ENVIRONMENTAL NOISE SURVEY

FOR

A LARGE SCALE RESIDENTIAL DEVELOPMENT (LRD)

AT

CARLISLE RESIDENTIAL DEVELOPMENT
KIMMAGE
DUBLIN 12

Prepared for

1 Terenure land Ltd

Prepared by:

Traynor Environmental Ltd

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This report refers, within the limitations stated, to the condition of the site at the time of the report. No warranty is given as to the possibility of future changes in the condition of the site. The report as presented is based on the information sources as detailed in this report, and hence maybe subject to review in the future if more information is obtained or scientific understanding changes.

CONTENTS

1.0 INTRODUCTION

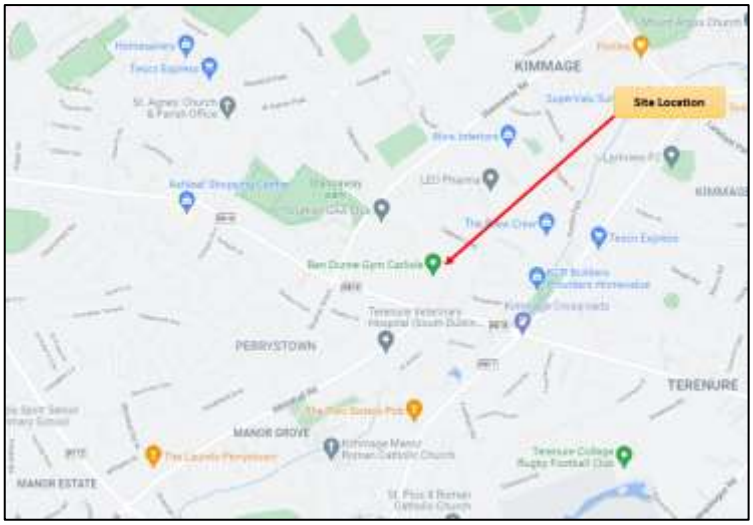
Traynor Environmental Ltd has been requested to carry out an independent environmental noise survey for a Large Scale Residential Development at Kimmage, Dublin 12 on behalf of 1 Terenure Land Ltd. A site location map relevant to the assessment is presented in Figure No. 1 below.

It is proposed to use guidance from British Standard BS 8233:2014 Guidelines for Sound Insulation and Noise Reduction for Buildings, World Health Organisation's (WHO) Guidelines for Community Noise (1999), Current Dublin Agglomeration Environmental Noise Action Plan (Volume 2) December 2018 – July 2023 and ProPG: Planning and Noise – Professional Practice Guidance on Planning & Noise – New Residential Development – May 2017. The assessment methodologies contained within these guidance documents are considered to be current best practice for the assessment of noise on developments.

This report will include the following:

- Review of the relevant content of the standards that will be used for the noise assessment.
- Comment on the predicted noise levels across the site, and;
- Recommend mitigation measures during construction and operation to be put in place that will be considered in relation to the levels of noise at the site.

Figure 1: Site Location Map.



Permission was granted, under ABP 313043 on the 22nd September 2022, for an SHD on the subject site comprising 208 no. apartment units in 5 no. blocks. The current proposed LRD application provides the same layout and quantum of units as this permitted development. The proposed LRD Environmental Noise Survey is the same as permitted in the SHD application.

2.0 BACKGROUND.

2.1 Principals of Acoustics

This section provides a brief overview of the fundamentals of acoustics and the basis for the preparation of this noise assessment, in order to provide a broader understanding of some of the technical discussion in this report.

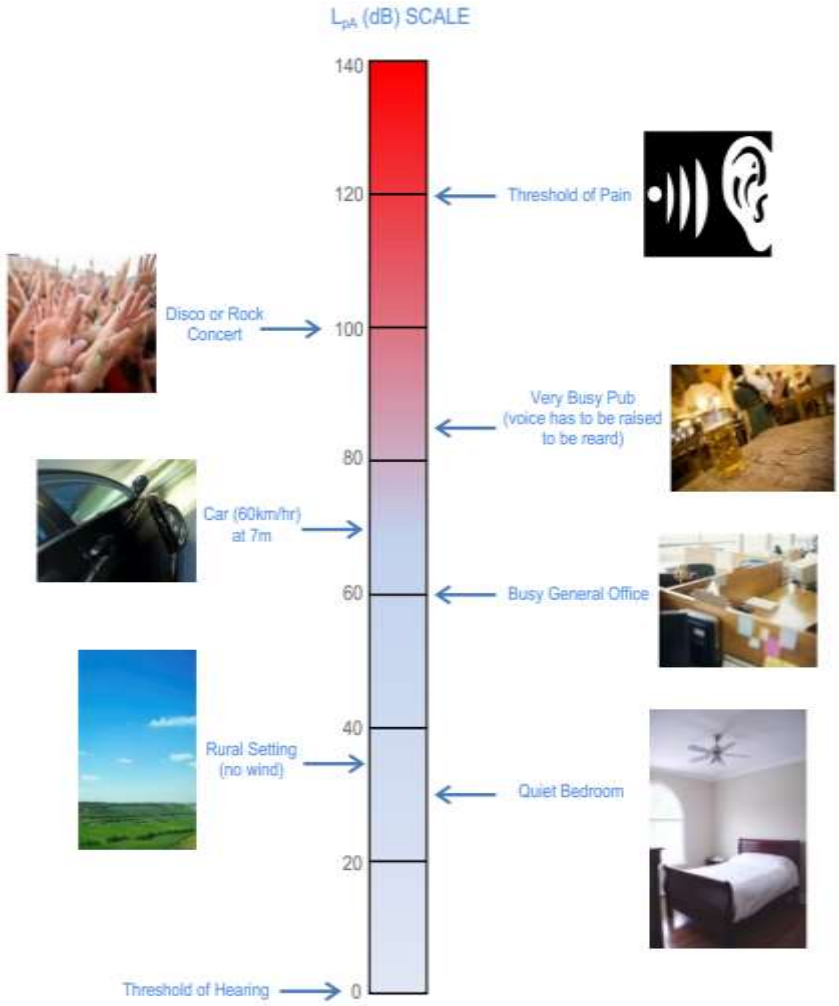
A sound wave travelling through the air is a regular disturbance of the atmospheric pressure. These pressure fluctuations are detected by the human ear, producing the sensation of hearing. In order to take account of the vast range of pressure levels that can be detected by the ear, it is convenient to measure sound in terms of a logarithmic ratio of sound pressures. These values are expressed as Sound Pressure Levels (SPL) in decibels (dB).

The audible range of sounds expressed in terms of Sound Pressure Levels is 0dB (for the threshold of hearing) to 120dB (for the threshold of pain). In general, a subjective impression of doubling of loudness corresponds to a tenfold increase in sound energy which conveniently equates to a 10dB increase in SPL. It should be noted that a doubling in sound energy (such as may be caused by a doubling of traffic flows) increases the SPL by 3dB.

The frequency of sound is the rate at which a sound wave oscillates and is expressed in Hertz (Hz). The sensitivity of the human ear to different frequencies in the audible range is not uniform. For example, hearing sensitivity decreases markedly as frequency falls below 250Hz. In order to rank the SPL of various noise sources, the measured level has to be adjusted to give comparatively more weight to the frequencies that are readily detected by the human ear. Several weighting mechanisms have been proposed but the 'A-weighting' system has been found to provide one of the best correlations with perceived loudness. SPLs measured using 'A-weighting' are expressed in terms of dB(A). An indication of the level of some common sounds on the dB(A) scale is presented in Figure 1.

The 'A' subscript denotes that the sound levels have been A-weighted. The established prediction and measurement techniques for this parameter are well developed and widely applied. For a more detailed introduction to the basic principles of acoustics, reference should be made to an appropriate standard text.

Figure 2 - dB(A) Scale & Indicative Noise Levels – (EPA: Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4 – 2012))



2.2 ASSESSMENT CRITERIA

The following section discusses the relevant guidance documents used to set appropriate external and internal noise levels across the site.

2.3 NATIONAL PLANNING FRAMEWORK 2040

The finalised 'National Planning Framework 2040' was published in 2018 and is to be used as the guideline for current planning policy. Specific reference to noise is made under Objective 65: *"Promote the pro-active management of noise where it is likely to have significant adverse impacts on health and quality of life and support the aims of the Environmental Noise Regulations through national planning guidance and Noise Action Plans."*

The National Planning Framework will support:

- Noise management and action planning measures through strategic noise mapping, noise action plans and suitable planning conditions.
- Good acoustic design in new developments, in particular residential development, through a variety of measures.
- The further enjoyment of natural resources through the preservation of low sound levels or a reduction of undesirably high sound levels. Extra value is placed on areas with low sound levels, coined Quiet Areas, because they are deemed to be of environmental quality and to have a positive impact on quality of life and health.

2.4 Dublin Agglomeration Environmental Noise Action Plan (NAP) 2018 - 2023

The Environmental Noise Action Plan states the following in terms of the proposed noise control measures to be adopted when considering developments which introduce people to noise:

"2.8 Regional or Local Legislation or Guidance

This document is a Action Plan which aims to manage environmental noise generated mainly by road traffic in the Dublin City Council Area. Currently there is no regional or local legislation relating to noise. However, there are a number of guidance documents that are relevant in the context of action planning: -

2.8.1 Regional Planning Guidelines

The Regional Planning Guidelines for the Greater Dublin Area 2010-2022 set out the planned direction for growth within the Greater Dublin Area up to 2022 by giving regional effect to national planning policy under the National Spatial Strategy (NSS). In this, it is stated that, 'Planning policies need to consider the added health burden from the effects of air and noise pollution, road traffic accidents, sedentary lifestyles, lack of safe community space or spaces with poor access……..'. Reference is also made to noise mitigation in the design of Green infrastructure in the guidelines.

2.8.2 Development Plans and Local Area Plans

Transportation, environment and development control policies and objectives that aim to reducing the negative and harmful effects due to exposure to environmental noise are contained in the Development Plans and Local Area Plans. Dublin City Councils current Development Plan 2016- 2022 sets out certain objectives in relation to noise management and includes the following: - It is an Objective of Dublin City Council: -

a) *SIO23: To implement the Dublin Agglomeration Environmental Noise Action Plan (2013– 2018) in co-operation with the other local authorities in Dublin and the Irish Aviation Authority.*
b) *SIO24: To protect the designated 'Quiet Areas' within the city from increased exposure to noise.*
c) *SIO25: To support new technologies and practices as a power source in transport to reduce noise.*
d) *SIO26: To protect residents of mixed-use developments from noise emanating from other uses such as shops, offices, nightclubs, late night busking, public houses and other night time uses through the planning system.*

e) *SIO27: To give careful consideration to the location of noise-sensitive developments, including the horizontal and vertical layout of apartment schemes, so as to ensure they are protected from major noise sources where practical".*

The NAP indicates that guidance within the ProPG Planning and Noise: Professional Practice Guidance on Planning and Noise document should be referred to:

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

In accordance with this NAP policy, the following Acoustic Report has been prepared to comply with the requirements of this policy.

2.5 BRITISH STANDARD BS 8233 (2014)

The standard, BS 8233 (2014) Guidelines for Sound Insulation and Noise Reduction for Buildings, sets out recommended internal noise levels for several different building types from external noise sources such as transport noise. The guidance is primarily for use by designers and hence BS 8233 may be used as the basis for an appropriate schedule of noise control measures. The recommended internal noise levels for residential developments are set out below.

Table 1: Summary of recommended internal noise levels from BS 8233 (2014)

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

The document also notes that where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.

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

"For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB L_{Aeq}, T, with an upper guideline value of 55 dB L_{Aeq}, T which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience

of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces but should not be prohibited".

2.6 WHO COMMUNITY NOISE (1999)

The World Health Organization (WHO) document Guidelines for Community Noise (1999) provides the following design criteria and guidelines in relation to noise:

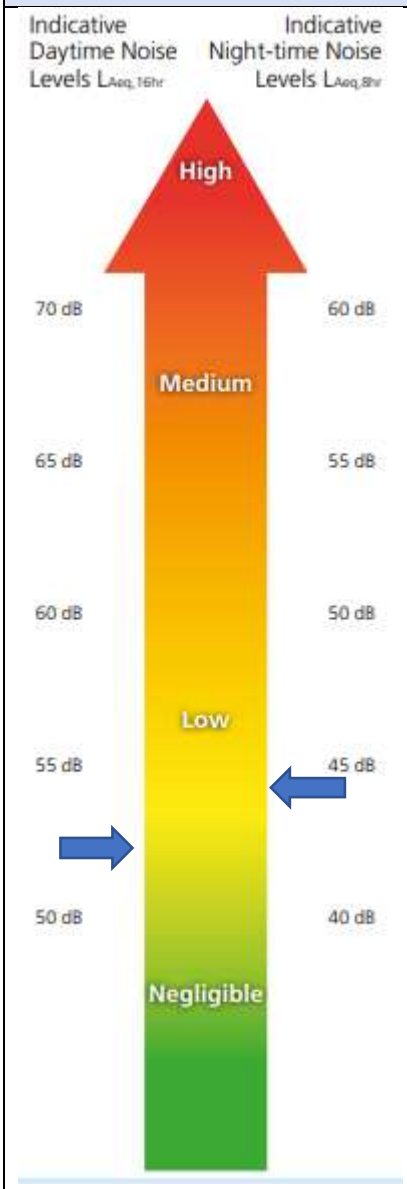
"The effects of noise in dwellings, typically, are sleep disturbance, annoyance, and speech interference. For bedrooms, the critical effect is sleep disturbance. Indoor guideline values for bedrooms are 30dB L_{Aeq} for continuous noise and 45dB LA_{max} for single sound events. Lower noise levels may be disturbing depending on the nature of the noise source. To enable casual conversation indoors during daytime, the sound level of interfering noise should not exceed 35dB L_{Aeq}".

2.7 PROPG: PLANNING AND NOISE – PROFESSIONAL PRACTICE GUIDANCE ON PLANNING & NOISE – NEW RESIDENTIAL DEVELOPMENT

ProPG: Planning and Noise is new guidance with the overall aim of delivering sustainable development by promoting good health and well-being through the effective management of noise. The guidance aims to complement the national planning policy and encourages the use of good acoustic design at the earliest phase of the planning process.

