

SANDY BROWN

Consultants in Acoustics, Noise & Vibration

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No. 3 Circle Square, Manchester

Construction noise and vibration assessment

London, Manchester, Edinburgh, Birmingham, Belfast, Leeds

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Version	Date	Comments	Author	Reviewer
A	5 Apr 22		Christian Clark	James Atha
B	16 Jun 22	Minor corrections following comments from Deloitte	Christian Clark	James Atha

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Summary

Sandy Brown has been appointed by Bruntwood Scitech to carry out a construction noise and vibration assessment for the Proposed Development at No. 3 Circle Square in Manchester.

An initial assessment of construction noise and vibration from the proposed works has been carried out in line with BS 5228: 2009 *Code of Practice for noise and vibration control on construction and open sites – Parts 1 & 2*. Details of the existing site and nearest noise sensitive premises are presented, along with a summary of the construction noise and vibration criteria and the methodology and results of the construction noise and vibration assessment.

This has been undertaken for the following three key phases of construction:

- Enabling works
- Substructure
- Superstructure.

In summary, temporary adverse noise impacts are predicted at the Vita Students building during the construction works.

Noise impact associated with construction noise is temporary, appropriate mitigation measures will be implemented, and local residents and occupants of surrounding buildings will be informed. With implementation of such measures, it is anticipated that the noise impact to the Vita Students Building can be reduced.

Construction vibration during worst-case phases of the construction programme featuring piling is expected to have a significance effect category of 'negligible' at the nearest noise sensitive premises.

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1 Introduction

Sandy Brown has been appointed by Bruntwood Scitech Limited to carry out a construction noise and vibration assessment for the Proposed Development at Alberton House in Manchester.

This report presents an initial assessment of construction noise and vibration from the proposed works which has been carried out in line with BS 5228: 2009 *Code of Practice for noise and vibration control on construction and open sites – Parts 1 & 2*.

Details of the existing site and nearest noise sensitive premises are presented, along with a summary of the construction noise and vibration criteria and the methodology and results of the construction noise and vibration assessment.

2 Policies and standards

2.1 Local authority

Manchester City Council require the following restrictions for all noisy works (i.e those that are audible beyond the site boundary) to minimise disruption (from MCC *Noise and Planning Guidance document – May 2022*):

- Monday – Friday: 7:30am – 6pm
- Saturday 8:30am -2pm
- Sunday / Bank holidays: No work

It is understood that Manchester City Council do not have specific limits on construction noise and vibration, however submission of a construction noise and vibration assessment based on BS 5228: 2009 + A1:2014 is required, as summarised below.

2.1 BS 5228

BS 5228: 2009 + A1:2014 *Code of Practice for noise and vibration control on construction and open sites – Parts 1 & 2* provides guidance on the control of noise and vibration during construction. The standard describes methods for calculating construction noise and provides summaries of case histories of vibration measured during piling operations.

3 Assessment method

The general approach to the construction noise and vibration assessment is as follows:

- The predicted impact due to construction noise and vibration has been carried out in accordance with BS 5228.

- The environmental noise survey results from a survey conducted between 21 March 2022 and 23 March 2022 have been used as the basis for determining baseline noise levels.
- The potential effects of the proposed development on nearby noise sensitive receptors has been assessed by 3D noise modelling. The results have been compared against the relevant criteria, and where appropriate, mitigation measures have been recommended.

4 Existing site

4.1 The site and its surroundings

The existing site location in relation to its surroundings is shown in Figure 1. The existing site is currently vacant. The proposals consist of an extension of the floor plate and construction of a new 15 storey office block.

