

**RESIDENTIAL
DEVELOPMENT AT
DALGUISE HOUSE,
MONKSTOWN,
CO. DUBLIN**

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**NOISE IMPACT
ASSESSMENT**

Technical Report Prepared For

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EXECUTIVE SUMMARY

The following document outlines a technical response to the further information request issued by Dun Laoghaire Rathdown County Council, ref: P/0164/23, in relation to the proposed development at the grounds of Dalguise House, Monkstown, Co. Dublin.

AWN Consulting was commissioned to prepare the Noise and Vibration Chapter for the Environmental Impact Assessment Report (EIAR) prepared as part of the planning application for the development. This document should be read in conjunction with the EIAR for the development.

The following items set out in the RFI relate to noise and vibration. Elements identified for inclusion in the EIAR have been included within this document in order to provide a summary of requested items. The various topics raised above are addressed in the relevant sections of this report:

- Demolition and construction noise impacts in relation to rock breaking and piling and associated mitigation measures.
- Noise management plan for construction phase.
- Baseline noise survey scope.
- Inward noise on proposed development.
- Operational plant noise.

Additional baseline noise levels have been measured at the development site in order to supplement the reported measurements.

Outward noise impact assessments have been undertaken for both construction and operational phases of the proposed development.

Construction noise thresholds have been determined and noise predictions have been undertaken for various individual elements of the construction process. The predictions indicate that at the nearest noise sensitive receivers, noise levels from construction activities are predicted to be above the threshold at which a likely significant impact will occur. Appropriate construction mitigation measures have been presented within this report to reduce the impact of construction activities on nearby sensitive receptors.

Once operational, it is expected that noise emissions will be limited to noise associated with plant items serving the development and with traffic moving to and from the development site. The latter has been assessed in the Environmental Impact Assessment Report prepared as part of the application submission.

An assessment of mechanical plant noise emissions has been undertaken. Suitable noise thresholds have been assigned based on the measured noise levels on the site. Plant items serving the proposed development will be designed such that the cumulative noise emissions will achieve the noise criteria set out in this report.

With respect to inward noise intrusion, guidance from the ProPG document has been referenced with respect to noise levels measured at the development site. When compared with the ProPG Noise Risk scale, the baseline noise levels at the site are judged to be of Negligible Noise Risk due to the large set-back distance from nearby roads and the enclosed nature of the site. No further assessment is required as it is expected that industry standard internal noise levels in residential units will be achieved with standard glazing and vent systems.

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1.0 INTRODUCTION

The following document outlines a technical response to the further information request issued by Dun Laoghaire Rathdown County Council, ref: P/0164/23, in relation to the proposed development at the grounds of Dalguise House, Monkstown, Co. Dublin.

Items 27 and 29(3) relate to noise and vibration:

Item 27

“27. The Applicant is requested to submitted comprehensive documentation/ report in respect of the following:

b. A Construction Management Plan which includes Environmental Management and Monitoring Proposals and Complaints management Proposals.

c. A Noise Planning Report, prepared by suitably qualified specialists detailing noise modelling in relation to anticipated noise levels in the completed development and design of building services in the completed development, such as heat pumps, to avoid creation of nuisance affecting adjoining residential areas. Said report should include detailing a selection of construction methodology, implementation of mitigation measures to minimise nuisance affecting adjoining properties”.

Item 29(3)

“3. Submission of an updated Noise Planning report, which accords with the requirements of Item no. 26 and which also provides

- a. Detailed analysis of the noise impacts of the demolition and construction phases on the receiving environment should be predicted and mitigation measures proposed, especially for any potential rock braking/piling activities.*
- b. The noise levels predicted for site activities relating to site clearance are predicted to be in the range of 76 to 82 LAeq, T at a distance of 10 meters. 82dB seems like a fairly low estimate for piling activity, especially for the area in which the proposed Blocks A, B and C are located. The 3 cable percussion boreholes in this area (BH 01, 02, 04) mentioned in The Ground Investigation Report Appendix all encountered obstruction ‘Presumed rock or boulder’ at depths between 2.1 and 3.7 meters, which suggests a high likelihood that any piling activities in these areas will encounter similar obstruction which will increase the duration and noise levels. Clarification of the predicted noise levels and noise sensitive locations should be included should rock be encountered.*
- c. Taking the above into account the possibility of a prolonged period of rock breaking should be investigated and the potential noise and vibration impacts on noise sensitive locations be predicted.*
- d. The impact of any potential excessively noisy works on neighbouring properties shall be predicted and measures suggested for reducing the impact of such works. Including adjusting working hours and setting a*

trigger point noise level that if exceeded works will stop and additional noise attenuation measures implemented.

- e. *A plan for continuous dust, noise and vibration monitoring shall be included, identifying the nearest noise sensitive locations at each boundary.*
- f. *Considering the size of the subject site a more representative baseline noise survey may be required. The survey should take measurements at various locations within the site, identifying the closest noise sensitive locations in each area. The noise survey shall include an inward noise impact assessment and consider ProPG: 'Professional Practice Guidance on Planning and Noise for new Residential Development' and BS 8233 'Guidance on Sound Insulation and Noise Reduction for Buildings'.*
- g. *Preparation of a report by suitably qualified specialists detailing noise modelling in relation to anticipated noise levels in the completed development and design of building services in the completed development, such as heat pumps, to avoid creation of nuisance affecting adjoining residential areas. The Applicant is advised to have regard to FI item no. 26 also.*
- h. *Preparation of a report detailing selection of construction methodology, implementation of mitigation measures to minimise nuisance affecting adjoining properties".*

The various subjects raised above are addressed in the following sections of this report:

Item	Subject	Section	Page No.
27 (b)	Construction Management Plan.	4.3	27
27 (c)	Noise planning report addressing operational noise and construction mitigation.	5.0, 4.2	27, 19
29(3) a	Noise associated with demolition, piling and rock breaking.	EIAR (Section 12.5.1), 4.1.1, 4.1.2	16
29(3) b	Noise associated with piling and rock breaking.	4.1.1, 4.1.2	16
29(3) c	Noise associated with rock breaking.	4.1.1, 4.1.2	16
29(3) d	Construction noise mitigation.	EIAR (Section 12.6.1), 4.2, 4.3	19
29(3) e	Construction noise monitoring.	4.3	21
29(3) f	Baseline noise levels and noise intrusion.	3.1.6, 6.1	13, 28
29(3) g	Noise associated with operation of the development.	5.0	27
29(3) h	Construction methodology and mitigation report.	4.3	27

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

2.0 RELEVANT GUIDANCE AND CRITERIA

2.1 Construction Phase – Noise

Section 12.4.1 of the EIAR sets out criteria for assessing the impact of construction noise on sensitive locations. This section is reproduced for information purposes here.

