ARUP

WEPCo | Cardiff and Vale College (CAVC)

Barry Waterfront Campus (BWC)

Building services noise assessment for planning

Reference: VG0201-ARP-XX-XX-RP-Y-00011

P02 | 11 March 2024

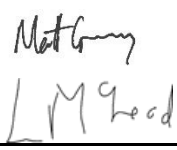
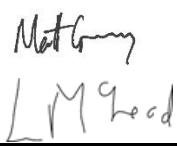
Job number 287279-00

Arup International Projects Limited
One Centenary Way
Birmingham, B3 3AY
United Kingdom
arup.com

ARUP

Document Verification

Project title	Barry Waterfront Campus (BWC)
Document title	Building services noise assessment for planning
Job number	287279-00
Document ref	VG0201-ARP-XX-XX-RP-Y-00011
File reference	

Revision	Date	Filename			
P01	18 January 2024	**Description**	First issue for PAC		
			Prepared by	**Checked by**	**Approved by**
		Name	Matthew Gray MSci PgDip MIOA Laura McLeod BSc Hons MSc AMIOA	Angus Deuchars BEng Hons CEng MIOA	Adrian Passmore BEng CEng MIOA
		Signature			
P02	11 March 2024				
		Description	Final issue for PAC		
			Prepared by	**Checked by**	**Approved by**
		Name	Matthew Gray MSci PgDip MIOA Laura McLeod BSc Hons MSc AMIOA	Angus Deuchars BEng Hons CEng MIOA	Adrian Passmore BEng CEng MIOA
		Signature			

Contents

Tables

Appendices

1. Introduction

This report provides an assessment of building services noise emissions in support of the planning application for the Barry Waterfront Campus (BWC). It demonstrates how noise emissions from the proposed development have been limited through design so that there will be little risk of causing disturbance or unacceptable impact to the nearest noise-sensitive receptors at Junction House and Mariner's Walk.

The following appendices are included with this report:

- Appendix A – Baseline Noise Survey Report
- Appendix B – MEP Plant Locations
- Appendix C – Glossary of Acoustic Terminology

1.1 Overview of the proposed development

The proposed development comprises a three-storey college building containing a range of vocational teaching spaces, and associated landscaping. The noise sources associated with the development that require assessment for planning approval are roof-mounted air handling equipment and an air source heat pump compound located to the north of the building, at ground level.

2. Noise policy, guidance and standards

This assessment has been undertaken with regard to the following planning policy, guidance and standards:

- Technical Advice Note 11[1] (TAN 11)
  - Provides guidance to ensure that noise generating development does not cause an unacceptable degree of disturbance and recommends that noise from industrial and commercial development be assessed following BS 4142: 1990. Arup has used the current version of this standard (see below) to assess noise emissions from the proposed development.
  - TAN 11 also requires consideration of whether proposals for new noise-sensitive development would be incompatible with the prevailing noise conditions at the site. To the extent that the proposed development is a noise-sensitive development this has been managed through the design of the building in accordance with Building Bulletin 93[2] (BB93), which limits the amount of noise exposure to internal teaching spaces by suitable sound insulation design of the façade.
- Vale of Glamorgan Local Development Plan 2011-2026[3] (LDP)
  - Policy MD2 states that proposals should "safeguard existing public and residential amenity, particularly with regard to privacy, overlooking, security, noise and disturbance."
  - Policy MD5 states that "new development within settlement boundaries will be permitted where the proposed development has no unacceptable impact on the amenity and character of the locality by way of noise."

[1] Welsh Government (1997) Planning Guidance (Wales), Technical Advice Note (Wales) 11, Noise

[2] Education Funding Agency. Building Bulletin 93: acoustic design of schools. v17. 2015

[3] Vale of Glamorgan Council (2017). Local Development Plan (2011-2026)

- Policy MD7 states that “development proposals will be required to demonstrate they will not result in unacceptable impact on people, residential amenity, property and / or the natural environment from noise and vibration”
- The LDP does not set numerical requirements for noise limits to achieve these policies, however, Arup has established noise limits at a level that will avoid noise impacts on people, residential amenity, and existing properties.

- BS4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound
- BS7445:2003 Description and measurement of environmental noise

3. Baseline noise climate

Arup conducted a baseline noise survey which was documented in the Baseline Noise Survey Report included in Appendix A. Table 1 summarises the baseline noise levels across the site (refer to Figure 1 for measurement locations).

