

# Report

09<sup>th</sup> April 2018



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## Report for – UCLH Charity Middlesex Hospital Annex Noise and vibration demolition assessment T3452.5

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## Document Version Control

Version	Date	Author	Reviewed by	Reviewed and Approved by
1	09/04/18	Lucia Rodriguez-Perez / John Fisk	John Fisk	Dani Fiumicelli

**Report for:** UCLH Charity

**Main Contributors:** Lucia Rodriguez-Perez

**Copy to**

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## Contents

1.0	Introduction	4
2.0	Guidance Considerations and Noise Standards	5
	British Standard 5228	5
3.0	Sensitive Receptors	6
4.0	Works description	8
	4.1 Indicative Activity Programme	8
	4.2 Plant and equipment	8
5.0	Noise and Vibration mitigation measures/best practicable means	9
	5.1 General Measures	9
6.0	Predicted noise levels	11
	6.1 CadnaA model assumptions	11
	6.2 Results	11
7.0	Vibration and Structure-borne noise	14
	7.1 Vibration	14
	7.2 Structure-borne noise and vibration	14
8.0	Conclusion	16

## **1.0 Introduction**

Temple has been instructed by UCLHC via Llewelyn Davies as lead consultant to predict and assess noise and vibration levels for demolition works at Middlesex Hospital Annex (MHA), situated at 44 Cleveland Street.

The works consist of part-demolition of the existing hospital annex building with the listed part of the structure, the former Strand Union Workhouse fronting onto Cleveland Street, being retained and refurbished as a mix of high quality residential units. The South House building (which is water damaged and in disrepair) will also partially be demolished.

Predicted noise levels have been calculated and presented in this document to assess demolition activities at the nearest sensitive receptors located around the proposed scheme. When applicable, outline recommendations for additional best practicable measures have been given.

## 2.0 Guidance Considerations and Noise Standards

### British Standard 5228

British Standard 5228: 'Code of practice for noise and vibration control on construction and open sites'<sup>1,2</sup>, provides a 'best practice' guide for noise and vibration control, and includes sound power level (SWL) data for individual plant as well as a calculation method for noise from construction activities. Part 1 relates to noise and part 2 relates to vibration.

#### Noise Assessment Criteria

BS5228 part 1 gives a number of example criteria for the assessment of the potential significance of noise effects. Example methods are given based on fixed noise threshold levels and based on noise change.

Nearby sensitive receptors to the site include commercial offices and residential receptors (see section 3).

Significance criteria based on noise change are generally applicable to dwellings and fixed noise threshold levels are applicable to offices.

The ABC method (example method 1) determines whether the receptor is in category A, B or C depending on whether the baseline noise level (when rounded to the nearest 5dB) is respectively less than, equal to or higher than 65dB  $L_{Aeq,T}$  during the day. Threshold values are given for categories A, B or C for which a potential significant effect occurs when exceeded by noise from site. Threshold values are 65dB, 70dB and 75dB  $L_{Aeq,T}$  for categories A,B and C respectively during the daytime.

For offices, the fixed noise threshold level is recommended as 70dB(A) in rural, suburban and urban areas away from main road traffic and industrial noise.

All noise levels are assumed to be measured at 1m from the façade of an occupied sensitive room of the building.

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<sup>1</sup> British Standard 5228-1: (2009 + A1:2014) Code of practice for noise and vibration control on construction and open sites – Part 1: Noise.

<sup>2</sup> British Standard 5228-2: (2009 + A2:2014) Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration.

