

## Stage 2 (Concept Design) Appendices

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38-42 MOSLEY STREET  
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M2 3AZ

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**Appendix 1 - Operational Energy Assessment: MOSE-HMM-ZZ-ZZ-RP-Y-0001**

## TM54 Operational Energy Assessment (Stage 2)

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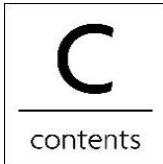
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## Executive Summary

### Intervention Optimisation

To understand the potential carbon savings associated with current scope of works and potential fabric energy interventions, a simplified model has been generated. This model gives a reflective potential carbon saving for discussion with the design team in order to understand whether these interventions are applicable for this scheme, the following scenarios were investigated:

- Existing Building – Using assumed existing U-Values and assumed lighting and mechanical systems (**BENCHMARK BUILDING**)
- Proposed Mechanical & Electrical Upgrades - Using assumed existing U-Values and proposed lighting and mechanical systems (**AS PROPOSED**)
- Proposed Mechanical & Electrical Upgrades and *Wall Insulation Upgrade* – Improvement to external wall U-Value only and proposed lighting and mechanical systems.
- Proposed Mechanical & Electrical Upgrades and *Wall & Roof Insulation Upgrade with reduced Infiltration losses* - Improvement to external wall U-Value and roof only and proposed lighting and mechanical systems. Air tightness was also improved to 25m<sup>3</sup>/h.m<sup>2</sup> as part of the building fabric upgrade.

The results for the four scenarios can be seen below in Table 1:

| Run                                                                                                                      | BER kgCO <sub>2</sub> /m <sup>2</sup> | Percentage Improvement Against Existing Building |
|--------------------------------------------------------------------------------------------------------------------------|---------------------------------------|--------------------------------------------------|
| Existing Building (BENCHMARK BUILDING)                                                                                   | 54.6                                  | -                                                |
| Proposed Mechanical & Electrical Upgrades (AS PROPOSED)                                                                  | 33.5                                  | 39%                                              |
| Proposed Mechanical & Electrical Upgrades and <i>Wall Insulation Upgrade</i>                                             | 28.7                                  | 47%                                              |
| Proposed Mechanical & Electrical Upgrades and <i>Wall &amp; Roof Insulation Upgrade with reduced Infiltration losses</i> | 23.8                                  | 56%                                              |

**Table 1: Building Emission Rate (BER) Benchmark and Intervention Results**

The results indicate that interventions over and above the current scope of proposed mechanical & electrical works are 8% for fabric upgrades and 17% when fabric and infiltration interventions are implemented.

### Operational Energy

Due to the early phase of the project, initial, and highly indicative calculations have been carried out using the methodology set out in CIBSE TM 54: 2013 (Evaluating operational energy performance of buildings at the design stage) and to meet the objectives of the Bruntwood Guide to Net Zero Operational Carbon.

The primary aim is to carry out this building modelling to provide initial high-level advice; highlighting and identify opportunities to reduce operational carbon, or measures which can be taken to mitigate against risks which may cause energy consumption, and associated carbon emissions, to increase at this very early stage (ensuring they can be acted upon going into stage 3). Due to considerable uncertainty linked to how incoming tenants will operate spaces post occupancy, it is not meaningful to provide a single figure for an operational energy prediction. It is more useful to estimate the range in which energy consumption is likely to be, low, central

and high. Inputs for each scenario has been referenced by Bruntwood. The results for operational energy can be seen below in Table 2:

| Scenario                       | Heating | Cooling | Auxiliary | Lighting | Hot Water | Equipment | Servers | Lifts | Catering (Environmental) | Total (kWh/year/m <sup>2</sup> ) |
|--------------------------------|---------|---------|-----------|----------|-----------|-----------|---------|-------|--------------------------|----------------------------------|
| <b>1-Low</b>                   | 42.1    | 0.1     | 7.9       | 11.3     | 1.6       | 16.9      | 0.2     | 2.9   | 86.6                     | 169.6                            |
| <b>2- Central (Optimistic)</b> | 45.0    | 0.3     | 8.7       | 15.6     | 2.2       | 33.0      | 0.3     | 3.2   | 86.6                     | 194.9                            |
| <b>3-High</b>                  | 40.0    | 1.2     | 9.1       | 19.3     | 2.8       | 65.9      | 0.7     | 3.3   | 86.6                     | 228.9                            |

**Table 2: Operational Energy Results**

Based on the current information it is estimated that the total annual energy consumption for Gross Internal Area (GIA) could be in the range of 169.6 kWh/year/m<sup>2</sup> to 228.9 kWh/year/m<sup>2</sup>.

The operational energy results have been plotted against the Bruntwood Existing Building Portfolio, where only the low scenario falls under the existing building Bruntwood portfolio figure of 188 kWh/year/m<sup>2</sup>.

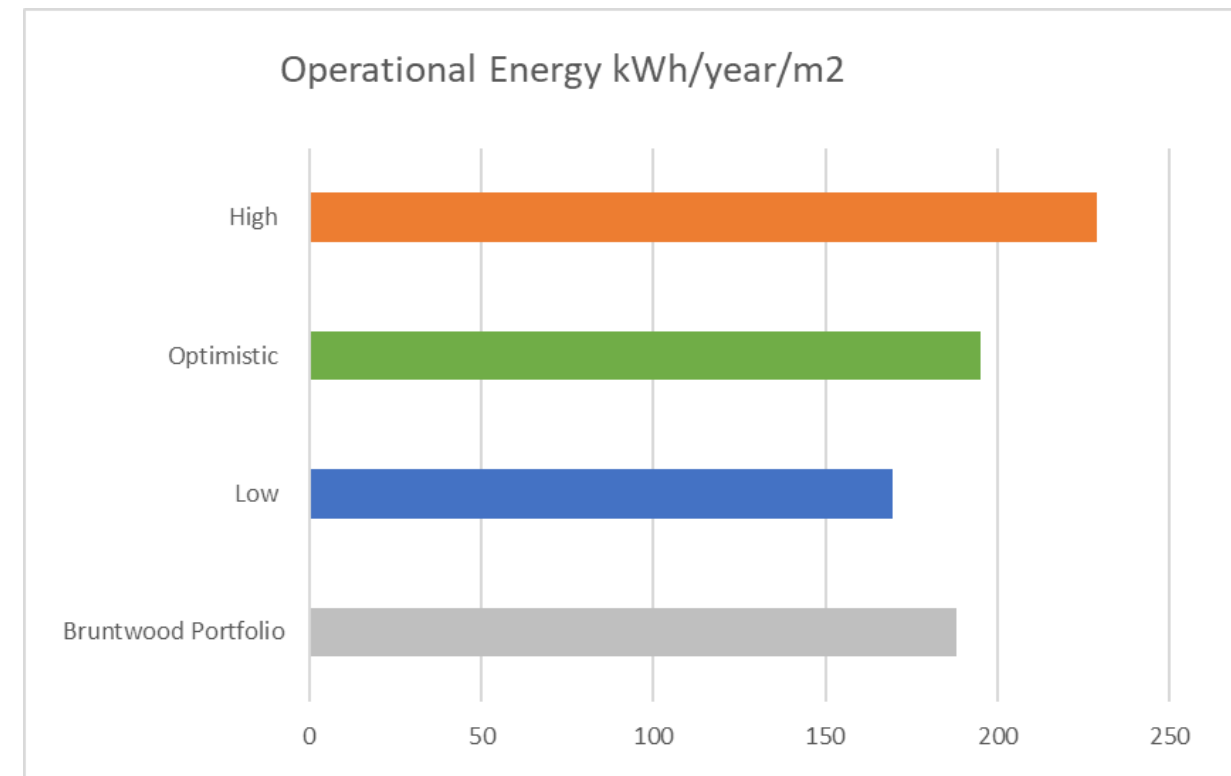


**Figure 1: Operational Energy Compared to Bruntwood's Existing Building Portfolio**



PV Analysis

The results in Table 3 below show the potential electricity generation per year from the integration of PV at 38-42 Mosley Street, which will be included in more detail at stage 3.

| Option              | Nominal Panel Efficiency (%) | Inclination | Estimated Electricity Generation kWh/annum | Annual Carbon Reduction (Tonnes)* | Recommended for Project |
|---------------------|------------------------------|-------------|--------------------------------------------|-----------------------------------|-------------------------|
| Potential Roof Area | 15.3                         | 37°         | 7,400                                      | 1.7                               | ✓                       |

Table 3: PV Results

\*Energy to carbon is based on DECC 2021 Energy to Carbon figures (0.233)

Recommendations

Within buildings the reduction of energy consumption requires multiple strategies in an effort to prove successful. Arguably key to this is a consistent management based on the visibility and information that metering can provide.

As such a more granular **metering strategy** than is usual is targeted as being implemented and validated in detail at the commissioning stage. It must be clear which meters serve which areas. Ideally meter readings can be accessed remotely and readings outside of expected values could be automatically flagged up. It will be very difficult to dynamically highlight areas for which the building could be running sub-optimally, let alone address these issues, or, realistically quantify the likely impact of potential future pro-active changes without this data. Additional tenant distribution for terminal units / HVAC related loads in addition to those for lighting and small power will be specified to help provide the delineation in tenant/landlord consumption for NABERS/UKGBC targets.

This metered data will provide the additional benefit of providing rapid feedback for any changes made to the buildings systems or operation. It is assumed a stringent and pro-active monitoring strategy will be followed. Additionally, it may help assess and provide further information for the modelling and optimisation of other/future Bruntwood buildings, allowing predictions in terms of real building post occupancy operation, and reduction of energy consumption. More accurate data on occupancy levels, typical small power consumption and domestic hot water consumption (and profiles for each) could be obtained and accounted for in future work.

Bruntwood target and further steps to achieve this.

The energy consumption of the proposed regeneration currently exceeds the Bruntwood 2020-2025 energy target of 160kWhe when including the environmental conditioning of the F&B and Office space.

Concerted and sustained effort through the commissioning and operation of the building will likely be required to initially achieve, and then improve upon, this in operation. Much further thought and detail will also be put into the design and control strategy in upcoming stages to help ensure the targets are achievable.

The following areas of focus, and potential opportunities in design are expanded on within the recommendations section of the report.

- **Fit out guidance and equipment consumption.**  
As the equipment loads have a high contribution to overall electricity consumption of all scenarios providing initial guidance and continual engagement with tenants is recommended to ensure tenant

related consumption (which will make up a significant proportion of the whole building consumption Bruntwood are targeting) is minimised, and hopefully continually improved upon is important. Giving direct access to relevant metered data to the tenants will also help in this goal, enabling tenants to better analyse and quantify the impact changes in operation may have. In this case guidance on specification of highly efficient equipment specifically laptops/monitors would be extremely beneficial to meeting targets, best practice would be to target <8.0w/m<sup>2</sup> tenancy small power consumption in office settings. Equally provision should be in place to ensure lighting performance is maintained by incoming tenant(s).

- **Design Opportunities**  
There are a number of design opportunities which are being/will be explored to minimise consumption in operation. These include specification of plant to optimally meet demands loads, more efficient lighting and integration of enhanced control strategies
  - The incorporation of an enhanced economy cycle for air handling units and system controls as referenced under the BMS controls section.
  - Plant will be specified to optimally meet the build. Whilst there may well be significant capital cost related savings due to not over-specifying plant; It is recommended that long term operational consumption savings are prioritised over those related purely to short term capital expenditure where possible, this should extend to all areas of energy consumption (e.g. it is recommended regenerative drives are specified to relevant lifts), it will also be important to note the impact changing the specification may have on building performance, particularly within VE exercises.
  - Typically lighting power densities of 4.5 w/m<sup>2</sup> are targeted in highly efficient buildings. This would be a pre-requisite for compliance of Australian buildings with the Australian building code allowance and will reduce whole building, tenant and landlord cooling consumption. This will likely come at an aesthetic cost as noted below.
  - In wider carbon terms consideration of the refrigerant type and GWP used in the heat pumps should be reviewed and procedures in place to prevent leakage.

**Note:** that to achieve much reduced operational energy targets there may be additional costs beyond capex/monetary ones e.g. in terms of aesthetic appearance in the case of lighting: feature, pelmet lighting is not inherently efficient in illuminating the working plane; in many cases a lower lux level is additionally specified to achieve the w/m<sup>2</sup> targets.

- **Out of hours controls**  
If the tenancies allow/are to be used for more office type applications, it may be appropriate to reduce the servicing hours. Bruntwood could agree with the tenants core ‘occupancy hours’, this is should be reduced from typical UK operation times to those more appropriate for core building occupation i.e. 8am to 6pm, during which central plant operates automatically to maintain conditions. Additional warm up or cool down required to achieve comfort conditions during those hours could be incorporated using optimum start/stop. Outside the occupancy hours, should the tenant require central services the web connection override (or similar) could be used to request central plant to operate automatically outside hours to meet this requirement.

- **BMS Control Strategy/Description of Operations**

- Enhanced control of systems.

The description of controls will be comprehensively completed at an earlier project stage than is usual to ensure the strategy is clear, and risks related to inefficient control are mitigated against.

Significant enhancing the control strategy for the systems will enable these to be put to better usage, enabling them to meet the building demands with reduced levels of energy consumption. This description of operation enables an easy reference point for the design intent which can be followed in operation, and, or modified at a later date to ensure the control strategy effectively and efficiently utilises the building systems, whilst also minimising unnecessary operation/maintenance etc.

- Items of control strategy which are likely to be implemented are:
    - Heating and cooling lock offs at inappropriate external temperatures. (e.g. cooling at <5 deg C external temperature)
    - Extended dead-bands for terminal systems to reduce heating and cooling loads as well as potential conflict of systems.
    - Enhanced air handling unit control in terms of preconditioning temperatures and air volumes, this control will be complimentary to demand controlled ventilation. This will help enable 'free cooling' to internal areas when possible and help minimise any conflict of heating and cooling between air handling units and terminal units.
    - Variable flow and temperature and flow controls for water side systems, particularly for condenser water loops in an effort to ensure optimal performance for variable and dynamically changing demands that the combination of office and leisure requirements presented by the building.

- **Commissioning and BMS strategy**

Consider a more detailed commissioning process, to ensure the plant operates optimally and as designed. An independent commissioning agent could be appointed for this process detailed commissioning brief must be developed, listing all of the commissioning tests to be performed, drawing on CIBSE, ASHRAE and NEBB standards as appropriate.

- **BMS Visibility**

It is impossible to control a building efficiently unless all of the plant is visible on a central HVAC controls interface. All plant should be shown and controllable on the BMS, ideally including HVAC equipment within the tenant demise (as referenced above under metering strategy) as is required by an on-site/FM team. This could also be enforced through a fit-out guide for tenancies to ensure that this design intent is carried through to tenant operation and future and installation of equipment. This is best achieved through enforcement of the tenant fit-out brief and commissioning verification of any installations.

- **Handover/Soft landings**

The Bruntwood guidance to implement the Soft Landings framework is commended. This focuses on ensuring there is collaboration and overlap of the design, construction and operation teams and all parties maintain an active presence for post practical completion. It also ensures that performance targets and success indicators are identified up front and verified to have been achieved post-construction. As highlighted in the Bruntwood documentation; BSRIA has published a Soft Landings and Design for Performance (BG 76/2019) guide.

- **Maintenance, Monitoring, targeting and tuning**

Maintenance strategies to preserve energy efficiency should be specified if targets are to be achieved. These will apply beyond the defects liability period or the tuning period. A consistent approach to monitor and optimise building operation should be taken to ensure targets are achieved, and then bettered continuously in operation. The relevant party/FM team could be given an enhanced scope and/or mandate to achieve this goal.



## 1. Introduction

### 1.1. Background

This report has been prepared by Hilson Moran to provide an estimate of the potential Operational Energy Performance of the proposed refurbishment of 38-42 Mosley Street. Separately, Hilson Moran will prepare an Embodied Carbon analysis which will be developed as the Bill of Quantities is provided.

The proposed building regeneration consists of a bank that was constructed between 1872 and 1880 for the former Manchester and Salford Bank. Over the years the building has been refurbished, modified and in some parts has seen major regeneration. Prior to this assessment being made, it is understood that the bank was used by the Royal Bank of Scotland from 2001. The building is now vacant with much of the building services removed. Parts of the building are Grade II listed and therefore careful consideration will be required when considering building interventions to reduce energy consumption.

The proposal that has been prepared by AXI Architects is to re-purpose the occupied office with the option to incorporate food and beverage to the ground floor.

## 2. Building Parameters

### 2.1. Model Inputs

Dynamic Thermal Modelling (DTM) software tracks the thermal state of the building on an hourly basis using real weather data, resulting in a detailed understanding of the building's performance.

DTM combines several mechanisms to calculate the building response:

- Conduction;
- Convection;
- Long wave radiation;
- Short wave radiation – absorbed, reflected and transmitted;
- Internal conditions – gains from lights, equipment and occupants along with plant operating hours and natural infiltration rates; and
- Ventilation and air movement from internal natural convection.

The accredited software EDSL TAS version 9.5.1 was used for all assessments within this report.

### 2.2. Weather Data

In accordance with CIBSE TM 32:2003 and the NCM Modelling Guide (2013 Edition), the weather data applied to the ADL2A:2013 computational Carbon Emissions Calculation Method (CECM) assessments is a CIBSE test reference year (TRY), which is based on an average of approximately 20 years. The weather file 'Manchester TRY' is chosen for its proximity to the project site.

### 2.3. Building Fabric

For all existing buildings, building fabric data is Building fabric data has not been provided for this assessment and therefore the assessment has been undertaken based on likely building constructions.

