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Plot 7 Substation WS4 Acoustic Design Assessment

For Bouygues UK Limited

Date 5 September 2024

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- Appendix A Baseline Noise Survey
- Appendix B SoundPlan Noise Model
- Appendix C BS4142:2014+A1 2019 Assessment

1. Introduction

This report presents the WS5 acoustic design assessment for the Plot 7 substation project at Vantage Newport with regard to noise emissions from the proposed transformer installation.

The findings of this report are based on the level of information provided to and prepared by Hydrock to date, specifically:

- » Information on the proposed substation, as provided by WBPS.
- » The substation design scope, as provided by ENERVEO.
- » Ventilation design by Hydrock MEP.
- » Construction details by Cluttons.

The noise emission level limits are outlined in the latest planning permission received on the 30th April 2024. Please see Section 3.2 for further details.

Hydrock have reviewed the proposed mitigation based on the WS45 information and assessed these against these limits.

This report was updated on the 21st February 2025 to incorporate advise provided on attenuation of intake and extract fans within Hydrock Technical Note CWL12-HYDR-XX-XX-RP-O-000003 "Substation Acoustic Mitigation Measures". This update also includes a review of the external walls and roof constructions (including break out panel) as shown in Cluttons drawing CWL12-CLUT-S1-XX-DR-A-160213.C03 et. al. Nb, the current iteration of the noise model has omitted the retaining wall that was proposed at an earlier stage of the design.

2. Site Description

Vantage have an established campus at Imperial Park in Newport and are the operator of one of Europe's largest data centre hubs.

The Proposed Development (PD), the Plot 7 substation, is designed to provide 4 no. 30 to 40 MVA transformers and ancillary electrical equipment to serve the overall site.

The site for the substation is located in the north eastern corner of Imperial Park, a business park on the western edge of Newport, near Junction 28 of the M4 motorway. The site is a brownfield site located immediately to the northeast of the existing Vantage data centre.

The proposed site layout is shown in Figure 1.

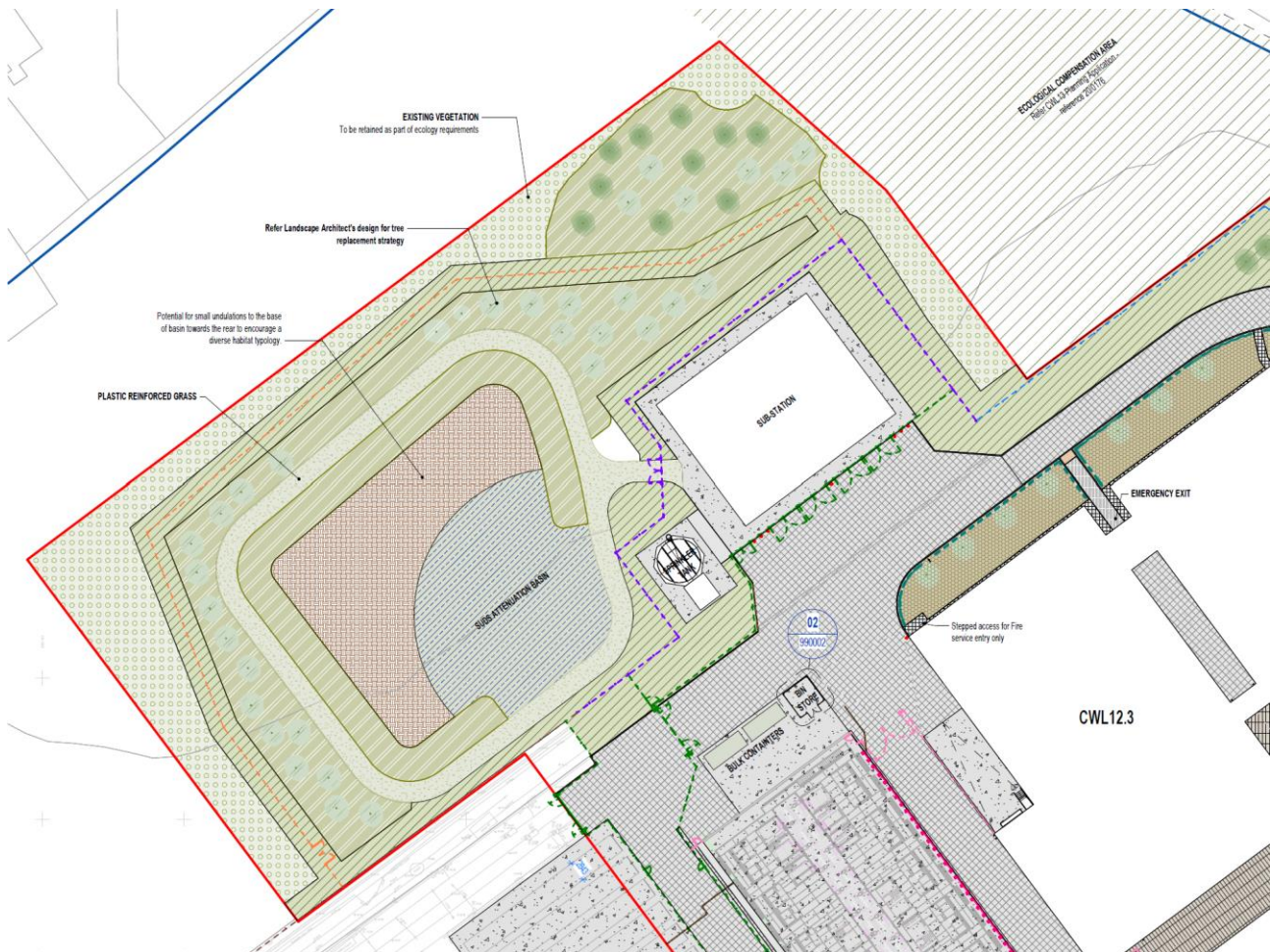


Figure 1: Proposed Site Plan and Substation Area

The nearest noise sensitive receptors (NSRs) to the development site are provided in Table 1 and Figure 2.

Table 1: Noise Sensitive Receptors to Proposed Site Boundary

NSR	Description	Approximate Distance (m)
1	Residential dwellings to the west of site, on Blacksmiths Way.	750
2	Residential dwellings to the northeast of site, on Pencarn Avenue and dwellings off the A48, to the north of site.	60
3	Residential dwellings to the east of site, on Edmundsbury Road and Sir Briggs Avenue.	350
4	Residential dwellings to the southeast of site, on Powis Close.	650
5	Residents staying at the Holiday Inn Express, Newport	250



Figure 2: Nearest Identified Noise Sensitive Receptors (NSR)

3. Assessment Methodology

3.1 Policy and Guidance

The assessment methodology is based on the following policy and guidance documents:

- » Newport County Council Planning Conditions
- » BS 4142:2014 + A1 2019 – "Methods for rating and assessing commercial and industrial sound".
- » BS 8233:2014 – "Guidance on sound insulation and noise reduction for buildings"

3.2 Newport Council Planning Consent

The latest planning permission for the development was granted on 30th April 2024 (planning ref 23/O954) with the following condition regarding noise:

Condition 4:

Prior to construction of the substation and sprinkler tank structures, full details of the proposed noise mitigation measures shall be submitted to and agreed with Local Planning Authority for approval. Noise rating levels during normal operation in the daytime and night time, calculated in accordance with BS4142:2014+A1 2019, shall not exceed a level of 5dBA below the measured pre-development background noise level at the nearest residential noise sensitive receptors.

