



1 – 8 Ashford Close

Halewood, Knowsley, L26 1XW

Noise Impact Assessment

24th January 2022

First Issue



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Revision History

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Executive Summary and Conclusions

This document, a Noise Impact Assessment (NIA) has been written to assess the risk of adverse impact from noise 'pollution' generated by the proposals to install a total of 8 no. air source heat pumps to a group of residential properties (1 per dwelling) at 1 – 8 Ashford Close, Halewood, Knowsley, L26 1XW.

The objective is to ensure that the risk of noise impact will be controlled sufficiently. This is based upon ensuring that the noise emissions from the proposed ASHPs will not cause a significant increase in external ambient noise levels at neighbouring residential properties once operational. The assessment has been conducted by assessing plant noise emissions (predicted through noise modelling) against existing background noise levels (determined by a baseline noise survey conducted over several days) in neighbouring residential gardens and outside of neighbouring windows.

In summary, background noise levels reached a minimum value of 27 dB $L_{A90,15min}$ during the survey. Therefore, the criteria usually conditioned by the Local Planning Authority of a plant noise rating level no greater than the background sound level minus 5 dB at the nearest residential property means that the rating level, in this case, should not exceed 22 dB overnight.

The subsequent modelling/calculations of the noise emissions from the ASHP has demonstrated that these criteria will be met providing a basic louvred enclosure is installed, with a rating level of 22 dB predicted outside of the worst-affected neighbouring window.

If assessing based on BS 8233:2014 and WHO guidelines, to exceed internal noise level targets (of 30 dB L_{Aeq}) within a bedroom, based on an estimated sound reduction across an open window of 10 - 15 dB, specific noise levels would have to exceed 40 - 45 dB $L_{Aeq,8hr}$ at night when measured outside of the window. The worst-case specific noise level, in this case, is 20 dB L_{Aeq} – hence these internal noise targets would easily be achieved, in the range of 5 - 10 dB L_{Aeq} . **This exceptionally low level would be inaudible.** An extensive research study published by DEFRA in 2006 (the *Noise from Pubs and Clubs Phase II Final Report*) indicated that the overwhelming majority of people could not perceive music noise levels within their dwelling of <17 dB L_{Aeq} . It is reasonable to believe that this also applies to plant noise. For context, professional broadcasting/recording studios will usually have an internal noise level designed to be below 20 dB L_{Aeq} to ensure that mechanical ventilation noise is inaudible on recordings.

Hence, in summary, noise emissions from the proposed ASHPs are expected to be low and compliant with the Council's limits providing the plant specification in **Section 5.4** and the recommendations regarding a simple louvred enclosure in **Section 5.6** are followed.

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1.0 Introduction

ParkerJones Acoustics Limited (PJA) has been instructed to undertake a Noise Impact Assessment to accompany a planning application with Knowsley Council (ref: 21/00928/FUL) which includes the installation of 8 no. new air source heat pumps (ASHPs) to service 8 no. existing dwellings at 1 – 8 Ashford Close, Halewood, Knowsley, L26 1XW.

1.1 Scope of Report

This document has been written to assess the risk of adverse impact from noise ‘pollution’ generated by the ASHPs (‘the plant’) on neighbouring residential properties.

The objective is to ensure that the risk of noise impact will be controlled sufficiently. This is based upon ensuring that the noise emissions from the plant will not cause internal ambient noise levels inside nearby residential properties to exceed typical levels which are deemed to be acceptable for good living and sleeping conditions and that external noise levels in gardens won’t affect the recreational use of these areas.

Therefore, the purpose of this report is to determine the representative background sound level outside of neighbouring residential properties; set appropriate noise level criteria based upon this pre-existing noise level (and other relevant residential/plant noise impact guidelines); and finally, demonstrate whether the plant has been designed and located to sufficiently mitigate noise levels to meet these noise level limits successfully – and if not, provide recommendations on how to mitigate the impact to an acceptable level.

Whilst every attempt has been made to ensure that this report communicates effectively to a reader who might not have much knowledge of acoustics, some parts are necessarily technical. A glossary of acoustic terminology and concepts is provided in **Appendix A**.

1.2 Regulations and Guidelines

This report takes into consideration national planning policies including the National Planning Policy Framework (NPPF), the Noise Policy Statement for England (NPSE) and the Planning Practice Guidance on Noise (PPG-N) (summarised in **Appendix B**), which outline the purpose and long-term vision of planning policy with respect to noise.

More specifically, the assessment has been conducted with consideration to the following guidelines:

- BS 4142:2014+A1:2019 ‘*Methods for rating and assessing industrial and commercial sound*’, which assesses the risk of an adverse impact of noise pollution from a sound source (or sources) of a commercial or industrial nature (i.e. mechanical/electrical plant);
- BS 8233:2014 ‘*Guidance on Sound Insulation and Noise Reduction for Buildings*’; and
- the WHO *Environmental Noise Guidelines for the European Region*.

