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PROPOSED KNOCKRABO PHASE 2 RESIDENTIAL DEVELOPMENT

NOISE AND VIBRATION ASSESSMENT OF DEVELOPMENT SITE

Technical Report Prepared For

Knockrabo Investments DAC

Technical Report Prepared By

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Our Reference

SS/20/11865NR01d

Date of Issue

13 October 2021

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Document History

Document Reference		Original Issue Date	
SS/20/11865NR01		2 February 2021	
Revision Level	Revision Date	Description	Sections Affected
a	16 February 2021	Updated to full assessment	various
b	2 March 2021	Addressed comments	various
c	12 October 2021	Updated to address final design	various
d	13 October 2021	Addressed comments	various

Record of Approval

Details	Written by	Approved by
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Date	13 October 2021	13 October 2021

EXECUTIVE SUMMARY

AWN Consulting has been commissioned to carry out a study in relation to the potential noise impacts incident to the proposed residential development at Phase 2, Knockrabo, Co. Dublin.

The future noise environment with the proposed Dublin Eastern By-Pass (DEBP) in operation has been determined through modelling. This assessment has classified the development site as having a range of noise risks associated, ranging from low to high risk.

Subsequent to the noise risk assessment a full Acoustic Design Statement has also been prepared to discuss how good acoustic design practice has been implemented. This document presents further discussion of the likely noise impact of both the external and internal areas of the proposed development.

It has been determined that mitigation measures in the form of boundary treatments to the external amenity spaces and façade treatments to development buildings will be required for the development. Furthermore, Winter Gardens have been provided to the facades most exposed to noise from the proposed DEBP. In addition, it will be necessary to provide enhanced acoustic glazing to the other façade elevations to ensure that when windows are closed that the internal noise environment is good. The specifications for all acoustic glazing have been provided in the body of this report. It is also proposed to provide mechanical ventilation to the development units which removes the need for any passive wall or window vents and effectively mitigates any noise intrusion via the ventilation path.

In conclusion, there are no building regulations that require new developments to achieve a certain level of noise insulation from external sources. However, for this development the site was identified as potentially being exposed to elevated noise levels due to the operation of the proposed DEBP road scheme. As a result, this report has provided specifications and design advice to the developer to ensure that the internal noise environment within the development buildings is fully compliant with best practice standards. This also ensures compliance with the requirements of the local Dublin Agglomeration Noise Action Plan document.

Furthermore, vibration impacts on the proposed development have been assessed both during the construction and operational phase of the DEBP road scheme. During construction it is concluded that there will be no adverse impact on the development structures, once the appropriate limits are adhered to by the relevant contractors. During operation of the DEBP it is concluded that the proper maintenance of the road surface on the DEBP will ensure that traffic induced vibration by road traffic, including heavy goods vehicles, is unlikely to be generated at a magnitude that would be subjectively noticeable within the proposed development buildings. Furthermore, any vibration generated during the operation of the DEBP would be far below the level at which any damage would be caused to the development buildings.

CONTENTS

1.0 INTRODUCTION

AWN Consulting has been commissioned to carry out a study in relation to the potential noise impacts incident to the proposed Phase 2 residential development at Knockrabo, Mt. Anville Road, Dublin 14. The focus of this report is to provide input into the acoustic design of the proposed development, identify any potential noise impacts and provide measures to minimise or mitigate those impacts.

Figure 1 presents the approximate outline of the proposed development site.

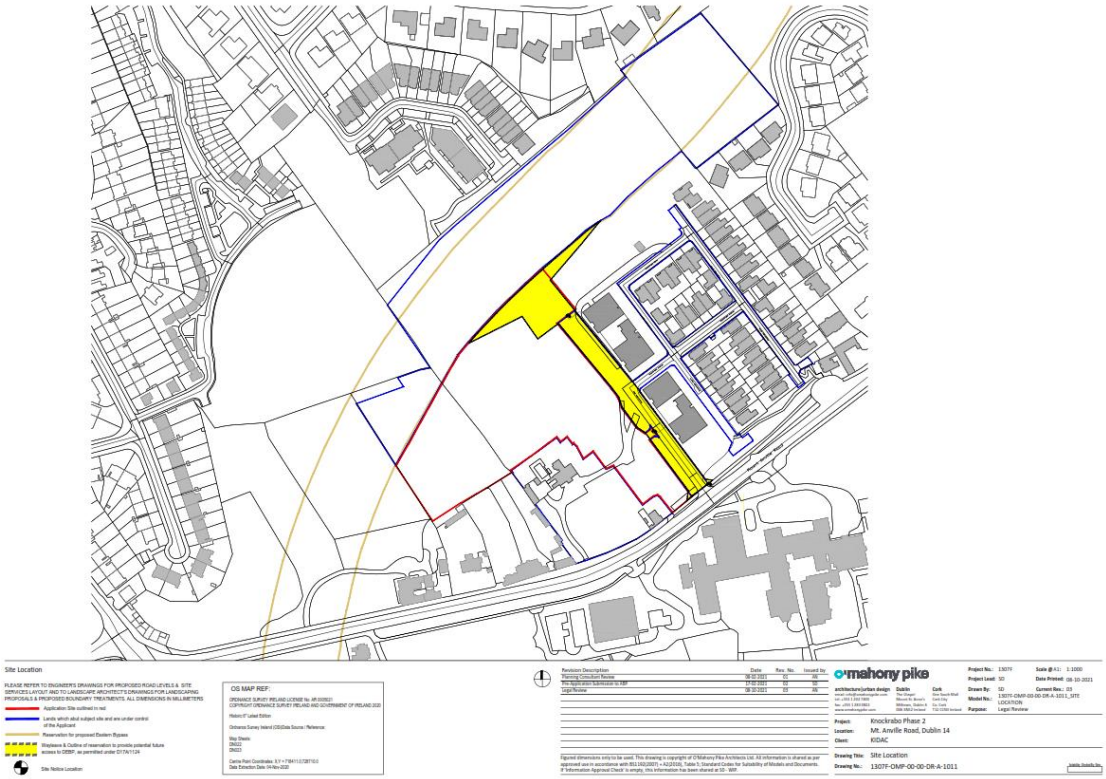

Figure 1 Location of proposed development

Appendix A presents a glossary of acoustic terminology that is used throughout this report.

2.0 DESIGN GUIDANCE

2.1 Dublin Agglomeration Noise Action Plan (NAP)

The Dublin Agglomeration Environmental Noise Action Plan December 2018 – November 2023 Volume 1: Dublin City Council states the following with respect to assessing the noise impact on new residential development:

"Acoustic privacy is a measure of sound insulation between dwellings and between external and internal spaces. Development should have regard to the guidance on sound insulation and noise reduction for buildings contained in BS 8233:2014. The following principles are recommended for minimising disruption from noise in dwellings:

- *Utilise the site and building layout to maximise acoustic privacy by providing good building separation within the development and from neighbouring buildings and noise sources.*
- *Arrange units within the development and the internal layout to minimise noise transmission by locating busy, noisy areas next to each other and quieter areas next to quiet areas*
- *Keep stairs, lifts, and service and circulation areas away from noise-sensitive rooms like bedrooms. Particular attention should be paid to the siting and acoustic isolation of the lift motor room. Proposals close to noisy places, such as busy streets may need a noise impact assessment and mitigation plan."*

2.2 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.