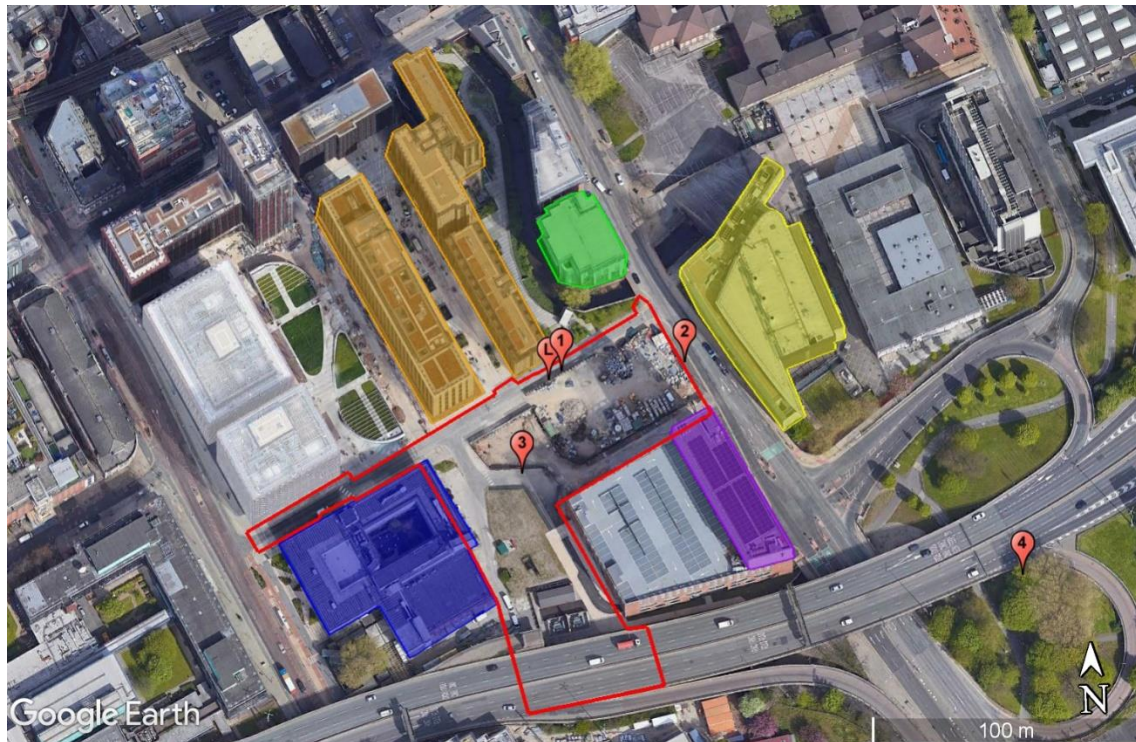


Figure 1 Aerial view of site (courtesy of Google Earth Pro)

4.2 Noise sensitive receptors

The noise sensitive premises as shown in Figure 1, which have been considered in the assessment are described below:

- A. Vita Students (shown in orange) – containing residential student accommodation
- B. Princess House (shown in green) – containing residential apartments
- C. Premier Inn (shown in purple) – containing hotel rooms.
- D. Manchester Institute of Biotechnology (shown in yellow) – containing office and research premises
- E. Manchester Technology Centre (shown in blue) – containing offices

4.3 Baseline noise levels

A noise survey has been carried out in the vicinity of the site to establish baseline noise levels.

The noise levels provided in Table 1 have been used as the basis of the construction noise assessment. These levels were measured in the free-field.

Table 1 Free-field daytime noise levels measured at the site

Date	Daytime ambient noise level, $L_{Aeq,12\text{ hr}}$ (dB)
Monday 21 March 2022	65
Tuesday 22 March 2022	65
Wednesday 23 March 2022	65
Average	65

The measured levels have been used as the basis for setting the noise criteria in Section 5.

5 Construction noise and vibration criteria

5.1 Significance of effects

Identification of potentially sensitive noise receptors on and surrounding the site and categorisation of the 'sensitivity', is illustrated in Table 2.

Table 2 Receptor sensitivity

Sensitivity of receptor	Description
High	Residential properties, hotels and hostels
Medium	Health care and educational buildings, offices
Low	Residential amenity, commercial and retail buildings

The magnitude of Impact shall be defined in accordance with recognised noise guidance and corresponding terminology – High, Medium, Low, Very Low.

The relationship between the magnitude of impact and the receptor sensitivities is determined by the significance evaluation matrix shown in Table 3.