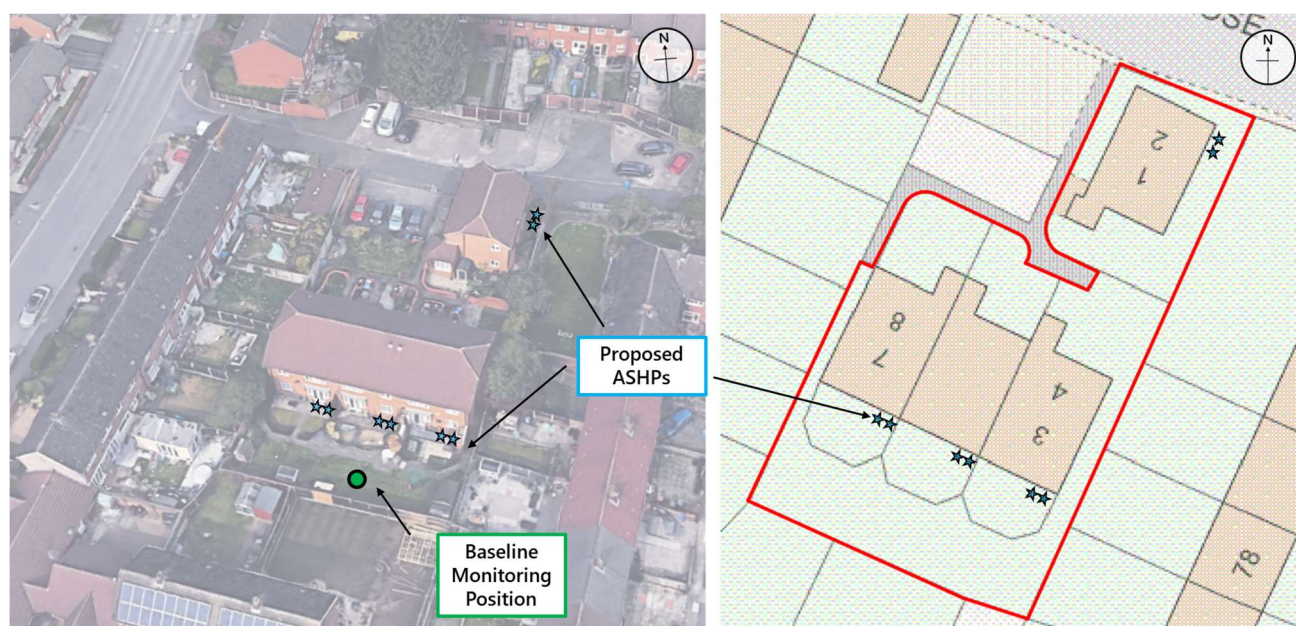
2.0 Site and Development Description

The site of the proposed air source heat pumps (ASHPs) is at an existing cluster of residential dwellings at 1 – 8 Ashford Close, Halewood, Knowsley, L26 1XW.

As shown in **Figure 2.1**, the dwellings sit in a residential area with terraced two-storey houses in all directions. Gardens are separated by $\approx 1.8\text{m}$ close boarded fencing around the outside of the site.

The proposed ASHPs will be installed in pairs in 4 locations, totalling 8 units, 1 per dwelling. Each ASHP will be a Daikin EDLQ05CV3 model.

Figure 2.1 – Indicative site plan and surrounding area



3.0 Consultation and Relevant Guidelines

3.1 EHO Consultation

The Applicant has received the following guidance with respect to the noise limits/assessment requirements from the Environmental Health department at Knowsley Council:

"With regards to fixed plant, we would require the noise from the equipment to be at least 5dB below the background noise level at any given time, so that the noise does not impact the surrounding residents."

A noise assessment, detailing the noise that will be associated with the 8 heat pumps during their operational phase, is required prior to determination. The assessment must be based on a BS4142 assessment, and include the potential maximum noise levels and the impact they may have on the nearby residents."

3.2 BS 4142:2014

BS 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound' is intended to be used to assess the potential adverse impact of sound of an industrial and/or commercial nature, at nearby noise-sensitive receptor (NSR) locations (i.e. residential windows) within the context of the existing sound environment. The method is based upon assessing the predicted noise emissions from plant/equipment against the existing background sound levels at NSRs, the latter of which is determined by a noise survey conducted at the site.

The predicted noise emissions are termed as a 'rating level', which is the 'specific sound level' from plant (the actual measurable noise level), plus 'penalties' which account for whether the noise has distinguishing characteristics such as tonality, intermittency, impulsivity, or is generally distinguishable from the ambient noise environment. Such features may attract attention and be considered annoying, hence sounds with these qualities should be penalised over sounds at the same specific noise level which is less intrusive.

The general aim is for the 'rating level' (plant noise emissions) to not exceed the existing background sound levels outside of residential windows. BS 4142:2014+A1:2019 states that *"the lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context."*

Appendix B.4 explains the methodology in further detail.

3.3 BS 8233:2014

BS 8233:2014 'Guidance on Sound Insulation and Noise Reduction for Buildings' suggests appropriate criteria and limits for different situations. This includes internal noise criteria for residential developments. The limits with BS 8233:2014 are similar to those in the WHO's 'Guidelines for Community Noise and Night Noise Guidelines for Europe' document.

Table 4 of BS 8233:2014 provides internal ambient noise level (IANL) limits for dwellings from "steady external noise sources". These are summarised in **Table 3.1** below – with the relevant night-time target highlighted in grey.

Table 3.1 – BS 8233:2014 internal ambient noise level (IANL) upper limits

Activity	Location	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Resting	Living Room	35 dB L _{Aeq,16hr}	-
Dining	Dining Room/Area	40 dB L _{Aeq,16hr}	-
Sleeping (daytime resting)	Bedroom	35 dB L _{Aeq,16hr}	30 dB L _{Aeq,8hr}

Annex G.1 of BS 8233:2014 suggests that "if partially open windows were relied upon for background ventilation, the insulation would be reduced to approximately 15 dB". Therefore, a noise limit directly outside of the nearest residential windows could be set based upon the values above plus 15 dB.

Therefore, to meet internal noise targets in nearby residential dwellings, noise from the proposed plant should not exceed 50 dB L_{Aeq} during the daytime and 45 dB L_{Aeq} during the night-time when measured/calculated directly outside of a residential bedroom or living room window.

3.4 World Health Organisation (WHO) Environmental Noise Guidelines

The WHO document *Guidelines for Community Noise 1999* has recently been superseded by the *Environmental Noise Guidelines for the European Region*. However, the updated guidance states that 'all WHO guidelines for community noise (CNG) indoor guideline values and any values not covered by the current guidelines (such as industrial noise and shopping areas) should remain valid'.

For steady continuous noise, the GCN recommends a night-time (23:00 – 07:00) indoor guideline value for bedrooms of 30 dB L_{Aeq,8hr} and 45 dB L_{Amax} for a single sound event to prevent sleep disturbance.

4.0 Baseline Noise Survey

4.1 Methodology

PJA has attended the site to conduct a baseline noise survey over a 24 hour period between Wednesday 19th January and Thursday 20th January 2021. The results have been used to determine a representative background sound level at nearby residential receptors in accordance with BS 4142:2014+A1:2019.

A single monitoring position was employed with a sound level meter installed in the rear shared garden area of no's 3 – 8 Ashford Close, at a height of approximately 1.5m. The position is considered representative of baseline noise levels in the gardens of and outside of the windows of the residential properties on all sides which overlook the garden.