Location (see Figure 1)	Time period	Representative daytime ambient sound level, dB L_{AeqT}	Representative daytime background sound level, dB L_{A90}
A1	Day (0700-1900)	46	42
	Evening (1900-2300)	48	37
A2	Day (0700-2300)	67	55
A3	Day (0700-2300)	51	45
U1 (Junction House)	Day (0700-2300)	60	52
	Night (2300-0700)	54	40

Table 1: Summary of baseline noise levels

Figure 1: BWC site map and measurement locations

4. Building services noise emissions

4.1 Assessment criteria

The proposed development is targeting BREEAM accreditation and the acoustic design has been developed to achieve the BREEAM Pol 05 credit, which requires limiting noise emissions to 5dB below the prevailing background noise level at the nearest sensitive receptors. Table 2 shows the adopted building services noise rating limits. Noise emissions at this level will typically not be discernible amongst the prevailing ambient noise and therefore would most likely result in no impact at the nearest sensitive receptors.

Properties (see Figure 1)	Assessment period	Representative background sound level, dB L_{A90}	Building services noise rating limit, dB $L_{Ar,Tr}$
Junction House	Day (0700-2300)	52	47
	Night (2300-0700)	40	35
Mariner's Walk	Day (0700-2300)	45	39
	Night (2300-0700)	33[1]	28[2]

Notes: [1] Corrected from daytime level at this location using the difference between night and day measured at Junction House, on the basis that the same roads are the dominant noise source.

[2] Where background sound levels and rating levels are low, BS4142 states absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night. In this case, an absolute noise emissions rating limit of 35$L_{Ar,Tr}$ would mean that noise intrusion to residences would be less than 25dBA assuming a worst-case open window scenario, which is 5dB less than the internal night-time noise limit in bedrooms recommended in BS8233.

Table 2: Building services noise emission limits

4.2 Building services equipment

The principal items of building services plant that require consideration are:

- 2 x Domestic Hot Water Air Source Heat Pump (DHW ASHP)
- 4 x Air Source Heat Pump (ASHP)
- 4 x Air Handling Unit (AHU)

Quieter plant items such as the hybrid ventilation and heat recovery units to classrooms do not require assessment because they produce noise levels of <30dBA at a distance of 2m (which would be significantly more than 10dB below the background noise level at the nearest sensitive receptors) and therefore will not contribute to the overall noise emissions at the nearest sensitive receptors.

At this point in the design (RIBA Stage 3), confirmed selections and noise data for all items of plant are not available, so we have assumed sound power levels for the air handling units (including attenuation) based on similarly-sized items from other previous projects.

Table 3 shows the sound power levels for the principal building services plant items including attenuation and operating at full design duty. Other building services plant items not listed in Table 3 are much quieter and are not significant in terms of the overall noise emissions. A mark-up of plant item locations are included in Appendix B.

Item	Noise source	A-weighted sound power level, dBA
AHUs	Fresh air	68
	Exhaust	84

Item	Noise source	A-weighted sound power level, dBA
	Casing-radiated	58
ASHPs	Casing-radiated	83
DHW ASHPs	Casing-radiated	75

Table 3: Sound power levels for each building services items

The following attenuation measures have been incorporated into the design and included for the purpose of this assessment:

- An acoustic louvre (e.g. Naco NAL300C) for the ASHP enclosure of 3.5m height
- 900mm attenuators on the exhaust and fresh air connections of the AHUs

Building services will operate at design duty during teaching hours, and at a reduced duty in the evenings. As a worst-case, the assessment assumes that plant is operating at full design duty throughout the daytime and evening (0700-2300).

During the night, the air handling units will not operate and only one air source heat pump will operate (compared to six during the day). Furthermore, the one air source heat pump will operate at a maximum 50% of design duty. All of this combined means that building services noise emissions will be at least 11dB quieter during the night, compared to the day.

4.3 Predicted noise levels at nearest sensitive receptors

Noise levels at the nearest sensitive receptors have been calculated using the methods defined in BS 4142, taking into account the following:

- Distance attenuation between the various items of plant and the receptor location
- Barrier effects from buildings and plant screens
- Hard ground conditions between source and receptor location

Table 4 compares the predicted noise level from the proposed building services (the 'rating level') to the noise rating limit established in section 4.1, at each assessment location.

