



**Independent Acoustic
Consultancy Practice**

Noise Impact Assessment

**Glasshouse at Five Fords
Wrexham**

5826/NIA1

Noise Impact Assessment

Project:	Glasshouse at Five Fords
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1. INTRODUCTION

A new agricultural Glasshouse at Five Fords is proposed adjacent to the water treatment works at Marchwiel, Wrexham, LL13 0PA.

The Client has requested a noise impact assessment is submitted to accompany the planning application.

It is understood that the main noise sources on site are CHPs, ventilation plant and HGV movements.

This report has therefore been commissioned to assess existing ambient and background noise representative of the closest sound sensitive receivers and predicts noise levels from proposed plant.

Survey results have been used for comparison with typical Local Authority Planning conditions and current planning guidance.

2. CRITERIA

2.1 British Standard 4142:2014

British Standard 4142:2014 “Methods for rating and assessing industrial and commercial sound”, provides current guidance for the assessment of industrial noise affecting residential receivers.

This standard describes a rating method comparing L_{Aeq} noise levels from the industrial source with pre-existing background L_{A90} levels at the residential receiver. It advises at a difference (industrial noise - background) of:

- +10dB or higher, likely to be an indication of a significant adverse impact, depending on the context.
- A difference of + 5dB, likely to be an indication of an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

A sliding scale of penalties can be applied to industrial/commercial sound levels which have acoustically distinguishing characteristics, including tonality, impulsivity and intermittency.

Tonality – A penalty of 2dB for a tone which is just perceptible at the noise receptor, 4dB where it is clearly perceptible, and 6dB where it is highly perceptible.

Impulsivity – A penalty of 3dB for impulsivity which is just perceptible at the noise receptor, 6dB where it clearly perceptible, and 9dB where it is highly perceptible.

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 3dB can be applied

Intermittency – If intermittency is readily distinctive against the residual acoustic environment, a penalty of 3dB can be applied.

BS 4142:2014 states under section 11;

“Where the initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration, including the following.

- 1) The absolute level of sound. 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.

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.”

The World Health Organisation (WHO) Guidelines for Community Noise 1999 advise a sleep disturbance criteria of 30dB(A) in bedrooms at night.

3. SOUND SENSITIVE RECEIVERS

In order to set environmental noise limits, it is first necessary to define the existing ambient and background noise climate at the agreed nearest Sound Sensitive Receivers (SSR's).

Figure 3.1 below shows the development site and the three closest existing SSRs in each direction. Continuous monitoring locations are also displayed for reference, discussed in section 4 below.

Figure 3.1 – Site Plan Showing Nearest SSRs & Measurement Positions

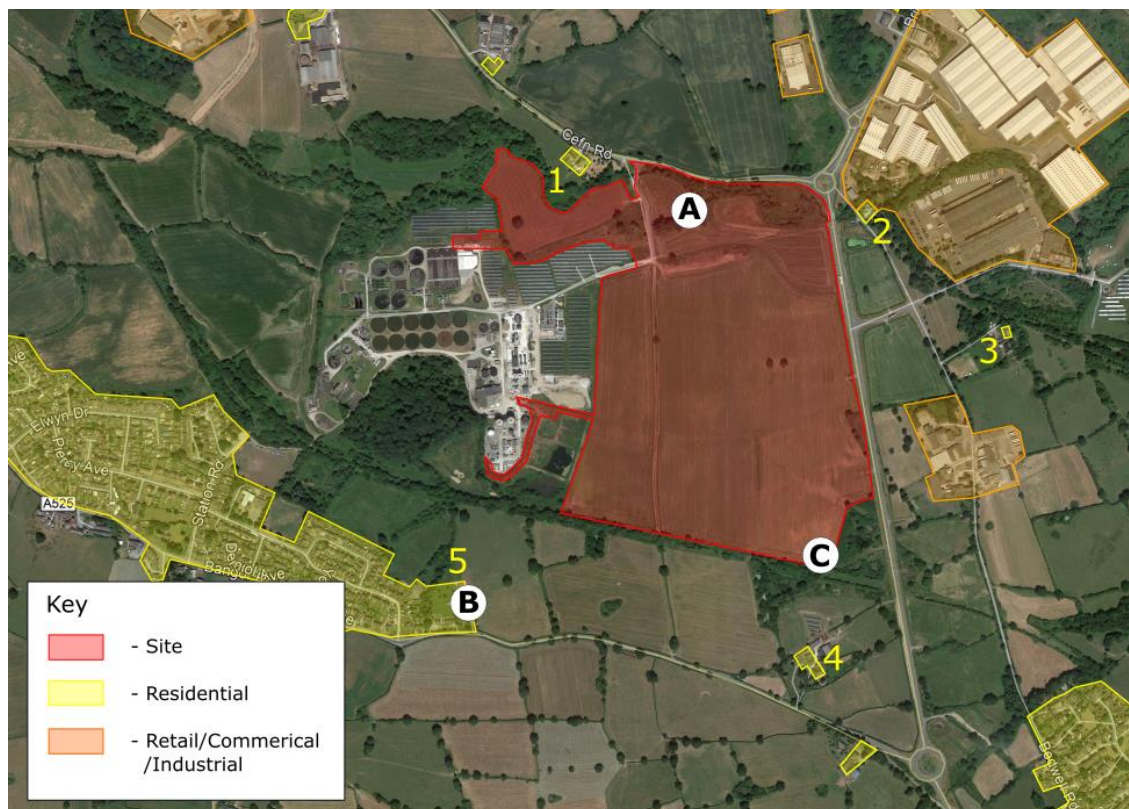


Table 3.1 – Nearest Sound Sensitive Receivers (Distance to Nearest Boundary)

SSR	Description	Approx. Distance (m)
1	Dwellings on Cefn Road to the north	50
2	Dwelling on Bedwell Road to the east	70
3	Farm house off Bedwell Road to the east	325
4	Dwelling off Bangor Road/A525 to the south	175
5	Holly Hedge Farm, Bangor Road/A525 to the south	275

4. ENVIRONMENTAL NOISE SURVEY

In order to set environmental noise limits, it is first necessary to define the existing ambient and background sound climate at the sound sensitive receivers (SSRs).

4.1 Procedures

Continuous noise monitoring was carried out from 1300hrs on Monday, 13 July 2020 to 1200hrs on Tuesday, 14 January 2020 at positions A-C to determine the existing daytime, evening and night-time background sound levels.

Data including L_{Amax} , L_{Aeq} and background L_{A90} was logged at 1 minute intervals over the monitoring period.

Site plan in Figure 3.1 above shows the development site and continuous monitoring positions used, namely:

Table 4.1 – Continuous Monitoring Location Details

Position	Description
A	Located at the northern end of the site, approximately 85m back from Cefn Road. Assessed representative of background sound climate at SSR1 and SSR2.
B	Located at south-eastern corner of the site. Assessed representative of background sound climate at SSR3 and SSR4.
C	Located at rear of Holly Hedge Farm (SSR5).

Note: All microphone positions approximately 1.5m above local ground level.

4.2 Meteorological Conditions

Approximate weather conditions are shown in time history graphs in Figure B.1 and Figure B.2 of Appendix B.

To summarise, the weather conditions during the monitoring period were dry with an occasional breeze.

4.3 Measurement Equipment

The following measurement equipment was used during the surveys:

Table 4.2 – Noise Monitoring Equipment List

Make	Description	Model	Serial Number	Last Calibrated	Certificate No.
NTi	Type 1 - Sound Level Meter	XL2-TA	A2A-08723-E0	30 October 2019	FL-19-235
	Preamplifier	MA220	1820	30 October 2019	FL-19-235
	Microphone	Capsule	9381	30 October 2019	FL-19-235
NTi	Type 1 - Sound Level Meter	XL2-TA	A2A-10021-E0	20 August 2019	TCRT19/1651
	Preamplifier	MA220	5435	20 August 2019	TCRT19/1651
	Microphone	Capsule	8547	20 August 2019	TCRT19/1651
NTi	Type 1 - Sound Level Meter	XL2-TA	ASA-14577-E0	22 June 2020	TCRT20/1313
	Preamplifier	MA220	7485	22 June 2020	TCRT20/1313
	Microphone	Capsule	A15594	22 June 2020	TCRT20/1313
Rion	Calibrator (94.03dB @ 984Hz)	NC-73	10355197	03 March 2020	UCRT20/1265

Measurement systems were calibrated before and after the surveys and no variation occurred.

