Environmental Noise Impact Assessment

Energy Centre Programme – SWEC Building, The British Museum, Great Russell Street, London, WC1B 3DG

22nd May 2023

ENVIRONMENTAL AND
SUSTAINABILITY CONSULTANTS

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Contents

1 Introduction

1.1 Overview

Encon Associates Ltd have been commissioned to prepare an environmental noise impact assessment for a new South-West Energy Centre (SWEC) building at The British Museum, Great Russell Street, London as part of the Energy Centre Programme.

The following report has been produced for planning purposes and is to be submitted to The London Borough of Camden.

This report details existing background sound levels at the noise sensitive receptors considered as the worst affected, as well as noise emissions associated with the fixed building services plant that is to be installed.

Due to the necessary technical nature of the report, a glossary of terms can be found in Appendix A to assist the reader.

2 Site Description & Background Information

2.1 Site & Surrounding Area

The proposed development will include:

- Demolition of existing Energy Centre to internal West Road.
- Removal of temporary buildings to the south of the existing energy centre on the internal West Road and to the north and east of the White Wing facing Montague Street.
- Erection of new energy centre incorporating maintenance support accommodation to internal West Road, new substation off Montague Street, all together with associated internal and external works, service runs, erection of plant, landscaping, and temporary works associated with construction.

The immediate surrounding area comprises public buildings, offices, hotels, residential properties and local transport networks. Immediately to the north of the proposed new building is The British Museum's main building. Immediately to the east of the proposed new SWEC building is The British Museum's main building and the Lycian Building also associated with The British Museum. To the south of the proposed building is office space associated with the British Museum. A mixture of residential properties, commercial premises and hotels are situated on Bloomsbury Street to the west of the site.

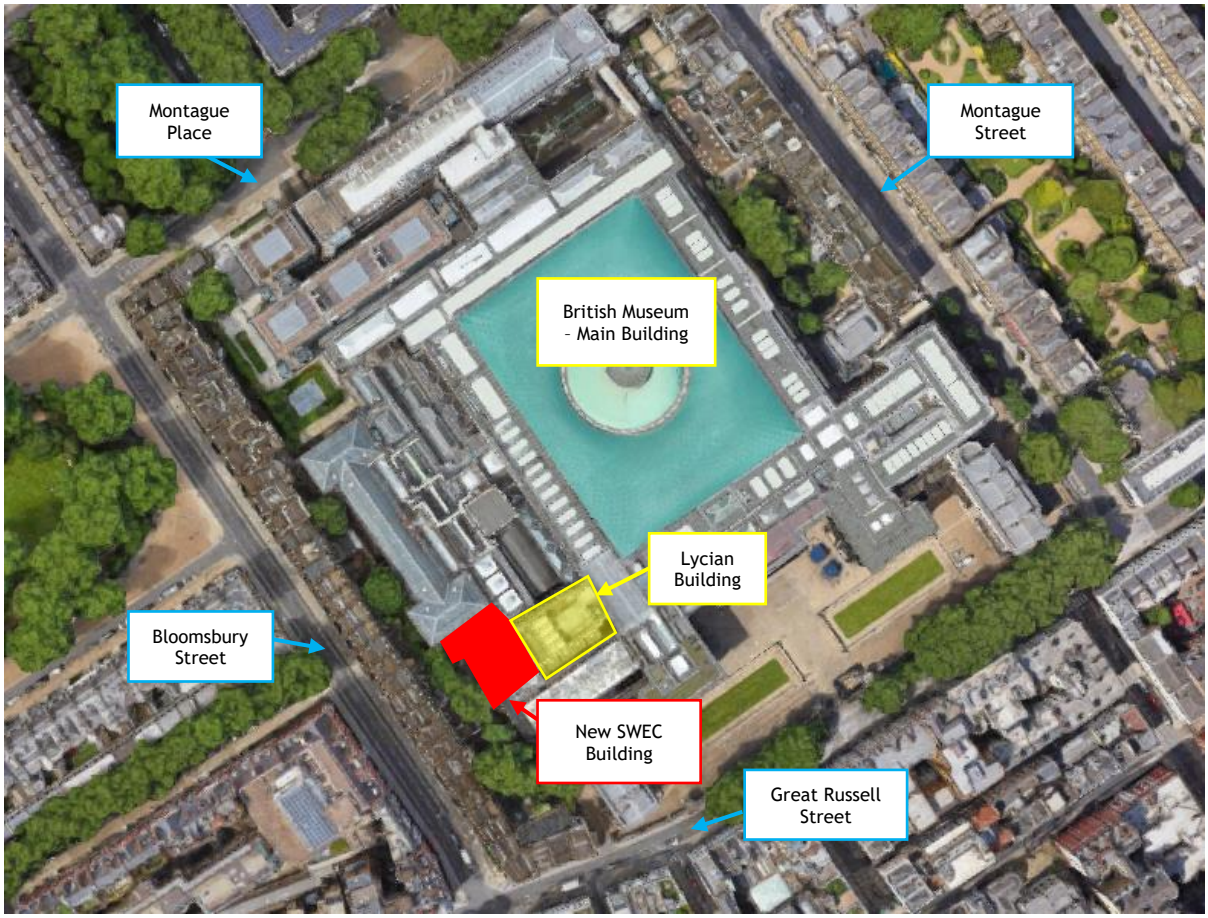

Figure 1.0 – Site and Surrounding Area

2.2 Background

It is proposed that 4no. Air Source Heat Pumps be installed on the roof of the new SWEC building. 4no Water Source Heat Pumps are to be installed internally on level three of the new SWEC building and 2no. 800kVA standby generators are to be installed internally on the ground floor. The generators are standby type and will only start up in the event of a loss of power to The British Museum. Additionally, 2no. Air Source Heat Pumps are to be installed on the roof of the existing Lycian building. Consequently, a noise impact assessment was required to determine the likelihood of adverse impact and to maintain an acceptable acoustic environment for those in the vicinity. The most exposed noise sensitive receptor for all items of plant is 40 Bloomsbury Street, a hotel located immediately to the west of the SWEC building. The acoustic environment at the worst-affected noise sensitive is dominated by noise from road traffic associated with nearby transport networks as well as noise from building services plant associated with the existing SWEC building.

3 Legislation, Policy and Guidance

This report is based on the following policy, guidance and legislation.

3.1 National Planning Policy Framework (NPPF)

The latest revision of the National Planning Policy Framework (September 2023) states that the planning system should contribute to, and enhance the natural and local environment by (amongst other things) “preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability.”

NPPF advises that planning policies and decisions should ensure:

“…new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development.” [In doing so they should] “mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life” and “identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.”

“…new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or ‘agent of change’) should be required to provide suitable mitigation before the development has been completed.”

3.2 The London Plan

Policy D14 Noise of The London Plan stipulates the following:

In order to reduce, manage and mitigate noise to improve health and quality of life, residential and other non-aviation development should manage noise by:

1) Avoiding significant adverse noise impacts on health and quality of life

2) Reflecting the Agent Change principle as set out in Policy D13 Agent of Change

3) Mitigating and minimising the existing and potential adverse impacts of noise on, from, within, as a result of, or in the vicinity of new development without placing unreasonable restrictions on existing noise-generating uses

4) Improving and enhancing the acoustic environment and promoting appropriate soundscapes (including Quiet Areas and spaces of relative tranquility)

5) Separating new noise-sensitive development from major noise sources (such as road, rail, air transport and some types of industrial use) through the use of distance, screening, layout, orientation, uses and materials – in preference to sole reliance on sound insulation

6) Where it is not possible to achieve separation of noise-sensitive development and noise sources without undue impact on other sustainable development objectives, then any potential adverse effects should be controlled and mitigated through applying good acoustic design principles

7) Promoting new technologies and improved practices to reduce noise at source and on the transmission path from source to receiver.

Boroughs and others with relevant responsibilities should identify and nominate new Quiet Areas and protect existing Quiet Areas in line with the procedure in Defra's Noise Action Plan for Agglomerations.

3.3 The London Borough of Camden

The London Borough of Camden stipulates that a noise impact assessment should include background noise levels measured over a 24-hour period. The noise impact assessment should also outline proposed noise levels (including the cumulative noise levels of all proposed units), any proposed measures to reduce noise from the proposed development and the system manufacturers specification of any proposed equipment to be installed, altered or replaced.

Appendix 3: 'Noise Thresholds' of the Camden Local Plan states the following:

The significance of noise impact varies dependent on the different noise sources, receptors and times of operation presented for consideration within a planning application. Therefore, Camden's thresholds for noise and vibration evaluate noise impact in terms of various 'effect levels' described in the National Planning Policy Guidance:

- NOEL – No Observed Level
- LOAEL – Lowest Observed Adverse Effect Level
- SOAEL – Significant Observed Adverse Effect Level

Three basic design criteria have been set for proposed developments, these being aimed at guiding applicants as to the degree of detailed consideration needed to be given to noise in any planning application. The design criteria outlined below are defined in the corresponding noise tables. The values will vary depending on the context, type of noise and sensitivity of receptor:

- Green – Where noise is considered to be at an acceptable level.
- Amber – Where noise is observed to have an adverse effect level, but which may be considered acceptable when assessed in the context of other merits of the development.
- Red – Where noise is observed to have a significant adverse effect.

For Industrial and Commercial noise sources a relevant guidance document should be referenced when determining values for LOAEL and SOAEL. Where appropriate and within the scope of the document it is expected that British Standard 4142:2014 'Methods for rating and assessing industrial and commercial sound' (BS 4142) will be used. For such cases a 'Rating Level' of 10dB below background (15dB if tonal components are present) should be considered as the design criterion.

Emergency equipment such as generators which are only to be used for short periods of time will be required to meet the noise criteria of no more than 10dB above the background level (L90 15 minutes). During standby periods, emergency equipment will be required to meet the usual criteria for plant and machinery.

3.4 Camden Local Plan

Policy A1 of the Camden seeks to ensure hat standards of amenity are protected. Other policies within the Plan also contribute towards protecting amenity by setting out our approach to specific issues, such as the impact of food, drink and entertainment uses in Policy TC4 Town centre uses, Policy A4 Noise and vibration, and Policy CC4 Air quality.

Policy A1: Managing the impact of development.

The Council will seek to protect the quality of life of occupiers and neighbours. We will grant permission for development unless this causes unacceptable harm to amenity.

The Council will:

a. seek to ensure that the amenity of communities, occupiers and neighbours is protected;

b. seek to ensure development contributes towards strong and successful communities by balancing the needs of development with the needs and characteristics of local areas and communities;

c. resist development that fails to adequately assess and address transport impacts affecting communities, occupiers, neighbours and the existing transport network; and

d. require mitigation measures where necessary

The that will be considered include:

e. visual privacy, outlook;

f. sunlight, daylight and overshadowing;

g. artificial lighting levels;

h. transport impacts, including the use of Transport Assessments, Travel Plans and Delivery and Servicing Management Plans;

i. impacts of the construction phase, including the use of Construction Management Plans;

j. noise and vibration levels;

k. odour, fumes and dust;

l. microclimate;

m. contaminated land; and

n. impact upon water and wastewater infrastructure

Noise and vibration can have a major effect on amenity. The World Health Organisation (WHO) for example states that excessive noise can seriously harm human health, disturb sleep, and have cardiovascular and behavioural effects. Camden's high density and mixed-use nature means that disturbance from noise and vibration is a particularly important issue in the borough.

Where uses sensitive to noise are proposed close to an existing source of noise or when development that is likely to generate noise is proposed, the Council will require an acoustic report to accompany the application. Further detail can be found in Policy A4 Noise and vibration and our supplementary planning document Camden Planning Guidance on amenity.

Policy A4: Noise and vibration.

Policy A4 seeks to ensure that noise and vibration is appropriately considered at the design stage and that noise sensitive uses are not negatively impacted by noise and vibration or that existing uses (such as music venues, theatres and some employment uses) are not unduly restricted through the introduction of nearby noise sensitive uses.

Noise and vibration can have a major effect on health and amenity and quality of life. Camden's high density and mixed-use nature means that disturbance from noise and vibration is a particularly important issue for health and wellbeing in the borough. The Council may seek to explore the identification and designation of Quiet Areas, which are local green spaces identified for their particular tranquillity and amenity value.

The Council will seek to ensure that noise and vibration is controlled and managed. Development should have regard to Camden's Noise and Vibration Thresholds (Appendix 3). Permission will not be granted for:

a. development likely to generate unacceptable noise and vibration impacts; or

b. development sensitive to noise in locations which experience high levels of noise, unless appropriate attenuation measures can be provided and will not harm the continued operation of existing uses.

Permission will only be granted for noise generating development, including any plant and machinery, if it can be operated without causing harm to amenity. The council will also seek to minimise the impact on local amenity from deliveries and from the demolition and construction phases of development.