#### 2.3.1. Glazing

Glazing within the building is generally single glazing. Some windows are also fitted with secondary glazing shutters, the assumed single glazing U-Value can be seen in Table 4.

| Application    | Existing U-value* (W/m <sup>2</sup> .K) | g-value | Light Transmittance |
|----------------|-----------------------------------------|---------|---------------------|
| Single Glazing | 5.68                                    | 0.827   | 89%                 |

**Table 4: Assumed Glazing Properties**

*\* This U-value should be derived as a combination of frame and centre pane U-values.*

#### 2.3.2. Existing Constructions

The existing constructions have been taken from information gathered on site and information from projects the same period. An existing survey is set to be complete which will provide a more accurate understanding of constructions throughout the building. Initial estimates on U-Values can therefore be improved upon resulting in better output results. The proposed improvement u-value can also be seen and is reflected in the results. The U-Values can be seen in Table 5.

| Application    | Existing U-value (W/m <sup>2</sup> .K) | Improvement U-value (W/m <sup>2</sup> .K) |
|----------------|----------------------------------------|-------------------------------------------|
| External Walls | 1.49                                   | 0.30                                      |
| Floors         | 1.49                                   | -                                         |
| Roof           | 3.19                                   | 0.10                                      |

**Table 5: Assumed Construction element U-Values**

#### 2.3.3. Air Tightness

The air permeability for this project is assumed to be 30.0 m<sup>3</sup>/h.m<sup>2</sup> @50pa. Further air testing should be carried out to establish the true air permeability of the building as this would have significant impacts upon the estimated energy consumption.

Should roof and wall insulation be incorporated within the building design proposals, there would be an opportunity to reduce the air permeability of the building. Therefore, the air permeability has been assumed to reduce to 25.0 m<sup>3</sup>/h.m<sup>2</sup> @50pa as part of this analysis.

### 2.4. Internal Conditions

To assess impacts of optioneering of various interventions, a Part L model has been used. In this case the internal conditions used within the DTM model are NCM Conditions Version 5.2.7. For the operational TM54 analysis, the Bruntwood specific internal conditions have been used. These Bruntwood specific conditions provide a benchmark for all building analysis to be assessed. Food and beverage areas have been assessed in line with TM50:2021 Energy Efficiency in Commercial Kitchens for both environmental and operational energy. To better understand the energy associated with this area, further operational data from an operator would provide a saleable model to better reflect actual consumption anticipated.

### 2.5. Lighting

The lighting systems were specified for the different uses within the project. The assumed existing and proposed lighting information can be seen in Appendix A - Existing and Proposed Lighting and Mechanical Systems

### 2.6. Mechanical Services

The mechanical services were specified for the different uses in the project. The assumed existing and proposed mechanical information can be seen in Appendix A - Existing and Proposed Lighting and Mechanical Systems.

### 3. Intervention Optimisation Review

#### 3.1. Introduction

To understand the potential carbon savings associated with current scope of works and potential fabric energy interventions, a simplified model has been generated. This model gives a reflective potential carbon saving for discussion with the design team in order to understand whether these interventions are applicable for this scheme.

#### 3.2. Option Appraisal Overview

The analysis for the proposed development has been carried out using EDSL TAS version 9.5.1 accredited software, which is an approved DTM software tool. In total 4 interventions were reviewed which explored options presented to the client in which they would like to explore. The interventions were:

- Existing Building – Using assumed existing U-Values and assumed lighting and mechanical systems (**BENCHMARK BUILDING**)
- Proposed Mechanical & Electrical Upgrades - Using assumed existing U-Values and proposed lighting and mechanical systems (**AS PROPOSED**)
- Proposed Mechanical & Electrical Upgrades and *Wall Insulation Upgrade* – Improvement to external wall U-Value only and proposed lighting and mechanical systems.
- Proposed Mechanical & Electrical Upgrades and *Wall & Roof Insulation Upgrade with reduced Infiltration losses* - Improvement to external wall U-Value and roof only and proposed lighting and mechanical systems. Air tightness was also improved to 25m<sup>3</sup>/h.m<sup>2</sup> as part of the building fabric upgrade.

#### 3.1. Results

The results of this analysis are used to establish how interventions can be implemented to influence energy reduction and subsequently carbon dioxide and can be seen below In Table 6.

The benchmark building provides a comparative baseline to assess savings over the assumed existing systems.

| Run                                                                                                                      | BER kgCO <sub>2</sub> /m <sup>2</sup> | Percentage Improvement Against Existing Building |
|--------------------------------------------------------------------------------------------------------------------------|---------------------------------------|--------------------------------------------------|
| Existing Building (BENCHMARK BUILDING)                                                                                   | 54.6                                  | -                                                |
| Proposed Mechanical & Electrical Upgrades (AS PROPOSED)                                                                  | 33.5                                  | 39%                                              |
| Proposed Mechanical & Electrical Upgrades and <i>Wall Insulation Upgrade</i>                                             | 28.7                                  | 47%                                              |
| Proposed Mechanical & Electrical Upgrades and <i>Wall &amp; Roof Insulation Upgrade with reduced Infiltration losses</i> | 23.8                                  | 56%                                              |

**Table 6: Building Emission Rate (BER) Benchmark and Intervention Results**

The results indicate that interventions over and above the current scope of proposed mechanical & electrical works are 8% for fabric upgrades and 17% when fabric interventions are implemented, and infiltration is reduced.

### 4. Operational Energy

Due to the early phase of the project, initial, and highly indicative calculations have been carried out using the methodology set out in CIBSE TM 54: 2013 (Evaluating operational energy performance of buildings at the design stage) and to meet the objectives of the Bruntwood Guide to Net Zero Operational Carbon.

The primary aim is to carry out this building modelling to provide initial high-level advice; highlighting and identify opportunities to reduce operational carbon, or measures which can be taken to mitigate against risks which may cause energy consumption, and associated carbon emissions, to increase at this very early stage (ensuring they can be acted upon going into stage 3). Further thought and detail is to be incorporated into the mechanical design and control strategy as the design progresses, the modelling will be updated to reflect this enabling the impact of opportunities and risks to be quantified with greater certainty in later stages.

The Bruntwood guide references UKGBC targets; These highlight the need to reduce building demand placed upon UK Grid supplied electricity, to ensure overall demand can be met via zero carbon sources as rapidly as possible.

The United Kingdom Green Building Council (UKGBC) sets targets for both Net Lettable Area and Gross Internal Area for building operational energy usage, with targets set for Interim and Paris Proof agreements, based on the Paris Climate Agreement and the UK's net zero carbon emissions. The targets can be seen in Figure 2, which targets for this project highlighted within the green area.

|                       |                                               | Interim Targets |           |           | Paris Proof Target |
|-----------------------|-----------------------------------------------|-----------------|-----------|-----------|--------------------|
| Scope                 | Metric                                        | 2020-2025       | 2025-2030 | 2030-2035 | 2035-2050          |
| Whole building energy | kWh <sub>e</sub> /m <sup>2</sup> (NLA) / year | 160             | 115       | 90        | 70                 |
|                       | kWh <sub>e</sub> /m <sup>2</sup> (GIA) / year | 130             | 90        | 70        | 55                 |
|                       | DEC rating                                    | D90             | C65       | B50       | B40                |
| Base building energy  | kWh <sub>e</sub> /m <sup>2</sup> (NLA) / year | 90              | 70        | 55        | 35                 |
|                       | kWh <sub>e</sub> /m <sup>2</sup> (GIA) / year | 70              | 55        | 45        | 30                 |
|                       | NABERS UK star rating                         | 4.5             | 5         | 5.5       | 6                  |
| Tenant energy         | kWh <sub>e</sub> /m <sup>2</sup> (NLA) / year | 70              | 45        | 35        | 35                 |

NLA = net lettable area      GIA = gross internal area

**Figure 2 – Energy performance targets for buildings targeting net zero carbon for operational energy**

## 5. CIBSE TM 54 Methodology

To conduct a CIBSE TM 54 assessment, the Part L model is usually used as a starting point and modified based on information on tenant occupancy patterns, operating hours, internal heat gains, controls and management regimes. Then a combination of DTM and manual calculation is adopted to predict the operational energy of the 38-42 Mosley Street development.

Figure 3 illustrates the methodology, proposed by CIBSE TM 54:2013 to predict operational energy at the design stage.

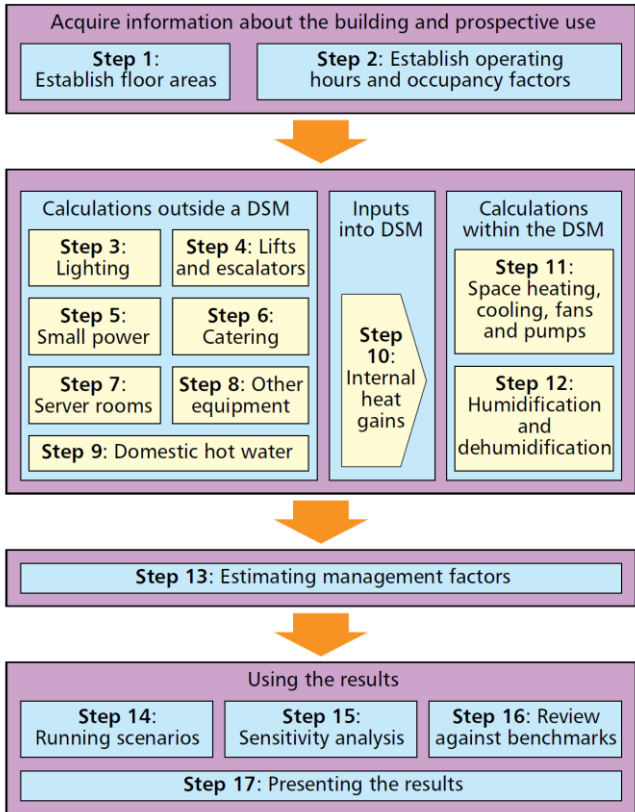


Figure 3 - CIBSE TM 54 methodology for evaluating operational energy use

The following five stages should be considered when conducting a CIBSE TM 54: 2013 analysis.

### 1. Establishing floor areas and operating hours

Since the results of CIBSE TM 54 analysis are usually compared with the results of benchmarks, establishing treated floor areas plays an important role for this comparison. The CIBSE TM54 model is developed based on the results of Part L model. All conditioned areas within thermal envelope are included as per the Part L assessment.

The results are displayed against Net Lettable Area. The occupancy behaviour within the building will introduce a high level of variability to the building's energy consumption and therefore establishing this parameter can influence the overall results. CIBSE TM 54: 2013 suggests conducting a survey to collect data from potential or actual occupants of the building. Considering the stage of development establishing this parameter is very

challenging. For this reason, a range of potential operating scenarios, and associated energy consumption are considered based on the outcomes of the operational energy.

### 2. Estimating end users energy consumption

Energy consumption for lighting, lifts, small power, catering and hot water should be estimated manually using relevant CIBSE guidance. To estimate energy use for heating, cooling, fans, pumps and humidification, dynamic thermal models should be adopted. Table 7 summarises the proposed methodologies by CIBSE TM 54: 2013 to estimate energy consumption for each individual end use categories.

| End use category                 | Calculation method                                                                                             |
|----------------------------------|----------------------------------------------------------------------------------------------------------------|
| Lighting                         | BS EN 15193: 2007 - Annex                                                                                      |
| Lift                             | CIBSE Guide D: 2015- Section 13                                                                                |
| Small power                      | CIBSE Guide F: 2012 –Section 12                                                                                |
| Catering                         | CIBSE TM 50:2021                                                                                               |
| Hot Water                        | CIBSE Guide G: 2004- Section 2 & Bruntwood Guide                                                               |
| Heating, cooling, fan, and pumps | To estimate HVAC energy consumption, TM 54 suggests modifying DTM based on the actual building characteristics |

Table 7: Proposed calculation methods

### 3. Estimating management factors

In many buildings, systems may not perform at the quoted efficiency due to poor commissioning, lack of efficient management etc. According to CIBSE TM 54: 2013, in order to account for this, an overall management factor can be applied to the calculation results, representing how well the building systems are likely to be managed during its operation.

### 4. Establishing scenarios

The operational use of the building is likely to introduce a high level of variability to the building's energy consumption and establishing this parameter can influence the overall results. As determining day to day operation of a building is almost impossible, CIBSE TM 54: 2013 suggests presenting the results as a range with high and low energy use scenarios to show the level of uncertainty around estimating operational energy use in buildings.

### 5. Analysing the results

As suggested by CIBSE TM 54: 2013, sensitivity analysis should be conducted to determine parameters which have high influence on overall energy consumption in the building.



6. Analysis Setup

6.1. Inputs

The physical geometry and orientation of the building is as per the reported drawings from AXI Architects dated 15/11/2021. The energy for the Gross Internal Area (GIA) has been calculated

For all tested scenarios identical building fabric has been modelled. It is assumed that this represents the existing fabric with improvements to be consulted with throughout the process of Stage 2.

1. Weather Data

The Manchester Test Reference Year (TRY)weather data is used for all scenarios analysed.

TRY weather data is used for the studies, being representative of typical site weather. Data files use a 30-year baseline, aiming to ensure that the observed effects of climate change will be included.

2. Occupancy Level and Profiles

The building is not currently occupied and as such the specific floor layouts and operating hours are yet to be defined. As far as can be projected with information available at this stage, the expected occupancy density for office areas is specified at (1p /8 m²). Often these fall below the maximum levels for which the building is designed to once tenancy requirements are incorporated into the fit-out designs and diversity is accounted for. As such, the occupancy densities accounted for are as follows:

Low occupancy scenario (1) – 1 person per 10 m²

Optimistic Case (2) – 1 person per 8m ²

High scenario (3) – 1 person per 6 m²

For the purposes of this analysis, it is assumed the building will not be occupied in office areas at weekends and bank holidays.

3. Domestic Hot Water Consumption

Domestic hot water consumption for the building is particularly difficult to estimate. Domestic hot water consumption will be dependent on the incoming tenant’s requirements in the food and beverage areas.

CIBSE Guide G (2004) predicts a daily consumption of 8 litres per person for an average ‘office’. It has also been suggested by the client, Bruntwood, to use a domestic hot water provision of 8 litres/person/day and has been followed in this assessment for all 3 investigated scenarios. The total office NLA is calculated at an area of 1788m². Domestic hot water has been calculated for the office spaces only and can be seen in Table 8. Food and beverage areas have been assessed in line with TM50.

| Inputs for Scenarios                   | Low    | Central | High   |
|----------------------------------------|--------|---------|--------|
| Occupancy Density                      | 12     | 10      | 8      |
| Domestic How Water<br>(8 L Per Person) | 1192 L | 1432 L  | 1792 L |

Table 8: Domestic Hot Water Calculation

4. HVAC & Lighting Systems

Much information from the Part L analysis has been used to determine the system specification (as recommended under section 7.11 of the CIBSE TM 54 methodology). As for occupancy gain; small power consumption is calculated for all areas and installed lighting power has been determined based on built definition and Part L model. Full details of proposed assumptions can be seen in Appendix A – Lighting and Mechanical Systems.

5. Lifts

Lift energy has been assessed in accordance with CIBSE Guide D: 2015- Section 13 and information provided by lecs UK Draft VT report. This can be improved upon in accordance with an updated report that references the proposed final solution.

6. External Lighting

There are no external lighting proposals included in the scheme.

7. Catering

CIBSE TM50 – Energy efficiency in commercial kitchens (2021) is referenced for operational energy in commercial kitchens. It has also been mentioned by the client that an existing portfolio for restaurants can be made available to assist in calculations for operational energy of the space.

A maximum restaurant capacity including bar seating has been referenced as 250.

8. Un-accounted for Consumption

In addition to the external lighting, there may be other areas of smaller consumption which are not accounted for at this stage but are unlikely to have significant impact upon the overall figures e.g. sump pumps, consumption linked to security/CCTV, and testing of life safety generators.

## 6.2. Evaluated Scenarios

Due to considerable uncertainty linked to how incoming tenants will operate spaces post occupancy, it is not meaningful to provide a single figure for an operational energy prediction. It is more useful to estimate the range in which energy consumption is likely to be. Considering the variability in occupancy behaviour or expected power small power consumption (how varying small power impacts the demand on the building's systems) leads to significant fluctuations in energy consumption. This approach allows the risks to operational energy to be better defined, and sensitivity to these risks quantified; allowing appropriate mitigation measures to be pinpointed and taken. Bruntwood has provided standardised inputs for scenarios for operational energy for office areas which have been followed at 38 - 42 Mosley Street and can be seen below in Table 9.

| Inputs for Scenarios                                | Low                                           | Central                                       | High                                          |
|-----------------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|
| Occupancy Density                                   | 12                                            | 10                                            | 8                                             |
| Operating Hours/Days                                | 09:00 -17:00<br>5 days a week                 | 08:00 -18:00<br>5 days a week                 | 08:00 -20:00<br>5 days a week                 |
| Heating & Cooling Set Points                        | 21°C Heating<br>24°C Cooling<br>16°C set back | 21°C Heating<br>24°C Cooling<br>16°C set back | 21°C Heating<br>24°C Cooling<br>16°C set back |
| Heating & Cooling Hours / Days                      | 09:00 -17:00<br>5 days a week                 | 08:00 -18:00<br>5 days a week                 | 08:00 -20:00<br>5 days a week                 |
| Out of Hours Heating/<br>Cooling Provision          | Heating night set back                        | Heating night set back                        | Heating night set back                        |
| Ventilation Rates<br>(litres/second/person)         | 14                                            | 14                                            | 14                                            |
| Ventilation Hours / Days                            | 09:00 -17:00<br>5 days a week                 | 08:00 -18:00<br>5 days a week                 | 08:00 -20:00<br>5 days a week                 |
| Out of Hours Ventilation Provision                  | None                                          | None                                          | None                                          |
| Domestic Hot Water Provision<br>(litres/person/day) | 8                                             | 8                                             | 8                                             |
| Office Small Power Loads (W/m²)                     | 8                                             | 15                                            | 25                                            |
| Office Small Power Hours / Days                     | 09:00 -17:00<br>5 days a week                 | 08:00 -18:00<br>5 days a week                 | 08:00 -20:00<br>5 days a week                 |

|                                                        |                               |                               |                               |
|--------------------------------------------------------|-------------------------------|-------------------------------|-------------------------------|
| Office Out of Hours Small Power Provision (W/m²)       | 20%                           | 20%                           | 20%                           |
| Common Areas Small Power Loads (W/m²)                  | 5                             | 5                             | 5                             |
| Common Areas Small Power Hours/Days                    | 09:00 -17:00<br>5 days a week | 08:00 -18:00<br>5 days a week | 08:00 -20:00<br>5 days a week |
| Common Areas Out of Hours Small Power Provision (W/m²) | 1                             | 1                             | 1                             |
| Lighting Hours / Days                                  | 09:00 -17:00<br>5 days a week | 08:00 -18:00<br>5 days a week | 08:00 -20:00<br>5 days a week |
| Lighting Power / Provision                             | 10% of load                   | 10% of load                   | 10% of load                   |
| Management Factor                                      | 1                             | 1.1                           | 1.15                          |
| Weather File                                           | Manchester TRY                | Manchester TRY                | Manchester TRY                |

Table 9: Bruntwood Standardised Inputs for Operational Energy

## 7. Results

Based on the current information it is estimated that the total annual energy consumption for Gross Internal Area (GIA) could be in the range of 169.6 kWh/year/m² to 228.9 kWh/year/m². The results can be seen in Table 10.

| Scenario                | Heating | Cooling | Auxiliary | Lighting | Hot Water | Equipment | Servers | Lifts | Catering (Environmental) | Total (kWh/year/m²) |
|-------------------------|---------|---------|-----------|----------|-----------|-----------|---------|-------|--------------------------|---------------------|
| 1-Low                   | 42.1    | 0.1     | 7.9       | 11.3     | 1.6       | 16.9      | 0.2     | 2.9   | 86.6                     | 169.6               |
| 2- Central (Optimistic) | 45.0    | 0.3     | 8.7       | 15.6     | 2.2       | 33.0      | 0.3     | 3.2   | 86.6                     | 194.9               |
| 3-High                  | 40.0    | 1.2     | 9.1       | 19.3     | 2.8       | 65.9      | 0.7     | 3.3   | 86.6                     | 228.9               |

Table 10: Operational Energy Results

Since the results of the 'Optimistic Case' were predicted based on actual operational periods and reasonable assumptions for occupancy density, internal loads, controls and management regimes, with ideal system performance this scenario is likely to provide a target which could be aimed towards, for typical tenants. However, based on the day-to-day operation of building and occupants' behaviour in future considerable variation from the baseline is possible. The breakdown for this scenario can be seen below in Figure 4.

