Kinnegad NIA

Noise Impact Assessment

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Document Information

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Draft	24/03/2025	Draft	Stephen McDonagh	Dr Emmet English
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Glossary

A-weighting	A spectrum adaption that is applied to measured noise levels to represent human hearing. A-weighted levels are used as human hearing does not respond equally at all frequencies.
dB	Decibel—a unit of measurement used to express sound level. It is based on a logarithmic scale which means a sound that is 3 dB higher has twice as much energy. We typically perceive a 10 dB increase in sound as a doubling of that sound level.
dB(A)	Units of the A-weighted sound level.
Frequency (Hz)	The number of times a vibrating object oscillates (moves back and forth) in one second. Fast movements produce high frequency sound (high pitch/tone), but slow movements mean the frequency (pitch/tone) is low. 1 Hz is equal to 1 cycle per second.
L_{eq}	Equivalent Noise Level—Energy averaged noise level over the measurement time.
L_{90}	Noise level exceeded for 90 % of the measurement time. The L_{90} level is commonly referred to as the background noise level.
R_W	Weighted Sound Reduction Index—A laboratory measured value of the acoustic separation provided by a single building element (such as a partition). The higher the R_W the better the noise isolation provided by a building element.
Reverberation Time (RT)	Of a room, for a sound of a given frequency or frequency band, the time that would be required for the reverberantly decaying sound pressure level in the room to decrease by 60 decibels.
$D_{n,e,w}$	Element normalised level difference, weighted - A laboratory measured value of the acoustic separation provided by a small building element.
L_{den}	(day-evening-night noise level) is the A-weighted, Leq (equivalent noise level) over a whole day, but with a penalty of +10 dB(A) for night-time noise (22:00-07:00) and +5 dB(A) for evening noise (19:00-23:00).
L_{day}	(day noise level), is the A-weighted, Leq (equivalent noise level) over the 16-hour day period of 07:00-23:00 hours, also known as the day noise indicator
L_{night}	(night noise level), is the A-weighted, L_{eq} (equivalent noise level) over the 8-hour night period of 23:00-07:00 hours, also known as the night noise indicator.

Executive Summary

Amplitude Acoustics have been engaged to conduct a Noise Impact Assessment of the proposed Large Scale Development located in Kinnegad, Co. Westmeath.

The proposed development consists of 129 no. residential units made up of 2 beds, 3 beds and 4 beds, and a childcare facility.

The criteria for the project have been developed with regard to the requirements of:

- Westmeath Noise Action Plan 2024 – 2028
- WHO Community Noise Guidelines
- British Standard BS8233:2014 'Guidance on sound insulation and noise reduction for buildings.
- BS 5228-1:2009+A1: 2014 Code of practice for noise and vibration control on construction and open sites: Part 1 – Noise (BS 5228-1), 2014
- BS 5228-2:2009+A1:2014 Code of Practice for Noise and Vibration Control on Open Construction Sites – Part 2: Vibration (BS 5228-2), 2014.
- ProPG: Planning & Noise – New Residential Development, May 2017

A noise and vibration impact assessment of the likely construction activities for the site was undertaken in general accordance with the methodology detailed in BS 5228-1:2009+A1: 2014 Code of practice for noise and vibration control on construction and open sites: Part 1 – Noise (BS 5228-1), 2014. Construction noise mitigation measures are provided and an overview of the potential noise and vibration issues during construction has been set out as preliminary guidance.

A review of the EPA Maps of Noise due to National Roads, including M4/M6 motorways and relevant access roads and junctions indicates the site lies with the extents of the following:

- L_{DEN} 55-59dB contour.
- L_{night} 50-54dB contour.

Attended and unattended noise surveys were conducted on 14th to 19th November 2024, in accordance with the guidance of *ISO 1996-2:2017 Acoustics — Description, measurement and assessment of environmental noise — Part 2: Determination of sound pressure levels* to assess the noise levels incident on the site. Using the measured noise levels, the daytime $L_{Aeq\ (07:00 – 23:00)}$ and night-time $L_{Aeq(23:00 – 07:00)}$ were determined. The measured noise level include all local contributions to the noise on site including local traffic, distant construction noise and the M4/M6 motorways.

The noise sources included within the development have been used to conduct an operational noise impact assessment with regards to environmental noise standards BS4142, EPA NG4 and Westmeath Noise Action Plan, and the existing background noise levels.

The assessment has shown that there is an ***insignificant*** noise impact at the nearby residential locations due to the proposed development in place.

A 'Stage 1: Initial Site Noise Risk Assessment' and a 'Stage 2: Full Assessment', in line with advice on Professional Practice Guidance (ProPG) – Planning & Noise were undertaken. During the daytime and night-time, the risk categories across the site are predominately Low to Medium risk, with the night-time L_{AFmax} levels being the driving factor for façade specification.

Interior noise levels for the whole development are predicted to comply with interior noise level criteria (including both L_{Aeq} and L_{AFMax}) from BS 8233 and referenced in ProPG provided that the construction requirements detailed in section 6.3 are implemented. Therefore, sleep disturbance due to the predicted internal noise levels is unlikely to occur.

The main external amenity areas have been designed to comply with the desirable criteria of L_{Aeq} 50 - 55 dBA which complies with the guidance values stated in BS8233.

Based on the results of the assessment the proposed development is predicted to comply with the relevant requirements of the Westmeath Noise Action Plan 2024 – 2028, WHO guidance and ProPG, subject to implementing the design guidance outlined within this report.

Table of Contents

1 Introduction

Amplitude Acoustics have been engaged to conduct a planning stage acoustic assessment of a proposed residential development at Tyrrell Lands, Kinnegad, Co. Westmeath. This document will form part of the planning application.

The proposed development will comprise 129 no. houses (1 bed, 2 beds, 3 beds and 4 beds) and the provision of a crèche facility.

The development also includes additional facilities infrastructure including car and bicycle parking facilities, bin storage areas, boundary treatments, and a substation.

This report details the findings of a noise impact assessment addressing the various aspects of the proposed development.

1.1 Statement of Authority

This report was completed by Amplitude Acoustics, an acoustic consultancy that specialises in noise and vibration. Amplitude's team have successfully completed a large number of projects throughout Ireland, Europe, the Middle East, Australasia and North America. Our approach to the provision of services is based upon experience gained on many projects, underpinned by a deep understanding of the technical and social principles behind government noise policy.

Dr Emmet English was the technical lead on the project, who has a degree in Mechanical Engineering and a PhD in Acoustics. Emmet has over 20 years of professional experience in acoustics and is a member of Engineers Ireland and the Institute of Acoustics. Emmet has extensive experience assessing the noise and vibration impacts of residential developments in Ireland and Internationally.

2 Site Description

The proposed development is located in Boreen Bradach, Kinnegad, Co. Westmeath.

The site is bounded by:

- Residential dwellings to North, South and East.
- St Etchen's National School to the West.
- Eurospar Supermarket and Carpark to the South-West.

Figure 1 shows an aerial view showing the approximate property boundary and proposed development area in relation to the surrounding area.

Figure 1: Site Location Map Image © Google Earth

The proposed development layout is presented Figure 2 below.

Figure 2: Proposed Development layout

3 Acoustic Criteria

3.1 Internal Noise Levels

The relevant internal noise criteria for the development have been based on the requirements of:

- Westmeath Noise Action Plan 2024 - 2028
- BS 8233:2014 *Guidance on sound insulation and noise reduction for buildings* and,
- ProPG: Planning & Noise Professional Practice Guidance on Planning & Noise New Residential Development May 2017
- WHO Community Noise Guidelines

Table 1 below provides relevant internal L_{Aeq} target levels for overall noise in the design of a building:

Table 1: BS 8233:2014 internal noise criteria – Commercial and Residential Buildings.

