Bickerdike Allen Partners
Architecture
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BRITISH MUSEUM, SOUTH EAST LOGISTICS HUB, CATERING FACILITIES

LONDON WC1B 3DG

NOISE IMPACT REPORT ON HOROLOGY WORKSHOP

Report to

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Bickerdike Allen Partners LLP is an integrated practice of Architects, Acousticians, and Construction Technologists, celebrating over 60 years of continuous practice.

Architects: Design and project management services which cover all stages of design, from feasibility and planning through to construction on site and completion.

Acoustic Consultants: Expertise in planning and noise, the control of noise and vibration and the sound insulation and acoustic treatment of buildings.

Construction Technology Consultants: Expertise in building cladding, technical appraisals and defect investigation and provision of construction expert witness services.

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1.0 INTRODUCTION

Bickerdike Allen Partners LLP (BAP) have been commissioned by the British Museum to provide acoustic consultancy services relating to the relocation of the logistics centre located in the Southeast of the Museum. The project is known as the SE Logistics Hub. The project is being erected under permitted development rights in respect of maintaining existing services displaced during the construction of the New Energy centre that has recently received planning permission.

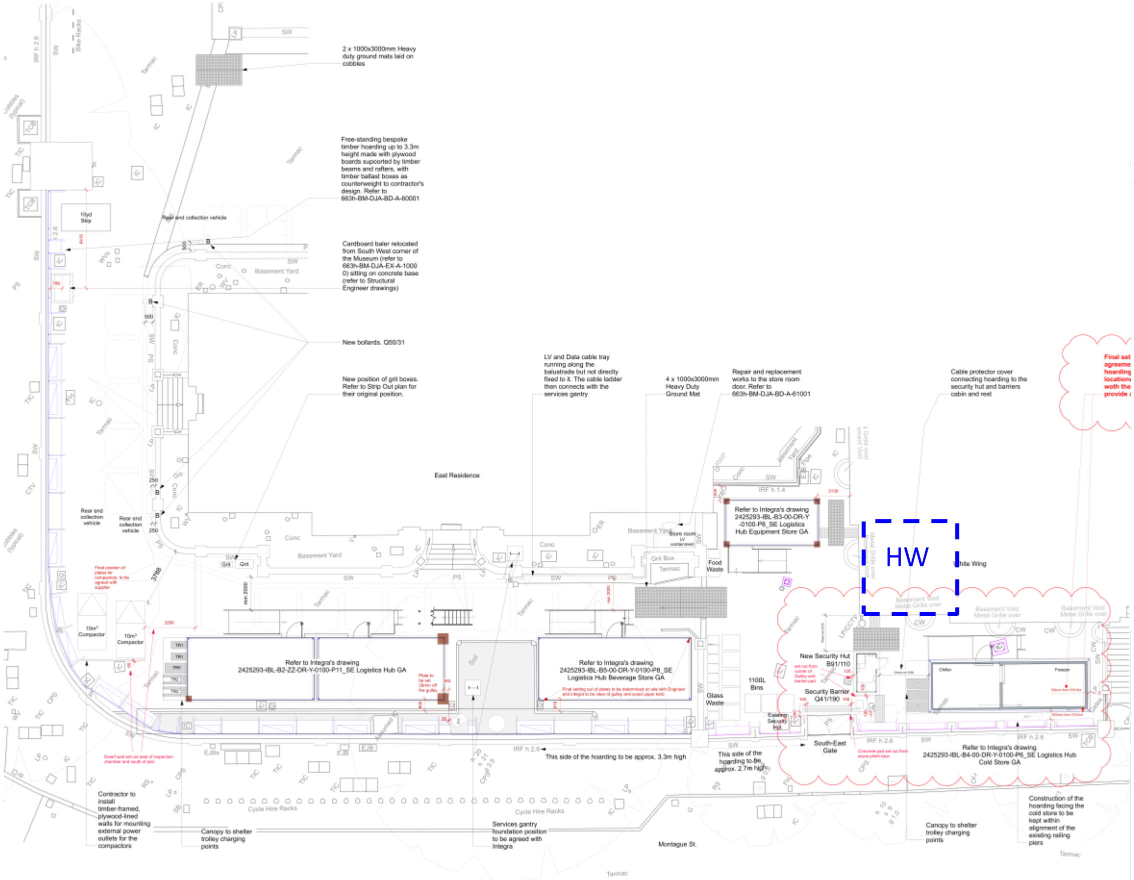
BAP have been asked to assess the noise generated by proposed logistics services and predict the noise impact those services will have on the Horology Conservation Workshop (B/1/096) located to the Northwest of the proposed Hub.