Reason: To ensure that the amenities of occupiers of other premises in the vicinity are protected in accordance with Policy GP2 and GP7 of the NLDP 2011-2026 (adopted January 2015).

Hydrock have adopted the levels outlined in the above condition for the purpose of this assessment.

4. Environmental Noise Survey

4.1 Survey Summary

For the purpose of this report, the details of the surveys undertaken at and around the site are not repeated, only the results of these surveys are provided below for reference. Full details of the survey are provided in Appendix A.

An environmental noise survey was undertaken to determine the background sound levels present at the nearest identified noise sensitive receptors (NSRs) on 25th to 31st May 2023. The results of the survey are repeated below in Table 2. These levels have been used to set plant noise emission limits, in accordance with relevant criteria provided in Section O of this document.

Table 2: Summary of Background Noise Levels at NSRs

Measurement Location	Receptor	Daytime 07:00 - 23:00	Night time 23:00 - 07:00
		L _{A90,1hr}	L _{A90,15min}
LT1	1	52	46
LT2	2	44	39
LT3	3	45	38
LT4	4	41	38
ST1	5	-	44

5. Transformer Noise Emission Limits

Measured background sound levels and the noise emissions limits set for the development are provided in Table 3 below.

Table 3: Proposed Noise Limits Applicable at NSRs

Receptor	Time Period	Background Noise Level at NSR L _{A90,T} dB	Continuous Noise Emission Limit L _{Ar,Tr} dB
1	Daytime (07:00-23:00)	52	≤ 47
	Night time (23:00-07:00)	46	≤ 41
2	Daytime (07:00-23:00)	44	≤ 39
	Night time (23:00-07:00)	39	≤ 34
3	Daytime (07:00-23:00)	45	≤ 40
	Night time (23:00-07:00)	38	≤ 33
4	Daytime (07:00-23:00)	41	≤ 36
	Night time (23:00-07:00)	38	≤ 33
5	Daytime (07:00-23:00)	-	-
	Night time (23:00-07:00)	44	≤ 39

The limits outlined in Table 3 are in terms of the BS4142:2014+A1 2019 rating level and therefore should include any applicable character corrections. Limits are free field levels, i.e. do not include reflections from receptor facades or other surfaces.

Noise from transformers includes a prominent tone at the first harmonic of the grid alternating current frequency (100Hz). This would result in a tonal correction to transformer noise if it is perceptible at receptors in the context of the residual sound from other sources.

6. Noise Impact Assessment

6.1 Proposed Transformers at the Development Site

It is understood that 4 no. 30 to 40 MVA transformers are proposed within the substation structure, as shown in Figure 3.



Figure 3: Proposed Transformer Locations in Substation

The proposed transformer supplier has provided the following information for the candidate units:

"As per NEMA standard the guaranteed Sound Pressure Level (SPL) @ 2m for 30/40MVA Tx is 75 dB(A) (Please refer attached NEMA TR- standard) , however the actual measured sound Pressure Level for this range of transformer is around 68 dB(A) . The SWL (sound power) can be determined from measurements of SPL (sound pressure) as 92 dB(A)."

Therefore, it appears they will guarantee a sound pressure level of 75dB(A) at 2m, although the actual measured sound pressure level is 68dB(A) at 2m (7 dB less). Noise emissions from transformers can vary from unit to unit due to manufacturing tolerances.

In the absence of a sound frequency spectrum from the supplier, this has been derived from a typical transformer frequency spectrum published in the article 'Low-frequency and Tonal Characteristics of Transformer Noise', M. Gange, Australian Acoustics Society, November 2011. The typical transformer sound spectrum is presented in Figure 4.

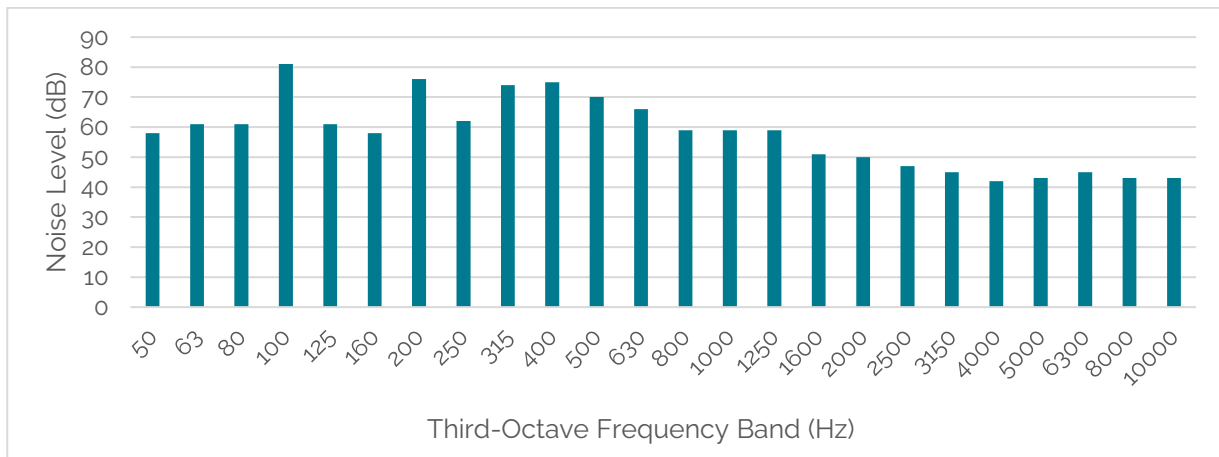


Figure 4: Typical Transformer Noise Spectrum (Gange, 2011)

6.2 Proposed Substation Construction

The proposed substation structure has been designed to minimise noise at receptors, and is formed of the following constructions:

- » External walls to substation enclosure formed of 100mm external brick + 150mm partially insulated cavity + 160mm block (assumed to be dense aggregate).
- » Knock-out brick panel to the south formed of twin layers of brick to a total of 215mm thickness.
- » Kingspan Multideck MD80-V2 composite concrete deck poured to 200mm above the 4 no. transformer units.
- » Attenuated supply and extract fans with attenuation as detailed in Section 7 of this report.
- » External access doorsets to each transformer bay providing a minimum weighted sound reduction index as provided by RoTec security solutions for a "Metal Door set with Mineral Wool plus one layer of 12.5mm plasterboard".

