Report Reference:

EV2422-01-A

22nd May 2024

Evolved Acoustics Ltd

Noise, Vibration & Acoustic Consultant

Registered Office:
2 St Andrews Place, Southover Road
Lewes, East Sussex
BN7 1UP

Company Registered in England & Wales, No. 14503285

Tel: 0333 7722 076
Email: info@evolvedacoustics.co.uk
www.evolvedacoustics.co.uk

Sound Survey Report

20 Hillside Avenue, Worthing

Client	Mr Grant Packham
Project Consultant	Tim Hegan MIOA

Revision	Date of Issue	Comment
A	22/05/24	First Issue

This report has been prepared for the exclusive use of the named Client using reasonable skill and care and all information is confidential to the Client. Any third party relying on the contents of this report do so entirely at their own risk and the author accepts no responsibility, including in negligence, to any such third party. Furthermore, no responsibility is accepted for matters falling outside of the scope of works agreed with the Client.

Table of Contents

1. Summary....1

2. Noise Criteria....1

2.1 Target Levels – Noise Impact Assessment....1
2.2 Site Visit....2

3. Site Details....2

3.1 Site Description....2
3.2 Receptors....3

4. Sound Survey....3

4.1 Attended Sound Measurements....3
4.2 Equipment....3
4.3 Field Calibration....4
4.4 Weather Conditions....4

5. Sound Measurement Results....4

5.1 Attended Sound Measurement Results....4
5.2 Subjective Observations....5

6. Assessment of Impact....6

6.1 Rating Level....6
6.2 Assessment of Compliance....6
6.3 Further Actions....7

7. Conclusion....7

Appendix A – Glossary of Acoustic Terms

Appendix B – Figures

1. Summary

Evolved Acoustics Limited was commissioned in May 2024 to undertake a sound survey at 20 Hillside Avenue.

The aim of the survey was to determine the Rating Level of an operational Air Source Heat Pump (ASHP) and to assess the levels against the limits established as part of the planning process. The survey has been carried out following the installation of an acoustic barrier which was specified as part an initial Noise Impact Assessment [1].

Sound measurements have been undertaken at various positions and the measured sound levels have been used to assess sound levels from the ASHP.

The Rating Level of the ASHP was determined to be 43 dB L_{Ar} at the nearest noise-sensitive façade. The Rating Level therefore exceeds the 35 dB limit ste by the Local Authority. Further studies will be required to determine the details of any additional mitigation measures to reduce the Rating Level of the ASHP.

A glossary of acoustic terms used in this report is provided in **Appendix A**.

2. Noise Criteria

2.1 Target Levels – Noise Impact Assessment

A Rating Level limit for the ASHP of 35 dB L_{Ar} has previously been set by Adur & Worthing Borough Council as documented in the Noise Impact Assessment report included with the application.

The NIA states that the predicted Rating Level ($L_{Ar,T}$) of the ASHP following installation of the acoustic barrier should be 27 dB. This level has been calculated at the first-floor window of the nearest receptor, 18 Hillside Avenue. The predicted Rating Level falls 8 dB below the plant noise emission limit of 35 dB L_{Ar}, indicating that the ASHP should have a ‘low impact’ in line with BS 4142:2014:A1:2019.

The assessment does not appear to consider the noise level at the ground-floor façade which is closer to the ASHP than the first-floor façade.

[1] RBA Acoustics. Plant Noise Assessment report Ref:13384.RP01.PNA.0. 4th March 2024.

2.2 Site Visit

During a site visit carried out by Evolved Acoustics on Monday 20th May 2024, it was agreed between the Consultant and the Local Authority representatives in attendance that any further assessment of the noise impact of the ASHP should consider the ground-floor façade of No. 18 Hillside Avenue. This is in line with the Local Authority's original requirements which refer to the *"nearest façade".*

To comply with these requirements, the ASHP sound must therefore be no greater than 35 dB L_{Ar} outside the ground-floor façade of No 18. Hillside Avenue.

