Chapter 8.0

Noise and Vibration

8.1 Introduction

This Chapter has been prepared by Brian Johnson, Acoustic Consultant at CLV Consulting.

Brian is an internationally experienced acoustic consultant who has been working in the fields of architectural / building acoustics and noise control since 1994. Brian has a Bachelor of Science in Acoustical Engineering (Purdue University), Certificate of Competence in Building Acoustic Measurements (Institute of Acoustics), Certificate of Competence in Environmental Noise Measurements (Institute of Acoustics) and he is a LEED Certified Green Professional.

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 impact associated with the proposed development both during construction and once operational on the surrounding environment.

Planning Permission is currently being sought for a residential development that is proposed to be constructed on lands that front on to the Ballyhooly Road in Ballyvolane, Cork. The proposed development is to consist of a strategic housing development including 753 residential units to be constructed in a series of phases (six neighbourhoods in total), a local centre including 2 no. retail units, a crèche, doctor's surgery and community use unit and all associated and ancillary infrastructure, services and site development works.

The proposed 753 no. dwellings are comprised of the following:

- 67 no. detached houses
- 278 no semi-detached houses
- 186 no. terrace houses
- 69 no. duplexes
- 153 no. apartments

The proposed development also includes the following:

- a series of open spaces and play areas along with general landscaping
- boundary treatments (including walls and landscaping to the houses to the north)
- an internal distributor road providing access to neighbouring lands and internal roads
- car and cycle parking, pedestrian and cycle paths
- public lighting, internal bus stops and turning area
- bin storage facilities (in apartment locations)
- site services infrastructure including include water supply, foul and surface / storm water drainage infrastructure to local services and drains and 5 no. unit substations
- provisions for two no. pumping stations

A layout schematic of the proposed development is shown in Figure 8.1 on the following page.

Figure 8.1 Proposed Site Layout

CLV Consulting Limited has been commissioned by Cunnane Stratton Reynolds to conduct an assessment of the likely noise and vibration impact associated with the development. This assessment has been detailed in the following chapter.

8.2 Methodology

The following was the approach taken for assessing the potential noise and vibration impact of the development:

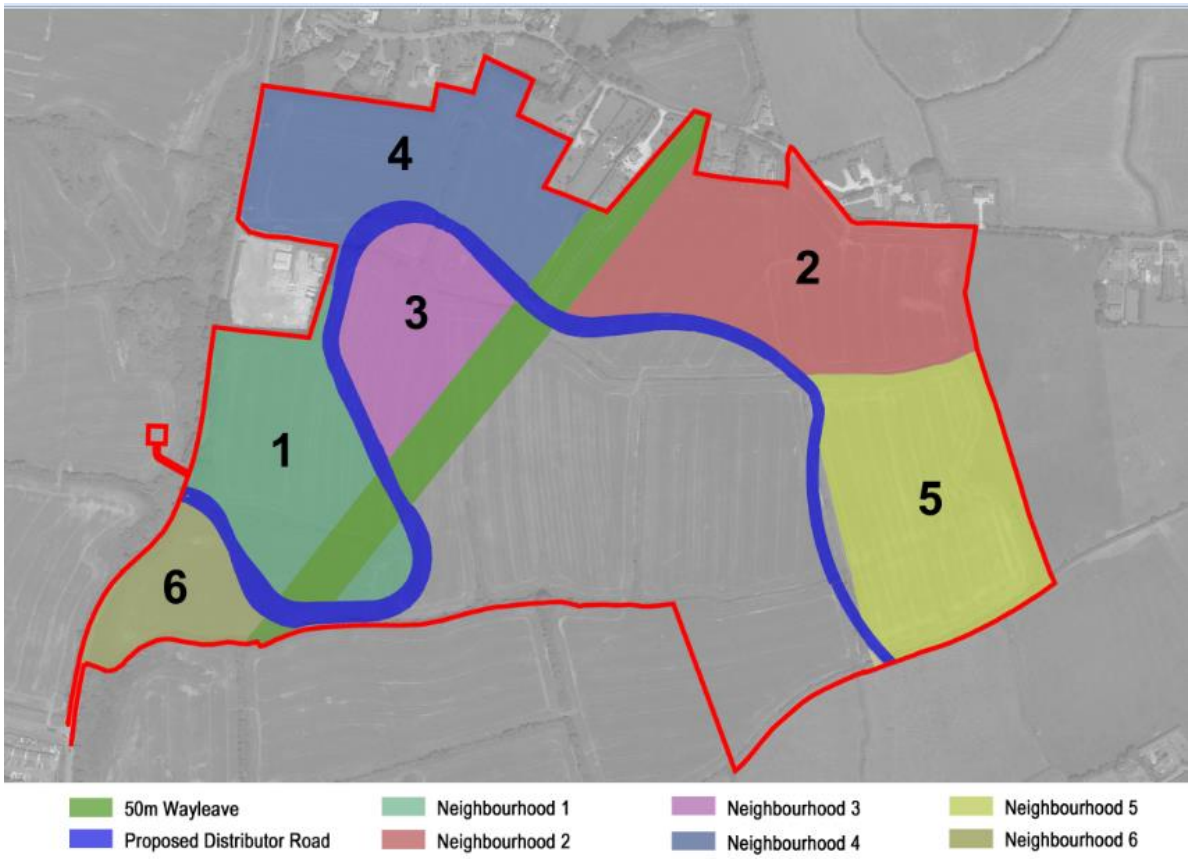
- Baseline noise monitoring was undertaken in the site area to determine the range of noise levels in the area.
- A review of the most applicable standards and guidelines was conducted in order to consider the acceptable noise range and vibration criteria for both the construction and operational stages of the proposed development.
- Predictive calculations were conducted in order to assess the penitential impacts of the construction and operational phases.

Mitigation measures were proposed where relevant to control noise and vibration associated with the construction and operation of the proposed development. Note that the guidance documents that were referenced in relation to this chapter are listed in Section 8.9.

8.2.1 Phasing

The development is to be constructed in six different phases that are currently as described in Chapter 2 of the EIAR. It is planned to commence during the second quarter of 2020 and be completed during 2029. The indicative phasing plan will generally divide the development into six different 'neighbourhood' zones as shown in Figure 8.2.

Figure 8.2 Proposed Development Neighbourhood Zones



The phasing programme is set out in Chapter 2 of the EIAR.

In order to take a prudent approach for assessing the noise and vibration impact from the development, we have considered the operational aspect of the entire development at the end of construction completion only (i.e. the end of Phase 6). The reason for taking this approach is that it not only considers the 'worst-case' operational condition for the development but also the permanently operating condition going forward. The evaluation of the 'worst-case' condition of the entire development in operation will need to be the basis for determining the appropriate mitigation measures that would be required. Individual consideration of each phase therefore becomes superfluous because the noise and vibration impact of each of the phases would only represent partial contributions from the development. It could also be misleading as individual consideration of each phase could indicate that no mitigation measures would be required whereas consideration of all phases in totality could indicate that they are.

Consideration of the construction phase, however, will be conducted on an individual phasing basis given that construction works are a temporary noise and vibration source that will only be present at discreet locations during each of the specific phases.

8.2.2 Primary Noise Sources of the Proposed Development

In consideration of any new development, the potential noise and vibration impact on the surroundings must be considered for each of two distinct stages: the short -term impact of the construction phase and the longer-term impact of the operational phase. As discussed in the previous section, the construction phase of the development will be considered on a phased basis whilst the operation phase will consider the fully completed development condition.

Development noise emissions during the construction phase will mostly be due to site clearance, landscaping and the construction of the various residential dwellings and other site buildings. Specific processes and equipment have been identified and are discussed in Section 8.4 of this chapter.

Development noise emissions during the operational phase of the project are expected to be from seven primary sources as follows:

- ✓ Activity noise from crèche;
- ✓ Delivery truck events;
- ✓ Building services plant;
- ✓ Pumping station emissions;
- ✓ Development car parking;
- ✓ Vehicular traffic on the development's new internal roads; and
- ✓ Additional vehicular traffic on surrounding public roads.

These are discussed in in Section 8.4.2 of this chapter.

8.2.3 Construction Phase

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 may 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 – Part 1: Noise*. This provides guidance on selecting appropriate noise criteria for construction works.

The approach adopted here calls for the designation of a noise sensitive location into a specific category (A, B or C) based on exiting ambient noise levels in the absence of construction noise. This then sets a threshold noise value that, if exceeded, indicates a significant noise impact is associated with the construction activities.

Table 8.1 sets out the values which, when exceeded, indicate a significant effect at the facades of residential receptors as recommended by BS 5228 - 1. Please note that these are cumulative levels, i.e. the sum of both ambient and construction noise levels.

Table 8.1 Example Threshold of Significant Effect At Dwellings

Assessment Category & Threshold Value Period (L_{Aeq})	**Threshold Value, Decibels (dB)**		
	Category A [A]	**Category B** [B]	**Category C** [C]
Night-Time (23:00 to 07:00hrs)	45	50	55
Evenings & Weekends [D]	55	60	65
Daytime (07:00 - 19:00) & Saturdays (07:00 - 13:00)	65	70	75

A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.

B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values.

C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category B values.

D) 19:00 - 23:00 weekdays, 13:00 - 23:00 Saturdays and 07:00 - 23:00 Sundays.

For the appropriate period (e.g. daytime), the ambient noise level is determined and rounded to the nearest 5dB. In this instance, properties in the vicinity of the development have daytime ambient noise levels in the range of 36 to 63dB L_{Aeq} (ref Section 8.3.6). These properties will therefore be afforded a Category A designation.