"The ProPG guidance is relevant to assess the impact of noise on the proposed residential development rather than determining the assessment of the impact of noise from the development upon the existing area. The guidance is applicable to new residential development which would be exposed predominantly to noise from existing transport sources. "

Table 2. ProPG Noise Risk Assessment

NOISE RISK ASSESSMENT	POTENTIAL EFFECT WITHOUT NOISE MITIGATION	PRE-PLANNING APPLICATION ADVICE
	Increasing risk of adverse effect	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. 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. 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.
	No adverse effect	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.
Typical Night-time LAmax (dB)	> 60 dB?	LAmax Level Comment
57-61	Yes	An indication that that there may be more than 10 noise events at night-time with L_{Amax} > 60 dB means the site should not be regarded as negligible risk.

The ProPG advocates a risk-based approach to noise with a two-stage sequential approach, which is:

- *Stage 1 – an initial noise risk assessment of the proposed development site; and*
- *Stage 2 – a systematic consideration of four key elements –*
  Element 1 – demonstrating a 'Good Acoustic Design Process.
  Element 2 – observing internal 'Noise Level Guidelines'.
  Element 3 – undertaking an 'External Amenity Area Noise Assessment' and
  Element 4 – consideration of 'Other Relevant Issues'
- *The ProPG approach is underpinned by the preparation and delivery of an 'Acoustic Design Statement' (ADS), whereby the higher the risk the site, the more detailed the ADS. The ADS should address the following issues:*
- *Present the initial site noise risk assessment, including the pre-development acoustic conditions prior to development.*
- *Describe the external noise levels that occur across the site both before and after mitigation measures. The external post mitigation noise assessment should use an informed judgement of typical worst-case conditions.*
- *Demonstrate how good acoustic design is integrated into the overall design and how the proposed acoustic design responds to specific circumstances of the site.*
- *Confirm how the internal noise level guidelines will be achieved, including full details of the design measures, and building envelope specifications.*
- *A detailed assessment of the potential impact on occupants should be undertaken where individual noise events are expected to exceed 45 dB L_{AFmax} more than 10 times a night inside bedrooms.*
- *Priority should be given to enable the use of openable windows where practical across the development. Where this is not practical to achieve the internal noise level guidelines with windows open, then full details of the proposed ventilation and thermal comfort arrangements must be provided.*
- *Present the findings of the external amenity area noise assessment.*
- *Present findings of the assessment of other relevant issues.*
- *Confirm for a low-risk site, however adverse impacts of noise will be mitigated and minimised.*
- *Confirm for a medium or high noise risk site how adverse impacts of noise will be mitigated and minimised and clearly demonstrate that a significant adverse noise impact has been avoided.*

2.8 Construction Phase

2.8.1 Noise Assessment Criteria

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. Dublin City Council (DCC) typically controls construction activities by imposing limits on the hours of operation and consider noise limits at their discretion.

In order to set appropriate construction noise limits for the development site, reference has been made to *BS 5228 - 1:2009 +A1 2014 Code of practice for noise and vibration control on construction and open sites- Noise*. Part 1 of this document Noise provides guidance on selecting appropriate noise criteria relating to construction works.

BS 5228-1:2009+A 1:2014 gives several examples of acceptable limits of construction noise, the most simplistic being based on upon the exceedance of fixed noise limits. For example, paragraph E.2 states:

'Noise from construction and demolition sites should not exceed the level at which conversation in the nearest building would be difficult with windows shut.'

Paragraph E.2 goes on to state:

'Noise levels, between 07:00 and 19:00 hours; outside the nearest window of the occupied room closest to the site boundary should not exceed:

70 decibels (dBA) in rural, suburban areas away from the main road traffic and industrial noise.

75 decibels (dBA) in urban areas near main roads in heavy industrial areas.'

Note that a typical planning condition in relation to construction noise issued by Local Authorities refer also to the compliance with BS 5228 part 1 as a means of controlling impacts to the surrounding environment. BS 5228 has therefore been used to inform the assessment approach for construction noise in line with Local Authorities requirements.

The TII published the 'Good Practice Guidance for the Treatment of Noise and Vibration in National Road Schemes'. These guidelines proposed design goals for noise related to construction and recommends a maximum noise level of 65 - 75 dB L_{Aeq} at noise sensitive receptors base on their baseline noise. Predicted noise levels have initially been assessed against these limits.

In addition to the TII criteria, based upon the analysis and summary of the results of the existing noise surveys undertaken for the Proposed Development. Table 3 sets out the BS 5228 'ABC' noise threshold categories.

Table 3: 'ABC' Assessment Category for Construction.

'ABC' Assessment Category for Construction	
ABC Category	**Construction Noise Limit**
A	65
B	70
C	75

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

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

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

For the appropriate assessment period (i.e., daytime in this instance) the ambient noise level is determined and rounded to the nearest 5dB. If the construction noise exceeds the appropriate category value, then a significant effect is deemed to occur.

Vibration

In terms of vibration, *British Standard BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Vibration* recommends that, for soundly constructed residential property and similar structures that are generally in good repair, a threshold for minor or cosmetic (i.e. non-structural) damage should be taken as a peak component particle velocity (in frequency range of predominant pulse) of 15mm/s at 4Hz increasing to 20mm/s at 15Hz and 50mm/s at 40Hz and above. The standard also notes that below 12.5 mm/s PPV the risk of damage tends to zero. It is therefore common, on a cautious basis to use this lower value. Taking the above into consideration the vibration criteria in Table 4 are recommended.

Table 4 Recommended Vibration Criteria During Construction Phase

Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of:		
Less than 15Hz	**15 to 40Hz**	**40Hz and above**
12 mm/s	20 mm/s	50 mm/s

2.9 SUMMARY OF GUIDANCE DOCUMENTS

On consideration of the guidelines outlined in the Dublin Agglomerate Noise Action Plan, NRA, WHO Guidelines for Community Noise and BS 8233:2014 in conjunction with ProPG it is considered that the following criteria are relevant in the context of the proposed development: BS 5228 -1:2009 +A1 2014 is relevant in the context of the proposed construction works.

- 35dB $L_{Aeq,16hour}$ daytime within living / bedrooms.
- 40dB $L_{Aeq,16hour}$ daytime within dining rooms, and.
- 30dB $L_{Aeq,8hour}$ night-time within bedrooms.
- 65dB – 75dB L_{Aeq} guidance limit for construction noise at nearest noise sensitive location.

External noise levels in amenity areas should be designed so as to achieve the lowest practicable levels, within reasonable design constraints.

Table 5: Summary of Internal Noise Criteria for sleeping and resting.

Internal Space	**Indoor ambient noise level L_{Aeq} (dB)**		
BS8233 (07:00 to 23:00)		**BS8233 (23:00 to 07:00)**	**Who**
Living Rooms	35	-	30/35[1]
Dining Rooms	40	-	-
Bedrooms	35	30[2]	30[2]

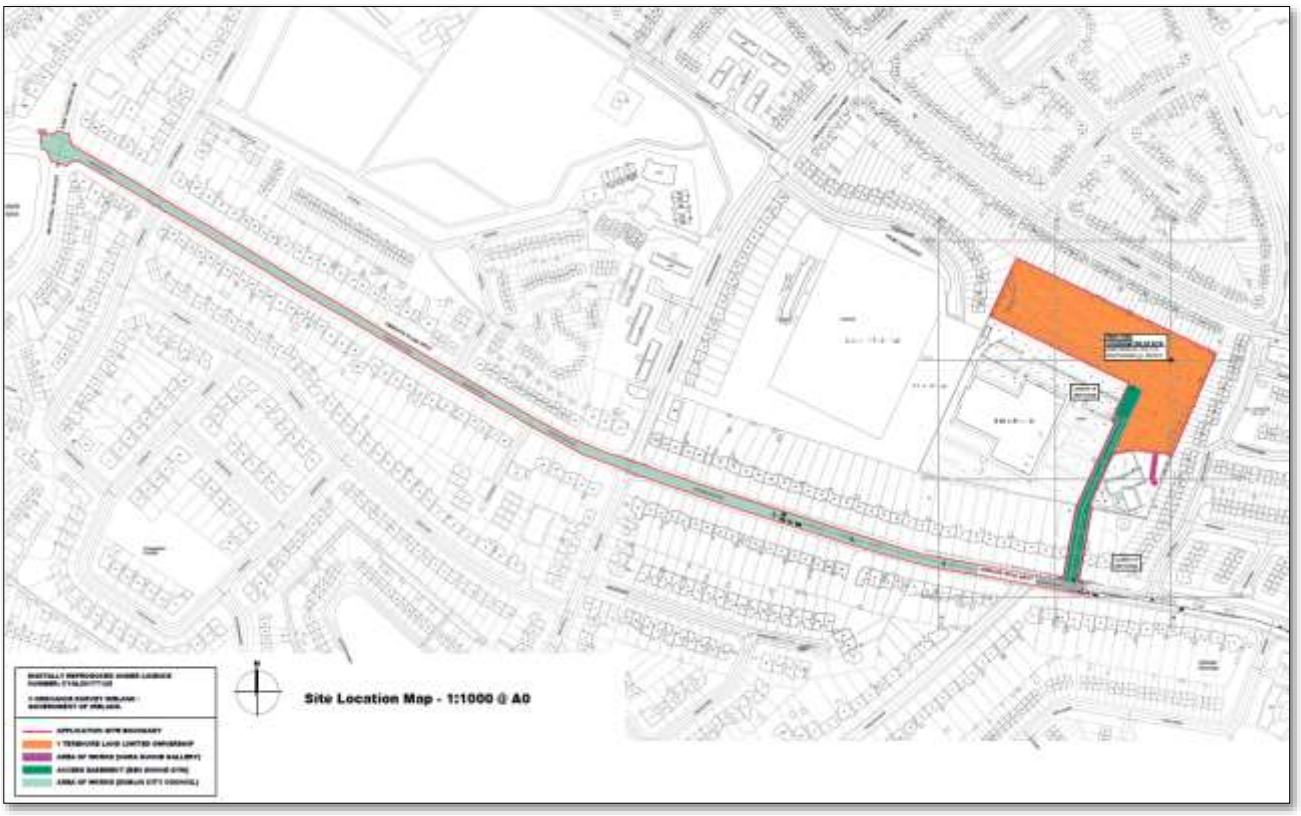
[1] WHO does not differentiate between different types of living spaces but recommends L_{Aeq} 30 dB in relation to sleep disturbance and L_{Aeq} 35 dB in relation to speech intelligibility. WHO provides a 16-hour time base when referring to speech intelligibility and an 8-hour time base when referring to sleep disturbance.

[2] BS8233 notes that individual noise events can cause sleep disturbance, and that a guideline value may be set depending on the character and number of events per night, although no specific limit is provided. Section 3.4 of the WHO guidelines suggest that good sleep will not generally be affected if internal levels of L_{Amax} 45 dB are not exceeded more than 10-15 times per night. This is used to determine an external noise criterion of L_{Amax} 60 dB on the basis that an open window will give 15 dB of attenuation.

3.0 SITE DESCRIPTION

'The proposed Large Scale Residential Development will consist of the construction of 5 no. blocks of development and will range in height up to 6 storeys. This will provide 208 no. residential units (104 no. 1 beds and 104 no. 2 beds) all of which will have associated private balconies/terraces. Car, cycle and motorbike parking will be located at undercroft and surface level. Vehicular/pedestrian/cyclist access is provided off Kimmage Road West via the existing Ben Dunne Gym access route. All associated site development works, open spaces, landscaping, boundary treatments, plant areas, waste management areas, and services (including ESB substations) shall be provided. A full description is set out in the statutory notices included with this application.'

Figure 3: Site location and boundaries in the context of the surrounding lands



4.0 NOISE MODELLING METHODOLOGY

4.1 SoundPLAN Modelling

Noise modelling has been undertaken based on the monitoring data to predict L_{Aeq} noise levels at a number of locations both horizontally and vertically. SoundPLAN noise modelling software has been used which is based on the Department of Transport Calculation of Road Traffic Noise (CoRTN) and ISO 9613 noise propagation methodology.

The modelling software calculates noise levels based on the emission parameters and spatial settings that are entered. Input data, assumptions and model settings as given in the table below. All drawings generated by the model are included in the Appendices. Predictive Noise for when the development is fully constructed has been modelled.

Table 6: Modelling Parameters Sources

Parameter	Source	Details
Horizontal distances – around site	bkd architects	Planning Drawings
Ground levels	BM Consulting	On-site topographical data
Traffic data	National Transport Authority	National Transport Authority traffic count data
Building heights	Bkd architects	Block 1-6
Barrier heights	Traynor Environmental Observations	Existing approx.1.8 - 2.5m high wall to the north & east of the site included within the models. Location of wall is shown in Appendix D
Receptor positions	Traynor Environmental	Receptor at each floor of the proposed development
Site Layout	Bkd architects	Planning Layout

4.2 Noise Monitoring Parameters

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

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).
L_{Aeq}	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 transport noise, on the background.
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 describe a background level. Measured using the "Fast" time weighting.
L_{AF10}	Refers to those A-weighted noise levels in the top 10 percentile of the sampling interval; it is the level which is exceeded for 10% of the measurement period. It is used to determine the intermittent high noise level features of locally generated noise and usually gives an indicator of the level of trains. Measured using the "Fast" time weighting.
L_{AFmax}	The maximum RMS A-weighted sound pressure level occurring within a specified time period. Measured using the "Fast" time weighting.
L_{den}	The Lden (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
L_{day}	is the A-weighted long-term average sound level as defined in ISO 1996-2, determined over all day periods of a year.
$L_{evening}$	is the A-weighted long-term average sound level as defined in ISO 1996-2, determined over all the evening periods of a year.

4.3 Model Input Data

4.3.1 Model Verification from On-Site Monitoring

The model was verified by modelling the monitoring locations for the 'existing' scenario. The daytime $L_{Aeq,}$ and night-time L_{Aeq} scenario has been verified for N1, N2, N3, N4, N5, N6, N7, N8 and N9. The comparison between the monitoring and modelling results are shown in the tables 7 and 8 below.

