INWARD NOISE IMPACT ASSESSMENT

STRATEGIC HOUSING DEVELOPMENT AT FORTUNESTOWN LANE, SAGGART, CO. DUBLIN

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EXECUTIVE SUMMARY

AWN Consulting has been commissioned to undertake an assessment of inward noise impact on proposed residential dwellings at Fortunestown Lane, Saggart, Co. Dublin.

For the purposes of this noise assessment, relevant guidance has been taken from the following documents:

- South Dublin County Council Development Plan (2016 – 2022);
- Dublin Agglomeration Environmental Noise Action Plan (2018 - 2023);
- The *Professional Guidance on Planning & Noise* (ProPG) document and,
- BS 8233:2014 *Guidance on Sound Insulation and Noise Reduction for Buildings*.

In order to ensure that the noise climate within the residential units is appropriate for the usage, the following internal noise criteria are proposed:

- Daytime in living areas – 35 dB $L_{Aeq,16hr}$; and,
- Night-time in bedrooms – 30 dB $L_{Aeq,8hr}$

The measured noise levels across the site have been used to calculate noise levels at specific facades of proposed residential properties and to predict the internal noise levels within living room and bedroom spaces, taking account of the proposed building envelope and conditions in the receiving rooms (e.g. volumes and room acoustic characteristics).

It has been found that with the specification of appropriate double-glazing elements and vents, intrusive noise levels are predicted to be in line with the recommended design goals. The glazing and ventilator performance requirements can be summarised as follows:

Typical Construction that would comply	Glazing Octave Band Centre Frequency (Hz)						R_w
	125	250	500	1k	2k	4k	
4 – 12 – 4 double glazing	24	20	25	34	37	35	33

Table A Minimum glazing performance requirements

The attenuation across any ventilation system will be required to offer a minimum performance of 36 dB $D_{n,e,w}$.

Based on the implementation of the measures outlined in this assessment the predicted noise levels conform to the criteria taken from *BS8233:2014* for acceptable internal noise levels. Please note that the predicted internal noise levels detailed above assume that windows and doors will be closed.

It is predicted that the majority of the amenity space will experience noise levels of the order ≤55 to 57dB $L_{Aeq,16hr}$ representing a marginal exceedance of the recommended noise level, i.e. ≤55dB $L_{Aeq,16hr}$. As per BS 8233, predicted noise levels where predicted noise levels are above this range, this is somewhat offset by the convenience of proximity to transport infrastructure.

CONTENTS

1.0 INTRODUCTION

AWN Consulting has been commissioned to undertake an assessment of inward noise impact on proposed residential dwellings at Fortunestown Lane, Saggart, Co. Dublin. Noise sources such as road traffic and Luas noise have been considered.

The assessment methodology may be summarised as follows:

- Reference was made to relevant published guidance to establish appropriate design goals;
- A baseline noise survey was undertaken at the site to determine the existing noise levels at the location of the most exposed proposed dwellings;
- Calculations were carried out in order to quantify the noise climate in the vicinity of the development site;
- Intrusive noise levels were assessed through calculation; and,
- Appropriate performance specifications were derived for key elements of the building envelope.

Full details are provided in the following sections. Appendix A presents a glossary of acoustic terminology used in this report.

2.0 ASSESSMENT CRITERIA

2.1 South Dublin County Council Development Plan (2016 – 2022)

Section 11.6.3 of the South Dublin County Council Development Plan (2016-2022) provides the following discussion in relation to *Environmental Hazard Management*:

> *(ii) Noise*
>
> > *The Planning Authority will have regard to the Dublin Agglomeration Environmental Noise Action Plan 2013 – 2018, Dublin Local Authorities (2013) when assessing development proposals along major road and rail transport corridors, with a view to reducing noise from new sources and to identify and protect areas of low sound levels.*

The NAP quoted above has been superseded by the Dublin Agglomeration Noise Action Plan 2018 – 2023 Volume 4: South Dublin County Council Public Consultation Document which is discussed in Section 2.2 below.

2.2 Dublin Agglomeration Environmental Noise Action Plan

Here, consideration has been given to the content of the Dublin Agglomeration Noise Action Plan 2018 – 2023 Volume 4: South Dublin County Council Public Consultation Document (NAP) was published for review in November 2018. The NAP states the following with respect to assessing the noise impact on new residential development:

> *"In the scenario where new residential development or other noise sensitive development is proposed in an area with an existing climate of environmental noise, there is currently no clear national guidance on appropriate noise exposure levels. The EPA has suggested that in the interim that Action Planning Authorities should examine the planning policy guidance notes issued in England titled, 'ProPG Planning and Noise: Professional Practice Guidance on Planning and Noise'. This has been produced to provide*

practitioners with guidance on a recommended approach to the management of noise within the planning system in England".

In addition, the following is provided

"In advance of any national guidance relating to noise in the planning process, the following actions relating to planning and development will be considered for implementation:

a. *To review existing guidelines and policy relating to Noise in the County Development Plan and to ensure noise is a consideration in Local Area Plans and Part 8's and enhanced in the next County Development Plan.*
b. *To develop guidance note on Noise considerations in the planning process that can be issued to developers at pre-planning stage.*
c. *To require developers to produce a sound impact assessment and mitigation plans, where necessary, for any new development where the Planning Authority considers that any new development will impact negatively on pre-existing environmental noise levels within their Council area.*
d. *To ensure that future developments are designed and constructed in accordance best Irish practice to minimise noise disturbances through good acoustic design and take into account the multifunction uses of street (e.g. movement, recreation) and to ensure central areas of large mixed used developments area quiet.*

As per the NAP reference has also been made to guidance note *ProPG Planning and Noise: Professional Practice Guidance on Planning and Noise.*

2.3 ProPG: Planning & Noise

The *Professional Guidance on Planning & Noise* (ProPG) document was published in May 2017. The document was prepared by a working group comprising members of the Association of Noise Consultants (ANC), the Institute of Acoustics (IOA) and the Chartered Institute of Environmental Health (CIEH). Although not a government document, since it's adoption it has been generally considered as a best practice guidance and has been widely adopted in the absence of equivalent Irish guidance.