Criteria relating to construction vibration are also set out in 12.4.1 of the EIAR and already protect against significant vibration impacts from expected activities, such as piling.

2.1.1 DLR County Council – Good Practice Guide for Construction and Demolition Environmental Management

Dun Laoghaire Rathdown County Council's "*Good Practice Guide for Construction and Demolition Environmental Management*" (hereinafter referred to as DLR GPG) outlines a risk assessment methodology directly applicable to the specific construction activities on the proposed site.

The Proposed Development has been classed overall as a high-risk category site based on the elements of the proposed construction programme in relation to DLR GPG risk assessment factors. These include:

- Duration of the works;
- Distance to NSLs;
- Ambient noise levels;
- Site working hours;
- Location of works;
- Duration of demolition;
- Ground works;
- Piling; and
- Vibration generating activities.

The DLR GPG document sets out mitigation measures in relation to sites of varying noise risk. These are included in Section 4.2 of this document.

Please note that construction works in relation to this development are proposed during normal working hours only as set out below:

- Monday to Friday: 07:00 to 19:00hrs
- Saturdays: 08:00 to 14:00hrs
- Sundays and Bank Holidays: No construction works.

2.1.2 British Standard BS 5228 – 1: 2009+A1:2014

There is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. Local Authorities typically control construction activities by imposing limits on the hours of operation and consider noise limits at their discretion. Construction noise sources include construction plant and machinery.

The DLR GPG document states that British Standard BS 5228–1 is referenced here for the purposes of setting appropriate construction noise limits for the development. This document sets out a method whereby construction noise thresholds are determined based on ambient noise level.

ABC Method

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

BS 5228-1:2009+A1:2014 sets out guidance on permissible noise levels relative to the existing noise environment. Table 1 sets out the values which, when exceeded, signify a significant effect at the facades of residential receptors.

Assessment category and threshold value period (L _{Aeq})	Threshold value in decibels (dB)		
	Category A ^A	Category B ^B	Category C ^C
Daytime (07:00-19:00) and Saturdays (07:00-13:00)	65	70	75
Evenings and Weekends ^D	55	60	65
Night-time (23:00to 07:00hrs)	45	50	55

Table 1 Example Threshold of Significant Effect at Dwellings

- A. Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.
- B. Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.
- C. Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.
- D. 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.

For the appropriate assessment period (i.e. daytime in this instance) the ambient noise level is determined and rounded to the nearest 5 dB. If the construction noise exceeds the appropriate category value, then a significant effect is deemed to occur. It should be noted that this assessment method is only valid for residential properties.

Interpretation of the CNT

In order to assist with interpretation of CNTs, Table 2 includes guidance as to the likely magnitude of impact associated with construction activities, relative to the CNT. This guidance is derived from Table 3.16 of *DMRB: Noise and Vibration*.

Construction Noise Level	Guidelines for Noise Impact Assessment Significance (DMRB)
Below or equal to baseline noise level	Negligible
Above baseline noise level and below or equal to CNT	Minor
Above CNT and below or equal to CNT +5 dB	Moderate
Above CNT +5 to +15 dB	Major
Above CNT +15 dB	

Table 2 Construction Noise Significance Ratings

The DMRB guidance outlined will be used to assess the predicted construction noise levels at NSLs and comment on the likely impacts during the construction stages.

2.2 Operational Phase – Noise

2.2.1 Mechanical Services Plant

As set out in Section 12.4.3 of the EIAR document, assessment methods in British Standard BS 4142 can be used to assess the impact of a new continuous source to a residential environment and is used commonly by local authorities in their standard planning conditions and also in compliant investigations. The relevant noise criteria are presented below.

The method for assessing plant noise set out in BS 4142 (BSI 2019) is based on the following definitions:

“ <i>Specific noise level, $L_{Aeq, T}$</i> ”	is the equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T;
“ <i>Rating level, $L_{Ar, T}$</i> ”	is the specific noise level plus adjustments for the character features of the sound (if any);
“ <i>Residual noise level, $L_{Aeq, T}$</i> ”	is the noise level produced by all sources excluding the sources of concern, in terms of the equivalent continuous A-weighted sound pressure level over the reference time interval, T;
“ <i>Background noise level, $L_{A90, T}$</i> ”	is the A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T. This level is expressed using the L_{A90} parameter. These levels were measured as part of the baseline survey.

Adjustments to the rating level are appropriate where noise emissions are found to be tonal, impulsive in nature or irregular enough to attract attention. In these cases, penalties are applied of either an additional 2 dB, 4 dB or 6 dB depending on how perceptible the tone is at the noise receptor.

The background level should then be subtracted from the rating level. The greater this difference, the greater the magnitude of the impact will be, in general. A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, while a difference of around +5 dB is likely to be an indication of an adverse impact (as referred to in BS 4142 (BSI 2019)), depending on the context.

2.3 Operational Phase – Vibration

There are no significant sources of vibration associated with the operation of the proposed development and therefore no further assessment of operational vibration has been undertaken.

2.4 Inward Noise Impact

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 its 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 approach for evaluating noise exposure on prospective sites for residential development. This assessment is presented in Section 6.0 of this document.

3.0 REVEIVING ENVIRONMENT

3.1 Baseline Noise Surveys

Section 12.3.1 of the EIA sets out results of baseline noise monitoring undertaken at the subject site. Supplementary noise monitoring has been carried out in response to Item 29(3) f of the RFI document and is presented here.

3.1.1 Survey Overview

Environmental noise surveys have been conducted in order to quantify the noise environment across the existing site. The external survey was conducted in general accordance with ISO1996-2:2017 *Acoustics - Description, Measurement and Assessment of Environmental Noise -- Determination of Environmental Noise Levels*. Specific details are set out in the following sections.

3.1.2 Survey Periods

Additional measurements were conducted at the development site over the course of the following survey periods:

- Daytime survey – 11:32hrs to 14:14hrs on 23/3/2023.
- Night-time survey – 23:41hrs to 01:31hrs on 24/3/2023.