Table 7: Daytime Modelled vs. Monitored Results L_{Aeq},T

Monitoring Position	Monitored L_{Aeq}	Modelled L_{Aeq}	Difference between modelled and measured noise level (dB)
N1	47	48.5	+1.5
N2	50	48.4	-1.6
N3	51	52.4	+1.4
N4	50	49.1	-0.9
N5	50	48.5	-1.5
N6	48	48.2	+0.2
N7	49	51.1	+2.1
N8	52	52.3	+0.3
N9	52	52.8	+0.8

All values are sound pressure levels in dB re: 2x 10-5 Pa.

Table 8: Night-time Modelled vs. Monitored Results L_{Aeq},T

Monitoring Position	Monitored L_{Aeq}	Modelled L_{Aeq}	Difference between modelled and measured noise level (dB)
N1	42	42.5	+0.5
N2	41	42.1	+1.1
N3	48	48.2	+0.2
N4	45	47.5	+2.5
N5	46	47.8	+1.8
N6	38	39.1	+1.1
N7	39	39.8	+0.8
N8	39	41.2	+2.2
N9	44	45.6	+1.6

All values are sound pressure levels in dB re: 2x 10-5 Pa.

As all of the verification points show a divergence between monitored and modelled results of no more than 3 dB, the models are considered suitably verified.

4.3.2 Verification from EPA Strategic Noise Mapping

The proposed site was not modelled in the EPA strategic noise mapping as indicated in Figure 4.

Figure 4: EPA Strategic Noise Mapping 2017 L_{den} Map (Site marked at X)

4.3.3 Green Area Model Data

Guideline criteria for external noise levels in the development common greens, apartment block central court yards and terraced housing rear gardens can be found in both the *BS 8233 Guidance on Sound Insulation and Noise Reduction for Buildings and ProPG: Planning & Noise (Professional Guidance on Planning & Noise for New Residential Developments) guidance documents.* Both of these document's state that ambient noise levels in external residential areas should ideally not be above 50 - 55dB L_{Aeq}.

Although exceedances of this criteria are naturally not desirable, both the *BS 8233 Guidance on Sound Insulation and Noise Reduction for Buildings and ProPG: Planning & Noise (Professional Guidance on Planning & Noise for New Residential Developments)* recognize that their stated guideline values are not achievable in all instances and that external noise levels in excess of this criteria would not be prohibitive provided additional considerations are made in relation to the development.

From BS 8233:

It is recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure

development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces but should not be prohibited.

In high-noise areas, consideration should be given to protecting these areas by screening or building design to achieve the lowest practicable levels. Achieving levels of 55dB LAeq,T or less might not be possible at the outer edge of these areas but should be achievable in some areas of the space.

From ProPG:

These guideline values may not be achievable in all circumstances where development might be desirable. In such a situation, development should be designed to achieve the lowest practicable noise levels in these external amenity spaces.

Where, despite following a good acoustic design process, significant adverse noise impacts remain on any private external amenity space (e.g., garden or balcony) then that impact may be partially off-set if the residents are provided, through the design of the development or the planning process, with access to:

- *A relatively quiet facade (containing openable windows to habitable rooms) or a relatively quiet externally ventilated space (i.e., an enclosed balcony) as part of their dwelling; and/or*
- *A relatively quiet alternative or additional external amenity space for sole use by a household, (e.g., a garden, roof garden or large open balcony in a different, protected, location); and/or*
- *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; and/or*
- *A relatively quiet, protected, publicly accessible, external amenity space (e.g., a public park or a local green space designated because of its tranquillity) that is nearby (e.g., within a 5-minute walking distance).*

Given the above guidance, the following general approach was developed as the development's external noise level strategy in order to provide an acceptable external ambient noise environment:

- The 50 - 55dB L_{Aeq} external criteria will be designed for in all instances where it is practically possible to be achieved.
- Where these external criteria are not achievable, external noise levels will be attenuated as far as practicable.
- Relatively quiet external amenity spaces will be incorporated into the development.

The façade design of all residential spaces will incorporate glazing / façade elements to achieve a quiet internal acoustic environment that will comply with criteria applicable to low level residential bedroom environments.

Table 9 presents predicted noise levels when buildings constructed and in full operation within green area.

Table 9: Green Area Noise Levels

Locations	Period	External L_{Aeq}	BS 8233 L_{Aeq}	Within BS 8233
Open Space	Daytime L_{Aeq} 16hr	46-50	50-55	Yes

As can be seen in Table 9 noise levels are predicted to be below 46-50 dB LAeq,16hours in the Open Space in the centre of the site as per BS 8233.

Open Space

Noise prediction calculations conducted based on the worst-case measured noise levels confirms that ambient noise levels in the open space would be reduced to an order of 46- 50dB L_{Aeq} with the location of the proposed buildings. Noise levels of this order would be within the 50 - 55dB L_{Aeq} external design criteria and therefore sufficient for open spaces.

4.4 Noise Survey

An attended baseline noise survey was conducted at the site from Thursday 23rd September 2021 – Friday 24th September 2021 to characterise baseline ambient noise levels currently experienced on the site and to establish existing noise levels.

The measurement equipment was checked against the appropriate calibrator at the beginning and end of the measurements, in accordance with recommended practice and no drift was observed.

Measurements were taken in general accordance with BS 7445-1:2003 The Description and Measurement of Environmental Noise: Guide to quantities and procedures. Weather conditions during the survey period were observed as being dry with no showers. Anemometer readings confirmed that wind speeds were less than 4 - 5 km/h at all times during the survey.

4.5 Survey Period

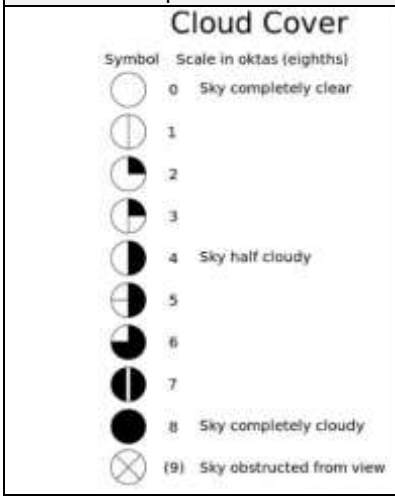
Noise levels were logged over 30-minute periods at each location for a maximum of 1.5 hours during the daytime and 1 hour during night time hours.

Table 10: Instrumentation Details.

Instrumentation Details		
Manufacturer	**Instrument**	**Calibrated by**
Larson Davis Sound Expert 831	(Serial No.3913)	Environmental Measurements, Unit 12, Tallaght Business Park, Dublin 24
Larson Davis Sound Expert LxT	(Serial No.5595)	Environmental Measurements, Unit 12, Tallaght Business Park, Dublin 24
Larson Davis Sound Expert LxT	(Serial No.5901)	Environmental Measurements, Unit 12, Tallaght Business Park, Dublin 24

4.6 Weather Conditions

Table 11: Meteorological Conditions during the Survey – 23rd – 24th September 2021

Date/Time	Weather Conditions		
	Description	**At the Start of Survey**	**On Completion**
23rd – 24th September 2021	Temperature	15 ˚C	18 ˚C
	Precipitation	Dry	Dry
	Cloud cover	4	5
	Any fog/snow/ice	No	No
	Any damp roads/wet ground	No	No
	Wind Speed	4 m/s	5 m/s
	Wind Direction	South	South
	Any conditions that may cause temp, inversion (e.g., calm nights with no cloud)	No	No

4.7. Survey Location

Location No.1 – No.1 is located within the development site to the south east corner of the site boundary and is in close proximity to Nora Dunne Gallery.

Location No.2 – No.2 is located within the development to the east boundary of the site and is in close proximity to the Brookfield Green housing Estate.

Location No.3 – No.3 is located within the development to the north eastern corner of the site boundary and is in close proximity to Brookfield Green housing Estate and houses along the Captain's Road.

Location No.4 – No.4 is located within the development site to the north boundary in close proximity to the houses along the Captain's Road

Location No.5 – No.5 is located within the development site to the north-western corner of the site boundary and is in close proximity to the houses along the Captain's Road & Park Crescent Housing Estate.

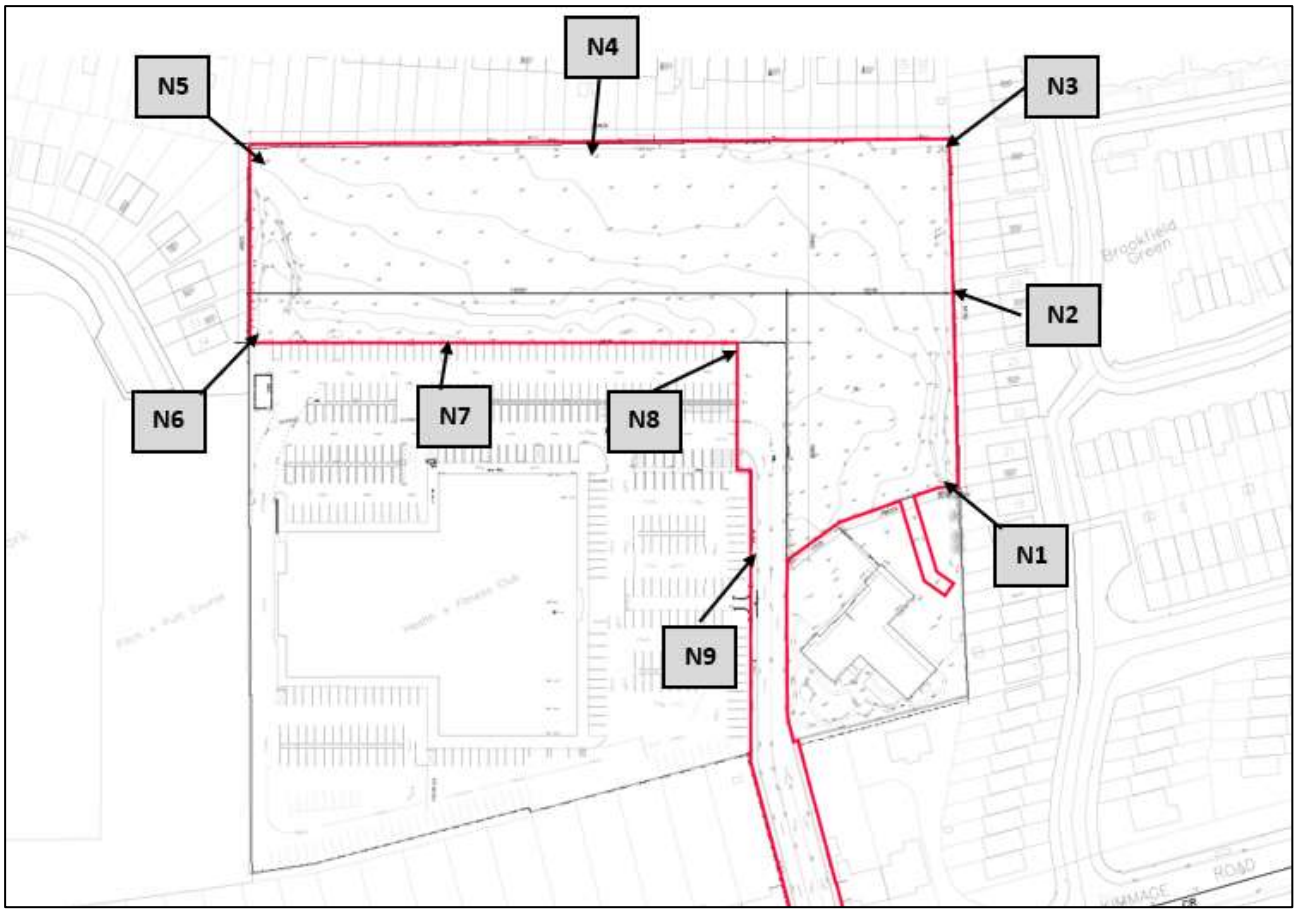
Location No.6 – No.6 is located within the development site to the west corner and in close proximity to the access road to Park Crescent Housing Estate and Ben Dunne car wash & valeting.

Location No.7 – No.7 is located within the development to the southwestern boundary of the site boundary beside Ben Dunne gym and carpark area.

Location No.8 – No.8 is located within the development site to the southwest corner and in close proximity to Ben Dunne gym and carpark area

Location No.9 - No.9 is located within the development to the south corner of the site boundary and in close proximity to Nora Dunne Gallery, Ben Dunne gym, carpark area and access road.

Figure 5: Noise Monitoring Locations



4.8. Survey Results

Nine measurement locations were selected as shown in figure 5 and the tables below.