The ProPG outlines a systematic risk based 2 stage approach for evaluating noise exposure on prospective sites for residential development. The two primary stages of the approach can be summarised as follows:

- Stage 1 - Comprises a high level initial noise risk assessment of the proposed site considering either measured and or predicted noise levels; and,
- Stage 2 – Involves a full detailed appraisal of the proposed development covering four "key elements" that include:
    - Element 1 - Good Acoustic Design Process;
    - Element 2 - Noise Level Guidelines;
    - Element 3 - External Amenity Area Noise Assessment
    - Element 4 - Other Relevant Issues

A key component of the evaluation process is the preparation and delivery of an Acoustic Design Statement (ADS) which is intended for submission to the planning authority. This document is intended to clearly outline the methodology and findings of the Stage 1 and Stage 2 assessments, so as the planning authority can make an

informed decision on the permission. ProPG outlines the following possible recommendations in relation to the findings of the ADS:

A. Planning consent may be granted without any need for noise conditions;
B. Planning consent may be granted subject to the inclusion of suitable noise conditions;
C. Planning consent should be refused on noise grounds in order to avoid significant adverse effects ("avoid"); or,
D. Planning consent should be refused on noise grounds in order to prevent unacceptable adverse effects ("prevent").

Section 3.0 of the ProPG provides a more detailed guide on decision making to aid local authority planners on how to interpret the findings of an accompanying Acoustic Design Statement (ADS).

A summary of the ProPG approach is illustrated in Figure 2.

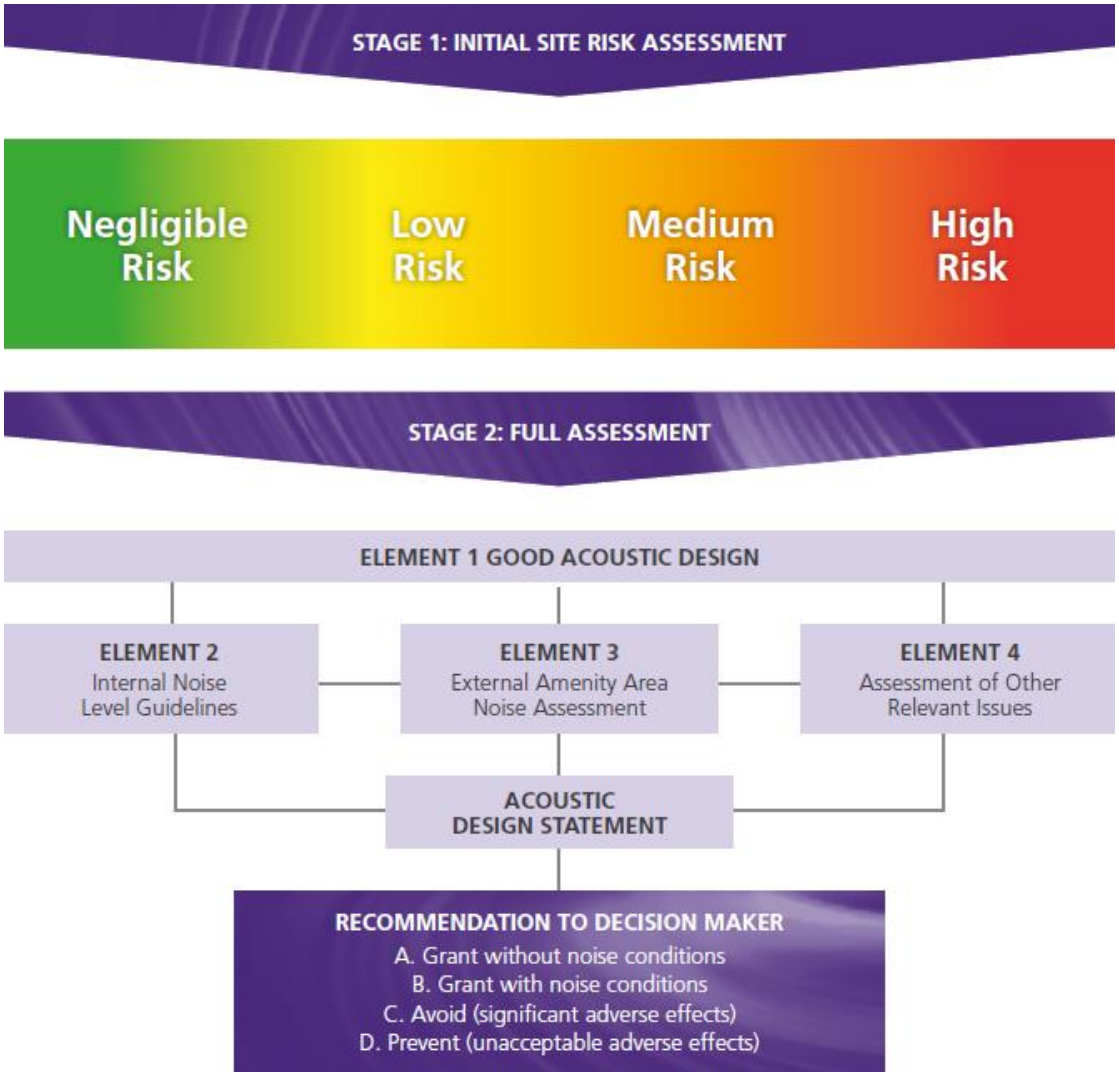

Figure 1 ProPG Approach (Source: ProPG)

2.4 British Standard 8233:2014 *Guidance on Sound Insulation and Noise Reduction for Buildings*

BS8233:2014 sets out recommended internal noise levels for several different building types; these are applicable to external noise sources such as road traffic. The guidance is primarily for use by designers and hence BS8233:2014 may be used as the basis for an appropriate schedule of noise control measures. The recommended internal noise levels for residential developments are set out below.

