



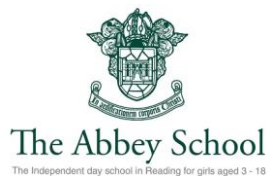
ACOUSTIC
CONSULTANTS LTD

Noise Impact Assessment

**Proposed External Plant
The Abbey School, Reading**

Reference: 9725/SF

Client:



Document Control

Version:	Revision Description:	Date:	Author:	Reviewed by:	Approved by:
1.0	First Issue	08/08/2023	Sam Frankcom	Laurence Nickolls	Jonas Lopez

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, acoustic, and vibration aspects as included in this report. We provide advice only in relation to noise, vibration 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.

Table of Contents

1.	Introduction	4
2.	Site & Proposals	5
3.	Planning Condition	6
4.	British Standard 4142:2014+A1:2019	7
5.	Baseline Noise Monitoring	8
6.	External Plant Noise	10
7.	Noise Modelling	13
8.	Noise Impact Assessment	15
9.	Summary and Conclusions	17
10.	Appendix 1 – Glossary of Acoustic Terminology	18

1. Introduction

The Abbey School appointed Acoustic Consultants Limited to undertake a noise impact assessment for the proposed external plant at The Abbey School, Reading.

This report addresses Planning Condition 12 (Application Reference 20061) through a noise impact assessment undertaken in accordance with British Standard 4142:2014+A1:2019 (BS4142).

The author of this report is a Technician Member of the Institute of Acoustics (TechIOA) with two years' experience in the field. This report has been reviewed by an Associate Member of the Institute of Acoustics (AMIOA) with 3 years' experience in the field and has been approved by full Member of the Institute of Acoustics (MIOA) with over 6 years' experience in the field.

2. Site & Proposals

The proposed school extension Phase 01 is to be carried out at the existing school grounds of The Abbey Senior School in Reading.

The proposal is to modify and extend the eastern area of the school building to provide new teaching spaces, offices, ancillary spaces, dining hall and kitchen. The proposals include the relocation of existing plant at the site as well as introducing new external plant.

The nearest noise sensitive residential properties to the proposed external plant are to the north of the site, on Crown Place.

The main source of noise affecting the site is road traffic on the local road network, with influence from occasional aircraft and rail noise.

Figure 1: Plant Location and NSR locations



3. Planning Condition

As follows is quoted Planning Condition 12 (Application Reference 20061):

"12. No mechanical plant shall be installed until a noise assessment of the proposed mechanical plant has been submitted and approved by the Local Planning Authority. The assessment shall be carried out for in accordance with BS4142:2014 methodology. The predicted specific sound level ($LA_{eq,TR}$) (with reference to BS:4142) as measured at a point 1 metre external to the nearest noise-sensitive facade shall be at least 10dB below the pre-existing background sound level, $LA_{90,T}$ when all plant/equipment (or any part of it) is in operation. The predicted rating level, $L_{Ar,Tr}$ (specific sound level plus any adjustment for the characteristic features of the sound) as measured at a point 1 metre external to the nearest noise-sensitive façade (habitable window of a dwelling) shall not exceed the pre-existing background sound level, $LA_{90,T}$ when all plant/equipment (or any part of it) is in operation. The plant shall thereafter only be installed in accordance with the assessment and shall thereafter be maintained so that it operates to the same standard.

Reason: To safeguard the amenities of the adjoining premises and the area generally, in accordance with Policy CC8 and EN17 of the Reading Borough Local Plan 2019."

4. British Standard 4142:2014+A1:2019

British Standard 4142:2014 entitled 'Method for rating and assessing industrial and commercial sound' use outdoor sound levels to assess the likely effects of sound upon people who might be inside or outside a dwelling or other premises used for residential purposes. The 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). Section 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 Section 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."*

5. Baseline Noise Monitoring

A noise monitoring exercise was undertaken at the site on the 20th of November 2019 at the school grounds and has been considered representative of the ambient noise levels at the surrounding sensitive receivers.

5.1. Monitoring Equipment

Sound Pressure Levels were measured using Class 1 sound level meters with a 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 "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 and the certificates are available for inspection.