Where uses sensitive to noise and vibration are proposed close to an existing source of noise or when development is likely to generate noise is proposed, the Council will require an acoustic report to accompany the application. In assessing applications, we will have regard to noise and vibration thresholds, set out in Appendix 3, and other relevant national and regional policy and guidance and British Standards. Further guidance on the application of these standards will be provided in supplementary planning document Camden Planning Guidance on amenity.

Noise generating uses and fixed machinery will likely have a greater impact on amenity when the background noise level is lower or in areas where noise sensitive uses such as residential developments co-exist with other uses. The Council will take into consideration the general character of the noise (whether noise is intermittent, has a distinct screech, bang, hiss) and where appropriate, the cumulative impacts of noise from one or more noise sources and will assess whether tighter noise restrictions, secured by planning condition, should be imposed.

Planning conditions will be imposed to require that plant and equipment which may be a source of noise is kept working efficiently and within the required noise limits and time restrictions. Air conditioning will only be permitted where it is demonstrated that there is a clear need for it after other measures have been considered (Policy CC2 Adapting to climate change). Conditions may also be imposed to ensure that attenuation measures are kept in place and are effective throughout the life of the development.
Emergency equipment such as generators which are only to be used for short periods of time will be required to meet the noise criteria of no more than 10dB above the background level (L90 15 minutes). During standby periods, emergency equipment will be required to meet the usual criteria for plant and machinery. Conditions to this effect may be imposed in instances where emergency equipment forms part of the application.

3.5 Camden Planning Guidance: Amenity

Noise and vibration can have a significant impact on amenity, quality of life and wellbeing. This section provides guidance regarding the application of Local Plan Policies A4 Noise and vibration and A1 Managing the impact of development, which seek to protect residents of both existing and new residential developments and the occupiers of other noise-sensitive developments from the adverse effects of noise and vibration. Appendix 3 of the Local Plan supports these policies and sets out expected standard in terms of noise and vibration.

When assessing acoustic reports, the Council will consider the reported measurements against the noise thresholds set out in Appendix 3 of the Local Plan. The thresholds are expressed as ‘effect levels’, which sets out a hierarchy of expected changes in behaviour and impact on health and wellbeing in response to increasing noise levels (measured in decibels - dB). The ‘effect levels’ are summarised below and explained in detail in National Planning Practice Guidance (NPPG). The table detailing each ‘effect level’ from NPPG is also set out in Appendix 1 to this guidance for ease of reference.

- No observed effect level (NOEL) – the level below which no effect can be detected on health and quality of life.

- Lowest observable adverse effect level (LOAEL) – the level above which changes in behaviour (e.g. closing windows for periods of the day) and adverse effects on health (e.g. sleep disturbance) and quality of life can be detected.

- Significant observed adverse effect level (SOAEL) – the level above which adverse effects on health and quality of life occur. This could include psychological stress, regular sleep deprivation and loss of appetite.

Developments proposing plant, ventilation, air extraction or conditioning equipment and flues will need to provide the system’s technical specifications to the Council accompanying any acoustic report. 'BS4142 Method for rating Industrial and Commercial Sound’ contains guidance and standards which should also be considered within the acoustic report.

Plant, ventilation, air extraction or conditioning equipment and flues can cause disturbance to residential properties. The Council would therefore welcome the use of long-term maintenance agreements to ensure that equipment maintains acceptable noise levels over its lifetime and the use of timers to limit any unnecessary operation of the equipment.

It should be noted that The British Museum is located outside of designated Neighbourhood areas and subsequently, Camden neighbourhood plans are not applicable.

3.4 BS4142: 2014 + A1: 2019 'Methods for rating and assessing industrial and commercial sound

British Standard 4142: 2014 + A1:2019 describes methods for rating and assessing sound of an industrial and/or commercial nature, which includes:

- Sound from industrial and manufacturing processes;
- Sound from fixed installations which comprise mechanical and electrical plant and equipment;
- Sound from the loading and unloading of goods and materials and/or commercial premises; and
- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as the from fork-lift trucks, or that from train or ship movements on or around an industrial and/or commercial site.

The methods described in the standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

The standard presents methods to measure and determine ambient, background and residual sound levels, and the rating levels of industrial/commercial sound. BS4142:2014+A1+2019 requires consideration of the level of uncertainty in the data and associated calculations.

The determination of noise amounting to a nuisance is beyond the scope of BS4142. The standard stipulates that it is not intended to be applied to the rating and assessment of sound from the passage of vehicles on public roads and railway systems, recreational activities, music and entertainment, shooting grounds, construction and demolition, domestic animals, public address systems and other sources not specified within the document.

The Reference Time Interval, T, is defined in the standard as the "specified interval over which the specific sound level is determined", which is 1 hour during the daytime (07:00 to 23:00 hours) and 15 minutes during the night (23:00 to 07:00 hours).

Ambient sound is defined as "totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far". It comprises the residual sound and the specific sound when present.

Residual sound is defined as "ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound".

The background sound level is the $L_{A90,\ T}$ of the residual sound level, and is the underlying level of sound. Measurements of background sound level should be undertaken at the assessment location where possible or at a comparable location.

The measurement time interval should be sufficient to obtain a representative value (normally not less than 15 minutes) and the monitoring duration should reflect the range of background sound levels across the assessment period. The background sound level used for the assessment should be representative of the period being assessed.

The specific sound level is the $L_{Aeq,T}$ of the sound source being assessed over the reference time interval, Tr. BS 4142: 2014 + A1: 2019 advises that Tr should be 1 hour during the day and 15 minutes at night.

The rating level is the specific sound level plus any adjustment for the characteristics that are present with the sound including tonality, impulsivity, intermittency or other acoustic characteristics. The standard describes subjective and objective methods to establish the appropriate adjustment. The characteristics and coinciding adjustments are defined as:

- Tonality: A rating penalty of + 2dB is applicable for a tone which I “just perceptible”, +4 dB where a tone is “clearly perceptible”, and +6 dB where a tone is “highly perceptible”.

- Impulsivity: A rating penalty of +3 dB is applicable for impulsivity which is “just perceptible”, +6 dB where it is “clearly perceptible”, and +9 dB where it is “highly perceptible”.

- Intermittency: When the specific sound has identifiable on/off conditions, the specific sound level ought to be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on-time if the intermittency is readily distinctive against the residual acoustic environment, a penalty of +3dB can be applied.”

- Other Sound Characteristics: Where the specific sound features that are neither tonal nor impulsive but are otherwise readily distinctive against the residual acoustic environment, a 3 dB penalty can be applied.

The level of impact is assessed by comparing the rating level with the background sound level. Typically, the greater the difference between the rating level and background sound level the greater the magnitude of impact, depending on context. A difference of +5 dB is likely to indicate an adverse impact and a difference of +10 dB is likely is likely to indicate a significant adverse impact, depending on context.

4 Environmental Noise Survey

To characterise the acoustic environment of the area, a 24-hour noise survey was carried out from the 19th – 20th April 2023.

4.1 Measurement Methodology

Unattended monitoring was carried out at two measurement positions (MP). One sound level meter (MP1) was positioned at ground floor level in the garden of 42 Bloomsbury Street. The microphone was mounted onto a tripod 1.5m above the ground in free-field conditions (more than 3.5m from any reflective surfaces apart from the ground). This measurement position was chosen to obtain background sound levels that are representative of the most exposed noise sensitive receptors during the daytime and night-time periods. Considering that the background was dominated by noise from building services plant associated with the existing South West Boiler House and that these units are going to be removed, another measurement location was chosen at an area where noise from the South West Boiler House was not contributing to the acoustic environment in order to obtain 'true background'. This sound level meter (MP2) was positioned on the edge of a courtyard at the north-west of the British Museum grounds. The microphone was mounted onto a tripod on top of flowerbed in free-field conditions. The measurement position is shown in Figure 2.0.

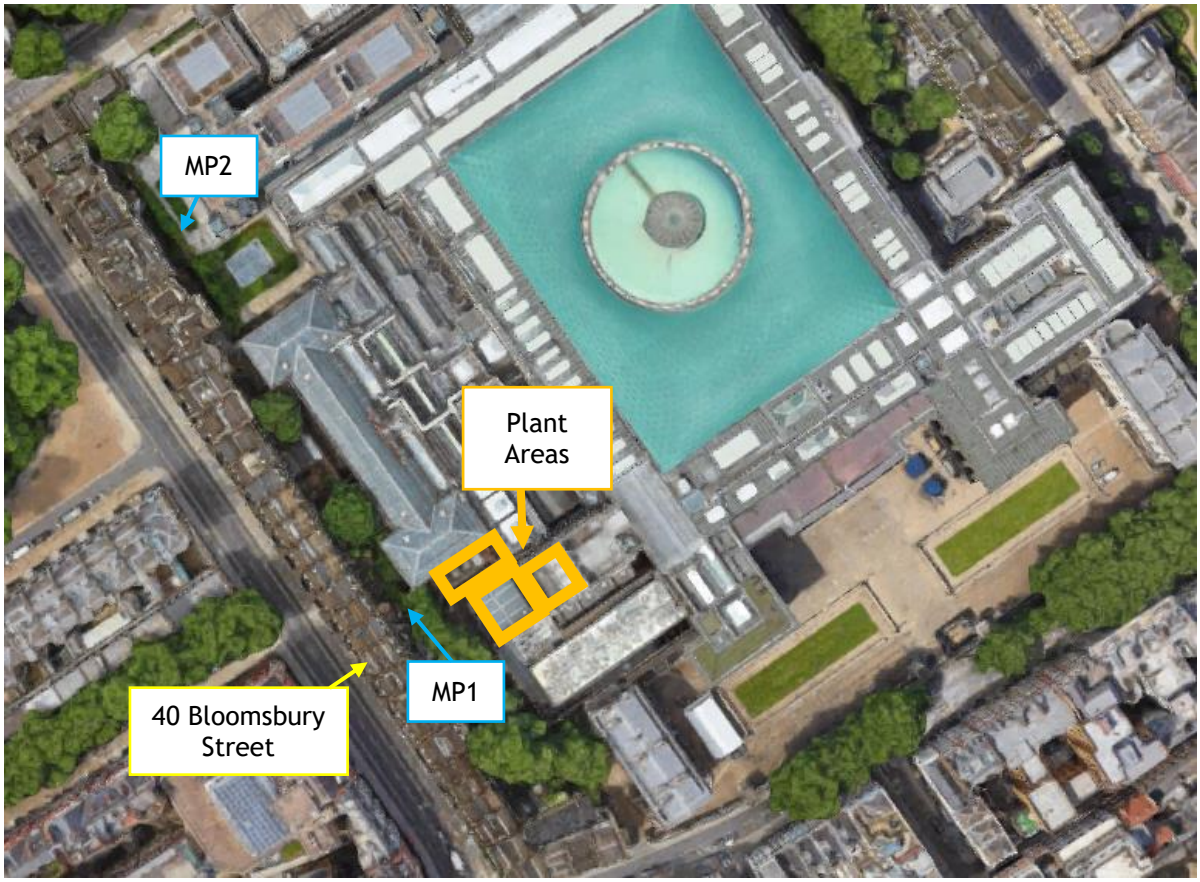

Figure 2.0 – Measurement Positions

4.2 Instrumentation

Equipment	Serial No.	Laboratory Calibration
Cirrus Optimus Green+ Class 1 Sound Level Meter	G303153	19/08/2021
Cirrus Optimus Green+ Class 1 Sound Level Meter	G303154	19/08/2021
Cirrus CR:515 Class 1 Acoustic Calibrator	96656	30/08/2022

Table 1.0 – Instrumentation

All sound level meters were field calibrated immediately before and after the measurement period and no significant drift (≤0.5 dB) occurred. Laboratory calibration by a third-party is carried out on all sound level meters every twenty-four months with all calibrators being calibrated every twelve months. All microphones were fitted with a protective windshield. Calibration certificates can be seen in Appendix E.

4.3 Weather Conditions

Localised meteorological conditions were recorded throughout the survey period during the measurement of the background sound levels from 19th - 20th April 2023 using a Kestrel 5500 weather

meter. The conditions were considered suitable i.e. in accordance with those laid out in BS 7445-2:1991 and provided no significant uncertainty to the measured data. A summary of the meteorological conditions can be found in Appendix C.

4.4 Survey Results

Time History Graphs showing the results of the automated survey can be found in Appendix B. These graphs display the 15-minute L_{A90}, L_{A10}, L_{Aeq}, and L_{AFmax} sound levels at each monitoring location throughout the survey period.

4.4.1 Background Measurement Results

The table below shows the L_{A90} measurements at MP1 during daytime hours.

Measurement Position 1			
Daytime (07:00 - 23:00)	**Typical $L_{A90, 15\ min}$ (mode)**	**Min. $L_{A90, 15\ min}$**	**Max. $L_{A90, 15\ min}$**
Wednesday – Thursday 19 - 20/04/23	53	51	54

Table 2.0 – Operational Hours Daytime Background Measurements - MP1

The background measurements at MP1 for the night-time period are shown below.