The sound level meter was set to log noise levels over continuous 15-minute averaging periods with a 1-second time history rate. The monitoring equipment was left unattended for the majority of the survey with the exception of a short period around the installation and collection of it.

The following noise indices were recorded (amongst others):

- $L_{A90,T}$: The A-weighted noise level that is exceeded for 90% of the measurement period T. This parameter is often considered as the 'average minimum level' and is therefore used in determining the 'representative background sound level' as defined by BS 4142:2014+A1:2019;
- $L_{Aeq,T}$: The A-weighted equivalent continuous noise level over the measurement period T. This parameter is typically considered as a good representation of the average ambient sound level; and
- $L_{AFmax,T}$: The maximum A-weighted noise level during the measurement period T.

Appendix C contains further information on the methodology of the survey, including photographs taken from the site; the equipment used; and the weather conditions at the time of the survey.

4.2 Results

A graph of the measured noise levels across the entire monitoring period is given in **Figure 4.1**. Noise sources are mainly from distant/intermittent road traffic and general noise from the surrounding houses and gardens. Noise levels in **Figure 4.1** are seen to follow a diurnal pattern associated with road traffic, dipping to low levels overnight when there are minimal vehicles on the road.

Table 4.1 summarises the results across the daytime (07:00 – 23:00) and night-time (23:00 – 07:00) periods. The most relevant parameter in terms of the 'representative background sound level' referenced in BS 4142:2014 is the $L_{A90,15min}$. **Figure 4.2** presents histograms of the $L_{A90,15min}$ values – showing modal values of 42 dB and 27 dB during the day and night-time periods respectively. The minimum $L_{A90,15min}$ values measured during the survey were 34 dB during the day and 27 dB overnight.

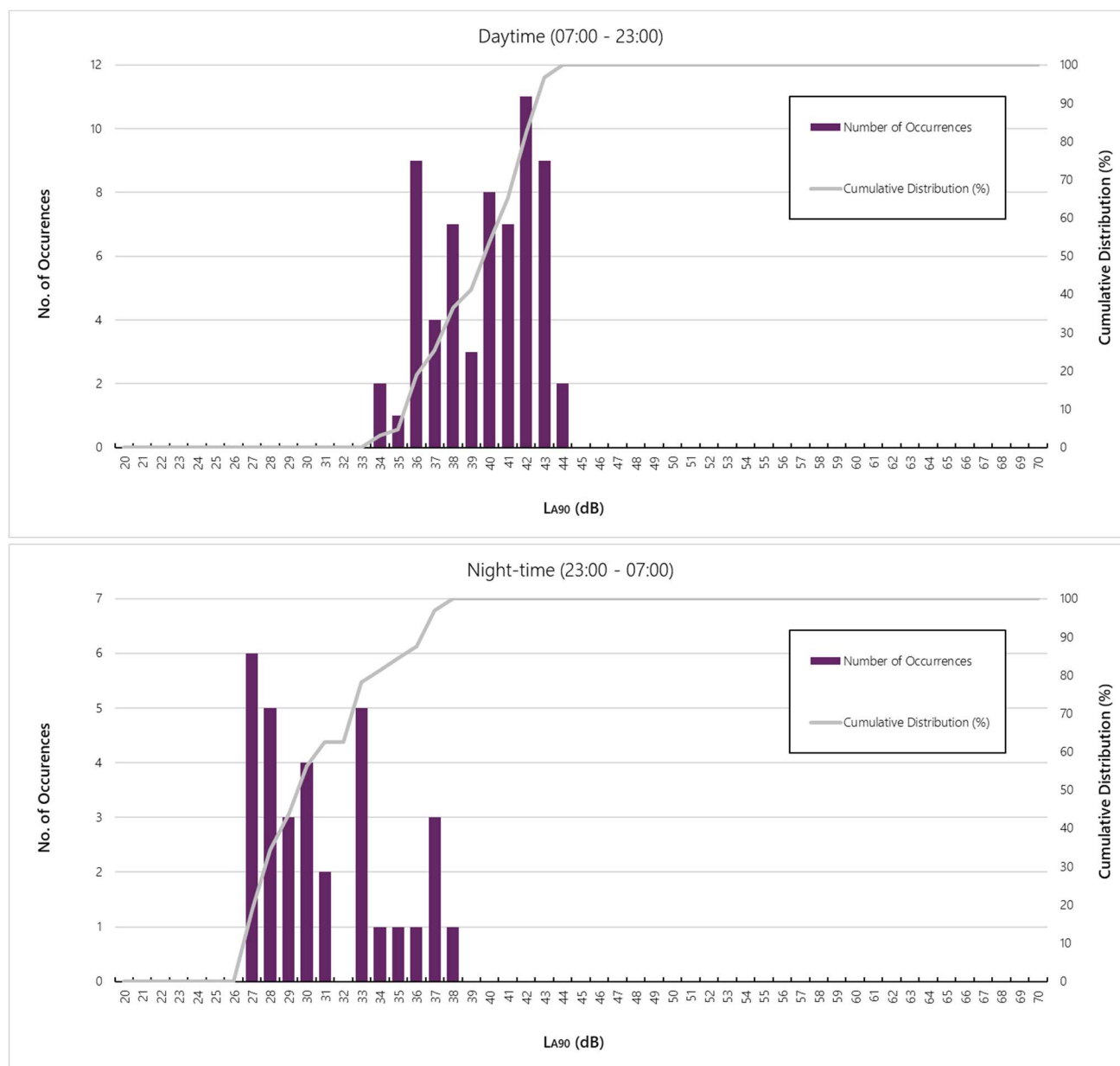
Table 4.1 – Summary of measured noise levels

Period	Parameter	Maximum	Minimum	Logarithmic Average	Mean Average	Modal Average	Median Average
Daytime (07:00 – 23:00)	L _{Aeq,15min} (dB)	53	39	46	45	47	45
	L _{AFMax,15min} (dB)	75	49	N/A	62	65	61
	L _{A90,15min} (dB)	44	34	N/A	40	42	40
Night-time (23:00 – 07:00)	L _{Aeq,15min} (dB)	43	32	39	38	40	39
	L _{AFMax,15min} (dB)	56	41	N/A	50	53	51
	L _{A90,15min} (dB)	38	27	N/A	31	27	30

