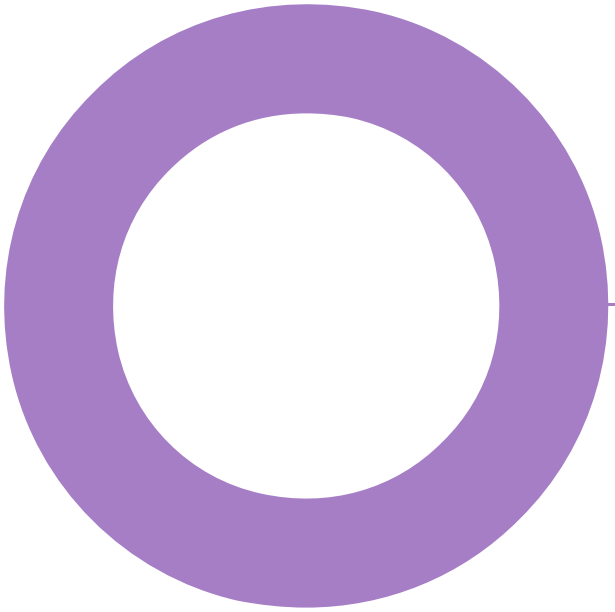
HOARE LEA

Curium Oxford Cyclotron.
Oxford.
STW Architect.

ACOUSTICS
NOISE IMPACT ASESSMENT FOR PLANNING

REVISION 00 – 15 FEBRUARY 2024



Audit sheet.

Rev.	Date	Description of change / purpose of issue	Prepared	Reviewed	Authorised
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Contents.

Executive summary

This report comprises a noise impact assessment of the Curium Cyclotron, proposed at Churchill Hospital, Oxford. The development includes the installation of a new particle accelerator within an existing building on the site. Operation of the accelerator requires an additional chiller to be installed. This new chiller has been identified as a new source of noise that requires assessment to ensure there is no detriment to nearby noise sensitive receptors, in accordance with the local planning guidance.

The noise assessment strategy is in accordance with the Local Authority guidance, which requires noise from new fixed plant noise sources to be less than the existing background sound level at the nearest noise sensitive receptors, rated in accordance with BS 4142.

The existing sound climate has been quantified through an acoustic survey undertaken by Hoare Lea in February 2024. Various acoustic parameters were measured over a 5-day period at a location deemed representative of the nearest noise sensitive receptors. Results were comparable to other survey work undertaken by Hoare Lea at the Churchill Hospital site.

Noise limits have been set based on the results of the acoustic survey, in accordance with the Local Authority.

The current chiller selection has been assessed to predict noise levels at the facade of the new 3-storey key worker accommodation block and existing residential properties on Churchill Drive. The maximum sound power level limits for daytime and night-time periods have been calculated, and these should be achieved at source to ensure that noise emissions to receptors are suitable.

The current selection exceeds the maximum sound power levels. In the first instance, it is advised to consider reselection with lower noise output. It is recommended that the chiller is reselected using the maximum sound power levels as design values to find a unit that emits a suitable amount of noise.

If the chiller cannot be reselected, built-on mechanical mitigation is advised. This could be acoustic packaging. Based on the current selection, packaging will need to provide an 8 dB(A) attenuation to meet the daytime and night-time sound power level limits.

Noise levels at receivers are predicted to have less than a low impact when assessed in accordance with BS 4142.

This report is suitable for submission to the Local Authority as part of the planning application.

1. Introduction.

This report comprises the noise impact assessment of the Curium Cyclotron development proposed at Churchill Hospital, Oxford. Proposals include a new chiller unit that will serve the building. The new chiller is a potential new source of noise. This is considered the only source of noise for assessment.

This report provides an acoustic assessment of the proposed plant equipment. External plant noise emission limits are proposed based on the Oxford City Council requirements, based on the results of an environmental noise survey of the prevailing acoustic climate at the site. Mitigation advice is provided to ensure that the plant noise emission limits are not exceeded at the nearest noise sensitive receptors.

This report is suitable for submission alongside the planning application for the development.

2. Site context.

The project involves the construction of a new cyclotron particle accelerator within an existing building on the Churchill Hospital site. The development building is on the east side of the site, to the south of Oxford City Ambulance station and approximately 50 metres west of Churchill Road. The nearest noise sensitive receptors to the development site have been identified as residential dwellings on Girdlestone Road and Spencer Court. The nearest sensitive healthcare / patient facility buildings are further away to the west of the site. The residential dwellings to the east are therefore chosen as the assessment location as worst case.

Figure 1 shows the nearest noise sensitive receptors within the context of the site.