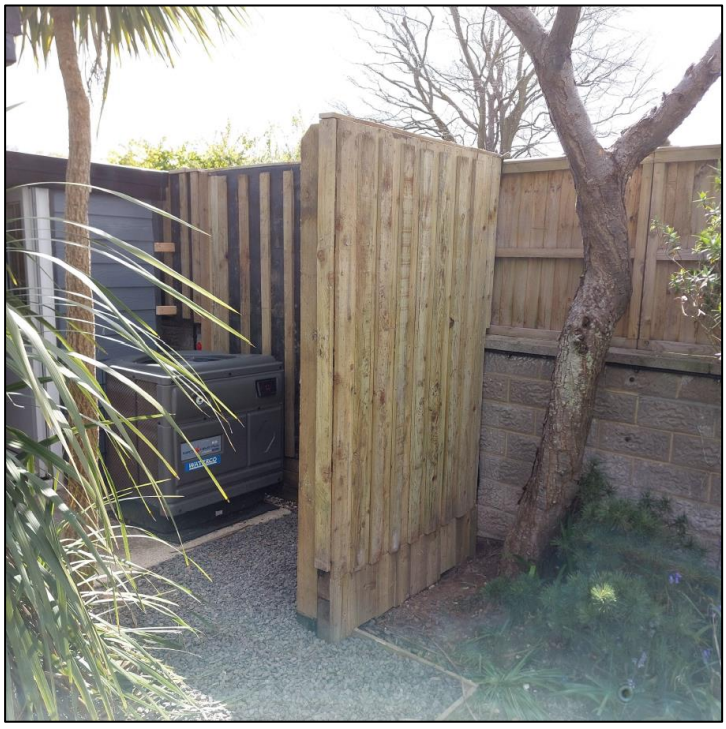
3. Site Details

3.1 Site Description

No. 20 Hillside Avenue is a residential property located in Worthing. The ASHP has been installed within the southern extent of the garden and an Acoustic Fence has been constructed as a form of sound mitigation.

An image of the ASHP and Acoustic Enclosure is shown in Figure 3.1:

Figure 3.1: ASHP and Acoustic Fence (Image from Planning App.)



3.2 Receptors

The survey was focussed on the nearest noise-sensitive receptor, No. 18 Hillside Avenue. The property is a residential dwelling with a single-storey extension placing the façade of the ground-floor around 9m from the ASHP location.

4. Sound Survey

4.1 Attended Sound Measurements

Attended sound measurements were undertaken using a handheld Sound Level Meter (SLM) at various positions in the vicinity of the ASHP including various positions in the neighbouring garden (No. 18 Hillside Avenue).

The ASHP was set to its normal expected duty for the sound measurements. A residual sound measurement was also taken with the ASHP switched off.

The SLM was configured to measure sound levels (dBA) in 5s or 1s intervals. Third-octave frequency band readings (L_{eq}) were also obtained along with audio recordings to accompany each measurement.

The measurement positions are shown on Figure B1 of Appendix B. All measurements were taken in conditions as close to free-field as possible.

4.2 Equipment

All sound measurements were undertaken using a Castle Mirus SLM, rated Class 1. A summary of the main details of the is provided in Table 4.2.

During the measurements the SLM was either placed on a tripod or held at arm's length with the microphone approximately 1.5m from the ground. A windscreen was fitted to the microphone.

TABLE 4.1: DETAILS OF SOUND MEASUREMENT EQUIPMENT

Type	Make	Model	Serial No.	Date of Last Laboratory Calibration
Class 1 Integrating Sound Level Meter	Castle	Mirus	35771	16/11/23

4.3 Field Calibration

Calibration checks were performed on the sound monitoring equipment before and after the measurements using a Castle dBCal GA611 acoustic calibrator. The calibration checks indicated that no significant drift occurred throughout the measurements.

4.4 Weather Conditions

Weather conditions were satisfactory for outdoor sound monitoring with temperatures of 19 °C, relative humidity around 60% and no precipitation. Wind speeds were measured using a handheld anemometer and were no higher than 2.5 $m \cdot s^{-1}$.

5. Sound Measurement Results

5.1 Attended Sound Measurement Results

A summary of the sound measurement results obtained during the attended survey is presented in Table 5.1.

All sound measurements contained some influence of residual sound of sources such as birdsong, road traffic and aircraft. For measurements obtained up close to the ASHP, the influence of the residual sound was negligible. For measurements obtained at the receiver positions, an analysis has been undertaken to separate the residual sound from the specific sound of the ASHP in order to quantify its contribution to the overall level.

As the sound level of the ASHP was steady and continuous it was possible to ascertain the specific level of the plant based on analysis of the graphical sound data obtained in 1s measurement intervals.

Both the total ambient sound level and the contribution of the ASHP are presented in Table 5.1.

TABLE 5.1: ATTENDED SOUND MEASUREMENT RESULTS – 20TH MAY 2024

Position	Description of Position	ASHP Status	Start Time	Duration, T	Total Measured Ambient Sound Level, dB LAeq,T	ASHP Contribution, dBA
S1	Inside acoustic enclosure, 1m from ASHP	ASHP **ON**	10:14	1 min	64	64
S2	Outside acoustic enclosure, (opposite side of acoustic fence)	ASHP **ON**	10:15	1 min	52	52
S4	Garden of No.18 Hillside Avenue. Approx. 5m from ASHP.	ASHP **ON**	10:41	4 mins	47	39
S5	Outside nearest noise-sensitive façade (ground-floor)	ASHP **ON**	10:47	4 mins	50	39
S4	Residual sound measurement.	ASHP **OFF (Residual Measurement)**	11:08	4 mins	42	N/A

The results in Table 5.1 show that the specific sound level of the ASHP at the nearest noise-sensitive façade of No. 18 Hillside Avenue was 39 dBA. It should be noted that this is a specific sound level which is subject to certain rating corrections under BS 4142 in order to obtain the Rating Level (L_{Ar}) for assessment purposes. The Rating Level has been determined in the next section of this report.