Figure 4.1 – Graph of measured noise levels



Figure 4.2 – Histogram of measured $L_{A90,15min}$ values



5.0 Assessment

5.1 Methodology

The assessment has been undertaken in accordance with BS 4142:2014+A1:2019. The following summarises the main steps of action in the assessment method:

- a representative background sound level $L_{A90,Tr}$ is determined based upon the results of the environmental noise survey;
- the specific sound level L_s outside of nearby residential windows/in neighbouring gardens is predicted;
- the rating level $L_{Ar,Tr}$ is determined by the application of any 'penalties' which adjust for characteristic features of the sound which may be perceptible and potentially cause annoyance at each NSR;
- the predicted rating level $L_{Ar,Tr}$ is compared to the $L_{A90,Tr}$ and assessed against the criteria set by the Council;
- the predicted specific noise levels are also compared against the guidelines of the WHO and BS 8233:2014, to provide further 'context' to the results (as referenced by BS 4142:2014+A1:2019);
- if necessary, mitigation measures are recommended to reduce the predicted rating level.

5.2 Background Sound Levels

In accordance with BS 4142:2014+A1:2019, the predicted rating level should be assessed against a 'representative' background sound level. This is commonly determined through the results of a baseline sound survey, as has been done here.

BS 4142:2014+A1:2019 states that *"in using the background sound level in the method for rating and assessing industrial and commercial sound it is important to ensure that values are reliable and suitably represent both the particular circumstances and periods of interest. For this purpose, the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods."* BS 4142:2014 further states that *"a representative level ought to account for the range of background sound levels and ought not automatically to be assumed to be either minimum or modal value"*.

As a worst-case for a robust assessment, the *lowest* measured value should be used. Therefore, the representative background sound level has been set based upon the minimum $L_{A90,15min}$ value from the noise survey listed in **Table 5.1**.

Table 5.1 – Derived representative background sound level $L_{A90,T}$ at nearby residential NSRs

Noise-Sensitive Receptor (NSR)	Time Period	Representative Background Sound Level $L_{A90,T}$ (dB)
1m outside neighbouring windows and 1.5m above ground in neighbouring gardens	Daytime (07:00 to 23:00)	34
1m outside neighbouring windows	Night-time (23:00 – 07:00)	27

5.3 Maximum Plant Noise Rating Level at Receptors

As per the Councils local planning requirements (see **Section 3.1**), the maximum rating level from the plant should not exceed the background noise level minus 5 dB.

As the plant can potentially run at any time during a 24 hour period, the design should realistically aim to meet the night-time target at all times when determined outside of neighbouring windows (only the daytime target is considered applicable to gardens given that gardens would rarely be in use at night).

Table 5.2 – Maximum plant noise level at nearby noise-sensitive receptors

Noise-Sensitive Receptor (NSR)	Time Period	Maximum Plant Noise Rating Level $L_{A,T}$ (dB)
1m outside neighbouring windows and 1.5m above ground in neighbouring gardens	Daytime (07:00 to 23:00)	29
1m outside neighbouring windows	Night-time (23:00 – 07:00)	22

5.4 Proposed Plant

All of the 8 no. proposed ASHPs will be a Daikin EDLQ05CV3 model ¹. The modelled source noise emission data (based on manufacturer datasheets ²) for the external units are outlined in the table below.

The spectral noise levels do *not* suggest a tonal quality – the lack of tonality being a typical trait of small ASHPs because the fan rotates at a relatively low speed and consequently the blade passing frequency (the main cause of tonality) is at a very low frequency, meaning the sound overall is perceived as broadband in nature.

The assessment has been based on the assumption that the unit can operate at any point over a 24-hour period.

Table 5.3 – Source noise emission data for the proposed external AC unit

Make/ Model	Sound Pressure Level (SPL) at 1m ³									Sound Power Level dB(A) ⁴
	dB at Octave Band Centre Frequencies, Hz								dB(A)	
	63	125	250	500	1 k	2 k	4 k	8 k		
Daikin EDLQ05CV3	51	47	46	45	44	39	35	34	48	61

1 - https://www.daikin.co.uk/en_gb/products/edlq-cv3.table.html

2 - https://www.daikin.es/content/dam/MDM/TechnicalDrawings/HEATING/EDLQ-CV3/en/EDLQ-CV3_spresc_3D097565A_EN.pdf

3 - Sound pressure levels measured 1m in front of the unit and 1.5m above a hard reflective ground in a semi-anechoic chamber.

4 - The sound pressure level spectrum has been adjust/increased in the modelling to ensure that the correct sound power level is used.

5.5 Predicted Rating Levels

The noise predictions within this report have been undertaken using the proprietary software CadnaA® by DataKustik, a 3-D noise mapping package that implements a wide range of national and international standards, guidelines and calculation algorithms, including those set out in ISO 9613-2:1996. A full explanation of the noise modelling is provided in **Appendix D**, along with images and noise maps/results from the model.

Figure D.2 shows the predicted specific noise levels (L_{Aeq}) from the ASHPs outside of all neighbouring residential windows. The receptor points in the modelling represent the highest noise level on each façade (receptors are placed to represent sensitive windows at ground floor and 1st floor heights, with the number on the map showing the highest value from the most exposed floor level).

The noise contour plot and receptors away from buildings in the gardens are plotted at a height of 1.5m.

As per **Section 3.2**, a rating level penalty should be applied when assessing in accordance with BS 4142:2014+A1:2019.

A 2 dB penalty has been applied on the basis that the combination of noise from several ASHPs may have a 'just perceptible' tonal quality.

Table 5.4 shows the rating level outside the worst affected neighbouring window and neighbouring garden in comparison to the background sound level.

It is seen that daytime rating level targets are met. However, whilst the specific noise level is very low to the point where it should be inaudible inside neighbouring dwellings with windows open, the night-time rating level limit based on the '5 dB under background' criteria imposed by the Council is *not* met.

Therefore, if the ASHPs are to operate overnight (at any point between 23:00 and 07:00), mitigation will be required in order to meet the Council's criteria.