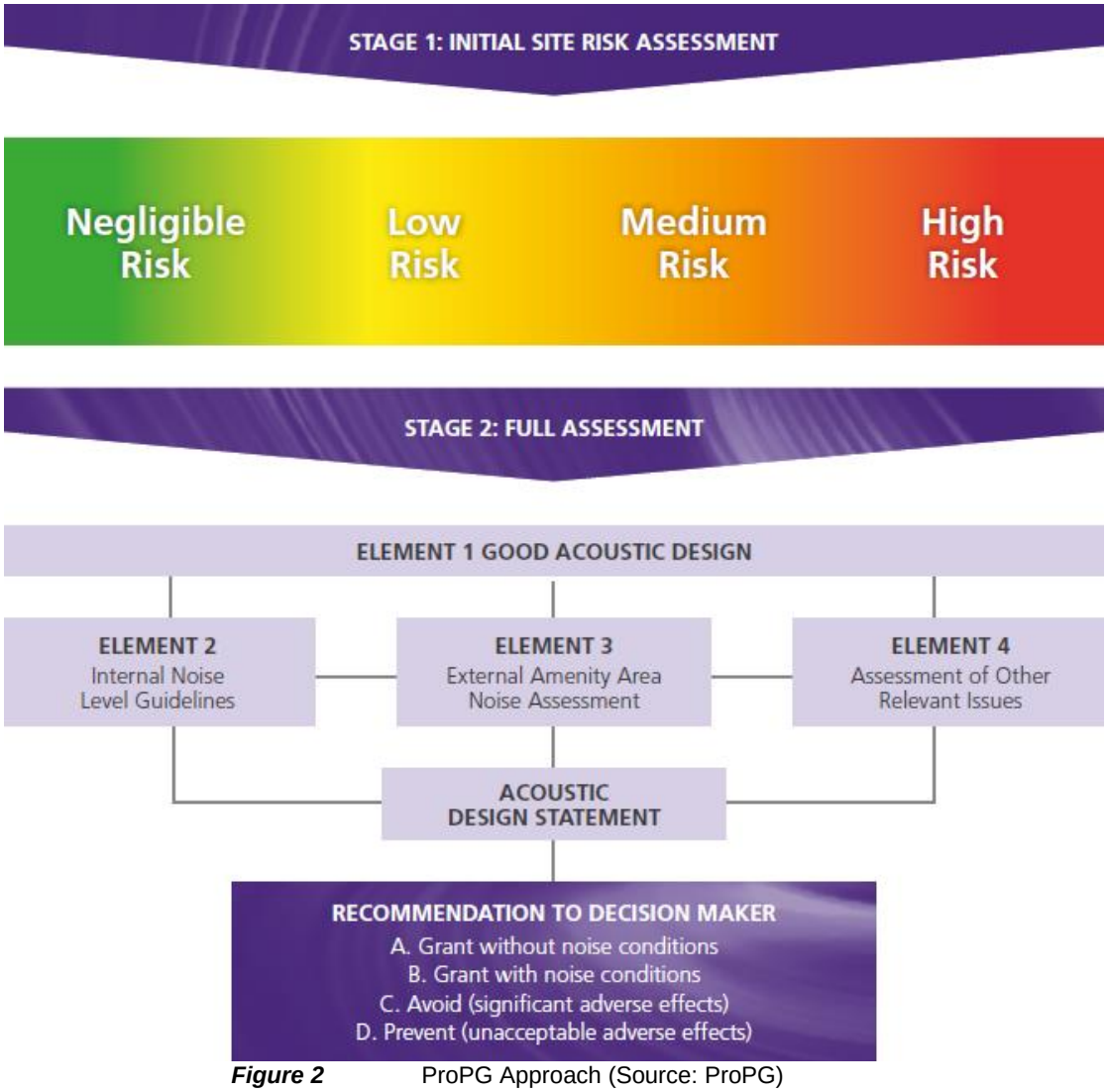

Figure 2 ProPG Approach (Source: ProPG)

3.0 STAGE 1 – NOISE RISK ASSESSMENT

3.1 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 3 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.

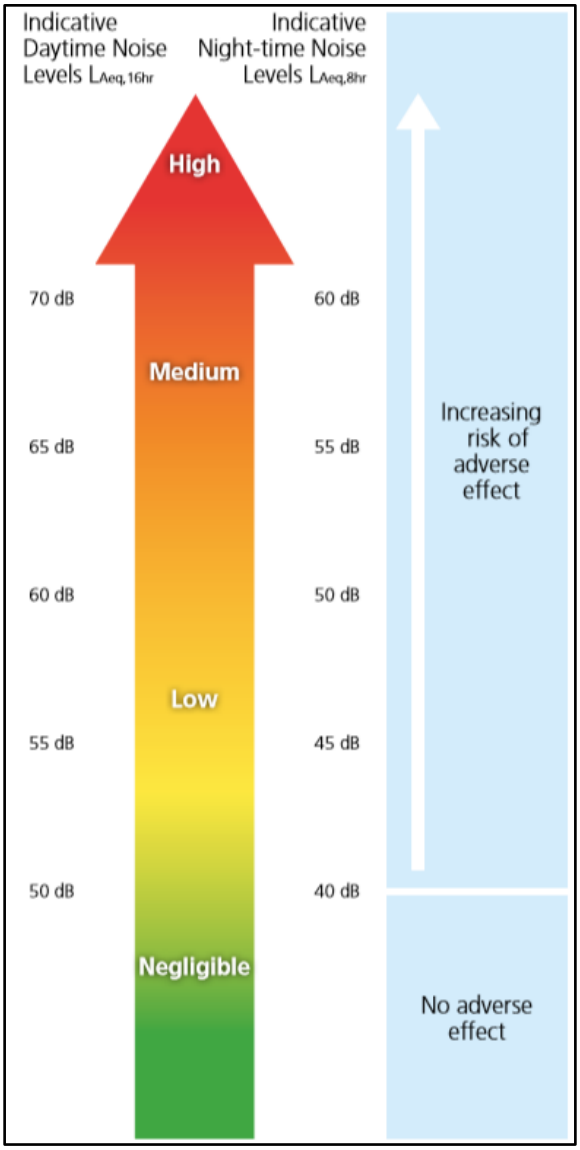

Figure 3 ProPG Stage 1 - Initial Noise Risk Assessment

It should be noted that a site should not be considered a negligible risk if more than 10 L_{AFmax} events exceed 60 dB during the night period and the site should be considered a high risk if the L_{AFmax} events exceed 80 dB 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."*

In this instance it is proposed to develop a 3D computer noise model of the development site and predict the noise levels across the entire site in order to investigate the initial noise risk. The noise model will use the measured noise levels during the survey, discussed in Section 3.2, to validate the model. Furthermore, the model allows the site to be assessed taking into account the changes in topography that are required to allow development. This is to comply with the requirements of paragraph 2.8 of ProPG which states,

> *"The risk assessment should not include the impact of any new or additional mitigation measures that may subsequently be included in development proposals for the site and proposed as part of a subsequent planning application. In other words, the risk assessment should include the acoustic effect of any existing site features that will remain (e.g. retained buildings, changes in ground level) and exclude the acoustic effect of any site features that will not remain (e.g. buildings to be demolished, fences and barriers to be removed) if development proceeds."*

In this instance the initial risk assessment will include the noise generated by the future Dublin Eastern By-Pass (DEBP). The reservation for this future road scheme runs to the north of the proposed development. More detail on this is presented in the following section.