Activity	Location	Daytime 07:00 to 23:00 Hrs	Night 23:00 to 07:00 Hrs
Resting	Living Room	35 dB $L_{Aeq,\ 16\ hour}$	-
Dining	Dining Room/Area	35 dB $L_{Aeq,\ 16\ hour}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,\ 16\ hour}$	30 dB $L_{Aeq,\ 8\ hour}$ 45dB L_{Amax} (Note 1)

Note 1: Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values. In most circumstances in noise sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB $L_{Amax,F}$ more than 10 times a night.

For the purposes of this assessment, we have determined glazing and ventilation requirements on the basis of achieving internal noise criteria as shown in Table 1 the living, sleeping and working areas of the proposed development.

3.2 External Amenity Areas

Guidance on noise levels for external amenity areas is provided by BS 8233:2014, and ProPG 2017. ProPG 2017 refers to the BS8233:2014 guidance which states that: "*the acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed, and noise levels should ideally not be above the range 50 – 55 dB $L_{Aeq,16hr}$".* The standard continues… *"These guideline values may not be achievable in all circumstances where development might be desirable. In such a situation, development should be designed to achieve the lowest practicable noise levels in these external amenity spaces but should not be prohibited."*

It should be noted that both BS8233:2014 and ProPG 2017 do not advise that development should be restricted in areas with undesirable noise levels, however it does recommend that appropriate mitigation measures are put in place and planning should not be restricted on this basis. Where required, design guidance has been provided to ensure lowest practicable external noise levels are achieved in line with ProPG 2017.

3.3 ProPG: Professional Practice Guidance on Planning & Noise

In order to assess the noise risk to the proposed development and as a result appropriate mitigation the methodology provided in ProPG has followed.

ProPG was published on 22 June 2017 and the scope is restricted to new residential development exposed predominantly to airborne noise from transport sources. The guidance encourages better acoustic design for new residential development and aims to protect people from the harmful effects of noise. The guidance was prepared by the Institute of Acoustics, the Association of Noise Consultants and the Chartered Institute of Environmental Health. It encourages a holistic design process where acoustics is integral to the living environment. This covers careful site layout and better orientation of rooms within dwellings. *ProPG acknowledges and reflects the Noise Policy Statement for England, the National Planning Policy Framework and Planning Policy Guidance – Noise.*

The recommended approach for new residential development is in two stages; Stage 1 is an initial noise risk assessment of the proposed development site for an early indication of the initial suitability of the site for new residential development.

3.3.1 Stage 1 Assessment

For reference, the indicative noise levels for the initial site noise risk assessment as presented in ProPG are illustrated below.

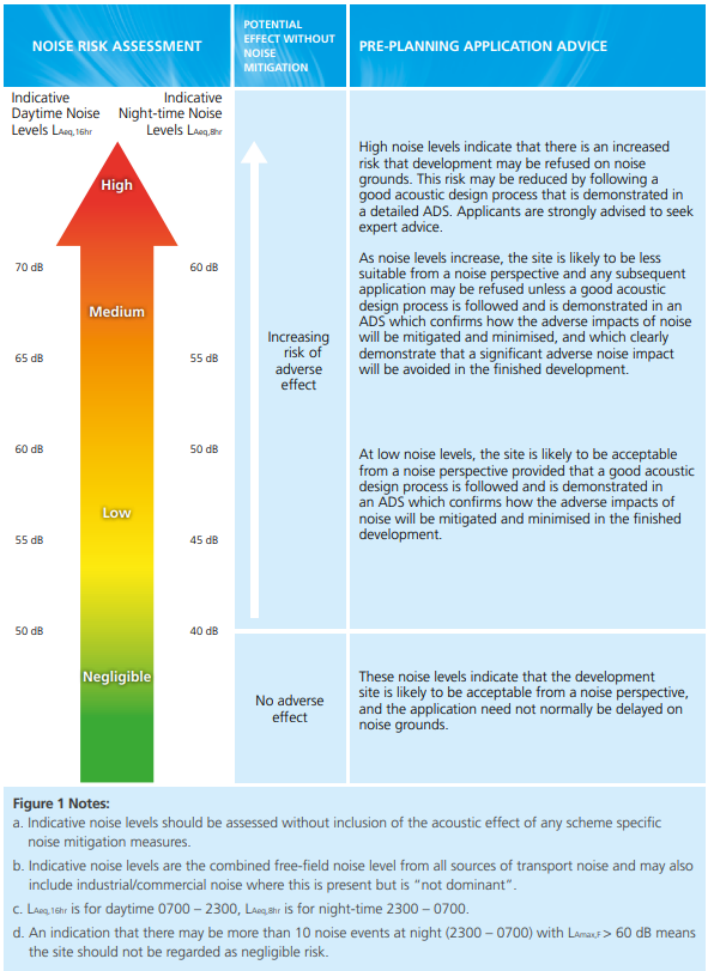

Figure 3: Stage 1 – Initial Site Noise Risk Assessment

3.3.2 Stage 2 Assessment

Stage 2 is a systematic consideration of four key elements:

- Demonstrating a “Good Acoustic Design Process”.
- Observing internal “Noise Level Guidelines”.
- Undertaking an “External Amenity Area Noise Assessment”.
- Consideration of “Other Relevant Issues”.

Good Acoustic Design Process

General principles (in order of preference):

- Maximising spatial separation of noise sources and receptors.
- Reducing existing noise levels or relocating noise sources, if possible.
- Using existing topography and existing structures.
- Incorporating noise barriers as part of the scheme.
- Using layout to reduce noise propagation across the site.
- Using orientation to reduce noise exposure of sensitive rooms.
- Using building envelope to mitigate noise.

Internal Noise Level Guidelines

ProPG guidance is based on BS 8233:2014 and World Health Organisation recommendations. Internal ambient noise levels (IANL) are provided in Table 1.

External Amenity Areas

External amenity areas which are an intrinsic part of the overall design should ideally not be above 50 - 55 dB $L_{Aeq,16hr}$; or designed to achieve the lowest practicable noise levels (BS 8233:2014).

If significant adverse noise impacts remain on any private external amenity space, then this is partially off-set if residents are provided with access to a “relatively quiet” alternative external amenity space.

Consideration of Other Relevant Issues

- Compliance with relevant national/local policy.
- Magnitude and extent of compliance with ProPG.
- Likely occupants of the development.
- Acoustic design versus unintended adverse consequences.
- Acoustic design versus planning objectives.

3.4 Construction Phase

3.4.1 Noise

British Standard 5228: PT1 Code of practice for noise and vibration control on construction and open sites provides guidance on methods for predicting and measuring noise from construction sites and assessing the impact on those exposed to it.

One method for assessing the impact of construction noise is the noise generated by construction activities are deemed to be significant if the total noise (pre-construction ambient plus construction noise) exceeds the pre-construction ambient noise by 5 dB or more, subject to a lower cut-off value of 65 dB L_{Aeq}. This is for the daytime period only and based on the noise lasting for a duration of one month or more.

The ‘ABC’ method detailed in Annex E.3.2 of BS 5228 is generally used to set site-appropriate noise limits for the control of construction noise having regard to ambient noise levels. Table E.1 summarises the ABC method and is reproduced in Figure 5 below.

Table E.1 **Example threshold of significant effect at dwellings**

Assessment category and threshold value period (L_{Aeq})	Threshold value, in decibels (dB)		
	Category A [A]	Category B [B]	Category C [C]
Night-time (23.00–07.00)	45	50	55
Evenings and weekends [D]	55	60	65
Daytime (07.00–19.00) and Saturdays (07.00–13.00)	65	70	75

NOTE 1 A significant effect has been deemed to occur if the total L_{Aeq} noise level, including construction, exceeds the threshold level for the Category appropriate to the ambient noise level.

NOTE 2 If the ambient noise level exceeds the threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a significant effect is deemed to occur if the total L_{Aeq} noise level for the period increases by more than 3 dB due to construction activity.

NOTE 3 Applied to residential receptors only.