Table 3 Significance of effects

Sensitivity of Receptor	Magnitude of Impact			
	High	Medium	Low	Very Low
High	Major	Moderate	Minor	Negligible
Medium	Moderate	Minor	Negligible	Negligible
Low	Minor	Negligible	Negligible	Negligible

In terms of nature and scale of effects, effects will be defined as either adverse, beneficial or neutral in nature. The scale of effects will refer to guidance within the Noise Policy Statement for England (NPSE), the decision making includes identifying whether the overall effect of the noise exposure generated by a development is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level. The definitions for the different effect levels are outlined below:

- Significant Observed Adverse Effect Level (SOAEL): The level of noise exposure above which significant adverse effects on health and quality of life occur
- Lowest Observed Adverse Effect Level (LOAEL): The level of noise exposure above which adverse effects on health and quality of life can be detected
- No Observed Effect Level (NOEL): The level of noise exposure below which no effect at all on health or quality of life can be detected.

Typically, effects (either before or after mitigation) that are major or moderate in scale shall be considered as 'significant effects' ie, exceeds the LOAEL. The exception to this will be temporary non-permanent sources where a moderate effect would be considered acceptable as it does not exceed the SOAEL.

5.2 Criteria

Suggested criteria for the assessment of enabling and construction noise effects are described below. These are subject to agreement with the Local Authority and also a Section 61 agreement where appropriate.

BS 5228-2 provides guidance on the perception of vibration within occupied buildings. This provides a simple method of assessing annoyance associated with vibration.

Table 4 details Peak Particle Velocity (PPV) levels and their potential effect on humans, and provides a semantic scale for description of construction vibration impacts on human receptors.

Table 4 Impact of peak particle velocity (PPV) levels

Magnitude of impact category	Peak Particle Velocity Level	Description
Negligible	0.3 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
Low	0.3 – 1.0 mm/s	Vibration might be just perceptible in residential environments.
Medium	1.0 – 10.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.
High	>10.0 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

The assessment criteria are based on the “ABC” methodology set out in British Standard BS 5228: 2009+A1:2014, and are applicable outside the nearest residential receptors, based on construction activity occurring on weekdays (0700-1900 hrs) and Saturday mornings between (0700 and 1300 hrs). The limits are based on ambient noise levels set out in Table 1 taking into account appropriate corrections for facade effects.

Table 5 Description of the magnitude of impact rating for assessing effects of construction noise and vibration

Magnitude of Impact	Daytime noise levels (07:00-19:00)	Peak particle velocities
Very low	L_{Aeq} less than or equal to 70 dB	Peak particle velocity (PPV) less than 0.3 mm/s
Low	L_{Aeq} between 71-75dB	PPV regularly exceeding 0.3 mm/s, but less than 1.0 mm/s.
Medium	L_{Aeq} between 76-80 dB	PPV regularly exceeding 1.0 mm/s, but less than 10.0 mm/s.
High	L_{Aeq} higher than 80 dB	PPV regularly exceeding 10.0 mm/s.

6 Proposed construction site and activities

6.1 Proposed construction site

6.1.1 Location

Site hoarding is proposed to the perimeter and has been confirmed to be solid and 2.5 m high, at approximately 2 m from the footprint of the building.

The access/exit points for deliveries and collections are understood to be a “run-in, run-out” lane on Brancaster Road within the hoarding line.

6.1.2 Operating hours

It is assumed that site working hours (and therefore construction activities) are as follows:

- 07:30 – 19:00 Monday to Friday
- No work to be carried out on Saturdays, Sundays or Bank Holidays.

6.2 Construction activities

In order to assess the worst-case construction noise events, the construction activities have been divided into three key phases, which are as follows:

1. Enabling works
2. Substructure
3. Superstructure.

6.2.1 Piling activities

The duration of piling activities is assumed to be short in relation to the construction programme as a whole.

6.2.2 Internal fit-out works activities

Construction activities relating to internal works (eg drilling / hammering) are to be carried out within the facade of the new building. The attenuation provided by the facade will provide mitigation and reduce possible disturbance at nearby noise sensitive premises.

7 Assessment

7.1 Construction noise

7.1.1 Noise modelling

In order to assess noise levels from construction activities at nearby premises, a 3D environmental acoustic mapping software CadnaA has been used to model the site and the surrounding buildings. The software uses the calculation methods set out in BS 5228 to calculate noise propagation outdoors, considering distance attenuation, barrier attenuation and ground absorption. A screenshot from the 3D model is provided in Figure 2.