Table 12: Noise Survey at Location No.1

Monitoring Location	Period	L_{Aeq}dB	L_{A10}dB	L_{A90}dB	L_{Amax}dB
Location No.1 (Day)	08:00 - 08:30	47	48	44	57
	08:30 - 09:00	47	48	45	54
	09:00 - 09:30	47	49	45	56
	Average	**47**	**48**	**45**	**56**
Location No.1 (Night)	11:00 – 11:30	42	44	40	55
	11:30 – 12:00	41	43	39	54
	Average	**42**	**44**	**40**	**55**

Table 13: Noise Survey at Location No.2

Monitoring Location	Period	L_{Aeq}dB	L_{A10}dB	L_{A90}dB	L_{Amax}dB
Location No.2 (Day)	08:00 - 08:30	50	55	48	66
	08:30 - 09:00	50	52	48	63
	09:00 - 09:30	51	53	48	62
	Average	**51**	**53**	**48**	**64**
Location No.2 (Night)	11:00 – 11:30	42	44	40	58
	11:30 – 12:00	40	45	38	57
	Average	**41**	**45**	**39**	**58**

Table 14: Noise Survey at Location No.3

Monitoring Location	Period	L_{Aeq}dB	L_{A10}dB	L_{A90}dB	L_{Amax}dB
Location No.3 (Day)	08:00 - 08:30	53	55	48	66
	08:30 - 09:00	50	52	48	63
	09:00 - 09:30	51	53	48	62
	Average	**51**	**53**	**48**	**64**
Location No.3 (Night)	11:00 – 11:30	47	49	45	59
	11:30 – 12:00	48	50	46	58
	Average	**48**	**50**	**46**	**59**

Table 15: Noise Survey at Location No.4

Monitoring Location	Period	L_{Aeq}dB	L_{A10}dB	L_{A90}dB	L_{Amax}dB
Location No.4 (Day)	10:30 - 11:00	50	52	47	60
	11:30 - 12:00	51	53	48	65
	12:00 - 12:30	50	53	47	61
	Average	**50**	**53**	**47**	**62**
Location No.4 (Night)	01:00 – 01:30	45	47	43	57
	01:30 – 02:00	44	46	42	56
	Average	**45**	**47**	**43**	**57**

Table 16: Noise Survey at Location No.5

Monitoring Location	Period	L_{Aeq}dB	L_{A10}dB	L_{A90}dB	L_{Amax}dB
Location No.5 (Day)	10:30 - 11:00	47	49	44	56
	11:30 - 12:00	50	52	45	63
	12:00 - 12:30	52	55	48	60
	Average	**50**	**52**	**46**	**60**
Location No.5 (Night)	01:00 – 01:30	45	46	43	58
	01:30 – 02:00	46	47	44	59
	Average	**46**	**47**	**44**	**59**

Table 17: Noise Survey at Location No.6

Monitoring Location	Period	L_{Aeq}dB	L_{A10}dB	L_{A90}dB	L_{Amax}dB
Location No.6 (Day)	10:30 - 11:00	47	49	43	60
	11:30 - 12:00	48	51	44	62
	12:00 - 12:30	50	52	45	62
	Average	**48**	**51**	**44**	**61**
Location No.6 (Night)	01:00 – 01:30	37	39	35	55
	01:30 – 02:00	38	40	36	56
	Average	**38**	**40**	**36**	**56**

Table 18: Noise Survey at Location No.7

Monitoring Location	Period	L_{Aeq}dB	L_{A10}dB	L_{A90}dB	L_{Amax}dB
Location No.7 (Day)	14:00 - 14:30	51	54	45	64
	14:30 - 15:00	48	51	46	62
	15:00 - 15:30	49	51	46	62
	Average	**49**	**52**	**46**	**63**
Location No.7 (Night)	03:00 – 03:30	39	41	37	57
	03:30 – 04:00	38	41	36	56
	Average	**39**	**41**	**37**	**57**

Table 19: Noise Survey at Location No.8

Monitoring Location	Period	L_{Aeq}dB	L_{A10}dB	L_{A90}dB	L_{Amax}dB
Location No.8 (Day)	14:00 - 14:30	50	52	46	65
	14:30 - 15:00	54	55	47	70
	15:00 - 15:30	51	53	48	66
	Average	**52**	**53**	**47**	**67**
Location No.8 (Night)	03:00 – 03:30	39	42	38	58
	03:30 – 04:00	39	41	37	57
	Average	**39**	**42**	**38**	**58**

Table 20: Noise Survey at Location No.9

Monitoring Location	Period	L_{Aeq}dB	L_{A10}dB	L_{A90}dB	L_{Amax}dB
Location No.9 (Day)	14:00 - 14:30	53	56	46	70
	14:30 - 15:00	53	57	46	70
	15:00 - 15:30	51	54	46	68
	Average	**52**	**56**	**46**	**69**
Location No.9 (Night)	03:00 – 03:30	43	45	40	60
	03:30 – 04:00	44	46	41	61
	Average	**44**	**46**	**41**	**61**

Table 21: Noise Survey Summary (Daytime)

Monitoring Location	L_{Aeq}dB	L_{A10}dB	L_{A90}dB	L_{Amax}dB
Location No.1	47	48	44	57
Location No.2	50	52	46	62
Location No.3	51	53	48	64
Location No.4	50	53	47	62
Location No.5	50	52	46	60
Location No.6	48	51	44	61
Location No.7	49	52	46	63
Location No.8	52	53	47	67
Location No.9	52	56	46	69

Table 22: Noise Survey Summary (Night Time)

Monitoring Location	L_{Aeq}dB	L_{A10}dB	L_{A90}dB	L_{Amax}dB
Location No.1	42	44	40	55
Location No.2	41	45	39	58
Location No.3	48	50	46	59
Location No.4	45	47	43	57
Location No.5	46	47	44	59
Location No.6	38	40	36	56
Location No.7	39	41	37	57
Location No.8	39	42	38	58
Location No.9	44	46	41	61

The noise climate at the site is dominated by road traffic noise from Kimmage Road west to the south and Captain Road to the north of the site. The access road to Ben Dunne Gym and the car park is also a contributing noise across the site. Background noise from the Ben Dunne Gym and Carlisle car wash & valeting was also noise source at locations N6 & N7. During the survey traffic flow on the Kimmage Road west and Captain Road noted as not being continuous but frequent.

5.0 CONSTRUCTION PHASE

The potential noise impacts associated with the construction of the proposed development are discussed in the following sections.

5.1 Noise

5.1.1 Noise Sensitive locations

A review of the noise survey and the threshold values detailed in Table 3 indicates that the daytime noise guidance limit for construction noise ranges from 65-75dB L_{Aeq}. It is assumed that construction and some minor demolition works will be undertaken between 07:00-19:00 Monday to Friday, 08:00-14:00 on Saturdays, with no working on Sundays or bank holidays. However, where emergency work is required, out of hours work will be subject to approval from DCC. During the construction phase of the proposed development, a variety of items of plant will be in use, such as excavators, dumper trucks, compressors, and generators.

Noise levels experienced by noise sensitive locations (NSLs) during such works depend upon a number of variables, the most significant of which are:

- The noise generated by plant or equipment used on Site, expressed as Sound Power Levels (Lw) or the vibration generated by the plant;
- The periods of use of the plant on Site, known as its on-time;
- The distance between the noise/ vibration source and the NSL;
- The noise attenuation due to ground absorption, air absorption and barrier effects;
- In some instances, the reflection of noise due to the presence of hard surfaces such as the sides of buildings; and
- The time of day or night the works are undertaken.

The closest NSLs have been identified as shown in Figure 6 and described below in Table 23. Table 23 also shows the L_{Aeq} at these locations. Figure 5 details the locations from the nearest façade of the neighbouring building to the proposed development.

Table 23: Description of NSLs and Noise Levels

Noise Sensitive Locations	Description	L_{Aeq}dB
Location NSL1	This represents the residential dwellings in Brookfield Green House Estate located to the east of the proposed site approximately 15m from the nearest significant site work.	49
Location NSL2	This represents the nearest residential dwelling located along Captains Road to the south of the proposed site approximately 22m from the potential nearest significant site work.	51
Location NSL3	This represents the 27-30 Park Cres located to the east of the proposed site approximately 23m from the nearest significant site work.	51
Location NSL4	This represents 31-34 Park Cres located to the east of the proposed site approximately 16m from the nearest significant site work.	50
Location NSL5	This represents a Ben Dunne Gym to the south of the proposed site approximately 33m from the nearest significant site works.	53
Location NSL6	This represents a Nora Dunne Gallery (not in use) to the south of the proposed site approximately 21m from the nearest significant site works.	52

Figure 6: Site Context & Noise Assessment Locations (Image Source: Bing Maps)

Table 24 sets out the BS 5228 'ABC' noise threshold categories at each NSL.

Table 24: Construction Phases L_{Aeq},T noise levels and associated 'ABC' assessment category At Each NSL

NSL	General Construction Phase Survey L_{Aeq}dB	ABC Category	Construction Noise Limit L_{Aeq},T dB
1	77	C	75
2	73	C	75
3	73	C	75
4	76	C	75
5	70	B	70
6	74	C	75

5.1.2 Predicted Construction Noise Levels

Predicted noise levels for construction of the Proposed Development have been based upon construction methods used for other similar developments. As a conservative approach, it is assumed that all plant and activities will be taking place at the closest approach to each NSLs, whereas in reality this will not always be the case and, in any event, activities are unlikely to occur for any significant duration. It is possible to predict typical noise levels using guidance set out in BS 5228-1:2009+A1:2014. Table 25 outlines typical plant items and associated noise levels that are anticipated for various phases of the construction.

Table 25: Predicted Noise Levels from Key Pieces of Equipment

Activity	Item of Plant (BS5228 Ref)	Noise level at 10m Distance (dB $L_{Aeq\ (1hour)}$)
Site Preparation	Wheeled Loader Lorry (D3 1)	75
	Track Excavator (C2 22)	72
	Dozer (C2.13)	78
	Dump Truck (C4.2)	78
	Cumulative Site Preparation	82
General Construction	Dump Truck (C2.30)	79
	Tracked excavator (02.21)	71
	Compressor (D7.08)	70
	Telescopic Handler (C4.54)	79
	Hand Held Circular Saw (C4.72)	79
	Diesel Generator (C4.76)	61
	Internal Fit out	70
	Cumulative General Construction	84
Road Works/Landscaping	Asphalt Paver & Tipping Lorry (C5.30)	75
	Electric Water Pump (C5.40)	68
	Vibratory Roller (C5.20)	75
	Cumulative General Landscaping and Road Work	78

The calculations also assume that the equipment will operate for 66% of the 12-hour working day (i.e., 8 hours). It is assumed that construction works will take place during normal working hours only.

Predicted Noise Level at Various Locations

Table 26 below presents the predicted daytime noise levels from an indicative construction period at the NSLs.

Table 26: Indicative Construction Noise Levels at Nearest Noise Sensitive Locations

Construction Phase	Item of Plant (BS5228-1 Ref)	L_{Aeq} at distance (m)					
		NSL1	NSL2	NSL3	NSL4	NSL5	NSL6
		15m	22m	23m	16m	33m	21m
		dB	dB	dB	dB	dB	dB
Site Preparation	Wheeled Loader Lorry (D3 1)	68	64	64	67	61	65
	Track Excavator (C2 22)	65	61	61	64	58	62
	Dozer (C2.13)	71	67	67	70	64	68
	Dump Truck (C4.2)	71	67	67	70	64	68
	Cumulative Site Preparation	**75**	**71**	**71**	**74**	**68**	**72**
General Construction	Dump Truck (C2.30)	72	68	68	71	65	69
	Tracked excavator (02.21)	64	60	60	63	57	61
	Compressor (D7.08)	63	59	59	62	56	60
	Telescopic Handler (C4.54)	72	68	68	71	65	69
	Hand Held Circular Saw (C4.72)	72	68	68	71	65	69
	Diesel Generator (C4.76)	54	50	50	53	47	51
	Internal Fit out	63	59	59	62	56	60
	Cumulative General Construction	**77**	**73**	**73**	**76**	**70**	**74**
Road Works/ Landscaping	Asphalt Paver & Tipping Lorry (C5.30)	68	64	64	67	61	65
	Electric Water Pump (C5.40)	61	57	57	60	54	58
	Vibratory Roller (C5.20)	68	64	64	67	61	65
	Cumulative General Landscaping and Road Work	**71**	**67**	**67**	**70**	**64**	**68**

A comparison of the predicted noise levels at NSLs with the BS 5228 ABC threshold values is provided in Table 27.

Table 27: Predicted construction noise level above threshold value.

NSL	Limits	Construction Phases		
		Cumulative Site Preparation	Cumulative General Construction	Cumulative General Landscaping & Roadwork
1	Construction Limit	75	77	71
	Level above limit	0	+2	-4
	Magnitude of Impact	Low	Medium	Low
2	Construction Limit	71	73	67
	Level above limit	-4	-2	-8
	Magnitude of Impact	Low	Low	Low
3	Construction Limit	71	73	67
	Level above limit	-4	-2	-8
	Magnitude of Impact	Low	Low	Low
4	Construction Limit	74	76	70
	Level above limit	-1	+1	-5
	Magnitude of Impact	Low	Low	Low
5	Construction Limit	68	70	64
	Level above limit	-2	0	-6
	Magnitude of Impact	Low	Low	Low
6	Construction Limit	72	74	68
	Level above limit	-3	-1	-7
	Magnitude of Impact	Low	Low	Low

The effects of the predicted daytime construction noise levels on NSLs have been classified by considering the daytime ABC noise threshold values.

At NSL1(residential), predicted noise levels exceed the TII limit of 75 dB LAeq during general construction and road works/landscaping phases, with the highest-level during cumulative general construction (77 dB LAeq). Using the ABC method in BS 5228, the magnitude of impact during activities is either negligible or medium resulting in a significance of effect of negligible or moderate.

At NSL2 (residential), predicted noise levels during all the construction phases fall below the TII limit of 75 dB LAeq. Using the ABC method in BS 5228, the magnitude of impact during activities is either negligible or low, resulting in a significance of effect of negligible or slight (not significant).

At NSL3 (residential), predicted noise levels did not exceed the TII limit of 75 dB L_{Aeq} during all construction phases, Using the ABC method in BS 5228, the magnitude of impact during activities is either negligible or low, resulting in a significance of effect of negligible or slight (not significant).

At NSL4 (residential), predicted noise levels exceed the TII limit of 75 dB L_{Aeq} during general construction phase only, with a level of 76 dB L_{Aeq}. Using the ABC method in BS 5228, the magnitude of impact during the majority of activities is Medium, resulting in a significance of effect of slight (not significant).

At NSL5 (Gym), predicted noise levels did not exceed the TII limit of 70 dB LAeq during all the construction phases. Using the ABC method in BS 5228, the magnitude of impact during activities is either negligible or low, resulting in a significance of effect of negligible or slight (not significant).

At NSL6 (Gallery (not in use)), predicted noise levels during all the construction phases fall below the TII limit of 75 dB L_{Aeq}. Using the ABC method in BS 5228, the magnitude of impact during activities is either negligible or low, resulting in a significance of effect of negligible or slight (not significant).

5.2 Vibration

The main potential source of vibration during the construction phase is associated with ground-breaking activities. During any rock breaking within the site, there is the potential for vibration to be generated through the ground. Empirical data for this activity is not provided in the BS 5228-2 standard, however the likely levels of vibration from this activity is expected to be significantly below the lower adopted criteria for building damage on experience from other sites.

6.0 OPERATIONAL PHASE

The potential noise impacts associated with the operational phase of the proposed development are discussed in the following sections.

6.1 Noise

There are four primary potential sources of noise associated with the development once operational these are:

- Additional vehicular traffic on public roads.
- Inward Noise Impact.
- Mechanical plant noise.
- Residential.

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

Note there is no significant source of vibration associated with the operational phase of the proposed development.

6.2 Additional Traffic on Adjacent Roads

During the operational phase of the proposed development, there will be a slight increase in vehicular traffic associated with the site on some surrounding roads.

A traffic impact assessment relating to the proposed development has been prepared.

With reference to traffic impact assessment, the predicted change in noise level associated with additional traffic accessing the proposed development, for the existing road network, has a negligible effect.

