

## Application for Approval of Details Reserved by Condition

Town and Country Planning Act 1990 (as amended); Planning (Listed Buildings and Conservation Areas) Act 1990 (as amended)

### Publication of applications on planning authority websites

Please note that the information provided on this application form and in supporting documents may be published on the Authority's website. If you require any further clarification, please contact the Authority's planning department.

### Site Location

**Disclaimer:** We can only make recommendations based on the answers given in the questions.

If you cannot provide a postcode, the description of site location must be completed. Please provide the most accurate site description you can, to help locate the site - for example "field to the North of the Post Office".

Number

Suffix

Property Name

Address Line 1

Address Line 2

Address Line 3

Town/city

Postcode

Description of site location must be completed if postcode is not known:

Easting (x)

Northing (y)

Description

## Applicant Details

### Name/Company

Title

Mr

First name

Mark

Surname

Jones

Company Name

Roberts Limbrick Architects

### Address

Address line 1

Gloucester Royal Hospital

Address line 2

Great Western Road

Address line 3

Gloucestershire

Town/City

Gloucester

Country

Postcode

GL1 3NN

Are you an agent acting on behalf of the applicant?

Yes

No

### Contact Details

Primary number

\*\*\*\*\* REDACTED \*\*\*\*\*

Secondary number

Fax number

Email address

## Agent Details

Name/Company

Title

First name

Surname

Company Name

## Address

Address line 1

Address line 2

Address line 3

Town/City

Country

Postcode

## Contact Details

Primary number

Secondary number

Fax number

Email address

## Description of the Proposal

Please provide a description of the approved development as shown on the decision letter

The proposed development includes the construction of an enclosed plantroom on the roof of existing departmental spaces and two HV transformer units in an existing courtyard. The plantroom will house air handling equipment for operating theatres and electrical switch gear.

Reference number

Date of decision (date must be pre-application submission)

**Please state the condition number(s) to which this application relates**

Condition number(s)

Has the development already started?

- Yes  
 No

## Part Discharge of Conditions

Are you seeking to discharge only part of a condition?

- Yes  
 No

## Discharge of Conditions

Please provide a full description and/or list of the materials/details that are being submitted for approval

This submission includes an Acoustic report prepared by Acoustic Consultants Ltd. The report concludes that the proposed plant operation is considered to be significantly below the existing background noise levels at the nearest noise sensitive receivers and therefore this is an indication of a low impact.

## Site Visit

Can the site be seen from a public road, public footpath, bridleway or other public land?

Yes

No

If the planning authority needs to make an appointment to carry out a site visit, whom should they contact?

The agent

The applicant

Other person

## Pre-application Advice

Has assistance or prior advice been sought from the local authority about this application?

Yes

No

## Declaration

I / We hereby apply for Approval of details reserved by a condition (discharge) as described in this form and accompanying plans/drawings and additional information. I / We confirm that, to the best of my/our knowledge, any facts stated are true and accurate and any opinions given are the genuine options of the persons giving them. I / We also accept that: Once submitted, this information will be transmitted to the Local Planning Authority and, once validated by them, be made available as part of a public register and on the authority's website; our system will automatically generate and send you emails in regard to the submission of this application.

