SHARPS REDMORE

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Report

Acoustic Planning Assessment of Building Services Plant in respect to Planning Condition 12
Baptist Chapel, Fressingfield

Prepared by
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Appendices

1.0 Introduction

1.1 Sharps Redmore have been instructed by CE Davidson Ltd on behalf of the Fressingfield Baptist Church to assess the atmospheric noise emissions from the building services plant associated with the scheme, in respect to the discharge of Planning Condition 12.

1.2 The scheme gained planning permission in July 2018 (App. No. 3872/16) from Mid-Suffolk District Council.

1.3 Condition 12 of the permission states:

> *Prior to the installation of any external equipment (such as air source heat pumps, extraction systems and ventilation systems) details of the equipment shall be submitted to and approved in writing by the local planning authority. Any such equipment shall be implemented in accordance with the approved details and thereafter retained as approved.*
>
> *Reason: In the interests of the amenity of neighbouring residents having regard to noise levels in the area and visual amenity of the area.*

1.4 Following a submission by the applicant for the discharge of the Condition, the environmental health feedback (David Harrold) noted the extent of plant to the rear of the Church being in close proximity to neighbours. He considered from the information provided that this could result in 'significant adverse noise impact' and recommended a noise assessment to be submitted, in accordance with BS 4142.

1.5 This report seeks to provide a BS 4142 noise assessment including provisional noise amelioration measures in order to aid the discharge of Condition 12.

1.6 The normal operating hours of the plant are anticipated from no earlier than 8 am and no later than 9 pm. There may be occasions when for specific uses this could extend to 10 pm, but the noise survey the environment changes little between evening hours.

1.7 Section 2 of the report summarises the noise guidance within BS 4142. Section 3 provides the findings of the noise survey. Section 4 provides the proposed plant information. Section 5 undertakes the assessment and makes recommendations. Section 6 concludes the report.

2.0 Noise Guidance

2.1 The standard method for assessing the impact of noise from new industrial and/or commercial sources affecting noise-sensitive receptors in the UK is given in British Standard 4142:2014+A1:2019 *'Method for rating industrial and commercial sound'.*

2.2 This British Standard enables the significance of sound impact is to be determined according to the following summary process:

- Determine the background sound levels, in terms of the index L_{A90}, at the receptor locations of interest.
- Determine the specific sound level of the source being assessed, in terms of its L_{AeqT} level (T = 1 hour for day or 15 minutes for night), at the receptor location of interest.
- Apply a rating level acoustic feature correction if the source sound has tonal, impulsive, intermittent, or other characteristics which attract attention.
- Compare the rating sound level with the background sound level; the greater the difference between the two, the higher the likelihood of adverse impact.
- A difference (rating – background) of around +10 dB is an indication of significant adverse impact, depending on the context; a difference of +5 dB is an indication of an adverse impact, depending on the context. 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 upon context.

2.3 BS 4142:2014 introduces the concept of '*context'* to the process of identifying noise impact. Section 11 of BS 4142:2014 explains "*The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs* (our emphasis). A*n effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context"* (our emphasis).

2.4 There are many *context* points to consider when undertaking an assessment of sound impact including:

- The absolute level of sound;
- The character and level of the specific sound in the context of the existing noise climate; for example is the sound to occur in a location already characterised by similar activities as those proposed?
- The sensitivity of the receptors;
- The time and duration that the specific sound is to occur;
- The conclusions of assessments undertaken using alternative assessment methods, for example WHO guidelines noise values or change in noise level;

2.5 In respect to the absolute level of sound, the Section 11 commentary of the standard states:

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. (our emphasis)

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.

2.6 It is therefore entirely possible that whilst the numerical outcome of a BS 4142 assessment is indicative of adverse or significant adverse impact, when the proposal is considered in *context* the significance of the impact is reduced to an acceptable level.

3.0 Noise Survey

3.1 A noise survey was undertaken on 6-7th January 2021 at the boundary of the site adjacent to the side of the nearest residential property at 12 Sancroft Way. The property is side on to the boundary with a garage. The facing window of the property to the site is likely to be for a small bathroom or landing. The nearest noise sensitive room and window would be the living and bedroom windows, some 4-5 metres from the boundary.