If the total noise level (i.e. construction noise plus existing ambient noise level) exceeds the appropriate category value (e.g. 65dB L_{Aeq} during daytime periods) then a relative noise impact is deemed to have occurred.

8.2.4 Operational Phase

Due consideration must be given to the nature of the primary noise sources when setting noise emissions criteria. In this instance, there are four primary sources of noise associated with the development once operational. Criteria for noise from all of these sources, will be considered in terms of the $L_{Aeq,T}$ parameter (the equivalent continuous sound level).

There is no Irish Standard containing guidance that is applicable in this instance. In the absence of such standards, best practice dictates that potential noise impacts of the proposed development is assessed against appropriate British and/or International Standards.

Appropriate guidance is contained within *BS8233 (2014): Guidance on Sound Insulation and Noise Reduction for Buildings*. This British Standard sets out recommended noise limits for indoor ambient noise levels in residential dwellings as detailed in Table 8.2 below.

Table 8.2 Recommended Indoor Ambient Noise Levels from *BS8233 (2014)*

Activity	**Room Type**	**Design Criterion $L_{Aeq,T}$ (dB)**	
		Daytime (07:00 - 23:00hrs)	**Night Time (23:00 - 07:00hrs)**
Resting / Sleeping Conditions	Living Rooms	35dB $L_{Aeq,16hr}$	-
	Bedrooms	35dB $L_{Aeq,16hr}$	30dB $L_{Aeq,8hr}$

For the purposes of this assessment, it is necessary to derive external limits based on the internal criteria listed in the table above. This is done by factoring in a degree of noise reduction afforded by an open window, which is defined in the standard as being 15dB (in accordance with BS 8233).

Applying the 15dB factor to the values from the BS8233 table, the following criteria would apply at the façades of the adjacent dwellings:

- *Daytime (07:00 to 23:00 hours)* *50dB $L_{Aeq,16hr}$*
- *Night-time (23:00 to 07:00 hours)* *45dB $L_{Aeq,8hr}$*

In order to assist with the interpretation of the noise associated with changes in noise level due to increases in road traffic, Table 8.3 on the following page offers guidance as to the likely impact associated with any particular relative change.

Table 8.3 Likely Impact Associated with Change in Noise Level

Change in Sound Level (dB L_{Aeq})	**Subjective Reaction**	**Impact**
< 3	Inaudible	Imperceptible
3 – 5	Perceptible	Slight
6 – 10	Up to a doubling of loudness	Moderate
11 – 15	Over a doubling of loudness	Significant
> 15		Profound

8.2.5 Vibration Guidelines

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 Peak Particle Velocity (PPV).

It is acknowledged that humans are particularly sensitive to vibration stimuli and that any perception of vibration may lead to concern. In the case of road traffic, vibration is perceptible at around 0.5mm/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 duration. For example, blasting and piling, two of the primary sources of vibration during construction, are typically tolerated at vibration levels up to 12mm/s and 5mm/s respectively. This guidance is applicable to the daytime only; it is unreasonable to expect people to be tolerant of such activities during the night.

Guidance relevant to acceptable building vibration is contained in the following documents:

- *British Standard BS 7385 (1993): Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration*, and;
- *British Standard BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites Part 2: Vibration.*

BS 7385 states that there should typically be no cosmetic damage if transient vibration does not exceed 15mm/s at low frequencies rising to 20mm/s at 15Hz and 50mm/s at 40Hz and above. These guidelines relate to relatively modern buildings and should be reduced to 50% or less for more critical buildings.

BS 5228 recommends that, for soundly constructed residential property, light commercial buildings and similar structures that are generally in good repair, a threshold for minor or cosmetic (i.e. non-structural) damage should be taken as a peak particle velocity of 15mm/s at 4Hz increasing to 20mm/s at 15Hz and increasing to 50mm/s at 40Hz and above for intermittent vibration. For reinforced or framed structures or industrial and heavy commercial buildings and similar structures that are generally in good repair, a threshold for minor or cosmetic (i.e. non-structural) damage should be taken as a peak particle velocity of 50mm/s at 40Hz and above again for intermittent vibration. In the case of continuous vibration, it states that these figures may need to be reduced by up to 50%. Below these vibration magnitudes minor damage is unlikely, although where there is existing damage these limits may be reduced by up to 50%.

8.3 Receiving Environment (Baseline Scenario)

An environmental noise survey was conducted in order to quantify the existing baseline noise environment. The survey was conducted in general accordance with *ISO 1996-2: 2017: Acoustics - Description, measurement and assessment of environmental noise*.

Specific details are set out in the following sections.

8.3.1 Choice of Measurement Locations

Three measurement locations were selected; each is described in turn below and shown in Figure 8.3 on the following page.

Location 1 is located near the southwest corner of the proposed development adjacent to the semi-detached dwellings in the Brookwood Estate. The noise levels measured at this location would be indicative of the ambient noise environment of the dwellings in this estate that are adjacent to the development.

Location 2 is located near the northwest corner of the proposed development adjacent to the intersection of Ballyhooly Road and the road to the north of the site. The noise levels measured at this location would be indicative of the ambient noise environment of the dwellings located near this intersection.

Location 3 is located near the northeastern corner of the development along the road to the north of the site. The noise levels measured at this location would be indicative of the ambient noise environment of the dwellings located along this road situated away from the Ballyhooly Road.

Figure 8.3 Site Layout Showing Approximate Positions of Measurement Locations 1, 2 & 3

8.3.2 Survey Periods

Noise measurements were conducted over the course of two survey periods as follows:

- Daytime 12:35 to 15:25hrs 6 July 2017;
- Night-time 23:05 to 02:00hrs 6/7 July 2017.

The daytime measurements cover a period that would provide a typical snapshot of the

existing noise climate, with the primary purpose being to ensure that the proposed noise criteria associated with the development are commensurate with the prevailing environment.

The night-time period provides a measure of the existing background noise levels.

The weather during the daytime survey periods was dry and relatively calm. The weather during the night-time survey was also dry and calm.

8.3.3 Personnel & Instrumentation

Brian S. Johnson (CLV) conducted the noise level measurements during all survey periods. He is an internationally experienced acoustic consultant who has been working in the fields of architectural / building acoustics and noise control since 1994. He has been based in America, Europe, Asia and holds a Certificate of Competence in Environmental Noise Measurements from the Institute of Acoustics.

The measurements were conducted using an NTI Audio type XL2 Sound Level Meter (Serial #A2A-10989-EO). It was fitted with a 90mm windshield and before and after the survey the measurement apparatus was check calibrated using a Casella Cel 120 Acoustic Calibrator (Serial #3921077). The microphone was positioned approximately 1.4m above the ground.

8.3.4 Procedure

Measurements were conducted at Locations 1 to 3 on a cyclical basis. Sample periods for the noise measurements were 15 minutes during both the daytime and night-time periods. The results were saved to the instrument memory for later analysis. All primary noise sources contributing to noise build-up were also noted.

8.3.5 Measurement Parameters

The noise survey results are presented in terms of the following five 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_{Amax} is the instantaneous maximum sound level measured during the sample period.

L_{Amin} is the instantaneous minimum sound level measured during 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.

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 $2x10^{-5}$ Pa.

8.3.6 Measurement Results

Location 1

The survey results for Location 1 are summarised in Table 8.4 below.

Table 8.4 Summary of Measured Noise Levels at Location 1

Time		Measured Noise Levels (dB re. $2x10^{-5}$ Pa)				
		L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}
Daytime	12:35 - 12:50hrs	62	74	33	65	47
	13:35 – 13:50hrs	61	76	31	65	44
	14:30 - 14:45hrs	63	83	31	66	47
Night-time	23:05 - 23:20hrs	57	77	23	58	25
	00:10 - 00:25hrs	50	69	21	51	23
	01:10 - 01:25hrs	52	72	21	54	22

During daytime monitoring periods, the dominant source of noise observed in the vicinity was local traffic along both the Ballyhooly and the Kilbarry Link Roads with contributions from birdsong and very low levels of wind generated noise. Daytime noise levels were in the range 61 to 63dB L_{Aeq} and 44 to 47dB L_{A90}.

The night-time noise measurements at this location were again dominated by local traffic along the adjacent roads. Noise levels were in the range 50 to 57dB L_{Aeq} and 22 to 25dB L_{A90}.

Location 2

The survey results for Location 2 are summarised in Table 8.5 below.

Table 8.5 Summary of Measured Noise Levels at Location 2

Time		Measured Noise Levels (dB re. $2x10^{-5}$ Pa)				
		L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}
Daytime	12:55 - 13:10hrs	53	76	29	56	33
	13:50 - 14:05hrs	52	79	29	53	32
	14:50 - 15:05hrs	54	76	29	57	33
Night-time	23:25 - 23:40hrs	49	71	22	49	25
	00:30 - 00:45hrs	50	74	22	50	24
	01:25 - 01:40hrs	50	74	21	48	23

The daytime noise levels at this location local were controlled almost exclusively by traffic along Ballyhooly Road as well as some low-level wind generated noise. Noise levels were in the range 52 to 54dB L_{Aeq} and 32 to 33dB L_{A90}.

The night-time noise measurements at this location were again dominated by traffic along Ballyhooly Road. Noise levels were in the range 49 to 50dB L_{Aeq} and 23 to 25dB L_{A90}.