This report has been prepared specifically in response to instructions received from the British Museum and is not intended for any other purpose. Survey work carried out in connection with this commission is limited in extent to the scope of those instructions.

A glossary of acoustic terminology used is included in Appendix 1.

2.0 THE SITE

A layout of the SE Logistics Hub can be seen below in Figure 1.



NB: an approximate location of the Horology Workshop is indicated by "HW"

Figure 1: Layout SE Logistics Hub (from drawing ref. 663h-BM-DJA-BD-A-10100, dated October 2024, not to scale)

The proposed development will introduce several noise sources into this area of the museum. These include the following:

1. **1 No. Cold Store**: - These will be temporary Portakabin structures with associated plant to provide cooling. These will generate steady, very low levels of noise 24/7.
2. **Beverage store**: This will be a single-storey Portakabin. At the time of writing, no details are available on the mechanical plant that will be installed for cooling/ventilation.

3. **Equipment store**: Single-storey Portakabin. At the time of writing, no details are available on the mechanical plant that will be installed for cooling/ventilation. It is unlikely this will require significantly noisy plant.

4. **General waste 10m^3 Portable Compactor**: These will generate relatively low levels of noise when used for compacting (typically 1-3 mins). Collection of the compactors via lorry will generate more significant levels of noise for a period of approximately 7 minutes in the morning between 07:00 and 10:00.

5. **Food and glass bins**: These will be relocated to the Southeast corner compound for collection via the Southeast Montague Gates. Collections will be arranged during Museum business times on an on-demand basis.

Currently, the SE corner is used as a car park. The noise environment is dominated by road traffic noise as well as intermittent deliveries/servicing to surrounding commercial premises (see Figure 2). This report assesses the potential noise effects on the Horology Conservation Workshop only.

Figure 2: Existing SE corner

3.0 NOISE LEVEL GUIDELINES

3.1 Introduction

BAP understand that there is concern that the proposed SE logistic hubs will introduce noise sources close to the Horology Workshops which could significantly interfere with tasks. The proposed logistics hub has the potential to generate irregular and intermittent high levels of noise or "events". BAP understand that these irregular noise events could distract and interfere with work which requires high levels of concentration. Objective guidelines are required on how to assess this potentially significant adverse noise impact.

3.2 Industry guidelines

The 2019 edition of the British Council for Offices (BCO) *Guide to specification* states that to avoiding speech interference, regular noise events (e.g. scheduled aircraft or passing trains) should not exceed 50 dB $L_{A01,1h}$ for cellular offices, as measured inside the space. The sources here will not be regular. However the guideline level is a suitable guide. The metric is the level exceeded for 1% of the time and is an indicator for peak levels of noise.

While the guideline is used to test for the risk of speech interference BAP recommend that this is used for this application to assess the potential impact for task interference.

For a cellular office the BCO guide recommends that for steady external noise sources a guideline noise level of ≤NR 35 should apply. This is broadly consistent with guidance within BS 8233:2014 *Guidance on sound insulation and noise reduction for buildings* which recommends noise levels should be less than 35-40 dB $L_{Aeq,T}$ for work spaces such as training rooms/executive offices where the activity is classified as "*Study and work requiring concentration.*"

It is also important to consider the context of existing baseline levels of noise. For this reason a noise survey was carried out within the horology workshops to establish current typical noise levels prior to the new SE logistics hub.