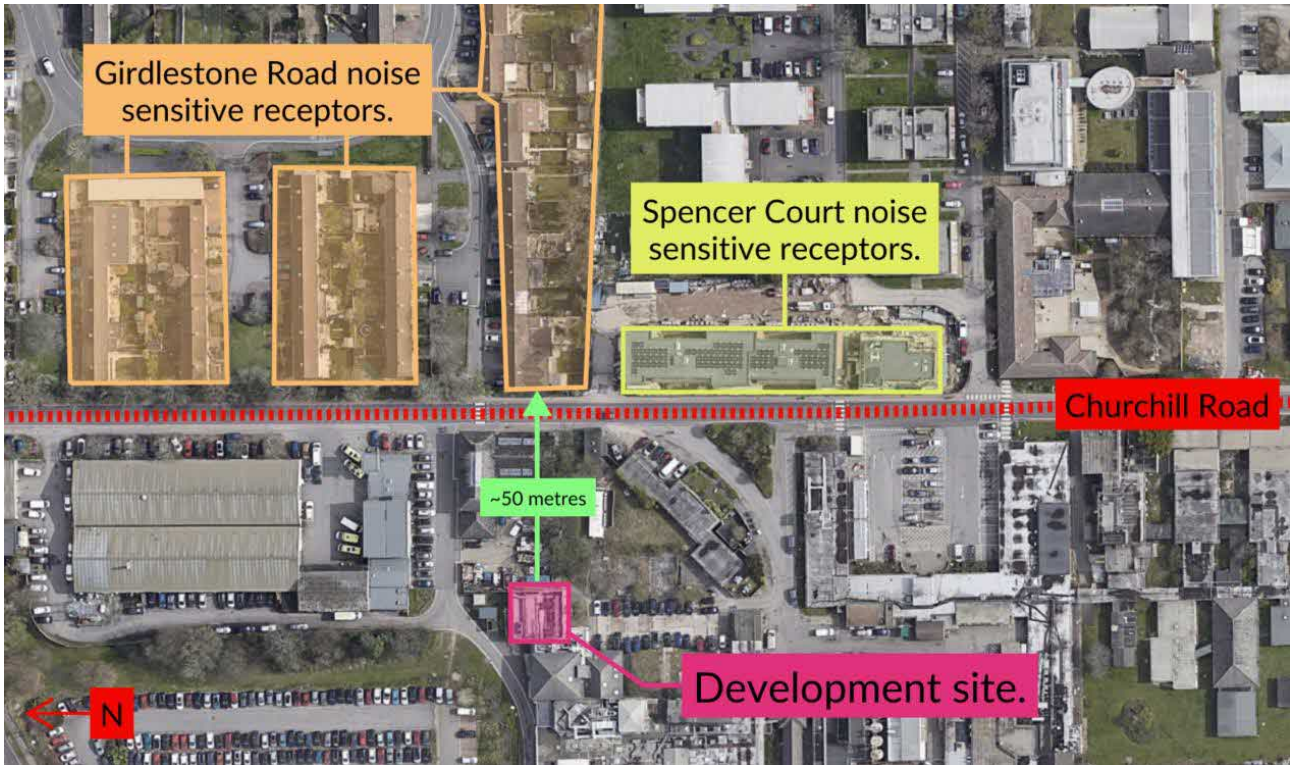

Figure 1: Site context.

Whilst on site, the dominant source of noise was noted to be road traffic on Churchill Road. This is a main access road into the hospital site; however traffic is slow moving due to site restrictions. Additional sources of noise include industrial process noise from nearby workshops, and existing plant noise including fume extract from the development building itself (noted to be retained).

3. National and local planning policy.

3.1 National policy.

3.1.1 Noise Policy Statement for England.

Noise Policy Statement for England (NPSE) (Department for Environment, Food & Rural Affairs, 2010) advises that noise impacts should be assessed on the basis of adverse and significant adverse effect but does not provide any specific guidance on assessment methods or noise limits.

NPSE introduces the concepts summarised in Table 1 that can be applied when considering the significance of noise impacts, which are applied by the World Health Organization.

The document advises that it is not possible to have *'a single objective noise based measure…that is applicable to all sources of noise in all situations*'. NPSE further advises that the sound level at which an adverse effect occurs is likely to be different for different noise sources, for different receptors at different times.

Effect Level	Description
No Observed Effect Level (NOEL)	This is the noise level below which no effect can be detected. In simple terms, below this level of noise, there is no detectable effect on health and quality of life due to the noise being assessed.
Lowest Observed Adverse Effect Level (LOAEL)	This is the level of noise above which adverse effects on health and quality of life can be detected.
Significant Observed Adverse Effect Level (SOAEL)	This is the level of noise above which significant adverse effects on health and quality of life occur.

Table 1: NPSE observed effect levels.

3.1.2 National Planning Policy Framework.

National Planning Policy Framework (NPPF, Dec 2023) sets out the Government's planning policies and how these are expected to be applied. In relation to noise and vibration, NPPF section 15 paragraphs 180, 191 and 193 are presented below:

'*180. Planning policies and decisions should contribute to and enhance the natural and local environment by:* …

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution..'.

'*191. 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[69];
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; and ..'.

'*193. Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed.'*

3.1.3 Planning Practice Guidance.

Online Planning Practice Guidance (PPG) (Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities & Local Government, 2016) has been published online to provide greater details in relation to the relevance of noise to the planning process following the introduction of the NPPF and NPSE.

Under *Noise*, this guidance states, under the heading *'How to Determine the Noise Impact'*, that the following should be considered by local authorities:

- *'whether or not a significant adverse effect is occurring or likely to occur;*
- *whether or not an adverse effect is occurring or likely to occur; and*
- *whether or not a good standard of amenity can be achieved.'*

In line with NPSE, this includes identifying where noise exposure is above or below the significant observed adverse effect level and the lowest observed adverse effect level for a given situation during the operation of the Proposed Development.

Further guidance on each of the various observed effect levels set out in the NPSE is provided in the '*Noise exposure hierarchy table*' which is reproduced below in Table 2. It is important to note that no specific noise parameters or target noise levels are defined in the text. Under the heading *'What factors influence whether noise could be a Concern?'*, the subjective nature of noise is discussed. It is stated that there is no simple relationship between noise levels and the impact on those affected. This depends on how various factors combine in particular situations.

Perception	Example of outcomes	Increasing effect level	Action
Not noticeable	No effect	No Observed Effect	No specific measures required
Noticeable and not Intrusive	Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.		No specific measures required
Lowest Observed Adverse Effect Level			
Noticeable and Intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; closing windows for some of the time because of the noise. Potential for non-awakening sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Noticeable and Disruptive	The noise causes a material change in behaviour and/or attitude, e.g. having to keep windows closed most of the time, avoiding certain activities during periods of intrusion. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect Level	Avoid
Noticeable and very	Extensive and regular changes in behaviour and/or inability to mitigate effect of noise leading to	Unacceptable Adverse Effect	Prevent

Perception	Example of outcomes	Increasing effect level	Action
Disruptive	psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.		

Table 2: PPG Observed Effects.

3.2 Local policy.

The local planning authority for the development site is Oxford City Council. The Oxford Development Plan consists of the Local Plan 2036, site specific Area Action Plans and made Neighbourhood Development Plans. The Oxford Local Plan 2036 (Oxford City Council, 2020) contains detailed policies which planning applications will be judged against. The following policy relates to noise and planning.

> '*Policy RE8: Noise and vibration*
>
> *Planning permission will only be granted for development proposals which manage noise to safeguard or improve amenity, health, and quality of life.*
>
> *Planning permission will not be granted for development that will generate unacceptable noise and vibration impacts.*
>
> *Planning permission will not be granted for development sensitive to noise in location which experience high levels of noise, unless it can be demonstrated, through a noise assessment, that appropriate attenuation measures will be provided to ensure an acceptable level of amenity for end users and to prevent harm to the continued operation of existing uses.*
>
> *Conditions will be used to secure such mitigation measures and operational commitments.*
>
> *Measures to mitigate the impacts of noise and vibration associated with demolition and construction will be secured by legal agreement through Construction Management Plans (Refer to Policy M2).'*

Policy RE8 and the supporting text in the Local Plan do not quantify what is an "unacceptable" noise impact.