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

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

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

[D] 19.00–23.00 weekdays, 13.00–23.00 Saturdays and 07.00–23.00 Sundays.

Figure 4: Table E.1 from BS 5228 detailing ABC method

The ABC method has been applied to determine noise threshold values for the site of the proposed development.

3.4.2 Vibration

Vibration criteria have been developed based on the guidance contained within TII document *Guidelines for the Treatment of Noise and Vibration in National Road Schemes - 2004* which makes reference to the following vibration limits to avoid the risk of cosmetic damage to buildings:

Table 2: Vibration limits at nearest noise sensitive receptor

Type of Building	Allowable vibration (PPV) at the nearest noise sensitive building		
	Less than 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz and above
Structurally sound and non-protected buildings (TII Guidance)	8 mm/s	12.5 mm/s	20 mm/s

In terms of human tolerance, the guidance suggests PPV limit values of up to 12mm/s for blasting and 2.5mm/s for piling.

3.5 Operational Noise Criteria

3.5.1 Building Services Plant

In the absence of any specific criteria for residential developments reference has been mase to the following documents:*EPA Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) and BS 4142:2014 Methods for rating and assessing industrial and commercial sound.*

BS 4142: 2014 + A1:2019 describes a method for assessing industrial, commercial and background noise levels in order to assess the likely effects on people who might be inside or outside a dwelling or premises used for residential purposes. BS4142 is referred to within *EPA NG4 Guidance Note for Noise* as the appropriate method to be adopted for complaints investigation. Notably, the standard outlines subjective and objective methods for assessing tonal and impulsive audibility. This involves applying a correction to the measured noise level of the source (L_{Aeq}) to give the rating level ($L_{Ar,T}$).

In addition, BS4142 states that the significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs. Put simply,

In order to establish an initial estimate of impact, BS 4142 states the following:

> *Obtain an initial estimate of the impact of the specific sound by subtracting the measured background sound level from the rating level, and consider the following:*
>
> *a) Typically, the greater this difference, the greater the magnitude of the impact.*
> *b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.*
> *c) A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.*
> *d) 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, depending on the context.*

Rating penalties for tonal, impulsive or other noise characteristics are applied only to outdoor measurements. The subjective method for applying a penalty for tonal sound characteristics outlined in BS 4142 recommends the application of a 2dB penalty for a tone which is just perceptible at the receptor, 4dB where it is clearly perceptible, and 6dB where it is highly perceptible. In relation to intermittency, BS 4142 recommends that if the intermittency us readily is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied. The above is commonly

Typically, above guidance is presented by Planning Authorities in the following form:

> *"Noise created due to the operation of a premises shall not cause a noise nuisance to nearby noise sensitive location and should not exceed the background level by 10dB(A) or more or exceed the typically NG4 limits outlined below - whichever is the lesser.*
>
> - *Daytime (07:00 to 19:00 hrs) – 55dB $L_{Ar,T}$*
> - *Evening (19:00 to 23:00 hrs) – 50dB $L_{Ar,T}$*
> - *Night-time (23:00 to 07:00 hrs) – 45dB $L_{Aeq,T}$*
>
> *It is also an offence under section 108 of the Environmental Protection Agency Act 1992 to cause a noise nuisance. A noise nuisance is defined as "noise to be so loud, so continuous, so repeated, of such duration or pitch or occurring at such time that it gives reasonable cause for annoyance. Therefore, no tone or impulsive characteristic should be audible at any noise sensitive location at night."*

3.5.2 Traffic Noise

In Ireland, there are no specific guidelines or limits concerning traffic-related noise sources along the local or surrounding roads. Since traffic from the development will utilize existing roads that already carry traffic volumes it is appropriate to assess the projected increase in traffic noise levels resulting from vehicular movements associated with the development. The degree of significance of operational noise has been established with regard to *UK document IEMA Guidelines for Environmental Noise Impact Assessment Version 1.2 2014.* The approach is to compare the predicted operational noise level with the existing noise levels and the significance of effects descriptors defined in Table 4below.

Table 3: Significance of effect due to noise level change with regard to EPA and IEMA Guidelines.

Noise Level Change [dB]	Subjective Perception of Change[1]	Significance of Effect	
		EPA Guidelines[2]	IEMA Guidelines[3]
0	Not significant	Imperceptible	None
0.1 – 2.9	Just perceptible	Not Significant	Minor
3.0 – 4.9	Clearly noticeable	Slight to Moderate	Moderate
5.0 – 9.9	Twice or half as loud	Significant	Substantial
10.0 or more	Much louder or quieter	Very Significant	Very Substantial

(1) Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3, Part 7, HD 213/11 (UK Highways Agency et al., 2011)

(2) As per description of effects defined in Table 3.4 of EPA Document Guidelines on the information to be contained in Environmental Impact Assessment Reports May 2022

(3) As per description of effects defined in Document Guidelines on the information to be contained in IEMA Guidelines for Environmental Noise Impact Assessment Version 1.2 2014.

The guidance outlined in will be used to assess the predicted increases in traffic levels on public roads associated with the proposed development and comment on the likely short-term impacts during the construction phase

4 Environmental Noise Survey

4.1 Details

The prevailing noise conditions in the area have been determined by a detailed environmental noise survey. An attended noise survey was conducted on Thursday 14th November 2024. Unattended measurements were conducted by deployment a remote noise logger on the site from Thursday 14th to Tuesday 19th November 2024.

4.2 Instrumentation

A Class 1 sound level meter/noise logger in accordance with IEC 61672-1:2013 was used for all measurements. Table 4 below summarises the measurement equipment used.

Table 4: Measurement Equipment

Description	Manufacturer	Model	Serial No.
Sound Level Meter	Svantek	SVAN971	94098
Noise Logger	Sonitus	EM2030	01425
Acoustic Calibrator	Larson Davies	CAL200	13592

All equipment has calibration certificates traceable back to the relevant Standard. A calibration check of the sound level meter was conducted prior to and following the assessment using an external acoustic calibrator, with no significant drift in calibration measured (<0.5 dB).

4.3 Procedure

4.3.1 Measurement Locations

The measurement locations are shown in Figure 5 below and summarised as follows:

- Logger – Logger position located at the site South-Eastern boundary side. The microphone was attached to a pole and extended to an approximate height of 2.5m
- MP1 –This location was selected to determine the noise climate East of the site. The microphone was located on a tripod approximately 1.2m from ground level.
- MP2 –This location was selected to determine the noise climate South of the site. The microphone was located on a tripod approximately 1.2m from ground level.
- MP3 –This location was selected to determine the noise climate North-West of the site. The microphone was located on a tripod approximately 1.2m from ground level.

Figure 5: Measurement Locations Image © Google Earth

4.3.2 Methodology

Measurements were undertaken in accordance with the following:

- Measurement samples at logger were for 15 minutes.
- Measurements were taken for a duration of 15 minutes at locations MP1 to MP3.
- A wind shield was used during all measurements, measurements were undertaken during a calm, still period (for which the wind velocity did not exceed 5 m/s).
- Care was taken to avoid any effect on the measurement of extraneous noise, acoustic vibration or electrical interference.

The sound indices measured during the sound survey are shown below:

- $L_{Aeq,T}$ - The A-weighted equivalent continuous sound pressure level over a period of time, T.
- $L_{Amax,T}$ - The A-weighted maximum sound pressure level that occurred during a given measurement period; Measured using the fast time weighting in accordance with the requirements of BS8233:2014.
- $L_{A90,T}$ - The A-weighted sound pressure level exceeded for 90% of the measurement period. Indicative of the background sound level.
- 1/3rd Octave band L_{Aeq} data was also recorded at each location.

4.3.3 Subjective Impression on Noise Climate

During the survey, the subjective noise climate was noted as quiet, with dominant noise source distant construction noise and road traffic noises. Observation on site indicate that the M4/M6 motorways was audible at a relatively low level. Other sources noted were dogs barking, birdsongs and noise from the school.