Location 3

The survey results for Location 3 are summarised in Table 8.6 below.

Table 8.6 Summary of Measured Noise Levels at Location 3

Time		**Measured Noise Levels (dB re. $2x10^{-5}$ Pa)**				
		L_{Aeq}	**L_{Amax}**	**L_{Amin}**	**L_{A10}**	**L_{A90}**
Daytime	13:15 - 13:30hrs	37	56	28	39	30
	14:10 - 14:25hrs	38	59	28	39	30
	15:10 - 15:25hrs	36	54	29	38	31
Night-time	23:45 - 00:00hrs	31	50	24	33	27
	00:50 - 01:05hrs	32	51	25	32	27
	01:45 - 02:00hrs	30	41	24	32	26

The daytime noise levels at this location local were controlled primarily by local traffic event noise along the road to the north of the site and distant traffic noise from adjacent roads (given its elevated position) along with some birdsong. Noise levels were in the range 36 to 38dB L_{Aeq} and 30 to 31dB L_{A90}.

Road traffic event noise from the road to the north of the site dominated the noise environment during night-time periods along with distant traffic hum from adjacent roads as a relatively constant background source. Noise levels were in the range 30 to 32dB L_{Aeq} and 26 to 27dB L_{A90}.

8.4 Potential Impact of the Proposed Development

Various elements of both the construction and operational phases of the proposed development have the potential to impact on the receiving on the local receiving noise environment, on adjacent residential properties and on human health. These phases are discussed separately in the following sections.

8.4.1 Construction Phase

A variety of items of plant will be in use during the construction phase of the development, such as excavators, lifting equipment, dumper trucks, compressors and generators. There will be vehicular movements to and from the site that will make use of both existing roads and the new internal roads.

Due to the nature of the activities undertaken on a large construction site, 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 works and lorry movements on uneven road surfaces. Considering the distance between the sensitive locations to potential site access points off the Ballyhooly Road and the current traffic use on surrounding roads, there is little potential for structural or even cosmetic damage to existing nearby dwellings.

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 Code of Practice for Noise and Vibration Control on Construction and Open Sites - Part 1: Noise.*

In order to consider a 'worst-case' condition for each of the project phases, distances from each construction phase site were estimated based on the closest point of the phasing area to the nearest residential dwelling in each of the nearby noise sensitive location areas. These numerical distance estimations are summarised in Table 8.7 below.

Table 8.7 Estimated Distances from Construction Works to Noise Sensitive Locations

NSL	Site Works	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
Existing Dwellings to North of the Site	30m	160m	530m	180m	10m	300m	15m
Brookwood Estate Dwellings	130m	900m	130m	500m	620m	315m	745m

It must be stated that for the majority of the time, plant and equipment will be at greater distances from the nearest noise sensitive dwellings than those used for the calculations and consequently will have lesser impact. Our assessment would therefore be representative of a 'worst-case' scenario.

During the construction phase, there will be extensive site works involving construction machinery, construction activities on site, and construction traffic, which will all generate noise. The highest noise levels will be generated during general construction activities. However, construction noise levels will be of relatively short-term duration and will only occur during daytime hours which will serve to minimise the noise impacts at local existing receptors.

The following assumptions have been made in the preparation of these construction noise predictions:

- A utilisation of equipment of 75% over a working day;
- Under construction areas will be screened by site hoarding a minimum of 2m in height.

The results of our construction noise assessment is provided in Tables 8.8 - 8.14 on the following pages.

Table 8.8 Construction Noise Emissions For Site Works Phase

Stage	Site Works Phase			
	Plant Item (BS 5228 Ref.)	**Plant Noise Level at 10m Distance[1] (dB L_{Aeq})**	**Predicted Noise Level At dwellings to the North of the Site (dB $L_{Aeq,1hr}$)**	**Predicted Noise Level at Brookwood Estate Residences (dB $L_{Aeq,1hr}$)**
Site Preparation	Tracked excavator (C3.92)	76	68	56
	Dumper (C3.100)	74		
	Lorry (D.3.57)	80		
Roadworks	Dumper (C3.100)	74	66	53
	Asphalt Spreader (D.8.24)	73		
	Road Roller (D.8.29)	77		

Table 8.9 Construction Noise Emissions for Phase 1

Stage	Phase 1			
	Plant Item (BS 5228 Ref.)	**Plant Noise Level at 10m Distance[9] (dB L_{Aeq})**	**Predicted Noise Level At dwellings to the North of the Site (dB $L_{Aeq,1hr}$)**	**Predicted Noise Level at Brookwood Estate Residences (dB $L_{Aeq,1hr}$)**
Site Preparation	Tracked excavator (C3.92)	76	44	44
	Dumper (C3.100)	74		
Foundation Laying	Compressor (C6.19)	72	43	43
	Poker Vibrator (C6.40)	73		
	Cement Mixers (C6.6)	71		

[1] Plant noise levels are derived from BS 5228: Part 1.

Stage	Phase 1			
	Plant Item (BS 5228 Ref.)	**Plant Noise Level at 10m Distance[9] (dB L_{Aeq})**	**Predicted Noise Level At dwellings to the North of the Site (dB $L_{Aeq,1hr}$)**	**Predicted Noise Level at Brookwood Estate Residences (dB $L_{Aeq,1hr}$)**
Steel Erection	Crane (C7.120)	76	43	43
	Lorry (C7.121)	70		
General Construction	Compressor (C7.70)	70	45	45
	Diesel Hoist (C7.97)	73		
	Pneumatic Circular Saw (C.79)	75		
	Generator (C7.51)	72		
Roadworks	Road Roller (D.8.29)	77	43	43

Table 8.10 Construction Noise Emissions for Phase 2

Stage	Phase 2			
	Plant Item (BS 5228 Ref.)	**Plant Noise Level at 10m Distance[9] (dB L_{Aeq})**	**Predicted Noise Level At dwellings to the North of the Site (dB $L_{Aeq,1hr}$)**	**Predicted Noise Level at Brookwood Estate Residences (dB $L_{Aeq,1hr}$)**
Site Preparation	Tracked excavator (C3.92)	76	70	36
	Dumper (C3.100)	74		
Foundation Laying	Compressor (C6.19)	72	69	35
	Poker Vibrator (C6.40)	73		
	Cement Mixers (C6.6)	71		
Steel Erection	Crane (C7.120)	76	69	35
	Lorry (C7.121)	70		
General Construction	Compressor (C7.70)	70	71	37
	Diesel Hoist (C7.97)	73		
	Pneumatic Circular Saw (C.79)	75		
	Generator (C7.51)	72		

Stage	Phase 2			
	Plant Item (BS 5228 Ref.)	**Plant Noise Level at 10m Distance[9] (dB L_{Aeq})**	**Predicted Noise Level At dwellings to the North of the Site (dB $L_{Aeq,1hr}$)**	**Predicted Noise Level at Brookwood Estate Residences (dB $L_{Aeq,1hr}$)**
Roadworks	Road Roller (D.8.29)	77	69	35

Table 8.11 Construction Noise Emissions for Phase 3

Stage	Phase 3			
	Plant Item (BS 5228 Ref.)	**Plant Noise Level at 10m Distance[9] (dB L_{Aeq})**	**Predicted Noise Level At dwellings to the North of the Site (dB $L_{Aeq,1hr}$)**	**Predicted Noise Level at Brookwood Estate Residences (dB $L_{Aeq,1hr}$)**
Site Preparation	Tracked excavator (C3.92)	76	49	40
	Dumper (C3.100)	74		
Foundation Laying	Compressor (C6.19)	72	47	39
	Poker Vibrator (C6.40)	73		
	Cement Mixers (C6.6)	71		
Steel Erection	Crane (C7.120)	76	48	39
	Lorry (C7.121)	70		
General Construction	Compressor (C7.70)	70	50	41
	Diesel Hoist (C7.97)	73		
	Pneumatic Circular Saw (C.79)	75		
	Generator (C7.51)	72		
Roadworks	Road Roller (D.8.29)	77	48	39

Table 8.12 Construction Noise Emissions for Phase 4

Stage	Phase 4			
	Plant Item (BS 5228 Ref.)	**Plant Noise Level at 10m Distance[9] (dB L_{Aeq})**	**Predicted Noise Level At dwellings to the North of the Site (dB $L_{Aeq,1hr}$)**	**Predicted Noise Level at Brookwood Estate Residences (dB $L_{Aeq,1hr}$)**
Site Preparation	Tracked excavator (C3.92)	76	74	38
	Dumper (C3.100)	74		
Foundation Laying	Compressor (C6.19)	72	73	37
	Poker Vibrator (C6.40)	73		
	Cement Mixers (C6.6)	71		
Steel Erection	Crane (C7.120)	76	73	37
	Lorry (C7.121)	70		
General Construction	Compressor (C7.70)	70	75	39
	Diesel Hoist (C7.97)	73		
	Pneumatic Circular Saw (C.79)	75		
	Generator (C7.51)	72		
Roadworks	Road Roller (D.8.29)	77	73	37

Table 8.13 Construction Noise Emissions for Phase 5

Stage	Phase 5			
	Plant Item (BS 5228 Ref.)	**Plant Noise Level at 10m Distance[9] (dB L_{Aeq})**	**Predicted Noise Level At dwellings to the North of the Site (dB $L_{Aeq,1hr}$)**	**Predicted Noise Level at Brookwood Estate Residences (dB $L_{Aeq,1hr}$)**
Site Preparation	Tracked excavator (C3.92)	76	50	35
	Dumper (C3.100)	74		
Foundation Laying	Compressor (C6.19)	72	49	34
	Poker Vibrator (C6.40)	73		