Activity	Location	Daytime 07:00 to 23:00hrs	Night 23:00 to 07:00hrs
Resting	Living room	35 dB $L_{Aeq,16hr}$	--
Dining	Dining room/area	40 dB $L_{Aeq,16hr}$	--
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$

Table 1 Summary of recommended internal noise levels from BS8233

The development site in question is in a busy urban environment, hence it is appropriate to adopt the standards for living rooms during the daytime and bedrooms during the night-time as follows:

- Living rooms in the daytime (07:00 to 23:00hrs) - 35 dB $L_{Aeq,16hr}$; and,
- Bedrooms in the night-time (23:00 to 07:00hrs) - 30 dB $L_{Aeq,8hr}$

In relation to noise levels in external amenity areas, BS 8233 provides the following guidance:

> *For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.*

As such it is acknowledged that noise levels in external amenity areas would ideally be maintained below 50-55dB L_{Aeq}, however, where predicted noise levels are above this range, this is somewhat offset by the convenience of proximity to transport infrastructure.

3.0 SITE DESCRIPTION

The site is located near Saggart, off Fortunestown Lane, as shown in Figure 2 below. The Luas Red line runs along the southern boundary of the site. Further from the site to the north west the N7 dual carriageway runs east-west.

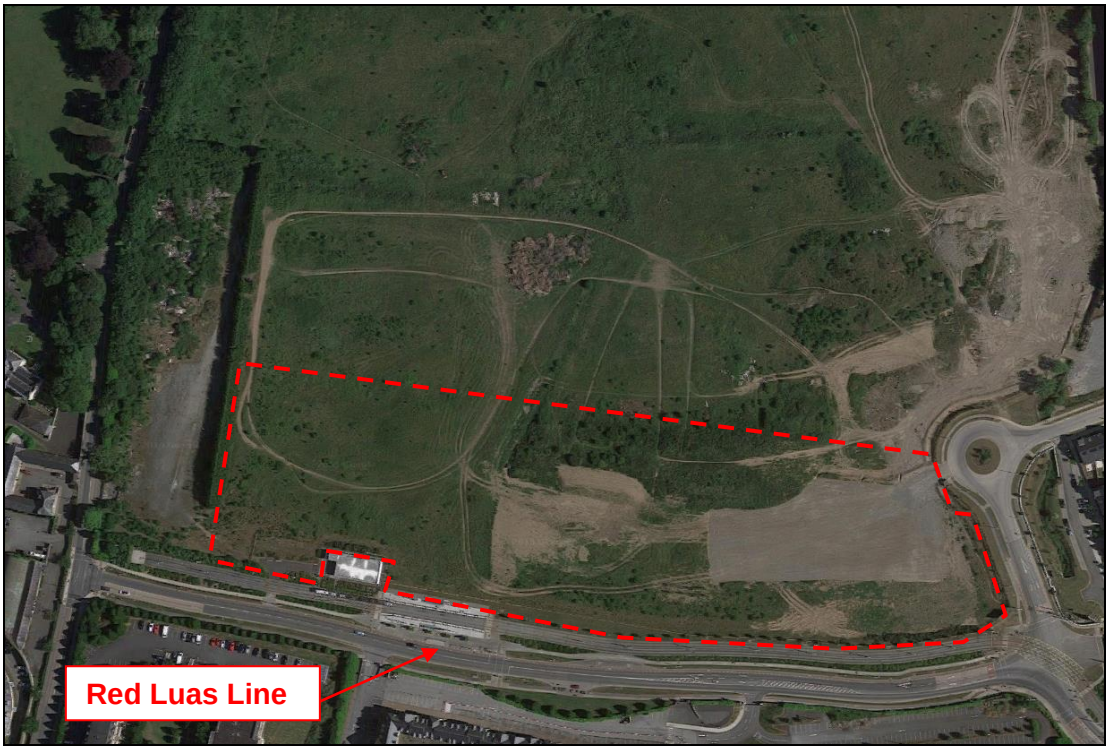

Figure 2 Site Location & Context

The proposed development comprises apartments, ground floor retail units and creche facility. Figure 3 presents the site layout assessed in this report and calculation points at the nearest exposed facades to the Luas line and Fortunestown Lane.

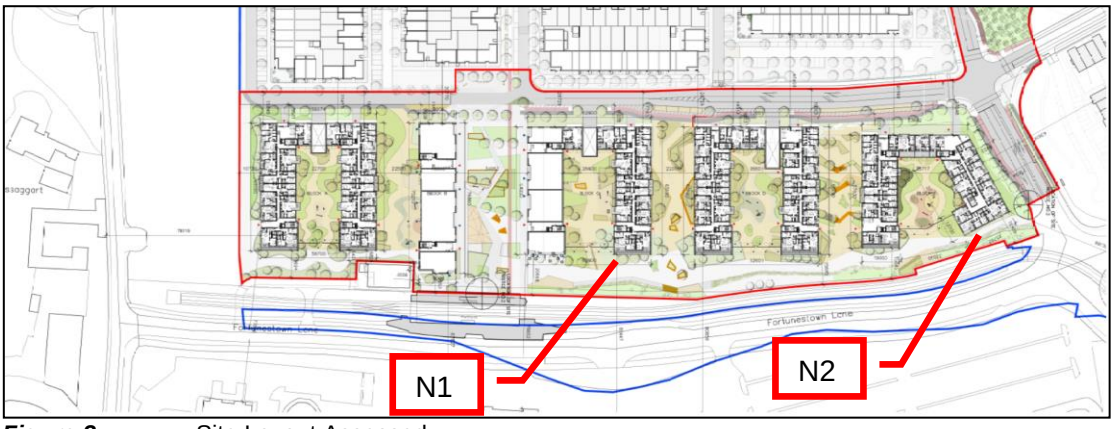

Figure 3 Site Layout Assessed

4.0 STAGE 1 – NOISE RISK ASSESSMENT

4.1 Methodology

The initial noise risk assessment is intended to provide an early indication of any acoustic issues that may be encountered. It calls for the categorisation of the site as a negligible, low, medium or high risk based on the pre-existing noise environment. Figure 4 presents the basis of the initial noise risk assessment, it provides appropriate risk categories for a range of continuous noise levels either measured and/or predicted on site.