The 'specific sound level ($L_{Aeq,Tr}$) is the noise produced solely by the new source(s), and is subject to corrections where it displays an identifiable acoustic feature, such as tonality, impulsiveness, or intermittency (or any combination of these), to provide a 'rating level' ($L_{Ar,Tr}$). No acoustic feature corrections are necessary for the proposed plant items.

Properties	Assessment period	Building services noise rating limit, dB$L_{Ar,Tr}$	Specific sound level, dBL_{Aeq}	Acoustic feature correction	Rating level, dB$L_{Ar,Tr}$	Exceedance of rating level over proposed limit	Assessment outcome (in BS 4142 terms)
Junction House	Day	47	45	+0	45	-2	No impact
	Night	35	34	+0	34	-1	No impact
Mariner's Walk	Day	39	36	+0	36	-3	No impact
	Night	35	25	+0	25	-10	No impact

Table 4: Specific sound levels at the noise sensitive receptors

The assessment in Table 4 shows that the rating level of the proposed building services noise satisfies the proposed limits and will be below the prevailing background noise level at the receptors. As a result, noise from the proposed building services is unlikely to have any impact on the receptors.

5. Conclusions

Based on the RIBA Stage 3 design the building services noise emissions are capable of satisfying the limits established for the project, which would result in no impact at the nearest sensitive receptors.

Further design development is required to the ensure that the finalised installation can achieve the noise emissions criteria.

Appendix A

Baseline Noise Survey Report

A.1 Introduction

An environmental baseline noise survey has been undertaken to determine the existing noise climate and character at the proposed site, Barry Waterfront Campus. This report details the baseline noise survey and results.

The aims of the noise survey were to:

- Establish the noise levels to inform the building envelope and ventilation strategy of the college.
- Establish the background noise levels at the nearest sensitive receptors for specifying plant noise limits.

The noise survey work was carried out by Laura McLeod (BSc Hons MSc AMIOA) and Gina Mackworth (BEng Hons) of Arup, with attended measurements taken between 14 June and 15 June 2023 and unattended measurements taken between 13 June and 15 June 2023.

A.1.1 BWC Site description

A map of the Barry Waterfront Campus (BWC) site and noise measurement locations are shown in Figure 2 below. The general noise environment is dominated by road traffic noise from Ffordd Y Mileniwm which is to the east of the site. Occasional aircraft noise was audible from Cardiff Airport which is situated ca. 4 km to the west of the site. There is a railway at around 180m to the west of the site. No noise from trains was observed during the survey at the BWC site. The Extrium Wales Noise and Air Quality Viewer[4] indicates that the lowest 55 – 60 dB $L_{Aeq,16hr}$ noise contour from the railway extends to around 60m from the railway track and hence the BWC site would be expected to experience noise levels lower than this and hence this source of noise is not a consideration for the façade design.

Figure 1: BWC site map and measurement locations

A.1.2 Instrumentation

The sound level meters (SLMs), microphones and sound pressure level calibrators used by Arup are Class 1 instruments, conforming to BS EN 61672-1:2013. All Arup instrumentation is calibrated annually and has

[4] http://extrium.co.uk/walesnoiseviewer.html accessed 17th August 2023.

full traceable calibration to national and international standards, which are undertaken by an accredited calibration laboratory. Calibration certificates can be provided upon request.

Each SLM was checked for correct calibration before and after each series of measurements. No significant fluctuation in level was noted throughout each survey period.

All of the SLMs and other related noise monitoring instrumentation used to undertake the survey is described in Table 1 below.

Description	Serial number	Item type
Norsonic 140	1405202	Sound Level Meter
Norsonic 1225	151245	Microphone
Norsonic 1209	15264	Preamp
Norsonic 1251	33554	Calibrator
Rion NL-52	264534	Sound Level Meter
Rion UC-59	22045	Microphone
Rion NH-25	22163	Preamp
Rion NC-74	34824366	Calibrator
Rion NL-52	120480	Sound Level Meter
Rion UC-59	03152	Microphone
Rion NH-25	10479	Preamp
Rion NC-74	35015346	Calibrator

Table 5: Measurement instrumentation

A.1.3 Measurement methodology

At each location, the L_{Aeq}, L_{A90}, L_{A10} and L_{Amax} metric parameters were measured and recorded. All broadband measurements were A-weighted and used a fast time constant (0.125s).