I / We agree to the outlined declaration

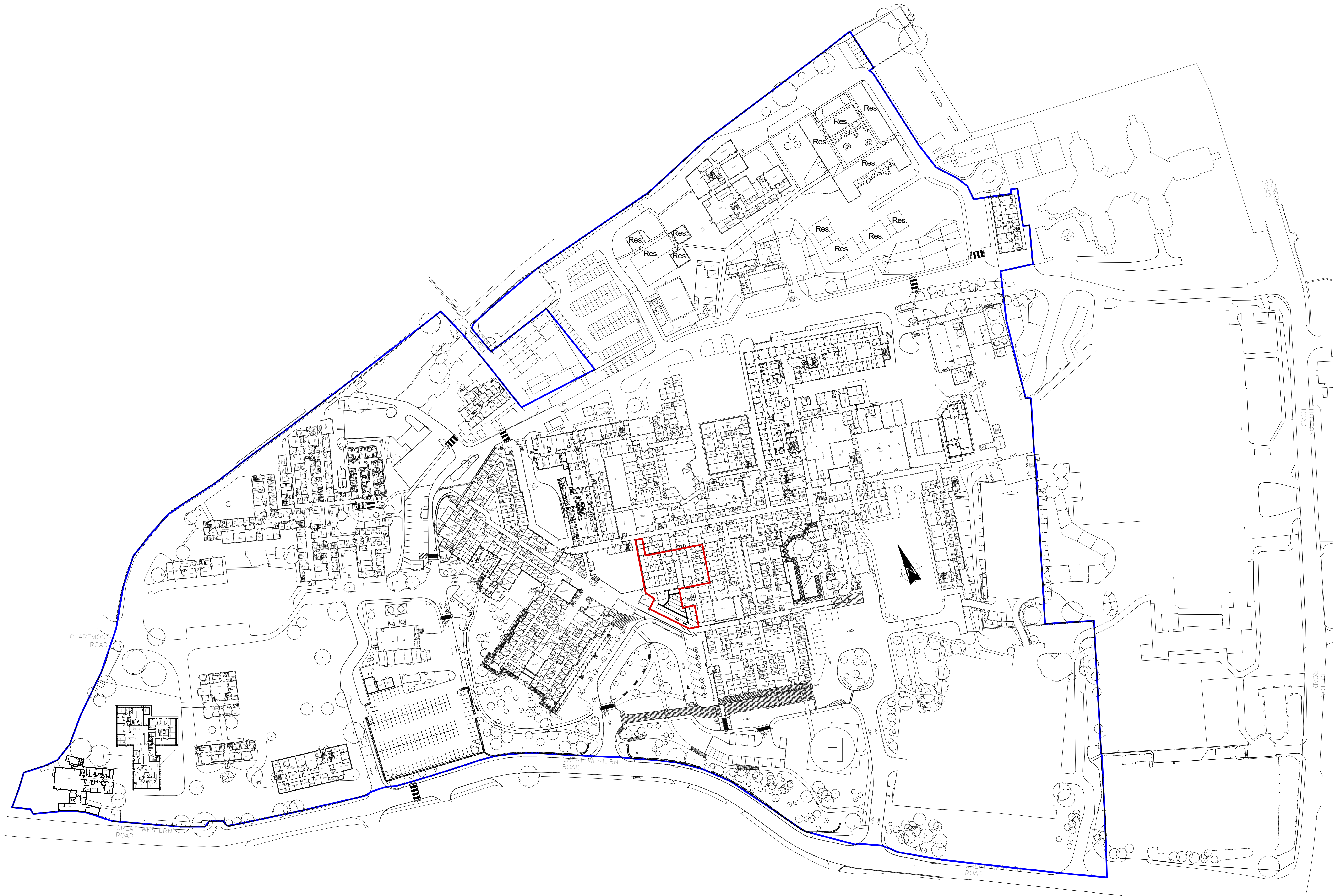
Signed

Roberts Limbrick Ltd

Date

19/07/2022





**Roberts Limbrick**  
ARCHITECTS

PROJECT  
GRH RADIOLOGY REDEVELOPMENT  
Cardiology Cath Labs, Recovery & Bed  
Waiting

CLIENT  
Gloucestershire Managed Services

DRAWING  
Site Location Plan

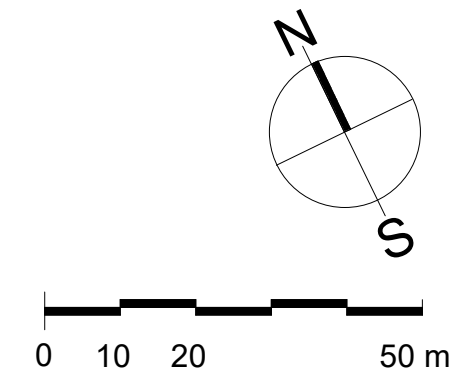
STATUS  
**PLANNING**

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**ACOUSTIC**  
CONSULTANTS LTD

# Noise Impact Assessment

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**Gloucester Royal Hospital  
External Plant Assessment**

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Reference: 9243/PR/BL

**Client:**



**Document Control**

<b>Version</b>	<b>Revision Description</b>	<b>Date</b>	<b>Author:</b>	<b>Reviewed by:</b>
1 <sup>st</sup> Issue	-	16/02/22	Pedro Rodrigues MIOA	Blake Lucas, MIOA

The report has been prepared in good faith, with all reasonable skill and care, based on information provided or available at the time of its preparation and within the scope of work agreement with the Client. We disclaim any responsibility to the Client and others in respect of any matters outside the scope of the above. The report is provided for the sole use of the named Client and is confidential to them and their professional advisors. No responsibility is accepted to other parties.

The report limits itself to addressing solely on the noise aspects as included in this report. We provide advice only in relation to noise and acoustics. It is recommended that appropriate expert advice is sought on all the ramifications (e.g. CDM, structural, condensation, fire, legal, etc.) associated with any proposals in this report or as advised and concerning the appointment. It should be noted that noise predictions are based on the current information as we understand it and on the performances noted in this report. Any modification to these parameters can alter the predicted level. All predictions are in any event subject to a degree of tolerance of normally plus or minus three decibels. If this tolerance is not acceptable, then it would be necessary to consider further measures.



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# 1. Introduction

Currie & Brown UK Ltd appointed Acoustic Consultants Limited to undertake a noise impact assessment in respect of the new proposed external plant at the Gloucester Royal Hospital.

This report addressed planning condition 3 of the approved scheme (Ref: 21/00335/FUL) and provides a noise assessment of activities associated with the proposed plant on the nearby sensitive receivers outside the hospital premises.

The noise impact assessment has been undertaken in accordance with British Standard 4142:2014+A1:2019 (BS4142) as required by planning condition 3 (Ref. 21/00335/FUL) and Local authority.

The author of this report is a full Member of the Institute of Acoustics with more than 12 years' experience within the field and, as such, is considered suitably qualified to undertake a noise impact assessment.