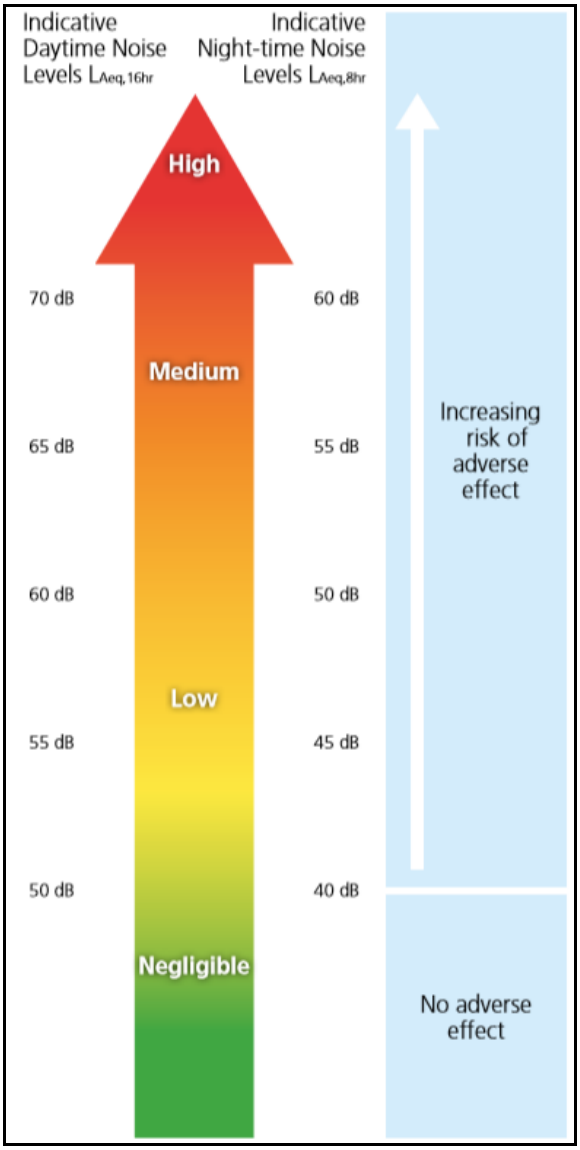

Figure 4 ProPG Stage 1 - Initial Noise Risk Assessment

It should be noted that a site should not be considered a negligible risk if more than 10 no. L_{AFmax} events exceed 60dB during the night period and the site should be considered a high risk if the L_{AFmax} events exceed 80dB more than 20 times a night.

Paragraph 2.9 of ProPG states that,

> *"The noise risk assessment may be based on measurements or prediction (or a combination of both) as appropriate and should aim to describe noise levels*

over a "typical worst case" 24 hour day either now or in the foreseeable future."

4.2 Baseline Noise Survey

A baseline noise survey was undertaken at the site to determine the existing noise climate. Due to the absence of a secure location to install an unattended noise meter, an attended survey was undertaken. Survey details are summarised in the following sections.

4.2.1 Survey Locations

Noise monitoring was undertaken at two monitoring locations at the development site, described below and illustrated in Figure 3.

Location A Monitoring location was positioned along the southern boundary of the site, approximately 30m from the edge of the Luas Line, representative of noise levels at dwellings proposed within this area of the development site.

Location B Monitoring location was positioned along the southern boundary of the site, approximately 10m from the edge of the Luas Line. Luas passbys were measured at this location.

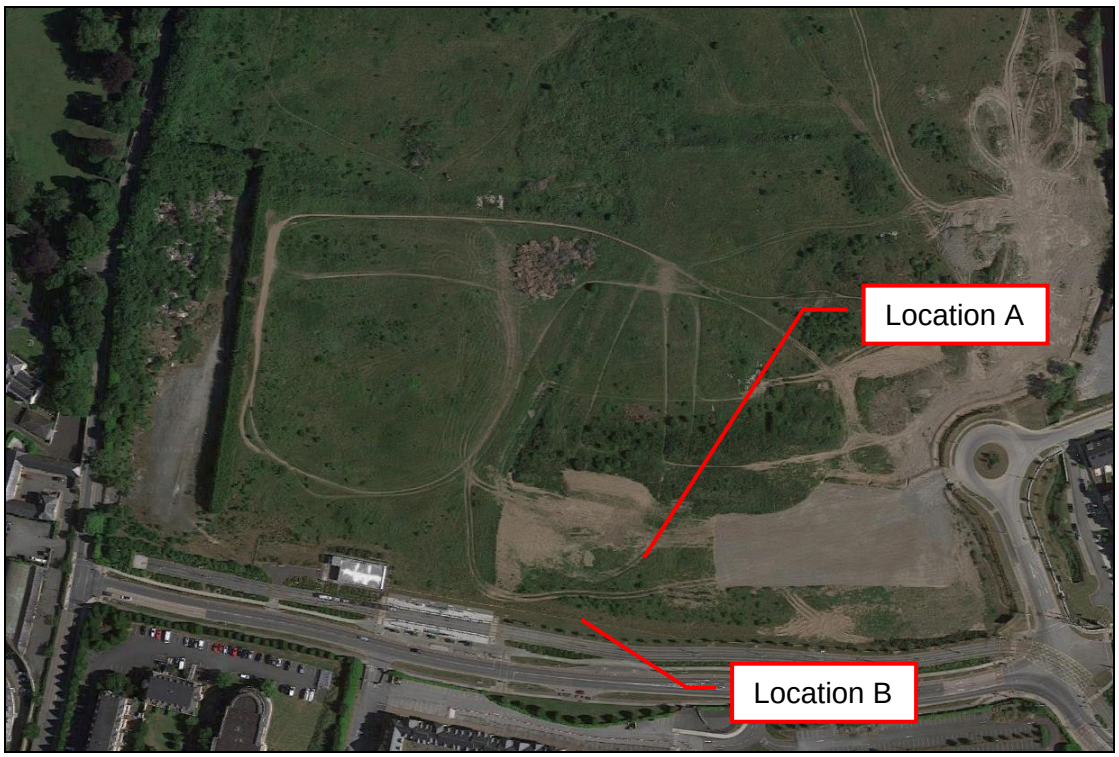

Figure 5 Noise Monitoring Locations

4.2.2 Survey Periods

The surveys were undertaken over the following survey periods:

Daytime: 10:05hrs to 11:50 hrs on 19 April 2019

Survey periods were 15 minutes. Due to construction activity and structures in the area the survey locations were constrained somewhat. Measurements of Luas movements were captured for arriving and departing trams.