Measurement Position 1			
Night-time (23:00 - 07:00)	**Typical $L_{A90, 15\ min}$ (mode)**	**Min. $L_{A90, 15\ min}$**	**Max. $L_{A90, 15min}$**
Wednesday – Thursday 19 - 20/04/23	50	48	52

Table 3.0 – Operational Hours Night-time Background Measurements - MP1

The table below shows the L_{A90} measurements at MP2 during daytime hours.

Measurement Position 2			
Daytime (07:00 - 23:00)	**Typical $L_{A90, 15\ min}$ (mode)**	**Min. $L_{A90, 15\ min}$**	**Max. $L_{A90, 15\ min}$**
Wednesday – Thursday 19 - 20/04/23	48	45	59

Table 4.0 – Operational Hours Daytime Background Measurements – MP2

The background measurements at MP2 for the night-time period are shown below.

Measurement Position 2			
Night-time (23:00 - 07:00)	**Typical $L_{A90, 15\ min}$ (mode)**	**Min. $L_{A90, 15\ min}$**	**Max. $L_{A90, 15min}$**
Wednesday – Thursday 19 - 20/04/23	44	44	46

Table 5.0 – Operational Hours Night-time Background Measurements – MP2

5 Plant Noise Emission Criteria

5.1 Non-Emergency Building Services Plant

Based on the requirements of the local authority and the results of the environmental noise survey, we propose the following plant noise emission criteria to be achieved at the most-exposed noise sensitive window. The criteria below are to be achieved with all proposed plant running simultaneously. Considering that the background sound levels at MP1 are being driven by building services plant associated with the South West Boiler House that is to be replaced, the limits have been set according with the statistically most-repeated background sound levels measured at MP2.

Plant Noise Emission Criteria (dBA)	
Daytime (07:00 – 23:00)	**Night-time (23:00 - 07:00)**
38	34

Table 6.0 – Non-Emergency Plant Noise Emission Criteria

5.2 Emergency Building Services Plant

Camden Council outline alternative noise requirements for emergency equipment such as stand-by generators which are only used for short periods of time. It is understood that the generators shall only run in the unlikely event of a loss of power to The British Museum and when they are tested for

a 30-minute period once a month. The following table outlines the emergency plant noise criteria to be achieved at most-exposed noise sensitive window.

Plant Noise Emission Criteria (dBA)	
Daytime (07:00 - 23:00)	**Night-time (23:00 - 07:00)**
58	54

Table 7.0 – Emergency Plant Noise Emission Criteria

6 Noise Impact Assessment

6.1 Non-Emergency Building Services Plant

The models of non-emergency building services plant have been established thus enabling for a noise impact assessment to be carried out. Noise emissions from each item of plant have been calculated at the worst-affected noise sensitive receptor by using manufacturer noise data. The manufacturer noise data for each plant item is shown in the table below. The following table shows manufacturer noise data for the air source heat pumps that are to be located on the roof of the SWEC building and the Lycian building.

Plant Item	Sound Power Level dB at Octave Band Centre Frequency								Lw dBA
	63Hz	125Hz	250Hz	500Hz	1KHz	2KHz	4KHz	8KHz	
WSAN-YSC4 480.12 RPM (Air Source Heat Pump)	100	94	99	104	96	93	92	82	103
WDAN-iK4 420.2 LN (Air Source Heat Pump)	83	85	87	91	92	89	81	70	95

Table 8.0 – External Non-Emergency Plant Noise Data

The following table shows the manufacturer noise data for the water source heat pumps that are to be located inside level 3 of the proposed SWEC building.

Plant Item	dBA @1m
WDH-SB4 440.2 (Water Source Heat Pump)	77

Table 9.0 – External Non-Emergency Plant Noise Data

The following table predicts the noise levels from the external plant units at 40 Bloomsbury Street with all items of plant running simultaneously. Two of the WDAN-iK4 420.2 LN models are located on the northern side of the roof of the SWEC building, whereas the other two WDAN-iK4 420.2 LN units are to be located on the roof of the Lycian building. The two WSAN-YSC4 480.12 RPM units are to be located on the south side of the roof of the SWEC building. The table shows the sound pressure level for each unit quoted at a distance of 1m and then at the most-exposed noise sensitive receptor.

	Sound Pressure Level dB at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1K	2K	4K	8K	
WDAN-iK4 420.2 LN – Unit 1 (1m from Plant)	72.0	74.0	76.0	80.0	81.0	78.0	70.0	59.0	75.4
Distance Correction (1m to 17.7m)	-24.9	-24.9	-24.9	-24.9	-24.9	-24.9	-24.9	-24.9	
Sound Pressure Level at Receptor (17.7m)	47.1	49.1	51.1	55.1	56.1	53.1	45.1	34.1	50.5
WDAN-iK4 420.2 LN – Unit 2 (1m from Plant)	72.0	74.0	76.0	80.0	81.0	78.0	70.0	59.0	75.4
Distance Correction (1m to 21m)	-26.4	-26.4	-26.4	-26.4	-26.4	-26.4	-26.4	-26.4	
Sound Pressure Level at Receptor (21m)	45.6	47.6	49.6	53.6	54.6	51.6	43.6	32.6	49.0
WSAN-YSC4 480.12 RPM – Unit 1 (1m from Plant)	89.0	83.0	88.0	93.0	85.0	82.0	81.0	71.0	92.5
Distance Correction (1m to 21.7m)	-26.7	-26.7	-26.7	-26.7	-26.7	-26.7	-26.7	-26.7	
Sound Pressure Level at Receptor (21.7m)	62.3	56.3	61.3	66.3	58.3	55.3	54.3	44.3	65.8
WSAN-YSC4 480.12 RPM – Unit 2 (1m from Plant)	89.0	83.0	88.0	93.0	85.0	82.0	81.0	71.0	92.5
Distance Correction (1m to 24.2m)	-27.7	-27.7	-27.7	-27.7	-27.7	-27.7	-27.7	-27.7	

Sound Pressure Level at Receptor (24.2m)	61.3	55.3	60.3	65.3	57.3	54.3	53.3	43.3	64.8
WDAN-iK4 420.2 LN – Unit 3 (1m from Plant)	72.0	74.0	76.0	80.0	81.0	78.0	70.0	59.0	75.4
Distance Correction (1m to 38.6m)	-31.7	-31.7	-31.7	-31.7	-31.7	-31.7	-31.7	-31.7	
Sound Pressure Level at Receptor (38.6m)	40.3	42.3	44.3	48.3	49.3	46.3	38.3	27.3	43.7
WDAN-iK4 420.2 LN – Unit 4 (1m from Plant)	72.0	74.0	76.0	80.0	81.0	78.0	70.0	59.0	75.4
Distance Correction (1m to 44.4m)	-32.9	-32.9	-32.9	-32.9	-32.9	-32.9	-32.9	-32.9	
Sound Pressure Level at Receptor (44.4m)	39.1	41.1	43.1	47.1	48.1	45.1	37.1	26.1	42.5
Cumulative Noise Emissions at Receptor	65.0	59.7	64.3	69.2	63.1	60.1	57.4	47.3	68.5

Table 10.0 – Noise Emissions from External Non-Emergency Plant

The table above predicts that the noise emissions from the external units located on the roof of the SWEC building and the Lycian building will greatly exceed the noise limits at 40 Bloomsbury Street. Therefore, mitigation measures are required.

Considering that the Water Source Heat Pumps are to be housed inside the SWEC building, the internal diffuse sound level must be calculated based on the amount of absorption in the room. The following table shows the total sound level from the Water Source Heat Pumps on level three of the SWEC building accounting for a diffused sound field. The assumption has been made that all surface finishes comprise unpainted concrete. Calculations for the total sound level are available upon request.

Description	dBA SPL
WDH-SB4 440.2 (Water Source Heat Pump) x4 @1m	83
Reverberant Sound Pressure Level	83
Total Sound Level in Level 3 Plant Room	86.0

Table 11.0 – Level Three Water Source Heat Pumps Noise Emissions

The following table shows the plant noise emissions from the internal Water Source Heat Pumps on level 3 of the SWEC building at 40 Bloomsbury Street without any attenuation from the façade of the SWEC building. This enables the sound insulation requirements of the SWEC building to be specified.

Description	dBA SPL
Total Sound Level in Level 3 Plant Room	86.0
Distance Attenuation from the façade to the receptor (16m)	24
Plant Noise Emissions at 40 Bloomsbury Street without Façade Attenuation	62.0

Table 12.0 – SWEC Level Three Noise Emissions at 40 Bloomsbury Street

6.2 Mitigation Measures

In order to control plant noise emissions to comply with the requirements of The London Borough of Camden, it is recommended that each external units be housed inside an acoustic enclosure. The table below shows the attenuation provided by the Allaway AA303S acoustic enclosure in each octave band.

	Sound Reduction Index dB at Octave Band Centre Frequency (Hz)							
	63	125	250	500	1K	2K	4K	8K
Allaway AA303S Acoustic Enclosure	4	8	13	22	24	21	18	14

Table 13.0 – Acoustic Enclosure Performance Data

The following table shows the noise emissions from the external non-emergency plant with all units housed in an Allaway AA303S Acoustic Enclosure.

	Sound Pressure Level dB at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1K	2K	4K	8K	
WDAN-iK4 420.2 LN – Unit 1 (1m from Plant)	72.0	74.0	76.0	80.0	81.0	78.0	70.0	59.0	75.4
Acoustic Enclosure Attenuation	-4	-8	-13	-22	-24	-21	-18	-14	
Distance Correction (1m to 17.7m)	-24.9	-24.9	-24.9	-24.9	-24.9	-24.9	-24.9	-24.9	
Sound Pressure Level at Receptor (17.7m)	43.1	41.1	38.1	33.1	32.1	31.1	27.1	20.1	38.2
WDAN-iK4 420.2 LN – Unit 2 (1m from Plant)	72.0	74.0	76.0	80.0	81.0	78.0	70.0	59.0	75.4
Acoustic Enclosure Attenuation	-4	-8	-13	-22	-24	-21	-18	-14	
Distance Correction (1m to 21m)	-26.4	-26.4	-26.4	-26.4	-26.4	-26.4	-26.4	-26.4	
Sound Pressure Level at Receptor (21m)	41.6	39.6	36.6	31.6	30.6	30.6	25.6	18.6	36.7
WSAN-YSC4 480.12 RPM – Unit 1 (1m from Plant)	89.0	83.0	88.0	93.0	85.0	82.0	81.0	71.0	92.5
Acoustic Enclosure Attenuation	-4	-8	-13	-22	-24	-21	-18	-14	
Distance Correction (1m to 21.7m)	-26.7	-26.7	-26.7	-26.7	-26.7	-26.7	-26.7	-26.7	

Sound Pressure Level at Receptor (21.7m)	58.3	48.3	48.3	44.3	34.3	34.3	36.3	30.3	45.8
WSAN-YSC4 480.12 RPM - Unit 2 (1m from Plant)	89.0	83.0	88.0	93.0	85.0	82.0	81.0	71.0	92.5
Acoustic Enclosure Attenuation	-4	-8	-13	-22	-24	-21	-18	-14	
Distance Correction (1m to 24.2m)	-27.7	-27.7	-27.7	-27.7	-27.7	-27.7	-27.7	-27.7	
Sound Pressure Level at Receptor (24.2m)	57.3	47.3	47.3	43.3	43.3	33.3	35.3	29.3	44.8
WDAN-iK4 420.2 LN - Unit 3 (1m from Plant)	72.0	74.0	76.0	80.0	81.0	78.0	70.0	59.0	75.4
Acoustic Enclosure Attenuation	-4	-8	-13	-22	-24	-21	-18	-14	
Distance Correction (1m to 38.6m)	-31.7	-31.7	-31.7	-31.7	-31.7	-31.7	-31.7	-31.7	
Sound Pressure Level at Receptor (38.6m)	36.3	34.3	31.3	26.3	25.3	25.3	20.3	13.3	31.4
WDAN-iK4 420.2 LN - Unit 4 (1m from Plant)	72.0	74.0	76.0	80.0	81.0	78.0	70.0	59.0	75.4
Acoustic Enclosure Attenuation	-4	-8	-13	-22	-24	-21	-18	-14	
Distance Correction (1m to 44.4m)	-32.9	-32.9	-32.9	-32.9	-32.9	-32.9	-32.9	-32.9	
Sound Pressure Level at Receptor (44.4m)	35.1	33.1	30.1	25.1	24.1	24.1	19.1	12.1	30.2
Cumulative Noise Emissions at Receptor	61.0	51.7	51.3	47.2	44.4	39.0	39.4	33.3	49.1

Table 14.0 – Noise Emissions from External Non-Emergency Plant Including Enclosures

In addition to the enclosures, it is proposed that acoustic louvre screening be installed between the plant area and the receptors. The performance data for an acoustic louvre system is shown in the table below.