3.2 The photo below show the property and the measurement location, and the concrete slab for the main AHU and ASHP plant. Appendix A shows a site plan indicating Sancroft Way and new church as a whole and the land to the south which has outline consent as part of the original wider planning application for residential dwellings, plus smaller noise sources relating to the scheme.

3.3 Measurements were undertaken over a period 22 hours approximately from 10am to 8 am, using a Norsonic 140 Class 1 sound level meter and wet weather kit, locating the microphone at 1.5 metres above ground level attached to the temporary hoarding. Measurements were taken in 5 minute samples.

- The meter was calibrated before and after use and showed no signficant drift. Weather conditions were dry, with wind speeds just around or below 5 m/s and considered suitable.

3.4 The survey results are charted in Appendix B. This shows the ambient (L_{Aeq}) , maximum ($L_{Amax,fast}$) and background (L_{A90}) noise levels, as defined in Appendix C.

3.5 The period either end of the chart is during site activities and can be ignored. During the night period the background noise level has typical minimum level is 20-21 dB L_{A90}, at which no plant is known to be operating. During the evening this reduces from around 27-22 dB L_{A90} and by the early morning is around 28 dB L_{A90}.

- Ambient noise levels, L_{Aeq}, are typically 5dB + above the background levels, during the mid-evening period.

3.6 The survey was undertaken during Covid lockdown and therefore less traffic movement would be expected on the surrounding roads. However this area is only local country roads and therefore this is not likely to affect the underlying background level significantly. We would suggest, from this survey that under normal (non-lockdown periods) this would still be no more than 25 dB L_{A90} during the typical evening period and 30 dB L_{A90} in the morning.

4.0 Plant

4.1 The plant proposed to be included on the scheme is outlined below. This plant is primarily located at the rear of the premises, with smaller items of plant servicing the kitchen and toilets. A small plant room is identified at the rear of the building on the drawing but is not believed to now include plant or signficant noise producing plant, due to the change in strategy.

External Rear Plant Area

- 5 No. Air source heat pumps. Sound power level (cooling) data is given in the table below:

	1/1 Octave Band Centre Frequencies (Hz) - Linear								
ASHP	63	125	250	500	1k	2k	4k	8k	dBA
RYMQ8U	88	81	79	77	71	68	64	64	78
REYQ12U	90	85	83	81	76	75	76	68	84
RYMQ16U	94	90	85	85	77	68	64	64	78
REYQ18U	92	84	81	83	76	74	73	70	84
RZA200D	76	75	73	72	67	65	60	56	73

Note the cooling values are the higher values when considering both heating and cooling, and hence are used for calculation.[1]

- AHU: duty 2.78 m^3/s @ 250 Pa. Sound power level data and casing breakout at 1 metre is given in the table below:

	1/1 Octave Band Centre Frequencies (Hz) - Linear								
*Lw***	63	125	250	500	1k	2k	4k	8k	dBA
Supply FAI	80	85	86	82	75	70	66	62	83
Exhaust	83	86	84	82	82	75	69	63	85
*Lp @ 1 m**									
Casing	58	63	57	54	53	44	38	18	57

- free field spherical propagation. ** taken as in-duct without outlet correction

[1] Notes: Unattenuated and solely in a horizontal free field direction 1 metre away and 1.5 m above ground level the units have an stated noise level of Q8U 57 dBA, Q12U 61 dBA, Q16U 63 dBA, Q18U 62 dBA, 200D 53 dBA. These levels do not define the overall source level, as included in the global sound power level, which will include for example for directionality, which vertically is normally louder from the larger sources due to the fan direction.