3.1.3 Measurement Parameters

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

L_{Aeq} is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period.

L_{AFmax} is the maximum sound pressure level recorded 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.

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

3.1.4 Instrumentation

A Bruel & Kjaer 2250 sound level meter (SLM) was used for the noise surveys. Measurements captured overall broadband noise parameters over 15-minute intervals. Before and after each survey the SLM and measurement system was check calibrated using a Brüel & Kjær Type 4231 Sound Level Calibrator.

3.1.5 Survey Locations

Three measurement locations were selected and are shown on Figure 1; each is described in turn below.

NM1 Attended location selected to capture daytime and night-time noise environment at the northern boundary of the site. Also representative of the noise environment at the existing housing on Purbeck and Heathfield streets.

NM2 Attended location selected to capture daytime and night-time noise environment at the western boundary of the site. Also representative of the noise environment at the Willows housing estate.

NM3 Attended location selected to capture daytime and night-time noise environment at the western boundary of the site. Also representative of the noise environment at the Brook Court estate to the south.



Figure 1 Noise Monitoring Locations

3.1.6 Noise Survey Results

Location NM1

The table below summarises the attended noise measurements at NM1.

Date	Period	Time	Measured Noise Levels, dB		
			L _{Aeq}	L _{Amax}	L _{A90}
23/3/2023 to 24/3/2023	Day	11:51	49	68	44
		12:45	45	53	43
		13:40	52	63	45
	Night	23:58	49	61	43
		00:56	48	61	41

Table 3 Summary of Attended Measured Noise Levels at Location NM1

The main contributors to noise build-up at this location were distant road traffic on the Monkstown Road, wind-generated foliage noise and birdsong nearby.

Daytime ambient noise levels were in the range of 45 – 52 dB L_{Aeq,15min}. Background noise levels were in the range 43 – 45 dB L_{A90,15min}.

Night-time ambient noise levels were in the range of 48 – 49 dB L_{Aeq,15min}. Background noise levels were in the range 41 – 43 dB L_{A90,15min}.

Location NM2

The table below summarises the attended noise measurements at NM2.

Date	Period	Time	Measured Noise Levels, dB		
			L _{Aeq}	L _{Amax}	L _{A90}
23/3/2023 to 24/3/2023	Day	11:32	50	65	43
		12:28	47	58	43
		13:23	52	66	47
	Night	23:41	48	58	44
		00:38	47	59	42

Table 4 Summary of Attended Measured Noise Levels at Location NM2

As was the case at location NM1, the main contributors to noise build-up at this location were birdsong nearby, wind-generated foliage noise and distant road traffic on the Monkstown Road. During the night-time measurements wind noise was noted to have increased compared to the daytime period.

Daytime ambient noise levels were in the range of 47 – 52 dB L_{Aeq,15min}. Background noise levels were in the range 43 – 47 dB L_{A90,15min}.

Night-time ambient noise levels were in the range of 47 – 48 dB L_{Aeq,15min}. Background noise levels were in the range 42 – 42 dB L_{A90,15min}.

Location NM3

The table below summarises the attended noise measurements at NM3.

Date	Period	Time	Measured Noise Levels, dB		
			L _{Aeq}	L _{Amax}	L _{A90}
23/3/2023 to 24/3/2023	Day	12:20	51	71	42
		13:04	53	74	41
		13:59	51	72	41
	Night	00:18	53	63	44
		01:16	52	61	43

Table 5 Summary of Attended Measured Noise Levels at Location NM3

Similar to the other survey locations, the main contributors to noise build-up at this location were birdsong nearby, wind-generated foliage noise and distant road traffic on the Monkstown Road. During the night-time measurements wind noise was noted to have increased compared to the daytime period.

Daytime ambient noise levels were in the range of 51 – 53 dB L_{Aeq,15min}. Background noise levels were in the range 41 – 42 dB L_{A90,15min}.

Night-time ambient noise levels were in the range of 52 – 53 dB L_{Aeq,15min}. Background noise levels were in the range 43 – 44 dB L_{A90,15min}.

Location UN01

The results of the initial baseline noise survey as reported in Section 12.3.5 of the EIAR, are presented below for discussion.

Date	Average Daytime Level	Background Daytime Level	Average Night-time Level	Background Night-time Level
	L _{Aeq,16hr}	L _{A90,16hr}	L _{Aeq,8hr}	L _{A90,8hr}
22/08/2022	46	38	36	30
23/08/2022	45	40	38	35
24/08/2022	42	41	-	-
Average	45	40	37	33

Table 6 Summary of Unattended Measured Noise Levels at Location UN01

3.1.7 Baseline Noise Survey Summary and Inward Noise

Supplementary noise measurements have been undertaken on site to obtain noise levels across the full extent of the proposed development. The measured noise levels at the three attended survey locations were relatively similar and little variation was noted between the northern, central and southern sectors of the proposed development site.

The measurements were noted to be higher than the initial baseline noise survey and it is judged that weather conditions, specifically wind, contributed to the increase in measured noise levels.

It is confirmed that the contribution of noise from traffic on the Monkstown Road is audible, but not the primary contributor to measured noise levels across the site. This is reflected in EPA noise mapping for the area, which is included below in Figure 2 and Figure 3.



Figure 2 EPA Daytime Noise Maps – Road Traffic



Figure 3 EPA Night-time Noise Maps – Road Traffic

On the basis of the above information, the road traffic noise levels across the proposed development site are judged to be of Negligible Noise Risk according to the criteria in Figure 6 on Page 29 of this report, with reference to the ProPG methodology. Further assessment discussion of noise intrusion on the proposed development is presented in Section 6.0.

4.0 CONSTRUCTION PHASE IMPACTS

4.1 Noise Impacts

Section 12.5.1 of the Environmental Impact Assessment Report (EIAR) sets out the assumptions, predicted construction noise levels and expected associated effects on nearby Noise Sensitive Locations (NSLs). In response to items raised in the RFI document, the following clarifications are provided.

4.1.1 Note Regarding Rock Breaking

Items 29(3) a and 29(3) c raise queries relating to rock breaking during the construction phase.

With reference to the Construction & Environmental Management Plan (CEMP) prepared in support of the planning application, the following is presented with respect to rock breaking during construction:

“A total of eight rotary cores were carried out across the site and the bedrock was identified at 10.5m to 14.0m below ground level. This is well in excess of any basement excavations, and as such, it is not envisaged that any rock breaking will be required as part of the works”.