4.4 Noise Survey Results

4.4.1 Attended Noise Survey Results

A summary of the attended measurements to establish noise levels at different locations across the site can be seen in Table 5.

Table 5: Summary of attended noise measurements.

Date	Time	Location	Duration (min)	Sound Pressure Level (dB RE $2x10^{-5}$ Pa)		
				L_{Aeq}	L_{AFmax}	L_{A90}
14/11/24	9:43	MP1	15	47	64	41
14/11/24	10:03	MP2	15	46	64	39
14/11/24	10:21	MP3	15	46	66	40

4.4.2 Unattended Noise Survey Results

Unattended measurements are summarized in Table 6. A time history graph has been plotted in Appendix A – Time History Graph.

Table 6: Summary of unattended measurements from 14/11/24 to 19/11/24.

Day	Date	Daytime (07:00 – 23:00) [dB]		Night-time (23:00hr – 07:00hr) [dB]		
		L_{Aeq}	L_{A90}	L_{Aeq}	L_{A90}	L_{Amax}
Thursday	14/11/2024	49	40	36	33	42
Friday	15/11/2024	54	51	46	37	58
Saturday	16/11/2024	51	47	N/A	N/A	59
Sunday	17/11/2024	50	46	N/A	N/A	57
Monday	18/11/2024	53	50	45	36	56
Tuesday	19/11/2024	-	44	44	41	57
Average Level(1)		**52**	**46**	**44**	**37**	**57**

(1) Daytime and Night-time L_{Aeq} have been logarithmically averaged, and L_{A90} levels have been arithmetically averaged.

(2) Lmax presented is the 10^{th} highest Lmax level during the night-time period.

5 Construction Phase

Noise and vibration levels generated by construction activities have the potential to impact upon nearby noise-sensitive receptors; however, the magnitude of the potential impact depends upon a number of variables, including type of activity; periods of operation; source to receiver distance; ground absorption and reflections.

The potential exists for adverse noise and vibration effects from construction works on sensitive receptors in the surrounding area and therefore the levels of expected construction noise are further assessed below.

The nearest noise sensitive receptors are considered to be the residential dwellings east and south of the site as well as the school to the west. Figure 6 below shows the location of the nearest sensitive receivers.

Figure 6: Nearest Noise Sensitive Receptors/Locations Image © Google Earth

The impacts of construction have been assessed in accordance with BS5228:2009 to assess whether mitigation measures will be required during construction.

5.1 Construction Noise Assessment

5.1.1 Noise Limits

According to the ABC method for assessing the significant effects from construction noise, in BS5228 “Code of practice for noise and vibration control on construction and open sites – Part 1: Noise”, states that “a potential significant effect is indicated if the L_{Aeq} noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level.”

Based on the results of the noise survey the ambient noise levels at the nearest noise sensitive receivers are expected to fall within Category A as given in Figure 4 which provides the following threshold values:

- Daytime – 65 dB L_{Aeq}
- Evenings and Weekends – 55 L_{Aeq}
- Night-time – 45 dB L_{Aeq}

5.1.2 Predicted Noise Levels from Construction Activities – No Mitigation

Noise predictions and baseline measurements have been used to provide an estimate of the construction noise emissions from the site during the daytime construction works at the nearest receptor. From these predictions it has been possible to determine whether the adopted daytime target noise criterion of 65 dBA $L_{eq,10hrs}$ is likely to be met during the works. The magnitude of any impact has then been determined and the requirement for further mitigation measures considered.

Operational times within the daytime period are based on the assumption that the majority of plant will run for six hours per day.

The distances between the proposed construction works and the nearest sensitive receptors will vary because plant will be used in a number of different areas of the site. Calculations have been undertaken at the centre of the site assumed to be approximately 112m from NSL1, 120m from NSL2 and 134m from NSL 3 as indicated in Figure 6. Façade reflections are included in the calculation, no mitigation has been allowed for including any potential screening from hoarding etc.

Calculations have been undertaken to predict the cited noise levels for the daytime periods due to different stages of construction set-out below:

- Site Clearance/Enabling works;
- Substructure
- Steel, Roofing and Cladding.
- Fit-Out

It is understood that piling is not proposed for this site.

Details of the construction phases of the development are shown in Appendix B of this report. Prediction construction noise levels are summarised in Table 7.

Table 7: Predicted Construction Noise Levels at each NSL without mitigation

Location	LAeq, 1hr [dB]		Predicted noise level (construction noise + ambient) With no mitigation L_{Aeq}, dB			
	Baseline	Threshold	Enabling Works	Substructure	Steel, roofing & cladding	Fit Out
NSL1	47	65	**67**	**68**	56	60
NSL2	46	65	**66**	**68**	55	60
NSL3	46	65	**65**	**67**	54	59

It can be seen that the predicted levels from Enabling and Substructure phase are predicted to exceed daytime noise limit and therefore mitigation measures should be considered for these phases.

5.1.3 Mitigation Measures

General

The following general mitigation measures are recommendations from BS5228 and should be employed on this site.

- Avoid unnecessary revving of engines and switch off equipment when not required;
- Keep internal haul routes well maintained and avoid steep gradients;
- Use rubber linings in, for example, chutes and dumpers to reduce impact noise;
- Minimize drop height of materials;
- Start plant and vehicles sequentially rather than all together;
- Use alternative methods

Community Relations

BS5228 suggests the following with respect to community relations:

"Good relations with people living and working in the vicinity of site operations are of paramount importance. Early establishment and maintenance of these relations throughout the carrying out of site operations will go some way towards allaying people's fears.

It is suggested that good relations can be developed by keeping people informed of progress and by treating complaints fairly and expeditiously. The person, company or organization carrying out work on site should appoint a responsible person to liaise with the public. The formation of liaison committees with members of the public can be considered for longer term projects when relatively large numbers of people are involved."

With vibration, the fear of building damage can be exacerbated where people are unsure of the levels of vibration it would take to impact upon their property, and therefore good communication can help to alleviate fears beforehand.

Specification and Substitution

All plant specifications must be reviewed to ensure they are the quietest available for the required purpose; this is in accordance with best practicable means.

Modification of Plant and Equipment

The following extract from BS5228 sets out how plant noise may be reduced by modification.

> *"Noise from existing plant and equipment can often be reduced by modification or by the application of improved sound reduction methods, but this should only be carried out after consultation with the manufacturer. Suppliers of plant will often have ready-made kits available and will often have experience of reducing noise from their plant. For steady continuous noise, such as that caused by diesel engines, it might be possible to reduce the noise emitted by fitting a more effective exhaust silencer system or by designing an acoustic canopy to replace the normal engine cover. Any such project should be carried out in consultation with the original equipment manufacturer and with a specialist in noise reduction techniques. The replacement canopy should not cause the engine to overheat nor interfere excessively with routine maintenance operations.*
> *It might be possible in certain circumstances to substitute electric motors for diesel engines, with consequent reduction in noise. On-site generators supplying electricity for electric motors should be suitably enclosed and appropriately located. Noise caused by resonance of body panels and cover plates can be reduced by stiffening with additional ribs or by increasing the damping effect with a surface coating of special resonance damping material. Rattling noises can be controlled by tightening loose parts and by fixing resilient materials between the surfaces in contact; this is generally a maintenance issue."*

The following table contains suggested methods for reducing noise levels from construction plant specific to this site. These measures should be implemented wherever possible.