Kitchen Plant – extracting through north façade

- Kitchen extract and supply fans are two types of the same Sileo Multibox fan unit. Induct sound power levels are provided below:

Lw	1/1 Octave Band Centre Frequencies (Hz) - Linear								
Kitchen	63	125	250	500	1k	2k	4k	8k	dBA
FAI	68	76	66	66	66	63	58	53	71
Exhaust	69	77	67	67	68	64	60	55	72

Toilet & small kitchen extract – extracting through south façade & north

- There are three TD 250/100 Silent In line duct fans, serving two sets of unisex toilets, and one disabled/changing room unit through the south façade; and one kitchen changing room adjacent to the kitchen supply. The extract Induct sound power levels are provided below:

Lw	1/1 Octave Band Centre Frequencies (Hz) - Linear								
Toilet	63	125	250	500	1k	2k	4k	8k	dBA
Exhaust	51	51	49	54	49	41	38	33	54

5.0 Assessment & Recommendations

5.1 It is clear from type of plant and its noise levels, alongside the closeness of the nearest residences and the quiet noise environment found, that this would be very likely, as identified by the mid-suffolk EHO, to have a signficant noise impact on the nearest neighbours unless suitably attentuated. The comments ahead provide recommendations of attenuation.

5.2 Selecting a suitable noise limit

5.2.1 From discussion with the EHO we are not aware that Mid-Suffolk have a specific noise criteria/policy other than national guidance/BS 4142 for such plant, alongside the specific view of EHO in each case.

- Initial discussion, prior to the survey considered a noise level, equal to the background noise level as reasonable. Under a BS 4142, this would result in less than an adverse impact.
- Following the survey, the background noise level was determined as exceptionally quiet, and based on the initial discussion would result in design noise limit around 22 dB L_{Aeq} (free field) at the residential window.
    - This level is so quiet as to likely make a suitable scheme impractical. However, as noted earlier, BS 4142 states:
        - *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.*
- Following further discussion with the EHO on this basis 30 dB L_{Aeq} was considered more suitable. There is support for this, as at 30 dB L_{Aeq}, the internal noise level within the residential property via open windows will be less than 20 dB. BS 8233: 2014[2] for continuous plant/transport recommends a maximum internal noise for 35 dB $L_{Aeq, 16hr\ (day\text{-}time)}$ / 30 dB $L_{Aeq, 8\ hr\ (night\text{-}time)}$, so the plant would be considered noticeably within this criteria. Meeting only the BS 8233 internal limits is not applicable as the source is not anonymous in the nature, so a lower internal level internally accommodates the identification of the noise source. Further the previous version of BS 4142: 1997 considered 'low' to be an absolute background level of 30 dB L_{A90} and a rating level of 35 dB L_{Ar}.
- Therefore, although the criteria set is around 8 dB above the background level in the evening, based on discussion with the EHO and BS 4142 guidance a design noise limit of 30 dB L_{Aeq} is proposed as this absolute level, such that the internal level will not cause any significant loss of amenity.

[2] BS 8233:2014 ' Guidance on sound insulation and noise reduction for buildings.

- The AHU and through wall supply/extract systems would be expected to run continuously and its frequency character does not indicate a need for a rating penalty.

- The ASHP's typically ramp up or down, and may have some tonal character, in which case for a rating penalty under BS 4142 (Commentary 9.2) we would propose + 2 dB for tonality (just perceptible) and +3 dB intermittency (readily distinctive against the residual acoustic environment).

  - This results in a rating noise limit of 35 dB L_{Ar}.

5.3 Recommended Noise Controls

AHU – Induct Control

5.3.1 The AHU is recommended to include atmospheric side attenuation to achieve the following minimum dynamic insertion losses (D.I.L).

	1/1 Octave Band Centre Frequecies (Hz)							
D.I.L. (dB)	63	125	250	500	1k	2k	4k	8k
Supply FAI	7	17	32	39	40	45	35	25
Exhuast	10	17	32	45	47	48	42	26

5.3.2 The final selection will be made the attenuator supplier but as an estimate of an order of magnitude this could be an 1800 mm long attenuator at 38% free area.

5.3.3 The attenuators are proposed to ensure the noise from the AHU is less than 25 dBA at the residences, is based also on an acoustic screen (discussed ahead) being included around the AHU and attenuators such that the line of sight is broken to the bedroom windows of the nearest residential properties.

- If it was not possible for the inlet and outlet to be screened within the enclosure an additional 5 dB would be required to the D.I.L performance between 125 Hz -500 Hz which would extend the attenuator lengths.