As per advice from the Project Team, rock breaking is not included in the construction process.

4.1.2 Note Regarding Piling

Items 29(3) a and 29(3) b raise queries relating to piling during the construction phase.

With reference to the Construction & Environmental Management Plan (CEMP) prepared in support of the planning application, the following is presented with respect to piling during construction:

“The majority of the excavations can utilise battered excavations (see the purple line in Figure 4 and drawing W3683-DR-1040-02), but some vertical temporary retaining walls will be required along the northern and western boundaries in close proximity to existing trees to be retained (see green line in Figure 4 and drawing W3683-DR-1040-02). The temporary retaining walls will include bored piles”.

The drawing referenced above is presented in Figure 4 overleaf.

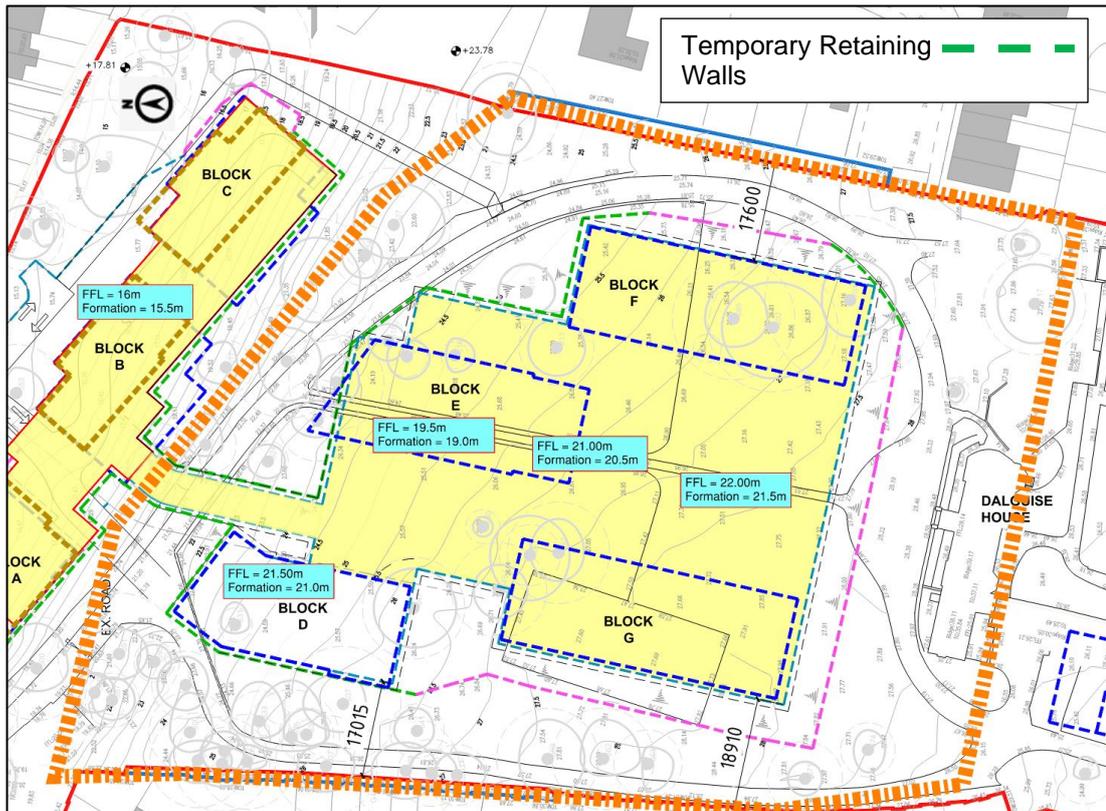


Figure 4 Location of Temporary Retaining Walls (from W3683-DR-1040-02) – Phase 1

It is also proposed to utilise augered mini-piles for construction of the bridge over the Stradbrook Stream, specifically for the bridge abutments. The location of the bridge is in the north of the development site.

BS 5228-1 (BSI 2014a) contains noise level data for various construction machinery. With reference to Item 29(3) b, the assumed value for rotary bored piling is the highest sound pressure level for this piling type presented in BS 5228 and is therefore considered robust for the assessment.

Construction Phase	Item of Plant (Ref BS 5228-1:2009+A1:2014)	BS5228 Reference Noise Level dB L _{Aeq} at 10m
Temporary Retaining Walls	Large Rotary Bored Piling Rig (C3.14)	83
Bridge Abutments	Mini piling rig (augered) (C3.17)	76

Table 7 Sound Level Data for Construction Machinery

The calculations include for a standard site perimeter hoarding of 2.4m height that will be installed around the site boundary. Guidance on the approximate attenuation achieved by barriers surrounding the site is also provided in BS 5228. It states that when the top of the plant is just visible to the receiver over the noise barrier, an approximate attenuation of 5 dB can be assumed, while a 10 dB attenuation can be assumed when the noise screen completely hides the sources from the receiver. The former scenario will be assumed in this case as the nearest noise-sensitive locations at first floor level partially overlook the site. Table 8 presents the potential noise levels calculated at various distances based on the assumed sound pressure level and

attenuation provided by the barrier of 5 dB. A 50% on-time for piling operations is assumed.

4.1.3 Supplementary Construction Noise Assessment

Based on the proposed piling locations to allow for construction of temporary retaining walls, the distances from piling locations vary from 20m and greater to NSLs located further from the piling locations. Piling at the bridge is located distances of 10m and greater for the nearest NSLs.

Description of Noise Source	Calculated noise levels at varying distances (dB L _{Aeq,T})				
	10m	20m	30m	40m	60m
Large Rotary Bored Piling Rig (C3.14)	N/A	72	68	66	62
Mini piling rig (augered) (C3.17)	71	65	61	59	55

Table 8 Predicted Construction Noise Levels

Temporary Retaining Walls

The calculated noise levels indicate that the piling of retaining walls will likely be above the construction noise significant thresholds at the closest NSLs, i.e those located from 20m to 50m from areas of piling. The predicted noise level in the absence of mitigation at these distances are 66 – 72 dB L_{Aeq}. With reference to Table 2 the associated effect at NSLs 20m away is of major significance, in the absence of mitigation. At distances of 30 to 40m distance the predicted effect is of moderate significance in the absence of mitigation. At distances of 50m and greater from the piling, representative of the majority of surrounding NSLs, is predicted to be within the construction noise threshold.