Table 8: Recommended Mitigation Measures

Plant Type	Source of Noise	Proposed Mitigation	Potential Sound Reduction dBA
Earth moving equipment	Engine	Fit more efficient exhaust sound reduction equipment Manufacturers' enclosure panels need to be kept closed	5 – 10
Breaker	Tool Bit	Fit suitably designed muffler or sound reduction equipment to reduce noise without impairing machine efficiency Ensure all leaks in airline are sealed	Up to 15
		Use dampened bit to eliminate ringing	
	Total Machine	Erect acoustic screen between compressor or generator and noise-sensitive area. When possible, line of sight between top of machine and reception point needs to be obscured	Up to 10
Concrete Pump	Engine Pushing	Use machine inside acoustic enclosure with allowance for engine cooling and exhaust	Up to 20
Concrete Mixers	Cleaning	Do not hammer the drum	n/a
Materials Handling	Impact of Material	Do not drop materials from excessive heights. Screen dropping zones, especially on conveyor systems. Line chutes and dump trucks with a resilient material	Up to 15

Enclosures

The significant sources of plant noise should be enclosed where possible. The close proximity of the nearest sensitive receptors means that all practicable means to reduce noise must be employed wherever possible.
The concrete pump is a significant noise source which could potentially be enclosed. Covers should enclose the plant as fully as possible, should be of sufficient mass (17kg/m^2 minimum), and should be lined inside with an acoustically absorbent material with minimum 25mm thickness. An example of the enclosure design is shown below.

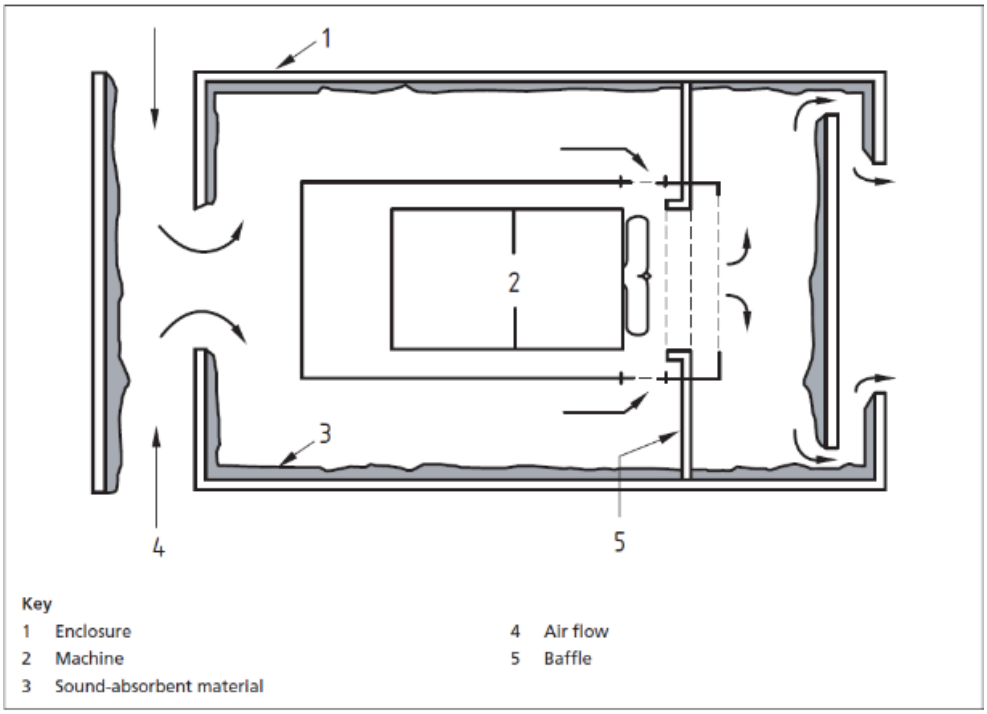

Figure 7: Example Plant Enclosure

A maximum of 20dBA sound reduction can be expected from a suitably designed enclosure with openings.

Use and Siting of Equipment

All plant should be used in accordance with manufacturers' instructions.

Plant should be located away from noise-sensitive areas where possible; loading and unloading should not be carried out next to the sensitive receptors. The concrete pump and drum should be located at least 25m from the nearest sensitive receptors wherever possible.

The plant used intermittently, should be shut down or throttled down to a minimum between work periods.

Acoustic convers to engines must be kept closed when the plant is in use or idling; compressors should have effective enclosures and should not be operated with access panels open.

The following advice is taken from BS5228:

"Materials should be lowered whenever practicable and should not be dropped. The surfaces on to which the materials are being moved should be covered by resilient material.

When a site is in a residential environment, lorries should not arrive at or depart from the site at a time inconvenient to residents."

Maintenance

Noise caused by vibrating machinery having rotating parts can be reduced by attention to proper balancing. Frictional noise from the cutting action of tools and saws can be reduced if the tools are kept sharp. Noises caused by friction in conveyor rollers, trolleys and other machines can be reduced by proper lubrication."

Screening

It is recommended that a high mass site hoarding is used along the West, North and East site boundaries to protect the worst-case noise level impact. This barrier should be as tall as is reasonably practical.

5.1.4 Predicted Construction Noise Levels with Mitigation Measures

The predicted construction noise levels further to the implementation of the mitigation measures outlined above are expected to fall within the limit value of 65dBA as indicated in Table 9.

Table 9: Predicted Construction Noise Levels at each NSL with mitigation

Location	LAeq, 1hr [dB]		Predicted noise level (construction noise + ambient) With mitigation L_{Aeq}, dB			
	Baseline	Threshold[1]	Enabling Works	Substructure	Steel, roofing & cladding	Fit Out
NSL1	47	65	61	63	52	56
NSL2	46	65	62	64	50	55
NSL3	46	65	60	61	49	54

5.1.5 Construction Noise Monitoring

A scheme of noise monitoring is recommended for the duration of the construction to ensure that construction noise levels do not exceed the proposed limit of 65dBA.

A minimum of two monitoring locations should be used; locations should be representative of the noise levels along the west and south boundaries.

It is recommended that a construction noise limit of 65dBA $L_{eq,10\ hours}$ is used at 1m from the façade of the nearest sensitive receptors. Alerts should also be set to a level of 60dBA and 65dBA $L_{eq,10\ hours}$.

Text message and/or email alerts should be set up at the guidance values to be received by the site manager, the monitoring personnel and any other relevant party. The noise data should be accessible via a web-based portal.

In the instance that the noise limits are exceeded, works should be halted and the reason for exceedance determined and remedied before works commence again.

5.2 Vibration Assessment

It is understood that piling is not required for the development, it is expected that likely construction activities will therefore not provide significant levels of vibration.

6 ProPG Noise Assessment

A review of the EPA Maps of Noise due to National Roads, including M4/M6 motorways and relevant access roads and junctions indicates the site lies with the extents of the following:

- L_{DEN} 55-59dB contour.
- L_{night} 50-54dB contour.

In accordance with 'Stage 1' of Professional Practice Guidance (ProPG) – Planning & Noise, a full , 'Stage 2' noise assessment of the proposed development has been undertaken. Elements 1 to 4 of the Stage 2 Assessment have been addressed in this section of the report.

6.1 Good Acoustic Design Process

ProPG states that *'Good acoustic design should provide an integrated solution whereby the optimum acoustic outcome is achieved, without design compromises.'*

Where feasible and practical, the following measures would provide an acoustic benefit to the scheme and would constitute good acoustic design.

- Maximise the distance between the proposed dwellings and the nearby roads.
- Locate external amenity space behind or between the proposed dwellings, away from the surrounding roads.
- Provide an appropriate ventilation strategy, as detailed later in this report; and
- Provide enough building envelope sound reduction, as detailed later in this report.
- Construction of boundary wall to reduce the levels across the site.

It is essential to note that the above recommendations will not be possible in all cases, and that it is possible and acceptable to provide suitable acoustic conditions without having to implement all the guidelines set out above.

6.2 External Building Fabric Assessment

6.2.1 Internal Noise Level Guidelines

In order to achieve appropriate noise levels within internal living spaces, the dwellings themselves need to be considered regarding the level of façade mitigation required. BS 8233:2014 states internal noise level criteria of <35 dB(A) in living rooms and bedrooms during the daytime (07:00 – 23:00) and <30 dB(A) in bedrooms during the night-time (23:00 – 07:00). In addition, individual noise events should not normally exceed 45 dB $L_{Amax,F}$ more than 5 times a night in bedrooms.