AHU Casing Noise

5.3.4 Based on the AHU casing noise radiation, from the 2.5 m high AHU; the height of the screen would need 4.5 m in its present location. However a re-arrangement discussed ahead reduces this marginally.

5.3.5 If the unit is acoustically mass lagged, the screen around the AHU could reduce to 3 metres high as long as it breaks the line of sight to the middle of the bedroom window, which would need to be very close to the unit.

- Note any connections between the AHU and attenuators should be rigid, not flexible to avoid noise leakage at this junction.

Kitchen Extract and Supply

5.3.6 The kitchen extract and supply should include atmospheric side attenuation to achieve the following minimum dynamic insertion losses (D.I.L).

	1/1 Octave Band Centre Frequecies (Hz)							
D.I.L. (dB)	63	125	250	500	1k	2k	4k	8k
Supply FAI & Exhaust	0	5	10	15	18	15	11	7

5.3.7 A small attenuator is required to provide this performance. The final selection will be made the attenuator supplier, but as an estimate of an order of magnitude this would be a 600 mm long attenuator at 50% free area.

Toilet extracts and similar

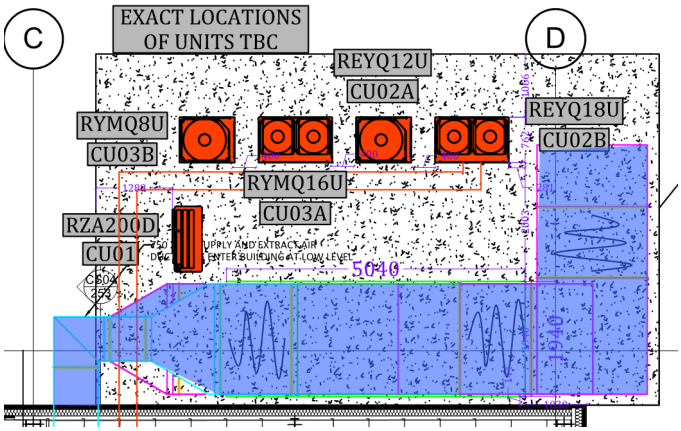
5.3.8 In respect to the smaller toilet fans and similar, based their locations and noise output these would not need attenuation. Those exhausting on the south façade towards future residential properties, (assuming the properties are likely to be at least 10 metre away) are predicted to be no more than 30 dBA, which is considered acceptable to new residential properties, against the criteria above. If this is not considered suitable to the EHO an in-line short attenuator would offer typical a 5 dB lower level.

Plantroom

5.3.9 Drawings indicate a small plantroom adjacent to the external area to the rear. The elevation do not indicate louvred doors, and because of the external plant; little plant is believed to be within this room. Nevertheless it is recommended that any noise from the room externally is controlled to a noise limit of no more than 40 dBA at 1 metre, just in case.

ASHPs

5.3.10 The air source heat pumps [ASHP] are indicates on the mechanical layout as a non-confirmed arrangement (see adjacent plan, with the AHU discussed above).



5.3.11 The combined noise level of the 5 items (mainly from the 4 larger units) is equivalent to single source sound power level of 89 dBA, which equates to a noise level at the nearest residential receiver of 59 dBA[3]

5.3.12 This is 29 dB above the recommend criteria. Considering this is based on an absolute level - this could be reduced to a 26 dB shortfall due to the angle of sound instance to the nearest noise sensitive window.

- In either case this is a significant reduction to be required over a short distance, when breaking the line of sight by an acoustic screen will only offer 5 dB reduction, and sound reflections may occur off the church building façade increasing the level, by typically 3 dB.

5.3.13 Keeping the plant all located on the concrete base, a proposed scheme is shown below which includes:

- Attenuation to the ASHP's with attenuators to both inlet and outlet air paths.
- Acoustic screening of both the AHU and ASHPs together with a 4.2 metre high screen (final height subject to plant positions and attenuation).