6.3 Inward Noise Impact

An assessment of the inward noise impact from road traffic sources has been carried out. In summary the noise levels across the site ranges from negligible to low noise risk in accordance with the guidance in ProPG.

6.4 Mechanical Plant

It is expected that the principal items of building and mechanical plant noise will be associated with the proposed development. These items will be selected at a later stage, however, they will be designed and located so that there is no negative impact on sensitive receivers within the development itself. 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 2.0.

6.5 Residential

The noise impact of the residential aspect of the development on the receiving environment will be slight. It will be limited to internal vehicle movements entering and exiting the undercroft carpark and residents using the public open space.

7.0 MITIGATION MEASURES

The mitigation measures associated with the construction & operational phases of the proposed development are discussed in the following sections.

7.1 Operational Mitigation Measures

Noise mitigation at the receiver can be achieved by either installing a fence on the property or by upgrading the façade/glazing and ventilation of a building to provide a greater degree of noise reduction to internal areas. In order to determine internal noise levels within the proposed site a review of the external noise levels, internal noise levels and building elements have been undertaken as set out below.

7.1.1 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. Glazing Type 1 offers a minimum sound insulation performance of 36dB Rw. A standard thermal double-glazed system will typically achieve this level of performance. Type 2 provides an enhanced sound insulation performance of 41dB Rw.

On review of the calculated noise levels across the development site over day and night-time periods, one glazing specifications have been determined for the residential properties in order to achieve the recommended internal noise levels for day and night-time periods within living rooms and bedrooms.

Site Layout Drawings in Appendix C show the recommended location of glazing types proposed. It is proposed that Standard glazing (Type 1) will be used on all facades of the proposed development.

Table 28: Below sets out the required sound insulation performance per octave band for the glazing specification.

Glazing Specification	Octave Band Centre Frequency (Hz)						Overall Rw
	125	250	500	1k	2k	4k	
Type 1	22	27	34	38	41	39	**36**
Type 2	29	35	41	40	39	57	**41**

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.

7.1.2 Ventilation

The ventilation strategy for the development will be in accordance with Part F of Building Regulations and will be finalised at the detailed design stage. Following a detailed noise model, by addressing the L_{Aeq} in bedrooms, the required glazing and ventilation specification is sufficient to address the noise levels from noise sources. Please refer to Appendix D.

For glazing Type 1, any installed window or wall ventilation will be required to achieve a minimum $D_{n,e,w}$ rating value of 36dB.

7.1.3 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 50dB Rw for this construction.

The predicted daytime noise levels at the open spaces of the development once built is currently modelled between 46– 50 dB L_{Aeq} and as such would achieve the Local Authority's daytime noise criteria in external amenity spaces.

Mitigating against noise from the access road, Ben Dunne Gym car park and neighbouring roads has formed an integral part of the design process from the early master planning stages. This exercise established that the most appropriate and beneficial form of mitigation is the positioning of the buildings facing the Ben Dunne Gym car park to function as a barrier. An extensive boundary treatment proposal is proposed as part of the development.

The existing approx. 1.8m – 2.5m high wall from finished ground level along the north, northwest and northeast boundary of the site is also included within the scheme design to provide localised screening along the site boundaries.

The location of the wall is presented in Appendix D.

7.1.4 Calculated Internal Noise Levels

Taking account of the external noise levels, the surface area of the glazing and walls, and the relevant receiving room volumes, the calculated internal noise levels are below 35dB $L_{Aeq,16hr}$ for daytime periods and 30dB $L_{Aeq,8hr}$ night-time within bedrooms. This glazing specification also achieves the internal daytime noise criterion for daytime periods within dining room/area of 40dB L_{Aeq}

7.2 Construction Mitigation Measures

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 impacts are expected to vary during the construction phase depending on the distance between the activities and noise sensitive locations, the contractor will ensure that all best practice noise control methods will be used, as necessary in order to ensure impacts at off-site noise sensitive locations

are minimised. The best practice measures set out in BS 5228 (2009) Parts 1 and 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.
- Liaison with the public
- Monitoring

A detailed comment is offered on these items in the following paragraphs. Noise control measures that will be considered include the selection of quiet plant, enclosures, and screens around noise sources, limiting the hours of work and noise and vibration monitoring, where required.

7.2.1 Selection of Quiet Plant

This practice is recommended in relation to static plant such as compressors and generators. It is recommended that these units be supplied with manufacturers' proprietary acoustic enclosures. The potential for any item of plant to generate noise will be assessed prior to the item being brought onto the site. The least noisy item should be selected wherever possible. Should a particular item of plant already on the site be found to generate high noise levels, the first action should be to identify whether or not said item can be replaced with a quieter alternative.

7.2.2 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 can 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 should be considered:

- Site compounds will be more than 30m from noise sensitive receptors within the site constraints. The use lifting bulky items, dropping, and loading of materials within these areas should be restricted to normal working hours.
- For mobile plant items such as dump trucks, excavators and loaders, the installation of an acoustic exhaust and/or maintaining enclosure panels closed during operation can reduce noise levels by up to 10dB. Mobile plant should be switched off when not in use and not left idling.
- 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. For concrete mixers, control measures should 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.
- For compressors, generators, and pumps, these can be surrounded by acoustic lagging or enclosed with in acoustic enclosures providing air ventilation.
- Demountable enclosures can also be used to screen operatives using hand tools and will be moved around site, as necessary.
- All items of plant should 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.

7.2.3 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. Construction site hoarding will be constructed around the site boundaries as standard. The hoarding will be constructed of a material to reduce noise by 20dB along the northwest, north, northeast & beside Nora Dunne Gallery of the site and by 15db in the other areas. Appendix E shows locations and type of hoarding required. This will ensure guidance limit for construction noise at nearest noise sensitive location is followed and potential impacts relating to noise nuisance and disturbance and vibration impacts are effectively minimised and controlled.

7.2.4 Liaison with the Public

A designated liaison officer(s) will be appointed to site during construction works. Any noise complaints should 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.

The Liaison officer(s) will also take notes of the following during complaint logging:

- Maintenance of a site complaints log detailing
- Name and address of complainant
- Time and date complaint was made.
- Date, time, and duration of noise
- Characteristics, such as rumble, clatters, intermittent, etc.

- Probable cause or source of noise
- Weather conditions, such as wind speed and direction
- Investigative and follow -up actions.
- Response to complainant

The Liaison officer(s) will also:

- Liaison with Local Community and Businesses
- Appointment of a Liaison Officer as a single point of contact to engage with the community and respond to concerns.
- Keeping residents informed of progress and timing of construction activities that may impact on them.

7.2.5 Monitoring

It is recommended that monthly noise and vibration monitoring surveys be carried along the boundary of the proposed site in order to monitor the effectiveness of noise and vibration management for the duration of the construction phase. Noise and vibration levels at Noise Sensitive Locations should not exceed the construction phase noise and vibration limit criteria. Any breaches of these limits will require a review of operations and mitigation measures if the exceedance is due to the construction works on site.

In order to effectively manage noise and vibration at residential dwelling located approximately 4m east of the proposed site, installation of continuous data logging live noise and vibration monitoring system is required. This software will require remote login, data download and text/email alert functionality. It will measure key noise and vibration parameters (e.g., LAeq, LAFMAX, LA90, LA10, PPV(mm/sec) and Frequencies as Hz.

Noise monitoring should be conducted in accordance with the International Standard ISO 1996: 2017: Acoustics - Description, measurement, and assessment of environmental noise.

7.2.6 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 or when 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 be phased so as to prevent unacceptable disturbance at any time.

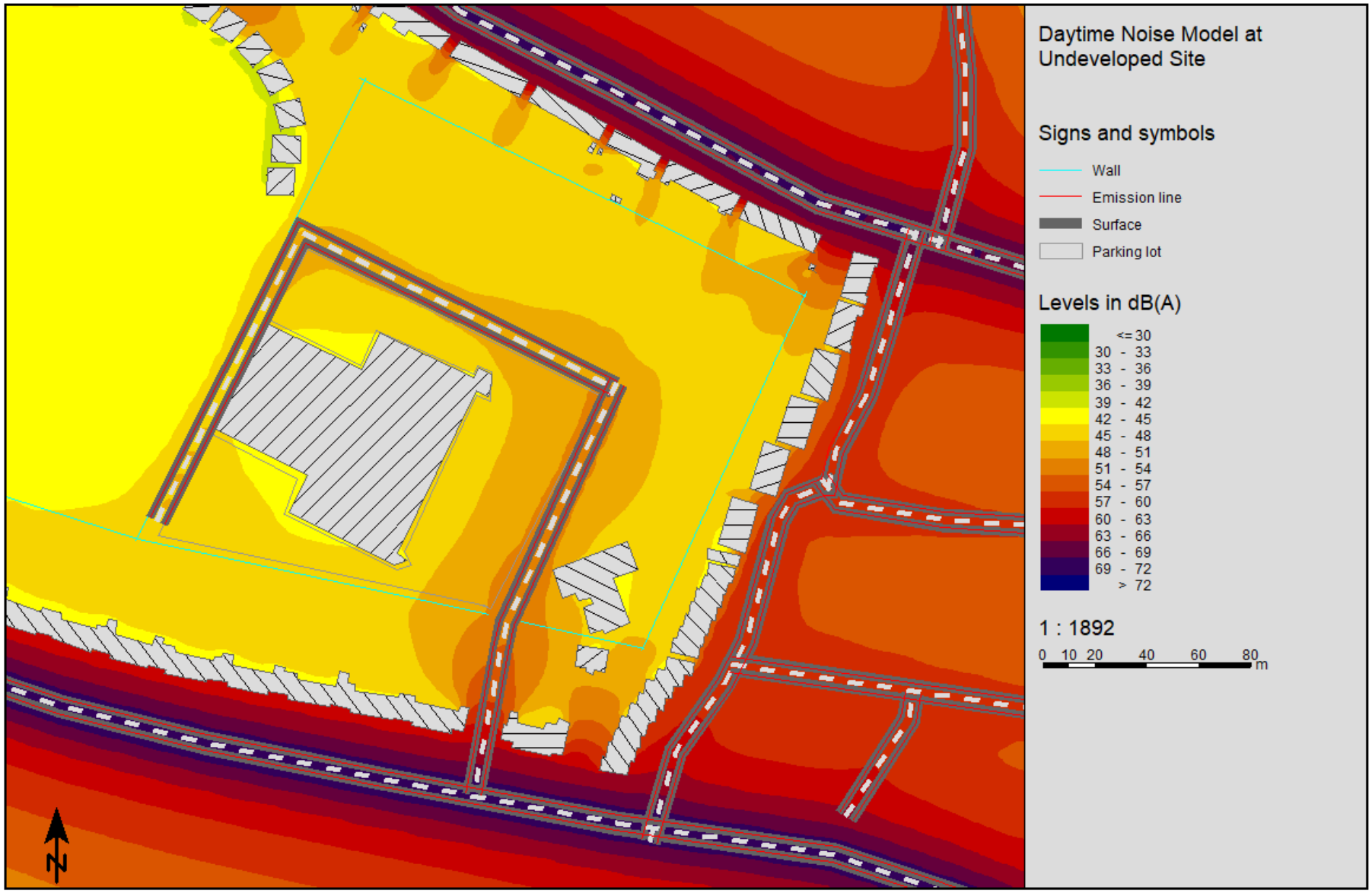
8.0 CONCLUSIONS

- The noise impact of the construction and operational phase of the proposed development has been assessed.
- During the construction phase noise is predicted while works are taking place in proximity to the nearest NSL's. Mitigation measures have been recommended so that any negative impact may be reduced, it is not expected that a negative impact will occur on existing noise sensitive locations.
- With respect to inward noise impact, to ensure that the noise climate within the residential units is appropriate, the following internal noise criteria are proposed:
    - Daytime in living areas – 35 dB L_{Aeq},16hr; and,
    - Night-time in bedrooms – 30 dB L_{Aeq},8hr.
- The measured noise levels across the site have been used to calculate noise levels at all facades of the proposed development and to predict the internal noise levels within living room and bedroom spaces, taking account of the proposed building envelope and conditions in the receiving rooms (e.g., volumes and room acoustic characteristics).
- It is predicted that the amenity spaces will experience noise levels of the order ≤55dB L_{Aeq},16hr in line with the recommended noise levels.
- Using guidance outlined in the current Dublin Agglomeration Environmental Noise Action Plan (Volume 2) December 2018 – July 2023, British Standard B5 8233 (2014), WHO Community Noise (1999) and ProPG (2017) an inward noise impact assessment inclusive of noise modelling has been undertaken at the proposed development site.
- The results of the assessment have concluded that during daytime and night-time periods, internal noise levels are calculated to be within acceptable levels for bedroom, living and dining areas, taking account of the proposed glazing and ventilation strategy recommended for the development.
- The assessment has recommended a Type 1 glazing on all façades.
- Standard ventilation strategy is recommended for all the development.
- With the implementation of the recommendations included in the report, it is considered that a suitable level of protection against noise will be provided to the occupants of the proposed development.
- Considering that sensitive receivers within the development are much closer than off-site sensitive receivers, once the relevant noise criteria is achieved within the development it is expected that there will be no negative impact at sensitive receivers off site, and therefore no further mitigation required.