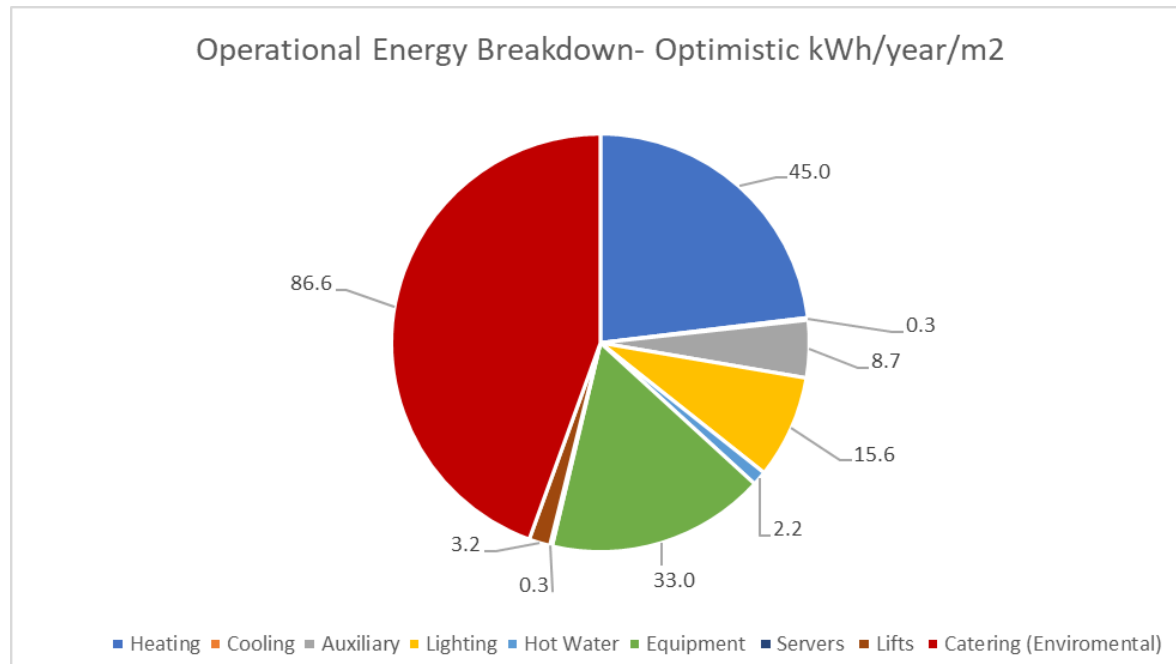


**Figure 4: Operational Energy Breakdown - Central (Optimistic) Case**

The operational energy results have been plotted against the Bruntwood Existing Building Portfolio, where only the low scenario falls under the existing building Bruntwood portfolio figure of 188 kWh/year/m<sup>2</sup> and can be seen below in Figure 5.



**Figure 5: Operational Energy Compared to Bruntwood's Existing Building Portfolio**

## 7.1. Results Discussion

The results of this assessment show that, among all tested variables, catering (environmental) in the Food and Beverage area is predicted to consume the highest amount of energy in the building. This load makes up for around 38-51% of total energy use of the building. This energy is associated with the environmental aspect of the building which includes, lighting, ventilation, air conditioning etc.

The operational energy usage associated with the Food and Beverage area is calculated at 129.31 kWh/m<sup>2</sup>. This energy is associated with the process necessary to provide a food service in operation including preparation, cooking, washing-up etc and would not be associated with Bruntwood.

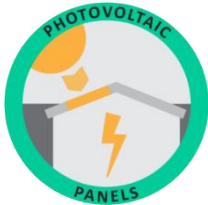
The second highest consumer of energy in scenario 1 and 2 is heating.

Electricity consumption for equipment ranges from 16.9 kWh/m<sup>2</sup> per year (Scenario 1) to 65.9 kWh/m<sup>2</sup> per year (Scenario 3). Considering that depending on the day-to-day operation of the building usage of equipment can vary considerably, equipment energy consumption is a significant unknown variable which has a considerable effect on the overall building energy consumption.

Based on the TM54 Compliant methodology, heating and cooling consumption is predicted by DTM which has some limitations. For instance, it is assumed that systems follow a regular schedule with fixed set-points which is an optimistic assumption. Simultaneous operation of heating and cooling in a room can occur in practice; however, this is not simulated currently. Moreover, out of hours operation of the building such as cleaning and maintenance has been ignored in DTM models. Considering these limitations, the CIBSE TM 54: 2013 methodology may underestimate the total heating and cooling demand in the building.

Server consumption makes up a small percentage of total electricity usage, however true consumption is highly uncertain due to tenancy usage and requirements currently being unknown. Exact landlord requirements (and corresponding likely power draw) from Main equipment rooms, switch rooms etc will additionally be confirmed in upcoming stages.

## 8. PV Analysis



Photovoltaic cells directly convert sunlight into electrical current using semi-conductors. The output of a cell is directly proportional to intensity of the light received by the active surface of the cell. Exposure to sunlight causes electricity to flow through the cells. Direct sunlight produces the greatest output, but power is still produced even when overcast.

- Photovoltaic panels can either be integrated modules (incorporated into glazing, the façade or roof tiles of a pitched roof, etc) or mounted in angled arrays on a flat roof.
- Photovoltaic modules are based on silicon cells of various types, with corresponding cost and performance benefits: Mono silicon panels are moderately cheaper with corresponding lower performance; poly-silicon panels are more expensive with higher performance.
- Electrical integration – electricity from the PV array is fed via inverters into the distribution network of the building where it is anticipated the majority of the electricity will be consumed. A further connection will enable unconsumed electricity to be sold back to the electricity grid.
- Optimum electrical output is obtained from PV panels facing +/- 45 degrees of south and should be ideally inclined at 10° to 40° from the horizontal, thereby optimising electricity generation and allowing the self-cleaning by the action of rain.
- Shading – it is important to avoid locating PV on surfaces that are permanently shaded, even transient shadows should be avoided where possible.
- Ventilation of the panel can enable the PV panel to remain cooling, improving its performance.
- Panels are typically warranted for 20 years

Roof mounted PV panels, particularly angled arrayed, and must not exceed the height restrictions imposed on the development. Safe access around the panels and to other roof plant should be considered and maintained. At 38-42 Mosley Street the Global tilted irradiation at optimum angle to the site at true south is **1065 kWh/m<sup>2</sup>** at the optimum tilt of **37°**.

Figure 6 shows an image of the plant room roof at 38-42 Mosley Street. The areas highlighted in the red box would have to be investigated for removal or an overshadowing analysis to be taken to see how they would obstruct potential PV development.

It has been mentioned that a structural analysis is set to be taken on the plant room roof to see if PV development is viable. Once this has been undertaken results can be provided in depth with a shading analysis.

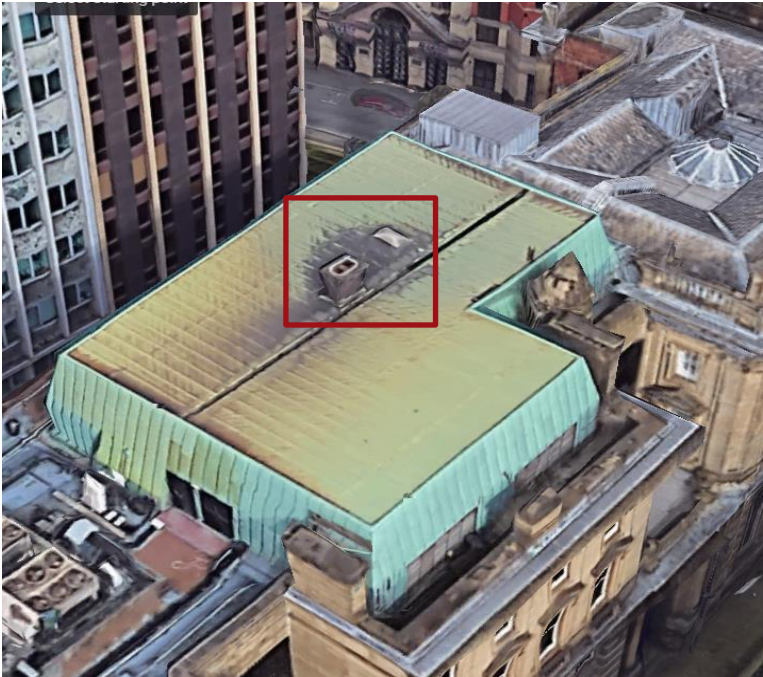


Figure 6 – 38- 42 Mosley Street Plant Room Roof

### 8.1. PV Results

The results in Table 11 below show the potential electricity generation per year from the integration of PV at 38-42 Mosley Street, which will be included in more detail at stage 3.

| Option              | Nominal Panel Efficiency (%) | Inclination | Estimated Electricity Generation kWh/annum | Annual Carbon Reduction (Tonnes)* | Recommended for Project |
|---------------------|------------------------------|-------------|--------------------------------------------|-----------------------------------|-------------------------|
| Potential Roof Area | 15.3                         | 37°         | 7,400                                      | 1.7                               | ✓                       |

Table 11: PV Results

\*Energy to carbon is based on DECC 2021 Energy to Carbon figures (0.233)



## 9. Conclusions

Based on the current information, very initial and indicative results suggest that electrical consumption for the 38-42 Mosley Street development will likely fall in the range of 169.6 kWh/year/m<sup>2</sup> to 228.9 kWh/year/m<sup>2</sup>).

PV has the ability to provide 7,400 kWh/annum and reduce operational energy of the whole building by around 2 kWh/year/m<sup>2</sup>. This has the ability to offset electricity consumption for cooling and servers in all scenarios and additionally domestic hot water usage in a low building scenario.

Since the results of the baseline model were predicted based on what, at this initial stage, are believed to be the most likely/reasonable operational periods and assumptions for occupancy density, internal loads, controls and management regimes, it provides the most representative results, based on the TM54 methodology. However, depending on the actual day to day operation of the building and occupants' behaviour as shown in this assessment; considerable variation from the baseline is possible.

## 10. Recommendations

Within buildings the reduction of energy consumption requires multiple strategies in an effort to prove successful. Arguably key to this is a consistent management based on the visibility and information that metering can provide.

As such a more granular **metering strategy** than is usual is targeted as being implemented and validated in detail at the commissioning stage. It must be clear which meters serve which areas. Ideally meter readings can be accessed remotely and readings outside of expected values could be automatically flagged up. It will be very difficult to dynamically highlight areas for which the building could be running sub-optimally, let alone address these issues, or, realistically quantify the likely impact of potential future pro-active changes without this data. Additional tenant distribution for terminal units / HVAC related loads in addition to those for lighting and small power will be specified to help provide the delineation in tenant/landlord consumption for NABERS/UKGBC targets.

This metered data will provide the additional benefit of providing rapid feedback for any changes made to the buildings systems or operation. It is assumed a stringent and pro-active monitoring strategy will be followed. Additionally, it may help assess and provide further information for the modelling and optimisation of other/future Bruntwood buildings, allowing predictions in terms of real building post occupancy operation, and reduction of energy consumption. More accurate data on occupancy levels, typical small power consumption and domestic hot water consumption (and profiles for each) could be obtained and accounted for in future work.

### Bruntwood target and further steps to achieve this

The energy consumption of the proposed regeneration currently exceeds the Bruntwood 2020-2025 energy target of 160kWh/m<sup>2</sup> when including the environmental conditioning of the F&B and Office space.

Concerted and sustained effort through the commissioning and operation of the building will likely be required to initially achieve, and then improve upon, this in operation. Much further thought and detail will also be put into the design and control strategy in upcoming stages to help ensure the targets are achievable.

The following areas of focus, and potential opportunities in design are expanded on within the recommendations section of the report.

- **Fit out guidance and equipment consumption.**

As the equipment loads have a high contribution to overall electricity consumption of all scenarios providing initial guidance and continual engagement with tenants is recommended to ensure tenant

related consumption (which will make up a significant proportion of the whole building consumption Bruntwood are targeting) is minimised, and hopefully continually improved upon is important. Giving direct access to relevant metered data to the tenants will also help in this goal, enabling tenants to better analyse and quantify the impact changes in operation may have. In this case guidance on specification of highly efficient equipment specifically laptops/monitors would be extremely beneficial to meeting targets, best practice would be to target <8.0w/m<sup>2</sup> tenancy small power consumption in office settings. Equally provision should be in place to ensure lighting performance is maintained by incoming tenant(s).

- **Design Opportunities**

There are a number of design opportunities which are being/will be explored to minimise consumption in operation.

These include specification of plant to optimally meet demands loads, more efficient lighting and integration of enhanced control strategies

- The incorporation of an enhanced economy cycle for air handling units and system controls as referenced under the BMS controls section.
- Plant will be specified to optimally meet the build. Whilst there may well be significant capital cost related savings due to not over-specifying plant; It is recommended that long term operational consumption savings are prioritised over those related purely to short term capital expenditure where possible, this should extend to all areas of energy consumption (e.g. it is recommended regenerative drives are specified to relevant lifts), it will also be important to note the impact changing the specification may have on building performance, particularly within VE exercises.
- Typically lighting power densities of 4.5 w/m<sup>2</sup> are targeted in highly efficient buildings. This would be a pre-requisite for compliance of Australian buildings with the Australian building code allowance and will reduce whole building, tenant and landlord cooling consumption. This will likely come at an aesthetic cost as noted below.
- In wider carbon terms consideration of the refrigerant type and GWP used in the heat pumps should be reviewed and procedures in place to prevent leakage.

**Note:** that to achieve much reduced operational energy targets there may be additional costs beyond capex/monetary ones e.g. in terms of aesthetic appearance in the case of lighting: feature, pelmet lighting is not inherently efficient in illuminating the working plane; in many cases a lower lux level is additionally specified to achieve the w/m<sup>2</sup> targets.

- **Out of hours controls**

If the tenancies allow/are to be used for more office type applications, it may be appropriate to reduce the servicing hours. Bruntwood could agree with the tenants core 'occupancy hours', this is should be reduced from typical UK operation times to those more appropriate for core building occupation i.e. 8am to 6pm, during which central plant operates automatically to maintain conditions. Additional warm up or cool down required to achieve comfort conditions during those hours could be incorporated using optimum start/stop.

Outside the occupancy hours, should the tenant require central services the web connection override (or similar) could be used to request central plant to operate automatically outside hours to meet this requirement.

- **BMS Control Strategy/Description of Operations**

- Enhanced control of systems.

The description of controls will be comprehensively completed at an earlier project stage than is usual to ensure the strategy is clear, and risks related to inefficient control are mitigated against.

Significant enhancing the control strategy for the systems will enable these to be put to better usage, enabling them to meet the building demands with reduced levels of energy consumption. This description of operation enables an easy reference point for the design intent which can be followed in operation, and, or modified at a later date to ensure the control strategy effectively and efficiently utilises the building systems, whilst also minimising unnecessary operation/maintenance etc.

- Items of control strategy which are likely to be implemented are:
    - Heating and cooling lock offs at inappropriate external temperatures. (e.g. cooling at <5 deg C external temperature)
    - Extended dead-bands for terminal systems to reduce heating and cooling loads as well as potential conflict of systems.
    - Enhanced air handling unit control in terms of preconditioning temperatures and air volumes, this control will be complimentary to demand controlled ventilation. This will help enable 'free cooling' to internal areas when possible and help minimise any conflict of heating and cooling between air handling units and terminal units.
    - Variable flow and temperature and flow controls for water side systems, particularly for condenser water loops in an effort to ensure optimal performance for variable and dynamically changing demands that the combination of office and leisure requirements presented by the building.

- **Commissioning and BMS strategy**

Consider a more detailed commissioning process, to ensure the plant operates optimally and as designed. An independent commissioning agent could be appointed for this process detailed commissioning brief must be developed, listing all of the commissioning tests to be performed, drawing on CIBSE, ASHRAE and NEBB standards as appropriate.

- **BMS Visibility**

It is impossible to control a building efficiently unless all of the plant is visible on a central HVAC controls interface. All plant should be shown and controllable on the BMS, ideally including HVAC equipment within the tenant demise (as referenced above under metering strategy) as is required by an on-site/FM team. This could also be enforced through a fit-out guide for tenancies to ensure that this design intent is carried through to tenant operation and future and installation of equipment. This is best achieved through enforcement of the tenant fit-out brief and commissioning verification of any installations.