	Transmission Loss dB at Octave Band Centre Frequency (Hz)							
	63	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**
Slimshield SL-600 Acoustic Louvres	7	9	12	24	31	33	29	30

Table 14.0 – Acoustic Enclosure Performance Data

The following tables show the noise emissions for each unit at 40 Bloomsbury Street, including attenuation provided by the acoustic enclosures and acoustic louvre screening. The calculations for the acoustic louvre screening consider sound passing through the louvre system as well as sound moving around the barrier. These figures are then combined at the most-exposed noise sensitive receptor. The barrier calculations are based on the top of the barrier being level with the top of the units (including the enclosures) on top of the SWEC building. The proposed location of the barrier is shown in Appendix F.

	Sound Pressure Level dB at Octave Band Centre Frequency (Hz)								**dBA**
	63	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**	

WDAN-iK4 420.2 LN – Unit 1 (1m from Plant)	72.0	74.0	76.0	80.0	81.0	78.0	70.0	59.0	75.4
Acoustic Enclosure Attenuation	-4	-8	-13	-22	-24	-21	-18	-14	
Louvre Attenuation	-7	-9	-12	-24	-31	-33	-29	-30	
Distance Correction (1m to 17.3m)	-24.8	-24.8	-24.8	-24.8	-24.8	-24.8	-24.8	-24.8	
Sound Pressure Level at Receptor (17.3m) (Via Louvres)	36.2	32.2	26.2	9.2	1.2	-	-	-	20.5
WDAN-iK4 420.2 LN – Unit 1 (1m from Plant)	72.0	74.0	76.0	80.0	81.0	78.0	70.0	59.0	75.4
Acoustic Enclosure Attenuation	-4	-8	-13	-22	-24	-21	-18	-14	
Barrier Attenuation	-12.9	-15.5	-18.3	-21.2	-24.2	-27.2	-30.2	-33.2	
Distance Correction (1m to 17.3m)	-24.8	-24.8	-24.8	-24.8	-24.8	-24.8	-24.8	-24.8	
Sound Pressure Level at Receptor (17.3m) (Around Barrier)	30.3	25.7	19.9	12.0	8.0	5.0	-	-	16.3
Cumulative Noise Emissions at Receptor	38.3	34.3	28.6	17.8	13.6	9.7	3.9	-	21.8

Table 15.0 - WDAN-iK4 420.2 LN – Unit 1 Noise Emissions Including Enclosure and Louvres

	Sound Pressure Level dB at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1K	2K	4K	8K	
WDAN-iK4 420.2 LN – Unit 2 (1m from Plant)	72.0	74.0	76.0	80.0	81.0	78.0	70.0	59.0	75.4
Acoustic Enclosure Attenuation	-4	-8	-13	-22	-24	-21	-18	-14	
Louvre Attenuation	-7	-9	-12	-24	-31	-33	-29	-30	
Distance Correction (1m to 21m)	-26.4	-26.4	-26.4	-26.4	-26.4	-26.4	-26.4	-26.4	
Sound Pressure Level at Receptor (21m) (Via Louvres)	34.6	30.6	24.6	7.6	-	-	-	-	18.9
WDAN-iK4 420.2 LN – Unit 2 (1m from Plant)	72.0	74.0	76.0	80.0	81.0	78.0	70.0	59.0	75.4
Acoustic Enclosure Attenuation	-4	-8	-13	-22	-24	-21	-18	-14	
Barrier Attenuation	-12.7	-15.3	-18.1	-21.0	-24.0	-27.0	-30.0	-33.0	
Distance Correction (1m to 21m)	-26.4	-26.4	-26.4	-26.4	-26.4	-26.4	-26.4	-26.4	
Sound Pressure Level at Receptor (21m) (Around Barrier)	28.9	24.3	18.5	10.6	6.6	3.6	-	-	14.9

Cumulative Noise Emissions at Receptor	37.7	33.9	28.4	19.0	15.2	12.4	5.1	-	20.4

Table 16.0 - WDAN-iK4 420.2 LN – Unit 2 Noise Emissions Including Enclosure and Louvres

	Sound Pressure Level dB at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1K	2K	4K	8K	
WSAN-YSC4 480.12 RPM - Unit 1 (1m from Plant)	89.0	83.0	88.0	93.0	85.0	82.0	81.0	71.0	92.5
Acoustic Enclosure Attenuation	-4	-8	-13	-22	-24	-21	-18	-14	
Louvre Attenuation	-7	-9	-12	-24	-31	-33	-29	-30	
Distance Correction (1m to 21m)	-26.7	-26.7	-26.7	-26.7	-26.7	-26.7	-26.7	-26.7	
Sound Pressure Level at Receptor (21m) (Via Louvres)	51.3	39.3	36.3	20.3	3.3	1.3	7.3	0.3	30.6
WSAN-YSC4 480.12 RPM - Unit 1 (1m from Plant)	89.0	83.0	88.0	93.0	85.0	82.0	81.0	71.0	92.5
Acoustic Enclosure Attenuation	-4	-8	-13	-22	-24	-21	-18	-14	
Barrier Attenuation	-12.7	-15.3	-18.1	-21.0	-24.0	-26.9	-29.9	-32.9	
Distance Correction (1m to 21.7m)	-26.7	-26.7	-26.7	-26.7	-26.7	-26.7	-26.7	-26.7	
Sound Pressure Level at Receptor (21.7m) (Around Barrier)	45.6	33.0	30.2	23.3	10.3	7.4	6.4	-	26.1
Cumulative Noise Emissions at Receptor	52.3	40.2	37.3	25.1	11.1	8.4	9.9	2.1	31.9

Table 17.0 - WSAN-YSC4 480.12 RPM – Unit 1 Noise Emissions Including Enclosures and Louvres

	Sound Pressure Level dB at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1K	2K	4K	8K	
WSAN-YSC4 480.12 RPM - Unit 2 (1m from Plant)	89.0	83.0	88.0	93.0	85.0	82.0	81.0	71.0	92.5
Acoustic Enclosure Attenuation	-4	-8	-13	-22	-24	-21	-18	-14	
Louvre Attenuation	-7	-9	-12	-24	-31	-33	-29	-30	
Distance Correction (1m to 23.5m)	-27.4	-27.4	-27.4	-27.4	-27.4	-27.4	-27.4	-27.4	
Sound Pressure Level at Receptor (24.2m) (Via Louvres)	50.6	38.6	35.6	19.6	2.6	0.6	6.6	0.0	29.9
WDAN-iK4 420.2 LN - Unit 2 (1m from Plant)	89.0	83.0	88.0	93.0	85.0	82.0	81.0	71.0	92.5

Acoustic Enclosure Attenuation	-4	-8	-13	-22	-24	-21	-18	-14	
Barrier Attenuation	-13.4	-16.0	-18.9	-21.8	-24.8	-27.8	-30.8	-33.8	
Distance Correction (1m to 23.5m)	-27.4	-27.4	-27.4	-27.4	-27.4	-27.4	-27.4	-27.4	
Sound Pressure Level at Receptor (24.2m) (Around Barrier)	44.2	31.6	28.7	21.8	8.8	5.8	4.8	-	24.6
Cumulative Noise Emissions at Receptor	51.5	39.4	37.3	23.8	9.7	6.9	8.8	1.4	31.0

Table 18.0 - WSAN-YSC4 480.12 RPM – Unit 2 Noise Emissions Including Enclosures and Louvres

	Sound Pressure Level dB at Octave Band Centre Frequency (Hz)								**dBA**
	63	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**	
WDAN-iK4 420.2 LN – Unit 3 (1m from Plant)	72.0	74.0	76.0	80.0	81.0	78.0	70.0	59.0	75.4
Acoustic Enclosure Attenuation	-4	-8	-13	-22	-24	-21	-18	-14	
Louvre Attenuation	-7	-9	-12	-24	-31	-33	-29	-30	
Distance Correction (1m to 38.3m)	-31.7	-31.7	-31.7	-31.7	-31.7	-31.7	-31.7	-31.7	
Sound Pressure Level at Receptor (38.3m) (Via Louvres)	29.3	25.3	19.3	2.3	-	-	-	-	13.6
WDAN-iK4 420.2 LN – Unit 3 (1m from Plant)	72.0	74.0	76.0	80.0	81.0	78.0	70.0	59.0	75.4
Acoustic Enclosure Attenuation	-4	-8	-13	-22	-24	-21	-18	-14	
Barrier Attenuation	-9.9	-12.1	-14.7	-17.5	-20.4	-23.3	-26.3	-29.3	
Distance Correction (1m to 38.3m)	-31.7	-31.7	-31.7	-31.7	-31.7	-31.7	-31.7	-31.7	
Sound Pressure Level at Receptor (38.3m) (Around Barrier)	26.4	22.2	16.6	8.8	4.9	2.0	-	-	13.1
Cumulative Noise Emissions at Receptor	31.1	27.0	21.2	9.7	5.3	2.4	-	-	16.4

Table 19.0 - WDAN-iK4 420.2 LN – Unit 3 Noise Emissions Including Enclosure and Louvres

	Sound Pressure Level dB at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1K	2K	4K	8K	
WDAN-iK4 420.2 LN – Unit 3 (1m from Plant)	72.0	74.0	76.0	80.0	81.0	78.0	70.0	59.0	75.4
Acoustic Enclosure Attenuation	-4	-8	-13	-22	-24	-21	-18	-14	
Louvre Attenuation	-7	-9	-12	-24	-31	-33	-29	-30	
Distance Correction (1m to 44.1m)	-32.9	-32.9	-32.9	-32.9	-32.9	-32.9	-32.9	-32.9	
Sound Pressure Level at Receptor (44.1m) (Via Louvres)	28.1	24.1	18.1	1.1	-	-	-	-	12.7
WDAN-iK4 420.2 LN – Unit 3 (1m from Plant)	72.0	74.0	76.0	80.0	81.0	78.0	70.0	59.0	75.4
Acoustic Enclosure Attenuation	-4	-8	-13	-22	-24	-21	-18	-14	
Barrier Attenuation	-10.1	-12.4	-15.0	-17.8	-20.7	-23.6	-26.6	-29.6	
Distance Correction (1m to 44.1m)	-32.9	-32.9	-32.9	-32.9	-32.9	-32.9	-32.9	-32.9	
Sound Pressure Level at Receptor (44.1m) (Around Barrier)	25.0	20.7	15.1	7.3	3.4	0.5	-	-	11.6
Cumulative Noise Emissions at Receptor	29.8	25.7	19.9	8.2	3.8	1.0	-	-	15.2

Table 20.0 - WDAN-iK4 420.2 LN – Unit 4 Noise Emissions Including Enclosures and Louvres

The following table predicts the cumulative plant noise emissions at 40 Bloomsbury Street for all external non-emergency plant including attenuation provided by acoustic enclosures and acoustic louvres.

	Sound Pressure Level dB at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1K	2K	4K	8K	
WDAN-iK4 420.2 LN – Unit 1	37.2	33.1	27.1	13.8	8.8	5.8	0.7	-	21.8
WDAN-iK4 420.2 LN – Unit 2	35.6	31.5	25.6	12.4	7.4	4.6	-	-	20.4
WSAN-YSC4 480.12 RPM – Unit 1	52.3	40.2	37.3	25.1	11.1	8.4	9.9	2.1	31.9
WSAN-YSC4 480.12 RPM – Unit 2	51.5	39.4	37.3	23.8	9.7	6.9	8.8	1.4	31.0
WDAN-iK4 420.2 LN – Unit 3	31.1	27.0	21.2	9.7	5.3	2.4	-	-	16.4
WDAN-iK4 420.2 LN – Unit 4	29.8	25.7	19.9	8.2	3.8	1.0		-	15.2
Cumulative Noise Emissions at Receptor	55.1	43.7	40.7	27.9	16.1	13.3	13.0	5.5	35.0

Table 21.0 – Cumulative External Non-Emergency Plant Noise Emissions Including Enclosures and Louvres

The table above predicts that the noise emissions from external non-emergency plant will comply with the daytime limit non-emergency plant limit at 40 Bloomsbury Street. When all items of external non-emergency plant are running simultaneously, it is predicted that the night-time noise limit will just be exceeded at 40 Bloomsbury Street. The M&E consultant has suggested that it is highly unlikely that of the WSAN-YSC4 480.12 RPM units will be running simultaneously and at full capacity between 23:00 and 07:00. It is therefore deemed that the night-time plant noise emissions limit will be achieved with the proposed mitigation measures in-situ. It should also be considered that BS 8233:2014 specifies an internal ambient noise level target of 30 dBL_{Aeq} inside bedrooms during the night-time. The same British Standard also predicts that 15dB of attenuation can be provided by a partially open window. This suggests that even if all items of external plant were to run simultaneously during night-time hours the plant noise emissions will fall well below the night-time internal ambient noise criteria specified in BS8233 inside 40 Bloomsbury Street if the windows are open.