At each measurement location, the SLM was mounted on a tripod with the microphone set between 1.2m to 1.5m above local ground level. All measurements were taken under acoustically free-field conditions. The appropriate windshield for the SLM was fitted to the microphone throughout to minimise wind-induced noise. Measurements were made in clear and dry conditions with wind speed below 5m/s.

Attended measurements of 15 minutes in duration were made at locations A1 and A3 for the plant noise limits and 30 minutes in duration at A2 for building envelope and ventilation strategy measurements. Unattended measurements consisting of a set of continuous 5 minute duration measurements were made at location U1 on 13/06/2023 18:15 until 15/06/2023 11:55. In each case, the time period was appropriate to provide a good representation of the typical noise climate at each measurement location.

A.2 Measurement results

A.2.1 Attended measurements

The summary tables for each measurement location provide an arithmetic average of the individual measurements during each time period for the range of values for $L_{A90,}$ $L_{A1,}$ L_{Aeq}, $L_{A10\ and}$ L_{Amax}.

A.2.1.1 Location A1 – Mariner's Walk (BWC)

Location description:
Mariner's Walk residential properties BWC measurements.

Measurement period:
Wed 14/06/2023 12:25
to
Wed 14/06/2023 20:40

Personnel:
Laura McLeod, Gina Mackworth

Additional comments :
None

Environment and observations:
Dominant noise source is road traffic on Ffordd Y Mileniwm. Plant noise audible from near the railway. Occasional aircraft passbys.

Figure 2: SLM setup at location A1

Date	Time		Sound Pressure Level, dB(A) (re 20 µPa)					Comments
	Start [hh:mm]	Duration [hh:mm:ss]	L_1	L_{90}	L_{eq}	L_{10}	L_{max}	
Day								
14/06/2023	12:25	00:15:00	53	42	46	48	69	Dominant noise source road traffic noise from Ffordd Y Mileniwm. Train passby audible. Noise from residents of nearby houses.
Evening								
14/06/2023	20:25	00:15:00	58	37	48	52	63	Dominant noise source road traffic noise from Ffordd Y Mileniwm. Aircraft noise from Cardiff Airport. Noise from residents of nearby houses.

Table 6: Measured sound pressure levels at Location A1

A.2.1.2 Location A2 – Ffordd Y Mileniwm (BWC)

Location description:
On the pavement next to Ffordd Y Mileniwm and the BWC site.

Measurement period:
Wed 14/06/2023 14:50
to
Wed 14/06/2023 16:40

Personnel:
Laura McLeod, Gina Mackworth

Additional comments :
None

Environment and observations:
Heavily dominated by road traffic noise along Ffordd Y Mileniwm.

Figure 3: SLM setup at location A2

Date	Time		Sound Pressure Level, dB(A) (re 20 µPa)					Comments
	Start [hh:mm]	Duration [hh:mm:ss]	L_1	L_{90}	L_{eq}	L_{10}	L_{max}	
Day								
14/06/2023	14:50	00:30:00	74	55	66	70	84	Dominant noise source road traffic noise from Ffordd Y Mileniwm and occasional passbys from pedestrians.
14/06/2023	16:10	00:30:00	76	56	68	71	87	

Table 7: Measured sound pressure levels at Location A2

A.2.1.3 Location A3 – Admirals Landing Apartments (BWC)

Location description:
Car park for the Admirals Landing Apartments at the back of the existing school and BWC site.

Measurement period:
Wed 14/06/2023 15:35
to
Wed 14/06/2023 21:05

Personnel:
Laura McLeod, Gina Mackworth

Additional comments:
None

Environment and observations:
Dominant road traffic noise on Ffordd Y Mileniwm. Some nature and distant plant noise.

Figure 4: SLM setup at location A3

Date	Time		Sound Pressure Level, dB(A) (re 20 µPa)					Comments
	Start [hh:mm]	Duration [hh:mm:ss]	L_1	L_{90}	L_{eq}	L_{10}	L_{max}	
Day								
14/06/2023	15:35	00:15:00	59	46	51	53	71	Dominant noise source road traffic noise from Ffordd Y Mileniwm. Some noise from children leaving the school.
Evening								
14/06/2023	20:50	00:15:00	57	44	50	53	62	Dominant noise source road traffic noise from Ffordd Y Mileniwm. Aircraft noise from Cardiff Airport. Noise from residents of nearby houses.