6.2.2 Assumptions

The site noise level at the façade is based on the noise levels e measured during the daytime and night-time on the proposed development site as outlined in Section 4.

Bedrooms and living rooms located at the most exposed facades (deemed worst-case) have been used to predict the internal noise levels. The rooms chosen are located on the southeast of the site, as they are considered to be the most exposed due to the orientation towards both a local road, main site entrance and the nearby R148.

The assessment considers the following room sizes (l x w x h):

- Bedroom – 6.7m x 3.4m x 2.4m (l x w x h)
- Living Room – 6.6m x 4m x 2.4m (l x w x h)

Glazing dimensions have been taken from the supplied drawings. It has also been assumed that bedrooms are to be acoustically 'soft', with carpets, curtains and other soft furnishings and living rooms to be less acoustically absorptive. For the purposes of analysis, we have assumed the following internal reverberation times:

Table 10: Mid-frequency reverberation time for specific room types.

Room	Mid-Frequency Reverberation Time (Seconds)
Bedroom	0.6
Living Room/Kitchen	0.8

As a reference, the following standard constructions and associated acoustic performance have been considered for the external wall and roof.

Table 11 Sound reduction of example external wall and roof, R (dB)

Description	Sound Reduction Indices (dB) at Octave Band Centre Frequency (Hz)								R_w
	63	125	250	500	1k	2k	4k	8k	
External Wall – Brick/Block Cavity	36	41	45	45	54	58	58	58	52
Roof – Tiled-slated roof, plasterboard ceiling, sound absorbing layer	19	24	34	40	45	49	49	49	43

6.3 Façade Mitigation

6.3.1 Glazing Requirements

Based on the predicted noise levels incident on the facades, the following glazing types and the corresponding sound reduction indices have been proposed:

Table 12: Proposed glazing sound insulation performance.

Glazing Type	Example Configuration	Sound Reduction Indices (dB) at Octave Band Centre Frequency (Hz)								R_w
		63	125	250	500	1k	2k	4k	8k	
GL1	6mm/12mm/6mm	16	20	19	29	38	36	45	43	32

The glazing system performance specifications detailed above apply to the glazing package as a whole, inclusive of glazing, framing, spandrel panels, etc. The performance of the glazing systems will depend on many factors, such as the glazing configuration, size of window panels, quality of framing, quality of sealing, etc. Performance specifications are frequency specific. Overall performance values are given for guidance purposes only, any alternative glazing configuration which achieves the required internal noise levels would be a suitable alternative. Any ventilation element which penetrates the façade will need to be selected to ensure the specified glazing performance values are not compromised.

6.3.2 Background Ventilation Requirements

The table below sets out the performance requirement for the ventilation elements to comply with the 'whole dwelling ventilation' condition when windows need to be closed to avoid noise ingress.

Table 13: Acoustic performance of example ventilation options, D (dB)

Ventilation Type	Element Level Difference at Octave Band Centre Frequency (Hz)								$D_{n,ew}$
	63	125	250	500	1k	2k	4k	8k	
Vent – example Renson AK35	33	35	30	31	34	44	42	40	36

One trickle ventilator or air inlet has been assumed per room. Where more ventilators are used, the acoustic performance of the ventilators would need to be upgraded by 10*log(N); being N the number of ventilators per room.

Provision of mechanical ventilation will reduce the performance required for the glazing. This should be reviewed during the detailed design stage.

6.4 External Amenity Areas

BS8233:2014 states that ambient noise levels in external amenity areas which form an intrinsic component of the overall design should ideally be limited to between 50 and 55 dB $L_{Aeq,16hour}$.

As seen through the unattended monitoring results in section 4.4, the levels across the site are in the order of 52dBA which is within the design range, with mitigation required.

7 Operational Noise Assessment

7.1 Building Services

It is currently too early in the design process to have to have specific details on building services equipment. A review of the design details available has indicated that heat pumps are the only potential sources of significant operational noise. All building services noise should be selected and/or designed to ensure the limits outlined in Table 14 are note exceeded. In addition, it should be ensured that no adverse tonal characteristics are introduced due to building services noise when measured at the nearby residential dwellings

Table 14: Noise Limits for Building Services

Receiver Type	Sensitive Period	Background Noise L_{A90} dB(A)	Noise Limit L_{Aeq}, dB(A)
Residential	Day	46	55
	Night	37	45

7.2 Traffic Noise

7.2.1 Assumptions

It is understood that the main noise contribution with regards to the new development is the traffic generated as a consequence of the construction of the 129 no. dwellings. Using the Traffic and Transport Assessment provided for the assessment, the noise impact generated by the implementation of the roads and traffic associated have been determined. **Table 15** shows the expected traffic profile once the residential development is fully operational below shows the predicted traffic levels for a typical day.

Table 15: Total typical Generated Profile for 129 dwellings

Time Range	Arrivals	Departures	Total
08:30 – 09:30	20	48	67
17:00 – 18:00	32	22	54

7.2.2 Traffic Noise Assessment

Noise model have been developed using proprietary software SoundPlan v.9, which implements the algorithms contained in CRTN, Calculation of Road Traffic Noise.

The model accounts for the following factors:

- Source sound power levels.
- Source directivity and orientation.
- Distance attenuation, including source and receptor heights.
- Barrier effects due to facility structures and other buildings.
- Ground effects and absorption.
- Atmospheric attenuation.
- Meteorological effects.

Both attended and unattended measurements were used to ‘calibrate’ the acoustic model with each measurement location acting as a receiver to allow an accurate representation of road traffic noise levels across the proposed development based on measured levels. The results of the noise model have been used to plot the daytime and night-time $L_{Aeq,T}$ noise levels across the proposed development site in the absence of any existing buildings.

The model has been updated to include the proposed new buildings and the associated road traffic noises. Figure 8 shows the predicted noise level due to typical internal traffic movements for the development. It can be observed from the figure that the predicted traffic noise is most significant near the proposed roads and reduces in level with increasing distance from the same. In addition, the introduction of the proposed residential buildings provides significant acoustic screening reducing the noise impact further.

Figure 8. Predicted noise levels due to internal traffic movements.

Table 16 outlines the predicted traffic noise levels at the receivers as well as the cumulative impact on the environment. It can be seen that a 'Just Perceptible' effect is produced at NSL 1, NSL 2 and NSL3.

Table 16. Traffic noise impact assessment

Noise Sensitive Receiver	Existing Daytime Noise Levels L_{Aeq} dBA	Predicted Traffic Noise Level from Development L_{Aeq} dBA	Operational Cumulative noise level L_{Aeq} dBA	Change in level, dB	Significance of effect
NSL1 - Residential	47	38	48	1	Just Perceptible
NSL2 - Residential	46	44	48	2	Just Perceptible
NSL3 - School	46	38	47	1	Just Perceptible

Comparison of the change in level for each of the noise sensitive location with the significance of effect due to noise level change defined in Table 3, indicates the predicted change in noise level is considered 'Not Significant' with regard to EPA Guidelines.

8 Conclusions

Amplitude Acoustics have been engaged to conduct a Noise Impact Assessment of the proposed Large-Scale Development located in Kinnegad, Co. Westmeath.

The proposed development consists of 129 no. residential units made up of 2 beds, 3 beds and 4 beds, and a childcare facility.