The constructions described above are shown in Figure 3 and Figure 5.

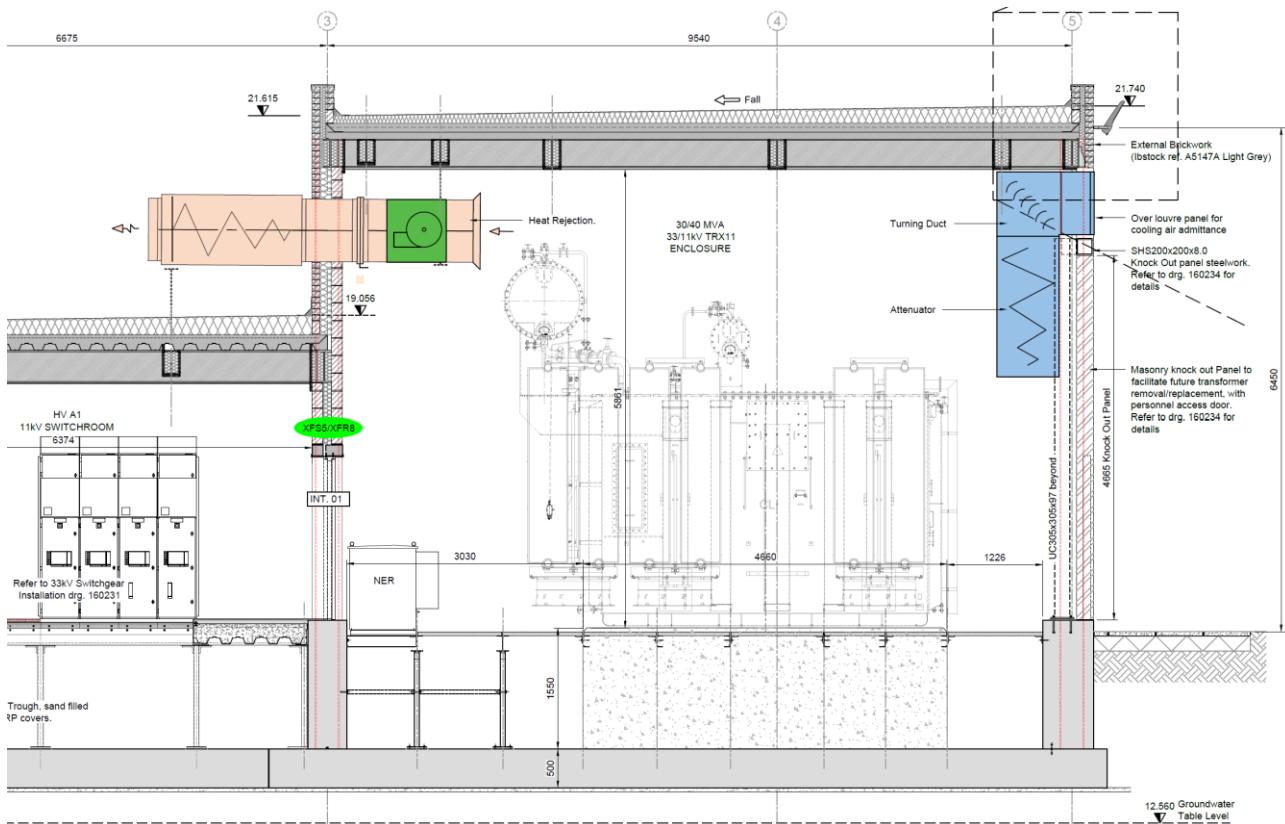


Figure 5: Proposed Substation Construction (Section)

The proposed transformers, substation structure and mitigation measures were originally modelled within noise mapping software, SoundPlan 8.2, to predict noise levels at the worst-affected façades of the nearest noise sensitive receptors. The model has been converted to SoundPlan Version 9.2, which implements the 2024 update to ISO 9613. The update did not result in a significant difference to predicted levels. Noise model outputs are presented within Appendix B, along with the input transmission and emission data for the external constructions and extract fans/transformers respectively.

6.3 Predicted Noise Levels at the NSRs

Based on the results of the noise modelling, the predicted sound levels at the nearest noise sensitive receptors due to operation of the proposed substation have been calculated. The results for the supplier guaranteed level (75dBA at 2m) are compared to the proposed noise emission limits in Table 4.

Table 4: Assessment of Noise Emissions from the Proposed Substation (supplier guaranteed level)

NSR	Predicted Rating Noise Level (dB)	Excess Above Limit (dB)	
		Daytime	Night time
2	33.9	-5.1	-0.1
5*	21.9	N/A	-12.1

*Based on background sound level at NSR2 (LT2)

Predicted Rating Noise Levels at NSR1, NSR3 and NSR4 were found to be negligible (<7dB). The predicted noise levels in Table 4 assume that the HVAC noise control strategy described in Section 7 is implemented.

6.4 Perceptibility of Tonal Noise at Receptors

A third-octave band tonal analysis of the calculated transformer noise emissions at the nearest receptors has been undertaken. The mitigation strategy has been designed specifically to control the 100Hz tone that is common to all electrical plant. With mitigation, a perceptible tone is not indicated at receptors from the combined substation and measured background sound levels. Therefore, a tonality acoustic feature correction is not necessary in this instance.

7. Control of Noise from and Via HVAC

The proposed substation comprises 4no. transformer bays. Each bay contains 1no. transformer, and is served for 4no. supply fans and 4no. extract fans. All transformers and associated supply fans are located internally within the substation structure, whereas the associated extract fans are located externally at the rear rooftop; see Figure 6.