### 3.0 Sensitive Receptors

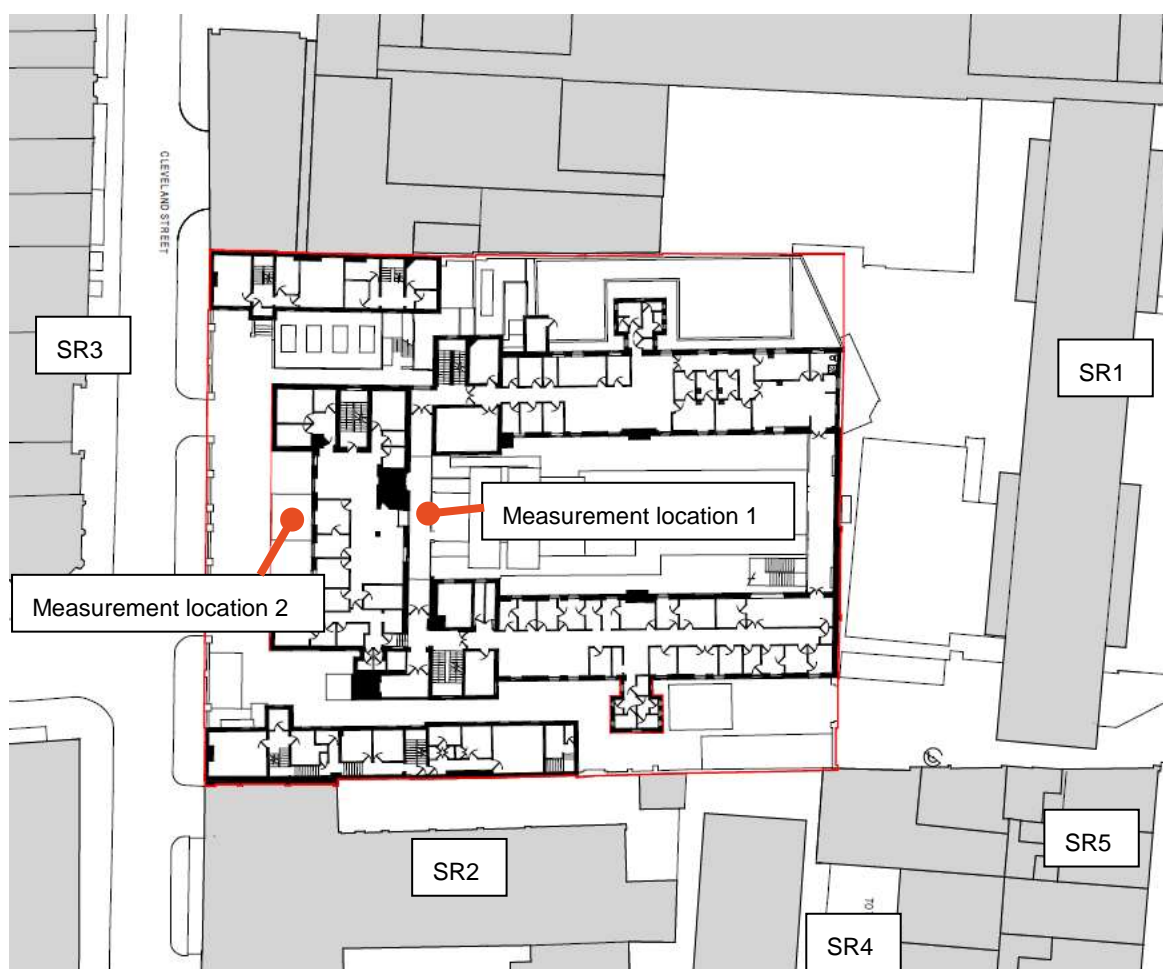
Sensitive receptors that are potentially impacted by the proposed works and the distance between the closest boundary of the site and the receptor are as follows;

- Residential units as part of Astor College building located on Charlotte street; located approx. 7m from the nearest site boundary (**SR1**);
- Office units as part of Middlesex House on Cleveland street; located approx. 5m from the nearest site boundary (**SR2**);
- Residential properties located on Cleveland street; located approx. 10m from the nearest site boundary (**SR3**);
- Residential Properties on Tottenham Mews (**SR4**);
- The rear of residential properties on Charlotte Street (**SR5**).