- **Handover/Soft landings**

The Bruntwood guidance to implement the Soft Landings framework is commended. This focuses on ensuring there is collaboration and overlap of the design, construction and operation teams and all parties maintain an active presence for post practical completion. It also ensures that performance targets and success indicators are identified up front and verified to have been achieved post-construction. As highlighted in the Bruntwood documentation; BSRIA has published a Soft Landings and Design for Performance (BG 76/2019) guide.

- **Maintenance, Monitoring, targeting and tuning**

Maintenance strategies to preserve energy efficiency should be specified if targets are to be achieved. These will apply beyond the defects liability period or the tuning period. A consistent approach to monitor and optimise building operation should be taken to ensure targets are achieved, and then bettered continuously in operation. The relevant party/FM team could be given an enhanced scope and/or mandate to achieve this goal.

## 11. Appendix A – Existing and Proposed Lighting and Mechanical Systems

### Existing Lighting Systems

| Zone           | Assumed Existing Power density (W/m <sup>2</sup> ) | Assumed Existing Illuminance (lux) | Assumed Existing Auto presence detection | Assumed Existing Daylight control |
|----------------|----------------------------------------------------|------------------------------------|------------------------------------------|-----------------------------------|
| Offices        | Unknown (12-15)                                    | Unknown                            | None                                     | None                              |
| Bar Restaurant | Unknown (12-15)                                    | Unknown                            | None                                     | None                              |
| Entrance Lobby | Unknown (12-15)                                    | Unknown                            | None                                     | None                              |
| Meeting Room   | Unknown (12-15)                                    | Unknown                            | None                                     | None                              |
| Reception      | Unknown (12-15)                                    | Unknown                            | None                                     | None                              |
| Corridor       | Unknown (12-15)                                    | Unknown                            | None                                     | None                              |
| Toilets        | Unknown (12-15)                                    | Unknown                            | None                                     | None                              |

Table 12: Assumed Existing Lighting System

### Proposed Lighting Systems

| Zone           | Proposed Power density (W/m <sup>2</sup> ) | Proposed Illuminance (lux) | Proposed Auto presence detection   | Proposed Daylight control                        |
|----------------|--------------------------------------------|----------------------------|------------------------------------|--------------------------------------------------|
| Offices        | 6                                          | 450                        | Auto on/Auto off                   | Photocell Control Dimming around perimeter       |
| Bar Restaurant | As existing                                | ?                          | Manual on/Manual off/Scene Setting | None                                             |
| Entrance Lobby | 6                                          | 450                        | Manual on/Manual off/Scene Setting | None                                             |
| Meeting Room   | 6                                          | 450                        | Auto on/Auto off/Scene Setting     | Photocell Control Dimming at perimeter locations |
| Reception      | 6                                          | 450                        | Manual on/Manual off/Scene Setting | None                                             |
| Corridor       | 6                                          | 200                        | Auto on/Auto off                   | None                                             |
| Toilets        | 6                                          | 200                        | Auto on/Auto off                   | None                                             |

Table 13: Proposed Lighting System



## Existing Mechanical Services

| Use                | Assumed System                  | Assumed Efficiency |
|--------------------|---------------------------------|--------------------|
| Heating            | Direct gas boiler               | 85%                |
| Cooling            | Air Cooled Chilled Water System | SEER = 3.0         |
| Domestic Hot Water | Hot Water<br>Calorifier         | 80%                |

Table 14: Assumed Existing Mechanical Services

## Proposed Mechanical Services

| Area           | Proposed System                            | Heating Source Efficiency | Cooling Source Efficiency | DHW efficiency                         | Heat Recovery efficiency | Ventilation Plant SFP (W/(l/s)) |      |
|----------------|--------------------------------------------|---------------------------|---------------------------|----------------------------------------|--------------------------|---------------------------------|------|
|                |                                            |                           |                           |                                        |                          | SP                              | EX   |
| Offices        | ASHP – VRF FCU with Mechanical Ventilation | 335%                      | 4.3                       | Heat Pump with Electric back up – 330% | 75%                      | 1.05                            | 1.05 |
| Bar Restaurant | ASHP – UFH with Mechanical Ventilation     | 335%                      | 4.3                       | Heat Pump with Electric back up – 330% | 75%                      | 1.05                            | 1.05 |
| Entrance Lobby | ASHP - VRF FCU with Mechanical Ventilation | 335%                      | 4.3                       | Heat Pump with Electric back up – 330% | 75%                      | 1.05                            | 1.05 |
| Meeting Rooms  | ASHP - VRF FCU with Mechanical Ventilation | 335%                      | 4.3                       | Heat Pump with Electric back up – 330% | 75%                      | 1.05                            | 1.05 |
| Corridors      | Mechanical Ventilation – Panel Heaters     | 100%                      | -                         | -                                      | -                        | -                               | 1.05 |
| Toilets        | Supply & Extract                           | 335%                      | 4.3                       | Heat Pump with Electric back up – 330% | 75%                      | 0.95                            | 0.95 |
| Gym            | ASHP - VRF with Mechanical Ventilation     | 335%                      | 4.3                       | Heat Pump with Electric back up – 330% | 75%                      | 1.05                            | 1.05 |
| Storerooms     | No Heating/Cooling                         | -                         | -                         | -                                      | -                        | -                               | -    |
| Stairs         | No Heating/Cooling                         | -                         | -                         | -                                      | -                        | -                               | -    |

Table 15: Proposed Mechanical Services



38-42 MOSLEY STREET MANCHESTER M2 3AZ  
Stage 2 (Concept Design) Appendices



## Appendix 2 - Embodied Carbon Analysis: MOSE-HMM-ZZ-ZZ-RP-Y-0002

To follow



38-42 MOSLEY STREET MANCHESTER M2 3AZ  
Stage 2 (Concept Design) Appendices



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**Appendix 3 – Acoustic Feasibility Report: MOSE-HMM-ZZ-ZZ-RP-Y-0003**

## RIBA Stage 2 Acoustic Feasibility Report

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## 1. Introduction

This section sets out the proposed acoustic criteria for the development with reference to the RIBA Stage 2 concept design. The criteria and guidance within this section are relevant for shell and core and Cat A completion.

There are five principal acoustic design elements to be addressed as part of the development:

- The control of external noise intrusion by the building envelope;
- The control of external vibration intrusion through the building structure;
- The sound insulation provided by internal wall and floor constructions;
- The control of reverberation (the time for sound to decay); and
- The control of building services noise emissions (to the environment and within the development).

Where appropriate, indicative acoustic design input has been provided based on pertinent industry standards and design guidance documents. The following documents are proposed as a basis of design in the development of acoustic specifications and criteria.

- British Standard (BS) 8233:2014 'Guidance on sound insulation and noise reduction in buildings'
- British Council for Offices 'Guide to Specification' 2019
- BS 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound
- Manchester City Council (MCC) Noise and Planning Guidance
- BREEAM UK RFO 2014 Credit Hea 05 & Pol 05
- Bruntwood Technical Standards for Mechanical Services
- BS 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings - Vibration sources other than blasting
- Association of Noise Consultants Red Book - Measurement and Assessment of Groundborne Noise and Vibration

There are two BREEAM credits that the scheme could target for acoustics in the RFO 2014 standard. Criteria and guidance are provided throughout this section based on achieving these credits where applicable.

The acoustic terminology used in this section is described in Section 9.

## 2. Site Description

The site is located within the jurisdiction of Manchester City Council (MCC). A site location plan is provided as Figure 2.1, showing the location of the site and orientation with respect to other existing developments and the road network for the area.

The site has frontages onto Mosley Street to the south-east, West Mosley Street to the north-west, York Street to the north-east and the building shares a party wall with 57 Spring Gardens to the south-west. A regularly trafficked tramline runs along Mosley Street which is noted to be dominant noise source in the immediate local area.

The surrounding area consists largely of commercial uses, although one residential building, typically considered sensitive to noise, has been identified within the vicinity of the site. The noise sensitive receptor (NSR) for assessment of impact from the development is detailed in Table 2.1 and the location is shown in Figure 2.1.

**Table 2.1 Noise Sensitive Receptors**

| Receptor Location (Figure 2.1) | Name                                   | Type of Receptor | Approximate Distance from Site Boundary |
|--------------------------------|----------------------------------------|------------------|-----------------------------------------|
| NSR A                          | Manhattan Apartments, 38 George Street | Residential      | 50 m to the south-east                  |
| CR A                           | 57 Spring Gardens                      | Commercial       | Adjacent to the south-west              |
| CR B                           | York House, 20 York Street             | Commercial       | 12 m to the north-west                  |
| CR C                           | Colwyn Chambers, 19 York Street        | Commercial       | 15 m to the north-east                  |
| CR D                           | One New York Street and City Gate      | Commercial       | 12 m to the south-east                  |

Commercial properties are also considered with respect to noise impact from the proposed development, although this is not expected to be a planning requirement. Commercial receptors (CRs) are also identified in Figure 2.1 and Table 2.1.

Figure 2.1 Site and Noise Sensitive Receptor Locations



### 3. Environmental Noise Survey

Environmental noise surveys have been undertaken at the proposed development site to establish and quantify the prevailing noise levels affecting the site and its surroundings.

#### 3.1. Survey Strategy

Long-term unattended noise monitoring was carried out externally between Monday 15<sup>th</sup> November and Thursday 18<sup>th</sup> November 2021 at a key location described in Table 3.1 and illustrated in Figure 2.1. Monitoring was carried out over a 72-hour period. The purpose of the measurements was to establish and quantify the existing noise climate at and within the vicinity of the site.

Table 3.1 Noise Monitoring Locations

| Monitoring Location (Figure 2.1) | Period   | Description                                                                                                                             | Observations and Predominant Noise Sources                                                                                                                                                                                                                                       |
|----------------------------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LT1                              | 72 hours | Façade measurement at a position fronting Mosley Street. Microphone position on the 3 <sup>rd</sup> floor roof overlooking the parapet. | Noise from regular trams (approximately one each way every 5 minutes), as well as regular, but not constant cars, buses and HGVs on Mosley Street. Plant noise from the surrounding buildings also contributes to the noise climate at the measurement location, to some degree. |

Noise measurements were taken with a calibrated precision grade (Class 1) frequency (one-third-octave band) sound level meters to provide a detailed description of the prevailing environmental noise characteristics. The sound level meter was set-up to record over consecutive 5-minute periods the  $L_{eq}$ ,  $L_{90}$ ,  $L_{10}$ ,  $L_{max}$  and  $L_1$  noise indices in the A-weighting network over a 125 ms fast response time constant interval for the duration of the survey. The indices are described in Section 9, but roughly translated they describe in turn the average, background, road traffic, maximum noise level and typical maximum noise level discounting one-off events.

Full details of the instrumentation used for the noise measurements, including calibration certificates are available on request.

Weather conditions, whilst not actively measured during the survey period, were monitored remotely throughout. Weather conditions were generally ideal for the measurement of noise, it being fine and mostly dry, with just light westerly winds ( $<5 \text{ ms}^{-1}$ ) prevailing. The data during instances of rainfall and one instance of wind speed above  $5 \text{ ms}^{-1}$  ( $5.8 \text{ ms}^{-1}$ ) has been checked to verify its suitability for use, with no data requiring removal from the dataset.

### 3.2. Noise Survey Results

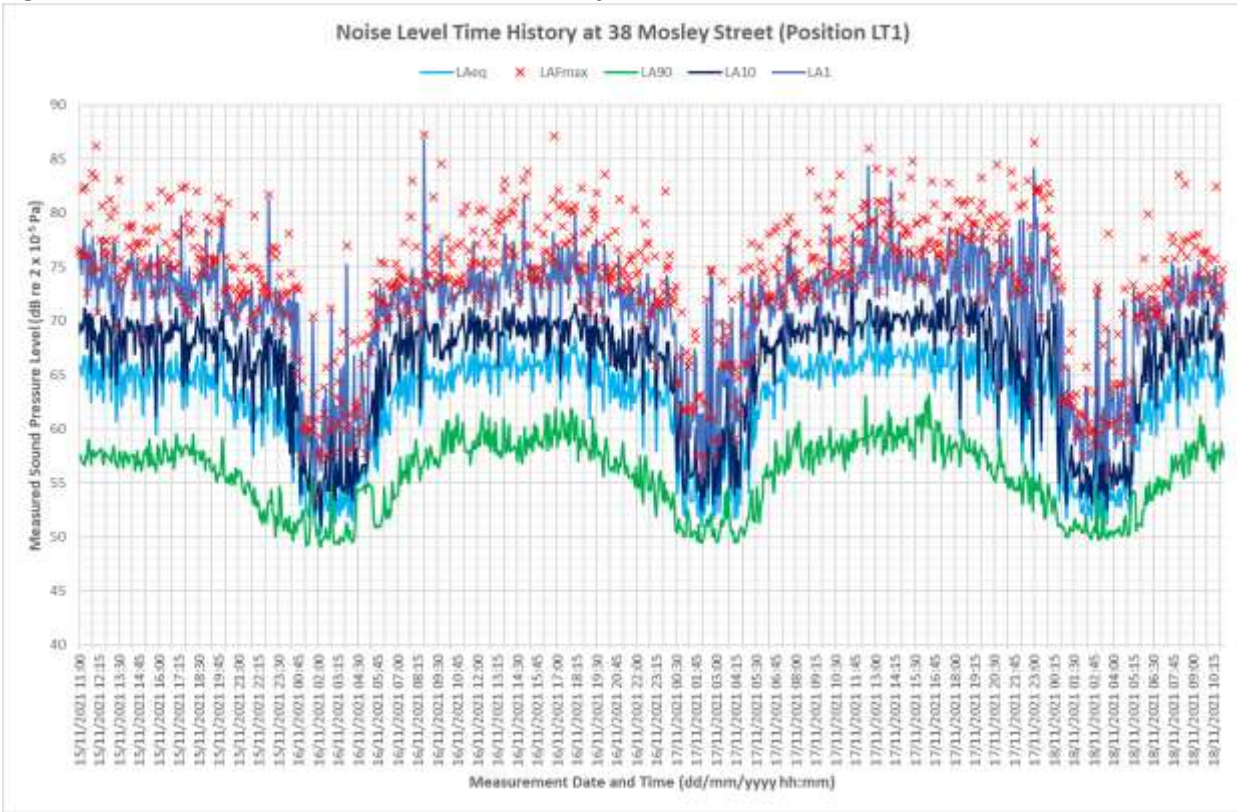
The full results of the long-term noise measurements are displayed graphically in time-history format in Figure 3.1, whilst a summary of the measured daytime (07:00 to 23:00 hours) and night-time (23:00 to 07:00 hours) noise levels for the survey period are provided in Table 3.2.

**Table 3.2 Summary of Baseline Noise Monitoring Results – Façade Values**

| Monitoring Location<br>(Figure 2.1) | Period | Duration | L <sub>Aeq,T</sub> dB | L <sub>A90,15min</sub> dB |                   | L <sub>AFmax,5min</sub> dB        | L <sub>A1,1hr</sub> |
|-------------------------------------|--------|----------|-----------------------|---------------------------|-------------------|-----------------------------------|---------------------|
|                                     |        |          | Ave <sup>1</sup>      | Min                       | Mode <sup>2</sup> | 95 <sup>th</sup> ile <sup>3</sup> | Max <sup>4</sup>    |
| LT1                                 | Day    | 16 hours | 65                    | 51                        | 58                | 83                                | 76                  |
|                                     | Night  | 8 hours  | 60                    | 49                        | 50                | 78                                | 72                  |

**Notes:** <sup>1</sup> Logarithmic average over the day/night survey periods; <sup>2</sup> Lowest modal value over the day/night survey periods, considered to represent the typical background noise level; <sup>3</sup> The 95<sup>th</sup> percentile L<sub>AFmax</sub> value presented is considered representative of typical L<sub>AFmax</sub> levels experienced; <sup>4</sup> The arithmetic average of the maximum L<sub>A1,1hr</sub> values measured during each of the day/night survey periods. All figures rounded to nearest whole decibel.

**Figure 3.1 Measured Noise Level Time History at Position LT1**



### 4. Internal Ambient Noise Levels

#### 4.1. Criteria

Within commercial properties, levels of comfort, distraction and speech privacy are the driving factors in determining appropriate levels of internal ambient noise.

BS 8233:2014<sup>1</sup> presents recommendations for appropriate internal ambient noise levels within various room types. In addition to this, the British Council for Offices (BCO) Guide to Specification<sup>2</sup> presents recommended internal noise levels within offices.

The BS 8233 and BCO guidance documents have been used to develop target internal noise levels for the proposed development. The guidance within BS 8233 stipulates noise criteria which are cumulative and therefore include both building services noise and external noise ingress. These are presented as a design range within which the internal noise levels should fall, depending on the room type. External noise ingress would be controlled by the sound insulation performance of the building envelope.

BCO guidance states that its recommendations are compatible with the BS 8233 recommended criteria, however they are presented as Noise Rating (NR) level limits, as opposed to L<sub>Aeq</sub> levels. BCO also provides NR criteria for noise ingress and noise from building services separately. NR levels incorporate a particular spectral shape and are typically used to evaluate noise from building services systems. An approximate correlation between the two can be calculated using the following:  $NR \approx L_{Aeq} - 5 \text{ to } -6 \text{ dB}$ . Bruntwood Technical Standards for Mechanical Services provides noise rating level targets for building services in specific spaces, which have been used to derive criteria where applicable.

Table 4.1 presents the recommended internal noise level performance targets for typical room types proposed for the development (both development options are included).

BREEAM recommends that the indoor ambient noise level criteria detailed within BS 8233 should be achieved to satisfy Hea 05 credit 2 (Internal indoor ambient noise levels). BS 8233 in turn references the guidance provided within BCO for office spaces. Therefore, by adopting the recommendations within BS 8233 and BCO, the BREEAM criteria for Hea 05 credit 2 is considered to be achieved.

<sup>1</sup> British Standards Institution (BSI) (2014); 'BS 8233:2014 Guidance on sound insulation and noise reduction for buildings', BSI.

<sup>2</sup> British Council for Offices (BCO) (2019); 'Guide to Specification 2019', BCO.