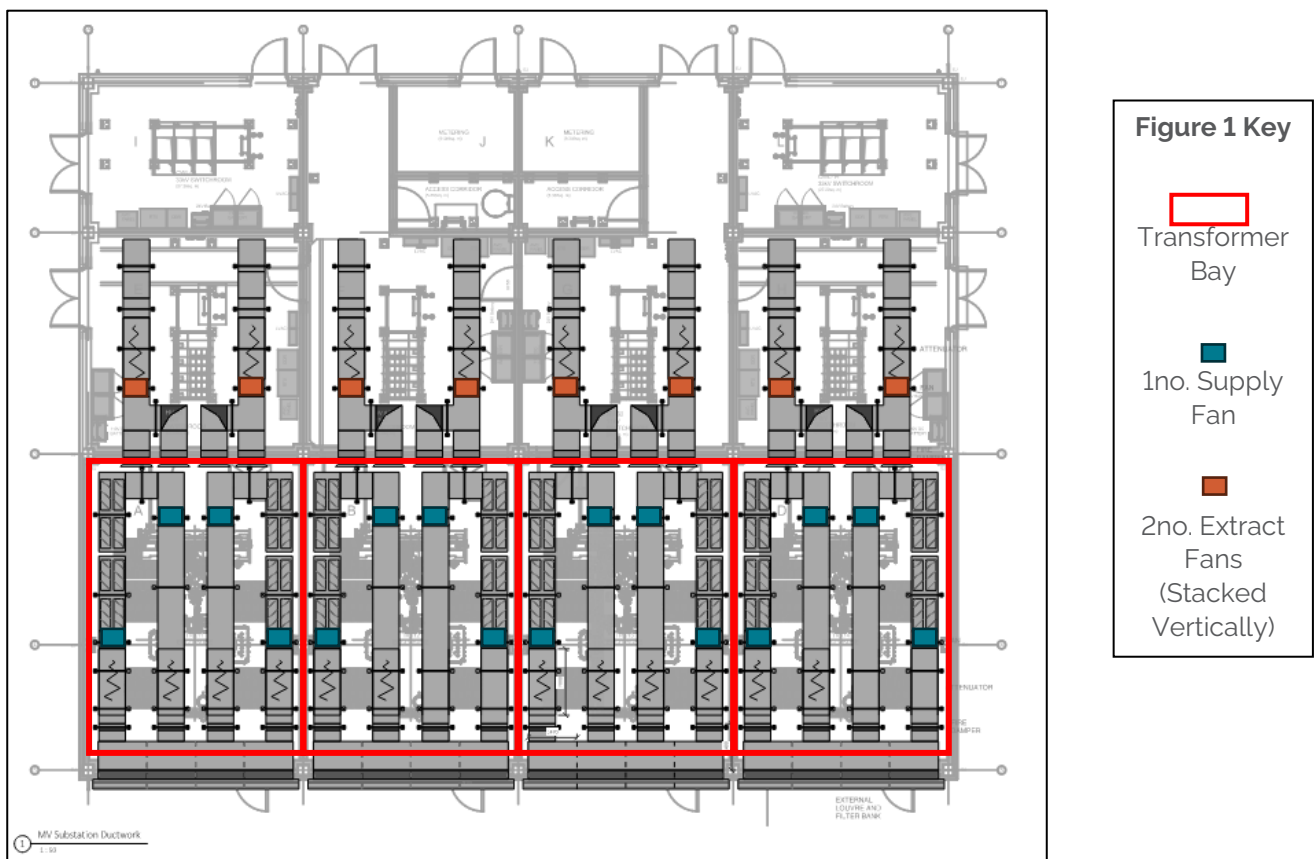


Figure 6: Transformer Bays and Associated Supply/Extract Fans

Attenuators are required to control atmospheric noise emissions from the supply and extract fans serving the transformer bays. Table 5 provides the minimum insertion loss figures (dB) in each centre frequency octave band (Hz) that are required from the transformer bay supply and extract attenuators.

Table 5: Transformer Bay Fans – Supply & Extract Attenuator Requirements

Supply/ Extract	Attenuator, Minimum Insertion Loss (dB) at Centre Frequency Octave Band (Hz)						
	63	125	250	500	1000	2000	4000
Supply	9	18	31	48	50	49	44
Extract	9	18	31	48	50	49	44

A 2100mm length attenuator with a 35% free area is expected to achieve the attenuator requirements shown above. However, this should be confirmed with an attenuator supplier and test data requested.

In addition to the attenuators located within the ductwork, lagging is required to control ductwork break-in and breakout noise emissions from the supply and extract fans. The lagging locations are shown in Figure 7.

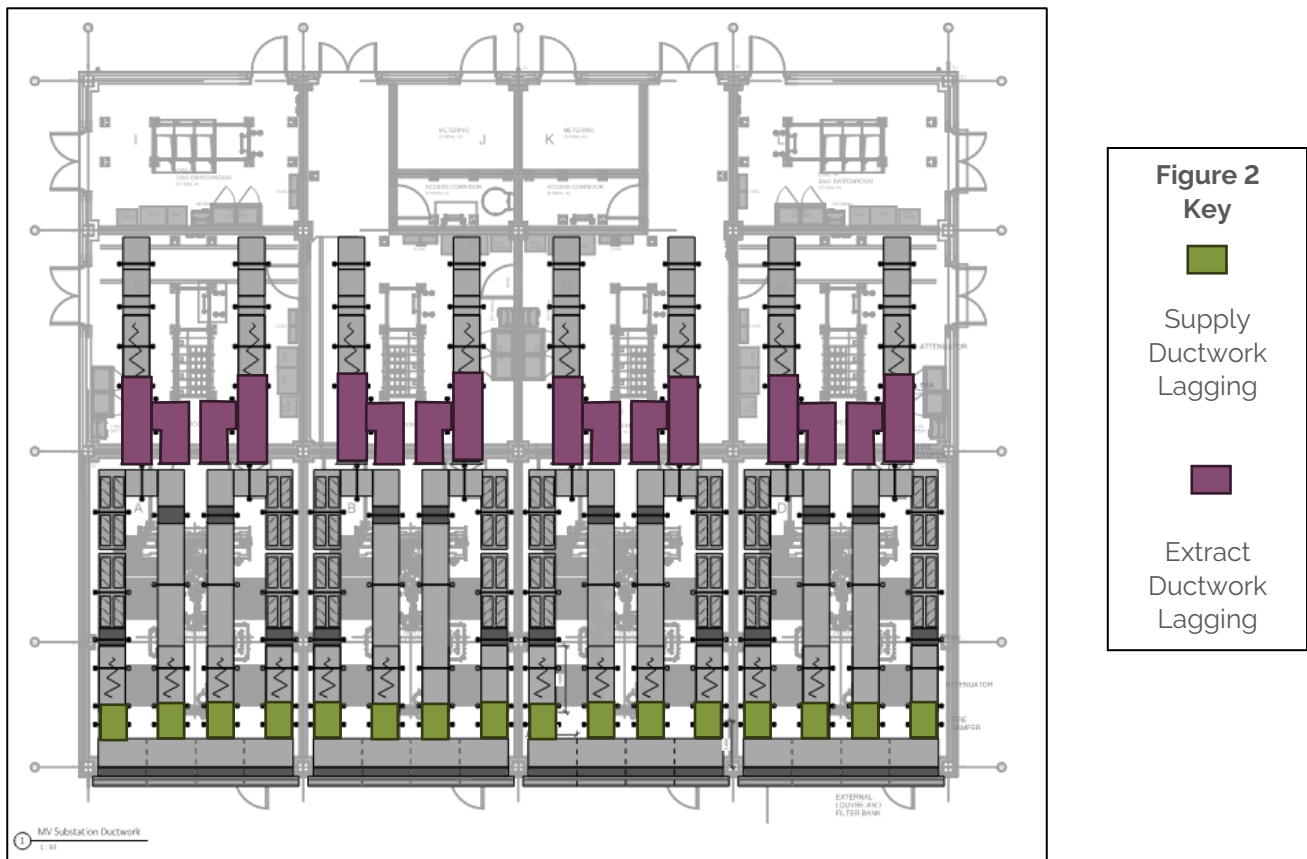


Figure 7: Transformer Bay Fans – Ductwork Lagging Locations

The ductwork lagging should be capable of achieving the minimum insertion loss figures (dB) in each centre frequency octave band (Hz) as shown in Table 6.