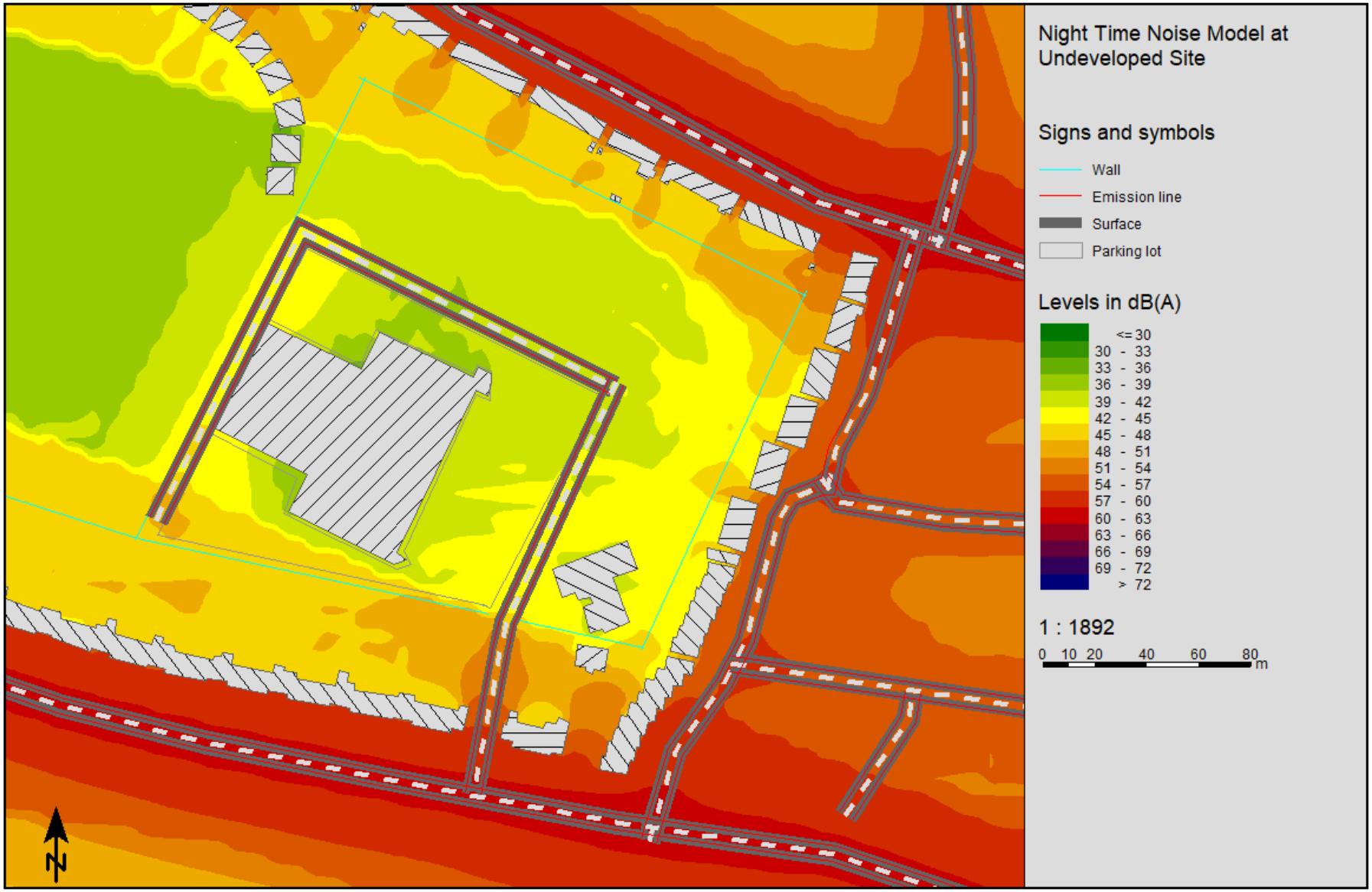
ENVIRONMENTAL NOISE ASSESSMENT
LARGE SCALE RESIDENTIAL DEVELOPMENT
COMPLETED BY
TRAYNOR ENVIRONMENTAL LTD

APPENDIX A – NOISE MODEL - NOISE AT UNDEVELOPED SITE

Noise Model of Daytime L_{Aeq} at the Undeveloped Site



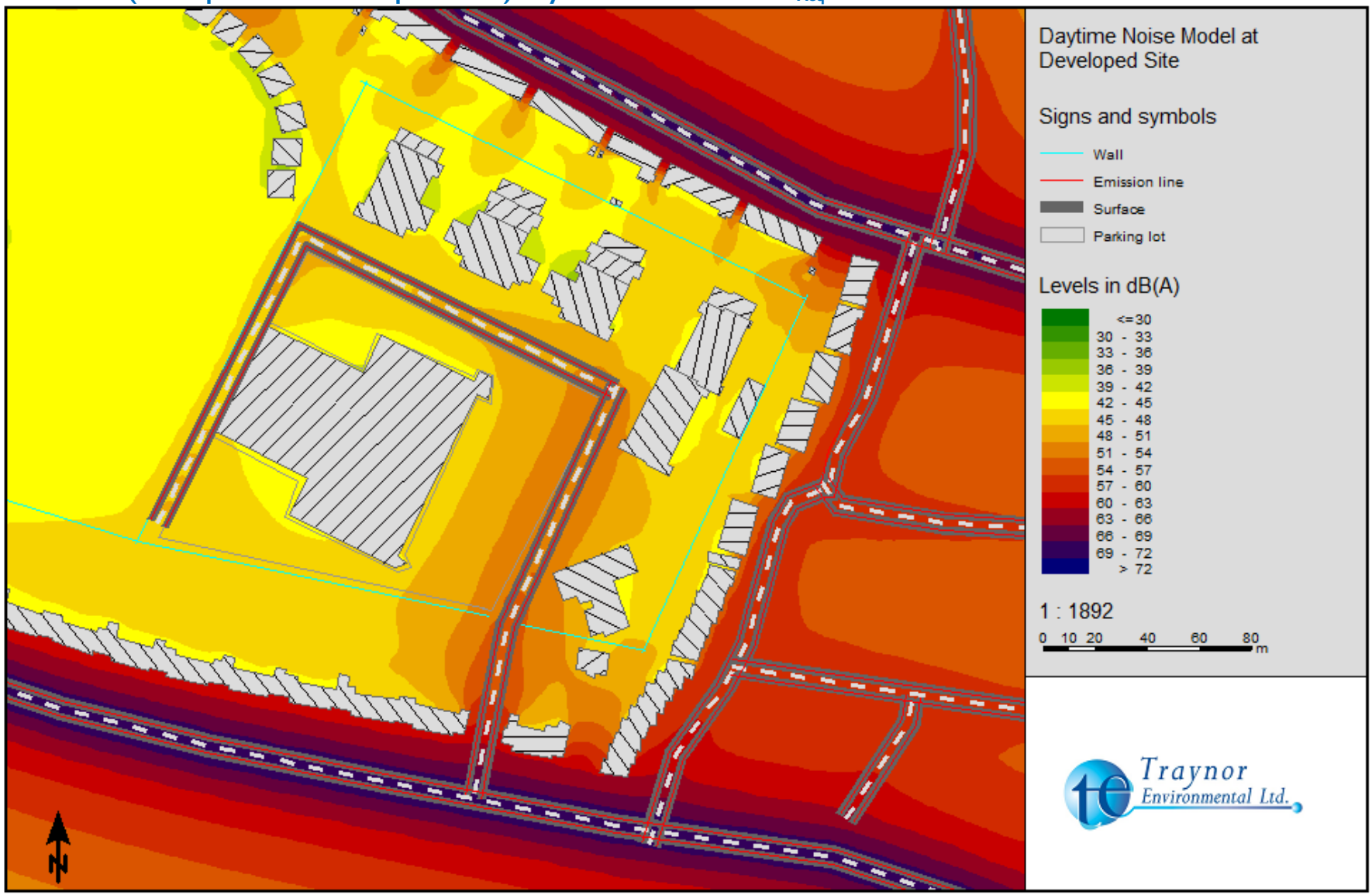
Noise Model of Night-time L_{Aeq} at the Undeveloped Site



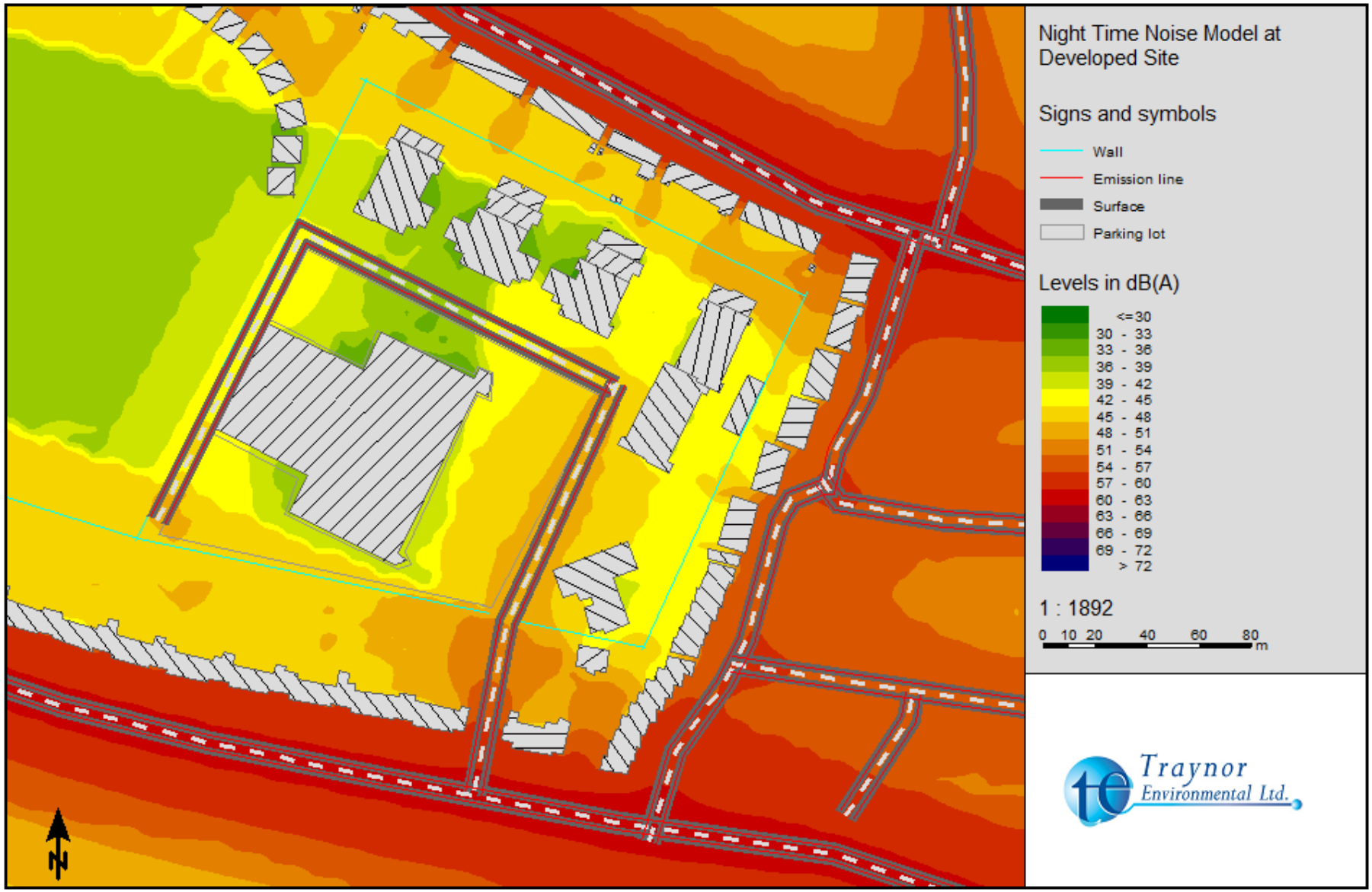
ENVIRONMENTAL NOISE ASSESSMENT
LARGE SCALE RESIDENTIAL DEVELOPMENT
COMPLETED BY
TRAYNOR ENVIRONMENTAL LTD

APPENDIX B – NOISE MODEL PREDICTED - BUILDINGS CONSTRUCTED AND OPERATING

Predicted (development built and operational) Daytime Noise Model of L_{Aeq} at the site.



Predicted (development built and operational) Noise Model of L_{Aeq} at the site. (Night-time)



ENVIRONMENTAL NOISE ASSESSMENT
LARGE SCALE RESIDENTIAL DEVELOPMENT
COMPLETED BY
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APPENDIX C –GLAZING TYPE

Traynor Environmental Ltd.

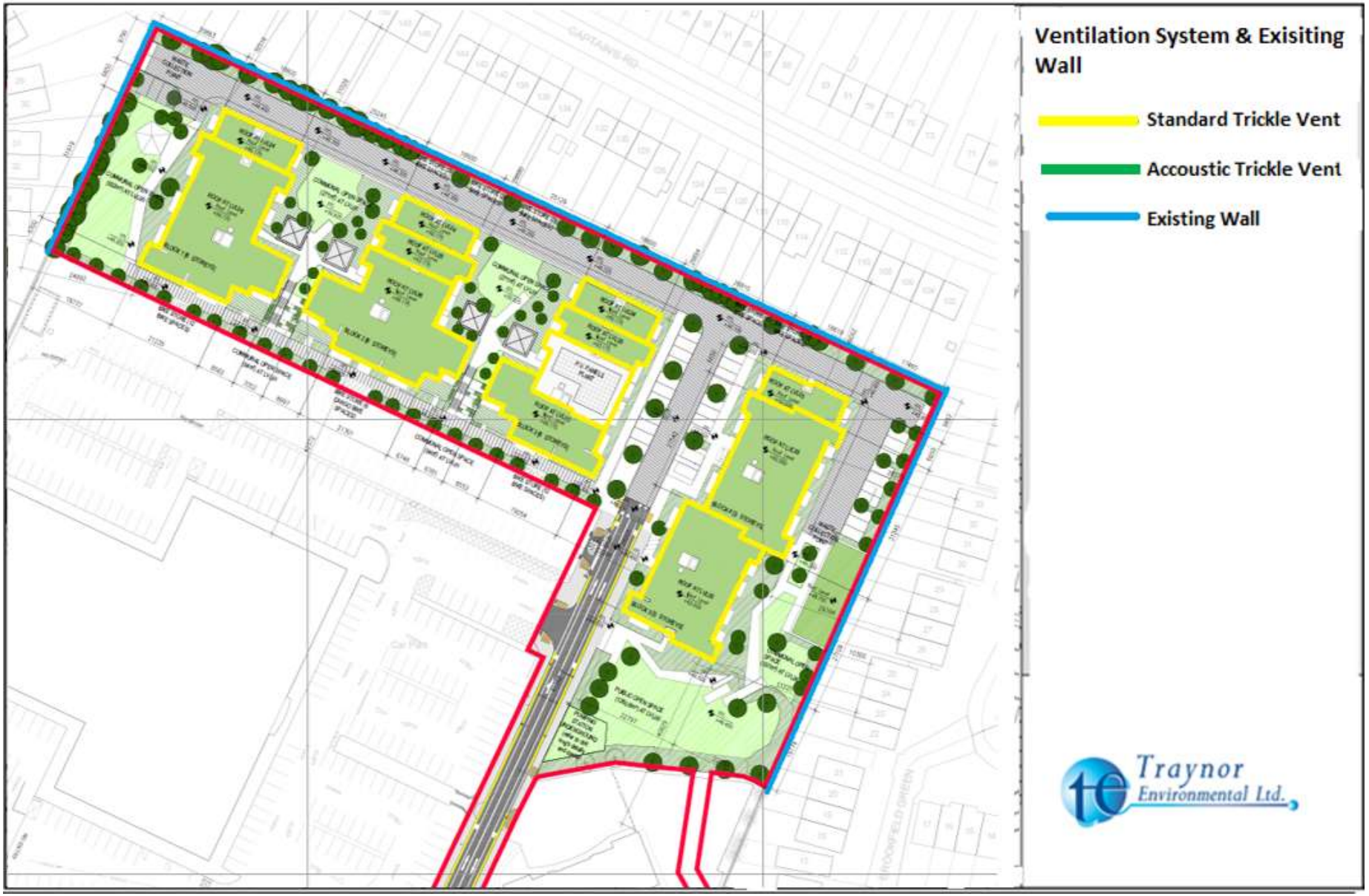
Location of Proposed Glazing Type 1, Type 2 for the Development.