Note: Copies of traceable calibration certificates for all equipment are available upon request.

4.4 Results

Time history graphs in Figure B.3, Figure B.4 and Figure B.5 of Appendix B show L_{Amax} , L_{Aeq} and L_{A90} sound pressure levels measured at positions A, B and C respectively.

Graphs in Figure B.6, Figure B.7 and Figure B.8 of Appendix B show statistical analysis of background sound levels measured at positions A, B and C respectively.

The following minimum consistent daytime and night-time background L_{A90} sound levels have been determined using statistical analysis in line with BS 4142 methodology;

Table 4.3 – Minimum Consistent Daytime and Night-time Background L_{A90} Results

Period	Position		
	A	B	C
Daytime (0700-2300hrs) $L_{A90,1hr}$ (dB)	42	38	37
Night-time (2300-0700hrs) $L_{A90,15mins}$ (dB)	32	33	31

In addition to the above, typical background and residual sound levels at Position A between 0530-0600hrs when staff vehicles may arrive were measured at;

- Position A $L_{Aeq,15mins}$ 51-52dB | $L_{A90,15mins}$ 46-48dB
- Position B $L_{Aeq,15mins}$ 43-45dB | $L_{A90,15mins}$ 40dB
- Position C $L_{Aeq,15mins}$ 46-49dB | $L_{A90,15mins}$ 41-42dB

Ambient noise levels were controlled by distant road traffic on the surrounding road network.

5. ENVIRONMENTAL NOISE CRITERIA

We propose setting the rating level (determined in accordance with BS 4142:2014) to be no more than 5dB above background sound level during the daytime (0700-2300hrs) and night-time (2300-0700hrs).

Table 5.1 – Proposed Environmental Rating Noise Limits

Residential SSR	Proposed Daytime Rating Limit $L_{Ar,1hr}$ (dB)	Proposed Night-time Rating Limit $L_{Ar,15mins}$ (dB)	Proposed 0530-0600hrs Rating Limit $L_{Ar,15mins}$ (dB)
SSR 1 (north) SSR 2 (east)	47	37	47*
SSR 3 (east) SSR 4 (south)	43	38	43*
SSR 5 (south)	42	36	42*

The above noise limits shall be confirmed acceptable with the Local Planning Authority/EHO.

* To form a robust assessment, these limits have been set in line with daytime limits as the period in question shows higher background sound levels..

6. NOISE IMPACT ASSESSMENT

Our analysis has used the proprietary NoiseMap Five (5.1.6) computer modelling software, in conjunction with procedures of;

BS 5228: Parts 1 & 2 2009 'Code of Practice for assessing noise and vibration on construction and open sites'.

This model allows noise levels from noise sources to be predicted over large distances and varying terrain. Attenuation is included accounting for distance, air absorption, ground absorption and screening losses from site topography/local structures. The analysis predicts resultant noise levels at the SSRs.

Drawings used in our assessment are referenced in Appendix D.

There are 3no main buildings containing fixed plant (some inside/some outside) on the scheme;

- **Energy Centre Building** – Containing CHP plant, heat pumps, standby boilers/generator with external CHP cooler fans and transformers. Located immediately north of the glasshouse buildings.

Figure B.10 in Appendix B shows the proposed layout of the Energy Centre plant which has been replicated in our model.

- **Heat Exchanger Building** – No significant noise sources in building, 1no transformer located externally. Located to the north-west of the site.
- **CO2 Recovery Building** – System yet to be engineered. Located to the south-west of the site.

6.1 Source Plant Noise Data

Source noise data for the various pieces of equipment is detailed below, taken from manufacturer's data sheets and test reports.

We have been advised from the CHP plant supplier that noise levels can vary due to ambient temperature (hotter ambient temperatures result in higher noise levels due to increased cooling requirements).

Based on historical meteorological data provided by our Client (shown in Figure B.9 in Appendix B), we have referenced CHP noise data based on 20°C at night to form a robust assessment covering the warmer summer nights.

The temperature figures provided are derived from Meteonorm, a leading international irradiation and ambient conditions software tool. The data set is an hourly typical meteorological year derived from 20 years of measured data from nearby met stations, derived for the specific site coordinates through a peer reviewed interpolation model.

Note: We understand that due to reduced heating & lighting requirements during summer months, only 2 CHPs are likely to run during night-time hours.

Table 6.1 – Plant Noise Schedule (Based on 20°C Ambient Temp)

Make	Model	Description	No	Location	Duty	Measurement Location	dB(A)	Unit
AB Cogeneration World	Ecomax 12 GH	CHP Plant (based on 20degC amb temp)	1	Internal	1.201 kWe	EXHAUST STACK	52.0	L_{eq} @ 10m
						AIR INLET SYSTEM	56.0	L_{eq} @ 10m
						AIR OUTLET SYSTEM	58.0	L_{eq} @ 10m
						ECOMAX WALLS	53.9	L_{eq} @ 10m
AB Cogeneration World	Ecomax 27 GH	CHP Plant (based on 20degC amb temp)	3	Internal	2.681 kWe	EXHAUST STACK	54.0	L_{eq} @ 10m
						AIR INLET SYSTEM	60.0	L_{eq} @ 10m
						AIR OUTLET SYSTEM	60.0	L_{eq} @ 10m
						ECOMAX WALLS	53.9	L_{eq} @ 10m
Armec	HWF7213A G0ZZ	Heat Pump	17	Internal	Full Load (Cooling)	Sound Power	97.5	L_w
Antonio Seveso	190972	CHP Dry Cooler Fan Bank (based on 20degC amb temp)	8	External	248kW	Per bank of fans	50.0	L_{eq} @ 10m
Unknown	Unknown	Transformer	7	External	2250K	At 1m (taken from data sheet on past project for 2MVA transformer)	59.8	L_{eq} @ 1m

Table B.1 in Appendix B includes octave band sound pressure level spectra for internal plant used to determine breakout from the building fabric of the plant room.

At 15°C ambient temperature (which is indicated to be met for the majority of summer nights - see Figure B.9 in Appendix B), the following reductions in noise levels are indicated for the CHP air inlet, outlet and dry coolers (stack noise not affected by ambient temperature).

Table 6.2 – CHP Plant Noise Schedule (Based on 15°C Ambient Temp)

Make	Model	Description	No	Location	Duty	Measurement Location	dB(A)	Unit
AB Cogeneration World	Ecomax 12 GH	CHP Plant (based on 15degC amb temp)	1	Internal	1.201 kWe	EXHAUST STACK	52.0	L_{eq} @ 10m
						AIR INLET SYSTEM	51.0	L_{eq} @ 10m
						AIR OUTLET SYSTEM	53.0	L_{eq} @ 10m
						ECOMAX WALLS	53.9	L_{eq} @ 10m
AB Cogeneration World	Ecomax 27 GH	CHP Plant (based on 15degC amb temp)	3	Internal	2.681 kWe	EXHAUST STACK	54.0	L_{eq} @ 10m
						AIR INLET SYSTEM	53.0	L_{eq} @ 10m
						AIR OUTLET SYSTEM	55.0	L_{eq} @ 10m
						ECOMAX WALLS	53.9	L_{eq} @ 10m
Antonio Seveso	190972	CHP Dry Cooler Fan Bank (based on 15degC amb temp)	8	External	248kW	Per bank of fans	50.0	L_{eq} @ 10m

The preferred suppliers should confirm noise levels of all plant to be installed prior to orders being placed.

In addition to the above, we understand that;

- Working hours (0600-1800hrs weekdays, occasional weekend work 0600-1500hrs)
- Up to 45 HGV collections per day (daytime hours only i.e. between 0700-1800hrs) HGVs modelled at L_{Amax} 83dB at 10m (ref BS 5228-1 table C.11)
- 143 staff car arrivals 0530-0600hrs and leave 1800-1830hrs

Staff cars modelled at L_{Amax} 60dB at 10m (ref Hunter Acoustics database)

Note: Emergency standby plant (boilers and diesel generator) has not been included in our predictions at this stage.