3.2 Baseline Noise Environment

To predict the noise levels across the proposed development site with the influence of the DEBP, a 3D traffic noise model has been developed. The general methodology and details of the software package used (i.e. Brüel & Kjær Type 7810 *Predictor)* are presented in Appendix A of this document.

The traffic noise model takes as inputs the 3D alignment of the road and the expected traffic flow in terms of the Annual Average Daily Traffic (AADT). Additional inputs giving details of the expected percentage of heavy goods vehicles (HGV) and traffic speed are also provided. These traffic details have been taken from the *Dublin Eastern Bypass Corridor Protection Study, January 2011* which suggests **worst case** traffic figures to be used as the basis of any noise assessment.

In the absence of any published documents detailing the expected traffic flow on the DEBP, the NRA have advised that the traffic volumes and speed detailed in Table 1 should be used.

Carriageway	AADT	%HGV's	Speed, km/h
2-way flow	80,000	10	120

Table 1 Traffic Data for DEBP

As there has been no guidance given on the likelihood of a low noise road surface being used, a standard surface has been assumed. This assessment can, therefore, be considered a worst-case scenario for the current traffic flow and alignment. It is important to note that due to the proximity of the proposed DEBP to other existing residential properties in the area, it is highly likely that a low noise road surface would

be considered by the road design team. The use of a low noise road surface is also identified as a noise mitigation measure within the Dublin Action Plan. This document states,

> *For new roads schemes, low noise surfaces will be considered as part of the overall design and in keeping with current design guidelines.*

A low noise road surface will reduce the noise levels across the site by a minimum of 2 dB and up to 6 dB is possible depending on the surface chosen.

Finally, the traffic volumes and %HGV's that have been assumed are also considered to be representative of worst-case scenarios. Any reduction in traffic volume would see a corresponding reduction in noise level.

Figures 6 to 9 present the predicted noise levels across the development site for road traffic in terms of $L_{Aeq,16hr}$ day and $L_{Aeq,8hr}$ night at a height of 1.5m and 4m above ground level (AGL).