Table 8:Measured sound pressure levels at Location A3

A.2.1.4 Location U1 – BWC site unattended measurement

Location description:
On the BWC site, approximately 10m from Ffordd Y Milenwm.

Environment and observations:
Dominant source is road traffic noise on Ffordd Y Milenwm. Occasional aircraft passbys.

Measurement duration:
Tue 13/06/2023 18:15
to
Thu 15/06/2023 12:20

Logging interval:
00:05:00

Additional comments:
None.

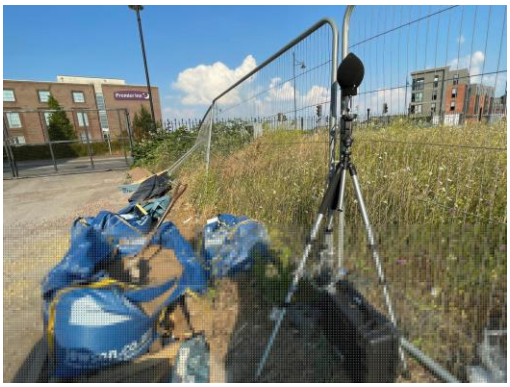




Figure 5: Logger setup location at U1

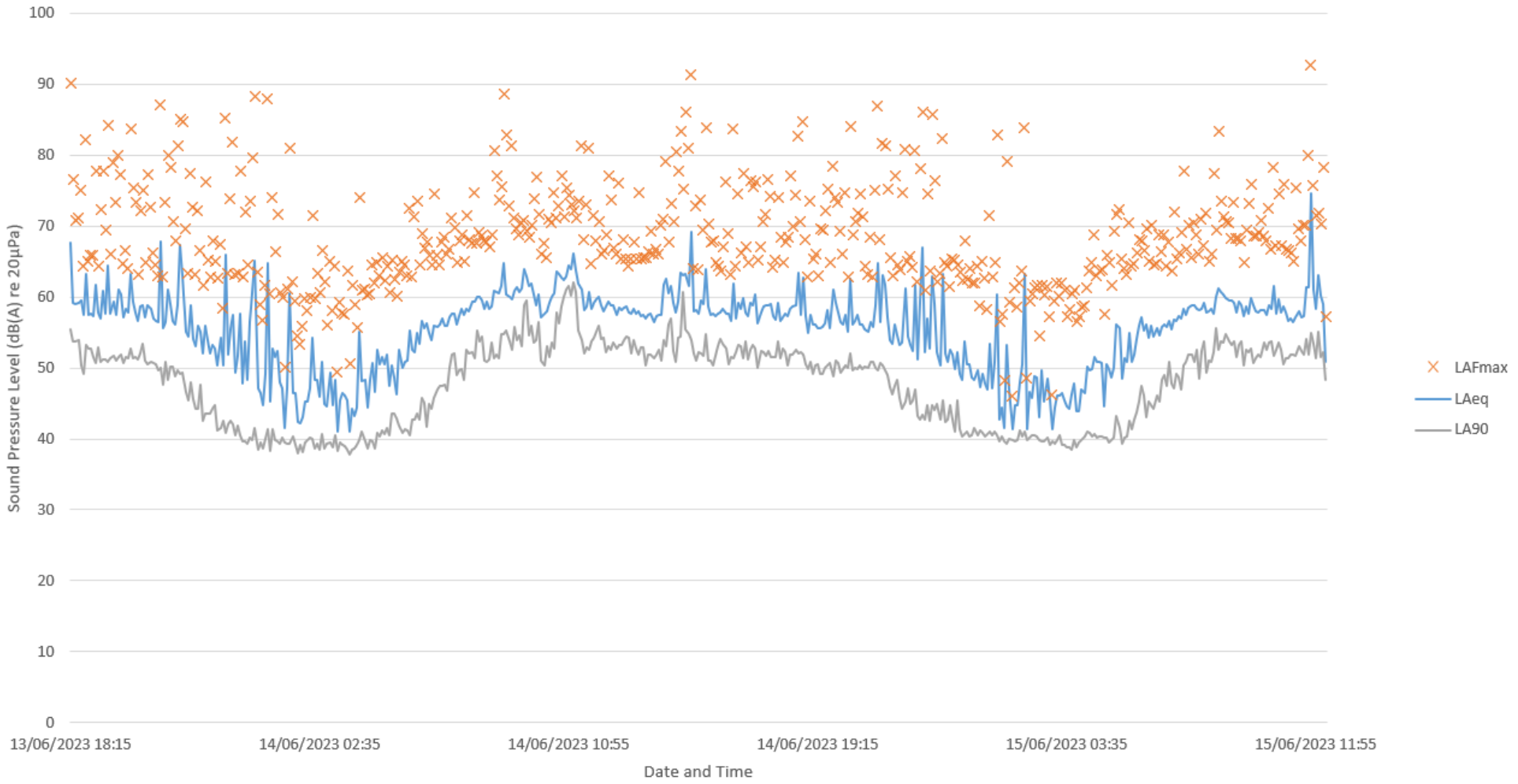


Figure 6: Time history for the unattended measurement at Location U1

Appendix B

MEP Plant Locations

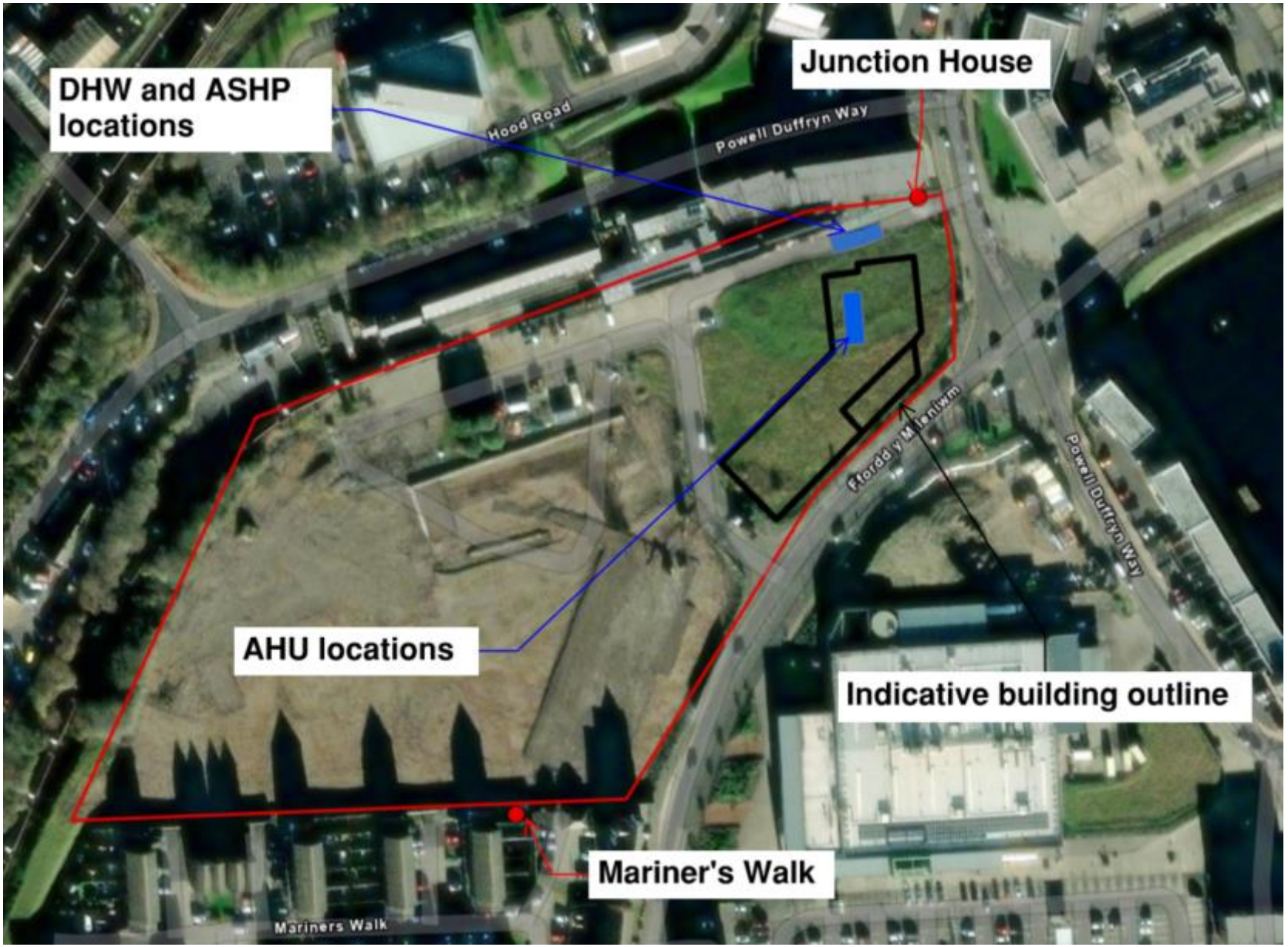


Figure 1: Building services locations relative to nearest noise sensitive receptors