Table 5.4 – Predicted noise levels and comparison with the background sound level

Location	Period	Specific Noise Level $L_{Aeq,Tr}$ (dB)	Rating Level Penalties (dB)	Rating Level $L_{Ar,Tr}$ (dB)	Maximum Rating Level $L_{Ar,Tr}$ (dB)	Difference (dB)
Outside worst-affected neighbouring window	Daytime (07:00 – 23:00) Tr = 1 hour	25	+2	27	29	-2
	Night-time (23:00 – 07:00) Tr = 15-minutes				22	+5
In worst-affected neighbouring garden	Daytime (07:00 – 23:00) Tr = 1 hour	27	+2	29	29	0

5.6 Mitigation

5.6.1 Louvred Enclosures

Some form of mitigation will be required in order for the rating level from the ASHPs to reach at least 5 dB below the background sound level at night. A reduction of 5 dB would be required to achieve this.

PJA propose that louvred enclosures should be installed around the units. Simple standard louvred enclosures will be sufficient enough to achieve the required reduction, rather than a full specialist acoustic enclosure (which uses staggered air paths, acoustic lining material, and can achieve reductions of 20 – 25 dB).

The enclosures can be constructed from timber ⁵ ⁶, thin metal ⁷, or otherwise, any solid material will achieve a reduction through it of at least 15 – 25 dB R_w . The main noise emissions will be from the louvres – a standard single bank non-acoustic louver with a large free area will typically achieve a sound reduction index of around 5 dB R_w .

The overall sound reduction achieved by the enclosure is typically around 6 – 8 dB, though a reduction of 5 dB has been assumed as a worst-case within the calculations.

PJA advise that the top panel and side panels should all be a solid/flat construction. Only the side panels should be louvred (or slatted/perforated with air gaps). **Figure 5.1** shows some examples of such an enclosure, which can be designed to provide a suitable aesthetic.

Figure 5.1 – Example ASHP enclosures



5 - <https://www.gardentrellis.co.uk/page/bespoke/stores/air-conditioning-covers>

6 - <https://www.heatdirect.co.uk/east-fit-wooden-guardsl-inv.html>

7 -

https://www.ebay.co.uk/itm/222405416362?_trkparms=aid%3D111001%26algo%3DREC.SEED%26ao%3D1%26asc%3D20160908105057%26meid%3D8e0fa99a993b4e559743be9361070e3d%26pid%3D100675%26rk%3D1%26rkt%3D15%26sd%3D222405416362%26itm%3D222405416362%26pm%3D1%26noa%3D1%26pg%3D2380057&_trksid=p2380057.c100675.m4236&_trkparms=pageci%3A96d7f238-bc8c-11eb-a508-da9a9f13831c%7Cparentrq%3A9e5fee6f1790a7b1f03a1658fff8beb8%7Ciid%3A1

5.6.2 Predicted Rating Levels

The noise model has been updated to reflect the addition of enclosures to each unit/each pair of units, with the predicted specific noise levels in **Figure D.3**. **Table 5.5** shows the rating level outside the worst affected neighbouring window and neighbouring garden in comparison to the background sound level – with the proposed mitigation in place.

Table 5.5 – Predicted noise levels and comparison with the background sound level – with mitigation

Location	Period	Specific Noise Level $L_{Aeq,Tr}$ (dB)	Rating Level Penalties (dB)	Rating Level $L_{Ar,Tr}$ (dB)	Maximum Rating Level $L_{Ar,Tr}$ (dB)	Difference (dB)
Outside worst-affected neighbouring window	Daytime (07:00 – 23:00) Tr = 1 hour	20	+2	22	29	-7
	Night-time (23:00 – 07:00) Tr = 15-minutes				22	0
In worst-affected neighbouring garden	Daytime (07:00 – 23:00) Tr = 1 hour	22	+2	24	29	-5

It is seen that the '5 dB under background' criteria imposed by the Council is met at all times with the proposed mitigation.

The context of the exceptionally low specific noise levels should also be considered.

If assessing based on BS 8233:2014 and WHO guidelines, to exceed internal noise level targets (of 30 dB L_{Aeq}) within a bedroom, based on an estimated sound reduction across an open window of 10 - 15 dB, specific noise levels would have to exceed 40 - 45 dB $L_{Aeq,8hr}$ at night when measured outside of the window.

The worst-case specific noise level, in this case, is 20 dB L_{Aeq} – hence these internal noise targets would easily be achieved, in the range of 5 - 10 dB L_{Aeq} . **This exceptionally low level would be inaudible.** An extensive research study published by DEFRA in 2006 (the *Noise from Pubs and Clubs Phase II Final Report*) indicated that the overwhelming majority of people could not perceive music noise levels within their dwelling of <17 dB L_{Aeq} . It is reasonable to believe that this also applies to plant noise. For context, professional broadcasting/recording studios will usually have an internal noise level designed to be below 20 dB L_{Aeq} to ensure that mechanical ventilation noise is inaudible on recordings.

Therefore, in conclusion, the risk of adverse impact from noise is considered to be negligible.

Appendix A – Acoustic Terminology and Concepts

A.1 – Glossary

Table A.1 – Glossary of acoustic terminology

Term	Description
dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio of the root-mean-square pressure of the sound and a reference pressure (2×10^{-5} Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
Frequency	Sound can occur over a range of frequencies extending from the very low, such as the rumble of thunder, up to the very high such as the crash of cymbals. Sound is generally described over the frequency range from 63Hz to 4000Hz (4kHz). This is roughly equal to the range of frequencies on a piano.
$L_{Aeq,T}$	L_{Aeq} is defined as the notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the A-weighted fluctuating sound measured over that period. This parameter is typically considered as a good representation of the 'average' overall noise level. It is referred to technically as the A-weighted equivalent continuous sound level and is a dB(A) as defined above.
$L_{A90,T}$	The A-weighted noise level that is exceeded for 90% of the measurement period T. This parameter is often considered as the 'average minimum level'.
$L_{AFmax,T}$	The maximum A-weighted noise level during the measurement period T.