The Welcome Building to the north of the site is not likely to be sensitive to noise from the demolition as it is a commercial development with closed façade overlooking the site.

**Figure 1** showing the location of sensitive receptors is included below:

**Figure 1: site plan showing measurement locations and receptors**



A baseline noise survey was completed in October 2016. Measurement locations are shown in **Figure 1** above. The survey was reported in the acoustic assessment report submitted for the planning application and dated 19<sup>th</sup> January 2017. Using the results of the noise assessment and making appropriate corrections for distance and screening where appropriate, **Table 1** includes calculated baseline noise levels at all receptors. A noise impact threshold is given according to the assessment criteria discussed in **section 2**.

**Table 1: baseline noise levels at all receptors**

Receptor	Daytime noise level $L_{Aeq,T}$ dB	Noise Impact threshold $L_{Aeq,T}$
SR1 - Astor College Student Accommodation	48	65 dB (category A)
SR2 - Middlesex House Office	60	70 dB
SR3 - Cleveland street residential	63	70 dB (category B)
SR4 - Tottenham Mews residential	48	65 dB (category A)
SR5 – Charlotte Street (rear) residential	48	65 dB (category A)

A distance correction (according to procedures from Calculation of Road Traffic Noise) has been applied to the baseline noise level at SR3 as the Cleveland Street façade is closer to the road than the measurement position (3.5m and 12m respectively from kurb). Otherwise all baseline noise levels are assumed to be similar to those measured at one of the two locations.

## 4.0 Works description

### 4.1 Indicative Activity Programme

The programme of demolition works is included in **Appendix A**. Structural demolition works progress over 6 phases over a period of 28 weeks from 2<sup>nd</sup> July 2018 to 18<sup>th</sup> January 2019. Site plans showing demolition phasing is shown in **Appendix B**.

### 4.2 Plant and equipment

As part of the initial demolition programme information related to activity plant items, angle of view and percentage on times which are likely to be used during the proposed works has been also provided.

A full of list of plant and machinery including heavy vehicles stating number, type, and sound power levels can be seen in **Table 2** below.

**Table 2 – Plant and equipment**

Activity	Equipment	Description	Quantity	BS5228 or other Ref for Spectrum	BS5228/ Ref L <sub>Aeq</sub> at 10m, dB	% On-Time
Site Access Enabling Works	JCB Wheeled Excavator	13 T	1	C.5.11	73	85
	Suitable MEWP (Model TBC)	1T	1	C.4.57	67	80
Pre-Demolition Soft-Strip / Retained Strip-Out	Kubota K-008	750Kg	2	C.4.68	65	75
	Bobcat / Skidsteer Loader	2T	2	C.4.14	67	75
	110v Reciprocating Saws	N/A	5	D.6.52	78	70
	General Hand Tools	N/A	1	C.4.96	77	2
	Scaffolding Lorries (Unloading)	N/A	1	C.11.10	77	20
Structural Demolition	Komatsu 450-6	45T	1	C.1.12	82	75
	Hitachi ZX210-3	21T	2	C.2.3	78	75
Waste Material Clearance	Various 8 Wheel Rigid Axle Roll On / Off Lorries 32 Ton Laden	16T	2	C.11.10	77	10



## **5.0 Noise and Vibration mitigation measures/best practicable means**

### **5.1 General Measures**

#### **Working hours**

Two distinct working periods have been identified as core working hours. Where practicable, all works shall be undertaken during normal working hours defined as follows:

- 08:00 – 18:00 hours weekdays; and
- 08:00 – 13:00 hours Saturday.

The core hours are in line with guidance in BS5228 Part 1<sup>1</sup>, any work outside these hours would be subject to prior agreement, and/or reasonable notice given to LBC and their Environmental Health Officers (EHOs). These hours would be strictly adhered to unless or in the event of:

- an emergency demands continuation of works on the ground of safety;
- works are being carried out within the containment of the building envelope; or
- completion of an operation that would otherwise cause greater interference with the environment / general public if left unfinished.