The predicted effects of piling should be considered in the context of the expected duration of the works, which is anticipated to be of the order of 10 – 14 weeks across the site as opposed to several months of continuous activity. At individual piling locations close to specific NSLs, the works will be of short duration and move onwards, increasing the separation distance between a given receiver and the works.

Mitigation measures applicable to piling activity are presented in Section 4.2 of this report.

Bridge Abutments

The calculated noise levels indicate that the piling of bridge abutments will likely be above the construction noise significant thresholds at the closest NSLs, i.e those located from 10m to 20m from areas of piling. The predicted noise level in the absence of mitigation at these distances are 65 – 71 dB L_{Aeq}. With reference to Table 2 the associated effect at NSLs 10m away is of major significance, in the absence of mitigation. At distances of 20m distance the predicted effect is of moderate significance in the absence of mitigation. At distances of 20m and greater from the piling, representative of the majority of surrounding NSLs, is predicted to be within the construction noise threshold.

Mini piles are proposed for the abutments of the bridge crossing the Stradbroke Stream in the north of the site. It is anticipated that these works will be of short duration (2 – 3 weeks) at a localised area of the site and therefore the vast majority of surrounding NSLs will not experience negative effects associated with this activity.

Mitigation measures applicable to piling activity are presented in Section 4.2 of this report.

4.2 Mitigation Measures

4.2.1 Mitigation Measures – EIAR Document

Mitigation measures to reduce negative noise and vibration impacts are presented in Section 12.6 of the EIAR. These are reproduced below.

With regard to construction activities, best practice control measures for noise and vibration from construction sites are found within BS 5228 (2009 +A1 2014) *Code of Practice for Noise and Vibration Control on Construction and Open Sites Parts 1 and 2*. Whilst construction noise and vibration impacts are expected to vary during the construction phase depending on the distance between the activities and noise sensitive buildings, the contractor will ensure that all best practice noise and vibration control methods will be used, as necessary in order to ensure impacts at off-site NSLs are minimised.

The best practice measures set out in BS 5228-1 and BS 5228-2 includes guidance on several aspects of construction site mitigation measures, including, but not limited to:

- selection of quiet plant;
- noise control at source;
- screening; and,
- liaison with the public.

Construction activities will vary depending on the phase of construction.

Noise Control at Source

If replacing a noisy item of plant is not a viable or practical option, consideration will be given to noise control “at source”. This refers to the modification of an item of plant or the application of improved sound reduction methods in consultation with the supplier. For example, resonance effects in panel work or cover plates will be reduced through stiffening or application of damping compounds; rattling and grinding noises can often be controlled by fixing resilient materials in between the surfaces in contact.

Referring to the potential noise generating sources for the works under consideration, the following best practice mitigation measures will be implemented:

- The lifting of bulky items, dropping and loading of materials will be restricted to normal working hours.
- Mobile plant should be switched off when not in use and not left idling.
- For piling plant, noise reduction can be achieved by enclosing the driving system in an acoustic shroud.
- For concrete mixers, control measures will be employed during cleaning to ensure no impulsive hammering is undertaken at the mixer drum.
- For all materials handling ensure that materials are not dropped from excessive heights, lining drops chutes and dump trucks with resilient materials.
- Demountable enclosures can also be used to screen operatives using hand tools and will be moved around site as necessary.

- All items of plant will be subject to regular maintenance. Such maintenance can prevent unnecessary increases in plant noise and can serve to prolong the effectiveness of noise control measures.

Piling

General guidance in relation to piling is outlined in the following paragraphs.

Piling programmes will be arranged so as to control the amount of disturbance in noise and vibration sensitive areas at times that are considered of greatest sensitivity. If piling works are in progress on a site at the same time as other works of construction or demolition that themselves may generate significant noise and vibration, the working programme will be phased so as to prevent unacceptable disturbance at any time.

Prior to construction the planner, developer, architect and engineer, as well as the local authority, will be made aware of the proposed method of working of the piling contractor. The piling contractor will in turn have evaluated any practicable and more acceptable alternatives that would economically achieve, in the given ground conditions, equivalent structural results.

On typical piling sites the major sources of noise are essentially mobile and the noise received at any control points will therefore vary from day to day as work proceeds. The duration of piling works is typically relatively short in relation to the length of construction work as a whole, and the amount of time spent working near to noise sensitive areas can represent only a part of the piling period.

Noise reduction can be achieved by enclosing the driving system in an acoustic shroud. For steady continuous noise, such as that generated by diesel engines, it may be possible to reduce the noise emitted by fitting a more effective exhaust silencer system or utilising an acoustic canopy to replace the normal engine cover. Impact noise when piling is being driven can be reduced by introducing a non-metallic dolly between the hammer and the driving helmet.

Screening by barriers and hoardings is less effective than total enclosure but can be a useful adjunct to other noise control measures. For maximum benefit, screens should be close either to the source of noise (as with stationary plant) or to the listener. Removal of a direct line of sight between source and listener can be advantageous both physically and psychologically. In certain types of piling works there will be ancillary mechanical plant and equipment that may be stationary, in which case, care should be taken in location, having due regard also for access routes. When appropriate, screens or enclosures should be provided for such equipment.

Screening

Screening is an effective method of reducing the noise level at a receiver location and can be used successfully as an additional measure to all other forms of noise control. It is understood that the existing stone perimeter wall and fencing will remain in place during the construction process and provide a degree of screening.

In addition, careful planning of the site layout will also be considered. The placement of site buildings such as offices and stores will be used, where feasible, to provide noise screening when placed between the source and the receiver.

Liaison with the Public

A designated environmental liaison officer will be appointed to site during construction works. Any noise complaints will be logged and followed up in a prompt fashion by the liaison officer. In addition, where a particularly noisy construction activity is planned or other works with the potential to generate high levels of noise, or where noisy works are expected to operate outside of normal working hours etc., the liaison officer will inform the nearest noise sensitive locations of the time and expected duration of the noisy works.

Project Programme

The phasing programme will be arranged so as to control the amount of disturbance in noise and vibration sensitive areas at times that are considered of greatest sensitivity. During excavation/ piling or other high noise generating works are in progress on a site at the same time as other works of construction that themselves may generate significant noise and vibration, the working programme will also be phased so as to schedule these works for daytime hours so as to avoid causing excessive disturbance.