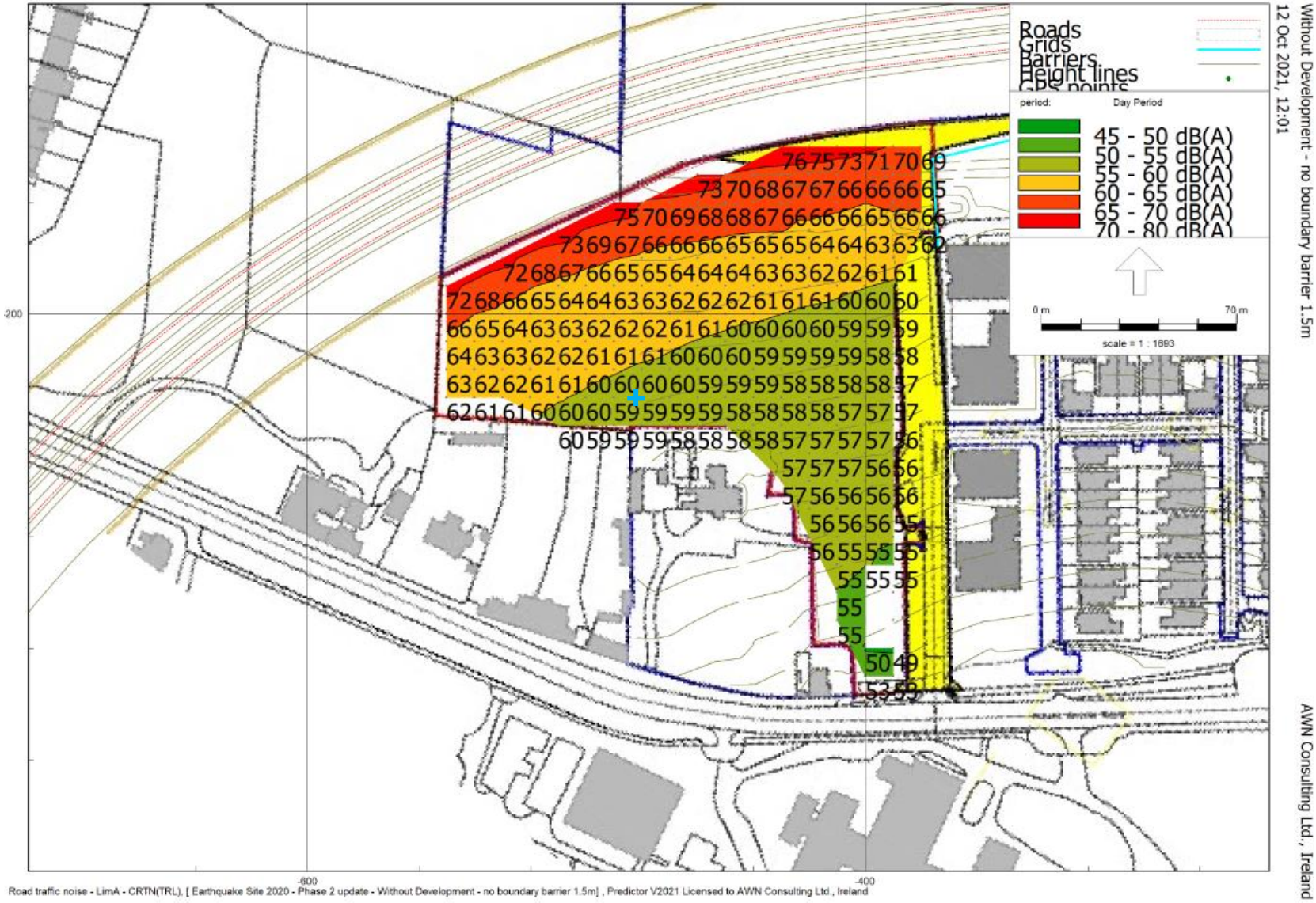

Figure 6 $L_{Aeq,16hr}$ Daytime Road Traffic Noise Levels – 1.5m AGL

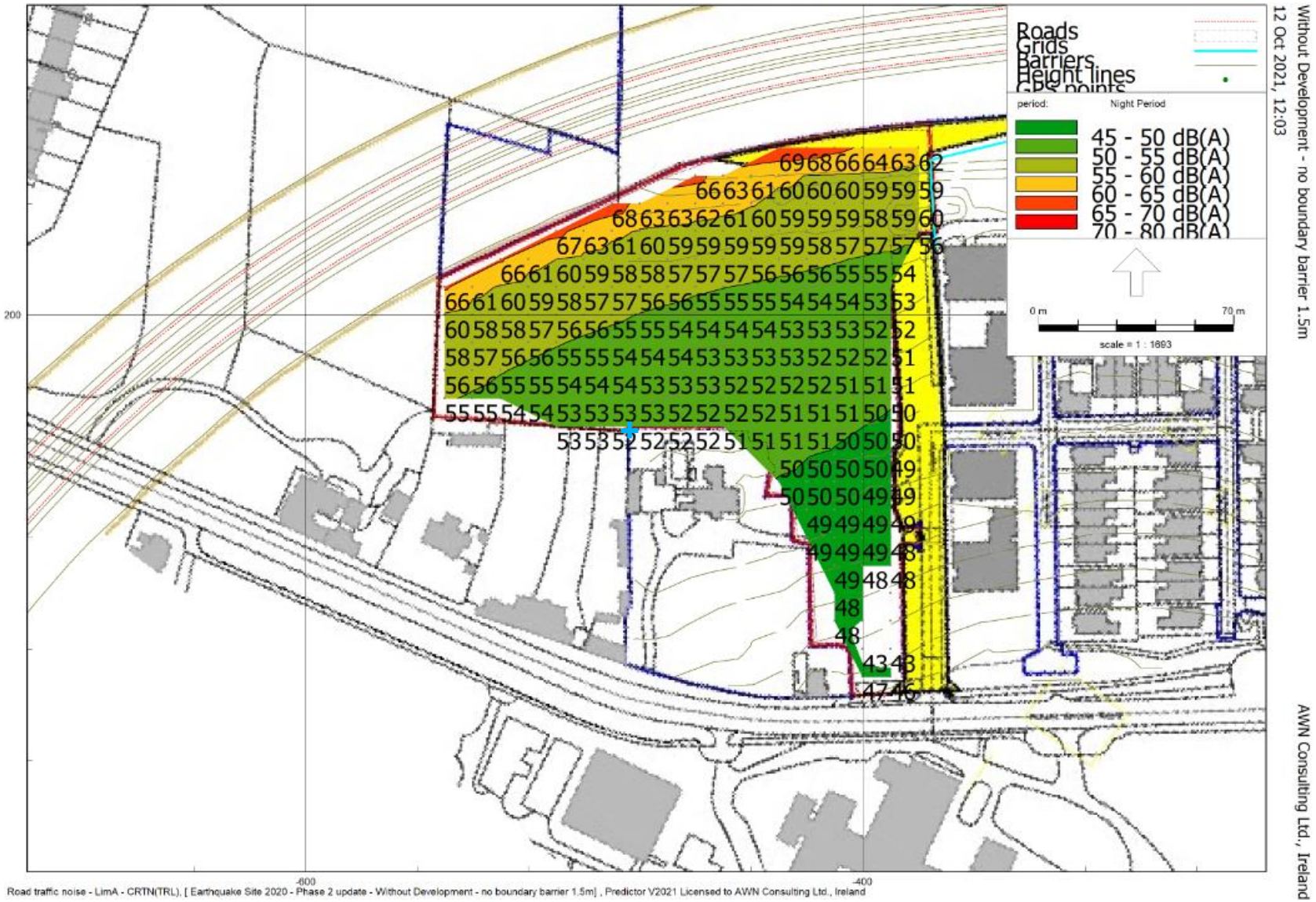

Figure 7 $L_{Aeq,8hr}$ Night Road Traffic Noise Levels – 1.5m AGL

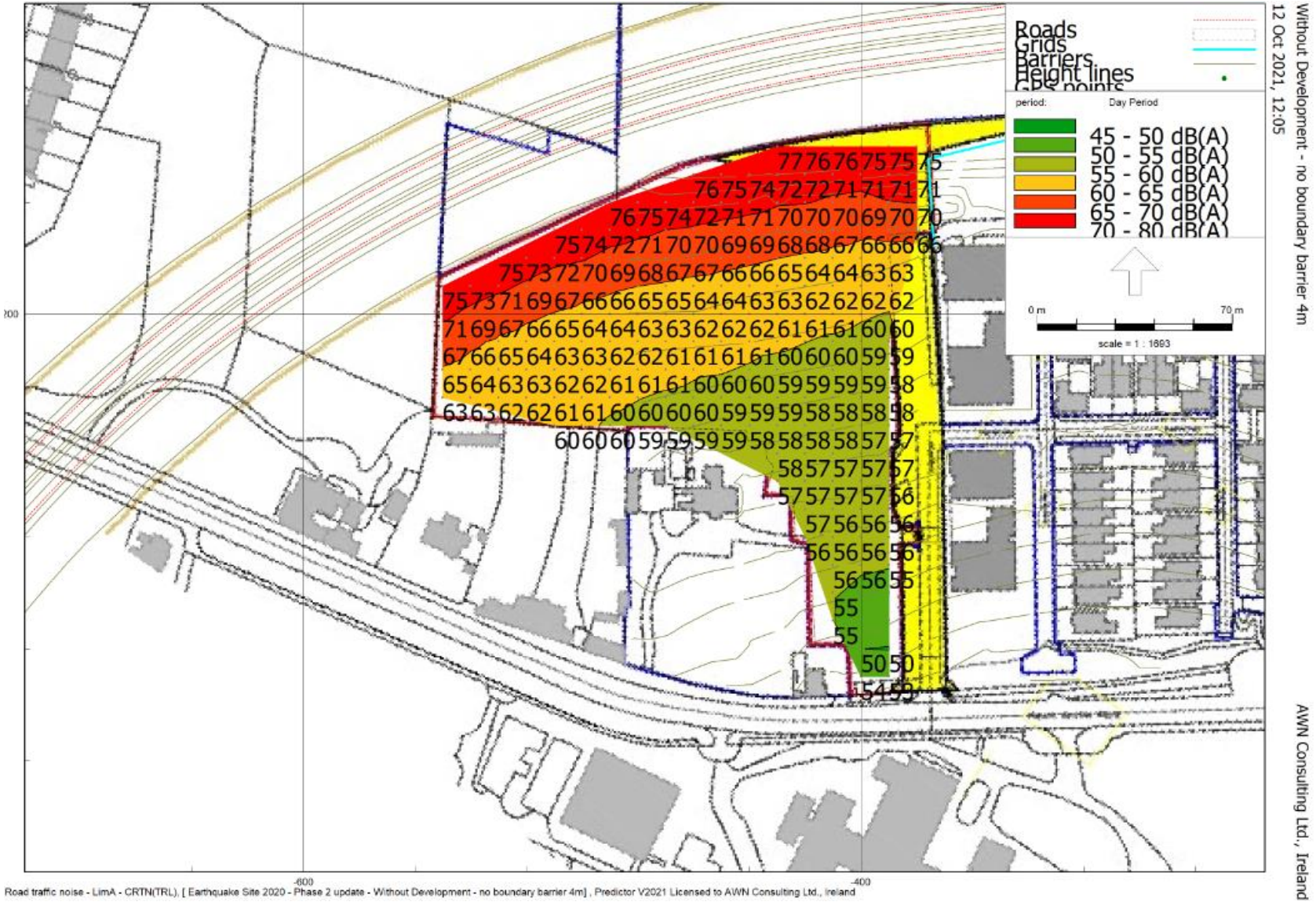

Figure 8 $L_{Aeq,16hr}$ Daytime Road Traffic Noise Levels – 4m AGL

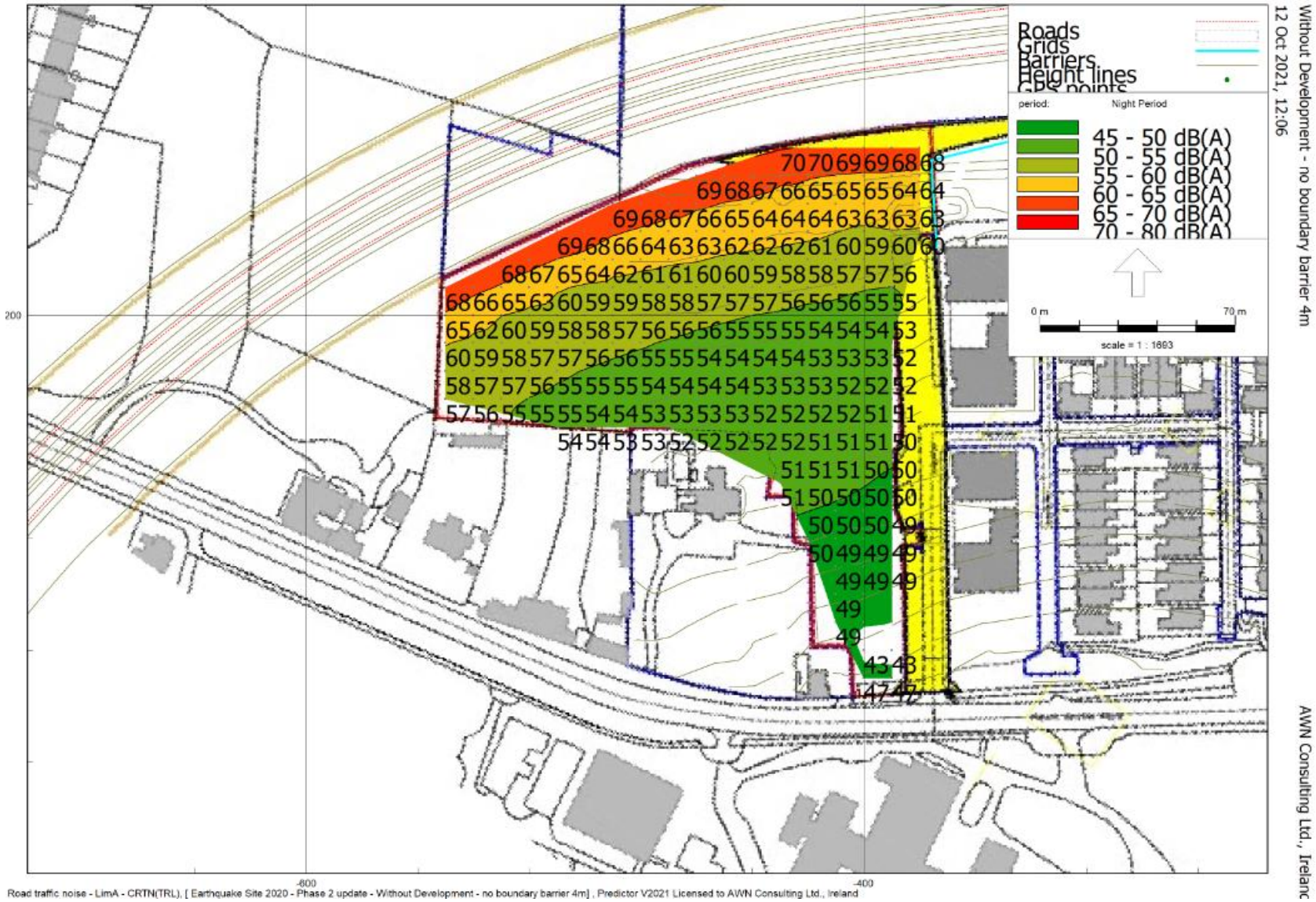

Figure 9 $L_{Aeq,8hr}$ Night Road Traffic Noise Levels – 4m AGL

Table 2 summarises the expected noise levels across the site with the DEBP in operation.

Height AGL	Daytime $L_{Aeq,16hr}$, dB	Night-Time $L_{Aeq,8hr}$, dB
1.5m	55 – 76	46 – 69
4m	55 – 76	47 – 70

Table 2 Noise Levels at Development Site

3.3 Noise Risk Assessment Conclusion

Giving consideration to the 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 high noise risk.

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 High 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.

It should be noted that ProPG states the following with regard to how the initial site noise risk is to be used,

> *"2.12 It is important that **the assessment of noise risk at a proposed residential development site is not the basis for the eventual recommendation to the decision maker**. The recommended approach is intended to give the developer, the noise practitioner, and the decision maker an early indication of the likely initial suitability of the site for new residential development from a noise perspective and the*

extent of the acoustic issues that would be faced. Thus, a site considered to be high risk will be recognised as presenting more acoustic challenges than a site considered as low risk. A site considered as negligible risk is likely to be acceptable from a noise perspective and need not normally be delayed on noise grounds. A potentially problematical site will be flagged at the earliest possible stage, with an increasing risk indicating the increasing importance of good acoustic design."

Therefore, following the guidance contained in ProPG does not preclude residential development on sites that are identified as having medium or high-risk noise levels. It merely identifies the fact that a more considered approach will be required to ensure the developments on the higher risk sites are suitably designed to mitigate the noise levels. The primary goal of the approach outlined in ProPG is to ensure that the best possible acoustic outcome is achieved for a particular site.

4.0 STAGE 2 – FULL ACOUSTIC ASSESSMENT

4.1 Element 1 – Good Acoustic Design Process

4.1.1 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.

4.1.2 Application of GAD Process to Proposed Application