	1/1 Octave Centre Frequencies (Hz)								
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	dBA
ASHPs									
Cumulative Sound Power Level (Lw)	97.6	92.4	88.7	88.5	81.7	78.6	78.2	73.4	**89.4**
Distance decay (15 m)	-23.5	-23.5	-23.5	-23.5	-23.5	-23.5	-23.5	-23.5	
Constant	-8	-8	-8	-8	-8	-8	-8	-8	
Lp (at receiver - unattenuated)	66.1	60.9	57.2	57.0	50.2	47.1	46.7	41.9	57.8
Attenuator	-11	-16	-26	-36	-45	-45	-33	-22	
Lp (at receiver -post attenuator)	55.1	44.9	31.2	21.0	5.2	2.1	13.7	19.9	33.3
Acoustic screening (4.2 metre high)	-5.2	-5.5	-6.1	-7.2	-8.7	-10.8	-13.2	-15.9	
Lp (at receiver - post attenuator & screen)	49.9	39.4	25.0	13.8	-3.5	-8.7	0.5	4.0	**27.6**
Casing breakout of AHU									
Casing noise level at 1 m	58	63	57	54	53	44	38	18	56.9
Distance decay (11 m)	-21	-21	-21	-21	-21	-21	-21	-21	
Lp at Receiver (unattenuated)	37	42	36	33	32	23	17	-3	36.1
Acoustic screening (4.2 metre high)	-7.6	-9.2	-11.4	-13.9	-16.6	-19.5	-22.4	-25.0	
Lp (at receiver - post screen)	29.6	33.0	24.8	19.3	15.6	3.7	-5.2	-27.8	**22.6**
Lp (at receiver (sum of ASHP & AHU)	50	40.3	27.9	20.4	15.6	3.9	1.5	4	**28.9**

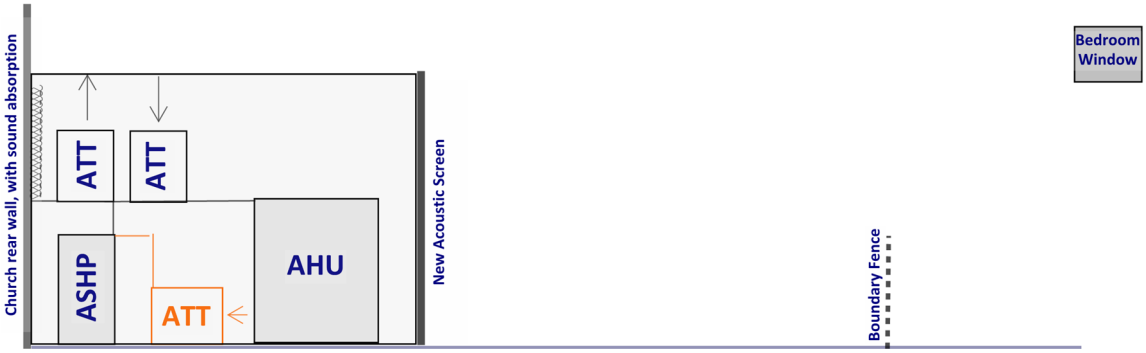
5.3.14 The calculation above shows distance attenuation, attenuation from the enclosure around the ASHP and the acoustic screening. It also looks at the casing breakout of the AHU which

[3] 89 dB (cumulative sound power) Lw – 20 *log(13 m – distance to window) – 8 dB

also screened by this barrier. The sum of the calculations predicts a noise level at the receiver of 29 dBA, and therefore within the proposed design criteria.

5.3.15 The diagram below is a Section illustrating the calculation and measures. It is solely indicative and not to scale, but approximate.

- It shows the bedroom window of the nearest residences and the wall of the church. The ASHP's are shown close the wall of the church proposed in a single row.
- A plenum is created above the unit to an exhaust attenuator to provide even air flow and lower resistance prior to the attenuator.
- The inlet air attenuator is shown adjacent to the outlet air attenuator separated by a septum plate, to aid the even entrainment of air. A second location for the inlet attenuator is shown in orange as an alternative, with the attenuator located at floor level.
- The minimum insertion loss performance of the attenuator is given in the calculation, and roughly equates to a 900 mm long 33% attenuator in this case.