Table 6: Transformer Bay Fans – Ductwork Lagging Insertion Loss Requirements

Ductwork Lagging, Minimum Insertion Loss (dB) at Centre Frequency Octave Band (Hz)						
63	125	250	500	1000	2000	4000
6	8	16	24	30	30	30

The supply ductwork lagging should encase all ductwork between the attenuator and the weather louvre.

The extract ductwork lagging should encase all ductwork up to and including the extract fan itself, in order to control breakout fan noise from the extract fan. It is noted that typical acoustic duct lagging products may not be suitably robust for lagging external fan ductwork. Therefore, a rooftop enclosure could be considered that is able to fully enclose the extract ductwork lagging areas shown in Figure 7. The enclosure should be capable of achieving the minimum insertion loss requirements outlined in Table 6. An enclosure constructed of a light-weight insulated panel is expected to be suitable.

The substation structure contains ancillary rooms that are mechanically ventilated via 1no. supply fan and 1no. extract fan. The supply and extract fans are located externally on the rear rooftop, as shown in Figure 8.

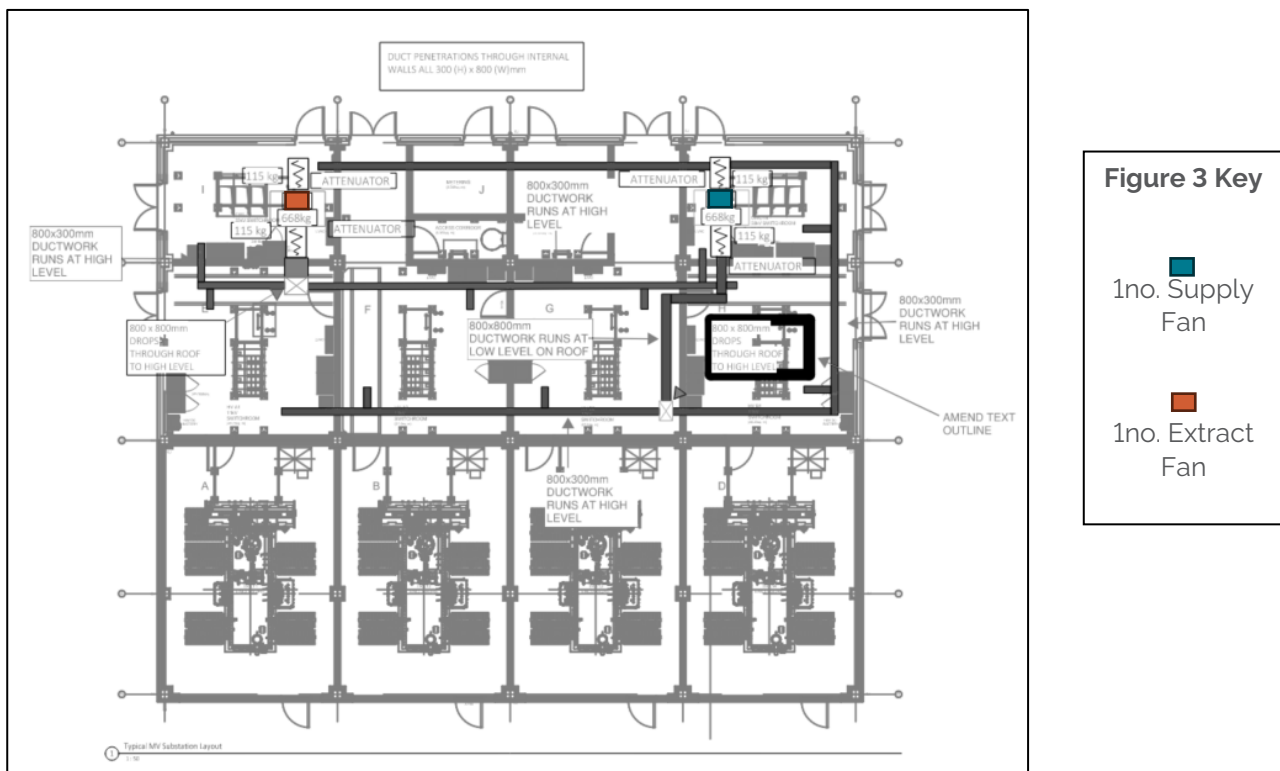


Figure 8: Supply/Extract Fans Serving Ancillary Rooms

Attenuators are required to control atmospheric noise emissions from the supply and extract fans serving the ancillary rooms. Table 7 provides the minimum insertion loss figures (dB) in each centre frequency octave band (Hz) that are required from the ancillary room supply and extract attenuators.

Table 7: Ancillary Room Fans – Supply & Extract Attenuator Requirements

Supply/ Extract	Attenuator, Minimum Insertion Loss (dB) at Centre Frequency Octave Band (Hz)						
	63	125	250	500	1000	2000	4000
Supply	4	9	17	26	31	30	23
Extract	4	7	13	19	23	23	16

A 1200mm length attenuator with a 40% free area is expected to achieve the supply attenuator requirements. A 900mm length attenuator with a 40% free area is expected to achieve the extract attenuator requirements. Again, attenuator selections should be made in consultation with the candidate supplier to achieve the insertion loss specification in Table 7.

In addition to the in-duct attenuators, lagging or an enclosure is required to control breakout fan noise from the supply and extract fans serving the ancillary rooms. The lagging or enclosure should fully enclose the supply and extract fans, and should be capable of achieving the minimum insertion loss figures (dB) in each centre frequency octave band (Hz) as shown in Table 8.

Table 8: Ancillary Room Fans – Lagging or Enclosure Insertion Loss Requirements

Lagging or Enclosure, Minimum Insertion Loss (dB) at Centre Frequency Octave Band (Hz)						
63	125	250	500	1000	2000	4000
6	8	10	10	10	10	10

Total noise from the substation HVAC plant should not be perceived as being tonal, intermittent, or impulsive at the nearby receptors. The fan supplier should be asked to confirm if noise emissions from the selected unit include a perceptible tonal character. It is advised that fan control systems aim for a slow ramp up and down to maximum designed RPM, over a period of circa 15 minutes.