3.3 Noise survey

BAP carried out an attended baseline survey to measure and carry out observations of the existing noise environment within the workshop during the afternoon (13:00-16:00).

BAP carried out a survey on the 15th October 2024. The survey was carried out in accordance with industry guidelines[1]. 15-minute measurements were taken inside the Horology Conservation Workshop (B/1/096) to obtain a baseline level.

The equipment used for background measurements is pictured in Figure 3. The microphone and sound level meter were placed approximately 1.2 m above the ground inside the workshop.

Figure 3: Horology Conservation Workshop baseline measurement setup

The sound level meters used during the survey are Class 1 in accordance with BS EN ISO 61672-1:2013. The sound level meter used during the survey was field calibrated before and after use and showed no significant levels of drift. Calibration details of the equipment are presented in Table 1.

[1] Measurements of sound levels in buildings Guidelines, Association of Noise Consultants, 1st edition 2020

Equipment	Serial Number	Date of last calibration	Calibration certificate number
Bruel & Kjaer Type 2270 Investigator	3028935	03/04/2024	UCRT24/1517
Bruel & Kjaer Type ZC 0032 Preamplifier	29580	03/04/2024	UCRT24/1517
Bruel & Kjaer Type 4189 Microphone	3232430	03/04/2024	UCRT24/1517
Bruel & Kjaer Type 4231 Calibrator	2309119	29/07/2024	UCRT24/2024

Table 1: Equipment details

A summary of measured noise data is presented in Figure 4**.**

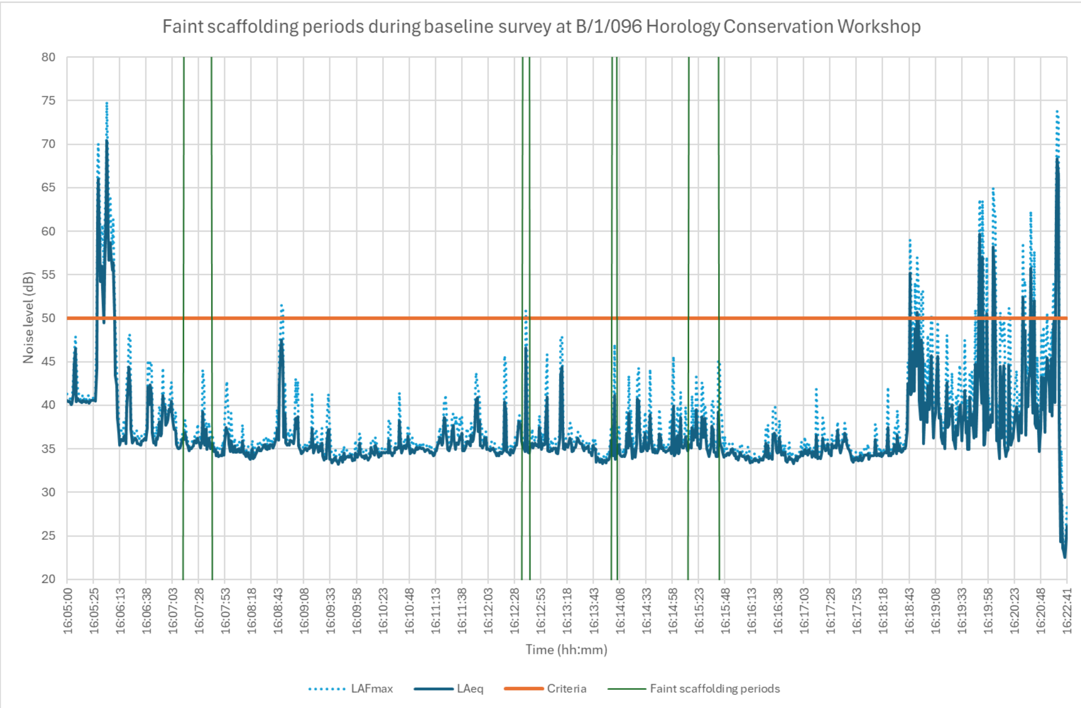


Figure 4: Noise levels in conservation workshop

The survey was carried out in the afternoon. During the survey the following observations were made:

- Ambient noise levels (with no internal activity) are around 35 dB consistent with recommended guidelines. These create noise events levels of 42-52 dB $L_{AF,max}$. BAP understand that these noise event levels were considered acceptable/tolerable for museum staff.