Stage	Phase 5			
	Plant Item (BS 5228 Ref.)	**Plant Noise Level at 10m Distance[9] (dB L_{Aeq})**	**Predicted Noise Level At dwellings to the North of the Site (dB $L_{Aeq,1hr}$)**	**Predicted Noise Level at Brookwood Estate Residences (dB $L_{Aeq,1hr}$)**
	Cement Mixers (C6.6)	71		
Steel Erection	Crane (C7.120)	76	49	34
	Lorry (C7.121)	70		
General Construction	Compressor (C7.70)	70	51	36
	Diesel Hoist (C7.97)	73		
	Pneumatic Circular Saw (C.79)	75		
	Generator (C7.51)	72		
Roadworks	Road Roller (D.8.29)	77	49	34

Table 8.14 Construction Noise Emissions for Phase 6

Stage	Phase 6			
	Plant Item (BS 5228 Ref.)	**Plant Noise Level at 10m Distance[9] (dB L_{Aeq})**	**Predicted Noise Level At dwellings to the North of the Site (dB $L_{Aeq,1hr}$)**	**Predicted Noise Level at Brookwood Estate Residences (dB $L_{Aeq,1hr}$)**
Site Preparation	Tracked excavator (C3.92)	76	39	52
	Dumper (C3.100)	74		
Foundation Laying	Compressor (C6.19)	72	38	50
	Poker Vibrator (C6.40)	73		
	Cement Mixers (C6.6)	71		
Steel Erection	Crane (C7.120)	76	38	50
	Lorry (C7.121)	70		
General Construction	Compressor (C7.70)	70	40	52
	Diesel Hoist (C7.97)	73		
	Pneumatic Circular Saw (C.79)	75		
	Generator (C7.51)	72		

Stage	Phase 6			
	Plant Item (BS 5228 Ref.)	Plant Noise Level at 10m Distance[9] (dB L_{Aeq})	Predicted Noise Level At dwellings to the North of the Site (dB $L_{Aeq,1hr}$)	Predicted Noise Level at Brookwood Estate Residences (dB $L_{Aeq,1hr}$)
Roadworks	Road Roller (D.8.29)	77	38	50

All of the predicted construction noise emission levels at the Brookwood Estate residences are well below the criterion of 65dB $L_{Aeq,1hr}$ for construction activities during a weekday. There should therefore be no disturbance caused to dwellings in the vicinity of this estate.

The predicted noise levels at the existing dwellings to the north of the site for Phases 1, 3, 5 & 6 are also well below the criterion of 65dB $L_{Aeq,1hr}$ for construction activities during a weekday. There should therefore be no disturbance caused to dwellings in this area for these phases.

The only predicted exceedances were during the Site Works phase and for Phases 2 & 4. However, these exceedances only occur at a handful of noise sensitive locations in this area as shown in Figure 8.4 below.

Figure 8.4 Noise Sensitive Locations Where Construction Noise Limit Exceedances May Occur

It should be highlighted that any potential construction noise emission exceedance that may occur at these identified locations will be relatively both temporary and short term in nature. The exceedances are due entirely to the close proximity of some of the development buildings and are therefore only likely to occur during construction of the nearest building(s) and not the entire phase (particularly during the site works phase when it will likely be limited to a few days at each). It is noted that the area is zone for development.

However, given that there are likely to be exceedances at these locations, detailed consideration should be given to the mitigation measures outlined in Section 8.6.1 of this document and we would recommend that no evening or weekend work be conducted on

development buildings that are located in the vicinity of the identified dwellings in Figure 8.4. Furthermore, continual noise monitoring should be carried out in accordance with the procedure detailed in Section 8.7.

With respect to vibration impact, the potential for vibration at neighbouring sensitive locations during construction is typically limited to excavation works and lorry movements on uneven road surfaces (we note that there is no blasting envisaged in the site preparation for the development). The more significant of these is the vibration from excavation operations; the method of which will need to be selected and controlled to ensure there is no likelihood of structural or even cosmetic damage to existing neighbouring dwellings. However, the relative distance between the excavation areas and the existing residences is such that any ground borne vibration should be well below threshold limits.

8.4.2 Operational Phase

There are seven primary sources of noise in the operational context:

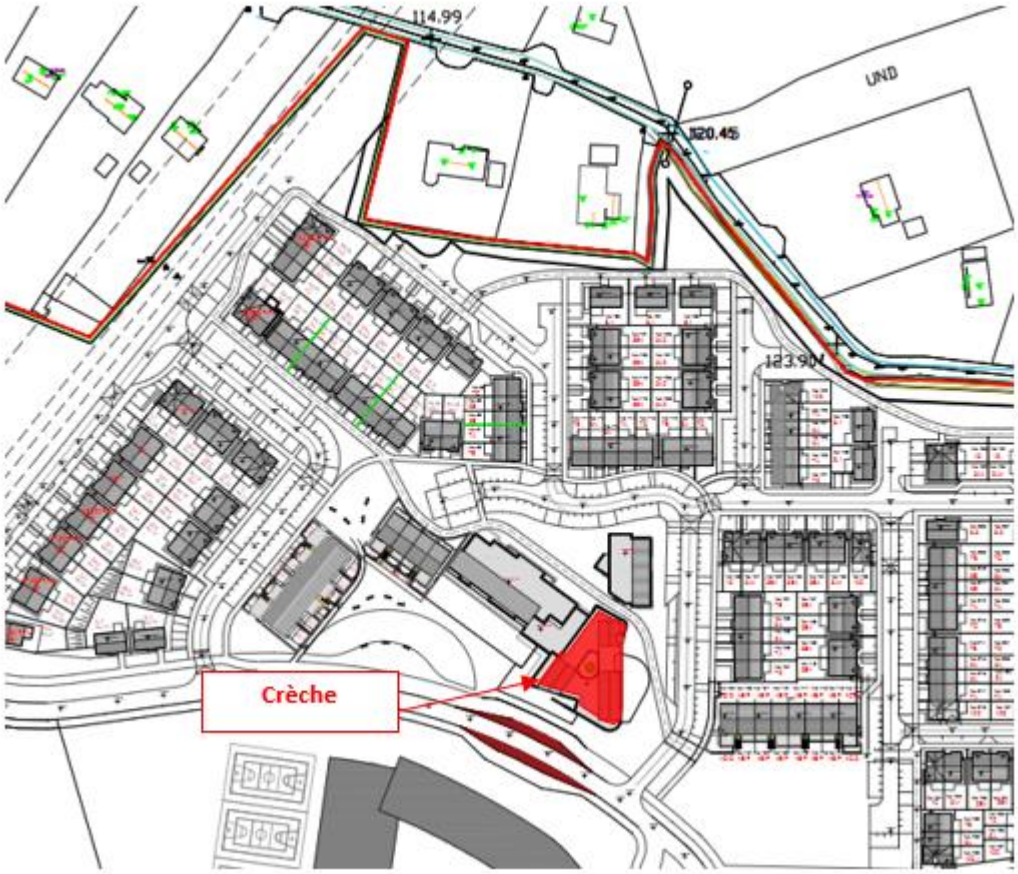
- ✓ Activity noise from crèche;
- ✓ Delivery truck events;
- ✓ Building services plant;
- ✓ Pumping station emissions;
- ✓ Development car parking;
- ✓ Vehicular traffic on the development's new internal roads; and
- ✓ Additional vehicular traffic on surrounding public roads.

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

Activity Noise from the Crèche

The crèche is to locate in Neighbourhood 2 of the development near the centre of the development as shown in Figure 8.5 below. Noise from the crèche will be primarily in the form of children playing and engaging in other outdoor activities.

Figure 8.5 Development Crèche Location



Measured noise levels for shouting / exclamatory voices in simulated conditions are 89dB L_{Aeq} when measured at a distance of 1m from the source. The nearest noise sensitive locations to the crèche are the existing dwellings located to the north of the site at a distance of 125m to the north and the Brookwood Estate dwellings located 850m to the southwest. Note that both of these locations will have a completely blocked line of sight with the crèche due to multiple numbers of development dwellings that will be situated between them.

Noise level emission predictions based on noise levels of this order to each of these nearby noise sensitive locations are as follows:

Noise Sensitive Receptor	**Noise Level**
Dwellings to North of Site	35dB $L_{Aeq,T}$
Brookwood Estate Dwellings	22dB $L_{Aeq,T}$

Predicted noise levels at the nearest noise sensitive locations resulted in levels of 35dB L_{Aeq} and 22dB L_{Aeq} for the existing dwellings to the north of the site and Brookwood Estate Dwellings respectively. These levels are below the established criteria during the daytime period (the crèche isn't expected to be operated during night-time hours) and would therefore be considered acceptable on an absolute basis.

With respect to potential relative noise impact, the measured noise levels in the vicinity of these areas (refer to reported levels in Tables 8.4 - 8.6) were in the range of 36 to 62dB L_{Aeq}

during daytime periods. The predicted crèche noise emission levels of 22 - 35dB L_{Aeq} therefore confirm that crèche noise emissions will also be below the current ambient noise levels in the surrounding vicinity.