3.3 Recognised standard guidance.

British Standard 4142:2014+A1:2019 (BS 4142) (British Standards Institute, 2014) provides guidance for assessing commercial operations and fixed building services plant noise. The British Standard provides an objective method for rating the significance of impact from industrial and commercial operations. It describes a means of determining sound levels from fixed plant installations and determining the background sound levels that prevail on a site.

The assessment of the impacts is based on the subtraction of the pre-existing background sound level ($L_{A90,Tr}$) from the rating level ($L_{Ar,Tr}$).

The standard does not give a definitive method for determining the background sound level but instead, as a commentary, states that:

> "*the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods*".

Clause 8.1.4, which discusses the monitoring duration, states "*there is no "single" background sound level as this is a fluctuating parameter. However, the background sound level used for the assessment should be representative of the period being assessed."* As a note to this clause the following commentary is given on obtaining a representative backgrounds sound level:

> "*To obtain a representative background sound level a series of either sequential or disaggregated measurements ought to be carried out for the period(s) of interest, possibly on more than one occasion. A representative level ought to account for the range of background sound levels and ought not automatically to be assumed to be either the minimum or modal value."*

The rating level is defined objectively as the specific source noise level in question (either measured or predicted) with graduated corrections for tonality (up to +6 dB(A)), impulsivity (up to +9 dB(A)), intermittency (+3 dB(A)) and other sound characteristics (+3 dB(A)) which may be determined either subjectively or objectively, if necessary.

The background sound level is subtracted from the rating level. The following is considered when evaluating the potential impact:

– A difference of around +10 dB is likely to be an indication of a significant adverse impact, depending on context;
– A difference of around +5 dB is likely to be an indication of an adverse impact, depending on context; and
– A difference of +0 dB or less is an indication of the specific sound source having a low impact, depending on the context, and the lower the rating is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact.

The importance of context is highlighted in BS 4142, which states that the following factors should be taken into consideration when the initial estimate of the impact needs to be modified due to the context:

"1) The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.

Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.

Where residual sound levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts, and the margin by which the rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse.

2) The character and level of the residual sound compared to the character and level of the specific sound. Consider whether it would be beneficial to compare the frequency spectrum and temporal variation of the specific sound with that of the ambient or residual sound, to assess the degree to which the specific sound source is likely to be distinguishable and will represent an incongruous sound by comparison to the acoustic environment that would occur in the absence of the specific sound. Any sound parameters, sampling periods and averaging time periods used to undertake character comparisons should reflect the way in which sound of an industrial and/or commercial nature is likely to be perceived and how people react to it.

NOTE 3 Consideration should be given to evidence on human response to sound and, in particular, industrial and/or commercial sound where it is available. A number of studies are listed in the "Effects on humans of industrial and commercial sound" portion of the "Further reading" list in the Bibliography.

3) The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as:

i) facade insulation treatment;

ii) ventilation and/or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation; and

iii) acoustic screening."

4. Basis for assessment.

Policy RE8 and its supporting text in the Oxford City Council (OCC) Local Plan does not quantify what is considered an "unacceptable" noise impact. OCC have been contacted to agree the noise assessment methodology and approach for setting operational noise emission limits. Edward Davis, Environmental Health Officer at the Council, has confirmed via email that the standard plant noise criteria is as follows:

> *'The external noise levels emitted from plant/ machinery/ equipment shall ensure that the rating level of the noise emitted from the proposed installation located at the site shall not exceed the existing background level at any noise sensitive premises when measured and corrected in accordance with BS4142:2014 +A1:2019 "Methods for rating and assessing industrial and commercial sound."'*

Based on this, the following noise limit is applied as a rating level that does not exceed the existing background level.

Rating level ≤ Background sound level

$L_{Ar,Tr} \leq L_{A90,Tr}$

The benchmarking acoustic survey has been undertaken at a location representative of the closest identified noise sensitive receptors. The closest identified noise sensitive receptors will be used as the assessment location. The locations of the closest noise sensitive receptors are residential dwellings on Churchill Drive and Girdlestone Road, as shown in Figure 1.

5. Assessment methodology.

Figure 2 outlines the assessment strategy for controlling fixed plant noise emissions. The assessment begins with a noise survey, the results of which are used to determine noise limits at the nearby noise sensitive receptors (see Section 6).

With noise limits set at receiver locations, noise limits at source can be determined through understanding of the environmental conditions around the site. This is typically taken into consideration through a noise propagation model.

Noise limits at source can be compared to manufacturers data to determine attenuation requirements. Where plant items are in exceedance of the source noise limits, some mitigation will be required.

As shown in Figure 2, attenuation requirements can be achieved through:

- Operational mitigation – typically a reduction in plant load through BMS specification.
- Mechanical mitigation – the installation of attenuation packaging locally around plant items.
- Architectural mitigation – the installation of barrier screening or enclosures.

If sufficient mitigation cannot be achieved through these methods, reselection will typically be required via the manufacturer to identify quieter plant equipment. Reselections will require reassessment.