6.2 External Building Fabric of Main Plant Room

Due to the proximity of nearby SSRs, an uprated cladding performance is indicated to be required for the walls/roof/door of the energy centre building in order to meet proposed limits.

- Roof Based on Kingspan insulated panel with 15mm plasterboard (10kg/m²) liner (R_w 41dB)
- Walls As above
- Door 1no insulated roller shutter door on eastern end of northern elevation (R_w 18dB)

Estimated sound reduction performance data is referenced below, taken from Kingspan test data for the cladding and from Clark Door test data for R_w 18dB roller shutter door.

This has been used in our model to predict plant noise breakout from the plant room.

Table 6.3 – Estimated Sound Reduction Performance for Main Plant Room

Element	Sound Reduction Index (SRI: BS EN ISO 140) at Octave Band Centre Frequencies (Hz)						
	63	125	250	500	1k	2k	4k
Wall / Roof	14	17	31	40	48	46	56
1no insulated roller shutter door	-	7	13	18	21	17	-

Your final supplier should provide laboratory test data to confirm the above SRI figures can be achieved for the complete system including walls, roof, doors and any ventilation elements. Final proposals should be forwarded for approval.

Note: Any duct, flue or cable penetrations through the walls/roof of the plant room, or louvred areas, would need to be acoustically treated so as to not compromise the sound reduction performance figures quoted for the walls/roof in Table 6.3 above.

6.3 Noise Map Analysis

The following noise sources are included in the model;

Energy Centre

- 4no CHP inlet noise sources modelled at 9.7m above local ground height
- 4no CHP outlet noise sources modelled at 9.7m above local ground height
- 4no CHP exhaust stack noise sources modelled 12m above local ground height
- 1no plant room containing internal plant modelled at 7m above local ground height
- 8no banks of CHP cooler fans at 2.95m above local ground height
- 6no transformer noise sources modelled at 2.5m above local ground height

Heat Exchanger Building

- 1no transformer noise source modelled at 2.5m above local ground height

CO2 Recovery Building

- Yet to be designed. Noise limits set at 55dB(A) at 10m from the building with all plant associated with this building running at normal design duty.

Vehicles

- HGV source modelled at 1.0m above local ground height (daytime only)
- Car source modelled at 0.5m above local ground height

Four models have been created to assess the impact of the proposed development;

- 1) A worst-case daytime (0700-2300hrs) based on 20°C CHP noise data
- 2) A worst-case summer night-time (2300-0700hrs) based on 20°C CHP noise data (only 2no CHPs running)
- 3) A worst-case rest of year night-time (2300-0700hrs) based on 15°C CHP noise data (all 4no CHPs running)
- 4) A 15minute summer night-time period for staff arrival (0530-0545hrs) based on 20°C CHP noise data (only 2no CHPs running)

6.3.1 Daytime Operation (1hr assessment period)

- 4 HGVs arriving and leaving
- All fixed plant running

Note: Loading is to take place by direct docking on to the loading bays so goods are not handled outdoors.

Predicted levels at critical receiver locations are shown in Table 6.4 below;

Table 6.4 – Daytime Noise Map Predictions

Sound Sensitive Receiver (SSR)	Level Above Ground	Predicted Daytime $L_{Aeq,1hr}$ (dB)
SSR1 (north)	1.5m	43
	4.5m	44
SSR2 (east)	1.5m	37
	4.5m	39
SSR3 (east)	1.5m	31
	4.5m	32
SSR4 (south)	1.5m	32
	4.5m	33
SSR5 (south)	1.5m	32
	4.5m	33

The noise map model in Figure C.1 of Appendix C shows the predicted daytime noise contour plot across the surrounding area to critical SSRs at 4.5m above local ground height.

Detailed line by line workings for the most critical receiver (SSR1) at first floor level are shown in Table C.1 of Appendix C.

6.3.2 Night-time Operation (15min assessment period)

- No HGV movements
- All fixed plant running (with exception of 2no CHPs when ambient temp is at 20°C)

Predicted levels at critical receiver locations are shown in Table 6.5 below;

Table 6.5 – Night-time (Plant Only) Noise Map Predictions

Sound Sensitive Receiver (SSR)	Level Above Ground	Predicted Night-time $L_{Aeq,15min}$ (dB)	
		20°C Ambient Temperature	15°C Ambient Temperature
SSR1 (north)	1.5m	34	34
	4.5m	35	35
SSR2 (east)	1.5m	30	32
	4.5m	33	35
SSR3 (east)	1.5m	25	27
	4.5m	26	28
SSR4 (south)	1.5m	29	30
	4.5m	30	31
SSR5 (south)	1.5m	28	29
	4.5m	29	30

Noise map models in Figure C.2 and Figure C.3 of Appendix C show the predicted night-time noise contour plots for 20°C and 15°C ambient temperatures respectively across the surrounding area to critical SSRs at 4.5m above local ground height.

Detailed line by line workings for the most critical receiver (SSR1) at first floor level are shown in Table C.2 (20°C) and Table C.3 (15°C) of Appendix C.

6.3.3 Staff Arrival during Night-time (15min assessment period)

An additional assessment has been undertaken covering a worst case 15minute period around 0530hrs with all 143 staff vehicles arriving in that period, as well as all night-time plant listed in section 6.3.2 above running during the 20°C summer night (2no CHPs running).

Predicted levels at critical receiver locations are shown in Table 6.6 below;

Table 6.6 – Night-time (Plant & Staff Arrival) Noise Map Predictions

Sound Sensitive Receiver (SSR)	Level Above Ground	Predicted Night-time $L_{Aeq,15min}$ (dB)
SSR1 (north)	1.5m	35
	4.5m	37
SSR2 (east)	1.5m	31
	4.5m	34
SSR3 (east)	1.5m	26
	4.5m	27
SSR4 (south)	1.5m	29
	4.5m	30
SSR5 (south)	1.5m	28
	4.5m	29

The noise map model in Figure C.4 of Appendix C shows the predicted daytime noise contour plot across the surrounding area to critical SSRs at 4.5m above local ground height.

Detailed line by line workings for the most critical receiver (SSR1) at first floor level are shown in Table C.4 of Appendix C.

7. DISCUSSION

At this initial stage, assessments are based on manufacturer's noise data which does not include full third-octave band or impulsivity information.

An initial assessment of possible BS 4142:2014 industrial characteristic penalties has therefore been undertaken to give an indicative rating level at this stage. Plant noise levels could exhibit tonal characteristics, but are unlikely to be impulsive.

Predicted noise levels should be agreed acceptable with the Local Planning Authority's Environmental Protection Team.

7.1 Daytime Operations

During the daytime, HGV pass-bys on the access road are indicated to be the dominant noise source. Predicted L_{Aeq} levels of up to 44dB are indicated. In the context of a pre-existing daytime noise climate controlled by road traffic, we would suggest additional HGV pass-bys are unlikely to exhibit significant additional tonal or impulsive characteristics, a 3dB rating penalty has therefore been applied to this source.

BS 4142:2014 assessments for the daytime scenario are included in Table B.3 to Table B.7 of Appendix B.

Results of these are summarised in Table 7.1 below;

Table 7.1 – Predicted Daytime Rating Levels at SSRs

Sound Sensitive Receiver (SSR)	Predicted Daytime Rating Level at First Floor Level $L_{Ar,1hr}$ (dB)	Proposed Daytime Rating Level Limit $L_{Ar,1hr}$ (dB)
SSR 1 (north)	47	47
SSR 2 (east)	42	47
SSR 3 (east)	35	43
SSR 4 (south)	36	43
SSR 5 (south)	36	42

Overall rating levels of 35-47dB $L_{Ar,1hr}$ at first floor levels of the sound sensitive receivers are therefore indicated to meet the proposed 42-47dB $L_{Ar,1hr}$ daytime noise criteria.

7.2 Night-time (Plant Only) Operations

Given the distance to receivers and relatively low absolute noise levels predicted outside residential dwellings ($\leq 35\text{dB } L_{Aeq,15\text{mins}}$), we have allowed a 2dB rating penalty for a tone which is just perceptible at the receiver at night.