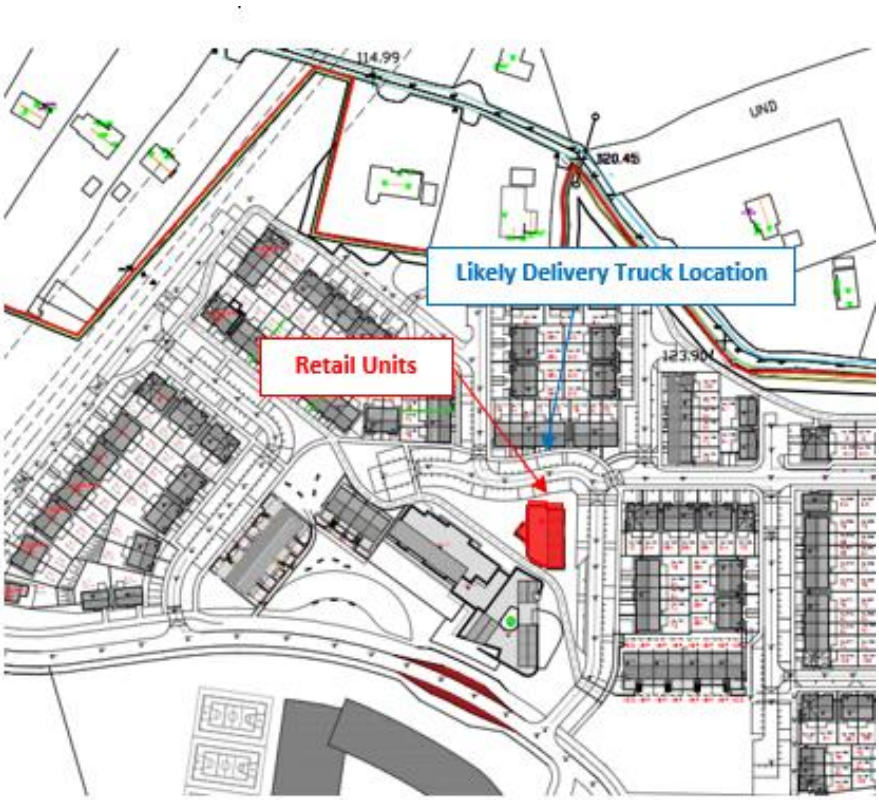
Given that the maximum noise level emission predictions from the crèche will be below both the criteria limits as well as the existing noise levels at the nearest noise sensitive locations, the likely amount of noise transmission to the local environment would therefore be considered insignificant.

No mitigation measures would therefore be required in respect of crèche noise emissions.

Delivery Truck Events

Deliveries will be required for the retail units that will be located in the local centre area of the development. In Phase 2. The retail units will likely have semi-regular deliveries that will be made with lorries that will access the building from the inner development road located along its northern façade. See Figure 8.6 on the following page

Figure 8.6 Development Retail Units Location



The noise level at a distance of 10m from a typical retail store delivery service yard is of the order of 64dB $L_{Aeq,1hr}$. This noise level includes the effects of reflections from building façades / service yard boundaries and contributions from all sources of delivery event noise, i.e. vehicles manoeuvring, air brakes, refrigeration units and trolleys. Although noise levels from smaller delivery lorries are lower than this, the 'worst-case' condition for the retail unit building service yard has been considered as a worst case condition in this instance.

As discussed above, the loading area for the retail units will be located on the northern side of the building so will not have a direct line of sight with either the existing dwellings to the

north of the site (located 105m away) and Brookwood Estate Dwellings (located 880m to the southwest). Considering the delivery noise level referred to above as well as the distance between the delivery area and the nearby noise sensitive locations, the resultant noise levels at the nearest dwellings in each of these two locations were calculated and predicted to be as follows:

Noise Sensitive Receptor	**Noise Level**
Dwellings to North of Site	33dB $L_{Aeq,T}$
Brookwood Estate Dwellings	13dB $L_{Aeq,T}$

Predicted noise levels at these locations resulted in levels of 33dB L_{Aeq} and 13dB L_{Aeq} for the dwellings to north of site and Brookwood Estate Dwellings respectively. These levels are below the established criteria during both the daytime and night-time periods and would therefore be considered acceptable on an absolute basis.

With respect to potential relative noise impacts, the measured noise levels in the vicinity of these areas (refer to reported levels in Tables 8.4 - 8.6) were in the range of 36 to 62dB L_{Aeq} during daytime periods and 30 to 57dB L_{Aeq} during night-time periods. The predicted delivery truck noise emission levels of 13 - 33dB L_{Aeq} would therefore be below the current ambient noise levels in the surrounding vicinity during the daytime period and most of the surrounding vicinity during night-time periods.

Given that the maximum noise level emission predictions from delivery events will be below the established criteria limits during both daytime and night time periods as well as being below the existing noise levels during the daytime and in most locations during night time periods, the likely amount of noise transmission to the local environment would therefore be considered insignificant.

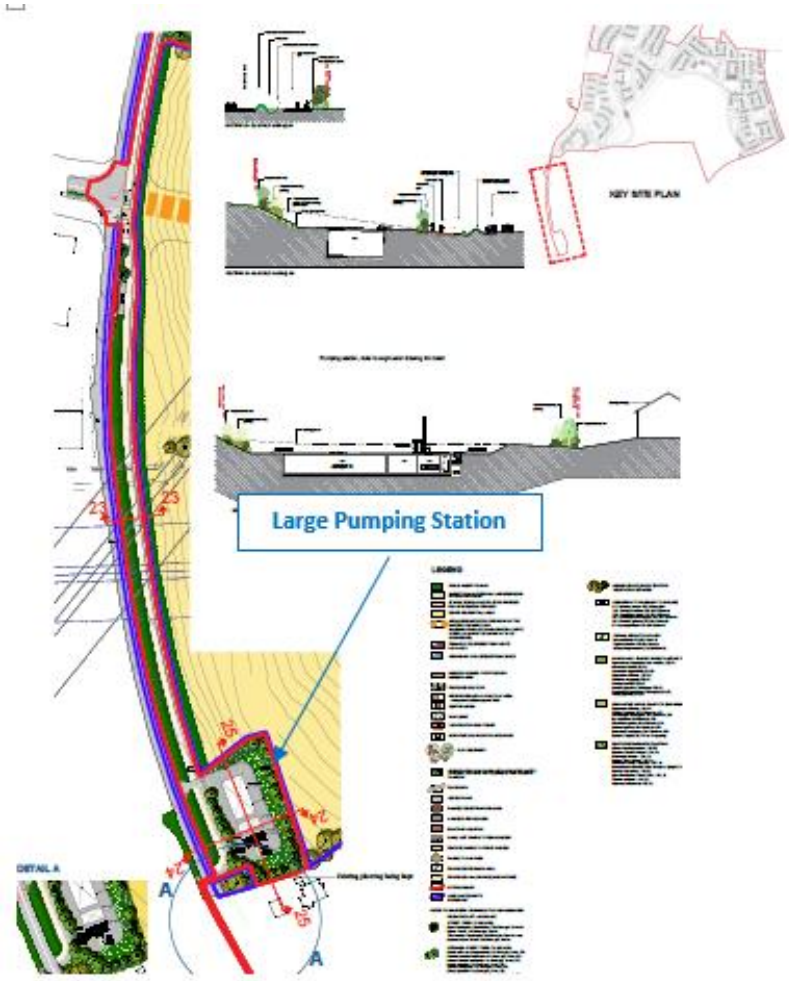
Although no mitigation measures would therefore be explicitly required in respect of delivery truck noise emissions, we would still recommend that delivery truck events are restricted to daytime periods only for the purposes of minimising any potential night time period impact to the nearest dwellings to the north of the site as well as to the adjacent residential dwellings that are within the development itself.

Pumping Station Emissions

There are two foul water pumping stations that are being included in the proposed development. The larger of the two is located approximately 400m to the south of the main development along the Ballyhooly Road in close proximity to a few detached dwellings and the smaller is located in Phase 5 aspect of the development. See Figures 8.7 and 8.8 below

Figure 8.7 Proposed Pumping Station Approximate Locations (PS in Phase 5)

Figure 8.8 Proposed Pumping Station Approximate Locations (PS on Ballyhooly Road)



Although specific pump selections are not carried out at the planning state, the proposed design of the pumping stations have the pumps located underground and in concrete block enclosure wall so external noise emissions from these pumps would therefore be negligible.

In considering the emergency generator, it should be highlighted that a relaxation in limits is typically allowed given that they only operate in emergency conditions and during occasional periodic testing as they would therefore not constitute a regular (or even semi-regular) noise source. The Environmental Protection Agency's Guidance Note for Noise: License Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) states the following:

> *"In some instances, licensed sites will have certain items of emergency equipment (e.g. standby generators) that will only operate in urgent situations (e.g. grid power failure). Depending upon the context, it may be deemed permissible for such items of equipment to give rise to exceedances in the noise criteria / limits during limited testing and emergency operation only. If such equipment is in regular use for any purposes other than intermittent testing, it is subject to the standard limit values for the site".*

Based on the above and standard best practice in similar situations, noise levels of up to 10dB(A) over the required noise criteria is normally considered acceptable, provided regular

testing only takes place during the times stated above (i.e. daytime on a weekday).

Given that sound level data for these units are not available at the planning stage, we would therefore recommend the following considerations in respect of emergency generator noise emissions:

- ✓ The units are selected and/or designed such that they do not emit noise levels of more than 70dB L_{Aeq} at a distance of 1m from the pumping station buildings.
- ✓ Restriction of testing times to maximum half hour periods during weekday daytime periods only.