- Noise from within the horology workshop was much higher at over 55 dB.
- Montague Street is currently closed to all but local traffic. No traffic pass-byes were counted.
- The main workshop space is adjoined by a lobby and another laboratory space. Both spaces include windows. These rooms are connected to the workshop via doors which are usually kept open. The window in the laboratory is currently inaccessible due to a large fume cupboard located in front of it:

Figure 5: A window in the laboratory with a fume cupboard in front of it

3.4 Summary

Based on industry guidelines and our survey we would recommend that acceptable levels could be achieved if external activity is controlled to a noise level of ≤50 dB $L_{AF,max}$.

It should be noted that these are considered acceptable rather than desirable levels. It would be desirable that for noise levels to be much lower than this. However, this may not be practicable to achieve.

4.0 NOISE IMPACT ASSESSMENT

4.1 Source levels

The following reference source levels have been used for this assessment.

Activity	L_{Aeq} (dB) at 10 m	L_{AFmax} (dB) (min-max) at 10 m
Delivery activity/trolleys	63	71-74
Plant noise	31	34-37
Glass waste	N/A	80-90

Table 2: Source levels used for the assessment

4.2 Source locations and distance to workshop

For the delivery and plant noise, the closest Workshop window is approximately 3 m away from the source. The plant noise levels are very low and broadband in nature – as such this has been excluded from further assessment. For the Glass waste the nearest window is approximately 10-12 m away from the source.

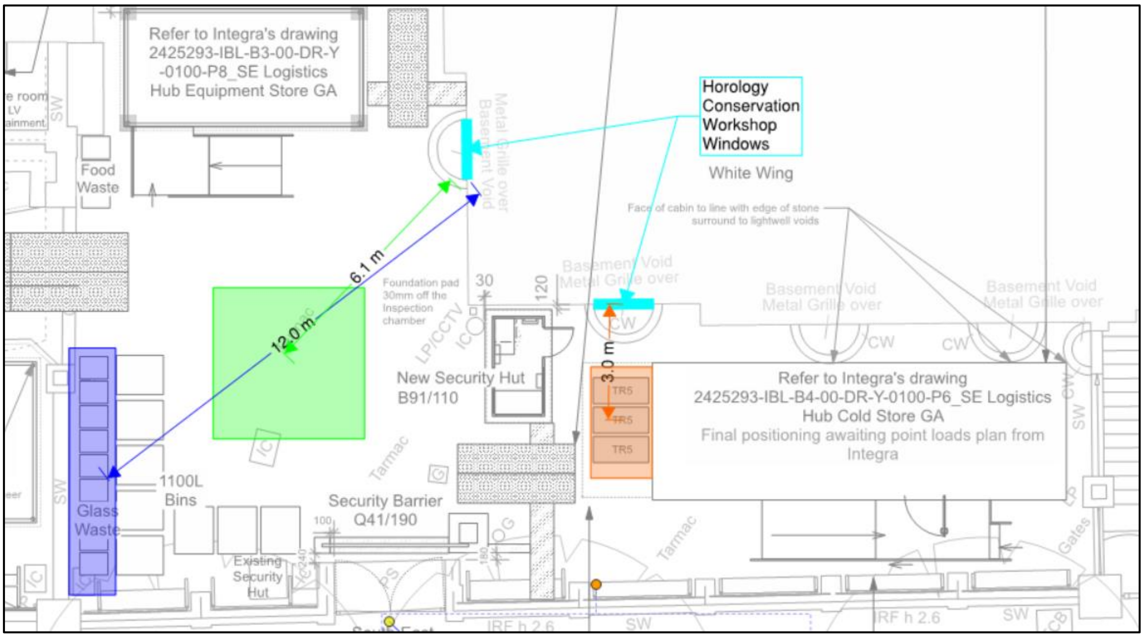


Figure 6: Noise source locations and distances (not to scale)

4.3 Predicted levels at the nearest workshop window

The predicted levels at the B/1/096 Horology Conservation Workshop for the yard activities are presented below.