BS 4142:2014 assessments for the night-time (plant only) scenario are included in Appendix B in Table B.8 to Table B.12 for the 20°C scenario and Table B.13 to Table B.17 for the 15°C scenario.

Results of these are summarised in Table 7.2 below;

Table 7.2 – Predicted Night-time (Plant Only) Rating Levels at SSRs

Sound Sensitive Receiver (SSR)	Predicted Night-time Rating Level at First Floor Level $L_{Ar,15\text{min}}$ (dB)		Proposed Night-time Rating Level Limit $L_{Ar,15\text{min}}$ (dB)
	20°C Ambient Temperature	15°C Ambient Temperature	
SSR 1 (north)	37	37	37
SSR 2 (east)	35	37	37
SSR 3 (east)	28	30	38
SSR 4 (south)	32	33	38
SSR 5 (south)	31	32	36

Overall rating levels of 28-37dB $L_{Ar,15\text{min}}$ at first floor levels of the sound sensitive receivers are therefore indicated to meet the proposed 37-38dB $L_{Ar,15\text{min}}$ night-time noise criteria.

With absolute L_{Aeq} levels at 35dB and lower, assuming a 15dB loss through a partially open window, noise levels in bedrooms are indicated to fall below the World Health Organisation (WHO) 30dB(A) sleep disturbance criteria, ensuring good internal ambient noise conditions.

7.3 Night-time (Plant & Staff Arrival) Operations

Given the distance to receivers and relatively low absolute plant noise levels predicted outside residential dwellings as discussed in section 7.2 above, we have again allowed a 2dB rating penalty for a tone which is just perceptible at the receiver at night.

BS 4142:2014 assessments for the night-time (plant & staff arrival) scenario are included in Table B.18 to Table B.22 of Appendix B.

Results of these are summarised in Table 7.3 below (20°C summer conditions);

Table 7.3 – Predicted Night-time (Plant & Staff Arrival) Rating Levels at SSRs

Sound Sensitive Receiver (SSR)	Predicted Night-time Rating Level Limit at First Floor Level $L_{Ar,15min}$ (dB)	Proposed Night-time Rating Level Limit $L_{Ar,15min}$ (dB)
SSR 1 (north)	39	47
SSR 2 (east)	36	47
SSR 3 (east)	29	43
SSR 4 (south)	32	43
SSR 5 (south)	31	42

Overall rating levels of 29-39dB $L_{Ar,15min}$ at first floor levels of the sound sensitive receivers are therefore indicated to easily meet the proposed 42-47dB $L_{Ar,15min}$ noise criteria for staff arrivals between 0530-0600hrs.

With absolute L_{Aeq} levels at 37dB and lower, assuming a 15dB loss through a partially open window, noise levels in bedrooms are indicated to fall below the World Health Organisation (WHO) 30dB(A) sleep disturbance criteria, ensuring good internal ambient noise conditions.

8. GOOD PRACTICE GUIDANCE

BS 5228-1:2009 gives general information on control of noise at source.

A summary of practical measures in the choice and use of plant to reduce noise is given below:

- Avoid unnecessary revving of engines and switch off equipment when not required.
- Ensure plant and vehicles are properly maintained, check silencers and bearings.
- If the noise is directional, point the source away from noise-sensitive locations.
- Keep internal haul routes well maintained and avoid steep gradients.
- Use rubber linings in, for example, chutes and dumpers to reduce impact noise.
- Minimise drop height of materials.
- Limit the use of particularly noisy plant or vehicles.
- Start-up plant and vehicles sequentially rather than together.
- Ensure the plant and vehicles are operated with noise control hoods closed.

In addition, we would advise that;

- Broadband reversing alarms should be fitted to all mobile plant on site.
- Refrigeration plant on HGV trailers should be powered by an electric hook-up if they are to be kept running for any extended period of time.

9. CONCLUSION

A noise impact assessment has been carried out for the proposed Glasshouse at Five Fords in Marchwiel, Wrexham, LL13 0PA.

An environmental noise survey has been carried out at the site which indicates low background sound levels during the night-time (31-33dB $L_{A90,15mins}$).

Rating level limits assessed in accordance with BS 4142:2014 have been proposed at 5dB above the existing background sound climate – these should be agreed acceptable with the Local Planning Authority's Environmental Health Officer (EHO).

A noise map model has been used to predict noise levels from the proposed plant layout to the existing sound sensitive receivers (SSRs) for comparison with proposed limits.

Note: Emergency standby plant has not been included in the noise model.

Four models have been created to assess the impact of the proposed development;

- 1) A worst-case daytime (0700-2300hrs) based on 20°C CHP noise data
- 2) A worst-case summer night-time (2300-0700hrs) based on 20°C CHP noise data (only 2no CHPs running)
- 3) A worst-case rest of year night-time (2300-0700hrs) based on 15°C CHP noise data (all 4no CHPs running)
- 4) A 15minute summer night-time period for staff arrival (0530-0545hrs) based on 20°C CHP noise data (only 2no CHPs running)

Based on the low predicted absolute noise levels at night (25-35dB $L_{Aeq,15mins}$), allowing for a 2dB penalty for tonality just perceptible under BS 4142:2014, the proposed limits are indicated to be met.

APPENDIX A - ACOUSTIC TERMINOLOGY

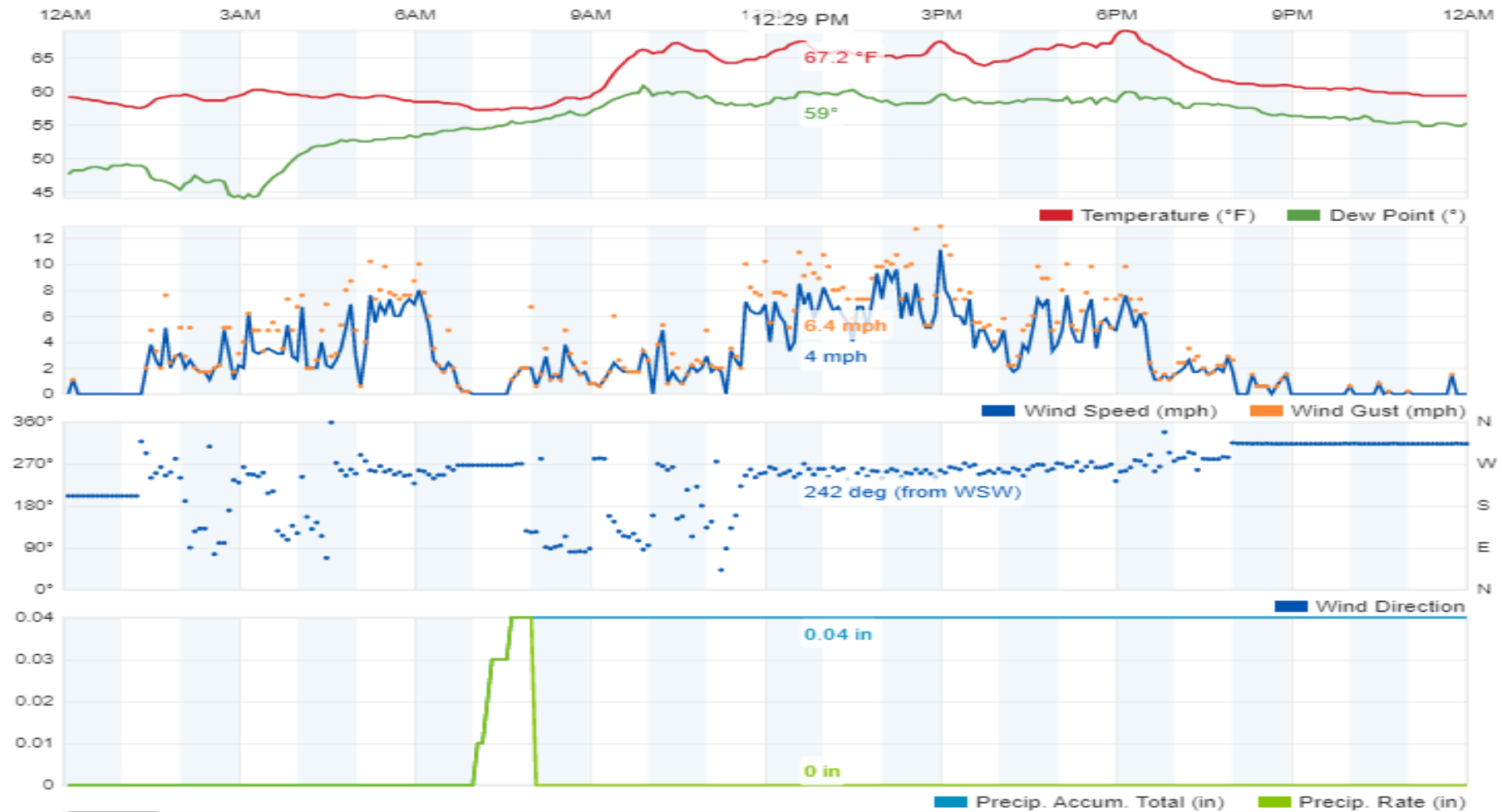
Human response to noise depends on a number of factors including loudness, frequency content and variations in level with time. Various frequency weightings and statistical indices have been developed in order to objectively quantify 'annoyance'.