- The resistance / pressure difference determine the size and make-up of the attenuator based on the total volume of air to be moved within the enclosure. The arrangement would need design development with a noise control manufacturer to ensure resistances are sufficient low, and this may alter the precise make-up and potentially all heights.
    - Note the enclosure in this diagram utilises the AHU on one side and would be closed on the ends by the returning acoustic screen. There are variations on this arrange that could give the same result.
- A degree of sound absorption is (100 mm mineral wool behind a perforated plate) is shown along the wall near the ASHP to reduce reflections off the building at the most likely point.
- The new acoustic screen goes fully around the plant and back to the Church building.
    - The acoustic screen could be insulated panel (with an aluminium outer face and perforated sound absorbent inner face) or a specialist system such as genworkltd.co.uk or a timber system such as by Jacksons Fencing-Jakoustic barrier which could also include a sound absorptive inner face to reduce noise build-up.
    - Note for barriers of this height, wind loadings need to be considered by the respective supplier/structural consultant.

Possible Alternative proposal

5.3.16 An alternative option would be to leave the AHU in place and move the ASHP's away from this location.

- Leaving the AHU similar to its present location against the wall, would still require an acoustic barrier of the order of 3.8-4 m high around the unit to control casing noise breakout. If the unit were fully acoustically mass lagged this could be potentially reduced to a lower screen, say 3 metres high, ensuring it broke the line of sight to the residential window.

- Moving the ASHPs to the front of the building, if space allowed, say between the kitchen windows and café windows, provide considerable screening to the properties off Sancroft Way. However future properties with outline application around 45-50 metres away would still exceed the criteria and therefore screening would be required here, potentially up to 3.5 metres at some point Visual (retained as solid) aspects through the screen could be an option. The resultant levels may exceed the criteria at the residential premises, but only marginally, say by 3 dB.

    - The south of the premises as a possible location for the ASHP is likely to lead to similar issues as at the rear, in terms of their impact on the future residences due to the similar close proximity, albeit not immediately, and there would remain lines of sight to residences on Oatfields Road.

6.0 Conclusions

6.1 Sharps Redmore have reviewed the plant submission, undertaken a noise survey and proposed a criteria which is considered likely to be suitable to the local authority.

6.2 The assessment has been based on a BS 4142 approach including context and absolute levels.

6.3 Based on the criteria and the building services to be installed, a noise control design proposal has been made for all plant known to be associated with the scheme. This main proposal retains the building plant primarily on the existing concrete slab. Switching the location of the ASHP's and AHU. It would include a single attenuated enclosure to a line of grouped ASHP's, with both the ASHP's and AHU surrounding by an acoustic barrier.