The criteria for the project have been developed with regard to the requirements of:

- Westmeath Noise Action Plan 2024 – 2028
- WHO Community Noise Guidelines
- British Standard BS8233:2014 'Guidance on sound insulation and noise reduction for buildings.
- BS 5228-1:2009+A1: 2014 Code of practice for noise and vibration control on construction and open sites: Part 1 – Noise (BS 5228-1), 2014
- BS 5228-2:2009+A1:2014 Code of Practice for Noise and Vibration Control on Open Construction Sites – Part 2: Vibration (BS 5228-2), 2014.
- ProPG: Planning & Noise – New Residential Development, May 2017

A noise and vibration impact assessment of the likely construction activities for the site was undertaken in general accordance with the methodology detailed in BS 5228-1:2009+A1: 2014 Code of practice for noise and vibration control on construction and open sites: Part 1 – Noise (BS 5228-1), 2014. Construction noise mitigation measures are provided and an overview of the potential noise and vibration issues during construction has been set out as preliminary guidance.

A review of the EPA Maps of Noise due to National Roads, including M4/M6 motorways and relevant access roads and junctions indicates the site lies with the extents of the following:

- L_{DEN} 55-59dB contour.
- L_{night} 50-54dB contour.

Attended and unattended noise surveys were conducted on 14th to 19th November 2024, in accordance with the guidance of *ISO 1996-2:2017 Acoustics — Description, measurement and assessment of environmental noise — Part 2: Determination of sound pressure levels* to assess the noise levels incident on the site. Using the measured noise levels, the daytime $L_{Aeq(07:00 – 23:00)}$ and night-time $L_{Aeq(23:00 – 07:00)}$ were determined. The measured noise level included all local contributions to the noise on site including local traffic, distant construction noise and the M4/M6 motorways at a low level.

The noise sources included within the development have been used to conduct an operational noise impact assessment with regards to environmental noise standards BS4142, EPA NG4 and Westmeath Noise Action Plan, and the existing background noise levels.

The assessment has shown that there is an ***insignificant*** noise impact at the nearby residential locations due to the proposed development in place.

A 'Stage 1: Initial Site Noise Risk Assessment' and a 'Stage 2: Full Assessment', in line with advice on Professional Practice Guidance (ProPG) – Planning & Noise were undertaken. During the daytime and night-time, the risk categories across the site are predominately Low to Medium risk, with the night-time L_{AFmax} levels being the driving factor for façade specification.

Interior noise levels for the whole development are predicted to comply with interior noise level criteria (including both L_{Aeq} and L_{AFMax}) from BS 8233 and referenced in ProPG provided that the construction requirements detailed in Section 6.2 are implemented. Therefore, sleep disturbance due to the predicted internal noise levels is unlikely to occur.

The main external amenity areas have been designed to comply with the desirable criteria of L_{Aeq} 50 - 55 dBA which complies with the guidance values stated in BS8233.

Based on the results of the assessment the proposed development is predicted to comply with the relevant requirements of the Westmeath Noise Action Plan 2024 – 2028, WHO guidance and ProPG, subject to implementing the design guidance outlined within this report.

Appendix A – Time History Graph

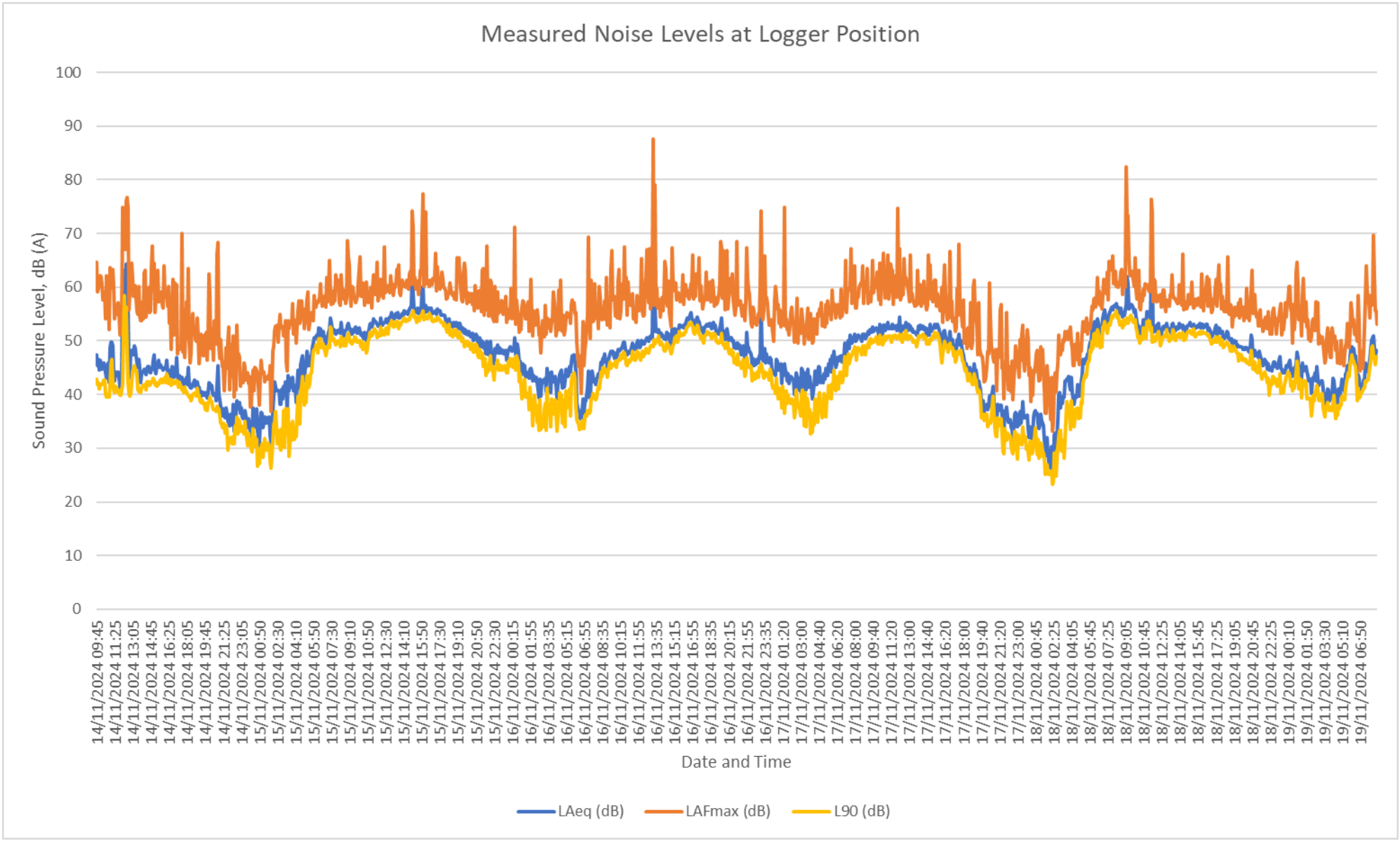

Figure 9. Time history noise levels at logger position during the monitoring period

Appendix B - Construction Noise Assessment

Table 17. Predicted Noise Levels from Enabling Works at each NSL

Works	SPL @10m	Distance from site	Dist att	Screening	Reflection	Resultant	% on time	% on time correction	Total const	Total with Screening	Criteria	Above criteria	Above criteria with Screening
NSL1													
Tracked excavator C2.16	75	134	-23	5	3	60	60	-2	53	48			
Tracked excavator C2.25	69	134	-23	10	3	59	60	-2	47	37			
Articulated Dump truck C4.1	81	134	-23	5	3	66	50	-3	58	53			
Dumper C4.6	79	134	-23	5	3	64	50	-3	56	51			
Dozer (C2.10)	80	134	-23	5	3	65	40	-4	56	51			
Wheeled Loader Lorry (C2.26)	79	134	-23	5	3	64	60	-2	57	52			
Telescopic handler C2.35	71	134	-23	5	3	56	50	-3	48	43			
hydraulic vibratory compactor C2.42	78	134	-23	10	3	68	30	-5	53	43			
Wheeled Loader Lorry (C2.26)	79	134	-23	5	3	64	40	-4	55	50			
Vibratory roller C2.39	74	134	-23	10	3	64	30	-5	49	39			
Telescopic handler C2.35	71	134	-23	5	3	56	40	-4	47	42			
								Total	**65**	**60**	**65**	0	-5
NSL2													
Tracked excavator C2.16	75	112	-21	5	3	62	60	-2	55	50			
Tracked excavator C2.25	69	112	-21	10	3	61	60	-2	49	39			
Articulated Dump truck C4.1	81	112	-21	5	3	68	50	-3	60	55			
Dumper C4.6	79	112	-21	5	3	66	50	-3	58	53			
Dozer (C2.10)	80	112	-21	5	3	67	40	-4	58	53			
Wheeled Loader Lorry (C2.26)	79	112	-21	5	3	66	60	-2	59	54			
Telescopic handler C2.35	71	112	-21	5	3	58	50	-3	50	45			
hydraulic vibratory compactor C2.42	78	112	-21	10	3	70	30	-5	55	45			