The following units have been used in this report:

dB(A)	The sound pressure level A-weighted to correspond with the frequency response of the human ear and therefore a persons' subjective response to frequency content.
L_{eq}	The equivalent continuous sound level is a notional steady state level which over a quoted time period would have the same acoustic energy content as the actual fluctuating noise measured over that period.
L_{max}	The highest instantaneous sound level recorded during the measurement period.
L_{10}	The sound level which is exceeded for 10% of the measurement period. i.e. The level exceeded for 6 minutes of a 1 hour measurement - used as a measure of background noise.
L_{90}	The sound level which is exceeded for 90% of the measurement period. i.e. The level exceeded for 54 minutes of a 1 hour measurement - used as a measure of background noise.
$L_{Ar,Tr}$	The 'rating' level, as described in BS 4142:2014 – the specific noise plus any adjustment for the characteristic features of the noise.
SSR	Sound sensitive receiver

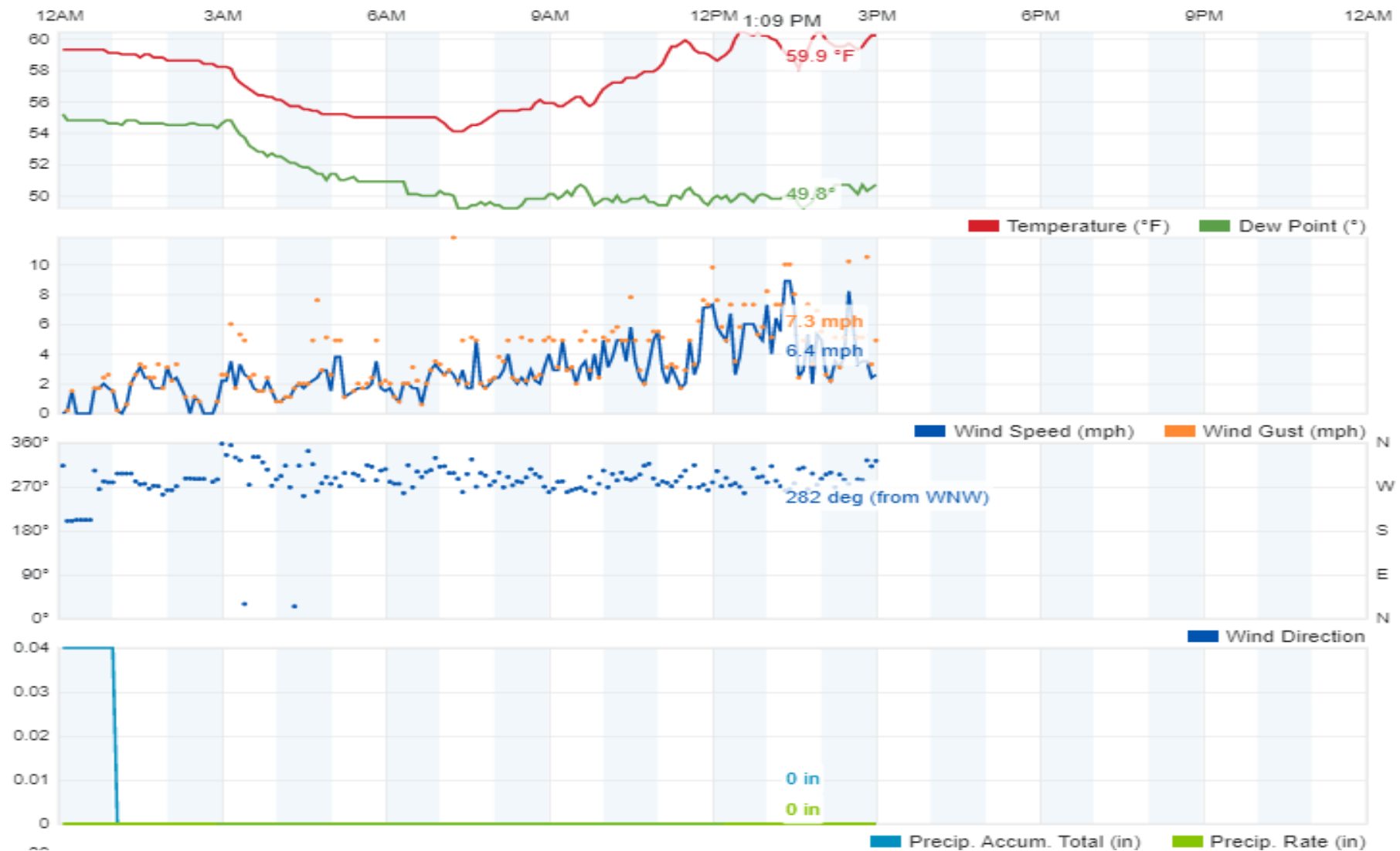
APPENDIX B - DIAGRAMS, GRAPHS AND TABLES

Figure B.1 – Approximate Weather History for Monday, 13 July 2020



Note: Taken from www.wunderground.com - weather station IWALESWR3 located in Wrexham [Elev 338, 53.035° N, 3.023° W]

Figure B.2 – Approximate Weather History for Tuesday, 14 July 2020



Note: Taken from www.wunderground.com - weather station IWALESWR3 located in Wrexham [Elev 338, 53.035° N, 3.023° W]

Figure B.3 – Time History at Position A (Monday, 13 July 2020 to Tuesday, 14 July 2020)