**Table 4.1 Internal Noise Level Targets**

| Space                                                 | BS 8233 Ambient Noise Level Design Criteria <sup>1</sup> | Recommended Building Services Noise Rating Level |
|-------------------------------------------------------|----------------------------------------------------------|--------------------------------------------------|
| Cat A Speculative Office (Base Build), Entrance Lobby | ≤50 dB $L_{Aeq}$                                         | NR 35 to 38                                      |
| Pop Up/Screening Room, Lecture Theatre                | 35 – 45 dB $L_{Aeq}$                                     | ≤NR 35                                           |
| Office Lounge, Restaurant/Bar/Cafe                    | 45 – 55 dB $L_{Aeq}$                                     | NR 35 to 40                                      |
| Circulation Spaces, Showers, Changing Rooms           | 45 – 55 dB $L_{Aeq}$                                     | ≤NR 40                                           |
| Gym, Kitchen, Restaurant BOH, WC                      | 50 – 55 dB $L_{Aeq}$                                     | ≤NR 45                                           |
| Bike Store                                            | -                                                        | ≤NR 50                                           |

**Notes:** <sup>1</sup> Where no ambient noise level design criteria are shown, the space is not considered sensitive with regards to BS 8233 and therefore no target for external noise intrusion is required. These spaces still have building services noise rating criteria to target which are considered appropriate for the intended use.

Where ranges are presented for recommended building services noise rating levels, the aim should be to achieve a noise level as close as possible to the upper limit of the range. This noise will be important for speech privacy in office spaces, as well as for masking any residual sound caused by vibration from passing trams following the refurbishment, so background noise levels that are too low will result in tram noise being more prominent.

The BS 8233 cumulative ambient noise level design targets should be considered the fundamental overall performance requirement, with the building services noise target being provided such that the cumulation of noise ingress and services noise does not exceed the BS 8233 limits. Noise within plant rooms should be controlled to meet a level 10 dB below the building services NR levels shown in Table 4.1. The sound insulation performance of the plant room wall, door and floor constructions will need to be designed accordingly.

BCO Guide to Specification also recommends limiting regular individual noise events (such as trams) to be below 55 dB  $L_{A1,1hour}$  in speculative office spaces, and below 50 dB  $L_{A1,1hour}$  in cellular offices/meeting rooms.

#### 4.1.1. Rain noise

Where rooflights are located above office use (whether retained or replaced), the noise generated by rainfall should be considered in line with BCO guidance. Rain noise should be controlled so it does not exceed 60 dB  $L_{Aeq,T}$  in the office space during heavy rainfall (as defined within BS EN ISO 140-18:2006).

## 4.2. Design Advice

### 4.2.1. Internal Ambient Noise Level Tests

Measurements of the internal ambient noise levels were taken on site at the same time as the environmental noise survey. Measurements were taken in a sample of 11 spaces, measuring both noise ingress and re-radiated groundborne noise generated by tram movements (see Section 5). The measurement locations are shown in Figures 4.1 to 4.3.

**Figure 4.1 Internal Noise and Vibration Testing Locations – Basement and Ground**

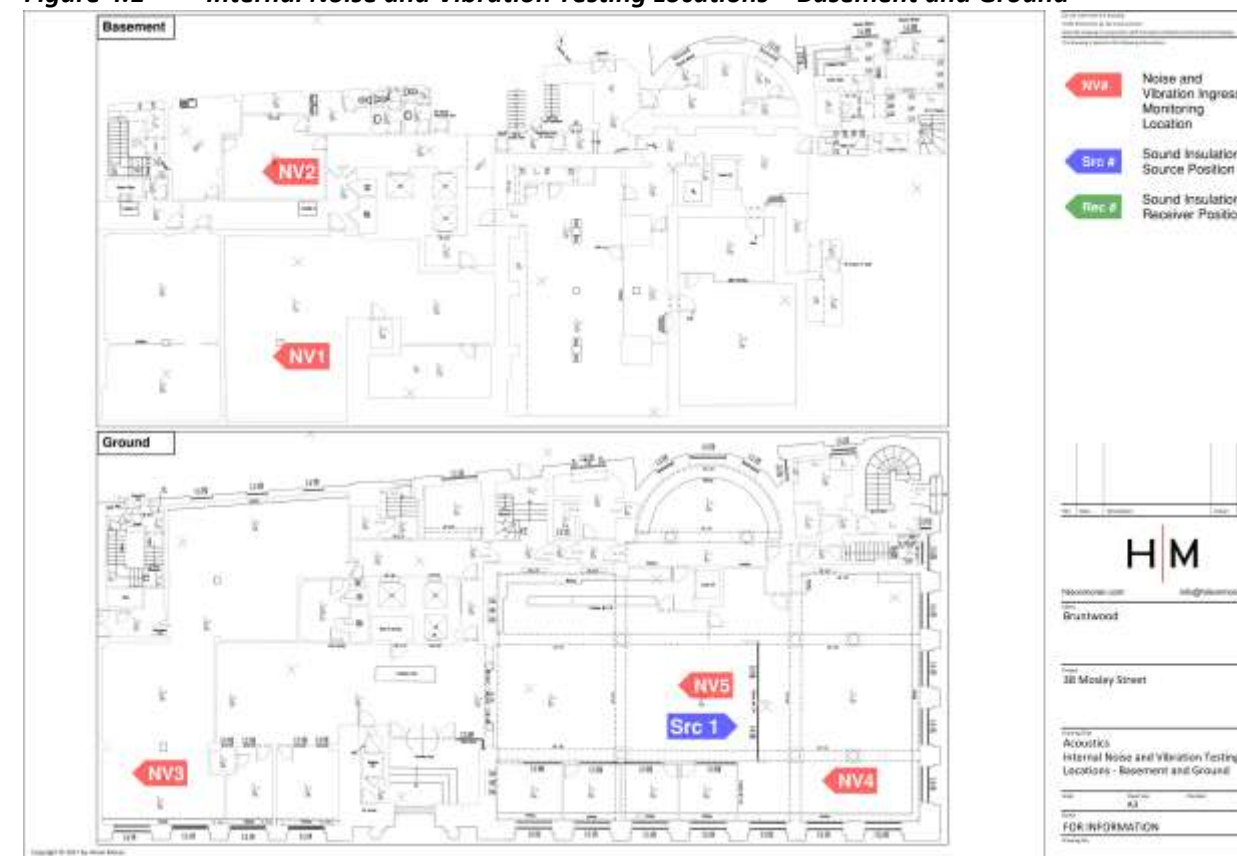
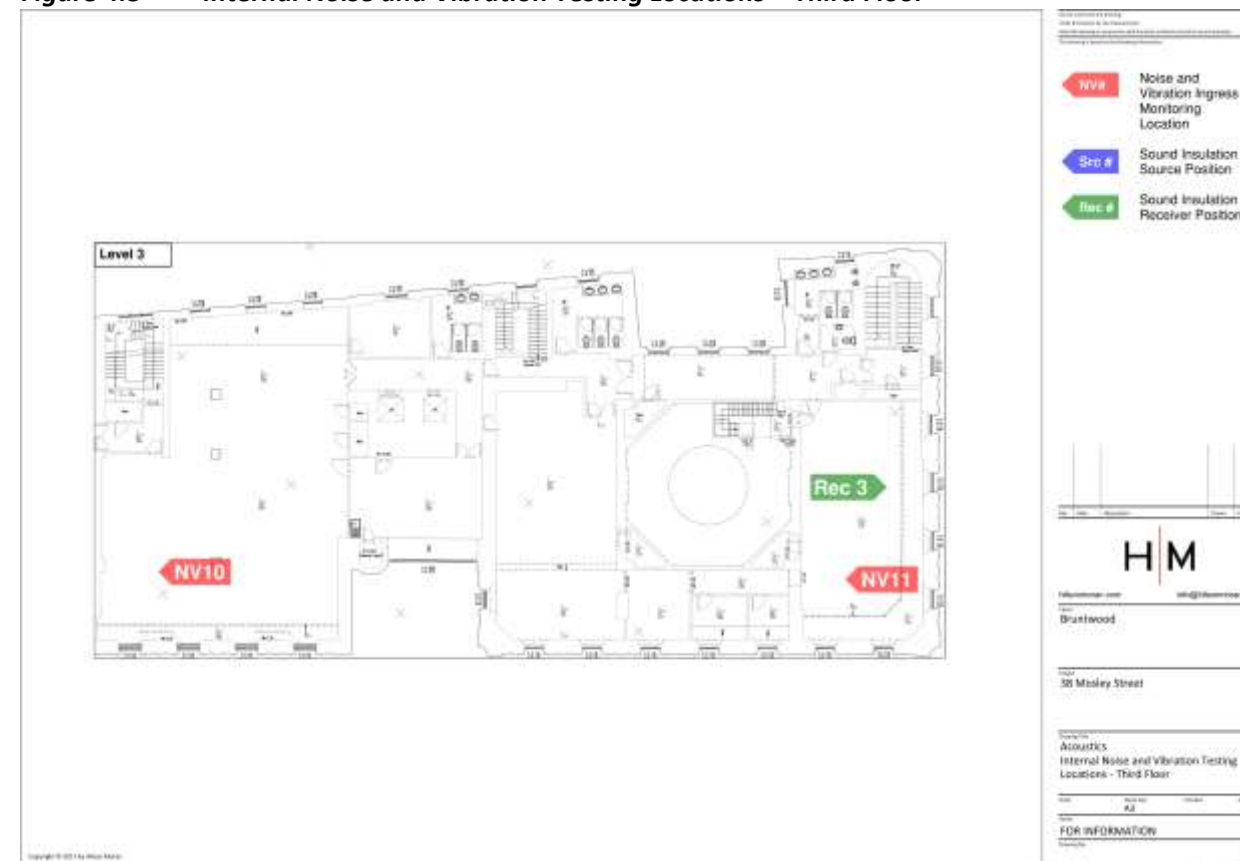


**Figure 4.2 Internal Noise and Vibration Testing Locations – First and Second Floors**



**Figure 4.3 Internal Noise and Vibration Testing Locations – Third Floor**



Existing glazing constructions comprised single glazing throughout the building, with secondary glazing installed to the roomside at ground, first and second floors at the south-eastern and north-eastern façades.

As the spaces had largely been stripped of floor, wall and ceiling finishes before the time of testing, the measured internal noise levels were greater than what would be expected in the finished office spaces as a result of longer reverberation times. The measured internal levels have therefore been corrected to a reverberation time considered to be more typical of an office space (see Table 4.2) As reverberation times were only measured in a handful of spaces, the areas not measured have been corrected based on an assumed reverberation time in line with the observed finishes and measurements in similar spaces in the building.

Table 4.2 shows the resulting predicted internal noise levels of the existing building.

**Table 4.2 Internal Noise Levels Corrected for Predicted Future Reverberation Time (RT)**

| Floor    | Location <sup>1</sup><br>(Room)           | L <sub>Aeq,T</sub><br>(dB) | L <sub>AFmax</sub> (dB) | L <sub>ASmax</sub><br>(dB) | L <sub>A1,T</sub><br>(dB) | RT During<br>Test  | Future<br>RT |
|----------|-------------------------------------------|----------------------------|-------------------------|----------------------------|---------------------------|--------------------|--------------|
| Basement | NV1 (Office<br>Southern Corner)           | 36                         | 51                      | 47                         | 46                        | 1.6 s<br>(assumed) | 1.0 s        |
| Basement | NV2 (Office<br>Western Corner)            | 35 <sup>2</sup>            | 47 <sup>2</sup>         | 46 <sup>2</sup>            | 47 <sup>2</sup>           | 1.6 s<br>(assumed) | 1.0 s        |
| Ground   | NV3 (Office<br>Southern Corner)           | 35                         | 52                      | 49                         | 47                        | 1.6 s<br>(assumed) | 1.0 s        |
| Ground   | NV4 (Banking<br>Hall, Northern<br>Corner) | 40                         | 50                      | 48                         | 47                        | 4.6 s              | 1.5 s        |
| Ground   | NV5 (Banking<br>Hall, Central)            | 40                         | 56                      | 52                         | 49                        | 4.6 s              | 1.5 s        |
| First    | NV6 (Office<br>Southern Corner)           | 38                         | 57                      | 52                         | 51                        | 1.6 s<br>(assumed) | 1.0 s        |
| First    | NV7 (Office<br>Eastern Corner)            | 31                         | 47                      | 43                         | 40                        | 1.6 s<br>(assumed) | 1.0 s        |
| Second   | NV8 (Office<br>Southern Corner)           | 34                         | 49                      | 46                         | 45                        | 1.6 s              | 1.0 s        |
| Second   | NV9 (Office<br>Dome Room)                 | 37                         | 53                      | 48                         | 44                        | 3.0 s              | 1.0 s        |
| Third    | NV10 (Office<br>Southern Corner)          | 35 <sup>2</sup>            | 50 <sup>2</sup>         | 45 <sup>2</sup>            | 45 <sup>2</sup>           | 1.6 s<br>(assumed) | 1.0 s        |
| Third    | NV11 (Office<br>Eastern Corner)           | 39                         | 51                      | 49                         | 49                        | 1.7 s              | 1.0 s        |

**Notes:** <sup>1</sup> Locations are shown in Figures 4.1 to 4.3. <sup>2</sup> Corrected for noise from existing plant items in the room, which were unavoidably in operation during the measurements. Corrections were made by logarithmically subtracting the measured L<sub>90</sub> from the parameters detailed above.

As noted in Table 4.2 all the proposed office spaces and basement ancillary spaces have been corrected to a reverberation time of 1.0 seconds. For the ground floor banking hall space (proposed restaurant/bar/cafe) this is considered difficult to achieve, and these values have therefore been corrected to 1.5 seconds.

In all cases (whether single-let or multi-let), based on the predicted levels presented above, the current internal levels into the building as a result of noise ingress and groundborne noise would not be prohibitive in achieving the BS 8233 ambient noise level design criteria for Cat A Speculative Office Space, as detailed in Table 4.1. This is providing that reverberation times and noise from building services are sufficiently controlled. The existing glazing systems are therefore considered sufficient with respect to sound insulation, although in some areas these may need replacing or made good due to dilapidation. It was also noted in some areas, the secondary glazing wasn't fully closable during the testing. If this secondary glazing is to be replaced or made good such that these can be fully closed, the applicable noise ingress levels can be expected to be lower than presented.

The predicted L<sub>A1</sub> values can also be seen to fall below the recommended level for open plan and speculative office space (55 dB L<sub>A1,1hr</sub>). However, many were close to, and in one case exceeded, the BCO recommended 50 dB L<sub>A1,1hr</sub> limit for cellular offices/meeting rooms. Where cellular offices and/or meeting rooms are located at the south-eastern façade these are likely to require additional implementation of reverberation control or glazing enhancements (within the constraints of the listed building status) to reduce the L<sub>A1,1hr</sub> values to below the recommended figure. Controls to reduce vibration related groundborne noise (see Section 5) would also assist in reducing the L<sub>A1,1hr</sub> levels further.

While the noise ingress through the façade is considered acceptable, it was noted onsite that in most cases internal noise levels during tram passes had a significant low frequency noise content, caused by vibration related groundborne noise. This is considered further in Section 5.

#### 4.2.2. Ventilation

Where mixed mode or natural ventilation is being considered, the method through which natural ventilation occurs will require assessment in terms of noise ingress. On the south-eastern façade overlooking Mosley Street it is likely that ventilation openings would undermine the sound insulation performance of the building envelope. Traditional openable windows provide very little noise attenuation and would result in an elevation of internal noise levels that would not be conducive with office working conditions. BCO does however allow a leniency to internal noise levels of +5 dB for mixed mode ventilation systems during natural ventilation modes. This could mean that natural ventilation openings are suitable on façades with lower noise levels, such as the north-west façade facing West Mosley Street. This relaxation shouldn't impact BREEAM compliance as the natural ventilation openings wouldn't be considered part of the 'permanent' ventilation strategy for the building.

Due to the listed nature of the façade of the building, it is unlikely that attenuated façade openings will be permitted, however a solution comprising an operable secondary internal panel may provide a practical solution. It should be appreciated that use of such a system would still require acceptance of elevated noise levels in parts of the offices during its operation. Note, the frequency and duration that the ventilation openings will be in use should be considered as this may offset the negative impacts of elevated noise levels if this should only occur for discreet periods, as stated in BCO 2019.

#### 4.2.3. Rooflights

The existing rooflight above the second-floor dome room is understood to be constructed from single glazing, which would likely require repair if retained. This glazing is considered unlikely to achieve levels of sound insulation performance comparable to the rest of the building envelope, however currently there are no specific noise sources nearby that might be a concern in terms of noise ingress. At the next design stage environmental noise levels at the rooflights will be predicted and a specification will be derived, which will show whether typical single glazed systems can control noise ingress to suitable levels.

If, however any new building services items or atmospheric duct terminations are to be located near to the rooflight, it will be critically important to consider the rooflight's sound insulation performance.

Furthermore, the intrusion of rain impact noise through the rooflight will require consideration, although if the existing rooflight is retained then rain impact mitigation options may not be considered feasible. If the rooflight is to be replaced then rain impact noise could be controlled by using heavier

glass, a suitable plastic glazing (e.g. ETFE) with low impact noise characteristics or replacing with double glazing. If the rooflight is to be retained then controls could potentially include installing secondary glazing panels internally or externally, or installing a retractable, rainproof blind system externally.

## 5. Vibration Ingress

Groundborne vibration from environmental sources can manifest itself within buildings both as tactile vibration (vibration you can feel) and re-radiated noise (vibration you can hear by causing surfaces to radiate noise).

### 5.1. Criteria

#### 5.1.1. Tactile Vibration

BS 6472-1:2008<sup>3</sup> provides procedures for assessing the potential human response to tactile vibration in offices. The human response to tactile vibration is assessed in terms of the equivalent 'vibration dose value' (VDV in  $\text{m/s}^{1.75}$ ), which relates to the level and duration of vibration, and effectively measures the accumulation of the vibration energy received over the period in question. The 16-hour daytime (07:00 to 23:00) VDV value corresponds most closely to the response of people to vibration inside a building. It is important to note, however that people exhibit wide variations of vibration tolerance. Specific responses are dependent upon social and cultural factors, psychological attitudes and expected degree of intrusion.

BS 6472-1 sets out guideline VDV values for evaluating the various probabilities of adverse comment within buildings. The guideline VDV values and likely responses relevant to the development are presented in Table 5.1. The criteria are presented as ranges to reflect the differing susceptibility to vibration evident among members of the population.