Noise level emissions based on the above noise level and taking into account the shielding from the development (in the case of the smaller pumping station generator) and attenuation due to distance, noise level emissions from the large and small pumping station emergency generators are predicted to be of the order of the following respectively:

Noise Sensitive Receptor	**Noise Level**
Dwellings to North of Site	21 / 15dB $L_{Aeq,T}$
Brookwood Estate Dwellings	30 / 13dB $L_{Aeq,T}$
Dwellings Immediately to South of Large Pumping Station	48 / 23dB $L_{Aeq,T}$

Given that the maximum noise level emission predictions from the pumping station emergency generators will be below the criteria limits at all nearby noise sensitive locations, the amount of noise transmission to the local environment would therefore be considered insignificant.

Development Car Parking

The car-parking facilities for the development will consist of surface level spaces in driveways and in front of homes. Given the large amount of land area that the development comprises, the vast majority of surface car park spaces will be in the interior of the development and therefore shielded by the development dwellings themselves. There are some areas that are exposed to the existing dwellings to the north of the site which are located primarily at the end of streets, but these areas would therefore experience minimal activity of the course of a day.

Taking into account the shielding from the development and attenuation due to distance, noise levels from residential car parking along the vast majority of the development boundary are predicted to be in the range of the following on a worst-case hourly basis:

Noise Sensitive Receptor	**Noise Level**
Dwellings to North of Site	< 20dB $L_{Aeq,1hr}$
Brookwood Estate Dwellings	< 10dB $L_{Aeq,1hr}$

These predicted level ranges are below both the established criteria limits and the existing noise levels at the nearest noise sensitive locations. The likely amount of noise transmission

to the local environment due to car parking activities would be imperceptible and therefore considered insignificant.

No mitigation measures would therefore be required in respect of car parking event noise emissions.

Building Services Plant

Once operational, the development will have various electrical and mechanical plant operating to service the Village Centre crèche, retail units, doctor's surgery, community centre and potentially some of the apartment blocks, e.g. heating / refrigeration plant, pumps, etc. Most of this plant will be capable of generating noise to some degree. Some of this plant may operate 24-hours per day and, therefore, would be more noticeable during quiet periods (typically night-time hours). Building services plant with a direct line-of-sight to adjacent properties to the residential dwellings to the north of the site would likely have the greatest impact.

It is expected that the majority of building services plant for this development will be located either internally or on building rooftops. Given that the building services plant design has not been completed at the planning stage, we would therefore recommend that the selected plant have a noise level no louder than 75dB L_{Aeq}[2] at a distance of 1m from the unit or building façade (or have noise control measures incorporated to achieve the same). In addition, a barrier wall should be provided to screen any noise producing mechanical equipment provided on the roof or at ground level with direct line-of-sight with the nearby existing dwellings.

Taking into consideration this noise level along with the appropriate corrections for distance, screening, and the presence of nearby reflecting surfaces, the resultant noise levels at the façades of the nearest noise-sensitive locations have been calculated and are predicted to be as follows:

Noise Sensitive Receptor	Noise Level
Dwellings to North of Site	30dB $L_{Aeq,1hr}$
Brookwood Estate Dwellings	10dB $L_{Aeq,1hr}$

The noise levels at the nearest residential dwellings are predicted to be in the range of 10 to 30dB L_{Aeq} which is lower than the established daytime and night-time criteria at all nearby noise sensitive locations. These levels are also below the existing daytime noise levels and consistent with or below the existing night-time noise levels at the nearby noise sensitive locations in the vicinity of the development. The likely amount of noise transmission to the local environment due to building services plant would therefore be considered insignificant.

No mitigation measures would therefore be required in respect of building services plant apart from the 65dB L_{Aeq} maximum noise level requirement for selected plant and provision

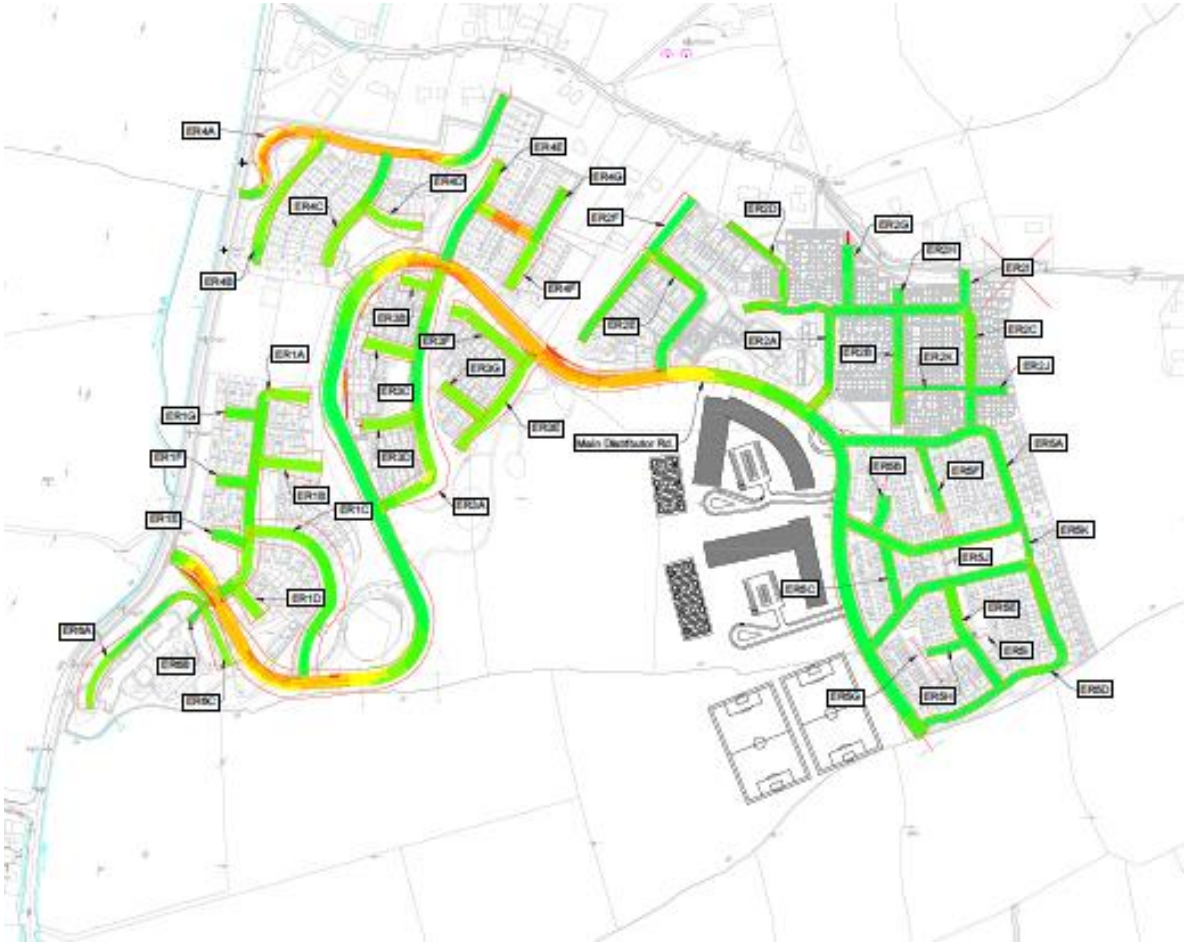
[2] Note that noise levels for the selected building services plant will be determined by the design stage acoustic consultant and will likely be lower than this due to the necessity to achieve similar noise level criteria for residential spaces internally within the development so the 75dB L_{Aeq} at 1m level would therefore be considered appropriate to consider as a worst case condition for outward noise impact purposes.

of screening walls for plant with direct line of sight with the existing dwellings to the north.

Vehicular Traffic on New Internal Road Network

The proposed development includes a new road network that provides access to areas throughout the development (see Figure 8.9 on the following page). The main internal road will primarily run along the south side of the development which will shield it from the existing dwellings to the north. However, there are a number of smaller estate roads located throughout the development.

Figure 8.9 Proposed Development Road Network



The noise level associated with an event of short duration, such as a vehicle drive-by, may be expressed in terms of its Sound Exposure Level[3] (SEL). The SEL can be used to calculate the contribution of an event or series of events to the overall noise level in a given period. The appropriate formula is as follows:

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

where: $L_{Aeq,T}$ is the equivalent continuous sound level over the time period T (s);

[3] Defined as being the "A-weighted" equivalent continuous sound level which, when maintained for one second, contains the same quantity of sound energy as the actual time varying level of one event.

SEL is the “A-weighted” Sound Exposure Level of the event under consideration (dB);

N is the number of events over the course of time period T.

The mean value of a Sound Exposure Level for a car movement, at low to moderate speeds, is of the order of 65dB(A) at a distance of 5m from the edge of the road. This figure is based on a series of measurements conducted under controlled conditions.

In order to consider the effect of development traffic flows, AM peak hour trip generation was estimated by MHL Consulting Engineers for each development phase. These AM peak hour trip estimates are provided in Table 8.15.

Table 8.15 Development AM Peak Hour Trip Estimates By Phase

Phase	In	Out	Total
1	48	101	149
2	47	98	145
3	60	125	185
4	70	147	217
5	88	185	273
6	111	233	344

In order to estimate a worst-case condition of the noise emissions from all of the internal road network in totality, we have conducted separate calculations for each phase primary road at dwellings to the north of the site and in the Brookwood Estate. Using the method outlined above, the predicted noise levels due to the development internal road networks are detailed in Table 8.16 below.