A.2 – Subjective Changes in Noise Level

Table A.2 – Subjective loudness from an increase or decrease in sound pressure level

Change in sound pressure level	Relative change in sound power energy (multiplier)		Change in apparent subjective loudness (for mid-frequency range)
	Decrease	Increase	
3 dB	1/2	2	'Just perceptible'
5 dB	1/3	3	'Clearly noticeable'
10 dB	1/10	10	'Half or twice as loud'
20 dB	1/100	100	'Much quieter, or louder'

Appendix B – Relevant Planning Policies and Guidelines

B.1 – National Planning Policy Framework (NPPF)

The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these are expected to be applied. The NPPF provides a framework within which local people and their council can produce their own distinctive local and neighbourhood plans. With explicit reference to noise, the NPPF states that *"Planning policies and decisions should contribute to and enhance the natural and local environment by ... preventing new and existing development from contributing to, being put at unacceptable risk from ... noise pollution"*.

B.2 – Noise Policy Statement for England (NPSE)

The NPPF refers to the Noise Policy Statement for England (NPSE), which applies to most forms of noise including environmental noise. The NPSE sets out the long-term vision of Government policy which is to *"Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development"*. It aims that *"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:*

- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life."*

The use of the terms *"significant adverse"* and *"adverse"* are key phrases within the NPSE. The guidance establishes the concept of how the level of adverse effect on health and quality of life can be referenced including:

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

Under the first aim of the NPSE (*"avoid significant adverse impacts on health and quality of life"*), an impact in line with SOAEL should be avoided. Under the second aim (*"mitigate and minimise adverse impacts on health and quality of life"*), where the impact lies somewhere between LOAEL and SOAEL, requiring that all reasonable steps are taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development, but does not mean that such adverse effects cannot occur.

B.3 - Planning Practice Guidance on Noise (PPG-N)

The Planning Practice Guidance on Noise (PPG-N) is part of a suite of web-based guidance which is intended to support the implementation of the policies in the NPPF and the NPSE.

It aids in expanding on the definitions from the NPSE of NOEL, LOAEL and SOAEL, by linking these terms to 'examples of outcomes', i.e. changes in behaviour and/or attitude to noise. The table below summarises the guidance from PPG-N in this regard.

Table B.1 – Noise exposure hierarchy based on the likely average response – adapted from PPG-N

Perception	Examples of outcomes	Increasing effect level	Action
NOEL - No Observed Effect Level ¹			
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 Observed Adverse Effect	No specific measures required
LOAEL - 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 the volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported 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
SOAEL - Significant Observed Adverse Effect Level			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. 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 a change in the acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate the effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent
¹ This line is an assumption of the adverse effect level and is not explicitly referenced by PPG-N, though this appears to be a safe assumption.			

B.4 – BS 4142:2014

BS 4142:2014 *'Methods for rating and assessing industrial and commercial sound'* is intended to be used to assess the potential adverse impact of sound of an industrial and/or commercial nature, at nearby noise-sensitive receptor (NSR) locations within the context of the existing sound environment.

B.4.1 – Definitions

BS 4142:2014 provides the following definitions which are relevant at this pre-construction stage of assessment:

- **Background Sound Level, $L_{A90,T}$:** A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given interval, T, measured using time weighting F and quoted to the nearest whole number of decibels.
- **Rating Level, L_{A,r,T_r} :** Specific sound level plus any adjustment for the characteristic features of the sound.
- **Reference Time Interval, T_r :** Specified interval over which the specific sound level is determined. This is 60-minutes during the day (07:00 – 23:00) and 15-minutes at night (23:00 – 07:00).
- **Specific Sound Level, $L_s = L_{Aeq,T_r}$:** Equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T_r .
- **Specific Sound Source:** Sound source being assessed.

The BS 4142:2014 definition of sound of an industrial and/or commercial nature includes *"sound from fixed installations which comprise mechanical and electrical plant and equipment"*. The scope of BS 4142:2014 is not intended for sound from the passage of vehicles on public roads; people; and 'other sources falling within the scopes of other standards or guidance'.

B.4.2 – Specific Sound Level

The specific sound level L_s is the 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 , of 60-minutes during the day (07:00 – 23:00) and 15-minutes at night (23:00 – 07:00).

B.4.3 – Rating Level

The rating level L_{A,r,T_r} is the specific sound level L_s plus any 'penalties' which account for the characteristic features of the sound.

BS 4142:2014 provides the following with respect to the application of penalties to account for *"the subjective prominence of the character of the specific sound at the noise-sensitive locations and the extent to which such acoustically distinguishing characteristics will attract attention"*.

- **Tonality** – For sound ranging from not tonal to predominantly tonal the Joint Nordic Method gives a correction of between 0 dB and +6 dB for tonality. Subjectively, this can be converted to a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible and 6 dB where it is highly perceptible;

- **Impulsivity** – A correction of up to +9 dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be converted to a penalty of 3 dB for impulsivity which is just perceptible at the noise receptor, 6 dB where it is clearly perceptible, and 9 dB where it is highly perceptible;
- **Intermittency** – When the specific sound has identifiable on/off conditions, the specific sound level ought to be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time. If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied; and
- **Other Sound Characteristics** – Where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied."

PJA consider the word 'perceptible' to be important, and variable depending on the context of a site. For example at a site with a relatively high background sound level of 50 dB(A), an 'impulsive' sound source with a specific sound level of 30 dB(A) at an NSR is unlikely to be perceptible and should probably not be penalised.

However, the same source at a site with a lower background level of 30 dB(A) would be perceptible, and therefore a penalty of 3 or 6 dB could be applied to the rating level, with possibly a 9 dB penalty being applied if the specific sound level were to rise from 30 to 40 dB(A). Therefore the context is important in applying rating level penalties.

B.4.4 - Background Sound Level

BS 4142:2014 states that "in using the background sound level in the method for rating and assessing industrial and commercial sound it is important to ensure that values are reliable and suitably represent both the particular circumstances and periods of interest. For this purpose, the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods."

BS 4142:2014 further states that "a representative level ought to account for the range of background sound levels and ought not automatically to be assumed to be either minimum or modal value". Hence BS 4142:2014 does not provide a 'black and white' method of obtaining the assessment level for background sound $L_{A90,T}$. Note that it is standard practice that the $L_{A90,T}$ is determinable from the results of a baseline sound survey conducted at positions representative of sound levels at the nearest or worst affected NSRs.