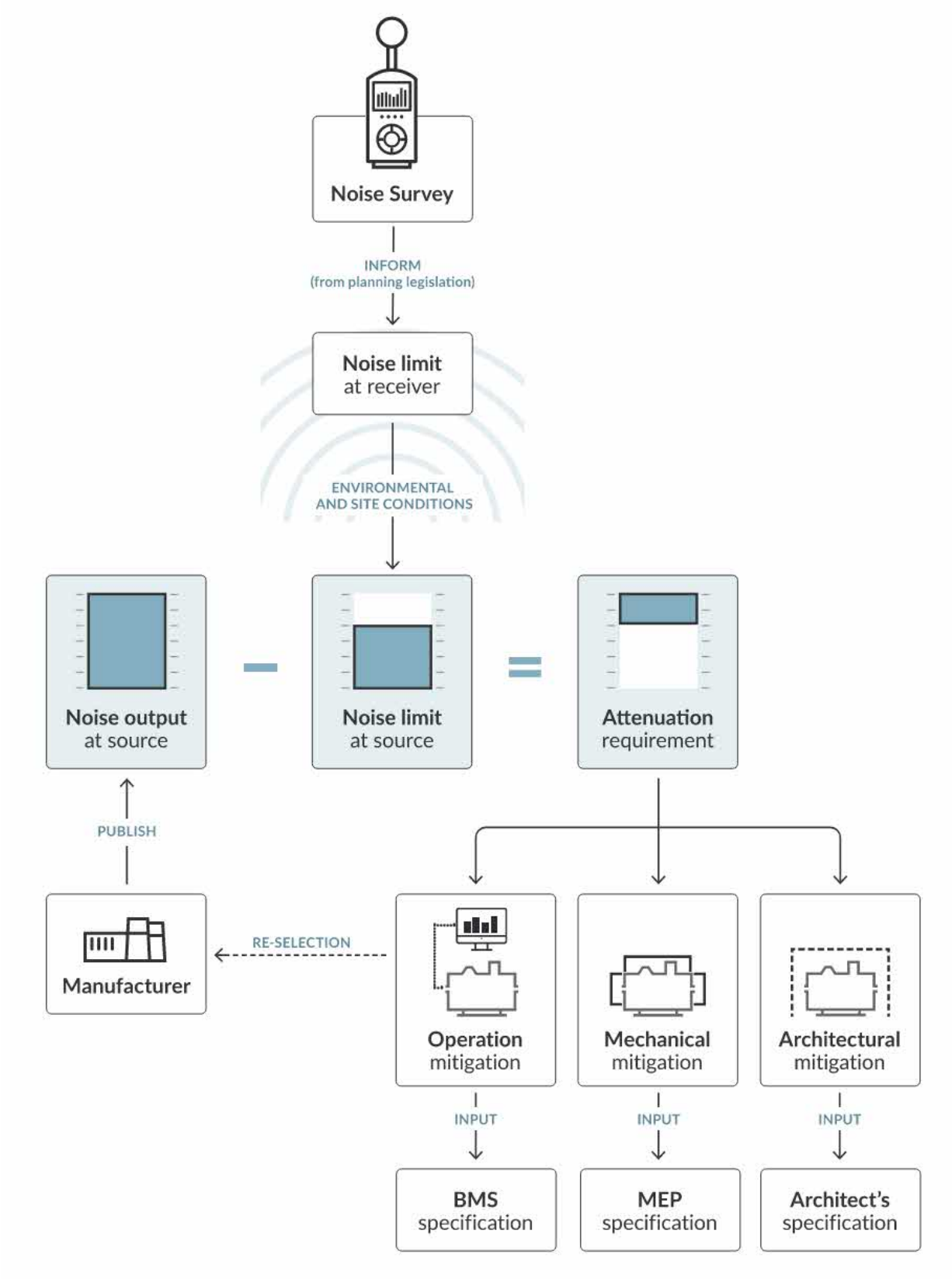

Figure 2: Fixed plant noise emissions assessment strategy.

6. Environmental acoustic survey.

This section summarises the environmental noise survey undertaken by Hoare Lea in February 2024. The purpose of the survey was to quantify the existing noise climate at a location deemed representative of the nearest noise sensitive receptor. Survey results are used in the determination of noise limits at receptors

6.1 Methodology.

The acoustic survey was undertaken to quantify the prevailing noise climate at the closest noise sensitive receptors (residential dwellings on Churchill Drive and Girdlestone Road). This was achieved through unattended noise monitoring at a single position on Churchill Drive over a 5-day period. Supplementary attended measurements were taken at other positions along Churchill Drive concurrently to the noise monitoring to understand variations in the sound climate between receptors.

The figure below shows the measurement positions in context of the development site and nearby noise sensitive receptors. Position L1 was the unattended noise monitoring (left for 5 days). Positions P1, P2, and P3 were the attended positions (3 no. 10-minute measurements at each position).

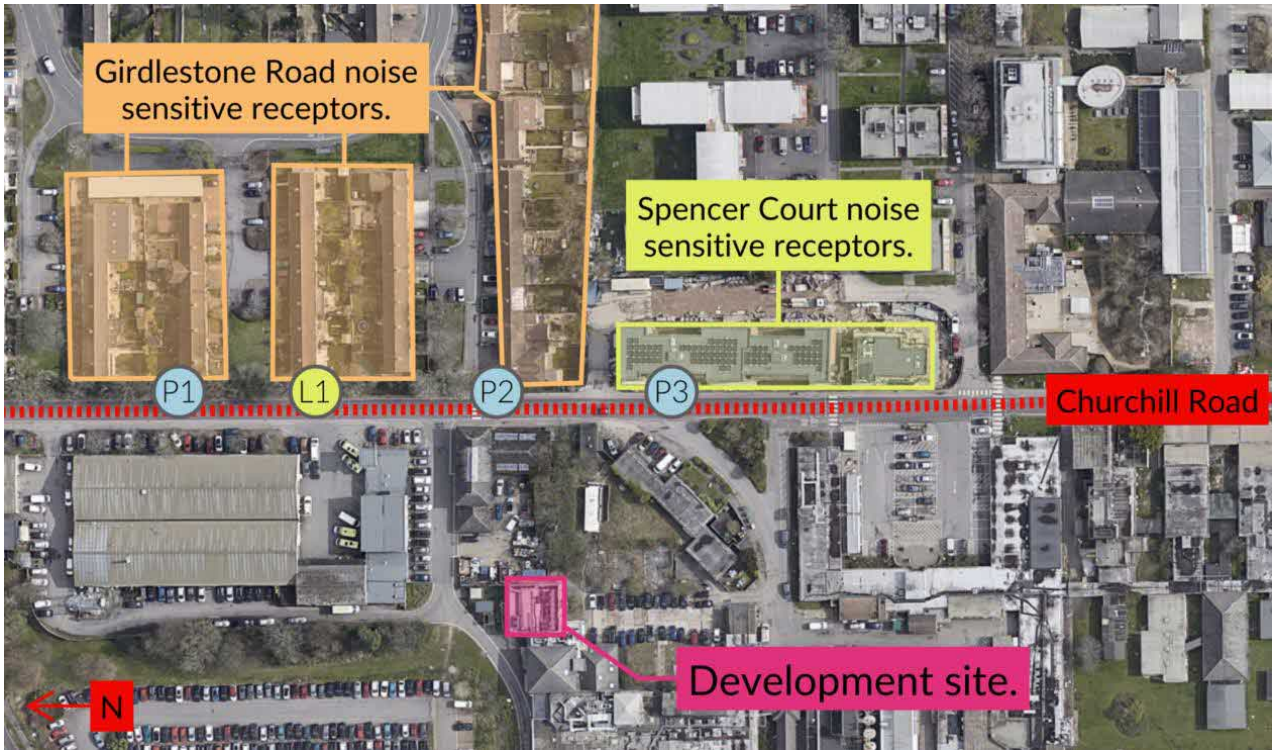

Figure 3: Measurement positions in relation to development site and nearby noise sensitive receptors.