4.2.3 Survey Equipment

The surveys were undertaken using a Brüel and Kjaer type 2250 Sound Level Meter and field calibrated using a Brüel and Kjaer Type 4321 sound level calibrator. All measurements were undertaken at a height of 1.5 metres above ground level.

4.2.4 Weather Conditions

The weather during the daytime survey was dry with wind speeds typically 3 – 4 m/s. temperatures were in the range 14 degrees Celsius.

4.2.5 Survey Parameters

The noise survey results are presented in terms of the following four 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_{A90} is the sound level that is exceeded for 90% of the sample period. It is typically used as a descriptor for background noise.

SEL Sound exposure level – a measure of the A-weighted sound energy used to describe noise events such as the passing of a train or aircraft; it is the A-weighted sound pressure level if occurring over a period of 1 second, would contain the same amount of A-weighted sound energy as the event.

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.

4.2.6 Survey Results

The results of the noise surveys are summarised in Table 2.

Location	Period	Start Time	Measured Noise Level, dB			Observations
			L_{Aeq}	L_{AFmax}	L_{A90}	
Location A	Day	10:05	52	74	46	• Traffic noise from adjacent road. • Intermittent construction noise • Luas movements
		10:39	49	61	46	
		11:35	57	72	48	

Table 2 Measured Noise Levels across development site.

During survey periods, the key sources of noise were noted to be traffic along Fortunestown Lane and intermittent noise from Luas Trams whilst passing the monitoring locations. At Location A daytime noise levels were in the range of 49 to 57dB $L_{Aeq.}$ Background levels were in the range 46 to 48dB L_{A90}.

It was not possible to securely install an unattended noise monitor to capture night time noise levels. Reference has been made to EPA Noise Maps in order to estimate night time traffic noise levels across the site. The site falls outside the 50 - 54dB L_{night} contour, i.e. L_{night} noise levels are less than this. Taking a conservative estimate a level of 50dB L_{night} has been used in the assessment.

Measurements of Luas movements were made while on site. The calculated Sound Exposure Levels (SEL) are detailed in the table below.

Activity	Location	Distance	SEL (dB)
Luas Movement	Inbound track	~5m	85
	Outbound track	~7m	87

Table 3 Calculated SELs

4.2.7 Luas Red Line Noise Levels

With the measured SEL of a Luas movement and the knowledge of the number of movements on the red line during a day and night time period the expected levels of Luas noise at the facades of the proposed buildings have been predicted. The expected level has been predicted to the closest façade on the proposed site. The review of this analysis is presented in Table 4.

Activity	Location	Period	No. Of Movements	Predicted Noise Level at Closest Façade
Tram Movements	Location N1 (Apartment)	Day	288	53 dB $L_{Aeq,16hr}$
		Night	20	44 dB $L_{Aeq,8hr}$
	Location N2 (Apartment)	Day	288	57 dB $L_{Aeq,16hr}$
		Night	20	49 dB $L_{Aeq,8hr}$

Table 4 Predicted Luas Red Line Noise Levels

The above calculation assumes no screening is afforded to the first floor of the buildings from Luas movements. Therefore, the approach adopted here is considered to be representative of the worst-case scenario.

4.3 Cumulative Noise Levels

Table 5 presents the predicted cumulative noise levels from traffic on Fortunestown Lane and Luas sources at the noise sensitive locations across the proposed site identified in Figure 2.

Activity	Location	Period	Predicted Noise Level at Closest Façade
Tram Movements + traffic noise	N1 (Apartment)	Day	58 dB $L_{Aeq,16hr}$
		Night	51 dB $L_{Aeq,8hr}$
	N2 (Apartment)	Day	60 dB $L_{Aeq,16hr}$
		Night	53 dB $L_{Aeq,8hr}$

Table 5 Predicted Cumulative (traffic & Luas) Noise Levels

4.4 Baseline Noise Review

4.4.1 Daytime Levels

Predicted noise levels incident to the façade of the proposed dwellings facing Fortunestown Lane and Luas Red Line are between 58 and 60 dB $L_{Aeq,16hr}$ and ground and first floor levels during daytime periods.

4.4.2 Night-time Levels

Predicted noise levels incident to the façade of the proposed dwellings facing Fortunestown Lane and Luas Red Line are between 52 and 53 dB $L_{Aeq,8hr}$ and ground and first floor levels during night periods.

4.4.3 Summary

With reference to the Noise Risk Assessment outlined in ProPG the noise levels for relevant periods have been derived in order to classify the proposed development site. The table below summarises the measured noise levels at the measurement location situated approximately at the proposed building facades as per the preliminary site layout.

Period	Measured Noise Level (dB, $L_{Aeq,T}$)	"Risk Category"
Daytime	60	Low - Medium
Night time	53	Low - Medium

Table 6 Categorising Proposed Site

4.5 Noise Risk Assessment Conclusion

Giving consideration to the measured and predicted noise levels presented in the previous sections the initial site noise risk assessment has concluded that the level of risk across the site varies from low to medium noise risk.

Additionally, the Stage 1 Noise Risk Assessment requires analyses of the L_{AFmax} noise levels. As discussed in the survey section, night time measurements were not carried out due to security of equipment. Review of L_{max} levels during the day indicates that events observed were below the 80dB threshold, as would be the case at night time also. Therefore the High Risk classification is not triggered.

ProPG states the following with respect to negligible, low, medium and high risks:

Negligible Risk — *These noise levels indicate that the development site is likely to be acceptable from a noise perspective, and the application need not normally be delayed on noise grounds.*

Low Risk — *At low noise levels, the site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised in the finished development.*

Medium Risk — *As noise levels increase, the site is likely to be less suitable from a noise perspective and any subsequent application may be refused unless a good acoustic design process is followed and is demonstrated in an ADS which confirms how the*

adverse impacts of noise will be mitigated and minimised, and which clearly demonstrate that a significant adverse noise impact will be avoided in the finished development.