#### **Pre-site preparation**

- Workforce briefings will be undertaken to explain BPM to minimise noise and the specific commitments / conditions arising from the proposed works.
- The use of 2.4m high hoarding to surround the site towards the north, south, west and east.
- Where practicable, carefully locate ordinary building materials normally stored on site (e.g. bricks, aggregate, timber or top soil) to provide noise screening.

#### **Equipment and vehicles**

- Where reasonably practicable the quietest and modern vehicle/plant machinery shall be used;
- All vehicles and mechanical plant used for the works shall be fitted with effective exhaust silencers, shall be maintained in good and efficient order and operated in such a manner as to minimise noise emissions;
- Audible reversing warning systems on mobile plant and vehicles shall be of a type which, whilst ensuring that they give proper warning, have a minimum noise impact on persons outside the site, such as broadband/white noise reversing alarms, and will be set to the minimum output noise level required for health and safety compliance;
- Plant and equipment to be located as far from sensitive receptors as reasonably practicable;
- When applicable, plant and vehicles will start-up sequentially rather than all together;
- Equipment and vehicles will be shut down when not in use and avoid unnecessary revving of engines;
- Handling of materials in manner which reasonably practicably minimises noise;
- Appropriate choice of routes and programming for the transport of construction materials, waste, equipment and personnel;
- Specifying the minimum sized generator required to power the site where necessary.

Additional mitigation measures which will be implemented to further mitigate and minimise adverse impact at receptors include the following:

- Liaise with representatives of the affected receptors to inform them of the impact and discuss potential mitigation measures;
- Monitoring of noise levels to be able to investigate and take action if noise level exceed expected levels or complaints are received.

Additional measures such as regular periods of respite during the day and taller site boundary screening have been considered by the contractor but they have not deemed them practicable due to various reasons including cost; increasing the duration of demolition works; restriction of access on the site to carry out demolition and safety.

## 6.0 Predicted noise levels

### 6.1 CadnaA model assumptions

The predicted noise levels for the demolition activities described in **section 4** have been calculated using CadnaA, a noise modelling software which implements calculation methods from BS5228 where the following assumptions have been made:

- plant and equipment assumptions as given in **Table 2**;
- 10dB screening attenuation has been assumed for static plant with localised mobile screening applied.
- a 2.4 m hoarding to the site boundaries towards the north, west, south and east;
- diagram F.3 from BS 5228 has been used to calculate screening attenuation;
- Activities have been modelled as area sources (mobile plant in a defined area).
- all the area sources have been located at 1.5m above local ground.
- all noise predictions have been made at a point 1m in front of the most exposed window and are representative of façade noise levels.
- All the activities have been modelled at one location representative of the worst case scenario (i.e. at the closest approach to receptors) except for the “structural demolition” activity.
- For the structural demolition activity, in order to indicate how the noise levels at receptors may change over time as this activity is carried out and distance and screening to receptors varies, each phase has been modelled separately assuming the activity occurs over an area of the building being demolished and the building which have not yet been demolished are retained.

### 6.2 Results

Activity noise levels at each receptor have been calculated based on the information presented in section 2 and the model assumption as explained above. Predicted noise levels per activity and at each receptor can be seen in **Table 3** below.

As stated within this section, predicted noise levels have been obtained using CadnaA software therefore the distance and screening attenuations per activity and receptor depend on the type of source/s used for each activity. These tables are available upon request.

Table 4 indicates in red where the highest predicted noise level is above the relevant noise impact threshold given in **Table 3**.