8. Conclusion

Based on the transformer supplier's guaranteed levels, the proposed cavity masonry enclosure with masonry knock-out panel to the south and 200mm composite concrete roof can control noise from the transformers to the level required by Planning Condition 4, provided the HVAC mitigation measures detailed in Section 7 of this report are incorporated.

The modelling results indicate compliance with the noise emission limits (5dB below predevelopment background level). Hydrock would therefore conclude noise levels during normal operation in the daytime and night time are compliant with Planning Condition 4.

Furthermore, BS 4142:2014+A1 2019 states the following with regard to rating levels below the measured background sound level:

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 context.

Appendix A Baseline Noise Survey

Survey Methodology

Procedures

Long term unattended noise monitoring was carried out from 13:00 on the 24/05/2023 to 15:00 on 31/05/2023 at Positions LT1-4. A short-term early night-time sample measurement was also conducted between 22:55 and 23:16 on 30/05/2023. Data including L_{Aeq} and background L_{A90} were logged over the monitoring periods.

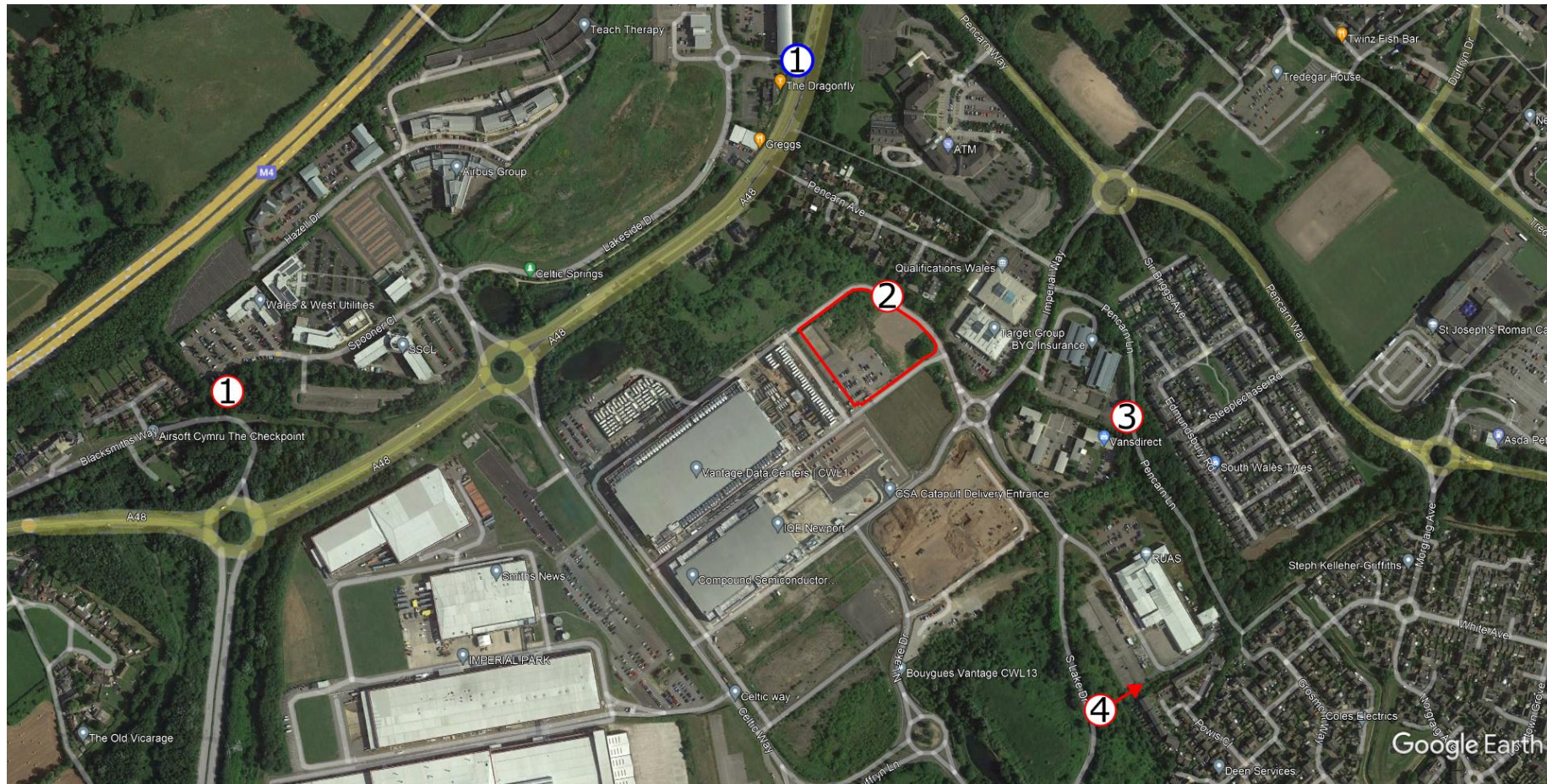
Measurements were undertaken in accordance with the guidance outlined in BS 4142:2014+A1 2019 and BS 7445-1:2003.

All measurement positions were free-field, i.e. at least 3.5m from sound reflecting surfaces except the ground. Wind shields were fitted to measurement microphones at all times.

The measurement locations are presented in Figure A1 below, and can be described:

- » LT1: Measurement position was located within woodland between residential properties on Blacksmiths Way and Wales & West Utilities' offices. Position was approx. 120m from the A48 roundabout and 150m from the M4 motorway.
- » LT2: Measurement position was located on the eastern site boundary at 1.5m above ground level and approximately 30m from the nearest residential dwelling on Pencarn Avenue.
- » LT3: Measurement position was located within woodland along Pencarn Lane, approximately 25m from the nearest dwelling on Edmundsbury Road.
- » LT4: Measurement position was moved during the survey period to a more secure location deemed more representative of the sound climate at residential properties on Powis Close. Between Wednesday 24/05/23 and Friday 13:00 30/05/23, the meter was setup just off South Lake Drive road. From Friday afternoon it was moved to the southern boundary of G24 Power Limited's carpark. This was after permission was received to enter the industrial site.
- » ST1: Short-term measurement position 1 was 1.5m above local ground height and approximately 10m from the A48 road. Measurement location was deemed representative of the sound climate impinging the hotel.

Monitoring Locations Site Plan



Long-term measurements are circled in **RED**. Short-term measurements are circled **BLUE**.

Meteorological Conditions

Weather conditions during the entire monitoring period were dry and sunny with an occasional breeze.