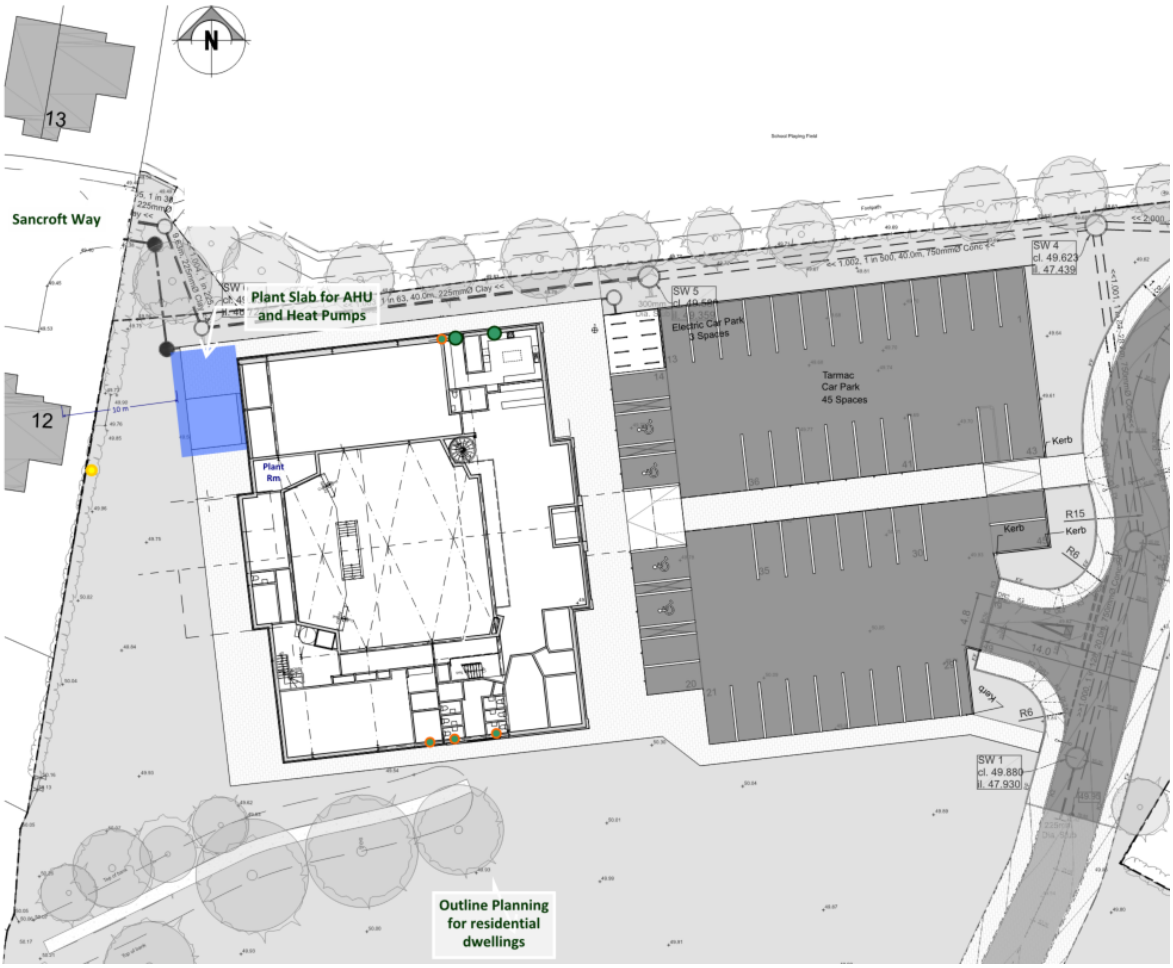
6.4 An alternative has been considered in part by relocating the ASHPs to the front of the building. Screening would be still be required here to the ASHP's as the impact would then move to the protection of potential future new housing. Screening would also still be required around the AHU.

6.4 Attenuation has also been included on the kitchen supply and extracts, and a noise limit set, if needed, for the plantroom depending upon its content.