**Table 3 – Predicted noise levels**

Activity	Activity L <sub>Aeq,10h</sub> at 10m (dB)	Activity Duration (days)	Highest Predicted noise level at façade of receptor during activity, L <sub>Aeq,10h</sub> (dB) (demolition only)				
			SR1 - Astor College Student Accommodation	SR2 - Middlesex House Office	SR3 - Cleveland street residential	SR4 - Tottenham Mews residential	SR5 – Charlotte Street (rear) residential
A1: Site Access Enabling Works	72	5	34	50	65	34	40
A2: Pre-Demolition Soft-Strip / Retained Strip-Out	75	78	56	40	40	38	39
A3: Scaffolding to Enable Site Demolitions	70	47	5	29	46	7	9
A4: Structural Demolition	83	142					
Phase 1 – lift and side extension (hand demo)		10	62	67	49	45	55
Phase 2 – south house rear parts (hand demo)		25	61	<b>78</b>	42	52	56
Phase 3 – Gable end facing Astor college (hand demo)		14	63	44	39	44	51
Phase 4 – South Annexe (machine demo)		55	<b>80</b>	<b>81</b>	49	56	<b>72</b>
Phase 5 – Party wall between the Welcome Building Yard and MAS (hand demo)		15	58	39	49	35	36
Phase 6 – North Annexe (machine demo)		33	<b>76</b>	<b>73</b>	70	51	<b>70</b>
A5: Waste Material Clearance	70	-	5	29	46	7	9

## Notes

SR1 – The highest noise levels are representative of most of the floors of the building, though noise levels at ground and first floor may be 10 or 5dB lower than highest level presented due to screening from site hoarding.

SR2 – The ground floor is likely to be around 10dB lower than the highest level presented due to site hoarding screening. The highest floors are likely to be around 5dB lower than the highest level presented due to additional distance from the works.

SR3 – During demolition of the North Annexe, some works may be unscreened to properties on Cleveland street which overlook directly opposite the gap in the Middlesex Annex buildings between the Listed Building and the North House, otherwise noise levels at properties on Cleveland street during this activity will be substantially lower than the highest presented due to screening.

SR4 – Windows of sensitive properties on Tottenham Mews are likely to be screened from the works throughout by existing surrounding buildings.

SR5 – Rear windows of the top floor of 97 Charlotte Street overlook the site and are likely to have some time where the works during phases 4 and 6 are unscreened.

Cumulative noise levels: The cumulative noise level of more than one activity occurring concurrently is not predicted to increase the highest noise level at any receptors.

General note: The highest noise level presented is usually the noise level of works which are unscreened at the receptors. Given the nature of the demolition works, some of the existing building will screen the works at the receptor whilst other parts are being demolished. The noise level will therefore vary over the course of the individual activity and so the highest noise level is unlikely to be experienced for the full activity duration.

## 7.0 Vibration and Structure-borne noise

In addition to the potential impact of airborne noise on adjacent receptors, the following also has the potential to adversely impact the same receptors:

- vibration to be generated by demolition activities transmitted through the ground to adjacent receptors;
- structure-borne noise and vibration transmitted through the structure to adjacent receptors where structurally connected;

### 7.1 Vibration

Vibration from ground breaking, piling or material compaction are generally the activities likely to give rise to adverse vibration impacts from construction or demolition.

The activities proposed for the demolition of Middlesex annex hospital, as described in **section 4** do not include these activities.

BS 5228 part 2 gives guidance on the effect of different vibration levels. Vibration above 1mm/s is likely to cause complaint in residential environments but can be tolerated if prior warning and explanation has been given to residents. Vibration above 10mm/s is likely to be intolerable for any more than a very brief exposure to this level.

There may be potential for perceptible vibration during some of the works when they take place particularly close to the receptor, however the vibration level is likely to be below 1mm/s.