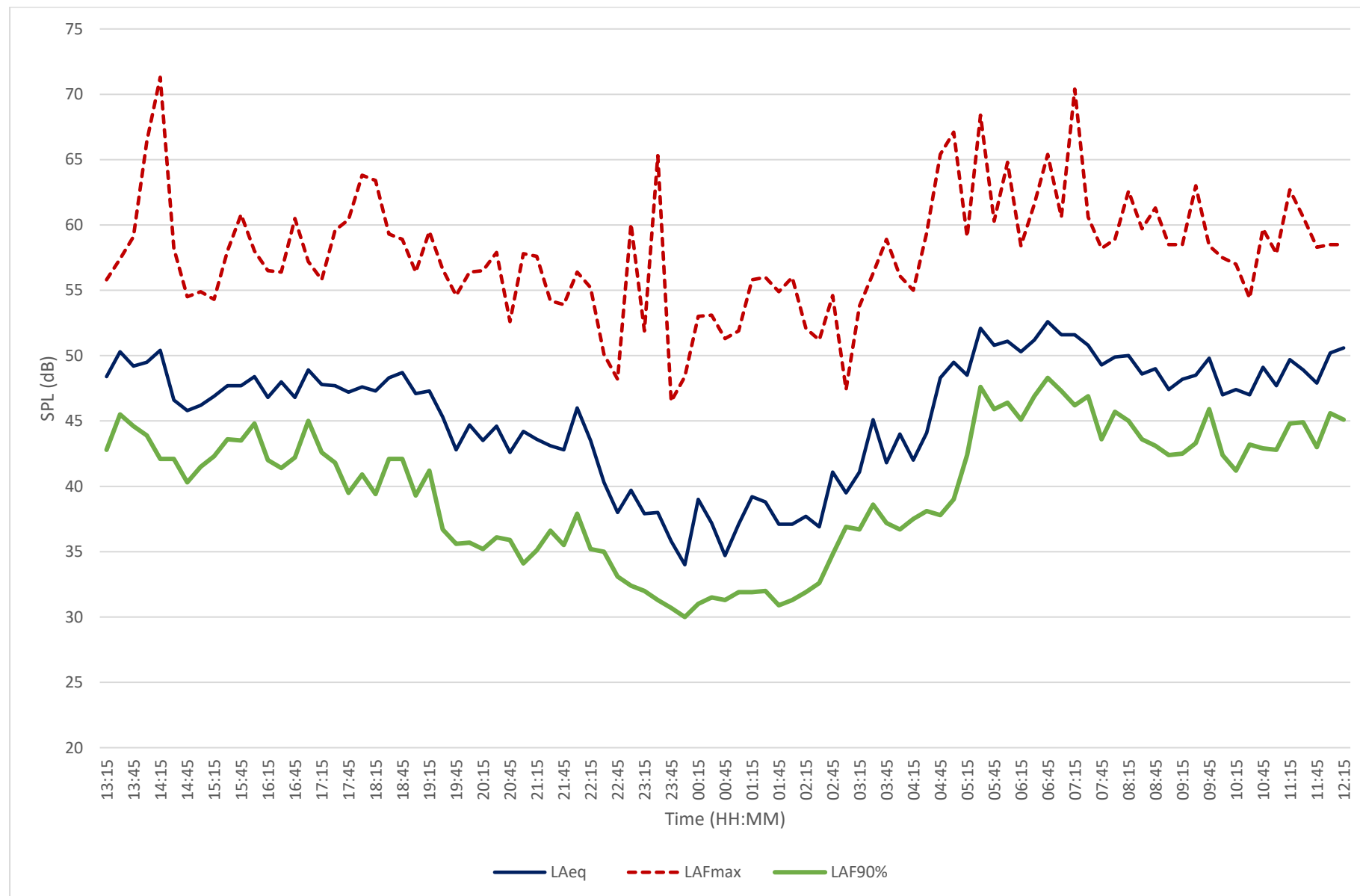


Figure B.4 – Time History at Position B (Monday, 13 July 2020 to Tuesday, 14 July 2020)

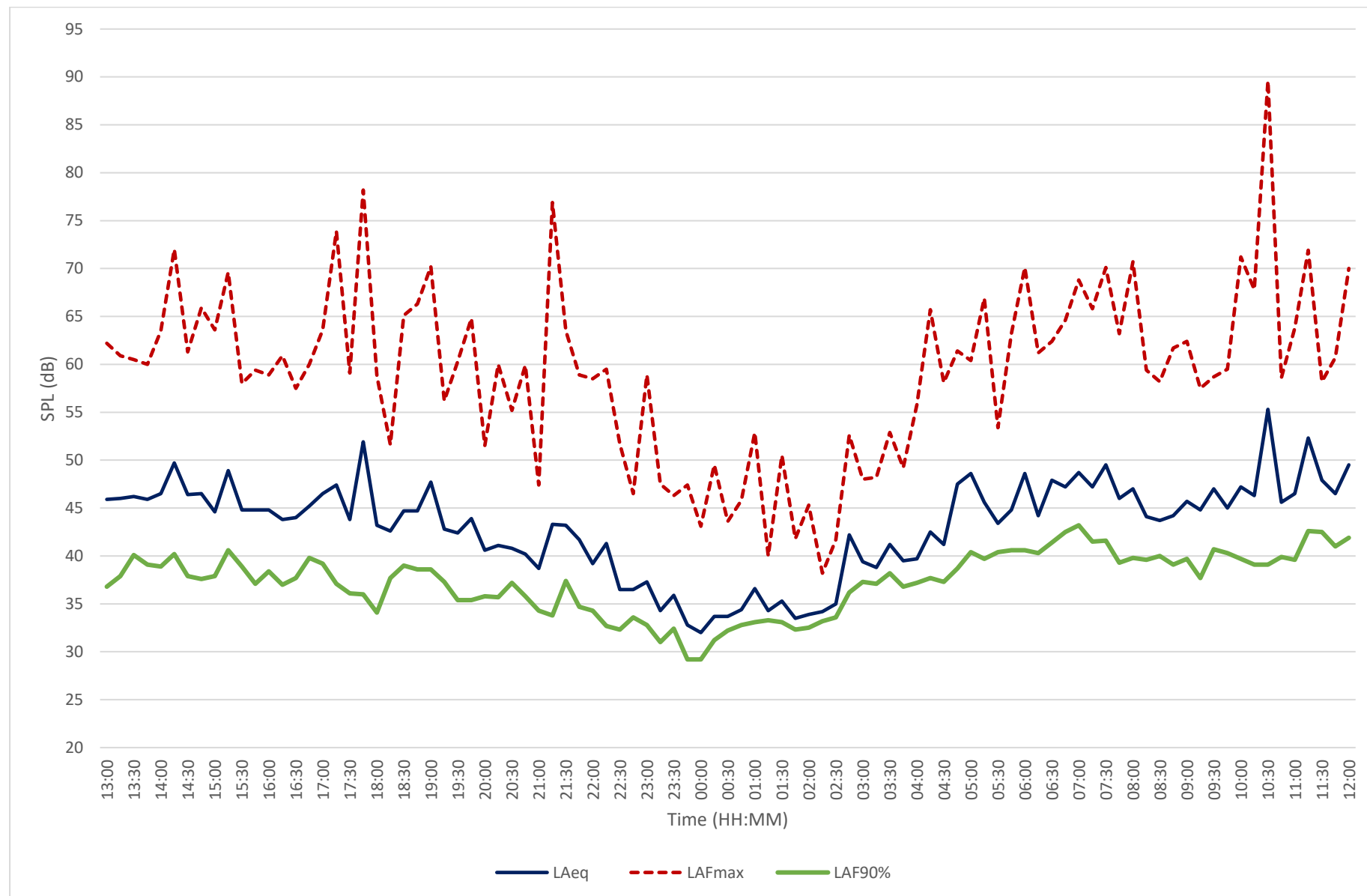


Figure B.5 – Time History at Position C (Monday, 13 July 2020 to Tuesday, 14 July 2020)