Table 1: Equipment and calibration status

Equipment Description / Manufacturer / Type	Serial Number	Date of Calibration	Calibration Certification Number
SLM, NTI, XL2	A2A-13617-E0	13/09/2018	FL-18-082
Pre-Amp, NTI, MA220	7727	13/09/2018	FL-18-082
Microphone, NTI, MC230A	A16151	13/09/2018	FL-18-082
Calibrator, Larson Davis, CAL200	12605	27/08/2019	32690

The measurement equipment was checked before and after use with the noted calibrators and no significant drift was detected.

5.2. Weather Conditions

The weather conditions at the monitoring location over the survey period are provided in the table below.

Table 2: Weather conditions during survey period

Date	Wind Speed (m/s)	Wind Direction	Temperature (°C)	Precipitation Time (hrs)	Cloud Cover (%)
20 th November 2019	≤5	SW	8	0	-

The weather conditions are not expected to have had an adverse effect on the collected data.

5.3. Monitoring Procedure & Measured Data

An attended site noise survey was undertaken on the 20th of November 2019 approximately between 10:20 and 11:30 hours at selected monitoring location; see figure below. The measurement location is considered representative of the existing ambient noise levels at the nearest noise sensitive receivers around the school site.

The nearest NSR is understood to be the University of Reading's halls of residence to the north of the site.

It was determined that the main source of noise affecting the monitoring location was distant road traffic with influence from occasional aircraft traffic.

Figure 2: Monitoring and NSR locations



From the measurement data the following typical equivalent noise levels have been determined at the survey locations for the proposed hours of school use.

Table 3: Design Measured Noise Levels

Time	L _{Aeq, T} dB	L _{A90, T} dB
10:20 to 11:35	50	48

6. External Plant Noise

There is potential for noise from building services plant to affect nearby noise sensitive receivers.

6.1. Proposed External Plant

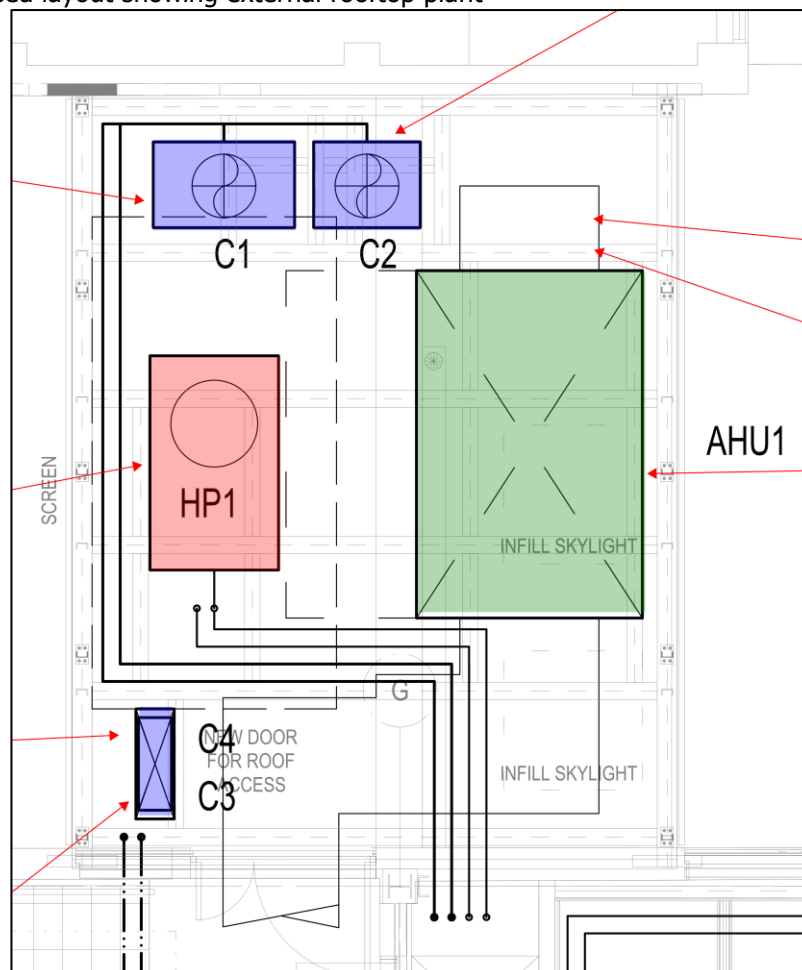
Proposed external plant includes rooftop units and louvred inlet/outlets associated with classroom MVHRs at the southern façade.