In addition to the above measures, further detail is presented in Section 4.3 regarding construction noise and vibration monitoring.

4.2.2 Dun Laoghaire Rathdown County Council's Good Practice Guide

The DLR GPG also sets out construction mitigation measures that will be implemented as part of the CEMP prepared in support of the planning application for the proposed development. The following relate to noise and vibration and have been divided into typical construction stages.

1. General Considerations	
All site staff shall be briefed on noise mitigation measures and the application of best practicable means to be employed to control noise.	All sites
Good Quality site hoarding should be erected, designed to maximise the reduction in noise levels	Medium and high risk sites
The contact details of the contractor and site manager shall be displayed to the public, together with the permitted operating hours, including any special permissions given for out of hours work	Medium and high risk sites
The site entrance shall be located to minimize disturbance to noise sensitive receptors, subject to traffic restrictions	Medium and high risk sites
Material and plant loading and unloading shall only take place during normal working hours unless the requirement for extended hours is for traffic management(i.e. road closure) or health and reasons (application must be made to DLR a minimum of 4 days prior to proposed works)	All sites
Use rubber linings in chutes, dumpers and hoppers to reduce impact noise	Medium and high risk sites

Minimise opening and shutting of gates through good coordination of deliveries and vehicle movements	Medium and high risk sites
Implementation of a detailed complaints recording and handling procedure	All sites

2. Plant	
Ensure that each item of plant and equipment complies with the noise limits quoted in the relevant European Commission Directive 2000/14/EC	All sites
Fit all plant and equipment with appropriate mufflers or silencers of the type recommended by the manufacturer	All sites
Use all plant and equipment only for the tasks for which it has been designed	All sites
Shut down all plant and equipment in intermittent use in the intervening periods between work or throttle down to a minimum	All sites
Power all plant by mains electricity where possible rather than generators	Medium and high risk sites
Maximise screening from existing features or structures and employ the use of partial or full enclosures for plant	Medium and high risk sites

3. Vehicle Activity	
Ensure all vehicle movements (on site) occur within normal working hours. (other than where extension of work requiring such movements has been granted in cases of required road closures or for health and safety reasons)	All sites
Plan deliveries and vehicle movements so that vehicles are not waiting or queuing on the public roads. If unavoidable engines should be turned off.	Medium and high risk sites
Minimise the opening and closing of the site access through good coordination of deliveries and vehicle movements	Medium and high risk sites
Plan the site layout to ensure that reversing is kept to a minimum	Medium and high risk sites
Where reversing is required use broadband reverse sirens or where it is safe to do so, disengage all sirens and use trained banks-men	Medium and high risk sites
Wheel washing of vehicles prior to exiting the site shall take place to ensure that adjoining roads are kept clean of dirt and debris. Regular washing of adjoining streets should also be carried out by the developer, as required by mechanical road sweepers	Medium and high risk sites
Ensure all vehicle movements (on site) occur within normal working hours. (other than where extension of work requiring such movements has been granted in cases of required road closures or for health and safety reasons)	All sites

4. Demolition Phase	
Employ the use of acoustic screening; this can include planning the demolition sequence to utilise screening afforded by buildings to be demolished.	Medium and high risk sites
If working out of hours for Health and Safety reasons (following approval by DLR) limit demolition activities to low level noise activity unless absolutely unavoidable)	All sites
Use low impact demolition methods such as non-percussive plant where practicable	Medium and high risk sites
Use rotary drills and 'bursters' activated by hydraulic or electrical power or chemically based expansion compounds to facilitate fragmentation and excavation of hard material.	Medium and high risk sites
Avoid the transfer of noise and vibration from demolition activities to adjoining occupied buildings where possible through cutting any vibration transmission path, or by structural separation of buildings	Medium and high risk sites
Consider the removal of larger sections by lifting them out and breaking them down either in an area away from sensitive receptors or off site.	High risk sites

5. Ground Work and Piling Phase	
The following hierarchy of groundwork/piling methods should be used if ground conditions, design and safety allows: <ul style="list-style-type: none"> • pressed in methods, e.g., hydraulic jacking • Auger/bored piling • Diaphragm walling • Vibratory piling or vibro-replacement • Driven Piling or dynamic consolidation 	Medium and high risk sites
The location and layout of the piling plant should be designed to minimise potential noise impact of generators and motors	Medium and high risk sites
Where impact piling is the only option utilise a non-metallic dolly between the hammer and driving helmet or enclose the hammer and helmet with an acoustic shroud	Medium and high risk sites
Consider concrete pour sizes and pump locations. Plan the start of concrete pours as early as possible, subject to DLR approval, to avoid time overruns	Medium and high risk sites
Where obstructions are encountered, work should be stopped and a review undertaken to ensure that work methods that minimise noise are used.	Medium and high risk sites
When using an auger piling rig do not dislodge material from the auger by rotating it back and forth. Use alternate methods where safe to do so.	Medium and high risk sites
Prepare pile caps using methods which minimise the use of breakers, e.g., use hydraulic splitters to crack the top of the pile.	Medium and high risk sites

6. Monitoring	
Establish pre-existing levels of ambient noise by baseline monitoring or use of the noise maps.	Medium and high risk sites
Carry out regular on site observation monitoring and checks/audits to ensure that BPM is being used at all times. Such checks shall include; <ul style="list-style-type: none"> • Hours of work • Presence of mitigation measures • Number and type of plant • Construction methods Site reviews must be recorded and made available for inspection	Medium and high risk sites
Monitor noise and vibration continuously during demolition, piling, excavation and sub and superstructure works at agreed locations and report to DLR at agreed intervals and in an agreed format. To comply with this the following must take place. <ul style="list-style-type: none"> • The initial monitoring locations must be agreed with officers of DLR and must remain in situ, unless agreed otherwise. If additional monitoring is required the new locations must be agreed with DLR. • The results of the monitoring must be forwarded to officers of DLR Environmental Enforcement Section every two weeks in the following format: <ol style="list-style-type: none"> 1. Provide the construction noise level as defined in British Standard 5228 and the peak particle velocity readings for the hours of operation of the site. This will include the construction noise level for any overtime period worked outside of normal working hours. 2. Provide a report detailing and discussing the noise and vibration levels over the reporting period. 3. If a breach is recorded the follow up action that took place to prevent any further breaches must be included in the report. 4. This information must be provided in electronic format If results are required owing to complaints the results will be provided as soon as possible by the contractor to DLR. 	Medium and high risk sites
Appraise and review working methods, processes and procedures on a regular basis to ensure continuous development of BPM	Medium and high risk sites
The 'ABC' Method detailed in Paragraph E.3.2 of BS 5228-1:2009 shall be used to determine acceptable noise levels for day, evening and night time work.	Medium and high risk sites