Table 12.0 of this report predicts that the internal non-emergency plant noise emissions will be 62 dB(A) at 40 Bloomsbury Street without any façade attenuation. The following table outlines the façade sound insulation performance requirements for the SWEC building. Considering that the mitigation measures for the external non-emergency plant are predicted to reduce the noise emissions to 35 dB(A), the façade for the SWEC building needs to reduce noise emissions from the internal Water Source Heat Pumps to below 34 dB(A) at 40 Bloomsbury Street to ensure that the daytime noise limit is not being exceeded at the noise sensitive receptor. The following table details the attenuation requirements for the façade of SWEC building.

Description	dBA SPL
Noise Limit for Level 3 Plant Emissions at Receptor	34.0
Total Sound Level in Level 3 Plant Room	86.0
Distance Attenuation from the façade to the receptor (16m)	24
Plant Noise Emissions at 40 Bloomsbury Street without Façade Attenuation	62.0
Minimum Required SWEC Level Three Façade Attenuation (Rw)	28.0

Table 22.0 – SWEC Level Three Façade Attenuation Requirements

6.3 National Planning Policy Framework

In this instance where British Standard 4142:2014 'Methods for rating and assessing industrial and commercial sound' (BS 4142) is applicable, The London Borough of Camden outline a design criteria for a 'Rating Level' of 10dB below background (15dB if tonal components are present).

Existing Noise Sensitive Receptor	Assessment Location	Design Period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAEL (Red)
Commercial (premises used for residential	Outside living or dining or bedroom window (façade)	Day	'Rating level' 10dB below background	'Rating level' between 9dB below and 5dB above background	'Rating level' greater than 5dB above background

purposes i.e. hotel)					
Commercial (premises used for residential purposes i.e. hotel)	Outside bedroom window (façade)	Night	'Rating level' 10dB below and events exceeding 57dBL_{Amax}	'Rating level' between 9dB below and 5dB above background or noise events between 57dB and 88dB L_{Amax}	'Rating level' greater than 5dB above background and/or events exceeding 88dB$_{LAmax}$

Table 23.0 – Effects Levels applicable to proposed industrial and commercial developments (including plant and machinery)

The noise impact assessment indicates that during the daytime period the plant noise emissions will be 13dB below the prevailing background sound level at the most exposed noise sensitive receptor with the recommended mitigation measures in place. According to Table 23.0, the noise source under investigation is below the Lowest Observed Adverse Effect Level. During the night-time period the plant noise emissions are predicted to be 9dB below the prevailing background sound level with all equipment running simultaneously at full capacity. This is just above the LOAEL but still well below the SOAEL. The M&E consultant has indicated that that it is highly unlikely that all external units will be running simultaneously during night-time hours. Therefore, the plant noise emissions are likely to fall below the Lowest Observed Adverse Effect Level. The London Borough of Camden considers a design criterion of 15dB below the background sound level if the source contains tonal components. Considering that the objective method for determining the presence of tones requires 1/3 octave band data, it is not possible at this stage to know if the noise source will contain tonal components. It is possible that several items of building services plant running simultaneously may result in tonal components within the specific sound. However, considering that during both the daytime and night-time periods plant noise emissions are predicted to be more than 10dB below the prevailing the background, tonal components are highly unlikely to be perceptible at the noise sensitive receptor because the plant noise emissions are not likely to be contributing to the acoustic when they are so far below the prevailing background sound level.

7 Conclusions

A sound survey was undertaken to establish the prevailing acoustic climate for a new SWEC building at The British Museum, London as part of the Energy Centre Program. Sound measurements were taken at one location to represent background sound levels at the most-exposed noise sensitive receptor, 40 Bloomsbury Street.

Plant noise emission criteria have been set for non-emergency and emergency building services plant based on the separate requirements of The London Borough of Camden.

An environmental noise impact assessment has been carried out to determine the plant noise emissions from non-emergency plant associated with the proposed building.

The initial environmental noise impact assessment predicts that noise emissions from non-emergency plant will exceed the stipulated plant noise emission limits at the closest noise sensitive receptor.

Mitigation measures, notably acoustic enclosures and acoustic louvre screening have been specified to reduce plant noise emissions to fall in-line with The London Borough of Camden criteria.

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Signed for and on behalf of Encon Associates Limited

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Date: 22nd May 2023

Appendix A – Acoustic Terminology & Definitions

Sound Pressure	The fluctuations in air pressure, from the steady atmospheric pressure, created by sound, measured in pascals (Pa).
Sound Pressure Level (SPL)	The sound pressure measured on a decibel scale relative to a standard reference pressure of 20µPa (20x10-6 Pascals).
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 log10 (s1 / s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20µPa.
Frequency (Hz)	The pitch of the sound, measured in Herts (Hz)
Integrating Sound Level Meter	An instrument used for measuring sound levels with the capacity to perform calculations to derive other parameters.
Calibration	A check of the function of a sound level meter by comparing the meter reading with a known sound pressure level. This is performed in the field before and after measurement and by a laboratory every year calibrators and every two years for Sound Level Meters.
A-Weighting, dB(A)	A frequency waiting devised to attempt to take the fact that human response to sound is not equally sensitive at all frequencies into account.
Z-Weighting	A zero frequency weighting (often referred to as unweighted).
Attenuation	Noise reduction, measured in decibels.
Ambient Sound Level $L_{Aeq.T}$	The total encompassing sound in a given situation, at a given time. Usually composed of sounds from many sources, near and far.
Residual Sound Level $L_{Aeq.T}$	The ambient sound remaining when the specific sound source is suppressed to a degree it does not contribute to the ambient sound.
Specific Sound Level $L_{Aeq.T}$	The equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, Tr
Rating Level $L_{Ar,\ tr}$	The specific sound level plus any adjustment for the characteristic features of the sound
Background Sound Level $L_{A90.T}$	A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels.
Frequency Analysis	Analysis of a sound into its frequency components. Commonly 1/1 or 1/3 octave bands
Frequency Spectrum	A graph resulting from frequency analysis and showing different levels of the signal in the various frequency bands.
Octave-bands	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
Noise Index	A method of evaluating or rating a noise, usually by assigning a single number to it, based on some combination of its physical parameters (sound pressure level, frequency, duration) and other factors such as time of day, tonal characteristics and impulsive characteristics.
Leq, T	Otherwise referred to as the 'continuous equivalent noise level' of a period of time (T). This is the steady noise level which contains the same amount of energy as the time varying sound level that was recorded.
Lmax,T	The maximum RMS sound pressure level that occurs within a specified time period. It is used often to describe occasional loud noise events that may have little influence on the Leq but will have an effect on the overall acoustic environment. The time weighting (Fast or Slow) is usually specified.

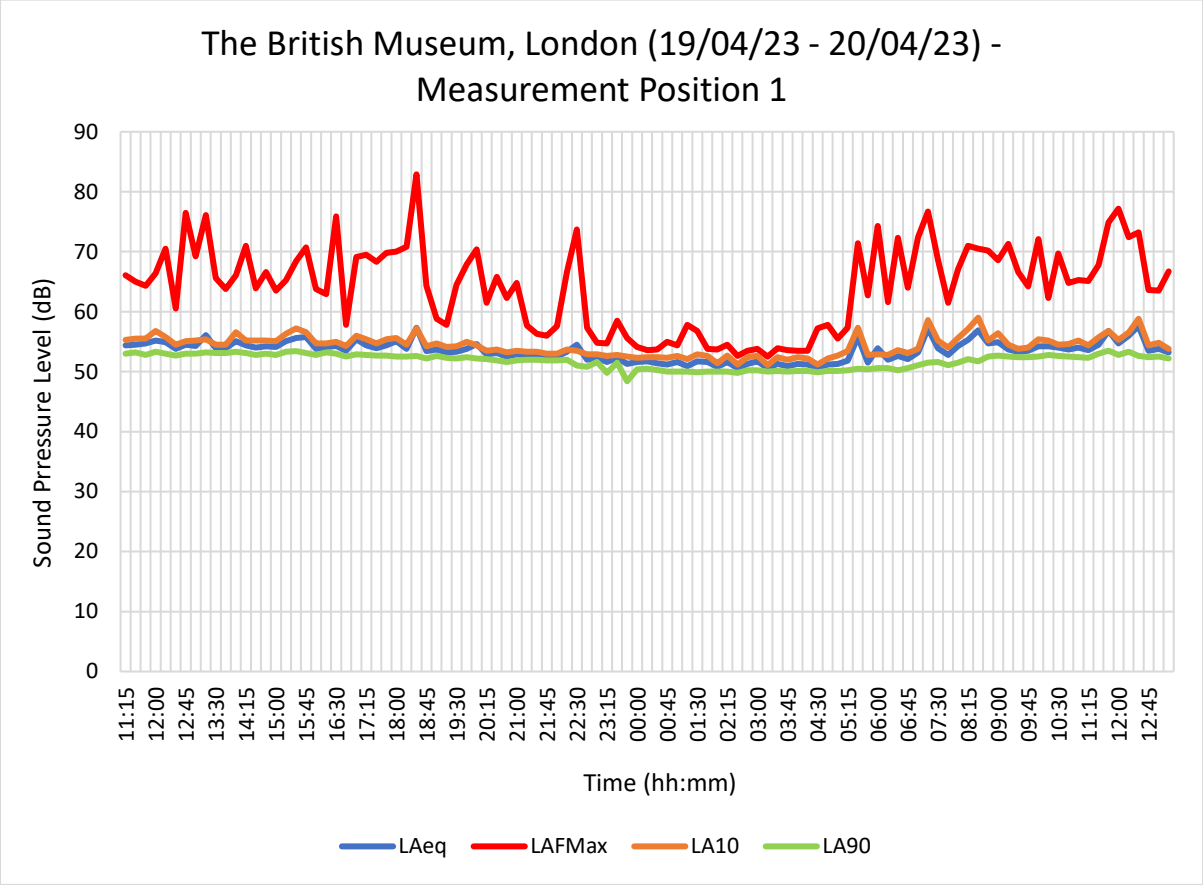
L90, T	The noise level exceeded for 90% of the specified time period (T). It is often used to characterise the background noise.
L10, T	The noise level exceeded for 10% of the specified time period (T). It is often used to characterise road traffic noise.
Free-Field	A situation where the radiation from a sound source is completely unaffected by the presence of reflective surfaces. In terms of environmental noise measurement, it is usually taken to mean at least 3.5m away from 3.5m away from reflective surfaces with the exception of the ground.
Façade Noise Level	A noise level measured within 3m of a building façade, which contains a contribution arising from reflection of sound at the façade. The difference between the façade level and free-field level is described as the façade correction factor.
Noise Sensitive Receptor	Premises that are used for purposes sensitive to noise and that require protection.
Line Source	A source of sound that as distance increases away from the source it still appears large in one dimension. Attenuation of this form of source occurs at a distance of (a/π) where a is the largest dimension of the source.
Point Source	A source of sound that as distance increases away from the source it appears as a point in space. Attenuation of this form of source occurs at a distance of (b/π) where b is the smallest dimension of the source.
Time Weighting	One of the standard averaging times (Fast, Slow or Impulsive) used for the measurement of RMS sound pressure level in sound level meters, specified in ISO 61671-1.
Rw	Single number quantity which characterises the airborne the airborne sound insulation of a material or building element over a range of frequencies, based on laboratory measurements.
DnT,w + Ctr	A single value that characterises the airborne sound insulation performance using the Ctr: spectrum adaption terms described in BS EN ISO 717-1. The value is based on field measurements and the value represents total sound transmission including flanking sound, not just the partition.

