should also be clearly stated.

5.10.9 Difficulties Encountered

There were no difficulties encountered during the production of this chapter of the EIAR.

5.10.10 Bibliography

- EPA Guidelines on the Information to be contained in Environmental Impact Statements, (EPA, 2002);
- EPA Advice Notes on Current Practice (in the preparation of Environmental Impact Statements), (EPA, 2003);
- EPA Guidelines on the Information to be contained in Environmental Impact Assessment Reports, (Draft August 2017);
- EPA Advice Notes for Preparing Environmental Impact Statements, (Draft, September 2015);
- BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.
- BS 5228 – Part 2: Vibration;
- BS 7385-2 (1993);
- BS 5228-2 (2009);
- BS 4142: 2014: Methods for Rating and Assessing Industrial and Commercial Sound;
- DMRB, 2011;
- ISO 1996: 2017: Acoustics – Description, measurement and assessment of environmental noise;
- Health Technical Memorandum 08-01: Acoustics
- BS 6841 (1987): Measurement and evaluation of human exposure to whole-body mechanical vibration and repeated shock;

5.10.11 Consultations

No consultations were required in the preparation of this Chapter.