5.2 Subjective Observations

The ASHP sound is subjectively broadband in character when observed in close proximity. At the neighbouring property (No. 18) the character is different, with subjectively less contribution from high-frequency levels resulting in an overall sound character which is more low-frequency dominated. This may be attributable to the acoustic fence being more effective against mid and high frequencies compared to lower frequencies due to diffraction effects.

6. Assessment of Impact

6.1 Rating Level

BS 4142 allows certain corrections to be applied to the rating level to account for sound characteristics which could attract attention such as tonality, intermittency and impulsivity. Feature corrections may be applied based on a subjective appraisal or, where appropriate, using objective methods prescribed in the standard.

No rating corrections were applied in the original Noise Impact Assessment.

The presence of tonality to the sound source was discussed with the Local Authority representatives during the sound survey on 20th May 2024. Based on these discussions it is understood that the view of the Local Authority is that the sound should be categorised as being tonal due to the audible low-frequency component. This aligns with the observations of the Consultant.

As a supplementary exercise, the objective method of BS 4142 has also been used to assess for tonality in the sound source. The graph of spectral sound levels is presented on Figure B2 in Appendix B. The graph shows that there is a difference of 16 dB between the sound levels in the 50 Hz band and the adjacent bands. This is a further indication that the sound source is tonal.

Both the subjective and objective methods indicate the presence of tonality and therefore it is necessary to apply a feature correction under BS 4142. The most appropriate feature correction has been deemed to be + 4 dB corresponding to perceptible tonality using the subjective method.

The calculation of the Rating Level is as follows:

Specific Sound Level (at nearest noise-sensitive façade – Ground Floor):	**39 dB L_{As}**
Rating Correction (Tonality):	**+ 4 dB**
Rating Level, dB L_{Ar}:	**43 dB L_{Ar}**

6.2 Assessment of Compliance

The Rating Level of 43 dB L_{Ar} exceeds the specified limit of 35 dB by 8 dB.

6.3 Further Actions

Alternative or additional mitigation is recommended to reduce the sound impact of the ASHP. Detailed mitigation design is outside of the scope of this study, however options for further investigation may include one or a combination of:

- relocation of the ASHP;
- use of a bespoke acoustic enclosure;
- placement of the ASHP within a building with provisions to allow sufficient air flow to the unit.

Based on the observations made on-site, it is not expected that the existing acoustic fence can be modified to achieve the required sound reductions without increasing its height considerably.

7. Conclusion

The Rating Level of the ASHP, assessed at the nearest noise-sensitive façade, exceeds the 35 dB L_{Ar} limit specified by the Local Authority. There are various potential options for reducing the sound levels of the ASHP and further investigation into these options will be required to determine their effectiveness.

Appendix A – Glossary of Acoustics Terms

Sound	Sound is a pressure wave creating by the physical vibration of an object. It can be transmitted through gases, solids and liquids.
Noise	Whilst the terms ‘sound’ and ‘noise’ are often used interchangeably, noise is sometimes defined as unwanted sound.
Decibel (dB)	A unit of measurement used to quantify the level of sound. It is a logarithmic scale that compares the sound pressure level to a reference level based on the threshold of audibility. An increase or decrease of 3 dB is typically the minimum change in sound level that can be detected by humans under controlled conditions. An increase or decrease of 10 dB is generally perceived as a doubling or halving of the perceived loudness.
A-Weighting (dBA)	Whilst the human ear is sensitive to frequencies of sound between around 20 Hz and 20,000 Hz, the ear does not perceive all frequencies equally. A-Weighting is a method of adjusting measured sound levels to reflect the human ear’s sensitivity to different frequencies. The overall A-weighted decibel level is denoted ‘dBA’.
C-Weighting (dBC)	C-Weighting is a type of frequency weighting more sensitive to the lower-frequencies. It is sometimes used in the assessment of music sound.
Equivalent Continuous Sound Pressure Level ($L_{eq,T}$ / $L_{Aeq,T}$)	The equivalent continuous sound pressure level is effectively a method of time-averaging a fluctuating sound level measured over a specific time period (T). It is defined as the continuous steady sound level which, if measured over the same time period (T), would produce the same amount of energy as the original, fluctuating sound signal. This time averaging is denoted dB Leq,T for unweighted sound signals or dB LAeq,T for A-Weighted sound signals.
L_{90}	The level exceeded for 90% of the time over a given time period, T.
Sound Level Meter	An instrument used to measure the sound pressure level (SPL) in the air.

Appendix B – Figures

Figure B1: Site and Measurement Positions (Approx.)



Figure B2: Spectrum of Sound Levels