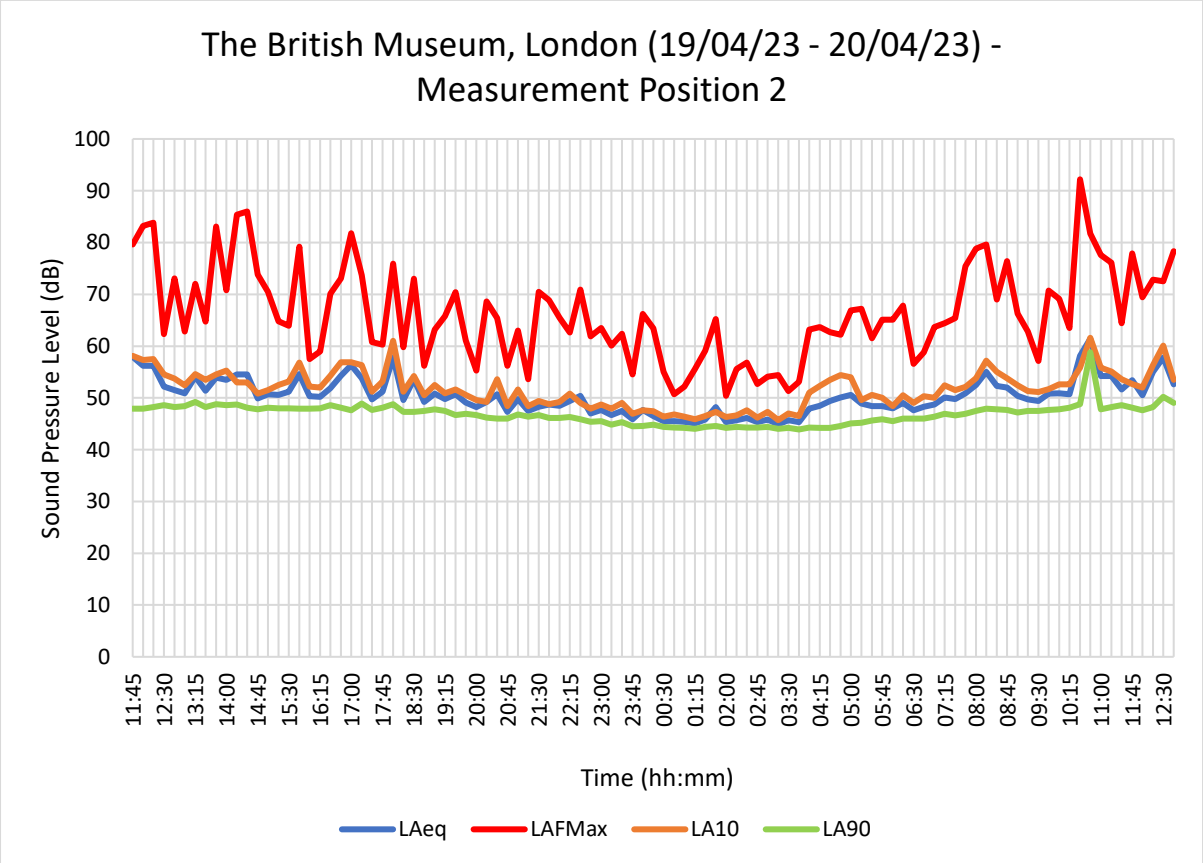
The table below presents an indication of sound levels associated with the environment starting from 0dB (the threshold of hearing) to 140dB (The threshold of pain).

Sound Level	Location/Activity
0 dB(A)	Threshold of Hearing
20 – 30 dB(A)	Inside Quiet Bedroom at Night
30 – 40 dB(A)	Inside a Living Room During the Day
40 – 50 dB(A)	Inside Typical Office
50 – 60 dB(A)	Inside a Car
60 – 70 dB(A)	Typical High Street
70 – 90 dB(A)	Inside Factory
100 – 110 dB(A)	Burglar Alarm at 1m
110 – 130 dB(A)	Jet Aircraft on Take Off
140 dB(A)	Threshold of Pain

The 'A' denotes the A-weighting scale used to replicate the frequency response of the human ear.

Appendix B – Time History Graphs





Appendix C - Weather Conditions

Upon installation of the noise monitoring equipment on 19/04/2023 the sky had 40% cloud cover. When the equipment collected on the morning of 20/04/23, the sky had 50% cloud cover. No precipitation occurred when sound levels were being measured 19/04/23 – 20/02/23.

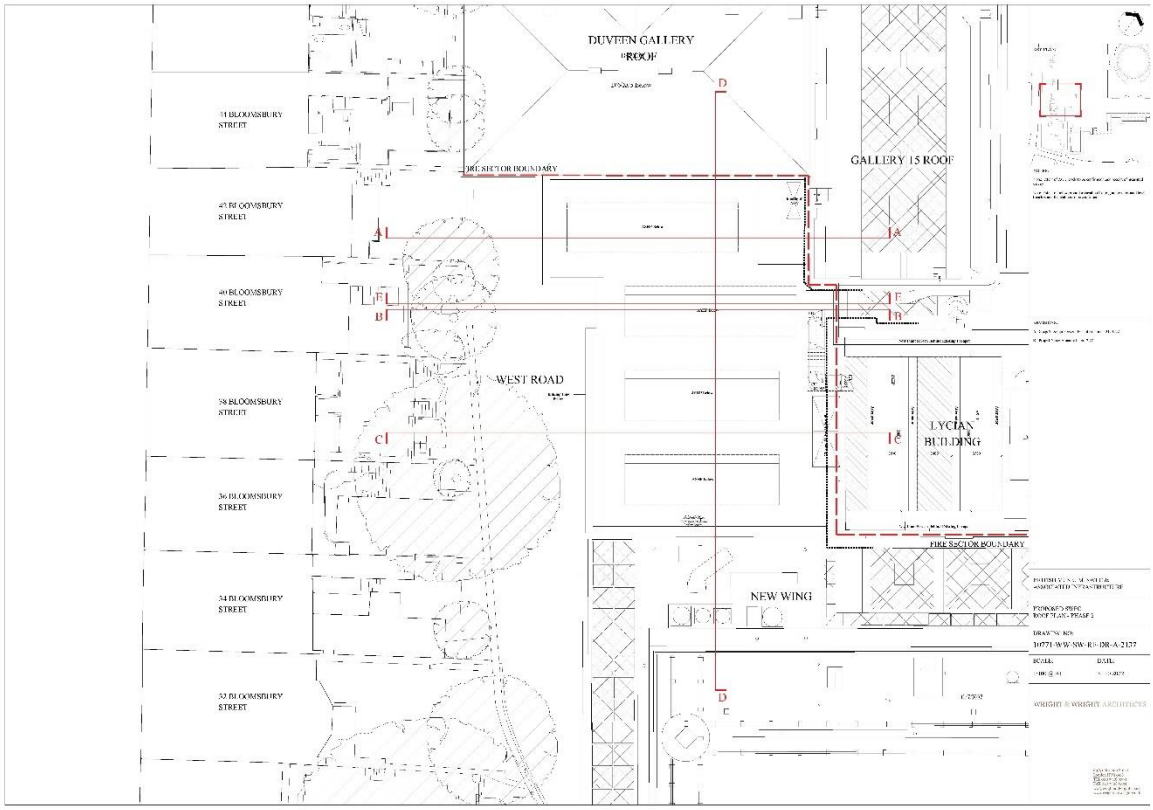
Device Information:				
Name:	WEATHER - 2655332			
Model:	5500			
Serial:	3E+06			
Firmware:	1.47			
Profile Version:				
Hardware Version:	Rev 14			
LiNK Version:	1.04.04			
Time	Temp	Rel. Hum	Wind Spe	Mag. Dir.
yyyy-MM-dd hh:mm:ss	Celsius	%	m/s	Degrees
19/04/2023 11:10	15.4	62	2.8	139
19/04/2023 11:20	15.6	60.2	0.8	137
19/04/2023 11:30	17	58.5	0.7	76
19/04/2023 11:40	15.7	61	1	88
19/04/2023 11:50	15.5	59.8	1	132
19/04/2023 12:00	18.4	60	0.8	139
19/04/2023 12:10	17	59.4	1.4	135
19/04/2023 12:20	15.9	58.7	1.7	96
19/04/2023 12:30	15.3	57.6	1	143
19/04/2023 12:40	15.6	57.2	2.1	139
19/04/2023 12:50	17.4	57.3	0.4	136
19/04/2023 13:00	16	57	2	124
19/04/2023 13:10	16.2	56.6	0	140
19/04/2023 13:20	15.4	56.3	1.2	140
19/04/2023 13:30	16.1	56.2	0.8	137
19/04/2023 13:40	15.5	55.9	2.3	141
19/04/2023 13:50	15.6	55.7	0.6	140
19/04/2023 14:00	15.7	55.6	1.1	140
19/04/2023 14:10	16.1	55.7	1.1	137
19/04/2023 14:20	16.2	55.5	2.1	135
19/04/2023 14:30	16.4	54.7	1.7	123
19/04/2023 14:40	15.8	53.5	0.8	140
19/04/2023 14:50	15.1	52.3	2.5	141
19/04/2023 15:00	15.2	51.5	1.3	131
19/04/2023 15:10	15.2	50.7	0.7	140
19/04/2023 15:20	14.7	49.9	1.5	121
19/04/2023 15:30	14.5	49.2	1.5	104
19/04/2023 15:40	14.3	48.5	2.5	135
19/04/2023 15:50	14.4	47.9	1	75
19/04/2023 16:00	14.4	47.2	0.9	134
19/04/2023 16:10	14	46.4	0.3	89
19/04/2023 16:20	13.9	45.6	1.3	130
19/04/2023 16:30	13.7	45.3	0.8	138
19/04/2023 16:40	13.6	44.2	0.8	144
19/04/2023 16:50	13.5	43.2	1.3	140
19/04/2023 17:00	13.4	42.2	1	139
19/04/2023 17:10	13.2	41.6	0.6	123
19/04/2023 17:20	13.1	41.1	1.3	144
19/04/2023 17:30	12.9	40.6	1.1	133
19/04/2023 17:40	12.9	40.3	1.1	138
19/04/2023 17:50	12.7	40.2	1.2	144
19/04/2023 18:00	12.3	39.9	0.9	124

19/04/2023 18:10	12.3	39.9	1.2	139
19/04/2023 18:20	12	40	0.6	141
19/04/2023 18:30	11.9	40.1	1.2	142
19/04/2023 18:40	11.7	40.3	0.6	142
19/04/2023 18:50	11.5	40.7	0.4	138
19/04/2023 19:00	11.4	41.2	1.6	144
19/04/2023 19:10	11.3	41.8	1.3	141
19/04/2023 19:20	11	42.4	0.7	123
19/04/2023 19:30	11	43	0.4	142
19/04/2023 19:40	10.8	43.7	0.9	145
19/04/2023 19:50	10.6	44.2	0.6	137
19/04/2023 20:00	10.4	45	0.5	135
19/04/2023 20:10	10.2	45.7	1.4	130
19/04/2023 20:20	9.9	46.2	1.2	92
19/04/2023 20:30	9.9	46.6	0.6	140
19/04/2023 20:40	9.6	47	0.7	138
19/04/2023 20:50	9.5	47.2	0.8	145
19/04/2023 21:00	9.2	47.3	1.2	99
19/04/2023 21:10	9.2	47.5	1.2	93
19/04/2023 21:20	8.9	47.5	0.9	94
19/04/2023 21:30	8.8	47.6	0.7	144
19/04/2023 21:40	8.7	47.8	0.8	145
19/04/2023 21:50	8.5	48	1.2	145
19/04/2023 22:00	8.4	48.4	1.5	141
19/04/2023 22:10	8.2	48.7	0.6	145
19/04/2023 22:20	8.1	49.1	0.4	143
19/04/2023 22:30	7.9	49.6	1.2	109
19/04/2023 22:40	7.8	49.9	0.8	126
19/04/2023 22:50	7.7	50.4	0.5	87
19/04/2023 23:00	7.8	51	0.9	145
19/04/2023 23:10	7.5	51.5	1.4	138
19/04/2023 23:20	7.4	52.1	0.7	120
19/04/2023 23:30	7.2	52.6	0	79
19/04/2023 23:40	7.3	53.1	0.8	144
19/04/2023 23:50	7.2	53.5	0.6	114
20/04/2023 00:00	6.9	54	0.7	88
20/04/2023 00:10	7	54.5	1	101
20/04/2023 00:20	6.7	55	0.6	132
20/04/2023 00:30	6.8	55.6	0.6	134
20/04/2023 00:40	6.7	56.2	0.6	125
20/04/2023 00:50	6.8	56.9	0.7	144
20/04/2023 01:00	6.7	57.7	0.6	122
20/04/2023 01:10	6.7	58.7	0.8	128
20/04/2023 01:20	6.6	59.8	0	131
20/04/2023 01:30	6.5	60.8	0	78
20/04/2023 01:40	6.6	61.8	0.8	98
20/04/2023 01:50	6.5	62.7	0.6	133
20/04/2023 02:00	6.4	63.7	0	125
20/04/2023 02:10	6.4	64.6	0	106
20/04/2023 02:20	6.6	65.5	0.7	119
20/04/2023 02:30	6.4	66.4	0	138
20/04/2023 02:40	6.5	67.3	0	144
20/04/2023 02:50	6.5	68.1	0.8	114