**Table 5.1** BS 6472-1:2008 Probability of Adverse Comment Due to Vibration

| Location                        | Period                   | VDVs ( $\text{m/s}^{1.75}$ ) above which might result in various degrees of adverse comment within office buildings |                          |                          |
|---------------------------------|--------------------------|---------------------------------------------------------------------------------------------------------------------|--------------------------|--------------------------|
|                                 |                          | Low Probability of Adverse Comment <sup>1</sup>                                                                     | Adverse Comment Possible | Adverse Comment Probable |
| Offices and Restaurant/bar/café | Daytime (07:00 to 23:00) | 0.4 – 0.8                                                                                                           | 0.8 – 1.6                | 1.6 – 3.2                |

**Notes:** <sup>1</sup> BS 6472-1:2008 states that adverse comment is not expected for VDV values below the ranges shown.

#### 5.1.2. Groundborne Noise

BCO guidance recommends limiting groundborne noise to a maximum of 45 dB  $L_{A\text{Smax}}$  in open plan offices and 40 dB  $L_{A\text{Smax}}$  in meeting rooms and cellular offices. In addition, it is recommended to target 45 dB  $L_{A\text{Smax}}$  in the restaurant/bar/café, and 40 dB  $L_{A\text{Smax}}$  in the pop up/screening room and lecture theatre options. These are guideline levels and may be difficult to achieve in refurbished, listed buildings due to the limited design measures that can be practically applied to reduce the levels of vibration entering the structure. Nonetheless, following noise and vibration testing undertaken at the site it has been determined that consideration of design measures is warranted, and potential measures are discussed along with details of the testing in the following sections.

<sup>3</sup> BSI (2008); 'BS 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings - Vibration sources other than blasting', BSI.

## 5.2. Design Advice

### 5.2.1. Vibration Measurements

#### 5.2.1.1. Tactile Vibration

Measurements of groundborne vibration were undertaken in the existing building during tram passbys on the Metrolink lines running along Mosley Street. These measurements were then corrected based on the number of tram movements expected over a typical daytime period (384, based on two passbys every 5 minutes), to provide an estimated Vibration Dose Value (eVDV). The estimated daytime eVDV values in the vertical axis (noted to be the dominant axis of movement) are shown in Table 5.2 and compared to the BS 6472-1 criteria for offices.

**Table 5.2 Measured Internal Tactile Vibration Levels (eVDV)**

| Floor    | Location (Room)                     | Calculated eVDV <sub>b,day</sub> z-axis (m/s <sup>1.75</sup> ) | BS 6472-1 Probability of Adverse Comment |
|----------|-------------------------------------|----------------------------------------------------------------|------------------------------------------|
| Basement | NV1 (Office Southern Corner)        | 0.09                                                           | Adverse comment is not expected          |
| Basement | NV2 (Office Western Corner)         | 0.01                                                           | Adverse comment is not expected          |
| Ground   | NV3 (Office Southern Corner)        | 0.14                                                           | Adverse comment is not expected          |
| Ground   | NV4 (Banking Hall, Northern Corner) | 0.13                                                           | Adverse comment is not expected          |
| Ground   | NV5 (Banking Hall, Central)         | 0.02                                                           | Adverse comment is not expected          |
| First    | NV6 (Office Southern Corner)        | 0.19                                                           | Adverse comment is not expected          |
| First    | NV7 (Office Eastern Corner)         | 0.07                                                           | Adverse comment is not expected          |
| Second   | NV8 (Office Southern Corner)        | 0.10                                                           | Adverse comment is not expected          |
| Second   | NV9 (Office Dome Room)              | 0.42                                                           | Low probability of adverse comment       |
| Third    | NV10 (Office Southern Corner)       | 0.05                                                           | Adverse comment is not expected          |
| Third    | NV11 (Office Eastern Corner)        | 0.32                                                           | Adverse comment is not expected          |

As shown in Table 5.2, adverse comment is not expected due to tactile vibration in the majority of spaces in the building based on the vibration levels measured in the stripped-out building. One of the

rooms tested – namely the second-floor dome room – is predicted to experience vibration levels above the threshold of ‘Low probability of adverse comment’, however this is a marginal exceedance. Consequently, it is considered that specific controls to mitigate groundborne vibration would be unnecessary. Nonetheless, the impact from re-radiated groundborne noise is considered significant enough to warrant design intervention. Design advice in this regard is discussed in the next section.

It should be noted that the installation of raised floors above existing concrete slabs would be expected to increase tactile vibration in the room, as the lightweight floor slab would be more easily excited by incoming vibration than the concrete slab. This effect can be seen when comparing the vibration level measured in the southern corner office at first floor (0.19 m/s<sup>1.75</sup>) – tested on a raised floor – to the vibration level in the equivalent offices at ground and second floors (0.14 and 0.10 m/s<sup>1.75</sup> respectively) – tested on concrete floor slabs. Levels of tactile vibration in rooms with concrete slabs and new raised floors would still be expected to be below the low probability of adverse comment threshold.

#### 5.2.1.2. Groundborne Noise

The measured internal noise levels (in L<sub>ASmax</sub>) during train passes are detailed in Table 4.2. At this stage the measured groundborne noise levels and airborne noise intrusion levels are given as combined levels, aside from in the basement where little to no airborne noise intrusion would be expected (due to there being no external façade). At the next design stage the two noise types will be split by reviewing the available structural building information to determine the likely contribution from groundborne noise, however for the purposes of this assessment the combined levels are reviewed.

The L<sub>ASmax</sub> noise levels shown in Table 1.5 are almost all above the level recommended by BCO (45 dB L<sub>ASmax</sub>) for open plan office spaces, and are all above the level recommended for cellular offices and meeting rooms. This includes rooms at the West Mosley Street façade of the building located at greater distance from the tramlines. While groundborne noise levels in isolation may be lower than this, it was observed onsite that low frequency characteristics were very noticeable during tram passes, and this can normally be attributed to groundborne noise effects.

The worst affected spaces are the ground floor banking hall (where the restaurant/bar/café is proposed), the first-floor office space (with concrete floors) at the Mosley Street façade and the offices at the eastern end of the building at second and third floors (timber floors). This shows that without mitigation groundborne noise is likely to be a concern in all areas of the building at the Mosley Street façade, regardless of floor type or height up the building.

In terms of the options of ground floor restaurant/bar or café use, external customers of a tenanted restaurant/bar would likely be affected by groundborne noise from trams to a greater degree than users of a café forming part of a single-let building. This is because the majority of café users would be familiar with the building and more used to the effects than external customers of a tenanted restaurant/bar.

#### 5.2.2. Groundborne Noise Control Options

It can be very difficult to control groundborne noise in a refurbishment project, particularly where the heritage of the building is a constraining factor in the design. The primary control for groundborne noise where a development is built next to an existing vibration source would be to isolate the building at its foundations, which is possible for some refurbishments but involves a complex construction process.

Table 5.3 details potential mitigation options that would be expected to improve the groundborne noise levels in the building, however it is not possible to accurately quantify by what degree each measure would improve the levels without detailed building response analysis. For many of the below options there will still, therefore remain a risk that the recommended BCO groundborne noise limits will not be met in either future open plan office spaces or cellular offices and meeting rooms, although a reduction in groundborne noise would be expected in all cases.

**Table 5.3 Potential Vibration Mitigation Measures**

| Mitigation Measure                                                        | Potential Improvement                                         | Project Possibility     | Comment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------------------------------------------------|---------------------------------------------------------------|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Isolate the building at its foundations                                   | Significant – Likely to meet BCO levels                       | Unlikely to be possible | This would involve undercutting the foundations of the building at basement level and inserting large isolation mounts. This can be done on some heritage projects as it should in theory be visually unintrusive, however the costs involved are likely to be prohibitive.<br><br>If this approach is considered to warrant further investigation it would be recommended to present the project to a specialist isolation supplier at the earliest juncture (e.g. Mason UK), who will be able to advise on feasibility. |
| Box-in-box constructions                                                  | Significant – Likely to meet BCO levels                       | Unlikely to be possible | The heritage nature of the building means that this is unlikely to be possible in the majority of spaces, as existing surfaces would be covered up by the inner ‘box’ construction. The approach could be considered in specific basement spaces if considered to be particularly noise sensitive (e.g. pop up/screening room), although box-in-box constructions can be prohibitive in terms of cost and space provision.                                                                                                |
| Increase floor stiffness<br>(e.g. by adding extra noggins between joists) | Moderate – Still unlikely to achieve BCO levels in some areas | Considered possible     | Increasing the stiffness of the timber floors would be expected to reduce the radiation of noise as the floor would be less excitable. Any reduction would be difficult to quantify however, and there would remain a risk that BCO levels are still not met.                                                                                                                                                                                                                                                             |
| Increase floor mass                                                       | Moderate – Still unlikely to achieve BCO levels in some areas | Considered possible     | Increasing the mass of the timber floors would be expected to reduce the radiation of noise as more energy is required to move the floor build-up. Any reduction would be                                                                                                                                                                                                                                                                                                                                                 |

|                                                                                                                                   |                                                                                       |                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-----------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (e.g. by replacing floor layers with mass materials)                                                                              |                                                                                       |                         | difficult to quantify however, and there would remain a risk that BCO levels are still not met.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Decouple floor from slab (e.g. by placing resilient matting on top of the existing floors and a separate mass floor finish above) | Moderate – Still unlikely to achieve BCO levels in some areas                         | Unlikely to be possible | The feasibility of this option will be restricted as the heritage nature of the building means that there are limitations on increasing the floor depths.<br><br>Additionally any reduction would be difficult to quantify, and there would remain a risk that BCO levels are still not met.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Control reverberation                                                                                                             | Minor – Only a marginal further improvement is likely                                 | Considered possible     | A typical level of reverberation control is already assumed in the corrections to the measured noise levels. Additional absorptive surfaces would reduce noise levels further, however this would likely be considered an item for tenants to install at fit-out.<br><br>See Section 7 for further advice.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Control vibration at source – Discuss with the tram operator regarding potential track improvements                               | Significant – Likely to meet BCO levels, depending on available improvement to tracks | Considered possible     | Transport for Greater Manchester (TGM)/Metrolink should have a budget allowance for track maintenance, but the tracks adjacent to the site may need additional improvement to reduce vibration. This could be as simple as smoothing the tracks so that they emit less vibration, or could require more complex improvements such as installing vibration mounts to the tracks to isolate them from the surrounding ground. This could be discussed with adjacent buildings to combine resources and reduce the project costs, particularly if they also experience negative effects caused by the tram vibration. It should be noted in discussions that tram vibration is particularly high where trams round the bend at the junction with New York Street.<br><br>If this approach is possible, it could end up being a considerably cheaper and more effective option than intrusive building alterations. |

In line with the above table, the most effective mitigation measure in terms of both control of vibration and project cost is likely to be to agree with TGM to improve the tram tracks. This would provide benefits to all other buildings located adjacent to the tram line and so it may be possible to split associated costs with other interested parties, existing or incoming. Other measures including increasing the mass and stiffness of the floors are likely to improve groundborne noise levels, but there will be a risk that improvements would only be marginal and the potential cost to the project could mean that these solutions are not viable or worthwhile. Isolating the building would be the most effective measure from a vibration mitigation perspective but may be cost prohibitive.

## 6. Internal Sound Insulation

### 6.1. Criteria

There are no statutory requirements for internal sound insulation for office buildings, therefore guidance has been sought from BS 8233 and BCO. BS 8233 suggests the minimum sound insulation performance of separating constructions is to be selected based on the noise levels generated by the 'source' room, the noise sensitivity and privacy requirements of the adjacencies. The BCO guidance stipulates an in-situ requirement between separate demises for walls and floors of 48 dB  $D_{nT,w}$  at Cat A, although this would also be recommended to be applied to the single let option between office floors, as a minimum.

The criteria applicable to the base-build separations are shown in Table 6.1, relevant to both the single-let and multi-let options.

**Table 6.1 Sound Insulation Performance Requirements**

| Adjacent Uses                         |                                                                          | Minimum In-Situ Sound Insulation Requirement for Partition and Floors ( $D_{nT,w}$ dB)                                                |
|---------------------------------------|--------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Office, Office Lounge, Entrance Lobby | Office, Office Lounge, Entrance Lobby                                    | 48                                                                                                                                    |
|                                       | Restaurant/Bar/Cafe, Bike Store, Pop Up/ Screening Room, Lecture Theatre | 53                                                                                                                                    |
|                                       | Kitchen, Gym                                                             | 58 (and see Section 6.1.3 below)                                                                                                      |
|                                       | WC, Showers, Changing Rooms                                              | 43                                                                                                                                    |
| Restaurant/Bar/Café                   | WC                                                                       | 43                                                                                                                                    |
|                                       | Restaurant BOH                                                           | 48                                                                                                                                    |
|                                       | Lecture Theatre, Pop Up/Screening Room                                   | 53                                                                                                                                    |
| Lecture Theatre, Kitchen              | WC                                                                       | 43                                                                                                                                    |
| Restaurant BOH                        | Pop Up/Screening Room                                                    | 53                                                                                                                                    |
|                                       | Gym                                                                      | 53                                                                                                                                    |
| Gym                                   | Bike Store                                                               | 43                                                                                                                                    |
| MEP Rooms                             | Any                                                                      | Such that intruding MEP noise does not exceed a level 10 dB below the target NR levels presented in Table 4.1 in any adjoining space. |

### 6.1.1. Flanking

BCO guidance also gives requirements for flanking transmission and states the following:

*“Flanking transmission horizontally across cladding mullions at potential office fit out partitions should be capable of demonstrating a weighted normalised flanking level difference of at least  $D_{nf,w}$  45 dB when tested in a laboratory in general accordance with BS EN ISO 10848-2:2006 and rated in accordance with BS EN ISO 717-1:2013. Flanking constructions should be capable of being upgraded in the (Cat B) fit out up to at least  $D_{nf,w}$  53 dB without affecting warranties.”*

There is no specific vertical flanking performance required by BCO, but any new flanking elements should be specified such that they do not undermine the floor separation. So as not to undermine the performance of the floor constructions, flanking constructions should achieve a  $D_{nf,w}$  performance 5 to 8 dB higher than the applicable  $D_{nT,w}$  performance. Slab edge details will need to be developed in due course.

### 6.1.2. Impact Sound Insulation

In addition to the airborne sound insulation requirements, BCO recommends that impact sound pressure levels of any floors over offices do not exceed 60 dB  $L'_{nTw}$ .

### 6.1.3. Gym

Gym use can have the potential to generate high impact events as part of their typical operation that if not controlled can cause disturbance to users of adjoining building spaces. The fit-out of such spaces should incorporate appropriate treatments to control vibration and structure-borne noise breakout to adjoining spaces (such as floating floors, resilient floor matting etc.). These treatments will be developed during the subsequent design stages, based on the specific details of the intended use of the gym space. At this stage it is recommended that such treatments are developed to mitigate vibration so as not to exceed a vertical weighted ( $W_b$ ) peak acceleration level of 0.01 m/s<sup>2</sup> in regularly occupied areas, as defined in BS 6472-1.

Furthermore, structure-borne noise generated by the gym activities should not normally exceed NR 25  $L_{Fmax}$  in any adjoining regularly occupied areas.

## 6.2. Design Advice

### 6.2.1. Partitions

To achieve the in-situ sound insulation requirements for the horizontally separating elements of the development, laboratory specifications for individual partitions and doorsets will be derived at the next design stage. It is recommended that pre-completion testing of a representative sample of partitions is carried out to confirm that the in-situ requirements have been met at the end of the project.

Where existing masonry walls are retained, it is likely that the performances given in Table 6.1 would be met due to the deep thicknesses of existing walls on site, although these should be reviewed on a case-by-case basis. If needed, the performance of these partitions could be improved through the introduction of acoustic wall linings.

### 6.2.2. Doors

Where doors are present in a partition, these will limit the overall sound insulation achieved by the partition system and therefore installing a wall with a high performance will offer negligible on-site benefit. Where this is the case, recommended partition performances will be limited to 10 dB above the performance of the recommended doorset. At this stage, it should be noted that double leaf doors or one and a half leaf doors can be inherently weak acoustically due to the presence of joints between each element. This should be considered when selecting doorsets that have an acoustic specification. In all instances at this stage, acoustic perimeter, jamb and threshold seals should be allowed for on all doorsets on to cellular rooms, corridors/lift lobbies that adjoin office space, risers and restaurant/bar demises.

### 6.2.3. Airborne Sound Insulation Measurements across Existing Floor Constructions

The internal sound insulation of a selection of the existing typical floor constructions have been tested on site to determine their suitability in the context of the project requirements. The exact floor constructions are unknown at this stage, however from site observations it was apparent that one end of the building (the north-eastern end) comprises relatively lightweight timber floors, while at the other end (the south-western end) the floors are a concrete construction, believed to comprise a concrete hollow-pot system with a screed topping. Details of the existing floor constructions should be provided to Hilson Moran Acoustics for review at a later design stage.

Airborne sound insulation tests were undertaken in three locations, although it was observed on site that two of the measurements were compromised to varying degrees by connecting open ductwork between the floors. The measured performances and observations are detailed in Table 6.2. The measurement locations are shown in Figures 4.1 to 4.3.

**Table 6.2 Sound Insulation Testing**

| Source Room                                                   | Receiver Room                                                | Observed Floor Construction                                                          | Observed Flanking Paths                                | Measured Sound Insulation Performance |
|---------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------------------------------------------|--------------------------------------------------------|---------------------------------------|
| Src 1 - Ground Floor Banking Hall (Restaurant/Bar/Café space) | Rec 1 - Second Floor Dome Room                               | Timber floor with feature ceiling below                                              | None specific                                          | 58 dB $D_{nT,w}$ (-6 $C_{tr}$ )       |
| Src 2 - First Floor Office at south-western end of building   | Rec 2 - Second Floor Office at south-western end of building | Hollow-pot concrete slab with screed top, raised floor and suspended ceiling removed | Ductwork connecting two floors                         | 46 dB $D_{nT,w}$ (-2 $C_{tr}$ )       |
| Src 3 - Second Floor Office at north-eastern end of building  | Rec 3 - Third Floor Office at north-eastern end of building  | Timber floor                                                                         | Compromised by open ductwork connecting the two floors | 35 dB $D_{nT,w}$ (-1 $C_{tr}$ )       |

#### 6.2.3.1. Ground Floor Banking Hall to Second Floor Dome Room

The sound insulation testing showed that the recommended performance between the banking hall (proposed restaurant/bar/café) and the office space above (53 dB  $D_{nT,w}$ ) is met by the current floor construction. Provided that any new flanking paths introduced are properly controlled and that noise within the restaurant is controlled to reasonable levels then it is anticipated that this construction will be sufficient from an acoustic perspective. Limits for the restaurant/bar tenant to achieve would be set in future design stages, and it would be recommended to include these in tenant handbooks. The café option would be operated by the single-let tenant so it would be their decision whether to control noise intrusion to their adjacent spaces.