The roof's plant area is understood to include 1No. AHU, 2No existing VRF Units (C1 & C2), and 1No. new proposed ASHP unit (HP1). There are also 2No. condenser units which will be relocated (C3 & C4).

There is also a total of 5 MVHR units each with both supply/ extract louvre positions located at the southern elevation on the first-floor level. These units will be screened from the nearby dwellings and therefore are not considered relevant in terms of addressing the Planning Condition.

The rooftop plant locations is shown in figure below.

Figure 3: Proposed layout showing external rooftop plant



Provided plant data for the rooftop plant is from the issued drawing '4548 SK60 Plant Deck Equipment Details 7 Jul 23' and is as follows.

6.1.1. Air Handling Unit (AHU)

The provided data of the AHU was unclear; we have assumed the provided extract & supply sound power levels are representative of the atmospheric terminals of the proposed unit. The supplier should confirm this is the case.

Table 4: Proposed AHU's atmospheric terminals maximum Operational Sound Power Noise levels

Unit	Source	Proposed Maximum Sound Power Level, L _z dB							
		63	125	250	500	1k	2k	4k	8k
AHU1	Supply Terminal	71	80	75	76	73	70	67	62
	Extract Terminal	71	81	75	76	73	70	67	62

The Insertion Loss (IL) of the proposed attenuators is also provided below.

Table 5: Atmosphere-AHU's side attenuators insertion losses (IL)

Unit	Attenuator	Proposed Insertion Loss, dB							
		63	125	250	500	1000	2000	4000	8000
A0/1	AHU1 Extract	12	20	30	40	49	46	40	29
A0/2	AHU1 Supply	11	16	25	33	42	40	35	24

Below is the provided data for the casing breakout. This is the sound pressure level at 3 metres. We have assumed pressure levels are with a sphere partition of 100%, this is worst case. The supplier should confirm this is the case.

Table 6: Proposed AHU casing breakout sound pressure level at 3m

Unit	Source	Proposed Sound Pressure Level at 3m, L _z dB							
		63	125	250	500	1k	2k	4k	8k
AHU1	Casing	43	49	42	26	19	16	14	9

6.1.2. Proposed ASHP

The proposed ASHP unit's (HP1) manufactures sound power level is provided below.

Table 7: Proposed ASHP sound power level

Unit	Source	Sound Power Level
ASHP	H01	84 dBA

6.1.3. Relocated VRFs

The existing VRFs are understood to be Mitsubishi PURY units. The manufactures sound power levels for the relocated VRF units (C1 & C2) are as follows.

Table 8: Existing VRFs' manufacturer's sound power levels

Unit/s	Source	Sound Power Level dBA
VRFs	C1	86
	C2	84

6.2. Relocated Condenser Units

The existing external condenser units are understood to be Mitsubishi MUZ units. The manufacturers sound power level for the relocated condenser units are as follows.

Table 9: Existing condenser units' manufacturer's sound power levels

Unit/s	Source	Sound Power Level dBA
Condensers	C3	64
	C4	61

6.2.1. Proposed MVHR Units

As stated above, these units will be screened from the nearby dwellings and therefore are not considered relevant in terms of addressing the Planning Condition.

7. Noise Modelling

7.1. Noise Modelling Parameters

Plant noise emission has been modelled in Cadna:A by DataKustik based on the data provided in Section 6 above. Calculations are undertaken using the General Method of Calculation from ISO 9613. The model is available on request.

- Plant locations are based on provided drawings.
- All buildings and ground are considered hard and reflective.
- Heights of existing buildings are based on google maps imagery.
- The noise map is predicted for a 1m by 1m grid at a height of 4.5 meters above the ground.
- The ground surrounding the site has been modelled as hard and reflective.