## 2. The Site & Proposals

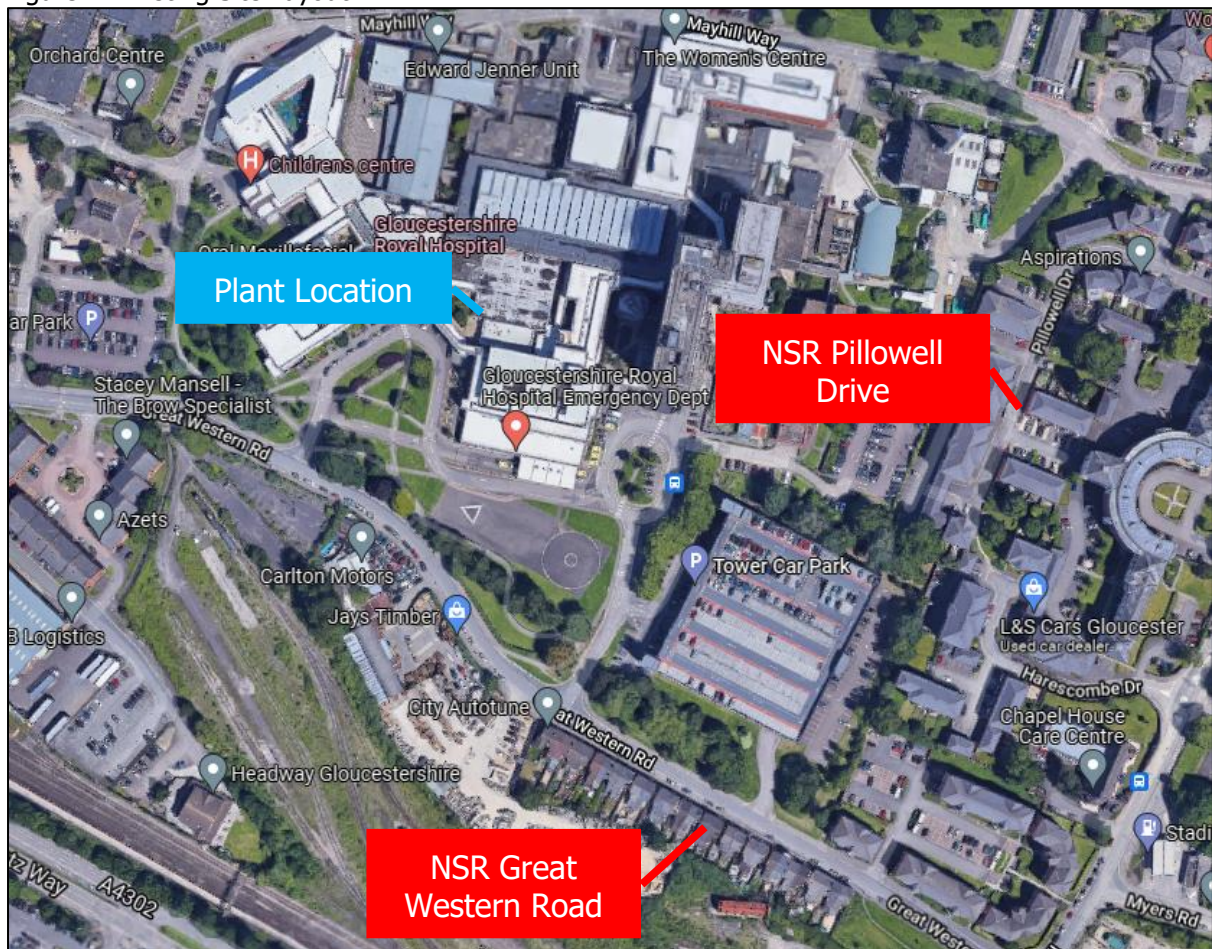
The proposal is for the refurbishment of the Gloucester Royal Hospital to include new external plant.

The new plant is to be located at roof level behind the main entrance to the hospital. The new plant includes a total of 6 new Air Handling Units (AHU) and transformer units which will be in an air handling plant enclosure. This enclosure will be 5.4 meters in height.

The nearest noise sensitive receivers are houses located to the east along Pillowell Drive 210 metres away from the proposed plant and to the south on Great Western Road at 200 meters away from the proposed plant.

The proposed site layout including the above noise sensitive receivers and building eastern elevation drawing is provided below:

Figure 1: Existing Site Layout



The proposed plant room is shown below in the Roberts Limbrick Architects drawing:



Figure 2: Proposed Plant Room Elevation and Sections

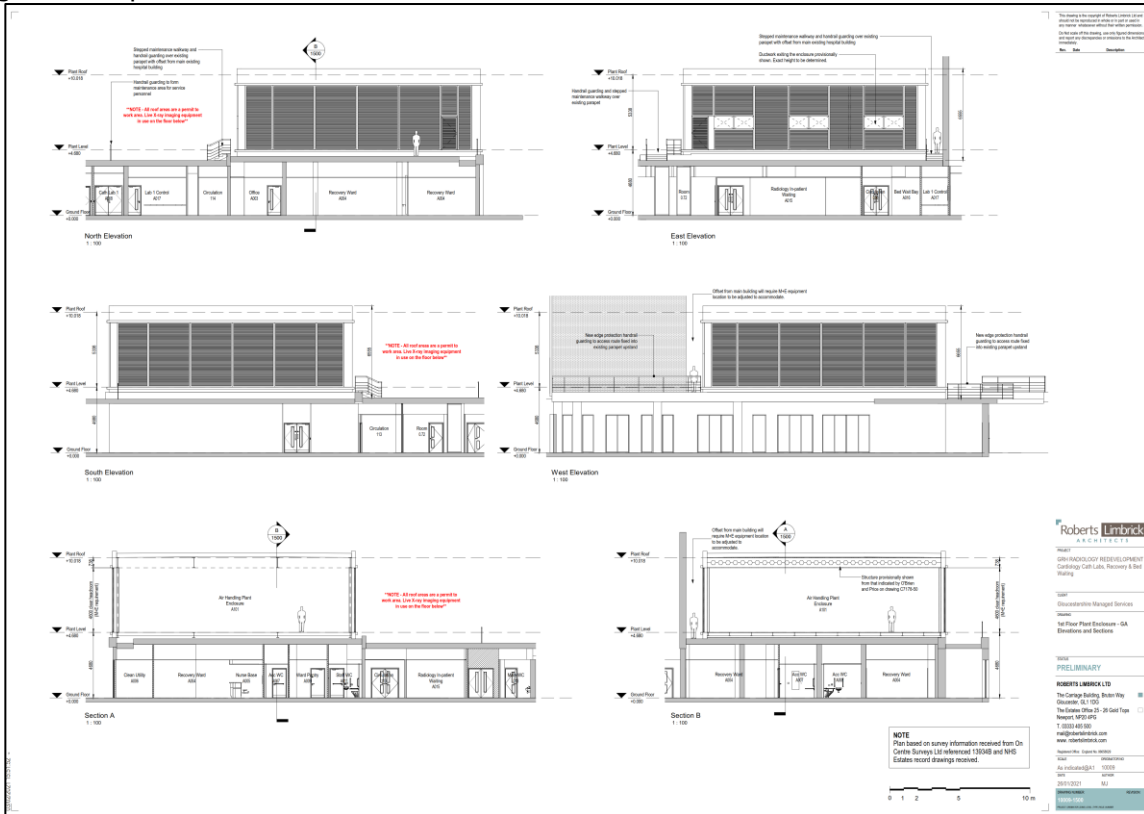


Figure 3: Proposed Plant Room and Transformers Locations



## 3. Planning & Noise

### 3.1. Planning Condition 3 (Ref: 21/00335/FUL)

The assessment is to address Planning Condition 3 (Ref: 21/00335/FUL) which states:

*"Prior to commencement of the construction works an assessment report of plant noise or plant room acoustic performance has to be submitted to the local authority and agreed in writing. The assessment report shall include the undertaking of a new background noise survey for comparison with the figures in Table 11 of the GL Hearn document ref: GH/006001 R01. The applicant has to demonstrate that noise from the Air Handling and Transformer units comply with the noise limits as per table 11 and accompanying text of 'Noise Impact Assessment - Gloucestershire Royal Hospital - AMU, AEC, ED and Gallery Wing extensions' prepared by GL Hearn ref: GH/006001 R01, or with the new background noise survey measurements if these are found to be higher than the values contained in the GL Hearn Table 11, to ensure there are no adverse impacts to nearby receptors. Any assessment of plant noise should be carried out utilising BS 4142 methodology.*

*Reason*

*To ensure there are no adverse impacts to nearby receptors."*

Table 11 from the GL Hearn report ref: GH/006001 is provided below.

Figure 4: Table 11 from GL Hearn report

Receptor	Location	Time period	Typical measured background noise levels, $L_{A90,T}$	Maximum plant noise emissions, $L_{A,T}$
Nearby noise-sensitive properties	Pillowell Drive	Daytime (07.00 – 23.00)	44 dB	39 dB
		Night time (23.00 – 07.00)	42 dB	37 dB
	Great Western Rd	Daytime (07.00 – 23.00)	49 dB	44 dB
		Night time (23.00 – 07.00)	40 dB	35 dB
Open external areas	All times	49 dB	50 dB	

### 3.2. British Standard 2014:2014+A1:2019

For industrial and commercial noise, the most relevant guidance is provided within British Standard 4142:2014+A1:2019. The methods described in the British Standard use outdoor sound levels to assess the likely effects of sound upon people who might be inside or outside a dwelling or other premise used for residential purposes.

The initial estimate principle is that of establishing the 'difference' between the 'rating level' and the 'background sound level'. The 'rating level' is the 'specific sound level' of the source over a period of one hour during the day (07:00 to 23:00 hours) and over a period of 15 minutes during the night (23:00 to 07:00 hours). Clause 9 entitled 'Rating Level' states:

*"Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, add a character correction to the specific sound level to obtain the rating level."*

An acoustic character correction should be added to the 'specific sound level' if it exhibits any tonality, impulsivity, other specific characteristics and/or intermittency at the assessment location. The value of the character correction varies, dependent on the prominence of the character of the sound source at the assessment location. In Clause 11 of the Standard, entitled 'Assessment of the Impacts', it states:

*"Obtain an initial estimate of the impact of the specific sound by subtracting the measured background sound level (see Clause 8) from the rating level (see Clause 9), and consider the following.*

- *Typically, the greater this difference, the greater the magnitude of the impact.*
- *A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.*
- *A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.*
- *The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context."*



## 4. Noise Monitoring

A partially attended noise survey was undertaken between 10:30 hours on the 29<sup>th</sup> of November to 10:30 hours on the 3<sup>rd</sup> of December 2021 to determine the existing noise climate at the site.

### 4.1. Monitoring Equipment

Sound Pressure Levels were measured using a sound level analyser with half-inch condenser microphone, using the 'fast' setting. The equipment is checked regularly using a Quality System meeting the requirements of British Standard EN ISO/IEC 17025:2017 entitled "General requirements for the competence of testing and calibration laboratories"; in accordance with British Standard EN 10012:2003 "Measurement management systems. Requirements for measurement processes and measuring equipment"; and traceable to the National Standards. This equipment was checked and calibrated as noted below.

Table 1: Monitoring Equipment

<b>Equipment Description / Manufacturer / Type</b>	<b>Serial Number</b>	<b>Date of Calibration</b>	<b>Calibration Certification Number</b>
SLM, Cirrus Research, CR:171C	G080650	09/07/2021	159776
Microphone, Cirrus Research, MK224	210551D	09/07/2021	159777
Calibrator, Cirrus Research, CR:515	84377	09/07/2021	159751
SLM, NTI, XL2	A2A-11053-E0	22/04/2020	34610
Pre-Amp, NTI, MA220	5871	22/04/2020	34610
Microphone, NTI, MC230A	9276	22/04/2020	34609
Calibrator, Nor-1251	35227	15/12/2021	39759
SLM, Svantek, 959	14784	22/04/2020	34608
Microphone, GRAS, 40AE	183810	22/04/2020	34607
Calibrator, Larson Davis CAL200	18293	15/09/2021	44454

The measuring systems were checked for calibration before and after the tests and no significant drift was detected.