B.4.5 - Assessment of Adverse Impact

The assessment of adverse impact contained in BS 4142:2014 is undertaken by comparing the rating level $L_{A,r,Tr}$ to the measured representative background sound level $L_{A90,T}$ outside the sensitive receptor location.

The significance of the impact of an industrial or commercial sound source depends on both the margin by which the rating level $L_{A,r,Tr}$ exceeds the background sound level $L_{A90,T}$ and the context in which the sound occurs. It is therefore essential to place the sound in context. But in general, "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."

Appendix C – Noise Survey Methodology

C.1 – Survey Equipment

The monitoring equipment used for the baseline noise survey is detailed in the table below. The sound level meter was calibrated before and after the survey, with no significant drifts of greater than 0.5 dB observed. The sound level meter has been calibrated to a traceable standard within the 24 months preceding the survey, and the calibrators have been calibrated to a traceable standard within the 12 months preceding the survey. The equipment complies with the standards of a BS EN 60942:2003 Class 1 device.

Table C.1 – Equipment used for the noise survey

Name	Serial Number	Last Calibrated	Calibration Due
Pulsar Quantifier 95 Class 1 Sound Level Meter	B21270	Oct-20	Oct-22
Pulsar MK:244 Class 1 Microphone	20043748	Oct-20	Oct-22
Cirrus CRL511E Class 1 Acoustic Calibrator	035235	Nov-21	Nov-22

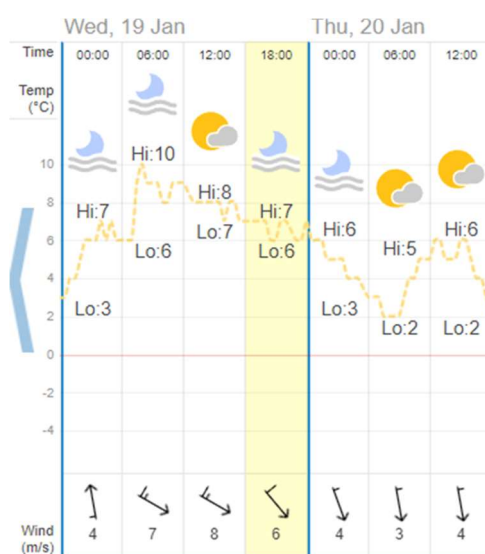
C.2 – Meteorological Conditions

During the survey, weather conditions were mostly dry and warm with wind speeds of less than 4 ms⁻¹ overnight (the microphone was fitted with a weather protection kit/windshield). These weather conditions are suitable for the measurement of environmental noise in accordance with BS 7445 'Description and Measurement of Environmental Noise'.

The weather data below has been sourced from

<https://www.timeanddate.com/weather/@2645097/historic?month=1&year=2022>.

Figure C.1 – Meteorological conditions during the survey



C.3 – Monitoring Position

Figure C.2 – Monitoring position



Appendix D – Plant Noise Emission Predictions

The noise predictions within this report have been undertaken using the proprietary software CadnaA® by DataKustik, a 3-D noise mapping package that implements a wide range of national and international standards, guidelines and calculation algorithms, including those set out in ISO 9613-2:1996.

All of the objects within the model (buildings, roads, barriers, foliage, etc) have been imported from OpenStreetMap. The heights of the buildings and roads have been based upon Google Earth Pro, using the 3D view to be able to measure the elevation heights at the tops of objects, and then inserting this manually into the model. Lastly, the scaled site plan, floor plan, and elevation for the proposed development have been accounted for in the model.

The noise model has been used to predict the resulting L_{Aeq} noise emissions from the proposed plant.

The noise model has assumed:

- a maximum reflection factor of three where buildings and barriers are assumed to have a 'smooth' reflective façade, as a worst-case;
- a ground absorption factor of 0, as a worst-case;
- receptor heights on the façade at ground floor, 1st floor, 2nd floor etc – with the map showing the highest values (unless stated otherwise);
- the noise contour map plotted at a height of 1.5m (unless stated otherwise) – as are receptors away from the building at the site boundaries;
- atmospheric sound absorption based upon a temperature of 10°C and a humidity level of 70%, as per Table 2 of ISO 9613-2:1996.

The images on the following pages contain the results of the mapping.