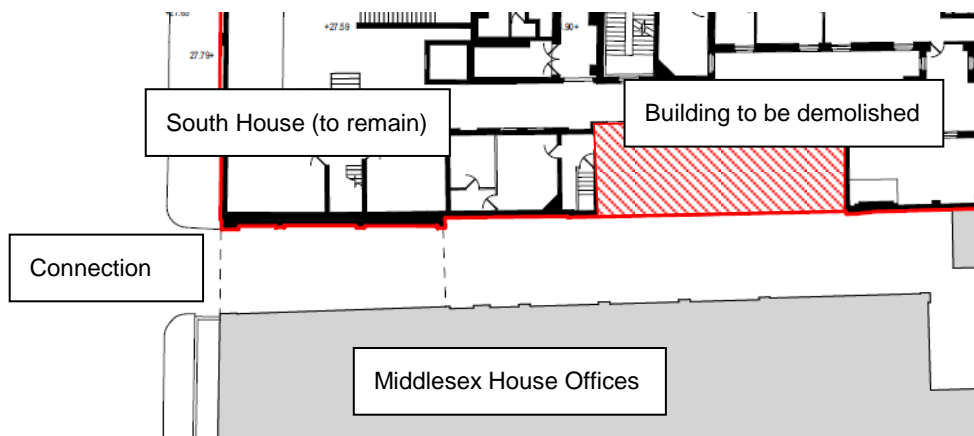
It is, however recommended that residents immediately adjacent to the works are warned in advance that vibration may be perceptible from the works.

Vibration generated by demolition activities transmitted through the ground is unlikely to reach a level which would cause cosmetic damage to adjacent buildings (levels listed in Table B.2 of BS5228 part, which are much higher than those listed which may cause complaint or be intolerable to people).

### 7.2 Structure-borne noise and vibration

The only structural connection between buildings being demolished and adjacent occupied buildings is at the South House building which is connected to the Middlesex House offices. This is illustrated in **Figure 2** below.

**Figure 2: showing connection between South House and Middlesex House offices**



The area of the South house building being demolished is not directly connected to the Middlesex House office, therefore structure-borne noise will need to transmit through the remaining South House building. It is unlikely, therefore, that high noise levels will be received inside the Middlesex House offices because of structure-borne noise from the demolition activity. However, to minimise the structure-borne noise transmission it is recommended to break connections where practicable prior to demolition works.

## 8.0 Conclusion

Temple Group Ltd (Temple) has been instructed by Llewelyn Davies to predict noise and vibration levels for demolition works at Middlesex Hospital Annex (MHA), situated at 44 Cleveland Street.

Predicted noise levels have been presented in this document to assess noise levels from demolition activities at MHA at the nearest sensitive receptors located around the proposed scheme.

Worst case predicted noise levels have been calculated with CadnaA for all the activities considering the closest distance between sensitive receptors and activities which may happen for short periods of time.

The highest predicted noise level at the façades of Astor College Student Accommodation, Middlesex House Office and Charlotte Street (rear) residential exceeds the threshold for noise impact according BS5228 guidance.

The highest noise level presented is usually the noise level of works which are unscreened at the receptors. Given the nature of the demolition works, some of the existing building will screen the works at the receptor whilst other parts are being demolished. The noise level will therefore vary over the course of the individual activity and the highest noise level is unlikely to be experienced for the full activity duration.