ENVIRONMENTAL NOISE ASSESSMENT
LARGE SCALE RESIDENTIAL DEVELOPMENT
COMPLETED BY
TRAYNOR ENVIRONMENTAL LTD

APPENDIX D –VENTILATION SYSTEM & EXISTING APPROX. 1.8M -2.5M HIGH WALL

Traynor Environmental Ltd.

Location of proposed Ventilation System and Existing Wall



ENVIRONMENTAL NOISE ASSESSMENT
LARGE SCALE RESIDENTIAL DEVELOPMENT
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APPENDIX E – LOCATIONS AND TYPE OF HOARDING REQUIRED

Traynor Environmental Ltd.


20dB Reduction Hoarding
15dB Reduction Hoarding

ENVIRONMENTAL NOISE ASSESSMENT
LARGE SCALE RESIDENTIAL DEVELOPMENT
COMPLETED BY
TRAYNOR ENVIRONMENTAL LTD

APPENDIX F – NOISE METER CALIBRATION CERTIFICATES OF CALIBRATION

Traynor Environmental Ltd.

Certificate of Calibration

Certificate Number: 36038

Measurement Microphone
Half-Inch diameter – Free-Field, 0 degree incidence response

Client: Traynor Environmental

Instrument Make: Larson Davis
Instrument Model: 377B02
Serial Number: 325451

Sensitivity is calculated by the Insert Voltage method. The frequency response calibration is one of three independent measurements of the pressure response of the Object Microphone obtained by the Electrostatic Actuator measurement method. Microphone Capacitance is the polarised capacitance of the test microphone measured on a capacitance bridge relative to a reference microphone.

The frequency response, capacitance, and sensitivity of the microphone are shown graphically on Page 2

Uncertainties of these measurements are:

31.5 Hz to 4kHz	0.41 dB (k = 2.04)
5kHz to 10 kHz	0.87 dB (k = 2.17)
12.5 kHz to 40 kHz	1.81 dB (k = 2.17)
Sensitivity at 250Hz	0.16 dB (k = 2.0)

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k (as above) to provide a level of confidence of approximately 95%. The uncertainty evaluation has been calculated in accordance with UKAS publication M 3003 (December 1997).

Measurement Conditions:

Polarisation Voltage	0V +/- 0.5V
Temperature	23.5 °C
Atmospheric Pressure	1015.8 mBar **
Relative Humidity	56.9 %

** Note that the computer-produced Certificate shows a Pressure of 1041.3 mbar - this is in error. The above measurement is traceable

Test Equipment:

Equipment	Manufacturer	Model	Serial No.	Traceability Ref.	Cal. Due
Condenser Microphone	Larson Davis	2541	7300	TE 157	November 2021
Acoustic Calibrator 250Hz	Larson Davis	CA250	2807	TE 104	November 2023
Real-Time Frequency Analyser	Larson Davis	2900	0492	TE 108	July 2021
Signal Generator	Hewlett Packard	33120A	US36016577	TE 111	August 2021
Digital Multimeter	Hewlett Packard	34401A	3146A63804	TE 105	August 2021

Date of Receipt : 28th June 2021
Date of Calibration : 1st July 2021
Date of Certificate: 1st July 2021

Authorised Signatory: .....

Tony Sherris

MTS Calibration Ltd
Company Registration Number: 06588525 England and Wales
The Grange Business Centre, Belasis Avenue, Billingham TS23 1LG, England

Telephone: 0044 1642 876410 Fax: 0044 1642 876411 E-Mail: dmarsh@slmcal.co.uk or tsherris@slmcal.co.uk
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MTS Calibration Ltd,
The Grange Business Centre,
Belasis Avenue,
Billingham TS23 1LG,
England
Telephone: 01642 876 410

CERTIFICATE OF CALIBRATION

Approved Signatory:

Tony Sherris

Issued by: MTS Calibration Ltd

Date of Issue: 02 July 2021 **Certificate Number:** 36030

Sound Level Meter

Sound Level Meter Periodic Tests to EN 61672-3: 2013 Class 1

Client: Traynor Environmental

Instrument Make: Larson Davis
Instrument Model: LxT1L
Serial Number: 0005901

Associated Equipment	Make	Model	Serial number
Preamplifier	Larson Davis	PRMLxT1L	055773
Microphone	PCB	377B02	325451
Calibrator	Larson Davis	CAL200	9175
Calibrator supplied by	MTS for this calibration		

Test results summary, detailed results are shown on subsequent pages.

Periodic tests were performed in accordance with procedures from IEC 61672-3:2013 Class 1

Tests performed	Section	Results of test	Page	Comments
Calibration Certificate	22		1	
Additional information			2	
Indication with Calibrator Supplied	10	No Limit	3	
Self-Generated Noise	11	No Limit	3	
Frequency and Time-weightings at 1kHz	14	Complies	3	
Long term stability	15	Complies	3	
High stability	21	Complies	3	
Acoustic Tests	12	Complies	4	
Frequency Weighting A	13	Complies	5	
Frequency Weighting C	13	Complies	6	
Frequency Weighting Z	13	Complies	7	
Level Linearity	16	Complies	8	
Level Linearity Range Control	17		n/a	SLM only has one range
Tone-burst Response	18	Complies	9	
Peak C sound level	19	Complies	10	
Overload indication	20	Complies	11	

The instrument was within the above specification as received - no modifications were made

The sound level meter submitted for testing has successfully completed the periodic tests of IEC 61672-3: 2013 for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2: 2013, to demonstrate that the model of sound level meter fully conformed to the Class 1 specifications in IEC 61672-1: 2013, the sound level meter submitted for testing conforms to the Class 1 specifications of IEC 61672-1: 2013

Additional tests performed	Reference	
Microphone full frequency response	36038	See additional certificate
Filter calibration, third octave or octave	36030F	See additional certificate

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Telephone: 01642 876 410

CERTIFICATE OF CALIBRATION

Approved Signatory:

Tony Sherris

Issued by: MTS Calibration Ltd

Date of Issue: 02 July 2021 Certificate Number: 36030F

Third Octave Band Filter

Third-Octave Band Filter verification to BS EN 61260:1996

Client: Traynor Environmental

Instrument Make: Larson Davis
Instrument Model: LxT1
Serial Number: 0005901

Associated Sound Level Meter

Instrument Make:	Larson Davis
Instrument Model:	LxT1
Serial Number:	0005901
Calibrated by:	MTS Calibration
Certificate Number:	36030
Date of SLM calibration	02 July 2021
Date of receipt	28 June 2021

Associated Preamplifier

Instrument Make:	Larson Davis
Instrument Model:	PRMLxT1L
Serial Number:	055773

Test results summary. Detailed results are shown on subsequent pages.

Third-Octave Band Filter Compliance with BS EN 61260: 1996 Class 1

		Comments
- Tabular Data		See Page 2
- Graphic Data for 125Hz filter	Complies	See Page 3
- Graphic Data for 1kHz filter	Complies	See Page 3
- Graphic Data for 8kHz filter	Complies	See Page 3

Because each digital filter will have the same amplitude characteristic relative to its centre frequency, only three filters were measured at each of the test frequencies specified by BS EN 61260:1996 for exact base 10 distribution. The measurements made were relative to the attenuation of the 1kHz filter at 1kHz input frequency and input level V. Because the measurements include a linearity contribution from the sound level meter, and could be variable with frequency, the assessment is valid only for this pairing. The sound level meter was set for "Linear" frequency response on the lowest range setting which did not give overload at any test frequency or test level. Its compliance with the standard was assessed by referring the measurements to the tolerances specified.

Agreed and reported Decision Rule:

"Complies" indicates that the instrument conforms with the relevant accuracy requirements of the testing standard AND the expanded measurement uncertainty (k = 2 for approximately 95 % coverage probability) is no greater in magnitude than the accuracy requirements defined in BS EN 61260:1996.

Comments

The sound level meter and preamplifier were calibrated as a unit.
The input level used is selected to produce a sound level at 1kHz that is close to but not exceeding the maximum level on the reference range.
The centre frequency sequence of this filter set follows the exact base 10 midband frequency sequence of IEC 61260 and the measurements have been made accordingly.

Measurement Conditions:			
Temperature	21.9	°C	± 1 °C
Atmospheric Pressure	1014.6	mBar	± 2 mBar
Relative Humidity	39.0	%	± 5 %

Uncertainties of measurements:		
Within Passband (0.89 to 1.12 of centre frequency)	0.42	dB
Outside Passband	2.46	dB

Test Equipment:

Equipment	Manufacturer	Model	Serial No.	Traceability Ref.	Cal. Due
Signal Generator (ser 2)	HP	33120A	US34007159	TE 183	Oct-21

Certificate of Calibration

MTS Calibration

Certificate Number: 34694

Measurement Microphone
Half-Inch diameter – Free-Field, 0 degree incidence response

Client: Environmental Measurements
Unit 12, Tallaght Business Centre
Whitestown Business Park
Co.Dublin 24, Ireland

Instrument Make: **Larson Davis**
Instrument Model: **377B02**
Serial Number: **302020**

Sensitivity is calculated by the Insert Voltage method. The frequency response calibration is one of three independent measurements of the pressure response of the Object Microphone obtained by the Electrostatic Actuator measurement method. Microphone Capacitance is the polarised capacitance of the test microphone measured on a capacitance bridge relative to a reference microphone.

The frequency response, capacitance, and sensitivity of the microphone are shown graphically on Page 2

Uncertainties of these measurements are:

31.5 Hz to 4kHz	0.41 dB (k = 2.04)
5kHz to 10 kHz	0.87 dB (k = 2.17)
12.5 kHz to 40 kHz	1.81 dB (k = 2.17)
Sensitivity at 250Hz	0.16 dB (k = 2.0)

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k (as above) to provide a level of confidence of approximately 95%. The uncertainty evaluation has been calculated in accordance with UKAS publication M 3003 (December 1997).

Measurement Conditions:

Polarisation Voltage	**0V +/- 0.5V**
Temperature	**22.7 °C**
Atmospheric Pressure	**1018.0 mBar ****
Relative Humidity	**55.5 %**

**** Note that the computer-produced Certificate shows a Pressure of 1043.5 mbar - this is in error. The above measurement is traceable**

Test Equipment:

Equipment	Manufacturer	Model	Serial No.	Traceability Ref.	Cal. Due
Condenser Microphone	Larson Davis	2541	4295	TE 102	November 2020
Acoustic Calibrator 250Hz	Larson Davis	CAL250	4483	TE 116	October 2021
Real-Time Frequency Analyser	Larson Davis	2900	0492	TE 108	August 2020
Signal Generator	Hewlett Packard	33120A	US36016577	TE 111	August 2020
Digital Multimeter	Hewlett Packard	34401A	3146A63804	TE 105	August 2020

Date of Receipt : 16th June 2020
Date of Calibration : 22nd June 2020
Date of Certificate: 22nd June 2020

Authorised Signatory: RA Sh

Tony Sherris

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The Grange Business Centre, Belasis Avenue, Billingham TS23 1LG, England

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Telephone: 01642 876 410

CERTIFICATE OF CALIBRATION

Approved Signatory:

Tony Sherris

Issued by: MTS Calibration Ltd

Date of Issue: 25 June 2020 **Certificate Number:** 34692

Sound Level Meter

Sound Level Meter Periodic Tests to EN 61672-3: 2013 Class 1

Client: Environmental Measurements
Unit 12, Tallaght Business Centre
Whitestown Business Park
Co.Dublin 24, Ireland

Instrument Make: Larson Davis
Instrument Model: 831
Serial Number: 0003913

Associated Equipment	Make	Model	Serial number
Preamplifier	Larson Davis	PRM831	036768
Microphone	PCB	377B02	302020
Calibrator	Larson Davis	CAL200	9175
Calibrator supplied by	MTS for this calibration		

Test results summary, detailed results are shown on subsequent pages.

Periodic tests were performed in accordance with procedures from IEC 61672-3:2013 Class 1

Tests performed	Section	Results of test	Page	Comments
Calibration Certificate	22		1	
Additional information			2	
Indication with Calibrator Supplied	10	No Limit	3	
Self-Generated Noise	11	No Limit	3	
Frequency and Time-weightings at 1kHz	14	Complies	3	
Long term stability	15	Complies	3	
High stability	21	Complies	3	
Acoustic Tests	12	Complies	4	
Frequency Weighting A	13	Complies	5	
Frequency Weighting C	13	Complies	6	
Frequency Weighting Z	13	Complies	7	
Level Linearity	16	Complies	8	
Level Linearity Range Control	17	Complies	9	
Tone-burst Response	18	Complies	10	
Peak C sound level	19	Complies	11	
Overload indication	20	Complies	12	

The instrument was within the above specification as received - no modifications were made

The sound level meter submitted for testing has successfully completed the periodic tests of IEC 61672-3: 2013 for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2: 2013, to demonstrate that the model of sound level meter fully conformed to the Class 1 specifications in IEC 61672-1: 2013, the sound level meter submitted for testing conforms to the Class 1 specifications of IEC 61672-1: 2013

Additional tests performed	Reference	
Microphone full frequency response	34694	See additional certificate
Filter calibration, third octave or octave	34692F	See additional certificate

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The Grange Business Centre,
Belasis Avenue,
Billingham TS23 1LG,
England
Telephone: 01642 876 410

CERTIFICATE OF CALIBRATION

Approved Signatory:

RA Sh

Tony Sherris

Issued by: MTS Calibration Ltd

Date of Issue: 25 June 2020 Certificate Number: 34692F

Third Octave Band Filter

Third-Octave Band Filter verification to BS EN 61260:1996

Client: Environmental Measurements
Unit 12, Tallaght Business Centre
Whitestown Business Park
Co.Dublin 24, Ireland

Instrument Make: Larson Davis
Instrument Model: 831
Serial Number: 0003913

Associated Sound Level Meter

Instrument Make:	Larson Davis
Instrument Model:	831
Serial Number:	0003913
Calibrated by:	MTS Calibration
Certificate Number:	34692
Date: of SLM calibration	25 June 2020
Date: of receipt	16 June 2020

Associated Preamplifier

Instrument Make:	Larson Davis
Instrument Model:	PRM831
Serial Number:	036768

Test results summary. Detailed results are shown on subsequent pages.