Relocation or Reduction of Noise from Source

The proposed DEBP 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

Those facades exposed to highest noise levels from the future DEBP have been provided with Winter Gardens to ensure that noise levels on the private balcony space is within reasonable targets.

The Block G communal open space is located on the podium level and a solid noise barrier will be provided to the northern boundary of this area to reduce the noise levels across the open space. This barrier is c3.0 metres higher relative to the podium level and comprises a masonry frame with glass infill.

Block F has been set back from the DEBP and the communal open space within this block is sheltered from the road by the development building itself. The roof garden area will also be provided with screening from the future DEBP.

Select Construction Types for meeting Building Regulations

A mix of construction types could be considered for the building envelope including masonry and curtain wall elements. Masonry construction types 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.

In this instance mechanical ventilation is being considered for the units to maximise the energy efficiency of the development. However, this approach also provides an acoustic benefit as it removes the need for window frame or through wall passive vents. However, if passive vents are required they can be accommodated by selecting acoustically attenuated vents as discussed in this document.

Note that it will not be possible to achieve the desirable internal acoustic environments with windows open in all areas. Instead the proposal here will be to provide dwelling units with glazed elements and ventilation systems 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 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*."

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

The noise control measures do not have any significant impact on other issues.

Assess Viability of Alternative Solutions

This will be explored as the project progresses and the noise model will be used to assess the acoustic benefit of any alternative solutions.

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

The values are largely based on WHO guideline values.

For this development the good acoustic design principals employed have ensured that the private external spaces are positioned to benefit from the screening effect of the development buildings or specific screening included within the design. Figure 10 illustrates that for the current layout the vast majority of the outdoor amenity areas achieve a noise level ≤55 dB $L_{Aeq,16hr}$.