6. Monitoring	
Vibration levels are recommended to be kept below 1.0 mm/sec (PPV) where possible. Where levels are expected to exceed this value residents must be warned and an explanation given.	Medium and high risk sites

7. Liaison with Local Community and Businesses	
Appointment of a Liaison Officer as a single point of contact to engage with the local community and respond to concerns	Medium and high risk sites
Keeping local residents and businesses informed of progress and timing of particular construction activities that may impact on them, including any special permissions given for out of hours work.	Medium and high risk sites
A copy of this plan must be sent to DLR as a matter of urgency in the case of sites 14 days in advance of commencement of works for any site	High risk sites
Send regular updates at appropriate intervals to all identified affected neighbours/ businesses via a newsletter and post relevant information on the site hoarding. Also make the information available via email/website including weekly noise monitoring reports	High risk sites

8. Complaint Handling	
Maintenance of a site complaints log detailing 1. Name and address of complainant 2. Time and date complaint was made 3. Date, time and duration of noise, or other issues complained of 4. Characteristics of nuisance, such as noise rumble, clatters, intermittent, etc. 5. Likely cause or source of nuisance 6. Weather conditions, such as wind speed and direction 7. Investigative and follow -up actions, including response sent to complainant	All sites
Contact details for the site manager and liaison officer should be displayed prominently on the site hoarding	All sites

4.3 Noise and Vibration Monitoring

Noise & vibration monitoring will be conducted throughout the construction period. This section sets out details of the proposed monitoring along with appropriate alert threshold levels and protocols to be followed in the event of certain findings.

4.3.1 Alert Threshold Levels Applicable During Demolition and Construction

No mandatory or statutory limits apply to the site in respect of either noise or vibration. Accordingly, it is proposed to establish alert threshold levels in respect of both noise

and vibration in order to assist with the interpretation and management of emissions from the site. Alert threshold levels will be applied to all vibration monitors and external noise monitors.

It is appropriate to establish “Amber” and “Red” alert threshold levels in respect of both noise and vibration. The discussion in Section 4.3.2 presents the rationale for selection of the initial values of alert threshold levels.

It is important to note that the alert threshold levels do not represent any kind of limit value. They are used to provide guidance as to when it may be appropriate to exercise caution and/or implement additional or enhanced mitigation measures. An exceedance of an alert threshold level does not therefore imply that emissions from the site constitute a problem.

4.3.2 Selection of Values for Alert Threshold Levels

Noise

In developing the following sections consideration has been given to best practice guidance typically considered in an Irish context.

As set out in Section 2.1.2, BS 5228: 2009 +A1 2014: *Code of practice for noise and vibration control on construction and open sites, Part 1: Noise* presents some guidance as how appropriate target values for noise emissions may be derived through the consideration of various factors.

Suggested Alert Trigger Levels for Noise

Taking the baseline noise levels and above guidance into account, the following initial values for alert trigger levels are proposed at the boundary of the construction site in proximity to the nearest noise sensitive locations located offsite.

Location	Day	Period	Alert Level	Noise Levels, L _{Aeq,1hr} (dB re. 2x10 ⁻⁵ Pa)
Boundary with Private Residences	Monday to Friday	07:00 – 19:00hrs	Amber	65
			Red	70
	Saturdays	08:00 – 14:00hrs	Amber	65
			Red	70

Details of the appropriate course of action to be followed whenever an alert is received are set out in Section 4.3.3.

Noise Monitoring Terminals (NMT) to be installed with the following specifications (or similar approved):

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

Vibration

Vibration monitoring stations should continually log vibration levels using the Peak Particle Velocity parameter (PPV, mm/s) in the X, Y and Z directions, in accordance with BS ISO 4866: 2010: Mechanical vibration and shock – Vibration of fixed structures – Guidelines for the measurement of vibrations and evaluation of their effects on structures. A minimum of 2 no. vibration monitors should be allowed for with locations to be agreed.

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

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

The monitoring equipment should be set to monitor vibration in 5 minute periods. Noise and vibration data should be downloaded and reviewed on a fortnightly basis.

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

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

Indicative noise and vibration monitoring positions include but are not limited to those illustrated in Figure 5. Residential buildings adjacent to the site boundaries will be considered. One noise monitor should be positioned to address noise levels experienced at the nearest apartments or residential units. Subject to constraints on site and the location of construction works, additional noise monitors should be considered and/or moved to address monitoring requirements.



Figure 5 Construction Monitoring Locations
General Good Practice

General good practice measures include:

- The contractor will appoint a site representative responsible for matters relating to noise.
- A noise and vibration monitoring specialist will be appointed to periodically carry out independent monitoring of noise and vibration during random intervals and at sensitive locations for comparison with limits and background levels.
- All ancillary pneumatic percussive tools shall be fitted with mufflers or silences of the type recommended by the manufacturers, and where commercially available, dampened tools and accessories shall be used.

4.3.3 Actions to be taken when an Alert Threshold Level is Exceeded

Whenever an alert threshold level is exceeded the monitor in question will issue an alert by way of text or email message to designated recipients as follows:

- The company responsible for the monitoring;
- The main contractor; and
- Any parties nominated by the main contractor or developer.

In the event of an alert being received, the following actions are to be taken:

- “Amber” – the contractor should assess activities currently taking place on the site and may take steps to limit emissions where practicable; and
- “Red” – the contractor should conduct a detailed review of activities on the site, in particular those deemed responsible for the exceedance of the alert threshold level. In particular, it should be verified that noise control measures

have been implemented in accordance with BS5228 and Best Practicable Means (BPM). Additional measures should be considered and introduced as required. This may include possible plant replacement or alternative methods of working.

4.4 Item 29(3) h

This item calls for '*Preparation of a report detailing selection of construction methodology, implementation of mitigation measures to minimise nuisance affecting adjoining properties*'.