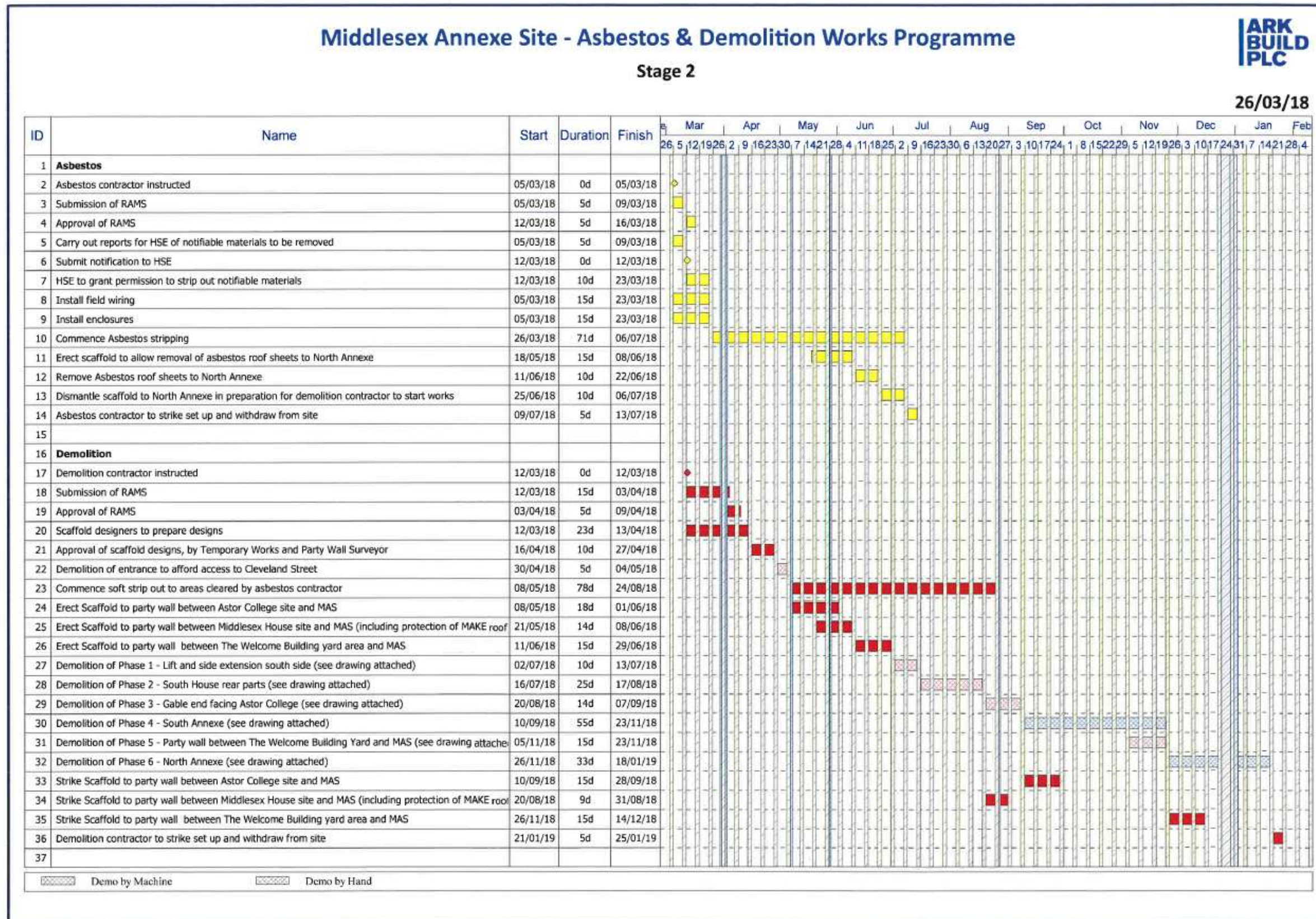
Vibration and structure borne noise is not likely to lead to significant adverse impacts at adjacent receptors with recommended best practicable means mitigation measures applied.

Additional mitigation measures which will be implemented to further mitigate and minimise adverse noise impacts at receptors include the following:

- Liaise with representatives of the affected receptors to inform them of the impact and discuss potential mitigation measures;
- Monitoring of noise levels to be able to investigate and take action if noise level exceed expected levels or complaints are received.