Activity	L_{AFmax} (dB)
Delivery activity/trolleys @ 3 m	81-84
Glass waste @ 12 m	78-88

Table 3: Predicted levels at the nearest window

4.4 Predicted levels inside the workshop

The worst case predicted level is 88 dB based on the glass waste activity. An assumption of -25 dB outside to inside level difference has been taken for the current scenario (single glazing sash windows), while -35 and -45 dB have been used for secondary glazing and timber panel scenarios respectively. These have been used to predict the noise level inside the workshop as shown in Table 4.

	Current	With mitigation Secondary glazing	With mitigation Solid/timber panels
Predicted level at B/1/096	63	53	43

Table 4: Predicted level at B/1/096 Horology Conservation Workshop, L_{AFmax} dB

The assessment indicates that with no mitigation noise levels within the Horology workshop could substantially exceed the recommended guideline by a margin of 13 dB. These intermittent levels of noise could cause speech interference and task interference.

Based on a nominal 35 dB reduction for secondary glazing noise levels are predicted to be up to 53 dB $L_{AF,max}$. This exceeds the recommended criterion by a small/negligible margin of 3 dB.

Based on a nominal 45 dB reduction for a solid panel mitigation solution the predicted sound levels are well within the recommended criterion.

4.5 Recommendations

Acoustically, the preferred solution is to board up the windows. This may not be acceptable due to non-acoustic factors, i.e. natural daylight and ventilation options. However, this will result in consistently higher performance. The recommended minimum mass of boards used should be a combined mass of 20 kg/m^2 separated from the primary windows by minimum cavity of

150mm. There should be minimum 100 mm of mineral wool in the cavity, min density of 30 kg/m^2 i.e. rockwool batt. The ventilation requirement should be reviewed by others.

A more pragmatic solution would be to install secondary glazing to reduce this potentially significant adverse noise effect. The assessment has assumed a nominal 35 dB reduction for secondary glazing. It is possible that a higher standard can be achieved this would be subject to the following recommendations.

- Inspecting and repairing the existing primary windows as far as possible. Any gaps around the frame should be sealed with a non-hardening acoustic sealant.
- Install a secondary glazing system with as deep a cavity as possible, ideally this should be at least 150 mm.
- The reveals should be lined with sound absorbing material.
- The secondary glazing system should use a heavier glass such as 6.8 mm stadip silence (or similar approved).
- A higher acoustic performance standard can be achieved if there is no need to open the windows for regular cleaning/ventilation. A “lift out” system performs better acoustically but is much less flexible for occupants for ventilation. A standard casement or sliding secondary option provides more flexibility with a reduced acoustic performance.
- Review the location of the glass bins to check if these can be located further from sensitive windows.

Windows in the adjoining lobby and the laboratory space may not need to be treated if the doors to the workshop can be kept closed.

5.0 SUMMARY

BAP have been commissioned by the BM to provide acoustic consultancy services relating to the relocation of the logistics centre located in the Southeast of the Museum. The project is known as the SE Logistics Hub.

An attended survey has been carried out to quantify baseline noise levels from the Horology Conservation Workshop.

The noise impact assessment for delivery and glass recycling operations indicates that, with no mitigation, noise levels will be above recommended level. Recommendations have been proposed for client consideration.

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for Bickerdike Allen Partners LLP	**Associate**	**Partner**

APPENDIX 1
GLOSSARY OF ACOUSTIC TERMINOLOGY

The Decibel, dB

The unit used to describe the magnitude of sound is the decibel (dB) and the quantity measured is the sound pressure level. The decibel scale is logarithmic and it ascribes equal values to proportional changes in sound pressure, which is a characteristic of the ear. Use of a logarithmic scale has the added advantage that it compresses the very wide range of sound pressures to which the ear may typically be exposed to a more manageable range of numbers. The threshold of hearing occurs at approximately 0 dB (which corresponds to a reference sound pressure of 2 x 10^{-5} Pascals) and the threshold of pain is around 120 dB.