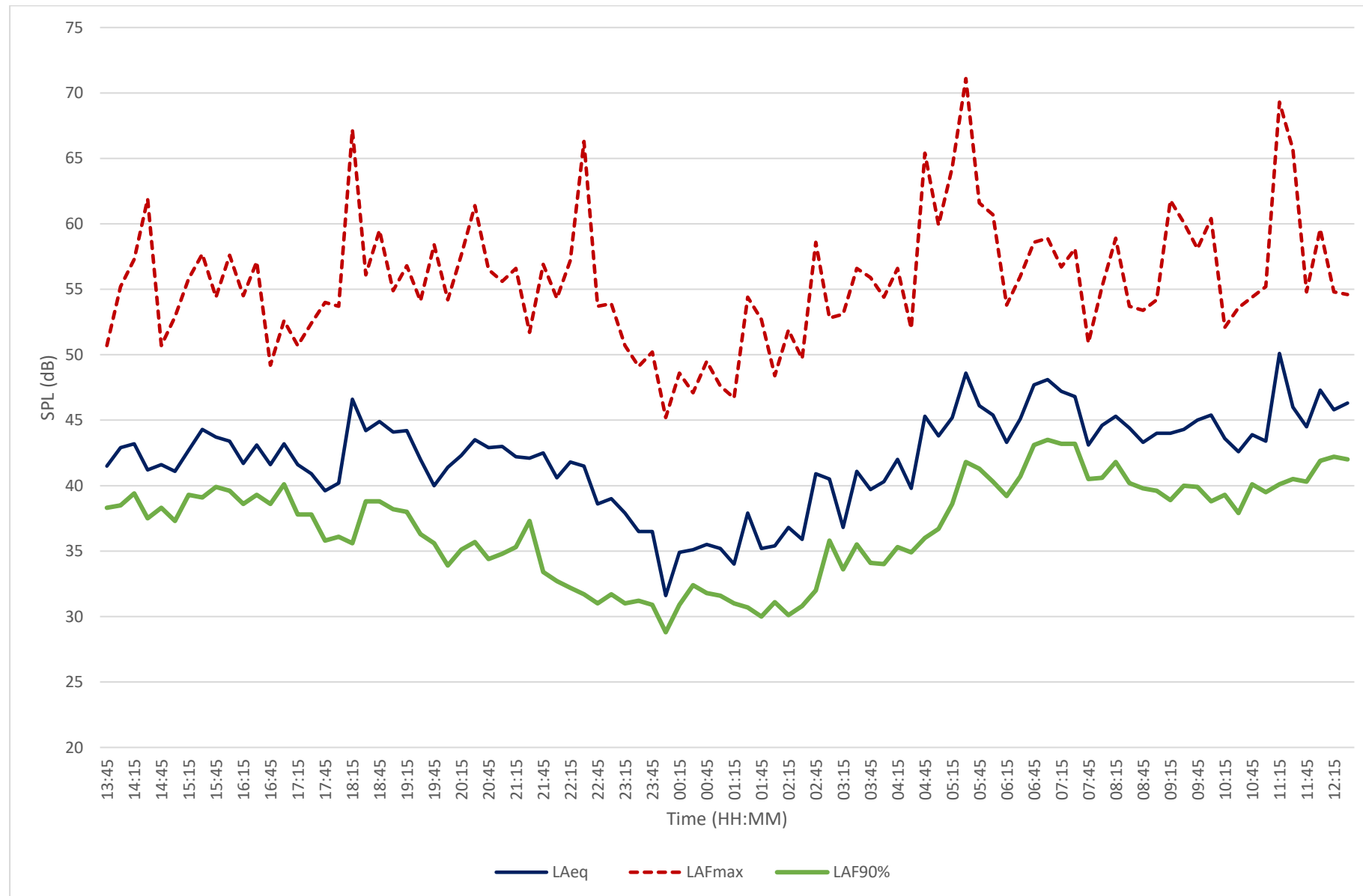


Figure B.6 – Statistical Analysis of Background Sound Levels Measured at Position A

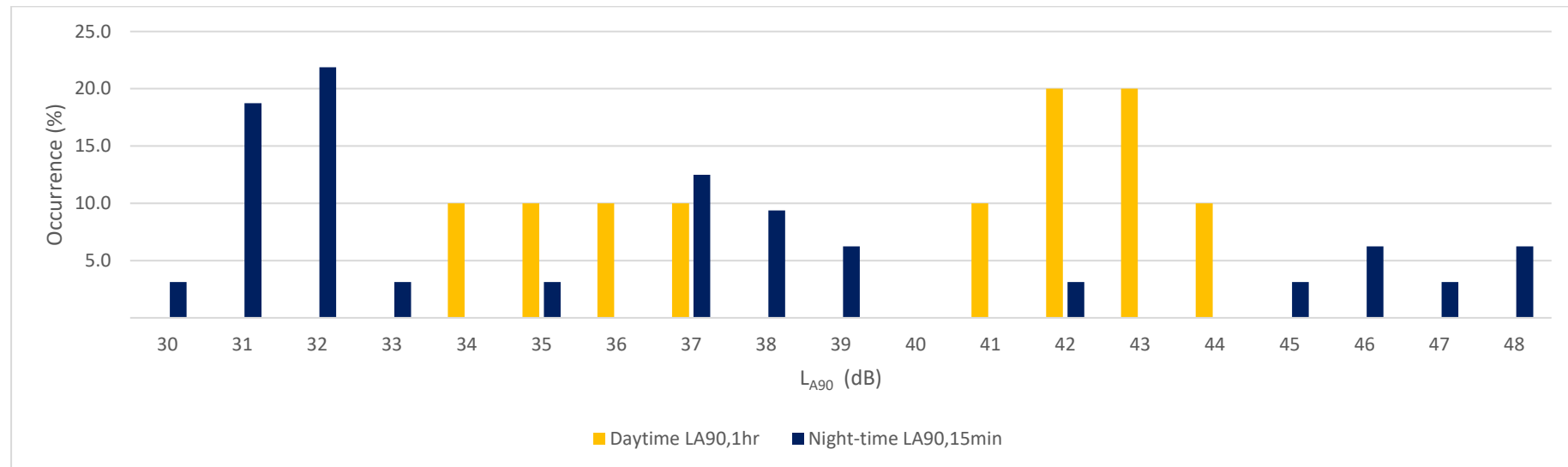


Figure B.7 – Statistical Analysis of Background Sound Levels Measured at Position B

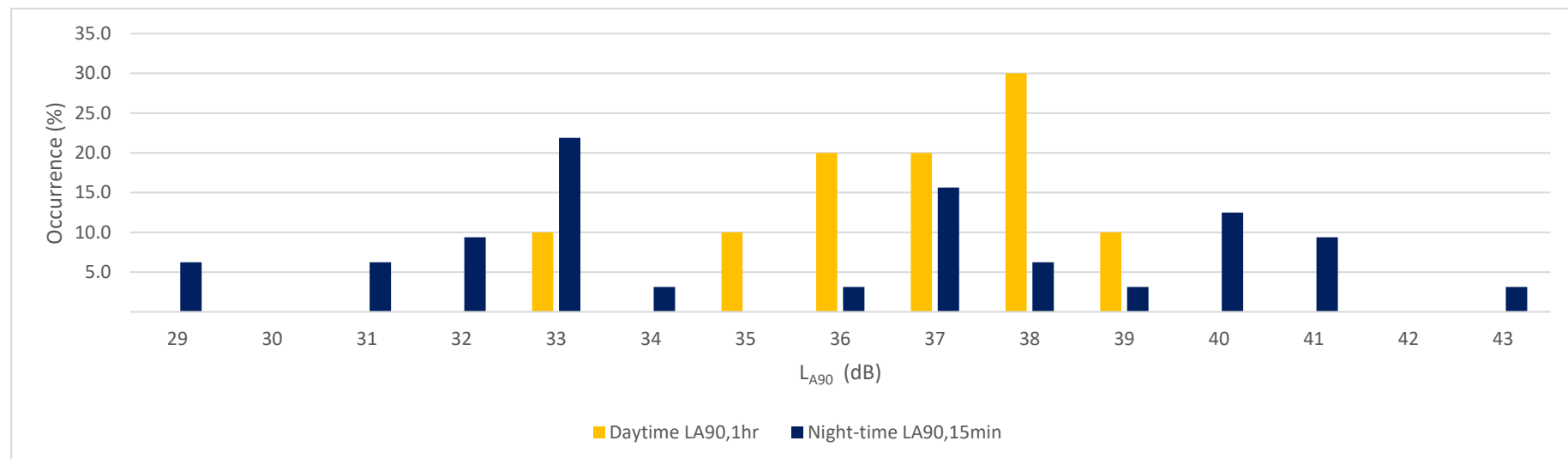


Figure B.8 – Statistical Analysis of Background Sound Levels Measured at Position C

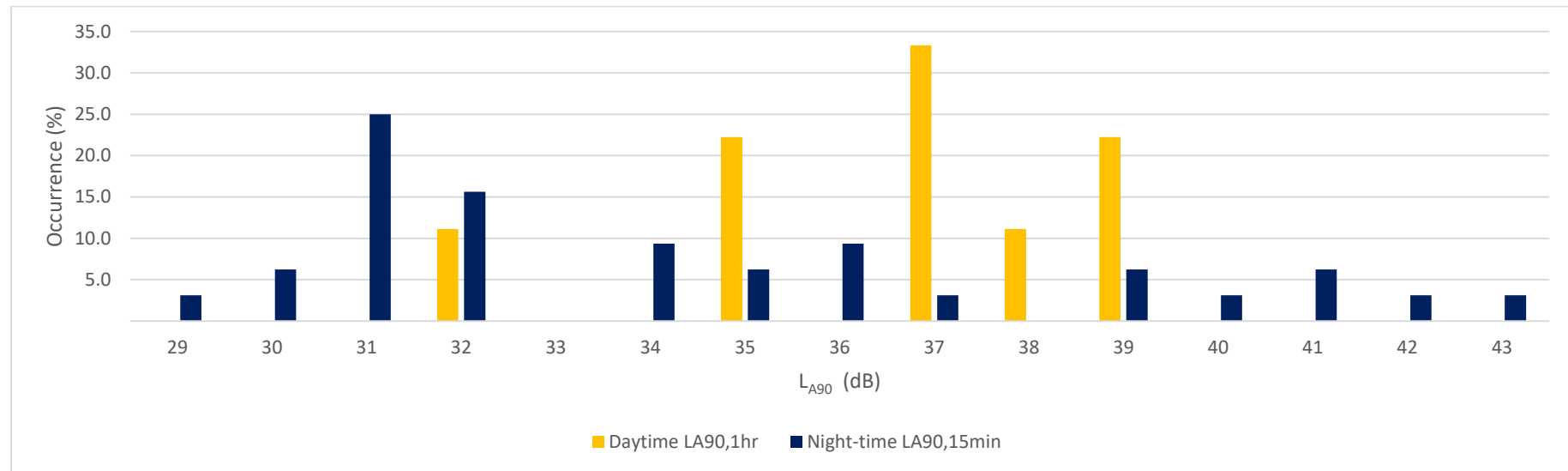


Figure B.9 – Night-time (2300-0700hrs) Temperature Model Data Provided by Client for Wrexham (May to September)