The noise monitors were positioned approximately 1.5 metres above the local ground levels and under free-field conditions. Unattended survey measurements consisted of fifteen-minute duration samples of ambient sound levels ($L_{Aeq,15\ min}$) and background sound levels ($L_{A90,15\ min}$), taken between Wednesday 7th February 2024 and Monday 12th February 2024. Attended survey measurements consist of ten-minute duration samples of ambient sound levels ($L_{Aeq,10\ min}$) and background sound levels ($L_{A90,10\ min}$), taken on Wednesday 7th February concurrently with the noise monitoring between 12:00 and 14:15.

The equipment was field calibrated immediately before and after the measurement period; no significant drift in level was found to have occurred. The measurement instrumentation used in listed in Appendix A.

Weather conditions were monitored remotely and did not affect the measured sound levels. Increased wind speeds on Thursday night did not increase background sound levels when compared to other days.

6.2 Results.

6.2.1 Variation across measurement positions.

The table and chart below present a comparison of the results from the attended measurements positions that were taken concurrently to the unattended noise monitoring. Ambient and background sound levels are shown as these are the key parameters that will be used in setting noise limits.

Measurement period.	L1		P1		P2		P3	
	$L_{Aeq,15\ min}$ dB	$L_{A90,15\ min}$ dB	$L_{Aeq,10\ min}$ dB	$L_{A90,10\ min}$ dB	$L_{Aeq,10\ min}$ dB	$L_{A90,10\ min}$ dB	$L_{Aeq,10\ min}$ dB	$L_{A90,10\ min}$ dB
12:00 – 12:15	61	48	62	51	-	-	-	-
12:15 – 12:30	61	48	-	-	62	46	-	-
12:30 – 12:45	63	48	-	-	-	-	62	47
12:45 – 13:00	61	48	62	44	-	-	-	-
13:00 – 13:15	62	46	-	-	62	47	-	-
13:15 – 13:30	63	47	-	-	-	-	61	47
13:30 – 13:45	65	47	64	47	-	-	-	-
13:45 – 14:00	62	47	-	-	62	49	-	-
14:00 – 14:15	63	47	-	-	-	-	63	50

Table 3: Variation across measurement positions between 12:00 - 14:15 (tabulated data).

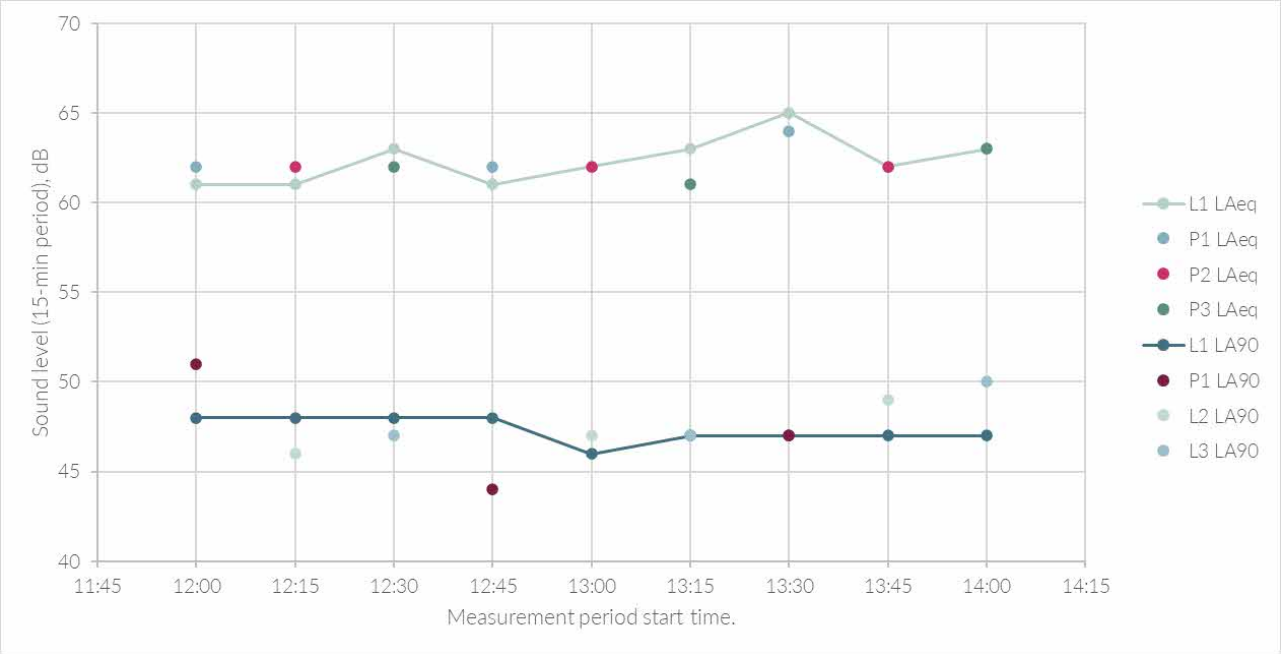

Figure 4: Variation across measurement positions between 12:00 - 14:15 (plotted data).

The data shows clear similarities across all measurement positions. The average ambient sound pressure level was 62 dB $L_{Aeq,15\ min}$. The average background sound pressure level was 47 dB $L_{A90,15\ min}$. The greatest outliers were background sound levels at position P1. This was due to idling vehicles near to the sound meters.

Based on this result, the logged data from position L1 will be used as the basis for assessment for all nearby noise sensitive receptors. These results are outlined in the following section.

6.2.2 Time history at unattended logging position.

A time history of the measured sound levels at the unattended survey location is provided in Figure 5 below.