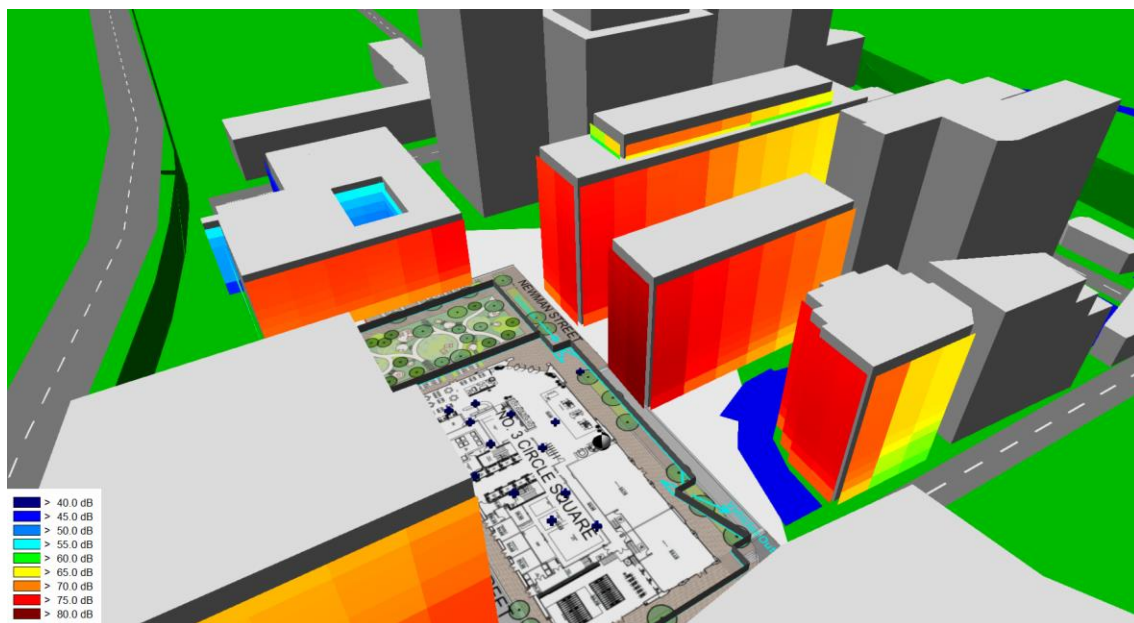


Figure 2 Screenshot from the 3D model

Typical noise generating plant associated with each construction phase, the assumed hours of operation and noise levels at 10 m are presented in Table 6 to Table 8. These are as per BS5228-1, the references to which are also provided.

7.1.2 Enabling works

The details included for the enabling works in the construction noise and vibration assessment of these works are detailed in Table 6.

Table 6 Enabling works plant assumptions

Construction plant	Number	% activity	BS5228-1 reference	L_{Ap} at 10 m (dB)
Bulldozer	1	50	C.8-8	75
Tracked excavators with breakers	2	25	C.1-9	90
Dumpers	2	50	C.4-5	63
Crawler Cranes	1	50	C.3-28	66
Concrete crusher	1	25	C.1-14	86
360 excavators	1	50	C.2-2	77
Mini Excavator	2	50	C.4-67	68
Generator	1	100	C.4-76	61
Water pump	1	10	C.2-45	65
Deliveries	20	10	D7-121	70

7.1.3 Substructure

The details included in the construction noise and vibration assessment of the substructure works are detailed in Table 7.

Table 7 Substructure construction plant assumptions

Construction plant	Number	% activity	BS5228-1 reference	L_{Ap} at 10 m (dB)
Dumpers	2	50	C.4-5	63
360 excavators	2	50	C.2-2	77
Tracked excavators with breakers	1	25	C.1-9	90
Tower Crane	2	50	C.4-47	76
Crawler Cranes	3	50	C.3-28	66
Generator	1	100	C.4-76	61
CFA piling rigs	2	70	C.3-21	79
Concrete pump and boom	1	35	C.4-32	78
Water pump	1	100	C.2-45	65
Deliveries	20	10	D7-121	70
Platform hoists	3	70	C.4-62	66

7.1.4 Superstructure

The details included in the construction noise and vibration assessment of the superstructure works are detailed in Table 8.