High Risk — *High noise levels indicate that there is an increased risk that development may be refused on noise grounds. This risk may be reduced by following a good acoustic design process that is demonstrated in a detailed ADS. Applicants are strongly advised to seek expert advice.*

Given the above it can be concluded that the development site may be categorised as *Low to Medium Risk* and as such an Acoustic Design Strategy will be required to demonstrate that suitable care and attention has been applied in mitigating and minimising noise impact to such an extent that an adverse noise impact will be avoided in the final development.

5.0 STAGE 2 – FULL ACOUSTIC ASSESSMENT

5.1 Element 1 – Good Acoustic Design (GAD) Process

5.1.1 ProPG Guidance

In practice, good acoustic design should deliver the optimum acoustic design for a particular site without adversely affecting residential amenity or the quality of life or occupants or compromising other sustainable design objectives. It is important to note that ProPG specifically states that good acoustic design is not equivalent to overdesign or "*gold plating"* of all new development but that it seeks to deliver the optimum acoustic environment for a given site.

Section 2.23 of the ProPG outlines the following checklist for Good Acoustic Design:

- Check the feasibility of relocating, or reducing noise levels from relevant sources;
- Consider options for planning the site or building layout;
- Consider the orientation of proposed building(s);
- Select construction types and methods for meeting building performance requirements;
- Examine the effects of noise control measures on ventilation, fire regulation, health and safety, cost, CDM (construction, design and management) etc;
- Assess the viability of alternative solutions; and,
- Assess external amenity area noise.

In the context of the proposed development, each of the considerations listed above have been addressed in the following subsections.

5.1.2 Application of GAD Process to Proposed Application

Relocation or Reduction of Noise from Source

The surrounding road and tram network is located outside the redline boundary of the site and therefore it is beyond the scope of this development to introduce any noise mitigation at source.

Planning, Layout and Orientation

Review of the site layout shows that the apartment blocks are positioned with the block-ends facing Fortunestown Lane, by doing this fewer facades are exposed to noise from the road and trams.

Amenity spaces are located at further distances from the road and are enclosed on three sides with a limited opening adjacent to the road, reducing the overall potential traffic and tram noise exposure in a given amenity space.

Select Construction Types for meeting Building Regulations

Masonry constructions will be used in constructing the external walls of the development. The masonry construction type offers high levels of sound insulation performance. However, as is typically the case the glazed elements and any required ventilation paths to achieve compliance with Part F of the Building Regulations will be the weakest elements in the façade in terms of sound insulation performance.

Consideration will therefore be given to the provision of upgraded acoustic ventilators. Note that it will not be possible to achieve the desirable internal acoustic environments with windows open. Instead the proposal here will be to provide dwelling units with ventilators that have good acoustic insulation properties so that when the windows are closed the noise levels internally are good. Inhabitants will be able to open the windows if they wish, however, doing so will increase the internal noise level. This approach to mitigation is supported in ProPG where it states the following (note my emphasis has been added in bold),

> "2.22 *Using fixed unopenable glazing for sound insulation purposes is generally unsatisfactory and should be avoided;* ***occupants generally prefer the ability to have control over the internal environment using openable windows, even if the acoustic conditions would be considered unsatisfactory when open****. Solely relying on sound insulation of the building envelope to achieve acceptable acoustic conditions in new residential development, when other methods could reduce the need for this approach, is not regarded as good acoustic design. Any reliance upon building envelope insulation with closed windows should be justified in supporting documents* "
>
> *Note 5 Designing the site layout and the dwellings so that the internal target levels can be achieved with open windows in as many properties as possible demonstrates good acoustic design. Where it is not possible to meet internal target levels with windows open, internal noise levels can be assessed with windows closed, however any façade openings used to provide whole dwelling ventilation (e.g. trickle ventilators) should be assessed in the "open" position and, in this scenario, the internal L_{Aeq} target levels should not normally be exceeded*
>
> 2.34 *Where the LPA accepts that there is a justification that the internal target noise levels can only be practically achieved with windows closed,* ***which may be the case in urban areas and at sites adjacent to transportation noise sources****, special care must be taken to design the accommodation so that it provides good standards of acoustics, ventilation and thermal comfort without unduly compromising other aspects of the living environment. In such circumstances, internal noise levels can be assessed with windows closed but with any façade openings used to provide "whole dwelling*

> *ventilation" in accordance with Building Regulations Approved Document F (e.g. trickle ventilators) in the open position (see Supplementary Document 2). Furthermore, in this scenario the internal L_{Aeq} target noise levels should not generally be exceeded*."

It is very important to note that it is impractical to achieve the good internal noise levels with windows open across the vast majority of development sites in urban or suburban locations. Such sites would need to be classified as having a negligible risk in accordance with the ProPG noise risk assessment approach. For this reason, there are no guidance documents either at a local level or an international level that AWN is aware of which would support the approach of achieving the ideal internal noise levels only in the open window scenario. It is therefore considered entirely correct and justifiable to provide building facades with a moderate degree of sound insulation such that with windows closed but vents opened a good internal acoustic environment is achieved.

Impact of noise control measures on fire, health and safety etc

The good acoustic design measures that have been implemented on site, e.g. locating properties away from the road, placing outdoor space on the quiet side of buildings, are considered to be cost neutral and do not have any significant impact on other issues.

Assess External Amenity Area Noise

ProPG provides the following advice with regards to external noise levels for amenity areas in the development:

> *"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 $L_{Aeq,16hr}$."*

Noise levels across amenity areas is addressed in Section 4.3 below.

5.2 Element 2 – Internal Noise Levels

Internal Noise Criteria

Element 2 of the ProPG document sets out recommended internal noise targets derived from BS 8233 (2014). The recommended indoor ambient noise levels are set out in Table 1, Section 2.4 above and are based on annual average data.