Figure 10 Noise Levels Across External Amenity Areas

The majority of the area**s** will experience noise levels that are within the recommended thresholds, however, the area in close proximity to the proposed DEBP will experience higher than ideal noise levels after the DEBP has been developed this is mitigated as much as is practical by providing a 3m high noise barrier to the boundary with the DEBP. Note that this barrier is only proposed to be installed once the DEBP is constructed. Prior to that this area of the site will be quiet and well within the most desirable level. It is important to note that the ProPG document allows for the impact of higher than desirable external noise levels to be off-set by *"a relatively quiet, protected, nearby, external amenity space for sole use by a limited group of residents as part of the amenity of their dwellings"*, for this site it's noted that there is additional external space set aside for the residents in the proposed development.

Regarding balcony spaces for apartments that face the DEBP Winter Gardens have been provided to apartments on the facades most exposed to noise from the proposed DEBP. This will ensure that the external noise level within these spaces will be within the 55 dB $L_{Aeq,16hr}$ criterion.

Summary

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 the provision of boundary treatments, winter gardens and the use of proprietary acoustic glazing and ventilation.

4.2 Element 2 – Internal Noise Guidelines

4.2.1 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 3 and are based on annual average data, that is to say they omit occasional events where higher intermittent noisy events may occur, such as New Year's Eve.

Activity	Location	(07:00 to 23:00hrs)	(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 $L_{Aeq,8hr}$ 45 dB $L_{Amax,T}$*

Table 3 ProPG Internal Noise Levels

*Note The document comments that the internal $L_{AFmax,T}$ noise level may be exceeded no more than 10 times per night without a significant impact occurring.

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 noise guidelines, then a relaxation of the internal L_{Aeq} values by up to 5 dB can still provide reasonable internal conditions.

4.2.2 Discussion on Open/Closed Windows

The typical level of sound reduction offered by a partially open window falls in the region of 10 to 15 dB[1].

Considering the design goals outlined in Table 2 and a sound reduction across an open window of 15 dB, the free-field noise levels that would be required to ensure that internal noise levels do not exceed good (i.e. at or below the internal noise levels) or reasonable internal noise levels (i.e. 5 dB above the internal noise levels) have been summarised in Table 4.

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 $L_{Aeq,16hour}$	45dB $L_{Aeq,8hour}$
Reasonable (i.e. 5 dB above the internal noise levels)	55 – 60dB $L_{Aeq,16hour}$	50dB $L_{Aeq,8hour}$

Table 4 External Noise Levels Required to Achieve Internal Noise Levels

In this instance the external noise levels are such that it will not be possible to achieve the desired internal noise levels with windows open on those facades overlooking the proposed DEBP once that road is developed and therefore appropriate acoustic specifications to windows and ventilation systems will be provided to ensure the rooms are adequately ventilated and achieve the good internal noise levels detailed here. Elsewhere, some parts of the development are screened from the proposed DEBP by development buildings themselves and therefore noise levels will be lower. This will allow reasonable internal noise levels to be achieved with open windows.

[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'*

4.2.3 Façade Levels

Table 5 summarises the range of noise levels at each façade of the most exposed Blocks of F, G and H. Note that Block E is located away from the proposed DEBP and is therefore screened out of this assessment.

Block	Facade	Daytime, dB(A)	Night-time, dB(A)
H & G	Northern	68 – 76	62 – 69
	Eastern	59 – 71	53 – 64
	Western	61 – 75	54 – 68
	Southern	53 – 66	46 – 60
F	Northern	64 – 72	56 – 65
	Eastern	54 – 70	48 – 63
	Western	56 – 69	49 – 62
	Southern	47 – 53	41 – 46

Table 5 Façade Noise Levels

4.2.3 Proposed 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[2] of BS8233 provides 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 road traffic noise as per the site survey.

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 most exposed facades will be provided with glazing that, when closed, achieve the minimum sound insulation performance as set out in Table 6.

[2] The methodology contained within Annex G of BS8233 is based on the assumption that the source is a line source (such as a road) and that the building facades are simple, i.e. do not have balconies. These assumptions are considered valid for the purposes of this assessment and have been adopted.

Glazing Specification	Octave Band Centre Frequency (Hz)						R_w
	125	250	500	1k	2k	4k	
Acoustic Glazing Type 1	20	19	29	38	36	45	32
Acoustic Glazing Type 2	27	29	36	41	42	52	39
Acoustic Glazing Type 3	31	37	46	54	56	63	49

Table 6 Sound Insulation Performance Requirements for Glazing, SRI (dB)

The acoustic specification listed in Table 6 can be achieved using a double or triple glazed unit with slightly thicker than standard glass. Figure 13 illustrates where the acoustic glazing specified here is required. Note that where Winter Gardens are specified the combined performance of the external Winter Garden glazing and the internal glazing to the apartment must meet the performance outlined in Table 6.

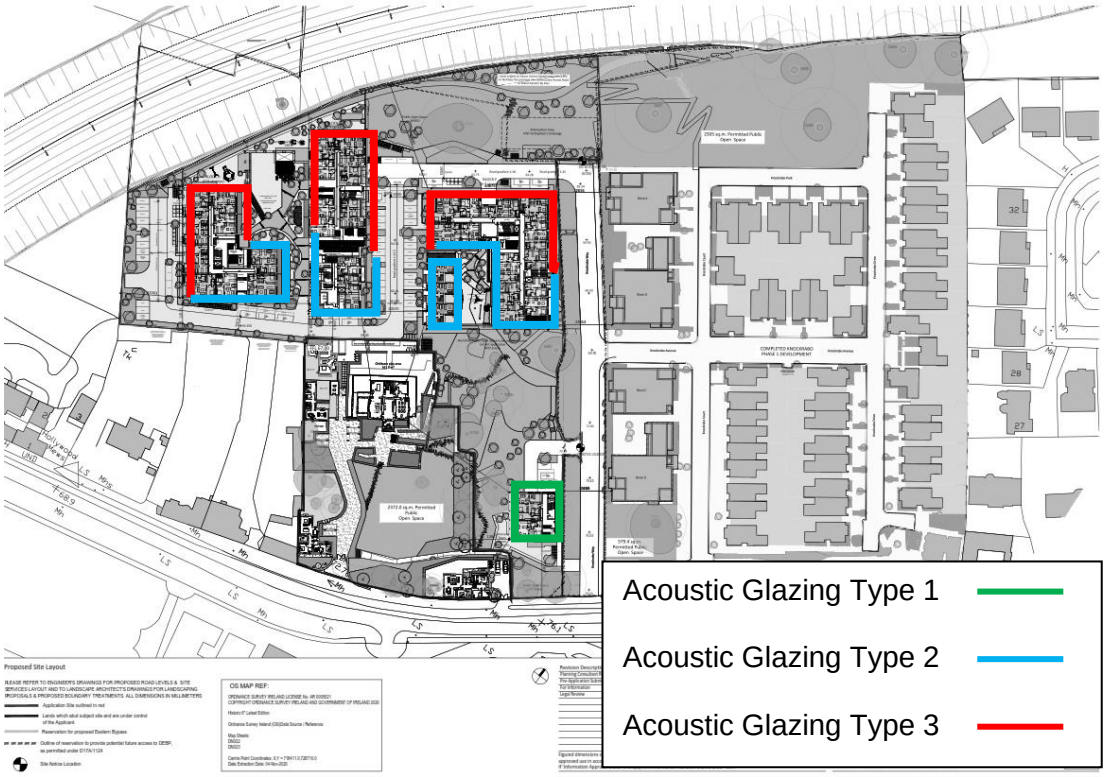

Figure 13 Extent of Acoustic Glazing

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.