Table 8 Superstructure construction plant assumptions

Construction plant	Number	% activity	BS5228-1 reference	L_{Ap} at 10 m (dB)
Dumpers	2	50	C.4-5	63
Tower Crane	2	50	C.4-47	76
Concrete lorry uploading	1	25	C.4-18	75
Generator	1	100	C.4-76	61
Platform hoists	2	70	C.4-62	66
Mast Climbers	11	10	C.4-62	66
Concrete pump and boom	2	35	C.4-32	78
Water pump	1	100	C.2-45	65
Hand tools – petrol saw	2	5	C.4.70	91
Deliveries	20	10	D7-121	70

7.1.5 Predicted noise levels

The predicted noise level and associated significance effect category are presented in Table 9 to Table 11 for each noise sensitive premises and construction phase.

Table 9 Predicted noise levels – Enabling works

Ref. (see Section 4.2)	Location	Predicted daytime noise level, L_{Aeq} (dB)	Significance effect category
A	Vita Students	81	Major
B	Princess House	77	Moderate
C	Premier Inn	76	Moderate
D	Manchester Institute of Biotechnology	77	Minor
E	Manchester Technology Centre	75	Negligible

Table 10 Predicted noise levels – Substructure

Ref. (see Section 4.2)	Location	Predicted daytime noise level, L_{Aeq} (dB)	Significance effect category
A	Vita Students	83	Major
B	Princess House	79	Moderate
C	Premier Inn	78	Moderate
D	Manchester Institute of Biotechnology	79	Minor
E	Manchester Technology Centre	77	Minor

Table 11 Predicted noise levels – Superstructure

Ref. (see Section 4.2)	Location	Predicted daytime noise level, L_{Aeq} (dB)	Significance effect category
A	Vita Students	80	Moderate
B	Princess House	76	Moderate
C	Premier Inn	77	Moderate
D	Manchester Institute of Biotechnology	76	Minor
E	Manchester Technology Centre	74	Negligible

7.2 Construction vibration

7.2.1 Vibration sources

During substructure phase of the construction works piling activities will be carried out, which can potentially cause significant levels of ground-borne vibration.

Calculations based on line source propagation have been carried out using historic data for CFA piling. Due to possible variations in ground conditions, it is difficult to reliably estimate levels of vibration. Monitoring of vibration levels during the construction phases are therefore advised.

Annex D of BS 5228: 2009 *Code of Practice for noise and vibration control on construction and open sites – Part 2* provides summaries of case histories of vibration measured during piling operations. Historic vibration data from CFA piling works indicates that particle peak velocities of between 0.05 to 0.23 mm/s at 20 m from a site have been recorded during CFA piling of 1.05 m diameter piles, with soil conditions described as, 'Fill/dense ballast/clay'. For the purposes of the assessment an average of the range of particle peak velocities is used.

7.2.2 Predicted vibration levels

The calculations indicate the following vibration levels set out in Table 12.

The River Medlock separates the construction site from Princess House. This is expected to provide additional attenuation to ground-borne vibration propagation which is not accounted for in the calculations. Additionally, the carpark beneath Premier inn is likely to provide additional attenuation to ground-borne vibration propagation.

As such, the presented values for these noise sensitive receptors are like to be worst-case.

Table 12 Predicted vibration level at receptors and significance level

Ref.	Receptor	Predicted vibration level (mm/s)	Magnitude of impact	Significance
A	Vita Students	0.2	Very low	Negligible
B	Princess House	0.13	Very low	Negligible
C	Premier Inn	0.26	Very low	Negligible
D	Manchester Institute of Biotechnology	0.16	Very low	Negligible
E	Manchester Technology Centre	0.12	Very low	Negligible

As per Section 6, the duration of the piling activities are short in relation to the construction programme as a whole and the time spent for the pile construction process for each individual pile location is also likely to occur for a short period of time.

As vibration effects at both residential and commercial buildings are expected to be negligible when considering rotary piling methods, further mitigation options are not considered necessary.

7.3 Significance assessment

The predicted noise and vibration levels, and associated significance effect categories presented in Section 7 indicate the following:

- Residential noise sensitive premises in the immediate vicinity of the site such as Vita Students, Princess House and Premier Inn generally have a significance effect category of 'moderately adverse' to 'major adverse' for construction noise throughout the construction programme.
- Office noise sensitive premises at Manchester Institute of Biotechnology and Manchester Technology Centre have a significance effect category of 'negligible' to 'minor adverse' for construction noise and vibration throughout the construction programme.