Appendix C

Glossary of Acoustic Terminology

Decibel (dB)

The ratio of sound pressures which we can hear is a ratio of 10^6:1 (one million:one). For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the 'sound pressure level' (L_p) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply.

dB(A)

The unit used to define a weighted sound pressure level, which correlates well with the subjective response to sound. The 'A' weighting follows the frequency response of the human ear, which is less sensitive to low and very high frequencies than it is to those in the range 500Hz to 4kHz.

In some statistical descriptors the 'A' weighting forms part of a subscript, such as L_{A10}, L_{A90}, and L_{Aeq} for the 'A' weighted equivalent continuous noise level.

Equivalent continuous sound level

An index for assessment for overall noise exposure is the equivalent continuous sound level, L_{eq}. This is a notional steady level which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period. Hence fluctuating levels can be described in terms of a single figure level.

Frequency

Frequency is the rate of repetition of a sound wave. The subjective equivalent in music is pitch. The unit of frequency is the hertz (Hz), which is identical to cycles per second. A 1000Hz is often denoted as 1kHz, eg 2kHz = 2000Hz. Human hearing ranges approximately from 20Hz to 20kHz. For design purposes the octave bands between 63Hz to 8kHz are generally used. The most commonly used frequency bands are octave bands, in which the mid frequency of each band is twice that of the band below it. For more detailed analysis, each octave band may be split into three one-third octave bands or in some cases, narrow frequency bands.

Maximum noise level

The maximum noise level identified during a measurement period. Experimental data has shown that the human ear does not generally register the full loudness of transient sound events of less than 125ms duration and fast time weighting (F) has an exponential time constant of 125ms which reflects the ear's response. Slow time weighting (S) has an exponential time constant of 1s and is used to allow more accurate estimation of the average sound level on a visual display.

The maximum level measured with fast time weighting is denoted as $L_{Amax,\,F}$. The maximum level measured with slow time weighting is denoted $L_{Amax,\,S}$.

Sound pressure level

The sound power emitted by a source results in pressure fluctuations in the air, which are heard as sound.

The sound pressure level (L_p) is ten times the logarithm of the ratio of the measured sound pressure (detected by a microphone) to the reference level of 2 x 10^{-5}Pa (the threshold of hearing).

Thus L_p (dB) = 10 log $(P1/P_{ref})^2$ where P_{ref}, the lowest pressure detectable by the ear, is 0.00002 pascals (ie $2x10^{-5}$ Pa).

The threshold of hearing is 0dB, while the threshold of pain is approximately 120dB. Normal speech is approximately 60dBL_A and a change of 3dB is only just detectable. A change of 10dB is subjectively twice, or half, as loud.

Statistical noise levels

For levels of noise that vary widely with time, for example road traffic noise, it is necessary to employ an index which allows for this variation. The L_{10}, the level exceeded for 10% of the time period under consideration, and can be used for the assessment of road traffic noise (note that L_{Aeq} is used in BS 8233 for assessing traffic noise). The L_{90}, the level exceeded for 90% of the time, has been adopted to represent the background noise level. The L_1, the level exceeded for 1% of the time, is representative of the maximum levels recorded during the sample period. A weighted statistical noise levels are denoted L_{A10}, dBL_{A90} etc. The reference time period (T) is normally included, e.g. $dBL_{A10,\ 5min}$ or $dBL_{A90,\ 8hr}$.

Typical levels

Some typical dBA noise levels are given below:

Noise Level, dBA	Example
130	Threshold of pain
120	Jet aircraft take-off at 100m
110	Chain saw at 1m
100	Inside disco
90	Heavy lorries at 5m
80	Kerbside of busy street
70	Loud radio (in typical domestic room)
60	Office or restaurant
50	Domestic fan heater at 1m
40	Living room
30	Theatre
20	Remote countryside on still night
10	Sound insulated test chamber