Table 8.16 Internal Road Network Noise Emissions

Phase	Noise Level, dB $L_{Aeq,1hr}$	
	Dwellings to North of Site	Brookwood Estate Dwellings
1	11	31
2	12	23
3	37	11
4	27	13
5	40	12
6	20	22
TOTAL	**42**	**33**

Predicted noise level emissions from the new road network are predicted to be of the order of 42dB L_{Aeq} and 33dB L_{Aeq} for the existing dwellings to north of site and Brookwood Estate Dwellings respectively. These worst-case peak noise levels are below the established noise emission criteria during both the daytime and night time periods and would therefore be considered insignificant on an absolute basis.

With respect to relative noise impacts, the predicted development traffic noise emission levels would be below the existing noise levels in the vicinity of the Brookwood Estate and at dwellings to north of site dwellings that are near to the Ballyhooly Road. It is also likely that development traffic noise emissions will be consistent or below with the existing noise levels in the vicinity of residential dwellings located further to the west along the road to the north of the site given that traffic flows along both the road to the north and the development internal roads will be similar during the AM peak hour period. The likely amount of noise transmission to the local environment due to traffic along the development internal road networks would therefore be insignificant.

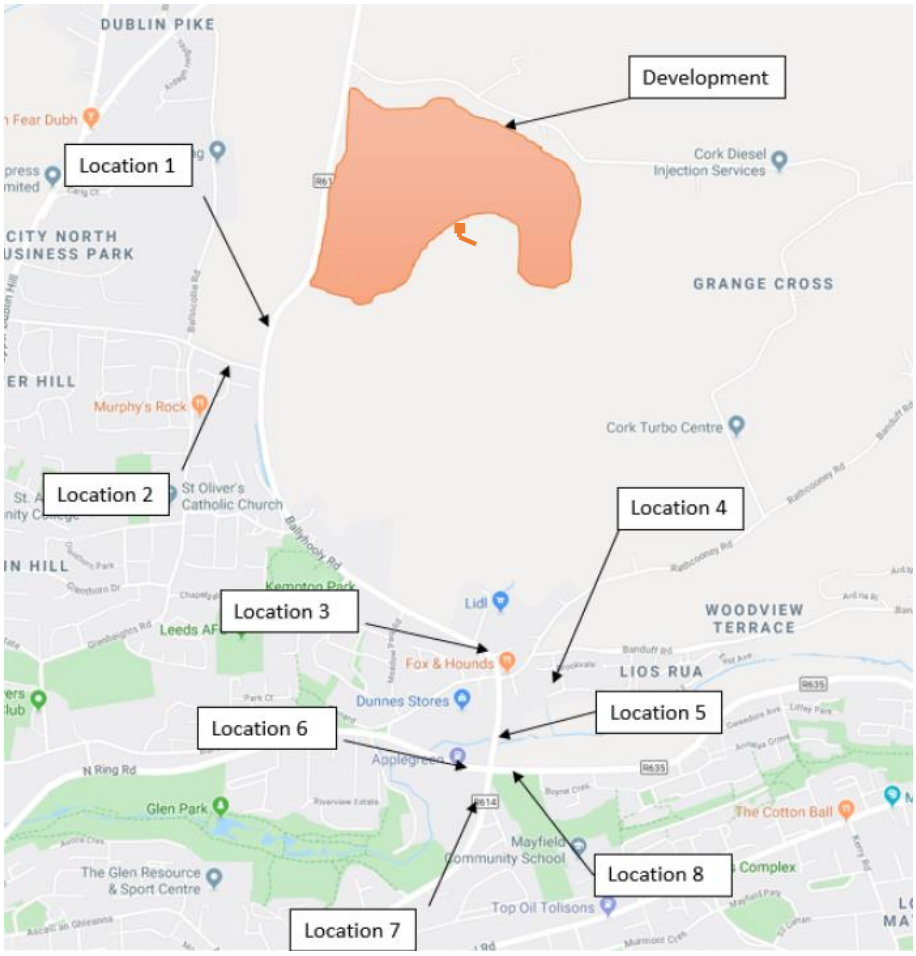
Note also that traffic noise emissions from the main internal distributor road (and smaller branch roads) are typical of residential developments of this order so standard insulating glass constructions would be sufficient to reduce traffic noise emissions to within acceptable criteria limits; however, glazing constructions with panes of different thicknesses are recommended to prevent the potential for resonant conditions.

No mitigation measures would therefore be required in respect of vehicular traffic on internal roads.

Additional Vehicular Traffic on Public Roads

The proposed development will introduce some additional traffic onto public roads in the locality of the site. The traffic flow information was provided by MHL Consulting Engineers for a number of points along the adjacent road networks. These assessment points are shown in Figure 8.10 below.

Figure 8.10 Proposed Development Adjacent Road Network Assessment Locations



The results of our analysis based on this information are presented in Table 8.17 on the following page.

Table 8.17 Change in Traffic Noise Level at Location 1

	Location							
	Loc 1	**Loc 2**	**Loc 3**	**Loc 4**	**Loc 5**	**Loc 6**	**Loc 7**	**Loc 8**
AADT Without Development	4,571	6,199	14,577	11,253	10,760	14,971	10,502	17,307
AADT With Development	5,132	6,325	15,012	11,392	11,005	14,979	10,678	17,368
Noise Level Change (dB)	+0.5	+0.1	+0.1	+0.1	+0.1	+0.0	+0.1	+0.0

The differences between predicted traffic flows with and without the site are such that the resulting increase in noise levels are ≤ 0.5dB on all surrounding road networks. Reference to Table 8.3 confirms that increases of this order would be imperceptible.

The likely amount of noise transmission to the local environment due to additional vehicular traffic on public roads would therefore be considered insignificant.

No additional mitigation measures would therefore be required in respect of additional vehicular traffic on public roads.

Cumulative Operational Noise Impact

The total level of combined noise emissions from the proposed development noise sources can be determined by summing together all of the individual contributions. The total levels of each are summarised and totalled in Table 8.18 below.

Table 8.18 Proposed Development Cumulative Noise Level Emissions Summary

Noise Source	**Noise Level Emission (dB L_{Aeq})**	
	Road to the North of the Site	**Brookwood Estate**
Crèche	35	22
Delivery Events	33	13
Car Parking Activities	< 20	< 10
Pumping Station Emissions[4]	Nil	Nil
Building Services	30	10
Vehicular Traffic On New Internal Road	42	32
Cumulative Noise Level	**43**	**33**

It should be highly emphasised that the predicted cumulative noise levels in Table 8.18 consider an extreme worst case condition. In this instance, they assume that deliveries are being made to retail outlets whilst the crèche is in operation and also that these events coincide with the AM Peak Hour. This will likely never be the case but it provides definitive confirmation that the cumulative noise levels for each worst case condition of all development noise sources are within the established project noise emission criteria. A comparison of these worst case daytime cumulative levels with the established noise emission criteria are shown in Table 8.19 below.

[4] Note that contributions from pumping station emergency generators have been excluded from the cumulative total given that they will only occur during emergency situations and/or during isolated and short term testing periods.

Table 8.19 Proposed Development Daytime Noise Emission Level Comparison with Established Criteria

Location	Predicted Noise Level	Noise Emission Criteria	Compliant?
Dwellings to North of Site	43dB L_{Aeq}	Daytime: 50dB $L_{Aeq,16hr}$	Yes
Brookwood Estate Dwellings	33dB L_{Aeq}		Yes

As can be seen from the comparison in Table 8.19, the expected levels of noise emissions from the proposed development are well within the established daytime criteria at all nearby noise sensitive receptors. It should also again be noted that the noise level conditions that were assessed and summarised in the table would be considered worst case in each instance.

Note that the predicted daytime noise levels in Table 8.19 are also less than the established night time criteria of 45dB $L_{Aeq,16hr}$ at all nearby noise sensitive locations. However, the only noise source of any significance associated with the development that is expected to occur during night time periods is building services noise along with occasional internal traffic and car parking events. This will mean that the development's night time noise emissions are expected to be in the range of 30 - 32dB L_{Aeq} and 10 - 15dB L_{Aeq} at the dwellings to north of site and Brookwood Estate dwellings respectively which are even further below the 45dB $L_{Aeq,16hr}$ night time criterion.

There is therefore no significant noise impact that is expected from the proposed development on any of the identified nearby noise sensitive receptors.

There are several permitted and proposed development in the wider area that have been considered as part of this assessment. These are:

- Cork County Council planning ref. 19/5326 for the construction of 20 no. residential units and all ancillary site works at Banduff Road approved in August 2019.

- Cork County Council planning ref. 17/6781 for the construction of 74 no. residential units at Dublin Pike, Ballincrokig approved in April 2018.

- Cork County Council planning ref. 16/5477 for development comprising the demolition of 1 no. building accommodating an existing Lidl Licenced Discount Foodstore (1,749 sq m Gross Floor Area with 1,391 sq m Net Retail Sales Area) and a disused retail unit formerly occupied by the New Furniture Centre (970 sq m Gross Floor Area with 776 sq m Net Retail Sales Area), and the construction of a new mono-pitched Licenced Discount Foodstore with ancillary infrastructure and associated site development works at Ballyhooly Road approved in August 2016.

- The Ballyvolane Strategic Transport Corridor Project: North Ring Road to Ballincolly. Design of the scheme is being advanced by a team of consultants instructed by Cork City Council supported by the National Transport Authority. The detailed design will be the subject of a Part 8 planning application by Cork City Council.