As construction works are temporary, noise egress is not expected to be an overriding factor with regards to the works on site providing that best practical means mitigation measures are implemented. These have been summarised below.

8 Mitigation options

8.1 Construction noise

The construction phase, and as such any effects associated with construction, will be temporary, appropriate mitigation measures should be implemented and local residents, community groups and building operators should be informed.

Based on the guidance provided in BS 5228: 2009 *Code of Practice for noise and vibration control on construction and open sites – Parts 1 & 2*, the following best practical means measures are to be used where appropriate to control noise associated with construction activities:

- Provision of 2.5 m high perimeter hoarding. This should be suitably sealed with no perforation or significant openings.
- Provision made for localised acoustic barriers or enclosures for particularly loud plant including the piling, cutting and breaking equipment.
- Where appropriate all mechanically powered plant should be fitted with suitable silencers. Items of plant on site operating intermittently should be shut down in the intervening periods between uses.
- The most significant noise sources for each construction phase, notably piling works will require careful selection of breakers, tracked / wheeled excavators, piling rigs and cutting tools. Additionally, the following should be considered:
- Maximising the offset distance between noisy equipment items and noise sensitive receptors;
- Avoiding the coincidence of noisy equipment working simultaneously close together when adjacent to noise sensitive receptors;
- Orienting equipment away from noise sensitive receptors; and
- Carrying out loading and unloading away from noise sensitive areas.
- Activities close to sensitive receptors which may result in impulsive and/or tonal noise generation should be undertaken for a maximum consecutive period of 3 hours and should include a minimum respite period of at least one hour before activities recommence.
- Unnecessary revving of engines should be avoided and equipment switched off when not required.
- Internal haul routes will be well maintained with steep gradients avoided.
- Rubber linings will be used in chutes, dumpers etc. as required reducing impact noise.
- Drop heights of materials will be minimised.
- Plant and vehicles will be started up sequentially rather than all together.
- The movement of plant onto and around the Site shall have regard for the normal operating hours of the Site and the location of noise sensitive receptors as is reasonably practicable.

- Audible reversing warning systems on mobile plant and vehicles will be of the type which, whilst ensuring that they give proper warning, has a minimum noise impact on persons outside open sites. When reversing, mobile plant and vehicles will travel in a direction away from noise sensitive receptors wherever possible.
- Where vibration from stationary equipment (e.g. generators, pumps, compressors) may in some instances prove disturbing when located close to sensitive receptors, equipment will be relocated or isolated using resilient mountings.

8.2 Residual effects

Although difficult to accurately quantify, the implementation of the best practice mitigation set out above could result in reductions in noise levels of 5-10 dBA. On this basis, the predicted noise level and associated residual significance effect category are presented in Table 13 to Table 15 at each noise sensitive premises and construction phase.

Table 13 Predicted noise levels – Enabling works – with mitigation

Ref. (see Section 4.2)	Location	Estimated noise level, L_{Aeq} (dB)	Estimated residual significance effect category
A	Vita Students	71-76	Minor-moderate
B	Princess House	67-72	Negligible-minor
C	Premier Inn	66-71	Negligible-minor
D	Manchester Institute of Biotechnology	67-72	Negligible
E	Manchester Technology Centre	65-70	Negligible

Table 14 Predicted noise levels – Substructure – with mitigation

Ref. (see Section 4.2)	Location	Estimated noise level, L_{Aeq} (dB)	Estimated residual significance effect category
A	Vita Students	73-78	Minor-moderate
B	Princess House	69-74	Negligible-minor
C	Premier Inn	68-73	Negligible-minor
D	Manchester Institute of Biotechnology	69-74	Minor
E	Manchester Technology Centre	67-72	Minor

Table 15 Predicted noise levels – Superstructure– with mitigation

Ref. (see Section 4.2)	Location	Estimated noise level, L_{Aeq} (dB)	Estimated residual significance effect category
A	Vita Students	70-75	Negligible-minor
B	Princess House	66-71	Negligible-minor
C	Premier Inn	67-72	Negligible-minor
D	Manchester Institute of Biotechnology	66-71	Negligible-minor
E	Manchester Technology Centre	64-69	Negligible