7.1.1. Noise Control Barrier

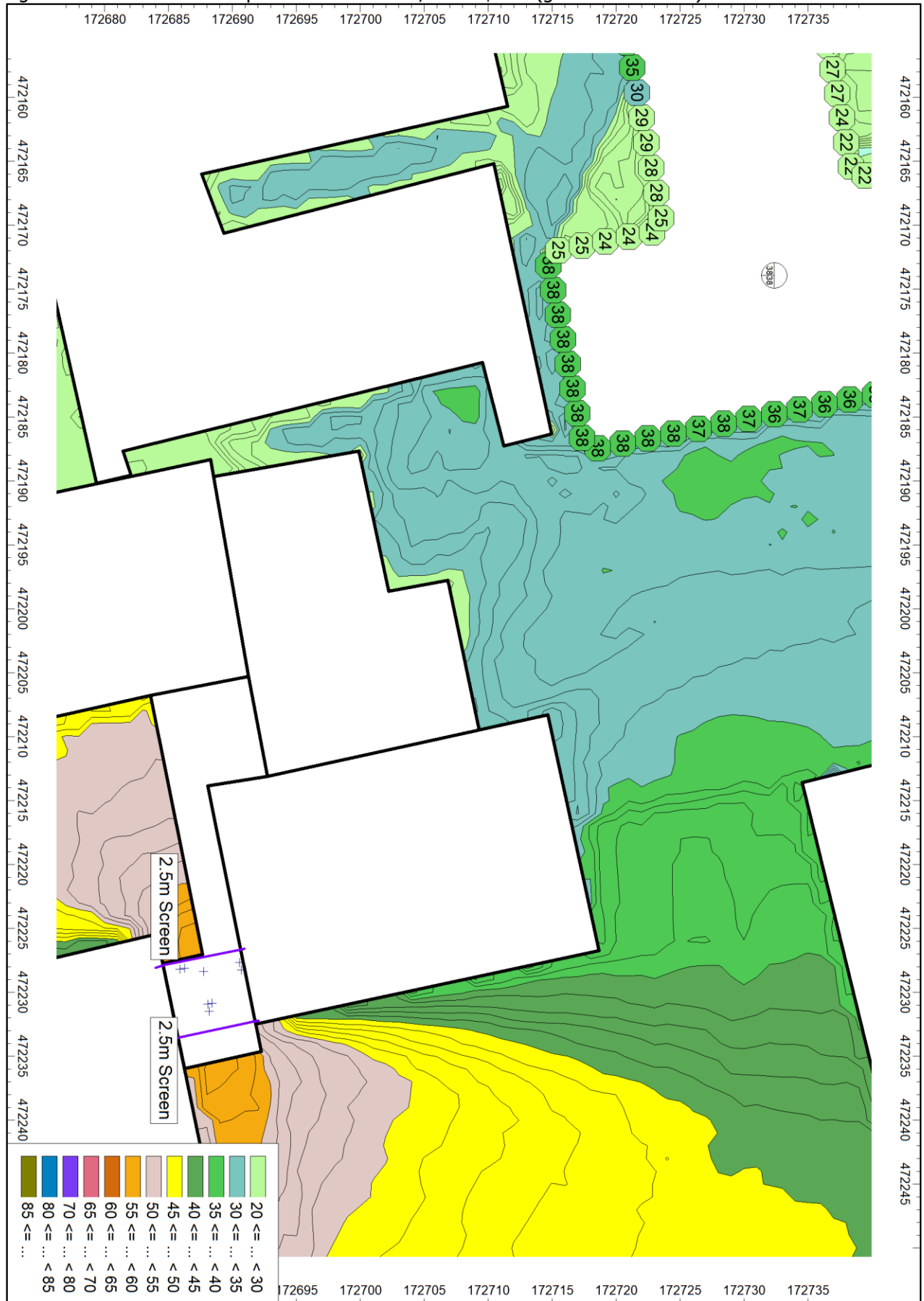
Two noise control barriers have been introduced within the proposed allocated 'New Architectural Screen' positions. These noise control barriers have been introduced assuming a total height of 2.5 metres above the roof level. The barrier cannot have any gaps and should have a minimum mass per unit area of 15kg/m^2 , excluding structural supports. The inner side of the screens (plant area) should be acoustically treated with an absorbent finish to achieving a minimum sound absorption coefficient a_w of 0.7 (e.g. perforated panel with absorptive mineral wool/ foam).

It is understood that current proposals issue to us by the architects meet the above criteria and will include absorption on the plant side as well as a thick galvanized steel blanking panel providing the minimum mass stated above.