In addition to these absolute internal noise levels ProPG provides guidance on flexibility of these internal noise level targets. For instance, in cases where the development is considered necessary or desirable, and noise levels exceed the external WHO guidelines, then a relaxation of the internal L_{Aeq} values by up to 5dB can still provide reasonable internal conditions.

Façade Noise Levels

Based on measured noise levels and calculated tram movements, façade noise levels have been predicted for the most exposed proposed facades in the development site during day and night-time periods. Table 5 presents the predicted noise levels for the various facades of the buildings on site that have been assumed for this assessment.

Discussion on Open/Closed Windows

The level of sound reduction offered by a partially open window is typically applied as 15dB[1] to 18dB.

Considering the design goals outlined in Table 1 and sound reduction across an open window of 15dB, the free-field noise levels that would be required to ensure that internal noise levels do not exceed 'good' or 'reasonable' internal noise levels have been summarised in Table 7.

Level Desired	Day 07:00 to 23:00hrs	Night 23:00 to 07:00hrs
Good (i.e. at or below the internal noise levels)	50 – 55dB $L_{Aeq,16hr}$	45dB $L_{Aeq,8hr}$
Reasonable (i.e. 5 dB above the internal noise levels)	55 – 60dB $L_{Aeq,16hr}$	50dB $L_{Aeq,8hr}$

Table 7 External Noise Levels Required to Achieve Internal Noise Levels

For sensitive rooms that face on to Fortunestown Lane a reasonable internal noise level will be achieved with windows open during the daytime. During the night time period level are marginally over the reasonable threshold (+1 to +3dB). For rooms located at further distances reasonable and good levels will be achieved with windows open.

An appropriate acoustic specification for ventilators shall be provided in this instance to ensure the rooms achieve good internal noise levels.

Recommend Façade Treatment

The British Standard BS EN 12354-3: 2000: *Building acoustics – Estimation of acoustic performance of buildings from the performance of elements – Part 3: Airborne sound insulation against outdoor sound* provides a calculation methodology for determining the sound insulation performance of the external envelope of a building. The method is based on an elemental analysis of the building envelope and can take into account both the direct and flanking transmission paths.

The Standard allows the acoustic performance of the building to be assessed taking into account the following:

- Construction type of each element (i.e. windows, walls, etc.);
- Area of each element;
- Shape of the façade, and;
- Characteristics of the receiving room.

The principals outlined in BS EN 12354-3 are also referred to in BS8233 and Annex G of BS8233 provide a calculation method to determine the internal noise level within a building using the composite sound insulation performance calculated using the methods outlined in BS EN 12354-3. The methodology outlined in Annex G of BS8233 has been adopted here to determine the required performance of the building facades. This approach corrects the noise levels to account for the frequency content of the source in question. In this instance, rail and road traffic noise, depending on the buildings in question.

[1] Section 2.33 of ProPG, additional information can be found in the DEFRA NANR116: *'Open/Closed Window Research' Sound Insulation Through Ventilated Domestic Windows'*

Glazing

As is the case in most buildings, the glazed elements of the building envelope are typically the weakest element from a sound insulation perspective. In this instance the facades will be provided with glazing that achieves the minimum sound insulation performance as set out in Table 8.

Typical Construction that would comply	Glazing Octave Band Centre Frequency (Hz)						R_w
	125	250	500	1k	2k	4k	
4 – 12 – 4 double glazing	24	20	25	34	37	35	33

Table 8 Glazing Sound Insulation Performance Requirements, SRI (dB)

The overall R_w outlined above are provided for information purposes only. The over-riding requirement is the Octave Band sound insulation performance values which may also be achieved using alternative glazing configurations. Any selected system will be required to provide the same level of sound insulation performance set out in Table 8 or greater.

It is important to note that the acoustic performance specifications detailed herein are minimum requirements which apply to the overall glazing system. In the context of the acoustic performance specification the 'glazing system' is understood to include any and all of the component parts that form part of the glazing element of the façade, i.e. glass, frames, seals, openable elements etc.

It is advised that the window supplier provides laboratory tests confirming the sound insulation performance, (to British Standard 2750 Part 3:1980 and British Standard 5821, or British Standard EN ISO 140 Part 3 1995 and British Standard EN ISO 717, 1997). It is important to note that the acoustic performance specifications detailed herein are minimum requirements which apply to the overall glazing system when installed on site.

Figure 6 Extent of Requirement for Appropriate Double Glazing (Green)

Non-living spaces such as toilets, corridors and bathrooms do not have the same acoustic requirements and standard thermal glazing would be considered acceptable within these areas.

Wall Construction

In general, all wall constructions (i.e. block work or concrete and spandrel elements) offer a high degree of sound insulation, much greater than that offered by the glazing systems. Therefore, noise intrusion via the wall construction will be minimal. The

calculated internal noise levels across the building façade have assumed a minimum sound reduction index of 50 dB R_w for this construction.

Internal Noise Levels

Taking into account the external façade levels and the specified acoustic performance to the building envelope, the internal noise levels have been calculated.

All locations are predicted to achieve good internal noise levels with windows closed. For locations highlighted orange and green in Figure 10, the good to reasonable internal noise levels are achieved with both windows open and closed.

Ventilation

Standard passive ventilation grilles offer minimal acoustic insulation however the magnitude of the predicted levels is such that standard non-acoustic ventilators are sufficient in this instance. The attenuation across any ventilation system will be required to offer a minimum performance of 36 $D_{n,e,w}$.

Summary

Considering the constraints of the site, in so far as possible and without limiting the extent of the development area, the principles of Good Acoustic Design have been applied to the development.

In terms of viable alternatives to acoustic treatment of façade elements, currently it is not considered likely that there will be further options for mitigation outside of proprietary acoustic ventilation. This will be developed further as the design progresses.

5.3 Element 3 – External Amenity Areas

For this development the good acoustic design principals employed have ensured that the private external spaces are positioned to benefit, to some extent, from the screening effect of the development buildings. Figure 7 illustrates that for the current layout the private outdoor amenity areas further from Fortunestown Lane achieves a noise level ≤55dB $L_{Aeq,16hr}$. In closer proximity to the road and tram line the predicted noise levels increase. It is predicted that the majority of the amenity space will experience noise levels of the order 55 to 57dB $L_{Aeq,16hr}$ representing a marginal exceedance of the recommended noise level, i.e. ≤55dB $L_{Aeq,16hr}$. As per BS 8233, predicted noise levels where predicted noise levels are above this range, this is somewhat offset by the convenience of proximity to transport infrastructure.