### 4.2. Weather Conditions

During the measurement, the weather was mainly dry with a temperature of approximately 1-12 degrees Celsius, with wind speeds not exceeding 5 metres per second. These weather conditions are not expected to have adversely affected the measured noise data.

### 4.3. Monitoring Procedure

A partially attended noise survey was undertaken between 10:30 hours on the 29<sup>th</sup> of November to 10:30 hours on the 3<sup>rd</sup> of December 2021 to determine the existing noise climate at the site following British Standard 4142:2014. The microphone was located approximately 1.5 metres off the ground when measured at ground level and 1.5m from the roof of the multistorey carpark at location B.

Location B location is considered representative of the nearest noise sensitive receivers on the other side of the road to the south. These houses are some 1.5 metres distance from the nearside road curb, and therefore more likely to be exposed to existing road traffic noise levels. Location A is representative of the nearest noise sensitive receivers to the east of the hospital site. The measurement location is therefore considered acceptable and provides a worst-case result for a BS4142 noise impact assessment.

The long term monitoring locations are shown below as A and B. The short term attended measurements were taken from locations 1, 2 and 3.

Figure 5: Monitoring Locations as shown in GL Hearn report



### 4.4. Measured Baseline Noise Levels

The noise monitoring location is considered representative of the sensitive receivers in the vicinity in terms of British Standard 4142:2014. A chart of the variation in ambient noise levels with time is provided below for monitoring locations A & B.

The following range and modal background sound levels are provided in the table below along with the equivalent noise level (residual sound level):

Table 2: Variation in Noise Levels at both long term locations(free-field)

Location	Time Period	Previous Measurements				Our Measurements			
		L <sub>Aeq</sub> (15 minutes) dB		L <sub>A90</sub> (15 minutes) dB		L <sub>Aeq</sub> (15 minutes) dB		L <sub>A90</sub> (15 minutes) dB	
		Range	Typical	Range	Mode	Range	Modal	Range	Mode
A	Daytime (07:00-23:00)	43-65	54	41-49	<b>44</b>	35-67	50	33-49	41
	Night-time (23:00-07:00)	41-72	50	41-47	<b>42</b>	32-64	51	30-40	34
B	Daytime (07:00-23:00)	51-62	57	43-55	49	50-68	58	42-57	<b>54</b>
	Night-time (23:00-07:00)	40-63	51	37-51	40	41-58	50	34-52	<b>42</b>

The following table shows the average spectral noise levels during the daytime measurements at locations 1, 2 and 3. The average for each is taken from the two measurements in each location.

Table 3: Variation in Noise Levels (free-field)

Location		Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	L <sub>Aeq</sub>
1	Previous Measurement	68	61	59	56	60	55	47	68	63
	Our Measurement	69	61	60	64	61	52	47	47	66
2	Previous Measurement	69	62	58	59	60	55	47	69	64
	Our Measurement	70	64	61	60	64	61	52	44	67
3	Previous Measurement	58	50	46	44	42	37	36	58	52
	Our Measurement	57	49	45	44	45	41	36	33	49

#### 4.5. Plant noise Limits

As the maximum noise levels from both locations will be used to determine the proposed plant limits for this refurbishment as stated in the planning condition 3 (Ref: 21/00335/FUL), the background noise levels for location A will be determined by the GL Hearn report measurements and the background noise levels for location B will be determined by our measured noise levels. These are as follows:

Table 4: Plant Noise Limits

Location	Time Period	L <sub>A90</sub> (15 minutes) dB
A	Daytime (07:00-23:00)	44
	Night-time (23:00-07:00)	42
B	Daytime (07:00-23:00)	54
	Night-time (23:00-07:00)	42



## 5. Noise Modelling

### 5.1. Proposed Plant & Noise Levels

It is understood that the proposed plant room will allocate the following items of plant:

- 3No. Dalair AHU (1, 2,&3)
- 2No. Dalair AHU (4)
- 1No. Dalair AHU (5)

The proposed plant noise data Supply and Extract Discharge Plant Noise Levels (atmospheric side) are based on supplied manufacturer’s sound power noise levels and are as follows:

Table 5: Dalair’s Sound Power Fan Discharge Noise Levels

Number of Items	Plant Type	63	125	250	500	1000	2000	4000	8000	A
3	AHU 1,2&3 - Supply Fan	85	79	86	84	84	81	77	75	88
3	AHU 1,2&3 Extract Fan	84	79	85	84	83	80	76	76	88
2	AHU 4 - Supply Fan	85	79	86	84	84	81	77	75	88
2	AHU 4 Extract Fan	84	79	85	84	83	80	76	76	88
1	AHU 5 - Supply Fan	82	78	89	85	85	82	78	75	90
1	AHU 5 Extract Fan	79	79	86	84	83	80	76	74	88

The proposed attenuator (atmospheric side) to be fit to each of the above units is also understood to be a 600mm Silencer, Melinex Lined and provides the following insertion losses (IL) as follows:

Table 6: IL provided by proposed attenuator

Plant Type	63	125	250	500	1000	2000	4000	8000	A
600mm Silencer, Melinex Lined	85	79	86	84	84	81	77	75	88

No case radiating was provided; however, the case radiating levels of these AHU are known to be below the discharge levels shown above even with attenuators.