7.2. Noise Modelling Results

As follows is the predicted noise emission grid:

Figure 4: Predicted external plant noise emission, dB LAeq 1 hour (grid at 4.5 metres)



8. Noise Impact Assessment

A noise impact assessment in accordance with British Standard 41412:2014+A1:2019 has been undertaken at existing noise sensitive receivers around the site. It should be of note that it is assumed that proposed and existing plant will run during school hours only.

8.1. Background Noise Level

As detailed in Section 5, the measured background noise level was 48 dB $L_{A90, T}$. This is considered representative of the typical background noise levels at the receiver location over an hour period of school operational hours.

8.2. Planning Condition Criteria

The planning condition (provided in Section 3) provides specific noise criteria relating to measured background noise levels. The table below summarises the assessment criteria derived from the planning condition and measured background noise levels; this is the maximum noise level of plant 1-metre from the NSR façade.

Table 10: External plant maximum noise level criteria

Parameter	Level at NSR Façade (dB)
Specific Sound Level	38 $L_{Aeq, 1 \text{ hour}}$
Rating Sound Level (with character)	48 $L_{Ar, 1 \text{ hour}}$

8.3. Predicted Specific Sound Level

The predicted specific sound level at the NSR façade is 38 dB $L_{Aeq, 1 \text{ hour}}$. This is detailed in Figure 4 above.

8.4. Character Corrections

The rating sound level is the specific sound level with corrections for noise character.

Character corrections 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 corrections are as follows:

- *Tonality* – Plant of this type is not normally tonal in nature; the supplier should confirm this.
- *Intermittency* – It is not expected that intermittency will be perceivable at the existing NSRs.
- *Impulsivity* – Plant of this type is not normally impulsive in nature.
- *Other Sound Characteristics* – We do not believe any correction is necessary for other sound characteristics.

Therefore, no corrections for character are applied to the specific sound level of external plant noise. The predicted rating sound level of external plant noise at the NSR façade is 38 dB $L_{Ar, 1 \text{ hour}}$.

8.5. Impact assessment

The table below compares the predicted specific sound level and rating sound level of plant to the planning condition criteria.

Table 11: Noise impact assessment

Parameter	Predicted Level at NSR Façade (dB)	Planning Condition Criteria	Criteria Met?
Specific Sound Level	38 $L_{Aeq, 1 \text{ hour}}$	38 $L_{Aeq, 1 \text{ hour}}$	Yes
Rating Sound Level	38 $L_{Ar, 1 \text{ hour}}$	48 $L_{Ar, 1 \text{ hour}}$	Yes

8.6. Context

British Standard 4142:2014 requires context to be considered and states:

"Where the initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration"

A contextual assessment is not considered necessary for the proposed external plant in relation to the existing NSRs.

8.7. Summary of Assessment

Both the predicted specific sound level and rating sound level are within the planning condition 12 criteria and therefore it is our opinion that planning condition 12 can be discharged.

9. Summary and Conclusions

The Abbey School appointed Acoustic Consultants Limited to undertake a noise impact assessment for the proposed external plant at The Abbey School, Reading.

Noise modelling has been undertaken to predict noise levels of proposed external plant at the nearby noise sensitive receivers at the site.

Within the noise assessment (in accordance with BS4142), it is predicted that noise levels from proposed external plant will meet noise level criteria within Planning Condition 12 (Application Reference 20061). We are therefore of the opinion that the requirements have been met and that planning condition 12 can be discharged.

10. Appendix 1 – Glossary of Acoustic Terminology

A-weighted sound pressure p_A – 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_{pA} – 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_A is the A-weighted sound pressure in pascals (Pa);
 p_0 is the reference sound pressure (20 μ Pa)

Background sound level, $L_{A90,T}$ – 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, $L_{Aeq,T}$ – value of the A-weighted sound pressure level in decibels of continuous steady sound that, within a specified time interval, $T = t_2 - t_1$, has the same mean-squared sound pressure as a sound that varies with time, and is given by the following equation:

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

where:

p_0 is the reference sound pressure (20 μ Pa); and

$p_A(t)$ 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_{pA} 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, $L_s = L_{Aeq,Tr}$ – 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, $L_{Ar,Tr}$ – 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).



ACOUSTIC
CONSULTANTS LTD

Head Office: 194 West Street, Bedminster, Bristol, BS3 3NB
T: 0117 986 2956

www.acoustic-ltd.co.uk

Registered Office: 194 West St, Bristol, BS3 3NB Registered No: 8544901