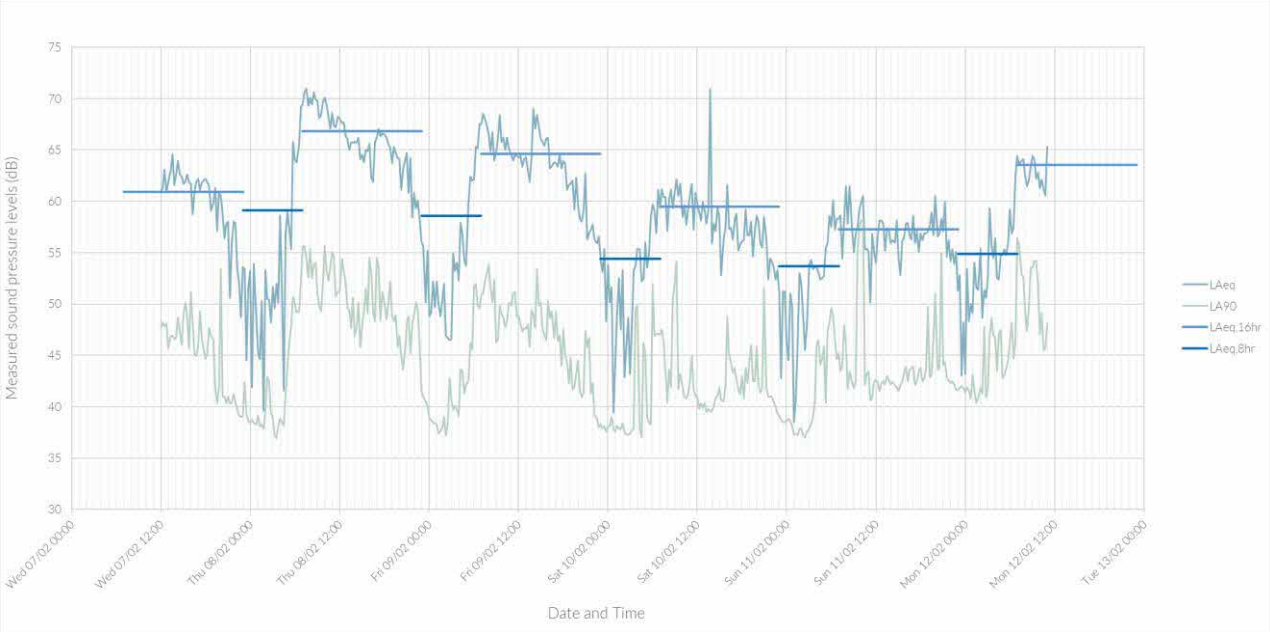

Figure 5: Time history chart of the ambient and background sound levels measured at the unattended measurement position.

6.2.3 Ambient sound levels.

The measured ambient sound levels at the survey position are summarised below. Daytime is taken as the 16-hours between 07:00 and 23:00 and night-time is taken as the 8-hours between 23:00 and 07:00. Note that the first and last survey dates do not represent full 16-hour periods due to equipment collection times.

Date	Daytime ambient sound level.	Night-time ambient sound level.
Wednesday 7th February 2024	61 dB $L_{Aeq,11\,h}$	59 dB $L_{Aeq,8\,h}$
Thursday 8th February 2024	67 dB $L_{Aeq,16\,h}$	59 dB $L_{Aeq,8\,h}$
Friday 9th February 2024	65 dB $L_{Aeq,16\,h}$	54 dB $L_{Aeq,8\,h}$
Saturday 10th February 2024	59 dB $L_{Aeq,16\,h}$	54 dB $L_{Aeq,8\,h}$
Sunday 11th February 2024	57 dB $L_{Aeq,16\,h}$	55 dB $L_{Aeq,8\,h}$
Monday 12th February 2024	64 dB $L_{Aeq,4\,h}$	-

Table 4: Measured residual sound levels at the unattended survey location.

Ambient noise levels were typically 62 dB $L_{Aeq,16\,h}$ (excluding the first and last measurement day as they were not full 16-hour periods), and 56 dB $L_{Aeq,8\,h}$ at night.

6.2.4 Background sound levels.

In-line with the guidance given in BS 4142, in order to *"quantify what is typical during particular time periods"*, a statistical analysis of the measured background sound levels has been undertaken.

The periods of interest for this development are daytime and night-time. Daytime is taken as the 16-hours between 07:00 and 23:00 and night-time is taken as the 8-hours between 23:00 and 07:00.

The 15-minute duration background sound levels measured during the day will never be higher than the 1-hour background sound level, so the 15-minute values represent a worst-case. Therefore, the measured 15-minute values will be used in place of the daytime 1-hour reference time interval required by BS 4142.

The following chart provides an analysis of the daytime and night-time period of interest background sound levels. A time history of the measured sound levels is presented in Figure 5.

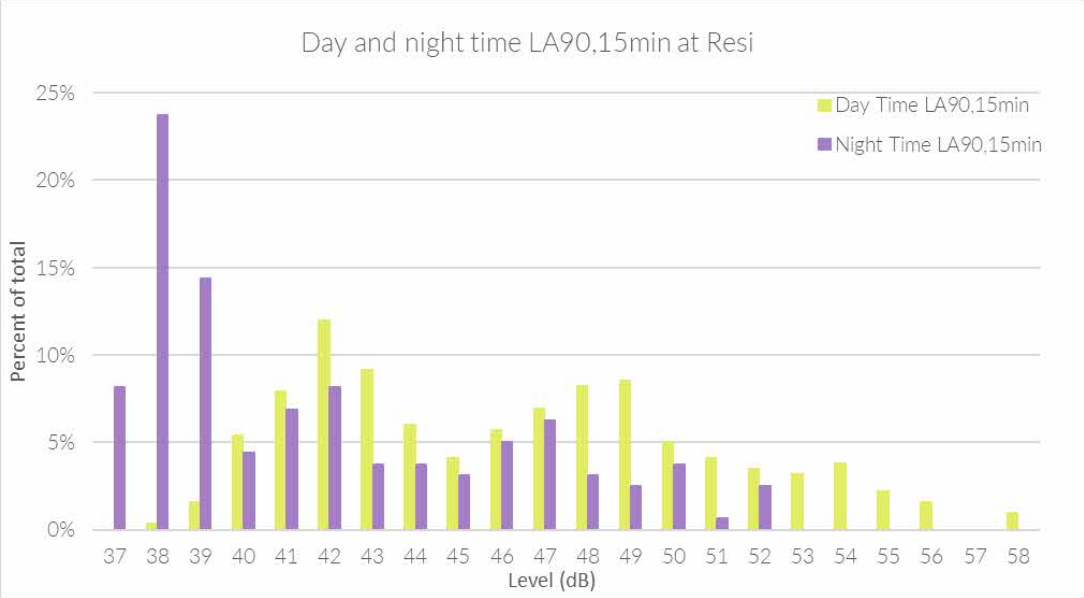

Figure 6: Statistical analysis of the background sound levels measured at the survey measurement position.