The Project Team have prepared the Construction and Environmental Management Plan (CEMP) for inclusion in the planning application documentation. The CEMP sets out construction methodology and references this report with respect to mitigation measures designed to reduce construction noise emissions.

5.0 OUTWARD NOISE ASSESSMENT – OPERATIONAL PHASE

5.1 Plant Noise

The mechanical plant serving the apartment blocks will be located internally within the buildings and noise emissions will therefore not be significant. The main item of external plant serving the development will be the plant required to service the basement level commercial elements of Dalguise House. This plant will be located at ground level adjacent to Dalguise House at a distance of approximately 40m from the nearest adjoining residential property to the development.

Final selections of the plant serving the commercial elements have not been made, however, preliminary selections have been made with a sound power rating of the order of 60 dB(A) L_w . Adopting this noise emission and accounting for the attenuation over distance the calculated noise level at the nearest adjoining residential property to the development is of the order of 40 dB L_{Aeq} .

Reviewing the measured baseline environment, as described in Section 3.0, the prevailing background noise level during the quietest day period when the commercial elements will be in operation is also of the order of 40 dB L_{A90} . Applying the methodology outlined in Section 2.2 would indicate that the noise impact resulting from the operation of this plant will not be significant.

Note that the noise emission values presented here are preliminary selections. During the detailed design stage all plant serving the development will be designed and located so that there is no negative impact on sensitive receivers in proximity to the proposed development. It is assumed that selected plant items will emit noise that is not tonal.

The services plant will be designed/attenuated to meet the relevant plant noise criteria for day and night-time periods at nearby sensitive receivers as set out in Section 2.2.1.

6.0 INWARD IMPACT ASSESSMENT

6.1 Intrusive Noise

With regards to the effect of noise inwards on the development, reference is made to The *Professional Guidance on Planning & Noise* (ProPG) document (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 its adoption it has been generally considered as a best practice guidance and has been widely adopted in the absence of equivalent Irish guidance.

In accordance with the ProPG document, the following noise risk assessment has been completed. The risk assessment calls for the categorisation of the site as a negligible, low, medium or high risk based on the pre-existing noise environment. Figure 6 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. 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.”

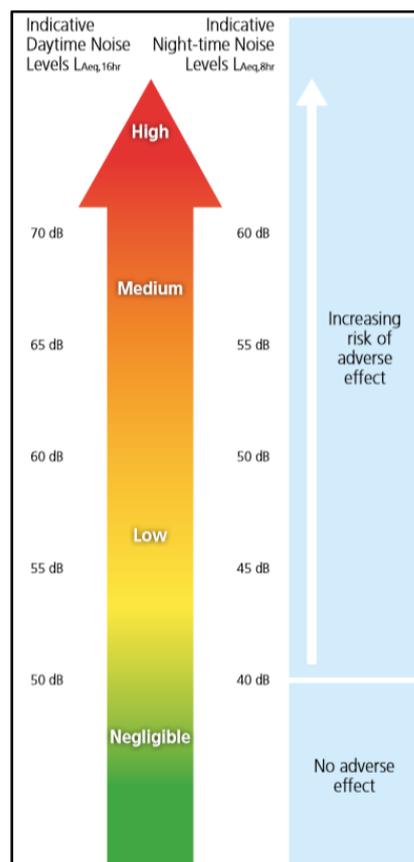


Figure 5 ProPG Stage 1 - Initial Noise Risk Assessment

In this instance reference is made to baseline noise surveys undertaken at the site. ProPG states the following with respect to the initial risk assessment:

“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.”

On review of noise levels at the site, with consideration for the contribution of weather effects, it is concluded that the site lies within a negligible noise risk for day and night-time periods. ProPG states the following with respect to the negligible risk category:

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.

Following the guidance contained in ProPG, due to the location of the proposed development site which is set back from the main noise source in the area, the Monkstown Road, the site is categorised as negligible noise risk. No further assessment of inward noise intrusion or mitigation is deemed necessary.

7.0 CONCLUSION

AWN Consulting has been commissioned to carry out a study in relation to the potential noise impacts associated with the proposed residential development at Dalguise House, Monkstown, Co. Dublin. This document has been prepared in response to a request for further information (RFI) from Dun Laoghaire Rathdown County Council. The RFI identifies potential for noise impacts associated with the construction and operational phases of the proposed development. This report presents the responses to these items with respect to the outward and inward noise impacts.

A supplementary baseline noise survey has been undertaken at the development site to provide further information regarding the existing noise environment across the site.

Information relating to the magnitude of construction noise impacts has been presented, including confirmation that rock breaking is not proposed. Supplementary construction noise predictions have been prepared in relation to piling activities. Noise control measures have been presented for inclusion in the Construction and Environmental Management Plan being prepared in support of the planning application, in accordance with the Dun Laoghaire Rathdown County Council's *“Good Practice Guide for Construction and Demolition Environmental Management”*.

A further assessment has been undertaken of proposed mechanical plant items that will be operational at the proposed development. While plant selections have not been finalised at this early stage, review of noise emissions for proposed systems indicated that, with reference to baseline noise levels measured at the site, plant noise emissions will not be significant at nearby noise sensitive location outside of the proposed development.

With respect to inward noise, the proposed development site has been classed as Negligible Noise Risk in accordance with *Professional Guidance on Planning & Noise* (ProPG). It is predicted that industry standard internal noise levels in residential units will be achieved with standard glazing and vent systems.

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 μ Pa).
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.
$D_{n,e,w}$	Weighted element-normalized level difference. This is the value of sound insulation performance of a ventilator measured under laboratory conditions. It is a weighted single figure index that is derived from values of sound insulation across a defined frequency spectrum. Technical literature for acoustic ventilators typically presents sound insulation data in terms of the $D_{n,e,w}$ parameter.
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_{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.
L_{AF10}	Refers to those A-weighted noise levels in the upper 10 percentile of the sampling interval; it is the level which is exceeded for 10%

of the measurement period. It is typically representative of traffic noise levels. Measured using the “Fast” time weighting.

L_{AFmax}

is the instantaneous fast time weighted maximum sound level measured during the sample period.

L_{den}

The L_{den} (Day Evening Night Sound Level) is the average sound level over a 24 hour period, with a penalty of 5 dB added for the evening hours or 19:00 to 22:00, and a penalty of 10 dB added for the night-time hours of 22:00 to 07:00.

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.