Predicted Noise Level (dB $L_{Aeq,16hr}$)	Contour
≤55	
55 – 57	
57 – 63	

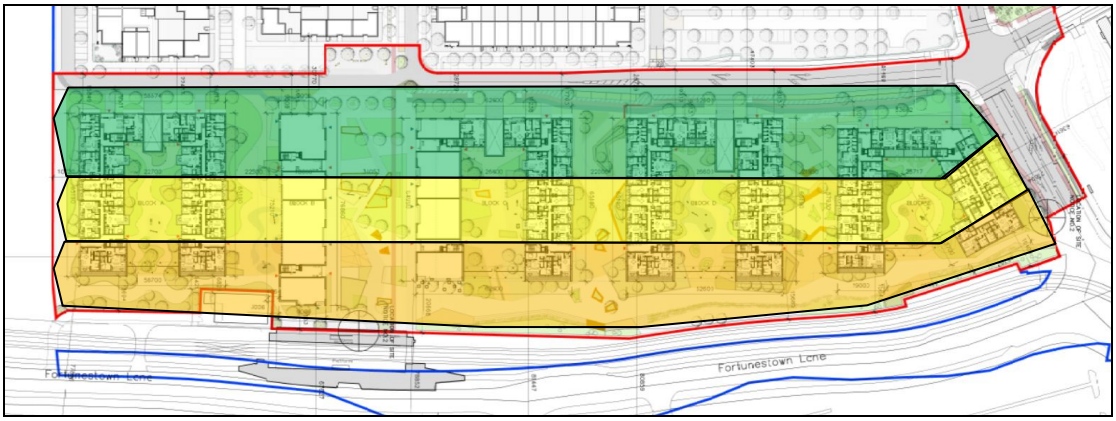

Figure 7 Graphical Representation of Predicted Noise Levels

Balconies facing Fortunestown Lane and tram line will experience elevated noise levels. In an urban setting elevated noise levels on balconies is compensated for by provision of dedicated sheltered community amenity space as is the case in this instance.

6.0 CONCLUSION

A site noise risk assessment has been carried out on the proposed Strategic Housing Development at Fortunestown Lane, Saggart, Co. Dublin. The assessment has classified the development site as having a range of noise risks associated ranging from medium to high risk. This was determined through a combination of measurements of noise levels on site and through review of noise maps of the site and surrounds.

Further discussion is presented in terms of the likely noise impact of both the internal and external areas of the proposed development. It has been found that a proportion of the inhabitants will have access to a quiet external area that is screened by the development itself from road traffic noise and other noise sources, while external areas closer to Fortunestown Lane will be exposed to noise levels marginally above the recommended noise range. This is somewhat offset by the proximity and convenience of local transport infrastructure.

In addition, it is expected that most habitable rooms will achieve a good internal noise environment while also allowing natural ventilation via an open window. However, for those rooms overlooking the local road network and rail line, it will be necessary to provide appropriate double glazing and ventilators to ensure that when windows are closed that the internal noise environment is good. In these rooms the noise level internally with the windows open will be higher than ideal, however, inhabitants will have the option to close the window to reduce the noise level internally, while also achieving adequate ventilation in accordance with Part F.

APPENDIX A
GLOSSARY OF ACOUSTIC TERMINOLOGY

ambient noise — The totally encompassing sound in a given situation at a given time, usually composed of sound from many sources, near and far.

background noise — The steady existing noise level present without contribution from any intermittent sources. The A-weighted sound pressure level of the residual noise at the assessment position that is exceeded for 90 per cent of a given time interval, T ($L_{AF90,T}$).

broadband — Sounds that contain energy distributed across a wide range of frequencies.

dB — Decibel - The scale in which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the RMS pressure of the sound field and the reference pressure of 20 micro-pascals (20 µPa).

dB L_{pA} — An 'A-weighted decibel' - a measure of the overall noise level of sound across the audible frequency range (20 Hz – 20 kHz) with A-frequency weighting (i.e. 'A'–weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.

Hertz (Hz) — The unit of sound frequency in cycles per second.

$L_{Aeq,T}$ — This is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period (T). The closer the L_{Aeq} value is to either the L_{AF10} or L_{AF90} value indicates the relative impact of the intermittent sources and their contribution. The relative spread between the values determines the impact of intermittent sources such as traffic on the background.

L_{AFN} — The A-weighted noise level exceeded for N% of the sampling interval. Measured using the "Fast" time weighting.

L_{AFmax} — is the instantaneous slow time weighted maximum sound level measured during the sample period (usually referred to in relation to construction noise levels).

$L_{Ar,T}$ — The Rated Noise Level, equal to the L_{Aeq} during a specified time interval (T), plus specified adjustments for tonal character and impulsiveness of the sound.

L_{AF90} — Refers to those A-weighted noise levels in the lower 90 percentile of the sampling interval; it is the level which is exceeded for 90% of the measurement period. It will therefore exclude the intermittent features of traffic and is used to estimate a background level. Measured using the "Fast" time weighting.

APPENDIX A
GLOSSARY OF ACOUSTIC TERMINOLOGY (continued …)

noise Any sound, that has the potential to cause disturbance, discomfort or psychological stress to a person exposed to it, or any sound that could cause actual physiological harm to a person exposed to it, or physical damage to any structure exposed to it, is known as noise.

noise sensitive location NSL – Any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or other area of high amenity which for its proper enjoyment requires the absence of noise at nuisance levels.

octave band A frequency interval, the upper limit of which is twice that of the lower limit. For example, the 1,000Hz octave band contains acoustical energy between 707Hz and 1,414Hz. The centre frequencies used for the designation of octave bands are defined in ISO and ANSI standards.

sound pressure level The sound pressure level at a point is defined as:

$$Lp = 20Log\frac{P}{P_0} \text{ dB}$$