Based on the chart above and the time history chart, the following typical background sound levels are chosen.

Daytime (07:00 – 23:00) 42 dB $L_{A90,1\,h}$

Night-time (23:00 – 07:00) 41 dB $L_{A90,15\,min}$

The night-time background sound level is chosen based on this level being typical of start and end of the night-time periods. It is these periods that are most sensitive, given these are typical times when people are starting to sleep / wake up.

6.2.5 Comparison with previous survey.

The results have been compared to another survey undertaken by Hoare Lea on the Churchill Hospital site in October 2022. The measurement position for this survey was outside Spencer Court, one of the nearest noise sensitive receptors to the development site. A summary of this survey is presented below.

Periods of interest.	Ambient sound pressure level.	Background sound pressure level,
Daytime (07:00 – 23:00)	57 dB $L_{Aeq,16\,h}$	45 dB $L_{A90,1\,h}$
Night-time (23:00 – 07:00)	51 dB $L_{Aeq,8\,h}$	43 dB $L_{A90,15\,min}$

Table 5: Ambient and background sound pressure levels measured in October 2022.

The results are approximately equivalent to those measured in the February 2024 survey, and therefore provide evidence for the chosen typical daytime and night-time background sound levels being appropriate.

6.2.6 Summary.

Typical 15-minute ambient and background sound levels for daytime and night-time periods are shown below.

Periods of interest.	Ambient sound pressure level.	Background sound pressure level,
Daytime (07:00 – 23:00)	62 dB $L_{Aeq,16\,h}$	42 dB $L_{A90,1\,h}$
Night-time (23:00 – 07:00)	56 dB $L_{Aeq,8\,h}$	41 dB $L_{A90,15\,min}$

Table 6: Typical ambient and background sound pressure levels for daytime and night-time periods (measured February 2024).

7. Proposed noise emission limits.

The proposed noise emission limit is for the rating level ($L_{Ar,Tr}$) of the combined fixed plant items to not exceed the background sound level ($L_{A90,Tr}$) at the closest residential receptors. This would provide an indication of the specified sound source having a low impact when assessed following the BS 4142 methodology. Based on this, the following noise emission limits are proposed, to be achieved at the closes noise sensitive receptors.

Period of interest.	Background sound level.	Proposed noise emission limit.
Daytime (07:00 – 23:00)	42 dB $L_{A90,1\ h}$	42 dB $L_{Ar,1\ h}$
Night-time (23:00 – 0&:00)	41 dB $L_{A90,15\ min}$	41 dB $L_{Ar,15\ min}$

Table 7: Proposed noise emission limits.

The above noise limits are given as rating levels. Corrections appropriate to the character of the sound should be applied when calculating this form the specific sound level, as defined in BS 4142.

8. Noise impact assessment.

8.1 Proposed MEP design.

Installation location.

The new chiller is proposed to be installed within the existing roof plant area in the free space adjacent to the existing chiller unit (which is to be retained). This area is shown in the site photo below. Other plant items on the roof include a fume extract system with associated ductwork.

The plant area is surrounded by an existing louvred screen that is approximately 1.5 metres tall. This screen is not expected to provide any acoustic attenuation given its construction and height. A sound insulating screen would require more mass (thicker and / or heavier) and should be taller than the noisy plant items.

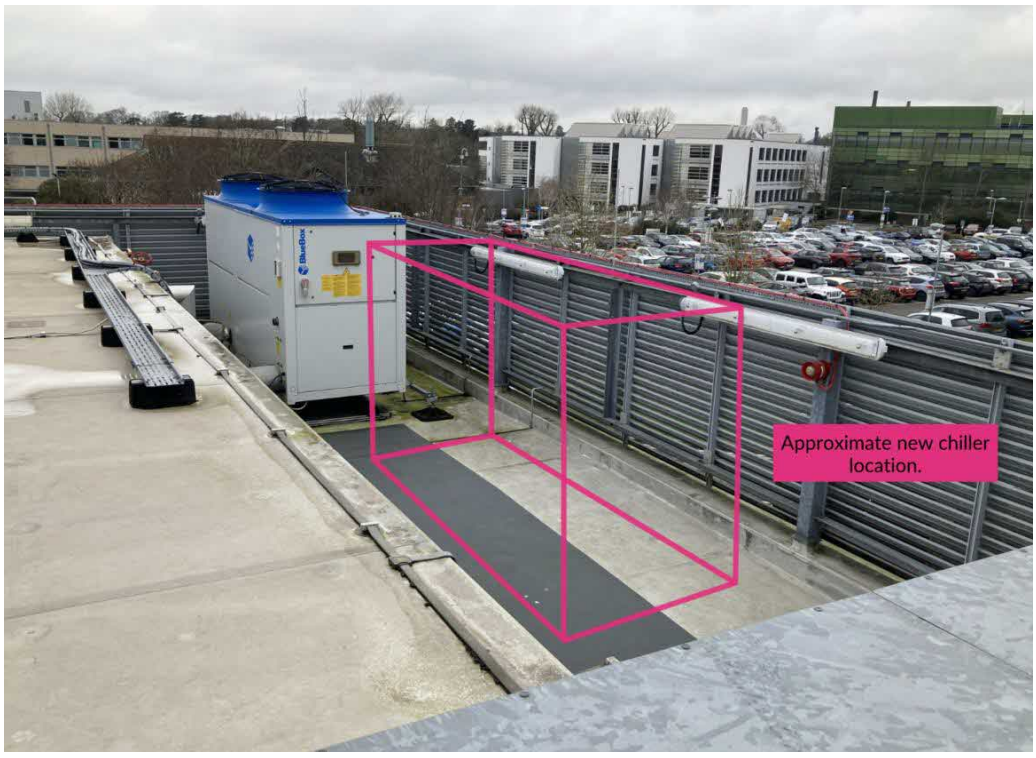

Figure 7: Approximate new chiller location in free space on existing roof plant area adjacent to existing chiller.

Noise data of current selection.