20/04/2023 03:00	6.5	68.8	0.6	130
20/04/2023 03:10	6.5	69.5	0	120
20/04/2023 03:20	6.5	70.1	0.5	118
20/04/2023 03:30	6.5	70.7	0.6	124
20/04/2023 03:40	6.5	71.2	0	122
20/04/2023 03:50	6.6	71.6	0.7	95
20/04/2023 04:00	6.6	72	1	105
20/04/2023 04:10	6.5	72.3	0.9	73
20/04/2023 04:20	6.5	72.5	0.9	100
20/04/2023 04:30	6.6	72.7	0.4	111
20/04/2023 04:40	6.6	72.9	0.6	143
20/04/2023 04:50	6.6	72.9	0	132
20/04/2023 05:00	6.6	72.9	0.7	135
20/04/2023 05:10	6.4	72.8	0.4	118
20/04/2023 05:20	6.4	72.7	0.5	94
20/04/2023 05:30	6.6	72.6	0.4	118
20/04/2023 05:40	6.6	72.5	0	135
20/04/2023 05:50	6.7	72.5	0	100
20/04/2023 06:00	6.8	72.4	1.4	119
20/04/2023 06:10	7	72.3	0.4	108
20/04/2023 06:20	6.9	72.3	0.8	108
20/04/2023 06:30	7.3	72.2	0.6	99
20/04/2023 06:40	7.5	72	1	141
20/04/2023 06:50	7.7	71.9	0.6	103
20/04/2023 07:00	7.9	71.9	0.9	81
20/04/2023 07:10	8.2	72.1	1.1	110
20/04/2023 07:20	8.4	72.5	0.9	98
20/04/2023 07:30	8.7	73	0	106
20/04/2023 07:40	9.2	73.5	0.4	140
20/04/2023 07:50	9.6	73.8	0.4	139
20/04/2023 08:00	10	73.4	0	140
20/04/2023 08:10	10.2	72.7	1.7	137
20/04/2023 08:20	10.6	71.5	0.4	116
20/04/2023 08:30	11.2	70.5	0.8	130
20/04/2023 08:40	11.6	69.4	0	134
20/04/2023 08:50	12	68.4	0.6	132
20/04/2023 09:00	11.8	67.4	1.9	134
20/04/2023 09:10	12.2	66.3	1.1	80
20/04/2023 09:20	12.7	64.8	1.9	126
20/04/2023 09:30	13.5	63.3	1.1	143
20/04/2023 09:40	13.1	61.5	2	113
20/04/2023 09:50	12.9	59.8	1.6	89
20/04/2023 10:00	15.9	59.5	1.2	89
20/04/2023 10:10	16.6	59.1	0.8	110
20/04/2023 10:20	15.3	58.3	1.9	135
20/04/2023 10:30	16.9	57.5	1.4	116
20/04/2023 10:40	18.3	56.6	0	139
20/04/2023 10:50	16.3	55.2	1	137
20/04/2023 11:00	16.1	53.9	3.1	99
20/04/2023 11:10	16.6	52.7	2.1	123
20/04/2023 11:20	16.8	51.9	1.5	91
20/04/2023 11:30	17.3	51.4	0	138
20/04/2023 11:40	15.8	50.5	1.8	136

20/04/2023 11:50	15.8	49.8	1.5	79
20/04/2023 12:00	16.2	49.2	1.8	143
20/04/2023 12:10	15.3	48.3	3.2	123
20/04/2023 12:20	15.9	47.5	1.3	101
20/04/2023 12:30	18	53.2	0	236
20/04/2023 12:40	17.9	59.3	0	113
20/04/2023 12:50	18.7	65.3	0	112

Appendix D – Site Plan




ASHP ATTENUATOR
ASHP ATTENUATOR
ASHP ATTENUATOR
TOILETS
OFFICE
MENS AREA
OFFICE
MENS AREA
WHIPS AND ANCILLARY PLANT
GENERATOR SWITCHROOM
SWITCHBOARDS
UV GENERATOR ROOM
GENERATOR FUEL TANK
GENERATOR
WATER TABLE
99 BLOOMSBURY STREET
WITT ROAD

Appendix E – Instrument Calibration Certificates

CERTIFICATE OF CALIBRATION

ISSUED BY **Cirrus Research plc**

DATE OF ISSUE **19 August 2021** CERTIFICATE NUMBER **161680**

Cirrus Research plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Page 1 of 2

Approved signatory
M.McDonald
Electronically signed:

M J McDonald

Sound Level Meter : IEC 61672-3:2013

Instrument information

Manufacturer:	Cirrus Research plc	Notes:
Model:	CR:171B	
Serial number:	G303153	
Class:	1	
Firmware version:	5.6.3177	

Test summary

The calibration was performed respecting the requirements of ISO/IEC 17025:2017.
Periodic tests were performed in accordance with procedures from IEC 61672-3:2013.

The sound level meter submitted for testing successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full specifications of IEC 61672-1:2013 because (a) evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to determine that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013 or correction data for acoustical test of frequency weighting were not provided in the Instruction Manual and (b) because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Notes

CERTIFICATE OF CALIBRATION

Certificate Number: **161680**

Page 2 of 2

Environmental conditions

The following conditions were recorded at the time of the test:

Before	Pressure:	99.90 kPa	Temperature:	21.9 °C	Humidity: 38.7 %
After	Pressure:	99.97 kPa	Temperature:	22.0 °C	Humidity: 42.1 %

Test equipment

Equipment	Manufacturer	Model	Serial number
Signal Generator	TTi	TGA1241	439193
Attenuator	Cirrus Research	ZE:952	80381
Environmental Monitor	Comet	T7510	17963955

Additional instrument information

Instruction manual:

Reference level range: Single range

Pattern approval: No

Source of pattern approval: -

Preamplifier

Model: MV:200F

Serial number: 11542F

Microphone

Model: MK:224

Serial number: 214523A

Test results summary

Test	Result
Toneburst response	Complies
Electrical noise-floor	Complies
Linearity	Complies
Electrical Frequency weightings	Complies
Frequency and time weightings at 1 kHz	Complies
C-weighted peak	Complies
Overload indication	Complies
High level stability	Complies
Long-term stability	Complies

CERTIFICATE OF CALIBRATION

ISSUED BY **Cirrus Research plc**

DATE OF ISSUE **19/08/21** CERTIFICATE NUMBER **161682**

Cirrus Research plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Page 1 of 2

Test engineer:
D.Swalwell
Electronically signed:

Microphone

Microphone capsule

Manufacturer: Cirrus Research plc

Model: MK:224

Serial Number: 214523A

Calibration procedure

Open circuit: 50.1 mV/Pa

Sensitivity at 1 kHz: -26.0 dB rel 1 V/Pa

The microphone capsule detailed above has been calibrated to the published data as described in the operating manual of the associated sound level meter (where applicable).

The frequency response was measured using an electrostatic actuator in accordance with BS EN 61094-6:2005 with the free-field response derived via standard correction data traceable to a National Measurement Institute.

The absolute sensitivity at 1 kHz was measured using an acoustic calibrator conforming to IEC 60942:2003 Class 1.

Environmental conditions

Pressure: 99.60 kPa

Temperature: 20.0 °C

Humidity: 31.0 %

CERTIFICATE OF CALIBRATION

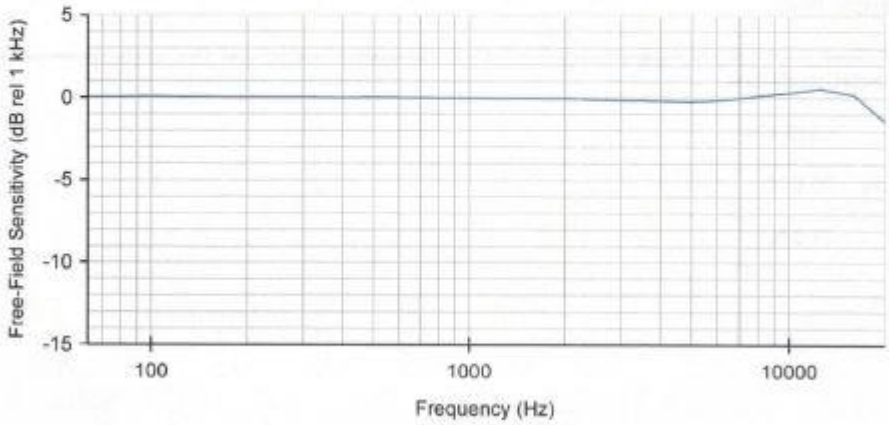
Certificate Number: 161682

Page 2 of 2

Free-Field Frequency Response : Tabular

Frequency (Hz)	Free-Field Sensitivity (dB rel 1 kHz)	Actuator Response (dB)
63	0.06	-0.11
80	0.05	-0.01
100	0.09	0.12
125	0.05	0.09
160	0.05	0.11
200	0.04	0.11
250	0.05	0.13
315	0.04	0.09
400	0.02	0.09
500	0.04	0.10
630	0.03	0.08
800	0.01	0.06
1 000	0.00	0.03
1 250	-0.02	-0.03
1 600	-0.02	-0.10
2 000	-0.02	-0.20
2 500	-0.08	-0.39
3 150	-0.13	-0.67
4 000	-0.16	-1.05
5 000	-0.19	-1.55
6 300	-0.11	-2.19
8 000	0.14	-3.03
10 000	0.33	-4.33
12 500	0.58	-5.84
16 000	0.21	-7.59
20 000	-1.38	-10.39

Free-Field Frequency Response : Graphical



CERTIFICATE OF CALIBRATION

ISSUED BY **Cirrus Research plc**

DATE OF ISSUE **19 August 2021** CERTIFICATE NUMBER **161679**

Cirrus Research plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Page 1 of 2

Approved signatory
M.McDonald
Electronically signed:

Sound Level Meter : IEC 61672-3:2013

Instrument information

Manufacturer:	Cirrus Research plc	Notes:
Model:	CR:171B	
Serial number:	G303154	
Class:	1	
Firmware version:	5.6.3177	

Test summary

The calibration was performed respecting the requirements of ISO/IEC 17025:2017.
Periodic tests were performed in accordance with procedures from IEC 61672-3:2013.

The sound level meter submitted for testing successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full specifications of IEC 61672-1:2013 because (a) evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to determine that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013 or correction data for acoustical test of frequency weighting were not provided in the Instruction Manual and (b) because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Notes

CERTIFICATE OF CALIBRATION

Certificate Number: **161679**

Page 2 of 2

Environmental conditions

The following conditions were recorded at the time of the test:

Before	Pressure:	99.97 kPa	Temperature:	22.0 °C	Humidity: 43 %
After	Pressure:	99.91 kPa	Temperature:	22.2 °C	Humidity: 43 %

Test equipment

Equipment	Manufacturer	Model	Serial number
Signal Generator	TTi	TGA1241	439193
Attenuator	Cirrus Research	ZE 952	80381
Environmental Monitor	Comet	T7510	17963955

Additional instrument information

Instruction manual:

Reference level range: Single range

Pattern approval: No

Source of pattern approval: -

Preamplifier

Model: MV:200F

Serial number: 11733F

Microphone

Model: MK:224

Serial number: 214535A

Test results summary

Test	Result
Toneburst response	Complies
Electrical noise-floor	Complies
Linearity	Complies
Electrical Frequency weightings	Complies
Frequency and time weightings at 1 kHz	Complies
C-weighted peak	Complies
Overload indication	Complies
High level stability	Complies
Long-term stability	Complies

CERTIFICATE OF CALIBRATION

ISSUED BY	Cirrus Research plc		
DATE OF ISSUE	19/08/21	CERTIFICATE NUMBER	161681

Cirrus Research plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Page 1 of 2

Test engineer:
D.Swalwell
Electronically signed:

Microphone

Microphone capsule

Manufacturer: Cirrus Research plc

Model: MK:224

Serial Number: 214535A

Calibration procedure

Open circuit: 45.9 mV/Pa

Sensitivity at 1 kHz: -26.8 dB rel 1 V/Pa

The microphone capsule detailed above has been calibrated to the published data as described in the operating manual of the associated sound level meter (where applicable).

The frequency response was measured using an electrostatic actuator in accordance with BS EN 61094-6:2005 with the free-field response derived via standard correction data traceable to a National Measurement Institute.

The absolute sensitivity at 1 kHz was measured using an acoustic calibrator conforming to IEC 60942:2003 Class 1.