- The development of the remainder of the Ballyvolane Urban Expansion Area. The lands have been designated for development through the Local Area Plan land use zonings. Infrastructure proposed as part of this planning application i.e. the distributor road and waste water infrastructure will help to unlock other lands within the expansion area for development. These lands will be subject to separate planning applications in the future.

During the construction phase of the proposed development, construction noise on site will be localised and will therefore likely be the primary noise source at the nearest noise sensitive receivers. In the event that construction activities associated with the majority of developments noted above occur simultaneous to the proposed development, they are at sufficient distances such that the cumulative noise levels will remain dominated by the localised works referred to in this Chapter.

In the event that works on site and works associated with adjoining sites in the urban expansion area were ongoing simultaneously, there is potential for cumulative noise impacts at assessment locations. However the contractor will be required to control noise impacts associated with other development in line with the relevant guidance levels. The impact from any construction works associated with the other developments listed above is considered to be imperceptible.

'*Do Nothing'* Scenario

If the site remains undeveloped it shall continue to have no noise or vibrational impact on the receiving environment. Increases in local traffic would be relatively minor and would not result in an imperceptible change in the existing noise climate at any local receptor.

8.5 Mitigation Measures

8.5.1 Construction Phase

The scheme contractor will be obliged to give due regard to *Code of Practice BS 5228: Noise Control on Construction and Open Sites*, which offers detailed guidance on the control of noise from construction activities. In particular, it is proposed that various practices be adopted during construction, including:

- Limiting the hours during which site activities likely to create high levels of noise are permitted. The hours listed in Table 8.1 should therefore be rigidly adhered to.

- Establishing channels of communication between the contractor/developer, local authority and residents.

- Appointing a site representative responsible for matters relating to noise.

- Ensuring all site access roads are kept as even as possible so as to mitigate the potential for vibration from lorries.

- Monitoring typical levels of noise during critical periods and at sensitive locations (at houses along the road to the north only) in accordance with the approach discussed in Section 8.7.

- Provision of site hoarding for screening purposes.

Furthermore, it is envisaged that a variety of additional and practicable noise control measures will be employed, including:

- Selection of plant with low inherent potential for generation of noise.

- Siting of noisy plant as far away from sensitive properties as permitted by site constraints.

- All compressors shall be "sound reduced" models fitted with properly lined and sealed acoustic covers which shall be kept closed whenever the machines are in use.

- All ancillary pneumatic percussive tools shall be fitted with mufflers or silencers of the type recommended by the manufacturers, and where commercially available, dampened tools and accessories shall be used.

- Blasting will only be permitted in agreement with Cork City Council. As outlined in the preliminary site investigation report rock encountered on-site is 'rippable' so blasting is not anticipated at this stage.

Vibration from construction activities will be limited to the values set out in Table 8.20 but will likely be far below these values. It should be noted that these limits are not absolute, but provide guidance as to magnitudes of vibration that are very unlikely to cause cosmetic damage. Magnitudes of vibration slightly greater than those in the table are normally unlikely to cause cosmetic damage, but construction work creating such magnitudes should proceed with caution. Where there is existing damage, these limits may need to be reduced by up to 50%.

Table 8.20 Allowable Vibration during Construction Phase

Allowable vibration (in terms of peak particle velocity) at the closest part of any sensitive property to the source of vibration, at a frequency of		
Less than 10Hz	**10 to 50Hz**	**50 to 100Hz (and above)**
3 mm/s	3 to 8 mm/s	8 to 10 mm/s

Where required, construction noise monitoring will be undertaken at periodic sample periods at the nearest noise sensitive locations to the development works to check compliance with the construction noise criterion. Noise monitoring should be conducted in accordance with the International Standard ISO 1996: 2017: *Acoustics – Description, measurement and assessment of environmental noise*.

8.5.2 Operational Phase

Activity Noise From Proposed Crèche

The noise impact assessment outlined in the previous section has demonstrated that no additional noise mitigation measures will be required in respect of activity noise from the crèche.

Delivery Truck Events

The noise impact assessment outlined in the previous section has confirmed that the following additional mitigation measure should be applied in relation to delivery truck events:

Mitigation Measure 8.1: Retail unit delivery truck events should be restricted to daytime periods only.

Pumping Station Emissions

The noise impact assessment outlined in the previous section has confirmed that the following additional mitigation measure should be applied in relation to pumping station emissions:

Mitigation Measure 8.2: Emergency generators shall be selected and/or designed such that they do not emit noise levels of more than 70dB L_{Aeq} at a distance of 1m from the pumping station buildings.

Mitigation Measure 8.3: Restriction of emergency generator testing times to maximum half hour periods during weekday daytime periods only.

Development Car Parking

The noise impact assessment outlined in the previous section has demonstrated that no additional noise mitigation measures will be required in respect of development car parking.

Building Services Plant

The noise impact assessment outlined in the previous section has confirmed that the following additional mitigation measures should be provided in relation to building services plant:

Mitigation Measure 8.4: Selected building services plant shall have a noise level no louder than 75dB L_{Aeq} at a distance of 1m from the unit or building façade (or have noise control measures incorporated to achieve the same).

Mitigation Measure 8.5: A barrier wall should be provided to screen any noise producing mechanical equipment provided on the roof (or if provided at ground level) with direct line-of-sight with the dwellings to the north.

Vehicular Traffic on New Internal Road Network

The noise impact assessment outlined in the previous section has demonstrated that no additional noise mitigation measures will be required in respect of vehicular traffic on the new internal road network.

Additional Vehicular Traffic on Public Roads

The noise impact assessment outlined in the previous section has demonstrated that no additional noise mitigation measures will be required in respect of additional vehicular traffic on public roads.

8.6 Predicted (Residual Impacts)

8.6.1 Construction Phase

The application of the practicable noise control mitigation measures listed in the previous section and controlled hours of working will ensure that the impact of construction noise and vibration associated with the development is mostly within the criteria limits established in this report and minimised as far as practicable.

There will be some slight noise impacts to a handful of residential dwellings located along the north of the site during periods of a few of the development construction phases but these exceedances are expected to be both minimal and temporary in nature.

No other significant residual noise or vibration impact from the development construction phases is expected at any of the other noise sensitive locations in the vicinity of the development.

8.6.2 Operational Phase

The provision of the delivery truck, pumping station and building services mitigation measures detailed in the previous section will ensure that the proposed development's cumulative residual noise levels detailed in Table 8.19 are achieved. These levels are within the criteria limits established in this report and would therefore be considered insignificant.

The noise impact generated by additional traffic movements associated with the development is predicted to be of an imperceptible impact on existing ambient noise levels at receptors along the local road network.

Impacts from all other noise sources associated with the development have been confirmed as being insignificant. No significant residual noise or vibration impact from the development operational phase is therefore expected at any of the noise sensitive locations in the vicinity of the development.

8.7 Monitoring

Further to the construction noise assessment which identified a number of existing dwellings along the north of the site that may encounter some slight exceedances during a few of the development phases, continuous boundary noise monitoring is recommended.

Monitoring locations should be selected so as to be representative of the closest dwellings to the works and as a minimum should include the locations shown in Figure 8.11 during the

Site Works Phase and Phases 3 & 5. Noise monitoring should be conducted continuously during each of these phases and take into account the following requirements:

- ✓ Noise levels shall be measured in terms of the following quantities: $L_{Aeq,1hr}$ & L_{Amax}.
- ✓ The sound level meter shall be a Class 1 integrating sound level meter, complying with BS EN 61672:2003.
- ✓ The field calibrator shall comply with BS EN 60942:2003.
- ✓ Both the sound level meter and calibrator will have valid calibration certificates issued not more than one year prior.
- ✓ The equipment should be calibrated on a weekly basis and any drift in calibration level identified.
- ✓ An SMS transmitter shall be fitted to the monitoring equipment. If the adopted threshold level for noise is exceeded, an SMS message shall be sent to the contractor's appointed Noise Liaison Officer.
- ✓ When an exceedance is confirmed, the works shall be halted and alternative working practices or additional mitigation measures implemented.
- ✓ Monitoring results shall be downloaded on a weekly basis and summarised in a report format to be agreed with the Noise Liaison Officer.

Figure 8.11 Recommended Construction Noise Monitoring Locations

8.8 Difficulties Encountered

There were no particular difficulties encountered in relation to the production of this chapter.

8.9 References

British Standard, *BS 8233 (2014): Guidance on Sound Insulation and Noise Reduction for Buildings.*

British Standard *BS5228-1:2009+A1 Code of practice for noise and vibration control on construction and open sites - Part 1: Noise.*

British Standard, *BS 5228-2: 2009: Code of practice for noise and vibration control on construction and open sites - Vibration*.

British Standard, *BS 7385: 1993: Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration.*

International Organization for Standardization *ISO 1996-2: 2017: Acoustics - Description, measurement and assessment of environmental noise.*

Environmental Protection Agency *(2002) Guidelines on Information to be contained in Environmental Impact Statements.*

Institute of Acoustics / Institute of Environmental Management and Assessment (2002) *The Draft Guidelines for Noise Impact Assessment*.

Office of Environmental Enforcement. (2003) *Advice Note on Current Practice (in the preparation of Environmental Impact Assessments).*

British (European) Standard, *BS EN 61672-1:2003 Electroacoustics. Sound level meters.*

British (European) Standard, *BS EN 60942:2003 Electroacoustics. Sound calibrators.*