Figure D.1 – 3D view of the model setup

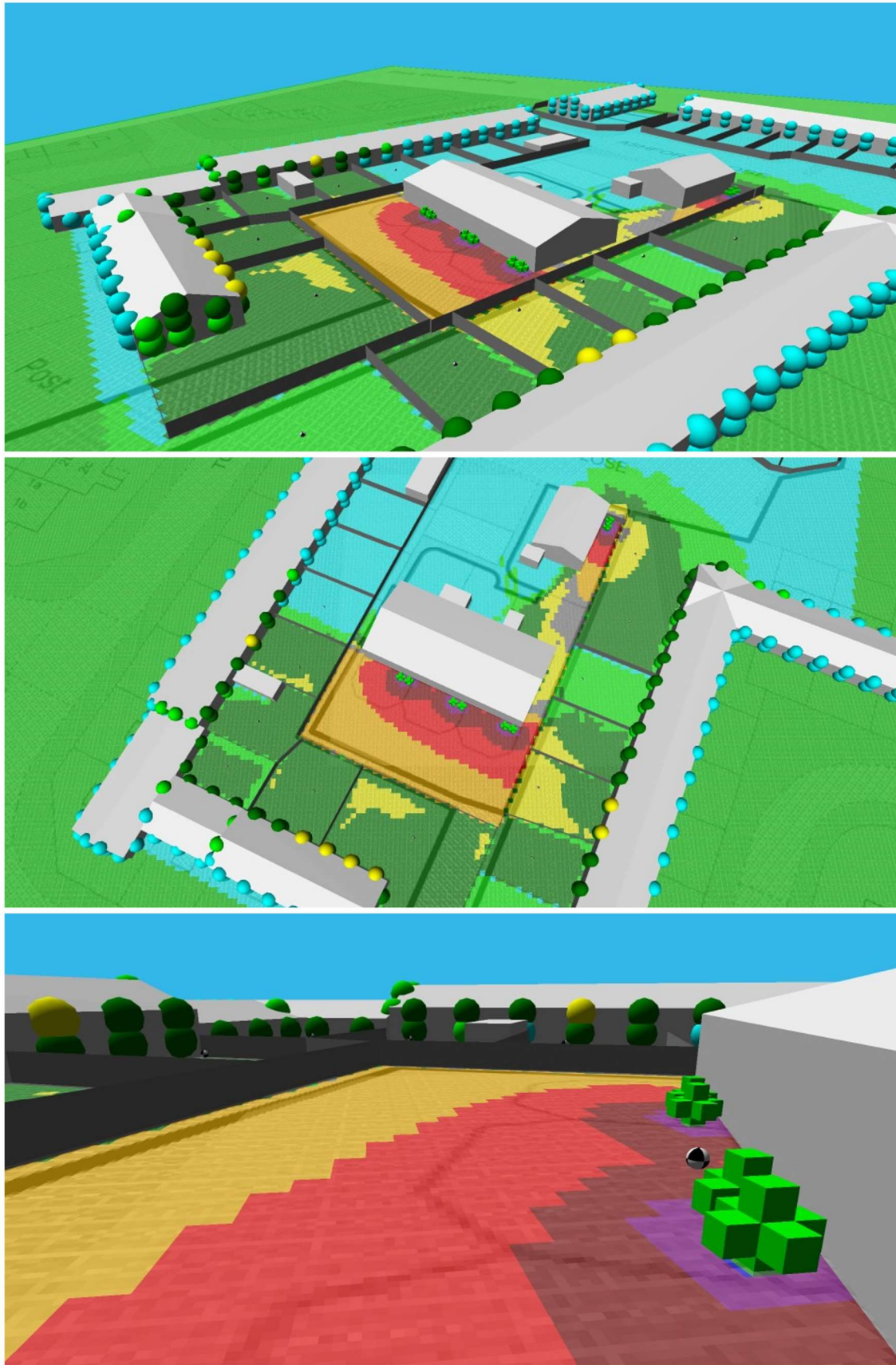
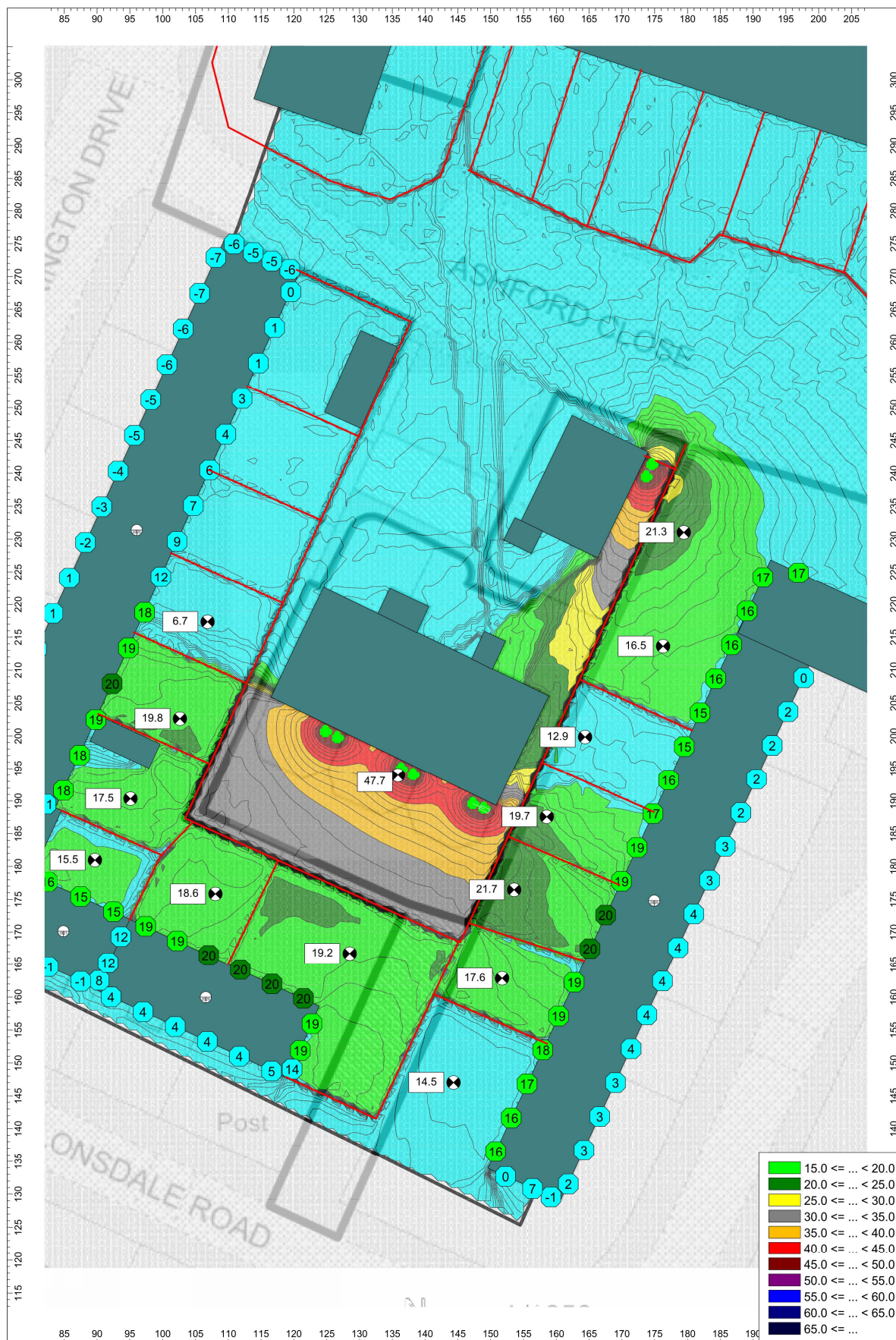


Figure D.2 – Predicted specific noise levels from the ASHPs (dB LAeq)



Figure D.3 – Predicted specific noise levels from the ASHPs (dB LAeq) – with mitigation





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