Environmental conditions

Pressure: 99.60 kPa

Temperature: 20.0 °C

Humidity: 31.0 %

CERTIFICATE OF CALIBRATION

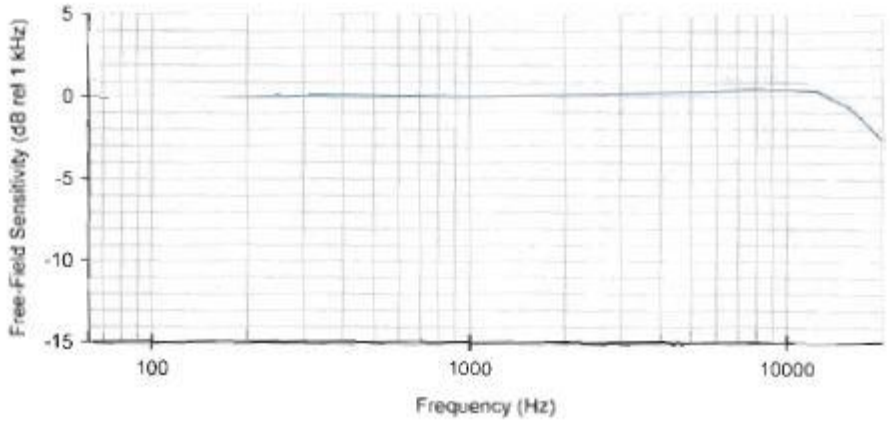
Certificate Number
161681

Page 2 of 2

Free-Field Frequency Response : Tabular

Frequency (Hz)	Free-Field Sensitivity (dB rel 1 kHz)	Actuator Response (dB)
63	0.01	-0.19
80	0.02	-0.07
100	0.00	-0.06
125	0.03	0.02
160	0.03	0.04
200	0.02	0.05
250	0.03	0.06
315	0.01	0.01
400	0.01	0.03
500	0.01	0.02
630	0.01	0.02
800	0.02	0.01
1 000	0.00	-0.02
1 250	0.01	-0.04
1 600	0.03	-0.08
2 000	0.06	-0.15
2 500	0.09	-0.25
3 150	0.14	-0.43
4 000	0.19	-0.70
5 000	0.26	-1.09
6 300	0.36	-1.71
8 000	0.46	-2.70
10 000	0.37	-4.25
12 500	0.32	-6.19
16 000	-0.75	-8.70
20 000	-2.59	-11.71

Free-Field Frequency Response : Graphical



Laboratory Location
Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, Essex, GB-CM6 1HD
Phone 01371 871030

Certificate of Calibration and Conformance

Certificate number: **U41812**

Test Object: **Sound Calibrator**

Producer: **Cirrus**
Type: **515**
Serial number: **96656**
Customer: **Encon Associates Ltd**
Address: **10 Chapel Lane, Arnold, Nottingham, NG5 7DR**
Contact Person: **Benjamin Daniel Phipps**
Order No:

Measurement Results	Level dB	Level Stability dB	Frequency Hz	Distortion %
Measurement 1	93.86	0.02	1000.30	0.76
Measurement 2	93.88	0.01	1000.30	0.82
Measurement 3	93.89	0.01	1000.29	0.65
Result (Average):	**93.88**	**0.01**	**1000.30**	**0.74**
Expanded Uncertainty:	0.1	0.02	1	0.27
Degree of Freedom:	>100	>100	>100	>100
Coverage Factor:	2	2	2	2

The stated level is relative to 20µPa. The level is traceable to National Standards. The stated level is valid at reference conditions. The following correction factors have been applied during the measurement
Pres:0 dB/kPa Temp:0 dB/°C Humi:0 dB/%RH Load volume: 0 dB/mm3

Conditions	*Pressure kPa*	*Temperature °C*	*Humidity %RH*
Reference conditions	101.325	23	50
Measurement conditions	101.704 ±0.040	21.9 ±0.1	49.8 ±1.6

The reported expanded uncertainty of measurements is based on a standard uncertainty multiplied by the coverage factor of k=2, providing a level of confidence of approximately 95%. Where the degrees of freedom are insufficient to maintain this confidence level, the coverage factor is increased to maintain this confidence level. The uncertainty has been determined in accordance with UKAS requirements.

Records: K:\C A\Calibration\Nor-1504\Nor-1018 CalCal\2022\CIR515_96656_M1.nmf

Preconditioning
The equipment was preconditioned for more than 4 hours in the specified calibration environment.

Method
Calibration has been performed as set out in the current version of CA Technical procedure TP01

Calibration Dates:

Received date:	19/08/2022	Reviewed date:	31/08/2022
Calibration date:	30/08/2022	Issued date:	31/08/2022

Technicians: (Electronic certificate)
Calibrated by: *David Egan*
Reviewed by: *Jenny Crawford*

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

Doc ref: Calb-Cert-Master-V3-05

Page 1 of 3

Certificate of Calibration and Conformance

Continuation of Certificate number: **U41812**

Reference Microphone: WSM5 - B&K4192-2496459

Measurements

The calibrator has been tested as described in the following annexes to BS EN IEC60942:2003 Sound Calibrators; B3.4 for sound pressure level, B3.5 for frequency, B3.6 for total distortion and A4.4 for short term stability of the pressure level.

Instruments and Program
A complete list of instruments, hardware and software that have been used for this calibration is available from the calibration laboratory

Comments

Statement of Conformance and Calibration
As public evidence was available*, from a testing organisation responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in annex A of BS EN IEC 60942:2003, the sound calibrator tested is considered to conform to all the class 1 requirements of that BS EN IEC 60942:2003.

*This evidence is held on file at the calibration laboratory.

Observations:
Continued on next page.

Certificate of Calibration and Conformance

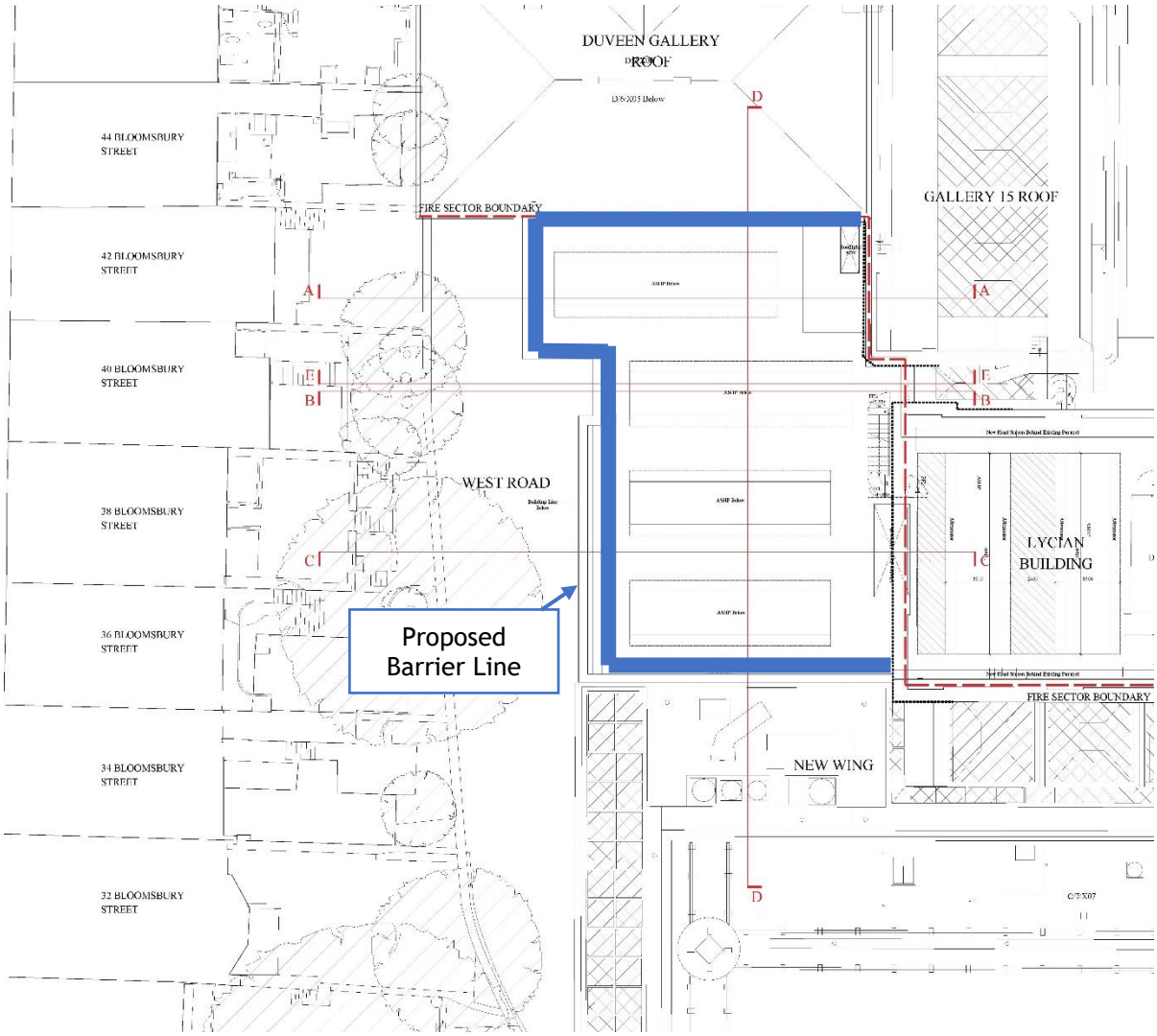
Continuation of Certificate number: **U41812**

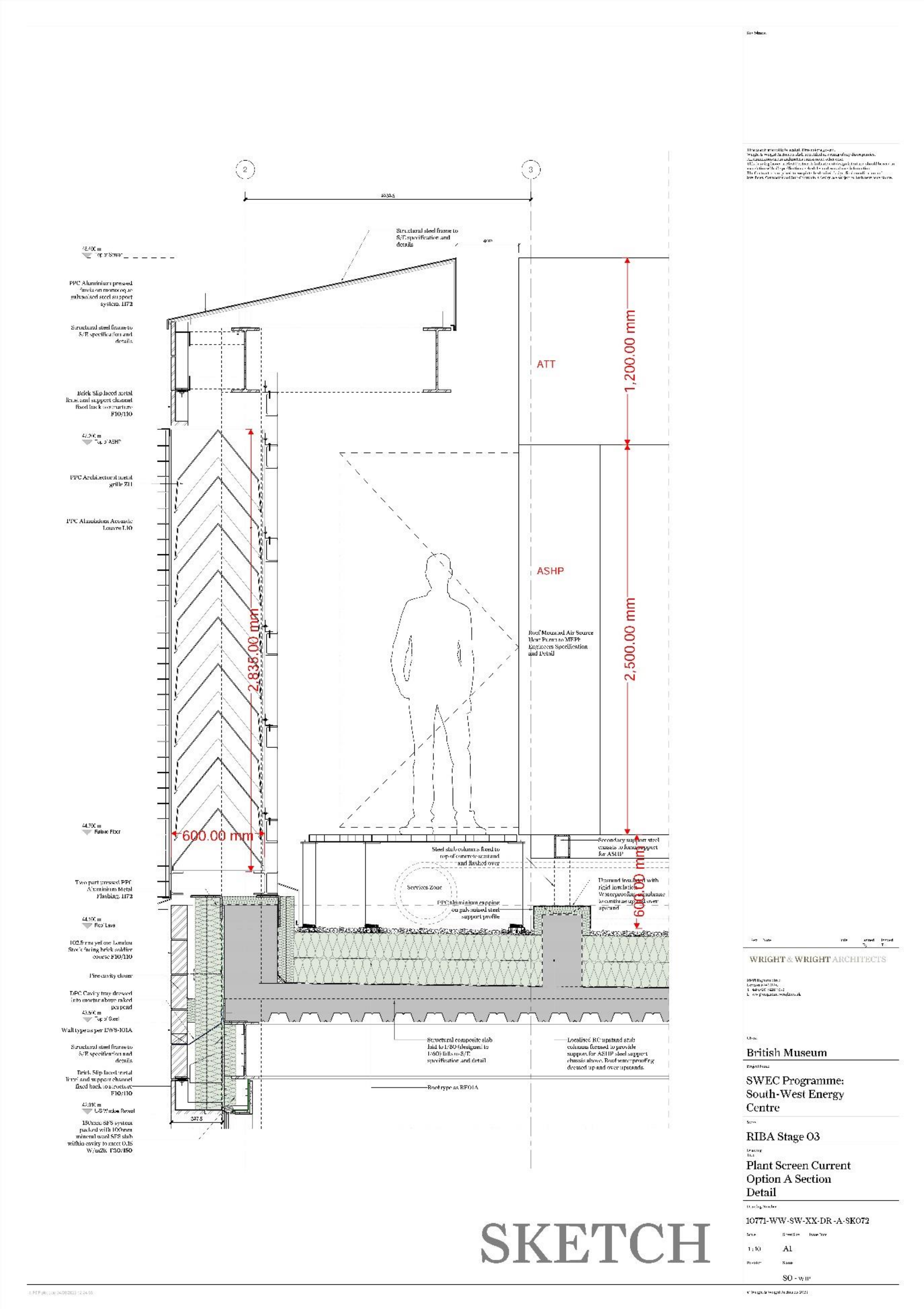
Decision Rule:
The decision rules have been applied in accordance with the procedure as described in BS EN 60942:2003

This certificate relates only to the items tested above.

** End of Certificate **

Appendix F – Proposed Acoustic Louvre Barrier Line




Structural steel frame to S/E specification and details
ATT
1,200.00 mm
ASHP
2,500.00 mm
2,835.00 mm
600.00 mm
PPC Aluminium pressed fascia on monocoque galvanised steel support system. H72
Structural steel frame to S/E specification and details
Brick Slip faced metal lintel and support channel fixed back to structure F10/110
PPC Architectural metal grille Z11
PPC Aluminium Acoustic Louvre L10
Roof Mounted Air Source Heat Pumps to MEPP Engineers Specification and Detail
Secondary support steel channels to form support for ASHP
Steel slab columns fixed to top of concrete upstand and flashed over
Services Zone
Two part pressed PPC Aluminium Metal Flashing. H72
Structural composite slab laid to 1:60 falls to S/E specification and detail
Localised RC upstand slab columns formed to provide support for ASHP steel support chassis above. Roof waterproofing dressed up and over upstands.
Roof type as RF01A
Fire cavity closer
Wall type as per EWS-101A
WRIGHT & WRIGHT ARCHITECTS
British Museum
SWEC Programme: South-West Energy Centre
RIBA Stage 03
Plant Screen Current Option A Section Detail
10771-WW-SW-XX-DR-A-SK072
1:10
A1
SKETCH