#### 6.2.3.2. First Floor Office to Second Floor Office

The concrete floor tested was shown to fall short of the recommended sound insulation performance between offices (48 dB  $D_{nT,w}$ ), however the dominant transmission path observed on site was a duct system penetrating the floor at the slab edge. If this ductwork is to be retained, then cross-talk attenuation and/or a combination of duct lagging and solid encasement of the duct should be used to control the transmission of noise between floors. Additionally, the introduction of a standard raised floor to the system would be expected to increase the floor performance in line with the recommended performance, in combination with controlling the ductwork transmission.

#### 6.2.3.3. Second Floor Office to Third Floor Office

The timber floor tested between proposed office floors was found to perform well below the recommended performance (48 dB  $D_{nT,w}$ ). This measurement was compromised however by a large open duct directly connecting the two rooms, which was observed to be the dominant flanking path between the spaces, thus significantly undermining the performance. The measurement is therefore not considered representative of the finished floor performance and consequently no firm conclusions can be drawn at this stage; these results are therefore provided for information purposes only. An intrusive investigation into the floor construction will be required to determine the build-up of the floors so that a calculation of the expected performance and comparison to recommended performances can be undertaken. This will be required during the subsequent design stages.

#### 6.2.3.4. General Floors

As for the timber floor reviewed above, intrusive investigations into the build-up of the ground floor constructions would enable comparisons between calculated and recommended performances between ground floor office spaces and ancillary spaces in the basement (e.g. bike store, gym, pop up/screening room).

Both the airborne and impact sound insulation performances of the final design will depend on the finished floor constructions in the base-build, and any changes to current elements that are made in the design.

#### 6.2.4. Gym

At this early stage, an allowance should be made for a resilient gym floor matting (e.g. Gerflor Powershock 300, a 30mm rubber tile), with the potential for a more robust isolation system (e.g. floating floor) to be required if more intense activities are expected. If high impact activities are likely to be conducted in the gym whilst the rest of the building is occupied, we would recommend an allowance

of at least 150 mm is made in the design of the gym floor finishes to facilitate the installation of a floating floor system.

A cavity blockwork construction built between the gym and any horizontally adjacent sensitive uses is likely to be required, along with an independent lining system to one or both of the blockwork leaves. To maintain acoustic integrity there should be no penetrations through these partitions. If not possible, gym use would require managing such that it does not coincide with the use of sensitive nearby spaces.

Depending on the floor construction, a suspended mass ceiling may be required in the gym to increase the airborne sound insulation to the potential office uses above. Improvements to the floor construction above may also be required, which will need to be determined at the next design stage when more information about the existing and proposed floor constructions is known.

## 7. Control of Reverberation

Controlling reverberation is necessary where speech intelligibility is important. Long reverberation times can give rise to pronounced late reflections which act to blur the direct sound from a speaker (person or loudspeaker). In large spaces, with larger groups of people, long reverberation times act to facilitate the build-up of noise, creating loud disruptive spaces, where raised voices are needed to communicate. For this development, controlling reverberation is also important to decrease the groundborne noise level in the building caused by passing trams.

### 7.1. Criteria

The current room finish proposals are not yet fully understood; however, it is proposed at this stage that the following mid-frequency reverberation times ( $T_{mf}$ ) are not exceeded in the stated room spaces. It is noted that the heritage nature of the building will mean that there are areas of ceiling in particular where applying acoustic materials will not be possible. Other materials will therefore require consideration, and carpet flooring is recommended to all spaces.

**Table 7.1 Recommended reverberation time criteria**

| Room Space                    | Recommended Mid-Frequency Reverberation Time ( $T_{mf}$ , seconds) |
|-------------------------------|--------------------------------------------------------------------|
| CAT A Offices                 | See Section 7.2                                                    |
| Pop Up/Screening Room         | $\leq 0.5$                                                         |
| Lecture Theatre               | $\leq 0.8$ (tenant space)                                          |
| Entrance Lobby, Office Lounge | $\leq 1.0$                                                         |
| Gym                           | $\leq 1.5$                                                         |
| Restaurant/Bar/Café           | $\leq 1.5$ (tenant space)                                          |

## 7.2. Design Advice

### 7.2.1. Offices

BREEAM Hea 05 refers to BS 8233 for criteria for reverberation time. However, BS 8233 provides no specific required reverberation times and limited guidance for acoustic treatment within offices. BS 8233 mentions BCO for acoustic guidance within offices. In both sets of guidance, it is appreciated that the level of control of reverberant sound is heavily reliant upon the ceiling and fit-out strategy which is not finalised at Cat A. Reverberation will therefore largely be controlled by the tenant and this BREEAM credit will typically be awarded by default.

Nevertheless, the prevalence of groundborne noise caused by passing trams may deter potential tenants. It would be recommended to apply some level of base-build reverberation control to reduce noise levels in the Cat A spaces, which would also assist in controlling noise from building services, potentially reducing the costs of equipment installed in the base-build. This approach may also be seen as favourable to the tenants as it would reduce the amount of material that they would need to provide in the space, and potentially reduce the amount of coordination work they may have to do with base-build services, lighting and sprinklers. BCO recommends an acoustically absorbent ceiling achieving Absorption Class A. While this may not be possible in many spaces due to the heritage nature of the

existing ceilings, the equivalent material can be applied to other surfaces in the room, which can be calculated as appropriate.

In line with BCO, where a Class A ceiling (or equivalent coverage) isn't provided the base build definition should clearly state what provisions are to be made for sound absorbing finishes in the office spaces, to enable the tenant to determine how much additional material will be required.

It should be noted that the second floor room with the rooflight dome will require particular attention when controlling reverberation for office use, as it is a large space, with high ceilings and limitations on material locations due to heritage reasons. The measured reverberation time in the exposed space was 3.0 seconds, which is three times the recommended maximum for open plan office use.

Example absorptive materials for consideration could include: carpet flooring; acoustic wall panels; soft furnishings; moveable floor-standing acoustic panels; hanging rafts/baffles; acoustic soffit spray; suspended acoustic ceiling tiles.

### 7.2.2. Ground Floor

The baking hall at ground floor, where a restaurant/bar tenant or café use may be located in considered to have inherent limitations in terms of available material locations and areas for acoustic absorption. The measured reverberation time in the existing space was 4.6 seconds, which is significantly higher than the reverberation time recommended for its intended use. A large area of absorptive material is likely to be required in the space to reduce the reverberation to a level suitable for a restaurant/bar/café use.

Carpet flooring would assist in reducing the reverberation in the space as it offers a large area of coverage with a simple solution, although it would not be sufficient by itself and consideration will be required as to what other locations an incoming tenant will be able to locate absorptive materials.

As for the office spaces, the base build definition for this room should clearly state what provisions are to be made for sound absorbing finishes in the space, to enable the tenant to determine how much additional material will be required.

### 7.2.3. Basement Uses

Various uses are proposed for the single-let and multi-let options in the basement. Allowance for absorptive materials to the walls and ceilings of regularly occupied basement areas or sensitive areas (e.g. gym, pop up/screening room) should be made, as this will reduce the impact of groundborne noise from passing trams, and increase general acoustic comfort and suitability in the space.

## 8. Building Services Plant Noise

### 8.1. Criteria

#### 8.1.1. External Plant Noise

The control of plant noise to the surrounding environment is required by the Local Authority and to achieve the BREEAM Pol 05 credit.

##### 8.1.1.1. Local Authority Criteria

MCC's plant noise requirements are set out in the Planning & Noise Technical Guidance document<sup>4</sup>. The MCC plant noise requirements are provided below:

*"Externally mounted ancillary plant, equipment and servicing shall be selected and/or acoustically treated in accordance with a scheme designed so as to achieve a rating level of 5dB (LAeq) below the typical background (LA90) level at the nearest noise sensitive location."*

There is no specific reference to noise from emergency plant in the guidance, where often a relaxed noise limit is considered acceptable. This should be verified on receipt of the planning conditions for the development.

##### 8.1.1.2. BREEAM Pol 05

BREEAM RFO 2014 credit Pol 05 requires the following regarding noise emission from fixed items of plant at the development.

- "2 Alternatively, where the building does have noise-sensitive areas or buildings within 800m radius of the site, one credit can be awarded as follows:
- a Where a noise impact assessment in compliance with BS 7445 has been carried out and the following noise levels measured/determined:
    - i Existing background noise levels at the nearest or most exposed noise-sensitive development to the proposed development or at a location where background conditions can be argued to be similar. The existing background noise levels shall not include existing plant associated with the assessed building (see CNs on Part applicability for exceptions).
    - ii The rating noise level resulting from the new noise source (see CN7).
  - 3 The noise impact assessment must be carried out by a suitably qualified acoustic consultant holding a recognised acoustic qualification and membership of an appropriate professional body (see Relevant definitions in the Additional information section).
  - 4 The noise level from the proposed site/building, as measured in the locality of the nearest or most exposed noise-sensitive development, is a difference no greater than +5dB during the day (07:00 to 23:00) and +3dB at night (23:00 to 07:00) compared to the background noise level.

- 5 Where the noise source(s) from the proposed site/building is greater than the levels described in criterion 4, measures have been installed to attenuate the noise at its source to a level where it will comply with criterion 4."

MCC's plant noise limits are more onerous than the BREEAM Pol 05 credit requirement and therefore by achieving them the requirements for the Pol 05 credit will also be achieved.

##### 8.1.1.3. External Plant Noise Limits

Based on the required plant noise criteria for residential receptors and the noise survey results the plant noise limits applicable to the proposed development shown in Table 8.1 have been derived. Due to the distance from the site, the background noise level at NSR A has been reviewed against the noise levels measured at LT1 by comparing to a historic noise survey undertaken at the site of NSR A, where background noise levels were found to be in line with those measured at LT1. More information on this comparison can be found in the Noise Impact Assessment prepared for 38 Mosley Street.

While not a requirement for BREEAM or planning, commercial receptors are also given limits for building services plant to achieve so as to provide a quality development that does not significantly increase the existing noise climate in the area. Limits at commercial receptors should be seen as recommendations however, rather than as a requirement, and are less onerous than for the residential receptor due to the lower sensitivity of commercial occupants.

**Table 8.1 Plant noise limits at 1 m from NSR façades**

| Location                             | Period                      | Plant Noise Emission Limit (dB LAeq) | Indicative Emergency Plant Noise Emission Limit (dB LAeq) <sup>1</sup> |
|--------------------------------------|-----------------------------|--------------------------------------|------------------------------------------------------------------------|
| NSR A                                | Daytime (07:00 to 23:00)    | 53 dB LAeq                           | 63 dB LAeq                                                             |
|                                      | Night-time (23:00 to 07:00) | 45 dB LAeq                           | 55 dB LAeq                                                             |
| Commercial Receptors (CR A, B, C, D) | Daytime (07:00 to 23:00)    | 58 dB LA <sub>Tr</sub> <sup>2</sup>  | 68 dB LAeq                                                             |

**Notes:** <sup>1</sup> To be confirmed on receipt of planning conditions for the development. <sup>2</sup> The commercial limit is given as a Rating Noise Level in line with BS 4142 so should account for acoustic characteristics (tonal/impulsive/intermittent), and is equal to the measured background noise level.

As a preliminary target, plant noise should be limited to no more than 48 dB LA<sub>Tr</sub> at 1 m from the surface of the rooflight. This limit is onerous and will need to be developed on confirmation of the rooflight construction, however it is not currently anticipated that any plant will be proposed near to or emit noise towards the rooflight.

##### 8.1.2. Internal Plant Noise

Internal plant noise levels should meet the internal ambient noise level criteria given in Table 4.1.

<sup>4</sup> Environmental Protection (2015); 'Planning & Noise Technical Guidance', MCC.

## 8.2. Design Advice

### 8.2.1. External Plant Noise

It shall be the responsibility of the contractor and their appointed acoustic consultant to design and install the MEP systems and associated noise control measures to achieve the external noise criteria, however the following may need to be considered and incorporated in the MEP design:

- Selection of high quality, low-noise building services equipment with night set-back modes, generally situated away, and shielded from the identified NSRs.
- Orientation of significant external plant items and duct terminations to exploit natural directionality characteristics and direct noise away from sensitive areas.
- All ductwork connecting to the external environment should be provided with in-duct attenuation, appropriately sized to achieve the external noise limits presented in Table 8.1. This also applies to emergency/life-safety systems.
- Attenuators should be placed as close to the associated fan as practical. Should significant lengths of ductwork between the fan and attenuator be exposed, it should be lagged with a product having a minimum mass per unit area of 9 kg/m<sup>2</sup> (such as Muftilag-R).
- Roof plant items are likely to require acoustic screening (as proposed) where positioned close to the noise sensitive receptors.

### 8.2.2. Internal Plant Noise

It shall be the responsibility of the contractor and their appointed acoustic consultant to design and install the MEP systems and associated noise control measures to achieve the internal noise criteria above, however the following may need to be considered and incorporated in the MEP design:

- Selection of high quality, low-noise mechanical equipment, generally situated away from sensitive room spaces (rooms with the lowest internal ambient noise level criteria). Particularly noisy items of plant should be located within dedicated plant rooms, where available.
- Grilles and diffusers should be selected, based on the expected maximum air volume, not to exceed a level 8-10 NR dB below the building services noise criteria shown in Table 4.1 to ensure airflow noise does not contribute significantly to the noise levels in the rooms.
- All air-handling and cooling plant in general should receive ductwork attenuation. The dynamic insertion loss requirements of attenuators should be calculated by the contractor and their appointed consultant to achieve the room criteria above. Note the criteria in Table 4.1 are cumulative limits and so should be achieved by a combination of all services within a given room, as opposed to each separate system.
- Attenuators should be placed as closely to the associated fan as practical. Should significant lengths of ductwork between the fan and attenuator be exposed and run through occupied rooms, the exposed ductwork should be lagged with a product having a minimum mass per unit area of 9 kg/m<sup>2</sup> (such as Muftilag-R). Where ductwork penetrates acoustically rated partitions, the associated attenuator should be placed about the adjoining partition, or else the ductwork on one side of the partition should be lagged as above.

- Services with a considerable casing breakout noise component should be placed in a proprietary acoustic enclosure or housed within a bespoke bulkhead, typically constructed of multiple layers of plasterboard having a combined mass per unit area of no less than 20 kg/m<sup>2</sup> (for example, 2 layers of 12.5mm Gyproc Soundbloc).
- Where additional building services are to be introduced as part of tenant fit-out it should be ensured that the total limits given in Table 4.1 are not exceeded. Therefore, where it is anticipated that future tenant plant will be included, the shell plant shall be specified to achieve levels lower than those presented in Table 4.1.

### 8.2.3. Building Services Vibration

Services should be sufficiently isolated from the structure to ensure that the frequency and amplitude of structure-borne vibration does not exceed 0.01 m/s<sup>2</sup> within any office areas as defined in BS 6472-1:2008<sup>5</sup>. Any structure-borne noise effects should be limited so that they do not cause the cumulative plant noise levels to exceed the limits given in Table 4.1. Generally, this should be controlled so as to be inaudible, to avoid the presence of low frequency tones that can be more disruptive than broadband noise.

<sup>5</sup> BSI (2008); 'BS 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting'. BSI.

## 9. Acoustic Terminology

This section provides a layperson's explanation of the acoustics terms that commonly appear in reports. It is not intended to give full scientific definitions and explanations or go into detail on how and why things are as they are. Some obsolete terms and abbreviations have been included as they still appear in documents from time to time.