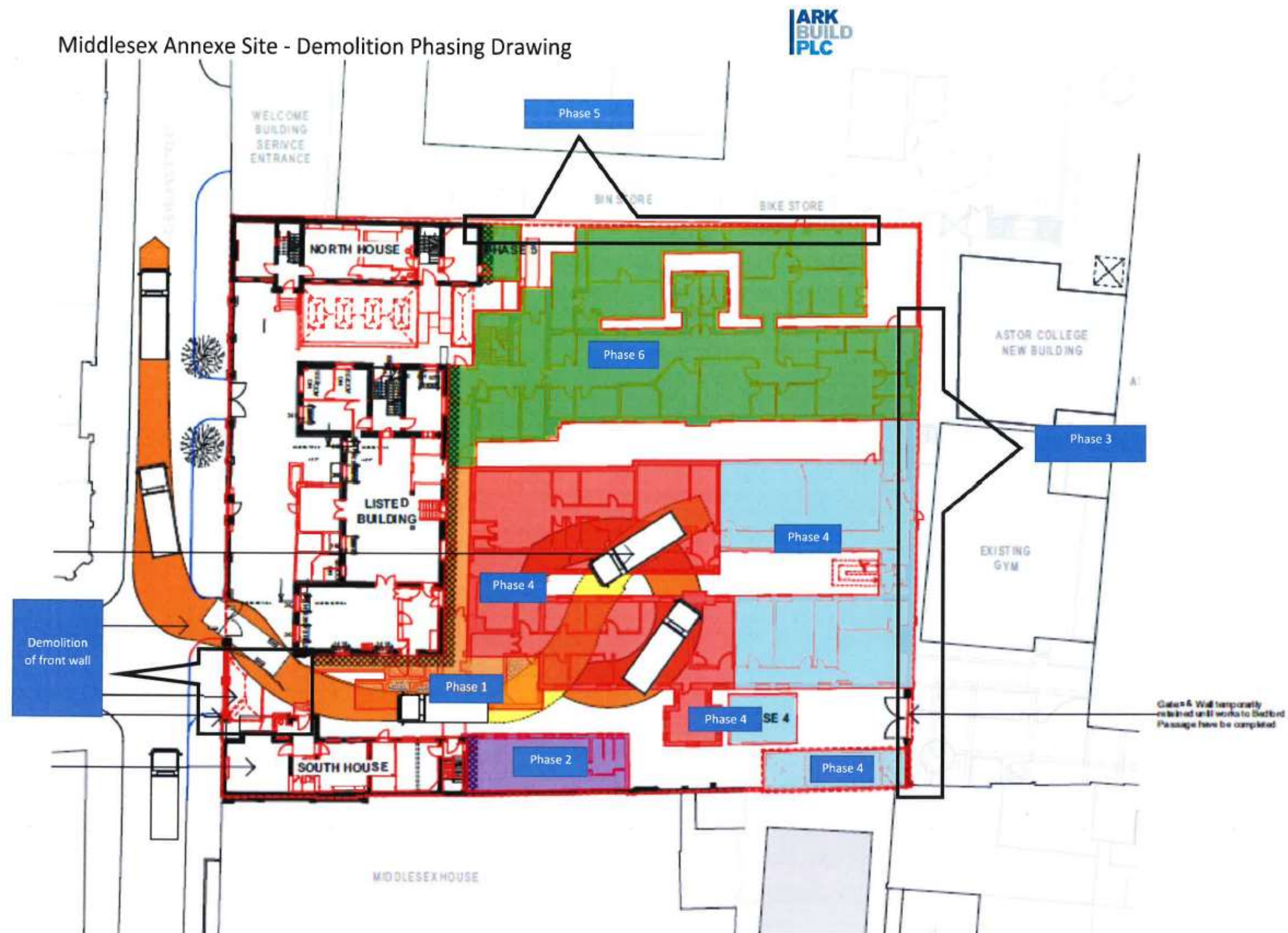


## Appendix A – Programme





## Appendix B – Site plan showing demolition phases



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**Temple Group Ltd**  
The Woolyard  
52 Bermondsey Street  
London SE1 3UD

Tel: +44 (0) 20 7394 3700  
Fax: +44 (0) 20 7394 7871

[www.templegroup.co.uk](http://www.templegroup.co.uk)

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