Measurement Equipment

The following measurement equipment was used during the surveys:

Table A 1: Survey Monitoring Equipment

Monitoring ID	Equipment	Manufacturer	Instrument	Serial No.	Date of Last Laboratory Calibration
LT1	Sound Level Meter	O1dB	FUSION	14940	12/01/2023
	Microphone	GRAS	40CD	494219	12/01/2023
	Calibrator	O1dB	CAL21	34213781	03/10/2022
LT2	Sound Level Meter	O1dB	FUSION	14526	02/05/2022
	Microphone	GRAS	40CD	470800	27/05/2022
	Calibrator	Cirrus	CR:515	96051	14/06/2022
LT3 *	Sound Level Meter	O1dB	FUSION	14016	18/05/2021
	Microphone	GRAS	40CD	415846	18/05/2021
LT4	Sound Level Meter	O1dB	FUSION	14018	12/04/2023
	Microphone	GRAS	40CD	504913	12/04/2023
ST1	Sound Level Meter	NTi Audio	XL2-TA	A2A-20607-E0	27/05/2022
	Pre-amp		MA220	10684	27/05/2022
	Microphone		MC230A	A23089	27/05/2022
	Calibrator	Cirrus	CR:515	95714	14/06/2022

*Note: LT3 sound level meter was out of calibration by 1 week. This error was not identified until after conducting the survey. Calibration of the sound level meter was carried out immediately after the survey - results of the calibration confirm SLM filters did not require significant corrections (i.e. <1dB). Therefore, it can be assessed that the accuracy of the measurements recorded during the survey period are sufficient and datasets remain valid.

Measurement systems were calibrated before and after the surveys and no variation occurred. Copies of traceable calibration certificates for all equipment are available upon request.

Survey Results

Long Term Measurements

Two main acoustic parameters were measured over the measurement period:

- » $L_{Aeq,T}$ dB, defined as the 'A' weighted equivalent continuous sound pressure level. Over a defined time period 'T', it is the sound pressure level equivalent to the acoustic energy of the fluctuating sound signal. It is often referred to as the 'ambient noise level'.
- » $L_{A90,T}$ dB, defined as the 'A' weighted sound pressure level exceeded for 90% of the measurement period 'T'. It is a statistical parameter and cannot be directly combined with other acoustic parameters. It is generally used to describe the prevailing background sound level within a BS4142:2014 +A1 2019 type assessment.

A summary of the 16-hour daytime (07:00 to 23:00) and 8-hour night time (23:00 to 07:00) equivalent continuous ambient sound levels ($L_{Aeq,T}$) for all monitoring positions are presented in the table below.

Table A 2: Measured Ambient Noise Levels

Measurement position	Period	Wed 24 May 2023	Thu 25 May 2023	Fri 26 May 2023	Sat 27 May 2023	Sun 28 May 2023	Mon 29 May 2023	Tue 30 May 2023	Wed 31 May 2023	Overall
LT1	Daytime L_{Aeq} (16hour) dB	54	58	58	57	58	56	59	60	58
	Night time L_{Aeq} (8hour) dB	57	58	57	57	58	58	58	-	58
LT2	Daytime L_{Aeq} (16hour) dB	51	53	52	53	51	48	50	51	52
	Night time L_{Aeq} (8hour) dB	51	50	49	47	48	45	49	-	49
LT3	Daytime L_{Aeq} (16hour) dB	54	55	55	53	52	52	52	53	53
	Night time L_{Aeq} (8hour) dB	52	52	53	50	51	49	50	-	52
LT4	Daytime L_{Aeq} (16hour) dB	55 *	56 *	54 *	45	45	45	49	50	47
	Night time L_{Aeq} (8hour) dB	48 *	48 *	49	47	52	48	49	-	49

*Note: LT4 monitoring position was moved, from its original position next to South Lake Drive road, to a more secure location within the carpark of G24 Power LTD. This was undertaken at 14:50 on Friday 26/05/2023. Survey data shows how vehicle pass-bys affected the daily L_{Aeq} values at the first monitoring position; therefore, these have been excluded from the overall (week) values. Infrequent vehicle pass-bys have not affected overall daytime & night-time background L_{A90} sound levels.

Table A3 shows the minimum consistent background L_{A90} noise levels for each long-term monitoring position. The values have been determined by analysing the L_{A90} background noise level distribution graphs - this is in line with BS 4142:2014+A1:2019 guidance and will be used for establishing environmental noise limits for plant.

Table A 3: Minimum Consistent Background Noise Levels

Period	Long Term Measurement Position			
	LT1	LT2	LT3	LT4
Daytime (07:00 to 23:00) $L_{A90,1hr}$ (dB)	52	44	45	41
Night-time (23:00 to 07:00) $L_{A90,15min}$ (dB)	46	39	38	38

Short Term Measurements

Two main acoustic parameters were measured using a time interval as stated in Table A4:

- » $L_{Aeq,T}$ dB, defined as the 'A' weighted equivalent continuous sound pressure level. Over a defined time period 'T', it is the sound pressure level equivalent to the acoustic energy of the fluctuating sound signal. It is often referred to as the 'ambient noise level'.
- » $L_{A90,T}$ dB, defined as the 'A' weighted sound pressure level exceeded for 90% of the measurement period 'T'. It is a statistical parameter and cannot be directly combined with other acoustic parameters. It is generally used to describe the prevailing background sound level within a BS 4142:2014+A1:2019 type assessment.

A summary of short-term sample measurements is presented in Table A4 below.

Table A 4: Summary of Attended Short-Term Sample Measurement Results

Position	Period (T)	Ambient Sound Level dB $L_{Aeq,T}$	Background Sound Level dB $L_{A90,T}$
ST1	30/05/23 22:55-23:16	47	44

Note: sample measurement results exclude vehicle pass-bys that were in close proximity of the measurement position. Measurement was controlled by distant road traffic and plant noise emissions from other commercial buildings.

Discussion

Observations of Residual Sound Climate

Based on on-site observations and an assessment of audio recordings obtained during the survey period, the prevailing ambient & background sound climate (or residual sound climate) at each monitoring location can be summarised:

- » LT1 Blacksmiths Way (NSR 1)
Sound climate dominated by A48 and distant M4 road traffic. Dawn chorus observed during early morning periods.
- » LT2 Pencarn Avenue (NSR 2)
Daytime sound climate controlled A48 road traffic. Night-time background sound climate controlled by hum from distant plant.

- » LT3 Edmundsbury Road (NSR 3)
Sound climate controlled by distant road traffic and continuous plant noise (broad band hum). Dawn chorus and bird noises throughout the daytime present.
- » LT4 Powis Close (NSR 4)
Sound climate controlled by occasional road traffic on South Lake Drive and construction activity on the near-by Bouygues Vantage CWL13 site. The background sound climate was controlled by distant plant noise hum likely emanating from the G24 Power Ltd facility. Note: Construction activity sound was not shown to significantly affect overall survey results.
- » ST1 Holiday Inn, Newport (NSR 5)
Sample measurement (when excluding near-by vehicle pass-bys) was controlled by distant road traffic and plant noise emissions from other commercial buildings.

Comparison with Atkins Survey Data

Atkins's survey data for the noise sensitive receptors shows reasonably good correlation with Hydrock's survey data. This is despite the Atkins survey data only covering a total 24-hour period at each monitoring location.