Based on the above items of plant and attenuators, we have applied the following cumulative Sound Power Level to each of the horizontal (roof) and vertical (weather louvres) area sources in the noise model below.

Table 7: Cumulative Sound Power Noise Levels

SPW Noise Source	63	125	250	500	1000	2000	4000	8000	A
Cumulative plant Sound Power Level	92	83	89	79	83	87	85	77	92

It is also understood that the plant will include further attenuation on the atmospheric side, however, we have not been provided with these. Therefore, calculations below assumed a worst case assumption.

Some transformer units / condenser units have also been proposed, however, we have not been provided with these units and plant data. Nevertheless, these units are not expected to be louder than the AHU's used and shown above. They are also known to be located at a lower ground level and therefore will be screened from the planning noise sensitive receiving locations A & B shown above and obtained from GL Hearn report. These are therefore expected to have a negligible impact upon the planning receivers considered above (monitoring Location A & B).

## 5.2. Building Construction

The proposed plant room construction is understood to comprise a metal deck on the roof and louvred weather areas on the surrounding walls. We have considered that the roof will be capable of achieving a sound insulation index of 25dB Rw. The louvres were assumed to provide no attenuation. The octave band performance used is the noise modelling below is as follows:

Frequency, dB	63	125	250	500	1000	2000	4000	8000	Rw
Corrugate Metal - Roof	10	14	16	20	25	29	23	20	25

## 5.3. Noise Modelling

The commercial noise emission of the site has been modelled in the noise modelling software Cadna:A by DataKustik. The modelling software calculates sound levels based on the inputted sound emission values, source and receiver locations, and primarily distance, barrier and ground attenuation. Calculations are undertaken using the General Method of Calculation from ISO 9613.

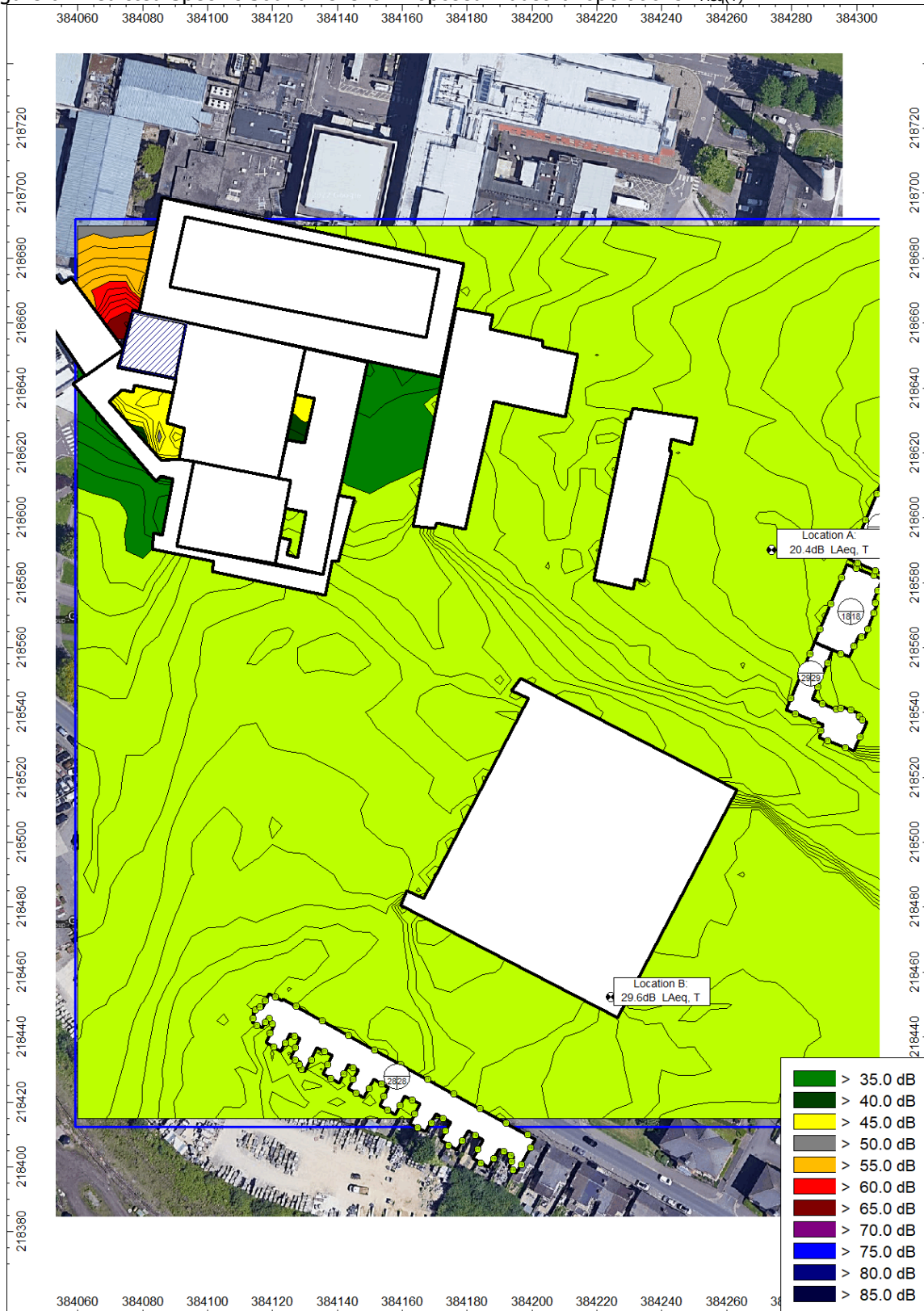
The parameters within the Cadna:A model are as follows and are considered reasonable assumptions:

- The store height is based on the supplied and google 3D view observations
- The order of reflections is 3, and all buildings are reflective.
- The ground across the site and surrounding area is considered hard and reflective.
- The topography of the site is was considered to be flat.
- The predictions are based on the plant noise levels shown above.
- The predicted noise map level is given at a height of 1.5 metres using a grid of 5x5m and at Receivers A & B
- Plant was assumed to run continuously (24-hours) and the cumulative sound power noise levels shown in Table 7 were applied to horizontal and vertical area sources.