The current selection is a Hiross ICE 116 chiller unit. Octave band sound power level data for this unit has been shared by the mechanical engineer / manufacturer and is presented below for use in the assessment.

Octave band centre frequency, Hz	63	125	250	500	1000	2000	4000	8000	Broadband sound power level, L_{wA} dB
Sound power level, L_w dB	82	86	89	91	89	84	77	69	93

Table 8: Source sound power levels provided by the mechanical engineer / manufacturer.

Acoustic character corrections.

The proposed noise emission limits are given as rating levels. Therefore, additional corrections must be applied for any tonality, intermittency, or impulsivity features of the new chiller in accordance with BS 4142. In total, a +2 dB feature correction will be applied in this assessment to account for tonality.

Acoustic character feature.	Correction.	Reasoning.
Tonality.	+2 dB	To account for a just perceptible tone.
Intermittency.	-	Intermittency is not expected.
Impulsivity.	-	Impulsivity is not typical of chiller units.
Total	+2 dB	Tonality features are expected.

Table 9: Acoustic character feature corrections to be applied in the assessment.

8.2 Preliminary noise impact assessment – before acoustic mitigation.

This section outlines the preliminary noise impact assessment before acoustic mitigation has been applied. The total rated noise level at the nearest noise sensitive receptor has been predicted based on the source sound power levels, predicted acoustic character feature corrections, and losses due to distance and barrier screening.

Source sound power level.	93 dB L_{wA}	Hiross ICE Axial 3 fans (provided by Mech engineer).
Losses due to distance.	-45 dB(A)	60 metres distance between source and receiver.
Total specific sound level.	47 dB $L_{Aeq,1\ h}$	Result at nearest noise sensitive receiver.
Acoustic feature correction.	+2 dB	As determined in Table 9
Total rated noise level.	49 dB $L_{Ar,1\ h}$	Specific sound level plus acoustic feature corrections.
Daytime limit.	42 dB $L_{Ar,1\ h}$	See Section 7.
Excess over daytime limit.	+7 dB(A)	Rated noise level is 7 dB(A) below the daytime limit.
Night-time limit.	41 dB $L_{Ar,15\ min}$	See Section 7.
Excess over night-time limit.	+8 dB(A)	Rated noise level is 8 dB(A) above the night-time limit.
BS 4142 assessment.	Rated level greater than background level – significant impact.	
Local Authority assessment.	Noise emissions exceed the required limit.	

Table 10: Preliminary noise impact assessment before acoustic mitigation.

The results indicate that the current chiller selection will be 7 dB(A) above the daytime limit and 8 dB(A) above the night-time limit at the nearest noise sensitive receptors. Acoustic mitigation is therefore required to reduce noise emissions to ensure that resultant levels are below the required limits for planning. Without acoustic mitigation, the chiller is predicted to have a significant impact on the local acoustic environment.

8.3 Mitigation advice.

Acoustic mitigation is required to reduce noise emissions to within the required limits. This section outlines the recommended mitigation strategies that if applied successfully are predicted to result in suitable rated noise levels at the nearby noise sensitive receptors.

8.3.1 Maximum sound power levels.

The maximum sound power levels for the chiller have been calculated for daytime and night-time periods. At these sound power levels, noise emissions from the roof plant area are predicted to be suitable at the Spencer Court receptors (worst-case given the uppermost flat will have line of sight of the plant area).

Daytime (07:00 – 23:00)	L_{wA} 86 dB(A)
Night-time (23:00 – 07:00)	L_{wA} 85 dB(A)

These sound power levels should be achieved either through unit reselection, or through installation of mechanical mitigation (acoustic packaging) on the current selection.

8.3.2 Solution 1 – Unit reselection.

The best solution for cost and carbon saving would be to reselect a quieter unit in place of the existing chiller, using the limiting values above as a design parameter.

It is advised that the new unit be selected to the daytime limit, and then have a 1 dB setback applied during night-time hours. If no night-time setback can be applied on the unit, then it is advised that the unit be selected to meet the night-time sound power level limit.

8.3.3 Solution 2 – Acoustic packaging.

If the unit cannot be reselected, some mechanical mitigation is advised to be installed around the unit to reduce noise emissions. This could be acoustic packaging. The mitigation measure would need to reduce noise emissions by 8 dB(A) to meet the night-time sound power level limit of L_{wA} 85 dB(A).

9. Conclusion.

Noise levels from the new chiller proposed for the Curium Cyclotron at Churchill Hospital (Oxford) are predicted to have a low impact on nearby noise sensitive receptors provided that the advice outlined in this report is adhered to. Three noise mitigation strategies have been proposed. Those are reselecting equipment, relocating equipment, and installing mechanical mitigation.

Maximum sound power levels for the chiller have been calculated for daytime and night-time periods. It is recommended that the chiller is reselected to a quieter unit that can operate within these sound power levels.

If neither reselection nor relocation are possible, mechanical mitigation is advised. This could be acoustic packaging around all sides. The mitigation will need to provide a minimum of 8 dB(A) insertion loss.

With any of these strategies implemented, noise emissions at nearby noise sensitive receptors are predicted to be suitable. This report is suitable for submission to the Local Authority as part of the planning application.

Appendix A – Survey equipment.

The tables below outline the equipment used in the acoustic survey.

Equipment.	Manufacturer.	Model (S/N).	Calibration cert. no.	Calibration date.
Sound level meter.	Rion	NL-52 (01010834)	UCRT22/1524	13/04/2022
Microphone.	Rion	UC-59 (20471)	UCRT22/1524	13/04/2022
Pre-amplifier.	Rion	NH-25 (11482)	UCRT22/1524	13/04/2022
Calibrator.	Rion	NC-75 (34324028)	UCRT23/1695	23/05/2023

Table 11: Survey equipment used in the unattended measurements.

Equipment.	Manufacturer.	Model (S/N).	Calibration cert. no.	Calibration date.
Sound level meter.	Brüel & Kjær	2250 (3004428)	UCRT22/1583	28/04/2022
Microphone.	Brüel & Kjær	4189 (2650833)	UCRT22/1583	28/04/2022
Pre-amplifier.	Brüel & Kjær	ZC 0032 (19784)	UCRT22/1583	28/04/2022
Calibrator.	Brüel & Kjær	4231 (3000377)	UCRT23/2508	23/11/2023

Table 12: Survey equipment used in the attended measurements.

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