Wheeled Loader Lorry (C2.26)	79	112	-21	5	3	66	40	-4	57	52			
Vibratory roller C2.39	74	112	-21	10	3	66	30	-5	51	41			
Telescopic handler C2.35	71	112	-21	5	3	58	40	-4	49	44			
								Total	**67**	**61**	**65**	2	-4
NSL3													
Tracked excavator C2.16	75	120	-22	10	3	66	60	-2	54	44			
Tracked excavator C2.25	69	120	-22	5	3	55	60	-2	48	43			
Articulated Dump truck C4.1	81	120	-22	5	3	67	50	-3	59	54			
Dumper C4.6	79	120	-22	5	3	65	50	-3	57	52			
Dozer (C2.10)	80	120	-22	0	3	61	40	-4	57	57			
Wheeled Loader Lorry (C2.26)	79	120	-22	5	3	65	60	-2	58	53			
Telescopic handler C2.35	71	120	-22	10	3	62	50	-3	49	39			
hydraulic vibratory compactor C2.42	78	120	-22	5	3	64	30	-5	54	49			
Wheeled Loader Lorry (C2.26)	79	120	-22	5	3	65	40	-4	56	51			
Vibratory roller C2.39	74	120	-22	10	3	65	30	-5	50	40			
Telescopic handler C2.35	71	120	-22	5	3	57	40	-4	48	43			
								Total	**66**	**62**	**0**	66	62

Table 18. Predicted Noise Levels from Substructure Works at each NSL

Construction Works	SPL @10m	Distance from site m	Dist att	Screening	Reflection	Resultant	% on time	% on time correction	Total const	Total with Screening	Criteria	Above criteria	Above criteria with screening
NSL1													
Tracked excavator C2.16	75	134	-23	5	3	60	50	-3	52	47			
Tracked excavator C2.25	69	134	-23	10	3	59	50	-3	46	36			
Dumper C4.6	79	134	-23	5	3	64	60	-2	57	52			
Wheeled Loader Lorry (C2.26)	79	134	-23	5	3	64	30	-5	54	49			
hydraulic vibratory compactor C2.42	78	134	-23	10	3	68	30	-5	53	43			
hydraulic hammer rig C3.2	87	134	-23	5	3	72	50	-3	64	59			
Wheeled Loader Lorry (C2.26)	79	134	-23	5	3	64	60	-2	57	52			
Vibratory roller C2.39	74	134	-23	10	3	64	50	-3	51	41			
Total									67	61	**65**	2	-4
NSL2													
Tracked excavator C2.16	75	112	-21	5	3	62	50	-3	54	49			
Tracked excavator C2.25	69	112	-21	10	3	61	50	-3	48	38			
Dumper C4.6	79	112	-21	5	3	66	60	-2	59	54			
Wheeled Loader Lorry (C2.26)	79	112	-21	5	3	66	30	-5	56	51			
hydraulic vibratory compactor C2.42	78	112	-21	10	3	70	30	-5	55	45			
hydraulic hammer rig C3.2	87	112	-21	5	3	74	50	-3	66	61			
Wheeled Loader Lorry (C2.26)	79	112	-21	5	3	66	60	-2	59	54			
Vibratory roller C2.39	74	112	-21	10	3	66	50	-3	53	43			
Total									68	63	**65**	3	-2
NSL3													
Tracked excavator C2.16	75	120	-22	10	3	66	50	-3	53	43			
Tracked excavator C2.25	69	120	-22	5	3	55	50	-3	47	42			
Dumper C4.6	79	120	-22	0	3	60	60	-2	58	58			
Wheeled Loader Lorry (C2.26)	79	120	-22	5	3	65	30	-5	55	50			
hydraulic vibratory compactor C2.42	78	120	-22	5	3	64	30	-5	54	49			

hydraulic hammer rig C3.2	87	120	-22	5	3	73	50	-3	65	60			
Wheeled Loader Lorry (C2.26)	79	120	-22	5	3	65	60	-2	58	53			
Vibratory roller C2.39	74	120	-22	0	3	55	50	-3	52	52			
Total									68	64	**0**	68	64

Table 19. Predicted Noise Levels from Steel, Roofing & Cladding Works at each NSL

Construction Works	SPL @10m	Distance from site m	Dist att	Screening	Reflection	Resultant	% on time	% on time correction	Total const	Total with Screening	Criteria	Above criteria	Above criteria with screening
NSL1													
tracked mobile crane C3.28	67	134	-23	5	3	52	60	-2	45	40			
Lifting platform C4.57	67	134	-23	10	3	57	60	-2	45	35			
handheld cordless nail gun C4.95	73	134	-23	5	3	58	70	-2	52	47			
Telescopic handler C2.35	71	134	-23	5	3	56	40	-4	47	42			
Total									54	49	**65**	-11	-16
NSL2													
tracked mobile crane C3.28	67	112	-21	5	3	54	60	-2	47	42			
Lifting platform C4.57	67	112	-21	0	3	49	60	-2	47	47			
handheld cordless nail gun C4.95	73	112	-21	5	3	60	70	-2	53	48			
Telescopic handler C2.35	71	112	-21	5	3	58	40	-4	49	44			
Total									56	52	**65**	-9	-13
NSL3													
tracked mobile crane C3.28	67	120	-22	5	3	53	60	-2	46	41			
Lifting platform C4.57	67	120	-22	5	3	53	60	-2	46	41			
handheld cordless nail gun C4.95	73	120	-22	5	3	59	70	-2	53	48			
Telescopic handler C2.35	71	120	-22	5	3	57	40	-4	48	43			
Total									55	50	**0**	55	50

Table 20. Predicted Noise Levels from Fit-Out Works at each NSL

Construction Works	SPL @10 m	Distance from site m	Dist att	Screening	Reflection	Resultant	% on time	% on time correction	Total const	Total with Screening	Criteria	Above criteria	Above criteria with screening
NSL1													
tracked mobile crane C3.28	67	134	-23	5	3	52	60	-2	45	40			
Tracked excavator C2.25	69	134	-23	10	3	59	60	-2	47	37			
Wheeled Loader Lorry (C2.26)	79	134	-23	5	3	64	70	-2	58	53			
Telescopic handler C2.35	71	134	-23	5	3	56	40	-4	47	42			
Total									59	54	**65**	-6	-11
NSL2													
tracked mobile crane C3.28	67	112	-21	5	3	54	60	-2	47	42			
Tracked excavator C2.25	69	112	-21	0	3	51	60	-2	49	49			
Wheeled Loader Lorry (C2.26)	79	112	-21	5	3	66	70	-2	59	54			
Telescopic handler C2.35	71	112	-21	5	3	58	40	-4	49	44			
Total									60	56	**65**	-5	-9
NSL3													
tracked mobile crane C3.28	67	120	-22	5	3	53	60	-2	46	41			
Tracked excavator C2.25	69	120	-22	5	3	55	60	-2	48	43			
Wheeled Loader Lorry (C2.26)	79	120	-22	5	3	65	70	-2	59	54			
Telescopic handler C2.35	71	120	-22	5	3	57	40	-4	48	43			
Total									60	55	**0**	60	55