## 5.4. Predicted Specific Sound Level

A noise map of the plant specific sound levels is provided below for the daytime/ night time operations.

Figure 6: Predicted Specific Sound Level of Proposed industrial operations  $L_{Aeq}(T)$



As it can be seen on the noise map above, the predicted free-field specific sound level of plant at the planning receiving locations A & B are understood to be 20 dB  $L_{Aeq}(T)$  and night time 30dB  $L_{Aeq}(T)$  respectively.



## 6. Noise Assessment

A British Standard 4142:2014 assessment has been undertaken at the sensitive receivers (Location A & B) around the site.

### 6.1. Initial Estimate

#### 6.1.1. Background Sound Level

Based on Table 2 above, we have determined the following background noise level limits at monitoring Locations A (based on GL Hearn report) and Location B (based on ACL measurements).

Table 8: Variation in Noise Levels at both long term locations (free-field)

Location	Time Period	LA90 (15 minutes) dB
A	Daytime (07:00-23:00)	44
	Night-time (23:00-07:00)	42
B	Daytime (07:00-23:00)	54
	Night-time (23:00-07:00)	42

#### 6.1.2. Specific Sound Level

The cumulative specific sound level at the worst-case receiver is 20 dB LAeq(1 hour) during the day, 20dB LAeq(15 min) during the night at monitoring Location A, 30 dB LAeq(1 hour) during the day, 30dB LAeq(15 min) during the night at monitoring Location B. These are the levels determined at the noise sensitive receivers without any character corrections applied.

#### 6.1.3. Character Corrections

Character corrections should be added to the 'specific sound level' if it exhibits any *tonality, impulsivity, other sound characteristics and/or intermittency* at the assessment location. The character corrections we have applied are as follows:

- **Tonality** – The proposed plant is not considered to be tonal.
- **Impulsivity** – The plant is not considered to be impulsive.
- **Intermittency** – We do not expect that the intermittency of the plant will be distinguishable at the sensitive receiver over the residual noise climate and we have not applied correction for intermittency. We have also assumed all plant is running continuously within our noise model and for the duration of the assessment period.
- **Other Sound Characteristics** – We do not believe a character correction is necessary for other sound characteristics. The nearest receivers are already subject to plant noise associated with the hospital and surrounding industrial/ commercial units. Nevertheless, a 3dB correction has been applied.

Therefore, the British Standard 4142:2014 initial estimate of the noise impact at the most sensitive location for the two noise models created above, is as follows:

Table 9: British Standard 4142:2014 Initial Estimate at worst case receiver to the west

Parameters	Assessment Period			
	Location A		Location B	
	Daytime	Night Time	Daytime	Night Time
Background Sound Level, $L_{A90}$ (1 hr) dB	44	42	54	42
Specific Sound Level, $L_{Aeq}$ (1 hr) dB	20	20	30	30
Acoustic Character Correction, dB	+3	+3	+3	+3
Rating Sound Level $L_{Ar}$ (1 hr) dB	23	23	33	33
Difference between rating and background, dB	-21	-19	-21	-9

This means that the proposed industry rating noise level will result in a British Standard 4142:2014 assessment 'difference' of -21 dB and +-19 dB during the daytime and night time periods respectively at noise-sensitive receiver A.

In addition, the assessment will also result in a 'difference' -21 dB and -9dB during the daytime and night time periods respectively at noise sensitive receiver B.

BS 4142 states that *"The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context."*

## 6.2. Summary of British Standard 4142:2014 Assessment

As it can be seen above, the noise impact of the proposed plant operation is considered to be significantly below the existing background noise levels at the nearest noise sensitive receivers and therefore this is an indication of a low impact.

In addition, we would also consider noise associated with the proposals to be acceptable in terms of environmental noise emission to the sensitive receivers in the area and to be within the Local Authority planning condition 3 requirements and noise limits.

## 7. Summary & Conclusions

Currie & Brown UK Ltd appointed Acoustic Consultants Limited to undertake a noise impact assessment in respect of the new proposed external plant at the Gloucester Royal Hospital.

This report addressed planning condition 3 of the approved scheme (Ref: 21/00335/FUL) and provides a noise assessment of activities associated with the proposed plant on the nearby sensitive receivers outside the hospital premises.

The noise impact assessment has been undertaken in accordance with British Standard 4142:2014+A1:2019 (BS4142) as required by planning condition 3 (Ref. 21/00335/FUL) and Local authority.

The BS4142 noise impact assessment of the proposed plant operation is considered to be significantly below the existing background noise levels at the nearest noise sensitive receivers and therefore this is an indication of a low impact.

In addition, we would also consider noise associated with the proposals to be acceptable in terms of environmental noise emission to the sensitive receivers in the area and to be within the Local Authority planning condition 3 requirements. Therefore, we are of the opinion that Planning Condition 3 can be discharged.