Wall Construction

In general, all wall constructions (i.e. block work or concrete) 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.

Ventilation

The ventilation strategy for the development will be in accordance with Part F of the Building Regulations. The proposal may be to use mechanical heat recovery ventilation throughout which removes the need for any passive wall or window vents and effectively mitigates any noise intrusion via the ventilation path. Alternatively if passive vents are required they must be selected to achieve an acoustic rating of 55 dB $D_{ne,w}$ on those facades specified to have Glazing Type 3 and 45 dB $D_{ne,w}$ on facades specified to have Glazing Type 2.

4.2.5 Internal Noise Levels

Taking into account the external façade levels and the specified building envelope the internal noise levels have been calculated. In all instances the good internal noise criteria are achieved for daytime and night-time periods.

4.3 Element 3 – External Amenity Area Noise Assessment

As previously discussed, the majority of external private amenity areas are expected to achieve the recommended 55 dB $L_{Aeq,16hr}$ noise level recommended in ProPG.

4.4 Element 4 – Assessment of Other Relevant Issues

Element 4 gives consideration to other factors that *may* prove pertinent to the assessment, these are defined in the document as:

- 4(i) compliance with relevant national and local policy
- 4(ii) magnitude and extent of compliance with ProPG
- 4(iii) likely occupants of the development
- 4(iv) acoustic design v unintended adverse consequences

Each is discussed in turn below.

4.4.1 Compliance with Relevant National and Local Policy

There are no National policy documents relating to the acoustic design of residential dwellings. Locally the Dublin Noise Action Plan specifies that the guidance contained within ProPG should be used in assessing the noise impact on new residential developments.

This Acoustic Design Statement has been prepared in compliance with the requirements of ProPG and therefore complies with the requirements of local policy.

4.4.2 Magnitude and Extent of Compliance with ProPG

As discussed within this report the following conclusions have been drawn with regards to the extent of compliance with ProPG:

- All dwellings as part of the development have been designed to achieve the good level of internal noise levels specified within ProPG. The units require closed windows and open vents to achieve this level, and;
- Private and public external amenity areas have been assessed and specific acoustic design measures have been included to mitigate noise levels on these

areas. This includes the provision of winter gardens and screening to the external spaces.

Based on the preceding it is concluded that the proposed development is in full compliance with the requirements of ProPG.

4.4.3 Likely Occupants of the Development

This element is not considered relevant here as the future occupants are unknown. It is included within ProPG to allow for some discussion on how the acoustic conditions may change depending on the likely occupants.

4.4.4 Acoustic Design v Unintended Adverse Consequences

Unintended adverse consequences did not occur on this project.

5.0 OTHER ISSUES

5.1 Construction Noise Impact of the DEBP

As per Transport Infrastructure Ireland (TII) guidance document *Guidelines for the Treatment of Noise and Vibration in National Road Schemes*[3], noise levels associated with the construction of road schemes may be calculated in accordance with methodology set out in BS 5228: Part 1. This standard sets out sound power levels for plant items normally encountered on construction sites, which in turn enables the prediction of noise levels at selected locations. However, it is not possible to conduct detailed prediction calculations for the construction phase of a project due to the fact that the programme for construction works has not been established in detail.

The TII guidance document specifies noise levels that it typically deems acceptable in terms of construction noise during road scheme construction. These limits are set out in Table 7.

Days & Times	$L_{Aeq\ (1hr)}$ dB	L_{Amax} dB(A)
Monday to Friday 07:00 to 19:00hrs	70	80
Monday to Friday 19:00 to 22:00hrs	60	65
Saturday 08:00 to 16:30hrs	65	75
Sundays and Bank Holidays 08:00 to 16:30hrs	60	65

Table 7 Maximum Permissible Noise Levels at the Façade of Nearby Dwellings during Construction

Based on the information contained within the *Dublin Eastern Bypass Corridor Protection Study, January 2011* it is assumed that a variety of items of plant will be in use, such as excavators, lifting equipment, dumper trucks, compressors and generators. It is also possible that rock breaking may be required on occasions and there will be vehicular movements to and from the site that will make use of existing roads.

Due to the fact that the construction programme has been established in outline form only, it is not possible to calculate the actual magnitude of noise emissions to the local environment. However, the following paragraphs present calculations of indicative noise levels for typical noise sources associated with road construction.

BS 5228: *Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1 Noise (2009)* sets out typical noise levels for items of construction plant. Tables 8 and 9 lists the sound power levels of the plant used for calculation of the expected noise level at various distances from the roadway.

[3] *Guidelines for the Treatment of Noise and Vibration in National Road Schemes, Revision 1, 25 October 2004* , Transport Infrastructure Ireland.

Plant Item (BS 5228 Ref.)	Sound Power Level, dB(A) re 10^{-12} W
Pneumatic breaker (C.8.12)	100
Wheeled loader (C.4.13)*	90
Tracked excavator (C.2.14)*	98
Dozer (C.2.10)*	99
Dump truck (C.2.30)*	98
Vibratory roller (C.5.20)	99
Asphalt Paver (C.5.31)	99
Wheeled Telescopic Crane (C.4.38)	102
Compressor (C.5.5)	89
Generator (C.4.84)	98
Road Roller (C.5.19)	104
HGV Movements (20 per hour)	77

Table 8 Typical Construction Plant Noise Levels

Note* Assume noise control measures as outlined in Table B1 of BS 5228 – 1 (i.e. fit acoustic exhaust).

Plant Item	Distance from road, meters			
	20m	35m	50m	60m
Pneumatic breaker (C.8.12)	58	55	51	49
Wheeled loader (C.4.13)*	48	45	41	39
Tracked excavator (C.2.14)*	56	53	49	47
Dozer (C.2.10)*	57	54	50	48
Dump truck (C.2.30)*	56	53	49	47
Vibratory roller (C.5.20)	57	54	50	48
Asphalt Paver (C.5.31)	57	54	50	48
Wheeled Telescopic Crane (C.4.38)	60	57	53	51
Compressor (C.5.5)	47	44	40	38
Generator (C.4.84)	56	53	49	47
Road Roller (C.5.19)	62	59	55	53
HGV Movements (20 per hour)	59	56	53	52

Table 9 Indicative Noise Levels from Construction Plant Items at Various Distances from the Road

Note* Assume noise control measures as outlined in Table B1 of BS 5228 – 1 (i.e. fit acoustic exhaust).

The noise levels presented are within the limit values shown in Table 7 for weekday daytime periods at distances greater than 20m from the works. The minimum distance has been chosen based on the closest buildings within this proposed development to the edge of the DEBP route corridor. It should be noted that the additional shielding benefit of the deep cutting which the DEBP will be located within has not been taken into account and therefore the noise levels presented in Table 8 are considered to be worst-case.

5.2 Construction Vibration Impact of the DEBP

In the event that the proposed development is granted permission and constructed prior to the DEBP there will be the potential for vibration impacts to occur at the proposed residential properties during construction of the DEBP. Previous discussions with the TII have raised potential vibration impacts in particular due to the potential requirement for blasting during the construction of the DEBP.