The sound energy radiated by a source can also be expressed in decibels. The sound power is a measure of the total sound energy radiated by a source per second, in watts. The sound power level, L_w is expressed in decibels, referenced to 10^{-12} watts.

Frequency, Hz

Frequency is analogous to musical pitch. It depends upon the rate of vibration of the air molecules that transmit the sound and is measure as the number of cycles per second or Hertz (Hz). The human ear is sensitive to sound in the range 20 Hz to 20,000 Hz (20 kHz). For acoustic engineering purposes, the frequency range is normally divided up into discrete bands. The most commonly used bands are octave bands, in which the upper limiting frequency for any band is twice the lower limiting frequency, and one-third octave bands, in which each octave band is divided into three. The bands are described by their centre frequency value and the ranges which are typically used for building acoustics purposes are 63 Hz to 4 kHz (octave bands) and 100 Hz to 3150 Hz (one-third octave bands).

A-weighting

The sensitivity of the ear is frequency dependent. Sound level meters are fitted with a weighting network which approximates to this response and allows sound levels to be expressed as an overall single figure value, in dB(A).

Environmental Noise Descriptors

Where noise levels vary with time, it is necessary to express the results of a measurement over a period of time in statistical terms. Some commonly used descriptors follow.

Statistical Term	Description
$L_{Aeq, T}$	The most widely applicable unit is the equivalent continuous A-weighted sound pressure level (LAeq, T). It is an energy average and is defined as the level of a notional sound which (over a defined period of time, T) would deliver the same A-weighted sound energy as the actual fluctuating sound.
L_{A90}	The level exceeded for 90% of the time is normally used to describe background noise.
$L_{Amax,T}$	The maximum A-weighted sound pressure level, normally associated with a time weighting, F (fast), or S (slow)

Sound Transmission in Rooms

Sound energy is reflected from the room surfaces and this gives rise to reverberation. At short distances from a sound source, the sound level will fall off at a rate of 6 dB per doubling of distance, as it would in the open air – this is known as the direct field. Beyond a certain distance, the effect of reverberation takes over and the level ceases to fall off significantly with distance from the source. This is known as the reverberant field. For receiver positions in this part of the room, sound levels can be reduced by applying sound absorbing finishes to the surfaces of the room. A 3 dB reduction can normally be obtained by doubling the absorption present, which corresponds to halving the reverberation time (see below).

Sound Insulation - Airborne

Voices, hi-fi systems, television and radio sound and musical instruments are all sources of airborne sound. They excite the air around them and the vibration in the air is transmitted to surrounding surfaces, such as walls, ceilings and floors. This sets these constructions into vibration and this vibration is radiated in neighbouring rooms as sound. Energy is lost in the transmission path and this is referred to as transmission loss or, more generally, sound insulation. The most simple measure of sound insulation is the sound level difference, D, which is the arithmetic difference between the sound level, in dB, in the source room and the sound level in the receiving room.

Other measures of sound insulation include the sound reduction index, R, which is a measure of the acoustical performance of a partition, obtained in a laboratory, and the standardised level difference, D_{nT}, which is used mainly in the sound insulation of domestic separating walls and separating floors. The relevant test procedures are laid down in BS EN ISO 140. A single figure "weighted" result can be obtained from one-third octave band test results by using a curve-fitting procedure laid down in BS EN ISO 717. The subscript "w" is added to the relevant descriptor (eg $D_{nT,w}$).

The sound reduction index, R, is used in the specification of components, such as partitions, doors and windows. It is important to bear in mind that the performance of components in the field is usually lower than can be obtained in a laboratory. The transmission of sound via other components common to both rooms ("flanking transmission") can reduce the apparent sound reduction index (R') significantly.