Third-Octave Band Filter Compliance with BS EN 61260: 1996 Class 1

		Comments
- Tabular Data		See Page 2
- Graphic Data for 125Hz filter	Complies	See Page 3
- Graphic Data for 1kHz filter	Complies	See Page 3
- Graphic Data for 8kHz filter	Complies	See Page 3

Because each digital filter will have the same amplitude characteristic relative to its centre frequency, only three filters were measured at each of the test frequencies specified by BS EN 61260:1996 for exact base 10 distribution. The measurements made were relative to the attenuation of the 1kHz filter at 1kHz input frequency and input level 6.8 V. Because the measurements include a linearity contribution from the sound level meter, and could be variable with frequency, the assessment is valid only for this pairing. The sound level meter was set for "Linear" frequency response on the lowest range setting which did not give overload at any test frequency or test level. Its compliance with the standard was assessed by referring the measurements to the tolerances specified.

Comments

The sound level meter and preamplifier were calibrated as a unit.
The input level used is selected to produce a sound level at 1kHz that is close to but not exceeding the maximum level on the reference range.
The centre frequency sequence of this filter set follows the exact base 10 midband frequency sequence of IEC 61260 and
the measurements have been made accordingly.

Measurement Conditions:

Temperature	23.9	°C	± 1 °C
Atmospheric Pressure	1014.1	mBar	± 2 mBar
Relative Humidity	47.0	%	± 5 %

Uncertainties of measurements:

Within Passband (0.89 to 1.12 of centre frequency)	0.42	dB
Outside Passband	2.46	dB

Test Equipment:

Equipment	Manufacturer	Model	Serial No.	Traceability Ref.	Cal. Due
Signal Generator (set 2)	Agilent	33120A	MY42007805	TE 160	Oct-20

MTS Calibration Ltd,
The Grange Business Centre,
Belasis Avenue,
Billingham TS23 1LG,
England
Telephone: 01642 876 410

CERTIFICATE OF CALIBRATION

Approved Signatory:

Tony Sherris

Issued by: MTS Calibration Ltd

Date of Issue: 23 June 2020 Certificate Number: 34689F

Third Octave Band Filter

Third-Octave Band Filter verification to BS EN 61260:1996

Client: Environmental Measurements
Unit 12, Tallaght Business Centre
Whitestown Business Park
Co.Dublin 24, Ireland

Instrument Make: Larson Davis
Instrument Model: LxT1
Serial Number: 0005595

Associated Sound Level Meter		*Associated Preamplifier*	
Instrument Make:	Larson Davis	*Instrument Make:*	Larson Davis
Instrument Model:	LxT1	*Instrument Model:*	PRMLxT1L
Serial Number:	0005595	*Serial Number:*	059065
Calibrated by:	MTS Calibration		
Certificate Number:	34689		
Date: of SLM calibration	30 December 1899		
Date: of receipt	16 June 2020		

Test results summary. Detailed results are shown on subsequent pages.

Third-Octave Band Filter **Compliance with BS EN 61260: 1996 Class 1**

		Comments
- Tabular Data		See Page 2
- Graphic Data for 125Hz filter	Complies	See Page 3
- Graphic Data for 1kHz filter	Complies	See Page 3
- Graphic Data for 8kHz filter	Complies	See Page 3

Because each digital filter will have the same amplitude characteristic relative to its centre frequency, only three filters were measured at each of the test frequencies specified by BS EN 61260:1996 for exact base 10 distribution. The measurements made were relative to the attenuation of the 1kHz filter at 1kHz input frequency and input level 0.613 V. Because the measurements include a linearity contribution from the sound level meter, and could be variable with frequency, the assessment is valid only for this pairing. The sound level meter was set for "Linear" frequency response on the lowest range setting which did not give overload at any test frequency or test level. Its compliance with the standard was assessed by referring the measurements to the tolerances specified.

Comments

The sound level meter and preamplifier were calibrated as a unit.
The input level used is selected to produce a sound level at 1kHz that is close to but not exceeding the maximum level on the reference range.
The centre frequency sequence of this filter set follows the exact base 10 midband frequency sequence of IEC 61260 and
the measurements have been made accordingly.

Measurement Conditions:			
Temperature	24.0	°C	± 1 °C
Atmospheric Pressure	1019.7	mBar	± 2 mBar
Relative Humidity	43.8	%	± 5 %

Uncertainties of measurements:		
Within Passband (0.89 to 1.12 of centre frequency)	0.42	dB
Outside Passband	2.40	dB

Test Equipment:

Equipment	Manufacturer	Model	Serial No.	Traceability Ref.	Cal. Due
Signal Generator (set 2)	Agilent	33120A	MY40007805	TE 160	Oct-20

MTS Calibration Ltd,
The Grange Business Centre,
Belasis Avenue,
Billingham TS23 1LG,
England
Telephone: 01642 876 410

CERTIFICATE OF CALIBRATION

Approved Signatory:

Tony Sherris

Issued by: MTS Calibration Ltd

Date of Issue: 23 June 2020 **Certificate Number:** 34689

Sound Level Meter

Sound Level Meter Periodic Tests to EN 61672-3: 2013 Class 1

Client: Environmental Measurements
Unit 12, Tallaght Business Centre
Whitestown Business Park
Co.Dublin 24, Ireland

Instrument Make: Larson Davis
Instrument Model: LxT1L
Serial Number: 0005595

Associated Equipment	Make	Model	Serial number
Preamplifier	Larson Davis	PRMLxT1L	055665
Microphone	PCB	377B02	305480
Calibrator	Larson Davis	CAL200	9175
Calibrator supplied by	MTS for this calibration		

Test results summary, detailed results are shown on subsequent pages.

Periodic tests were performed in accordance with procedures from IEC 61672-3:2013 Class 1

Tests performed	Section	Results of test	Page	Comments
Calibration Certificate	22		1	
Additional information			2	
Indication with Calibrator Supplied	10	No Limit	3	
Self-Generated Noise	11	No Limit	3	
Frequency and Time-weightings at 1kHz	14	Complies	3	
Long term stability	15	Complies	3	
High stability	21	Complies	3	
Acoustic Tests	12	Complies	4	
Frequency Weighting A	13	Complies	5	
Frequency Weighting C	13	Complies	6	
Frequency Weighting Z	13	Complies	7	
Level Linearity	16	Complies	8	
Level Linearity Range Control	17		n/a	SLM only has one range
Tone-burst Response	18	Complies	9	
Peak C sound level	19	Complies	10	
Overload indication	20	Complies	11	

The instrument was within the above specification as received - no modifications were made

The sound level meter submitted for testing has successfully completed the periodic tests of IEC 61672-3: 2013 for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2: 2013, to demonstrate that the model of sound level meter fully conformed to the Class 1 specifications in IEC 61672-1: 2013, the sound level meter submitted for testing conforms to the Class 1 specifications of IEC 61672-1: 2013

Additional tests performed	Reference	
Microphone full frequency response	34691	See additional certificate
Filter calibration, third octave or octave	34689F	See additional certificate

Certificate of Calibration

Certificate Number: 34691

Measurement Microphone
Half-Inch diameter – Free-Field, 0 degree incidence response

Client: Environmental Measurements
Unit 12, Tallaght Business Centre
Whitestown Business Park
Co.Dublin 24, Ireland

Instrument Make: **Larson Davis**
Instrument Model: **377B02**
Serial Number: **305480**

Sensitivity is calculated by the Insert Voltage method. The frequency response calibration is one of three independent measurements of the pressure response of the Object Microphone obtained by the Electrostatic Actuator measurement method. Microphone Capacitance is the polarised capacitance of the test microphone measured on a capacitance bridge relative to a reference microphone.

The frequency response, capacitance, and sensitivity of the microphone are shown graphically on Page 2

Uncertainties of these measurements are:

31.5 Hz to 4kHz	0.41 dB (k = 2.04)
5kHz to 10 kHz	0.87 dB (k = 2.17)
12.5 kHz to 40 kHz	1.81 dB (k = 2.17)
Sensitivity at 250Hz	0.16 dB (k = 2.0)

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k (as above) to provide a level of confidence of approximately 95%. The uncertainty evaluation has been calculated in accordance with UKAS publication M 3003 (December 1997).

Measurement Conditions:

Polarisation Voltage	**0V +/- 0.5V**
Temperature	**22.5 °C**
Atmospheric Pressure	**1019.0 mBar ****
Relative Humidity	**55.6 %**

**** Note that the computer-produced Certificate shows a Pressure of 1044.6 mbar - this is in error. The above measurement is traceable**

Test Equipment:

Equipment	Manufacturer	Model	Serial No.	Traceability Ref.	Cal. Due
Condenser Microphone	Larson Davis	2541	4295	TE 102	November 2020
Acoustic Calibrator 250Hz	Larson Davis	CAL250	4483	TE 116	October 2021
Real-Time Frequency Analyser	Larson Davis	2900	0492	TE 108	August 2020
Signal Generator	Hewlett Packard	33120A	US36016577	TE 111	August 2020
Digital Multimeter	Hewlett Packard	34401A	3146A63804	TE 105	August 2020

Date of Receipt : 16th June 2020
Date of Calibration : 22nd June 2020
Date of Certificate: 22nd June 2020

Authorised Signatory: .....

Tony Sherris

MTS Calibration Ltd
Company Registration Number: 06588525 England and Wales
The Grange Business Centre, Belasis Avenue, Billingham TS23 1LG, England

Telephone: 0044 1642 876410 Fax: 0044 1642 876411 E-Mail: dmarsh@slmcal.co.uk or tsherris@slmcal.co.uk
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0607

CERTIFICATE OF CALIBRATION

Approved Signatory:

Tony Sherris

Issued by: MTS Calibration Ltd

Date of Issue: 14 July 2020 **Certificate Number:** 34743U

Sound Calibrator

Client: Environmental Measurements
Unit 12, Tallaght Business Centre
Whitestown Business Park
Co.Dublin 24, Ireland

On behalf of: Traynor Environmental

The measured values were:

Cirrus **Model CR:515** **Serial Number 44501**

Output Level 1:	94.16	dB re 20µPa	± 0.14 dB (k= 2)
Fundamental Frequency 1:	1000.04	Hz	± 0.11 Hz (k= 2)
Total Harmonic Distortion 1:	0.12	%	± 0.295 % (k= 4.53

This measurement is valid only for the above device configured for calibration of a WS-2 microphone under the above environmental conditions. For deviation of prevailing conditions, the manufacturer's literature for the calibrator should be referred to.

Date of Measurements: 14 July 2020 *Date of Receipt:* 08 July 2020

Method of calibration

A Reference Calibrator was used to establish the sensitivity of the measurement chain. The same measurement chain is then used to determine the output level of the Object Calibrator by the difference between its output and that of the nominated Reference Calibrator. Four independent measurements of the third-octave band sound pressure levels produced by the Reference Calibrators and the Object Calibrator are averaged to minimise uncertainties of the calibration. The measurement chain consists of a calibrated, Reference Microphone, Reference Preamplifier and Reference Analyser.

As well as providing a traceable measurement of the sound pressure level in the cavity of the Object Calibrator, the Calibrator's frequency and total harmonic distortion are also measured. Frequency is determined from the average of four independent measurements using a multimeter. The total harmonic distortion is measured from the average of three independent measurements by third octave analysis, subtracting the level of the fundamental frequency from the sum of the combined harmonics in the frequency band to 20kHz. The complete procedure is detailed in the MTS Calibration Ltd work procedure WP01.

The sound pressure level generated by the calibrator in its WS2 configuration was measured by reference to B&K Model 4133 Microphone and reference Sound Calibrator as shown in the Test Equipment section below.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k (individually calculated as above), providing a coverage probability of approximately 95%. The uncertainty evaluation has been calculated in accordance with the current version of UKAS publication M3003. The uncertainty quoted for the Distortion Measurement is the Distortion Percentage as measured, multiplied by our Uncertainty as calculated for the individual measurement or our CMC, whichever is the larger.

Measurement Conditions:

Temperature	24	°C	± 1 °C
Atmospheric Pressure	1013	mBar	± 2 mBar
Relative Humidity	52	%	± 5 %

Test Equipment used during this calibration:

Equipment	Manufacturer	Model	Serial No.	Traceability Ref.	Calibration Due
Reference Calibrator	Brüel & Kjær	4231	2343058	TE 132	Oct-22
Multimeter	HP	34401A	36146A63804	TE 105	Aug-20
Signal Generator (set 1)	HP	33120A	US36016577	TE 111	Aug-20
Real-Time Analyser (set 1)	Larson Davis	2900	0492	TE 108	Aug-20

APPENDIX G – COMPETENCY CERTIFICATE FROM INSTITUTE OF ACOUSTICS

Institute of
Acoustics

Certificate of Competence in Environmental Noise Measurement

This is to certify that

Nevin Traynor

has completed a course of instruction approved by the Institute of Acoustics and designed to enable the candidate to undertake environmental noise measurements in a competent manner and has achieved a satisfactory performance in the written and practical examinations thereof and that this fact has been recorded in a Register kept by the Institute for this purpose.

Education Committee Chairman

Institute Secretary

Date 11/10/2019

Centre Maloney & Associates

Reference Number MO111

For the purposes of Credit Transfer or Professional Development this Certificate may be considered to be equivalent to 25 points or hours