It is expected that the DEBP construction programme would have to comply with the guidelines contained within the TII document *Guidelines for the Treatment of Noise and Vibration in National Road Schemes*. This document recommends that in order to ensure that there is no potential for damage during construction, vibration from construction activities should be limited to the values set out in Table 10.

Allowable vibration velocity (Peak Particle Velocity) at the closest part of any sensitive property to the source of vibration, at a frequency of		
Less than 10Hz	10 to 50Hz	50 to 100Hz (and above)
8 mm/s	12.5 mm/s	20 mm/s

Table 10 Allowable Vibration Levels During Construction Phase

During the construction of the DEBP the vibration levels at the existing residential properties along the scheme will have to be controlled by the contractor such that the vibration levels recommended in the TII guidelines are not exceeded. Considering that the proposed development buildings are set back a similar distance from the proposed DEBP route as other existing residential properties in the area it is concluded that the vibration limits in Table 10 will be the maximum levels experienced by the development buildings during construction of the DEBP. Furthermore, the structural design of the proposed development buildings has not yet commenced but the form of construction is likely to be as follows.

- Upper levels in multi-storey buildings – concrete or loadbearing masonry walls and reinforced concrete or prestressed concrete floors.

Considering this construction and making reference to *British Standard BS 7385: Evaluation and Measurement for Vibration in Buildings Part 2: Guide to Damage Levels from Ground Borne Vibration (1993)* there is no risk of structural damage from vibration levels of the order of those listed in Table 10. Therefore, it is concluded that there will be no adverse impact on the development structures as a result of blasting during the construction of the DEBP, once the appropriate limits are adhered to by the relevant contractors.

5.3 Operational Vibration Impact of the DEBP

As a vehicle travels along a road, vibration can be generated in the road and subsequently propagate towards nearby buildings. Such vibration is generated by the interaction of a vehicle's wheels and the road surface and by direct transmission through the air of energy waves. Some of these waves arise as a function of the size, shape and speed of the vehicle, and others from pressure fluctuations due to engine, exhaust and other noises generated by the vehicle. It has been found[4] that ground vibrations produced by road traffic are unlikely to cause perceptible structural vibration in properties located near to well-maintained and smooth road surfaces. Problems attributable to road traffic vibration can therefore be largely avoided by maintenance of the road surface.

It is therefore concluded that the proper maintenance of the road surface on the DEBP will ensure that traffic induced vibration by road traffic, including heavy goods vehicles, is unlikely to be generated at a magnitude that would be subjectively noticeable within the proposed development buildings. Furthermore, any vibration generated during the operation of the DEBP would be far below the level at which any damage would be caused to the development buildings.

[4] Traffic Vibration in Buildings, Construction Technology Update No. 39, June 2000, National Research Council of Canada

6.0 CONCLUSION

An initial site noise risk assessment has been carried out on the proposed Phase 2 residential development at Knockrabo, Mt. Anville Road, Dublin 14. The future noise environment with the proposed Dublin Eastern By-Pass (DEBP) in operation has been determined through modelling. This assessment has classified the development site as having a range of noise risks associated ranging from low to high risk.

Subsequent to the noise risk assessment a full Acoustic Design Statement has also been prepared to discuss how good acoustic design practice has been implemented. This document presents further discussion of the likely noise impact of both the external and internal areas of the proposed development.

It has been determined that mitigation measures in the form of boundary treatments to the external amenity spaces and façade treatments to development buildings will be required for the development. Furthermore, Winter Gardens have been provided to the facades most exposed to noise from the proposed DEBP. In addition, it will be necessary to provide enhanced acoustic glazing to the other façade elevations to ensure that when windows are closed that the internal noise environment is good. The specifications for all acoustic glazing have been provided in the body of this report. It is also proposed to provide mechanical ventilation to the development units which removes the need for any passive wall or window vents and effectively mitigates any noise intrusion via the ventilation path.

In conclusion, there are no building regulations that require new developments to achieve a certain level of noise insulation from external sources. However, for this development the site was identified as potentially being exposed to elevated noise levels due to the operation of the proposed DEBP road scheme. As a result, this report has provided specifications and design advice to the developer to ensure that the internal noise environment within the development buildings is fully compliant with best practice standards. This also ensures compliance with the requirements of the local Dublin Agglomeration Noise Action Plan document.

Furthermore, vibration impacts on the proposed development have been assessed both during the construction and operational phase of the DEBP road scheme. During construction it is concluded that there will be no adverse impact on the development structures, once the appropriate limits are adhered to by the relevant contractors. During operation of the DEBP it is concluded that the proper maintenance of the road surface on the DEBP will ensure that traffic induced vibration by road traffic, including heavy goods vehicles, is unlikely to be generated at a magnitude that would be subjectively noticeable within the proposed development buildings. Furthermore, any vibration generated during the operation of the DEBP would be far below the level at which any damage would be caused to the development buildings.

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 ($L_{AF90,T}$).

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(A) — 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_{AFmax} — is the instantaneous fast time weighted maximum sound level measured during the sample period.

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.

APPENDIX B

NOISE MODEL TECHNICAL DATA

B.1 Noise Model

A computer-based prediction model has been prepared in order to quantify the traffic noise level associated with the DEBP on the proposed development site. This section discusses the methodology behind the noise modelling process.

B.2 Brüel & Kjær Type 7810 *Predictor*

Proprietary noise calculation software was used for the purposes of this impact assessment. The selected software, Brüel & Kjær Type 7810 *Predictor*, calculates traffic noise levels in accordance with CRTN guidance.

Brüel & Kjær Type 7810 *Predictor* is a proprietary noise calculation package for computing noise levels in the vicinity of noise sources. *Predictor* predicts noise levels in different ways depending on the selected prediction standard. In general, however, the resultant noise level is calculated taking into account a range of factors affecting the propagation of sound, including:

- the magnitude of the noise source in terms of sound power or traffic flow and average velocity;
- the distance between the source and receiver;
- the presence of obstacles such as screens or barriers in the propagation path;
- the presence of reflecting surfaces;
- the hardness of the ground between the source and receiver.

B.3 Prediction of traffic noise

Noise emissions during the operational phase of the project have been modelled using *Predictor* in accordance with CRTN. The CRTN method of predicting noise from a road scheme consists of the following five elements:

- divide the road scheme into segments so that the variation of noise within this segment is small;
- calculate the basic noise level at a reference distance of 10 metres from the nearside carriageway edge for each segment;
- assess for each segment the noise level at the reception point taking into account distance attenuation and screening of the source line;
- correct the noise level at the reception point to take account of site layout features including reflections from buildings and facades, and the size of source segment;
- combine the contributions from all segments to give the predicted noise level at the receiver location for the whole road scheme.

Note that all calculations are performed to one decimal place.

APPENDIX B

NOISE MODEL TECHNICAL DATA (Continued)

B.4 Input to the Noise Model

The noise model was prepared using the following data:

- topographical data and Ordnance Survey mapping supplied by O'Mahony Pike Architects.

B.5 Output of the Noise Model

Predictor calculates noise levels for a set of receiver locations specified by the user. The results include an overall level in daytime (i.e. 07:00 to 23:00hrs) and night time (i.e. 23:00 to 07:00hrs) levels.