## 8. Appendix 1 – Glossary of Acoustic Terminology

*A-weighted sound pressure p<sub>A</sub>* – value of overall sound pressure, measured in pascals (Pa), after the electrical signal derived from a microphone has been passed through an A-weighting network

*A-weighted sound pressure level, L<sub>pA</sub>* - quantity of A-weighted sound pressure given by the following formula in decibels (dBA)

$$L_{pA} = 10 \log_{10} (p_A/p_0)^2$$

where:

p<sub>A</sub> is the A-weighted sound pressure in pascals (Pa);  
 p<sub>0</sub> is the reference sound pressure (20 μPa)

*Background sound level, L<sub>A90, T</sub>* – A-weighted sound pressure level that is exceeded by the residual sound assessment location for 90% of a given time interval, T, measured using weighting F and quoted to the nearest whole number of decibels

*Break-in* - noise transmission into a structure from outside.

*Decibel (dB)* – The decibel is the unit used to quantify sound pressure levels. The human ear has an approximately logarithmic response to acoustic pressure over a very large dynamic range (typically 20 micro-Pascals to 100 Pascals). Therefore, a logarithmic scale is used to describe sound pressure levels and also sound intensity and power levels. The logarithms are taken to base 10. Hence an increase of 10 dB in sound pressure level is equivalent to an increase by a factor of 10 in the sound pressure level (measured in Pascals). Subjectively, this increase would correspond to a doubling of the perceived loudness of sound.

*Equivalent continuous A-weighted sound pressure level, L<sub>Aeq, T</sub>* – value of the A-weighted sound pressure level in decibels of continuous steady sound that, within a specified time interval, T = t<sub>2</sub> – t<sub>1</sub>, has the same mean-squared sound pressure as a sound that varies with time, and is given by the following equation:

$$L_{Aeq, T} = 10 \log_{10} \left\{ (1/T) \int_{t_1}^{t_2} [p_A(t)^2/p_0^2] dt \right\} \quad (1)$$

where:

p<sub>0</sub> is the reference sound pressure (20 μPa); and

p<sub>A</sub>(t) is the instantaneous A-weighted sound pressure (Pa) at time t

*NOTE* The equivalent continuous A-weighted sound pressure level is quoted to the nearest whole number of decibels.

*Facade level* – sound pressure level 1 m in front of the façade. Facade level measurements of L<sub>pA</sub> are typically 1 dB to 3 dB higher than corresponding free-field measurements because of the reflection from the facade.

*Free-field level* – sound pressure level away from reflecting surfaces. Measurements made 1.2 m to 1.5 m above the ground and at least 3.5 m away from other reflecting surfaces are usually regarded as free-field. To minimize the effect of reflections the measuring position has to be at least 3.5 m to the side of the reflecting surface (i.e. not 3.5 m from the reflecting surface in the direction of the source).

*Octave and Third Octave Bands* – The human ear is sensitive to sound over a range of frequencies between approximately 20 Hz to 20 kHz and is generally more sensitive to medium and high frequencies than to low frequencies within the range. There are many methods of describing the frequency content of a noise. The most common methods split the frequency range into defined bands, in which the mid-frequency is used as the band descriptor and in the case of octave bands is double that of the band lower. For example, two adjacent octave bands are 250 Hz and 500 Hz. Third octave bands provide a fine resolution by dividing each octave band into three bands. For example, third octave bands would be 160 Hz, 250 Hz, 315 Hz for the same 250 Hz octave band.

*Sound pressure level* – Sound pressure level is stated on many of the charts. It is the amplitude of the acoustic pressure fluctuations in a sound wave, fundamentally measured in Pascals (Pa), typically from 20 micro-Pascals to 100 Pascals, but commonly simplified onto the decibel scale.

*Sound reduction index, R* – laboratory measure of the sound insulating properties of a material or building element in a stated frequency band.

*Specific sound level,  $L_s = L_{Aeq, T_r}$*  – equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval,  $T_r$ .

*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

*Rating level,  $L_{Ar, T_r}$*  – Specific sound level plus any adjustment for the characteristic features of the sound.

*Reverberation Time, T* – The reverberation time is defined as the time taken for a noise level in an enclosed space to decay by 60 dB from a steady level, once the noise source has stopped. It is measured in seconds. Often a 60-dB decay cannot be measured so the reverberation time is measured over a lesser range and corrected back to the time for a 60-dB drop assuming a constant decay rate. Common parameters are T20 (time taken for a 20-dB decay multiplied by three) and T30 (time taken for a 30-dB decay multiplied by two).

*Vibration Dose Value, VDV* – measure of the total vibration experienced over a specified period of time.

*Estimated Vibration Dose Value, eVDV* – estimation of the total vibration experienced over a specified period of time. This is usually based on the number of events and shortened measurement data.

*Weighted sound reduction index,  $R_w$*  – Single-number quantity which characterizes the airborne sound insulating properties of a material or building element over a range of frequencies. The weighted sound reduction index is used to characterize the insulation of a material or product that has been measured in a laboratory (see BS EN ISO 717-1).

*Weighted standardized impact sound pressure level,  $L'_{nT, w}$*  - single-number quantity used to characterize the impact sound insulation of floors over a range of frequencies. NOTE weighted standardized impact sound pressure level is used to characterize the insulation of floors in buildings (see Annex C and BS EN ISO 717-2).

*Weighted standardized level difference,  $D_{nT, w}$*  – single-number quantity that characterizes the airborne sound insulation between rooms. NOTE Weighted standardized level difference is used to characterize the insulation between rooms in a building (see Annex C and BS EN ISO 717-1).





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