Table A5 below summarises a comparison of overall survey results:

Table A 5: Survey Results Comparison - Hydrock vs Atkins

Unattended Monitoring Location	Hydrock Survey		Atkins Survey		Difference (dB)	
	Day L _{A90} (dB)	Night L _{A90} (dB)	Day L _{A90} (dB)	Night L _{A90} (dB)	Day L _{A90} (dB)	Night L _{A90} (dB)
Blacksmith Way	52	46	51	45	1	1
Pencarn Avenue	44	39	45	41	1	2
Edmundsbury Road	45	38	47	43	2	5
Powis Close	41	38	36	36	5	2

With good correlation between both sets of surveys, this further reduces measurement uncertainty of background sound levels at the noise sensitive receptors, based on BS 4142:2014+A1:2019 guidance.

Appendix B SoundPlan Noise Model

Transformer Emission Data

Noise Source	Sound Power Level (dB) at Third-Octave Frequency Band (Hz)																					dB(A)
	50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k	
Transformer (Supplier Measured)	75	78	78	98	78	75	93	79	91	92	87	83	76	76	76	68	67	64	62	59	60	92
Transformer (Supplier Guaranteed)	82	85	85	105	85	82	100	86	98	99	94	90	83	83	83	75	74	71	69	66	67	99

Construction Transmission Data

Construction	Sound Reduction Index (dB) at Third-Octave Frequency Band (Hz)																					R _w
	50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k	
200mm Concrete	44	44	45	46	45	43	45	47	50	52	55	57	60	62	63	65	67	68	70	71	73	59
100mm Concrete	38	39	40	41	42	43	43	41	38	41	43	46	48	51	54	56	58	60	62	64	65	49

Ventilation Data

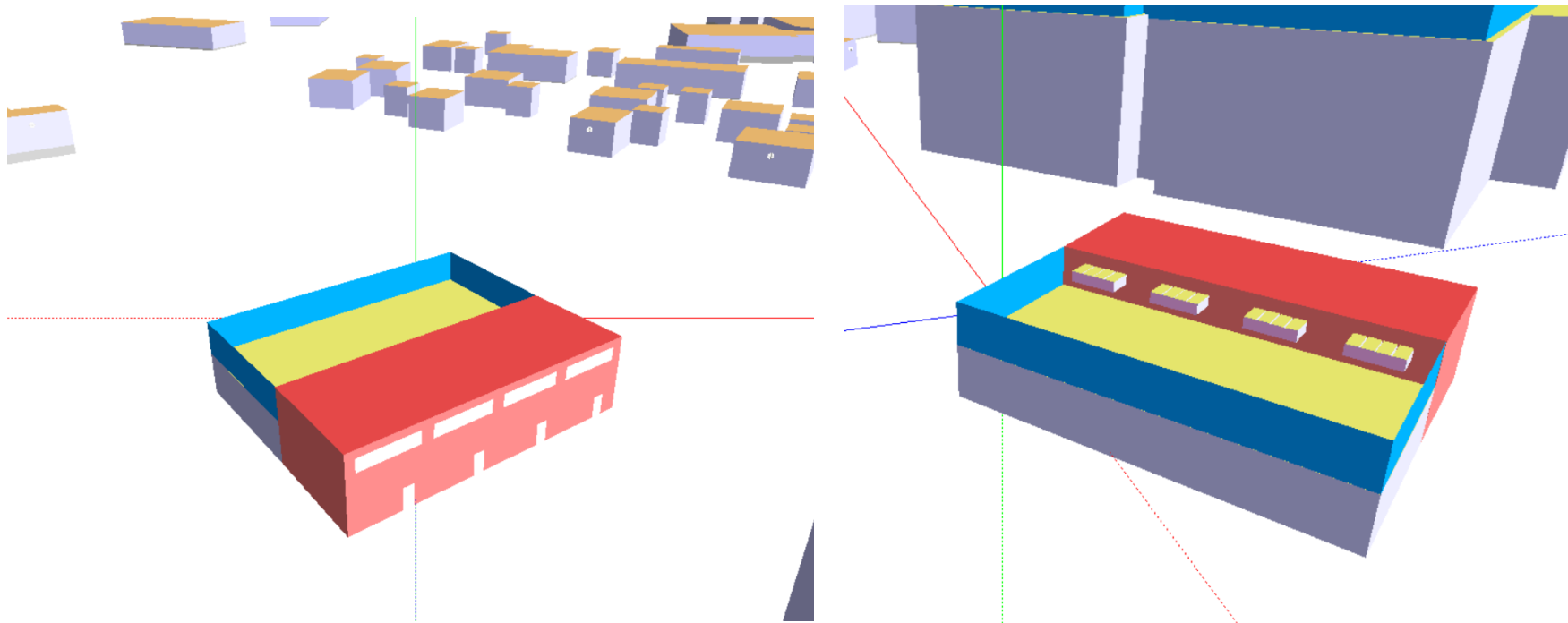
Supply Air Path to Each Transformer Bay

Supply Attenuator Insertion Loss (dB) as a function of octave-band frequency (Hz)							
63	125	250	500	1k	2k	4k	8k
-8	-18	-31	-49	-50	-50	-38	-24

Extract Air Path to Each Transformer Bay

Sound Power Level per Extract Fan as a function of octave-band frequency (Hz)							
63	125	250	500	1k	2k	4k	8k
70	72	73	74	74	71	68	67

Exhaust Attenuator Insertion Loss (dB) as a function of octave-band frequency (Hz)							
63	125	250	500	1k	2k	4k	8k
-6	-13	-25	-37	-44	-43	-30	-20



South Façade – 3D View

North Façade – 3D View

Appendix C BS4142:2014+A1 2019 Assessment

Estimate Transformer Noise Night-time Assessment

Results			Relevant Clause	Commentary
Estimated sound level at worst-affected receptor (NSR2) due to proposed substation	$L_{Aeq} =$	33.9 dB	7.3.2	Estimated sound level at receptor calculated using SoundPlan 8.2 noise model, see Table 4.
Background sound level at receptor (night-time)	$L_{A90} =$	39 dB	8.1.1, 8.1.3, 8.3	Background sound level measured at Position LT2.
Assessment made during the night-time so the reference time interval is 15 minutes.			7.2	
Acoustic feature correction		0 dB	9.2	No acoustic feature corrections deemed necessary in this instance.
Rating level	$(33.2 + 0) =$	33.9 dB		
Excess of rating over background sound level	$(33.2 - 39) =$	-5.1 dB	11	
Assessment indicates adverse impact unlikely depending on context			11	At 5.1dB below background, this is an indication of the sound having a low impact, depending on the context.
Uncertainty of assessment			10	Uncertainty in background noise measurements is considered low.