**Table 9.1: Acoustic Terminology**

| Term                                                               | Description                                                                                                                                                                                                                                                                                                                                      |
|--------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Decibel, dB                                                        | The decibel is a logarithmic unit of measurement used for quantifying sound. It is derived from the logarithm to base 10 of the ratio of two quantities. Use of a logarithmic scale has the 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. |
| Frequency, Hz                                                      | In sound, the number of cycles per second of a pressure fluctuation and frequency in sound is proportional to its pitch. Different frequencies are divided into octave and one third octave bands.                                                                                                                                               |
| Sound Pressure Level, $L_p$                                        | This is the unweighted or linear level which is measured prior to any weightings being applied. The sound pressure level is 20 times the logarithm to base 10 of the ratio of the reference sound pressure ( $2 \times 10^{-5}$ ) and the measured sound pressure.                                                                               |
| Sound Power Level, $L_w$                                           | This is the total sound energy radiated from a given source. The sound power level is 10 times the logarithm to base 10 of the ratio of the reference sound power level ( $1 \times 10^{-12}$ ) and the measured power.                                                                                                                          |
| Frequency Weightings                                               | Weightings can be applied to a spectrum of sound and act as a filter to account for different sensitivities and conditions.                                                                                                                                                                                                                      |
| Time Weightings                                                    | A time weighting to denote the response of the sound level meter. For most measurements the Fast time weighting is selected (F) however, a slow time weighting (S) is often used to for the measurement train noise and vibration.                                                                                                               |
| A-weighted sound pressure level, $L_{pA}$                          | The sound pressure level with the A-weighting applied. The A-weighting is used for most environmental noise measurements and is used to weight a spectrum of sound to match the sensitivity of the human ear.                                                                                                                                    |
| Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$ | The $L_{Aeq}$ is an energy average and defined as the level of sound which, over a given period of time, would equate to the same A-weighted sound energy as the actual fluctuating sound.                                                                                                                                                       |
| Octave Bands                                                       | A band of frequencies in which the upper limit of the band is twice the frequency of the lower limit.                                                                                                                                                                                                                                            |
| Maximum noise Level, $L_{AFmax}$                                   | The maximum instantaneous noise level measured during a given period of time. The time weighting to which the meter is set for this measurement parameter is always indicated by either an F or S.                                                                                                                                               |
| Minimum Noise level, $L_{AFmin}$                                   | The minimum instantaneous noise level measured during a given period of time. The time weighting to which the meter is set for this measurement parameter is always indicated by either an F or S.                                                                                                                                               |
| Percentile level, $L_{AN,T}$                                       | A-weighted sound pressure level obtained using time-weighting F, which is exceeded for N% of a specified time interval.<br>An example of this is background noise which is quantified with the $L_{A90}$ descriptor, which is the A-weighted level which is exceeded for 90% of the measurement period.                                          |

|                                                           |                                                                                                                                                                                                                                                                                                                                                                                |
|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sound exposure level $L_{AE}$                             | A level of a sound, of 1 s duration, that has the same sound energy as the actual noise event considered.                                                                                                                                                                                                                                                                      |
| Rating Level, $L_{Ar,Tt}$                                 | The equivalent continuous A-weighted sound pressure level of the noise, plus any adjustment for the characteristic features of the noise.                                                                                                                                                                                                                                      |
| Ambient Noise Level                                       | The noise level in a given environment whilst it is subject to all of its normal sources of noise.                                                                                                                                                                                                                                                                             |
| Background Sound / Noise Level, $L_{A90}$                 | These are amongst the lowest noise levels measured over a given period of time and exclude short term, intermittent noise sources. The background noise level is quantified by the $L_{A90}$ descriptor and is therefore the level which is exceeded for 90% of a given period of time.                                                                                        |
| Reverberation Time, $T$                                   | The time that would be required for the sound pressure level to decrease by 60 dB after the sound source has stopped. The descriptor $T$ , often includes other nomenclature to describe the type of reverberation time measurement or if the reverberation time is an average taken for specific frequencies. For example a $T_{mf}$ is the mid-frequency reverberation time. |
| Absorption Coefficient, $\alpha$                          | The fraction of reverberant sound energy absorbed by a material. It is expressed as a value between 1.0 which equates to perfect absorption and 0 which equates to zero absorption.                                                                                                                                                                                            |
| Absorption, A                                             | The acoustic absorption derived from the multiplication of the absorption coefficient by the surface area of a given material.                                                                                                                                                                                                                                                 |
| Acoustic Class, A - E                                     | Classification of sound absorbers into Sound Absorption Classes A-E, according to BS EN ISO 11654, including frequencies 200-5000 Hz                                                                                                                                                                                                                                           |
| NRC                                                       | A single-number rating system used to compare the sound-absorbing characteristics of building materials. A measurement of the acoustical absorption performance of a material, calculated by averaging its Sound Absorption Coefficients at 250, 500, 1000 and 2000 Hz                                                                                                         |
| Sound Reduction Index, $R$                                | The laboratory measured sound insulation properties of a material or building element in octave or third octave bands.                                                                                                                                                                                                                                                         |
| Weighted Sound Reduction Index, $R_w$                     | A single number which represents the sound reduction of a material. It is derived by plotting the sound reduction index against a set of reference curves. The curves are shifted until a best-fit is established and the curve which best fits the sound reduction spectrum is used to represent the single figure value.                                                     |
| Weighted Level Difference, $D_w$                          | The weighted level difference between a pair of rooms, stated as a single figure.                                                                                                                                                                                                                                                                                              |
| Standardized Weighted Level Difference, $D_{nT'w}$        | The standardized, weighted difference in sound level between a pair of rooms, stated as a single figure. The level difference in octave bands is first normalized to a reference reverberation time and then plotted against a set of reference curves to establish a single figure value.                                                                                     |
| Weighted, Normalised Flanking Level Difference, $D_{nFw}$ | The normalised, weighted difference in sound level between a pair of rooms via a flanking element, such as mullion or ceiling detail. The level difference in octave bands is first normalized to a reference amount of absorption and then plotted against a set of reference curves to establish a single figure value.                                                      |
| Normalised Element Level Difference $D_{ne}$              | The normalised difference in sound level between a pair of rooms via a small element such as a trickle ventilator. The level difference in octave bands is normalized to a reference amount of absorption.                                                                                                                                                                     |
| Weighted, Normalised Element Level Difference, $D_{new}$  | The normalised, weighted difference in sound level between a pair of rooms via a small element such as a trickle ventilator, stated as a single figure. The level difference in octave bands is normalized to a reference amount of absorption                                                                                                                                 |

|                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                               | and then plotted against a set of reference curves to establish a single figure value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| $C_{tr}$                                                      | A correction term applied to the sound insulation single-number values ( $R_w$ , $D_w$ , and $D_{nT,w}$ ). Applying the $C_{tr}$ penalises a construction's performance if its low frequency performance is poor in relation its performance at higher frequencies.                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Impact Sound                                                  | The noise generated by an impact on a structure. This is normally used to describe the noise created by people walking on a floor structure.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Weighted standardized impact sound pressure level, $L_{nT,w}$ | A single-number quantity used to characterize the impact sound insulation of floors over a range of frequencies.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Cross-talk                                                    | Noise transmission between one room and another room or space via a duct or other path.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Insertion Loss, IL                                            | The reduction of noise level due to the presence of a noise control device such as an attenuator, excluding any regeneration noise created by its presence.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Dynamic Insertion Loss, DIL                                   | The reduction of noise level due to the presence of a noise control device such as an attenuator, including any regeneration noise created by its presence.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| NR                                                            | The Noise Rating level. This is a single figure value derived by plotting a noise spectrum against a set of curves. The curve under which the spectrum fits is the resulting NR level.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Vibration                                                     | <p>The vibratory motion of a surface can be characterised by:</p> <p>(a) displacement (m),</p> <p>(b) velocity (m/s), or</p> <p>(c) acceleration (<math>m/s^2</math>).</p> <p>The magnitude of the vibration can be quantified in several ways:</p> <p><b>Peak to Peak</b> - The total excursion of the oscillation about the zero datum.</p> <p><b>Peak</b> - This value gives the maximum excursion of the oscillation above or below the zero datum.</p> <p><b>r.m.s.</b> - This value gives the root mean square of the time history over a specific time interval (time constant).</p> <p><b>dB</b> - Vibration levels can be expressed in dB. A reference level of <math>10^{-6} m/s^2</math> r.m.s. is usually used for acceleration.</p> |
|                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Ground borne noise                                            | Audible noise caused by the vibration of elements of a structure, for which the vibration propagation path from the source is partially or wholly through the ground                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Structure borne noise                                         | Audible noise caused by the vibration of elements of a structure, the source of which is within a building or structure with common elements.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| V.D.V,                                                        | The VDV is the Vibration Dose a person is expected to be exposed to over the course of the day or night. The VDV is given by the fourth root of the time integral of the fourth power of the acceleration after it has been frequency-weighted.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| eVDV                                                          | The estimated vibration dose value based on short duration measurements of transients with known durations and occurrences                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |



38-42 MOSLEY STREET MANCHESTER M2 3AZ  
Stage 2 (Concept Design) Appendices



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**Appendix 4 – Noise Impact Assessment: MOSE-HMM-ZZ-ZZ-RP-Y-0004**



## Noise Impact Assessment

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report

38-42 MOSLEY STREET MANCHESTER M2 3AZ  
Noise Impact Assessment

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Executive Summary

Bruntwood is seeking to obtain full planning permission for the refurbishment of 38 Mosley Street, Manchester, to include the provision of new tenanted office space with ground floor and basement tenanted restaurant/bar use, as well as basement ancillary spaces including a gym. Replacement building services plant will be provided as part of the refurbishment, with the majority of plant emitting noise externally expected to be located at roof level where the existing plant is currently located.

A noise impact assessment has been undertaken to determine the key noise considerations and impacts associated with the proposals, with limits set for the development to achieve based on Manchester City Council (MCC) planning criteria.

To facilitate this assessment, a comprehensive noise survey has been undertaken between Monday 15<sup>th</sup> November and Thursday 18<sup>th</sup> November 2021 to establish and quantify the existing noise climate at, and in the vicinity of, the site and nearest noise sensitive receptors. Noise monitoring results confirm the site to be exposed to noise levels expected of an urban location, with elevated noise levels at the façade of the building overlooking the Metrolink tramlines.

Building services plant noise emission limits have been specified in accordance with MCC’s standard planning criteria. All fixed plant shall be designed during the subsequent project stages to collectively achieve these limits. Emergency plant noise limits have also been proposed.

Noise break-out associated with the ground floor and basement restaurant/bar unit would be controlled by the sound insulation of the building fabric and is shielded from sensitive receptors by intervening buildings. Sufficient levels of sound insulation are assumed to be inherent in the building design and noise break out is not expected to give rise to disturbance to NSRs or future occupants of the development. Nonetheless, limits have been set for any entertainment noise based on MCC’s standard entertainment noise criteria.

Based on the outcomes of the noise assessment, it is considered that impacts associated with the operation of the development can be controlled to an acceptable level and that the site should be considered suitable for the proposed development.

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## 1. Introduction

This Noise Impact Assessment has been prepared by Hilson Moran Partnership Ltd on behalf of Bruntwood (hereafter referred to as ‘the Applicant’). It accompanies a planning application to Manchester City Council (MCC) for the redevelopment of the existing office building at 38 Mosley Street, Manchester M2 3AZ.

This report presents the results of a baseline noise survey undertaken at the site, together with calculated noise emission limits applicable to building services noise emissions and breakout from restaurant/bar operation.

A glossary of the acoustic terminology used in this report is presented in Appendix A.

## 2. The Site, Site Setting and Proposed Development

### 2.1. Site Description

The site is located within the jurisdiction of Manchester City Council (MCC). A site location plan is provided as Figure 2.1, showing the location of the site and orientation with respect to other existing developments and the road network for the area.

The site has frontages onto Mosley Street to the south-east, West Mosley Street to the north-west, York Street to the north-east and the building shares a party wall with 57 Spring Gardens to the south-west. A regularly trafficked tramline runs along Mosley Street.

### 2.2. The Noise Climate

The noise climate in the area is dominated by noise from regularly passing trams (approximately one each way every 5 minutes during typical daytime hours) on the Metrolink tramlines on Mosley Street. Noise from plant units serving commercial properties surrounding the site, intermittent local road traffic on Mosley Street and more distant road traffic from the Manchester city centre road network also contribute to the noise climate at the site.

Noise monitoring results confirm the site to be exposed to typical noise levels for an urban location, albeit elevated noise levels at the façade of the building overlooking the Metrolink tramlines were observed.

### 2.3. Noise Sensitive Receptors

The surrounding area consists largely of commercial uses, although one residential building considered sensitive to noise has been identified within the vicinity of the site. The noise sensitive receptor (NSR) for assessment of impact from the development is detailed in Table 2.1 and the location is shown in Figure 2.1.

**Table 2.1**      *Noise Sensitive Receptors*

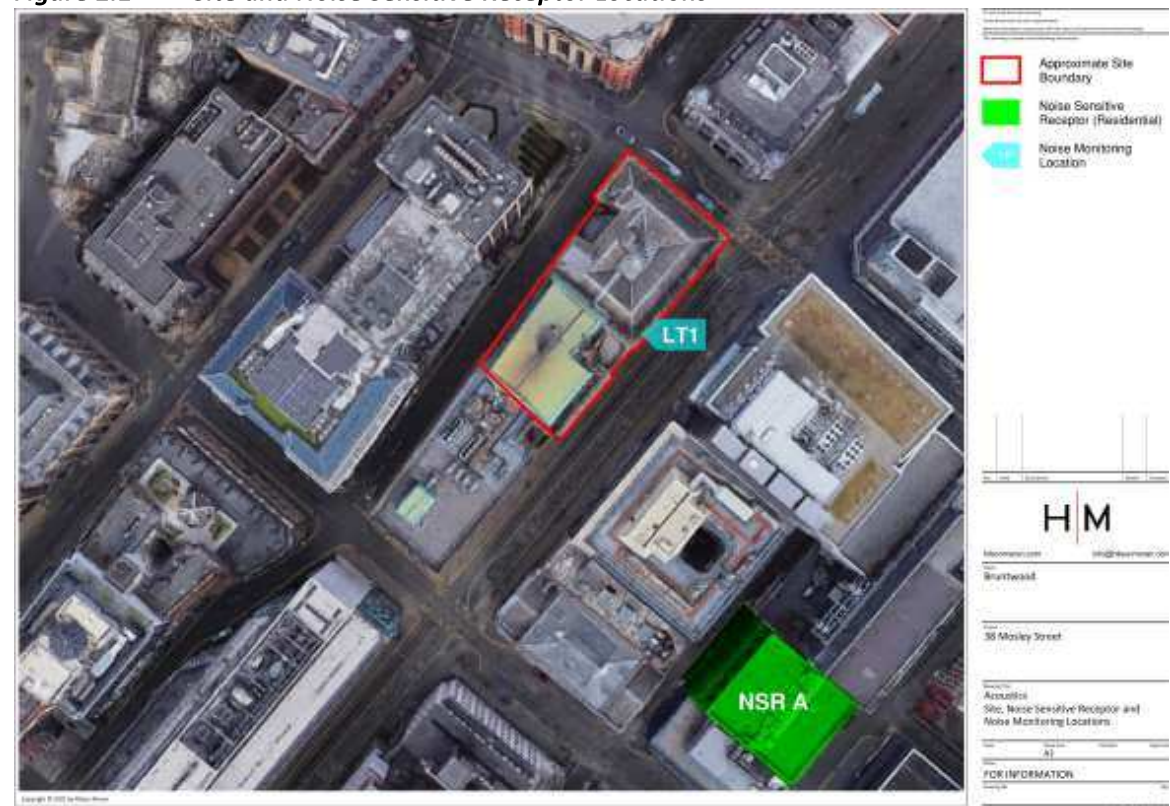
| Receptor Location (Figure 2.1) | Name                                   | Type of Receptor | Approximate Distance from Site Boundary |
|--------------------------------|----------------------------------------|------------------|-----------------------------------------|
| NSR A                          | Manhattan Apartments, 36 George Street | Residential      | 50 m to the south-east                  |

### 2.4. Proposed Development

The proposed development comprises the refurbishment of the vacant 38 Mosley Street building to provide new tenanted office space with ground floor and basement tenanted restaurant/bar use, as well as basement ancillary spaces including a gym.

Replacement building services plant will be provided as part of the refurbishment, with the majority of plant emitting noise externally expected to be located at roof level where the existing plant is currently located.

Figure 2.1 Site and Noise Sensitive Receptor Locations



### 3. Planning Policy and Guidance

#### 3.1. National Planning Policy

##### 3.1.1. National Planning Policy Framework, 2019

The National Planning Policy Framework (NPPF)<sup>1</sup> for England was revised in June 2019. The NPPF, which is based on the principle of sustainable development, sets out nationally important issues and leaves other matters for determination by local councils and communities.

In relation to noise, the NPPF seeks to conserve and enhance the local environment, including preventing developments from contributing to, and/or, being put at an unacceptable risk from, noise pollution. In support of this, paragraph 185 of the NPPF states that:

*“Planning policies and decisions should also ensure that 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:*

- a) 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;*
- b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason”.*

There is currently no specific guidance within England for the assessment of the suitability of a site for non-residential noise sensitive development.

#### 3.2. Local Policy

##### 3.2.1. MCC Planning & Noise Technical Guidance

###### 3.2.1.1. Noise Emissions from External Plant

MCC’s plant noise requirements are set out in the Planning & Noise Technical Guidance document<sup>2</sup>. The MCC plant noise requirements are provided below:

*“Externally mounted ancillary plant, equipment and servicing shall be selected and/or acoustically treated in accordance with a scheme designed so as to achieve a rating level of 5dB (LAeq) below the typical background (LA90) level at the nearest noise sensitive location.”*

There is no specific reference to noise from emergency plant in the guidance, where often a relaxed noise limit may be considered acceptable.

<sup>1</sup> Department for Communities and Local Government (DCLG) (2019); ‘The National Planning Policy Framework’, HMSO, London.

<sup>2</sup> Environmental Protection (2015); ‘Planning & Noise Technical Guidance’, MCC.

### 3.2.1.2. Entertainment Noise

As well as plant noise, the Planning & Noise Technical Guidance document details specific requirements to achieve in terms of controlling entertainment noise, which will apply to the proposed ground and basement level restaurant/bar.

The MCC requirements state:

*“Entertainment noise ( $L_{Aeq}$ ) should be controlled to 10dB below the background noise level ( $L_{A90}$ ) without the entertainment noise present, in each octave band at the nearest noise sensitive location”.*

## 4. Noise Impact Assessment Criteria

### 4.1. Building Services Plant Noise Emission

The significance of building services noise impacts depends upon a number of factors. These include:

- the absolute noise level;
- the nature of the noise;
- the time and duration at which the noise occurs;
- whether the noise is temporary, intermittent or permanent;
- whether the impact is as a result of a new source; and
- whether it is a change to an existing source and/or the sensitivity of the receptor.

At this stage in the design of the development, specific details of the type, number and configuration of new building services plant are not fixed. As a consequence, it is not possible to undertake predictions to determine whether standards might be met. Therefore, noise emission limits to which plant should adhere have been set, based on the results of the baseline noise survey (see Section 5) and MCC's plant noise criteria (see Section 3).

### 4.2. Noise Breakout from Use of Non-office Units

The significance of noise impacts associated with the ground and basement level restaurant/bar and basement gym space depends upon the type of tenants and the nature of noise sources, as these will dictate the sound insulation performance of the primary building fabric in controlling noise break-out.

The basement gym does not have any façades above ground level, meaning that any noise emitted would need to pass through the ground floor before escaping to the surrounding environment. Because of this, no noise impacts are expected at NSRs, and this use is not considered further in assessment.

Specific details of the end users of the restaurant/bar unit and operational times of the development are not known at this stage and would be dependent on the future tenants and licencing regulations. Details of the incoming tenant are not currently known, so an assessment of noise breakout from these uses cannot yet be undertaken. However, noise emission limits have been set for restaurant/bar tenants to achieve at the façades of NSRs so that noise breakout from these uses are in line with MCC requirements.

It should be noted that the nearest residential NSR is shielded from the ground floor restaurant/bar façade by intervening buildings, as well as considerable distance (50 m) and so negligible impacts are expected at this receptor.