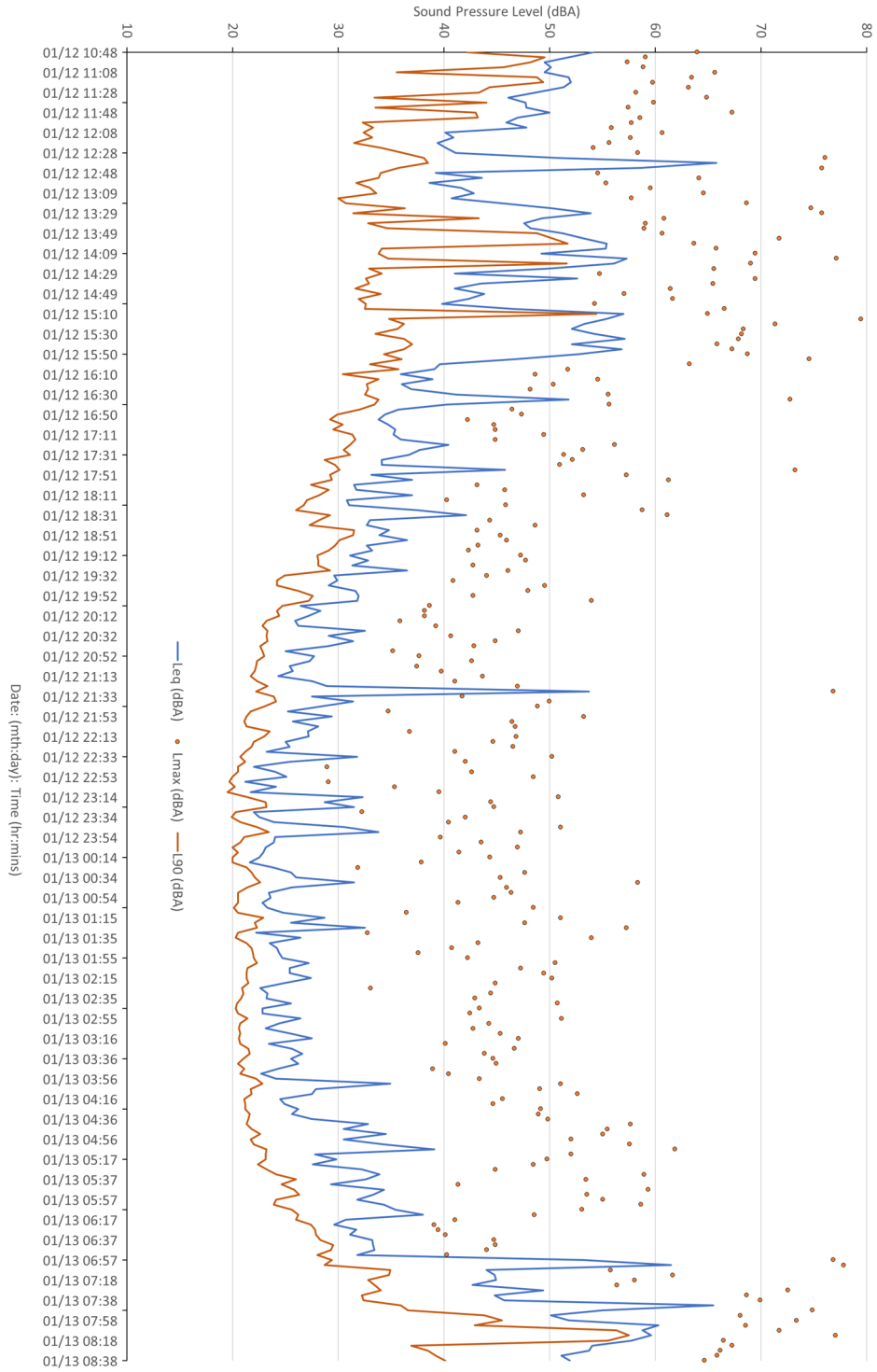
6.5 Overall extensive treatment will be required to attenuate the plant to the nearest neighbours; but with such in place a significant noise impact to neighbours would not be expected. On this basis we consider Condition 12 could be discharged.

Appendix A: Site location plan

The plan indicates the present location of plant slab for the AHU and ASHPs (blue square); nearest existing residential properties and future residential zone with outline planning approval; the noise measurement location (yellow circle); kitchen supply and extract (green circles) and toilet/changing room extracts (orange circles).



Appendix B: Chart of noise survey at boundary measurement location



Typical background noise spectra around 9 pm

	1/1 Octave band centre frequencies (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
L90	34	26	23	19	17	11	10	11	22

Appendix C: Common acoustic parameters for environmental noise surveys

C.1 These are the main noise indices in use in the UK:

L_{A90} :The sound level (in dBA) exceeded for 90% of the time. This unit gives an indication of the sound level during the quieter periods of time in any given sample. It is used to describe the "background noise level" of an area.

$L_{Aeq,T}$:The equivalent continuous sound level over a period of time, T. This unit may be described as "the notional steady noise level that would provide, over a period, the same energy as the varying noise in question". In other words, the energy average level. This unit is now used to measure a wide variety of different types of noise of an industrial or commercial nature, as well as road traffic, aircraft and trains.

L_{A10} :The sound level (in dBA) exceeded for 10% of the time. This level gives an indication of the sound level during the noisier periods of time in any given sample. It has been used over many years to measure and assess road traffic noise.

L_{A1} :The sound level (in dBA) exceeded for 1% of the time. This unit can give an indication of a regular maximum noise level from such activities as dance music.

SEL :The sound exposure level, (often denoted LAE) is the noise level of an event, such as a train or aircraft event, normally expressed in a 1 second time period.

L_{Amax} :The maximum level of sound, i.e. the peak level of sound measured in any given period. This unit is used to measure and assess transient noises, i.e. gun shots, individual vehicles, etc.