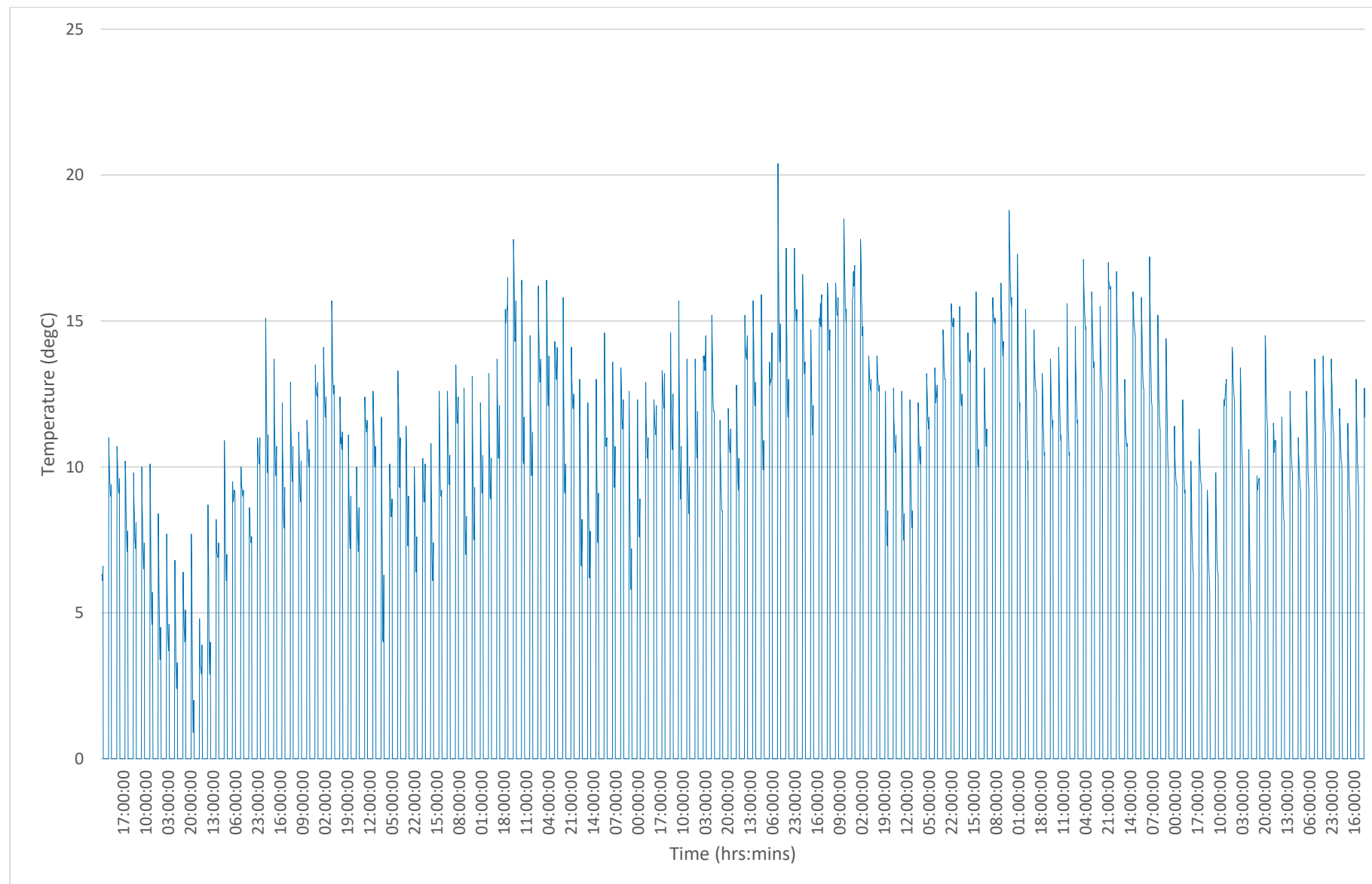


Table B.1 – Plant Noise Schedule Including Octave Band Data

Make	Model	Description	No	Location	Duty	Measurement Location	Octave Band Centre Frequency (Hz)								dB(A)	Unit		
							31.5	63	125	250	500	1K	2K	4K			8K	
AB Cogeneration World	Ecomax 12 GH	CHP Plant (based on 20degC amb temp)	1	Internal	1.201 kWe	EXHAUST STACK	-	-	-	-	-	-	-	-	-	52.0	L_{eq} @ 10m	
						AIR INLET SYSTEM	-	-	-	-	-	-	-	-	-	56.0	L_{eq} @ 10m	
						AIR OUTLET SYSTEM	-	-	-	-	-	-	-	-	-	58.0	L_{eq} @ 10m	
						ECOMAX WALLS	65.7	58.8	62.3	58.8	52.0	39.8	38.8	32.7	31.3	53.9	L_{eq} @ 10m	
AB Cogeneration World	Ecomax 27 GH	CHP Plant (based on 20degC amb temp)	3	Internal	2.681 kWe	EXHAUST STACK	-	-	-	-	-	-	-	-	-	54.0	L_{eq} @ 10m	
						AIR INLET SYSTEM	-	-	-	-	-	-	-	-	-	-	60.0	L_{eq} @ 10m
						AIR OUTLET SYSTEM	-	-	-	-	-	-	-	-	-	-	60.0	L_{eq} @ 10m
						ECOMAX WALLS	65.7	58.8	62.3	58.8	52.0	39.8	38.8	32.7	31.3	53.9	L_{eq} @ 10m	
Armec	HWF7213A GOZZ	Heat Pump	17	Internal	Full Load (Cooling)	Sound Power	-	86.0	83.6	86.5	93.8	95.3	88.6	78.4	69.9	97.5	L_w	
Antonio Seveso	190972	CHP Dry Cooler Fan Bank (based on 20degC amb temp)	8	External	248kW	Per bank of fans	-	-	-	-	-	-	-	-	-	50.0	L_{eq} @ 10m	
Unknown	Unknown	Transformer	7	External	2250K	At 1m (taken from data sheet on past project for 2MVA transformer)	-	55	70.1	68.9	66.4	52.5	44.6	38.3	38.5	59.8	L_{eq} @ 1m	

Table B.2 – Transformer Third Octave Band Spectra (2MVA Transformer Applicable on this Site)

Plant Item	SPL (dB) at 1m at Octave Band Centre Frequencies (Hz)																								dB(A)
	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	
40MVA Transformer	55	58	58	77	58	55	74	60	71	72	66	63	55	55	54	49	46	44	42	39	40	42	40	40	66.8
2MVA Transformer	48	51	51	70	51	48	67	53	64	65	59	56	48	48	47	42	39	37	35	32	33	35	33	33	59.8

Note: The typical transformer spectra data has been provided by an equipment supplier on a past and is taken from Paper Number 23, Proceedings of Acoustics 2011, 2-4 November 2011, Gold Coast, Australia. We have shifted the spectrum down by -2dB and -9dB respectively to match the overall dB(A) figures quoted for 40MVA and 2MVA transformers.

Figure B.10 – Plant Room Layout with External Plant/Flues

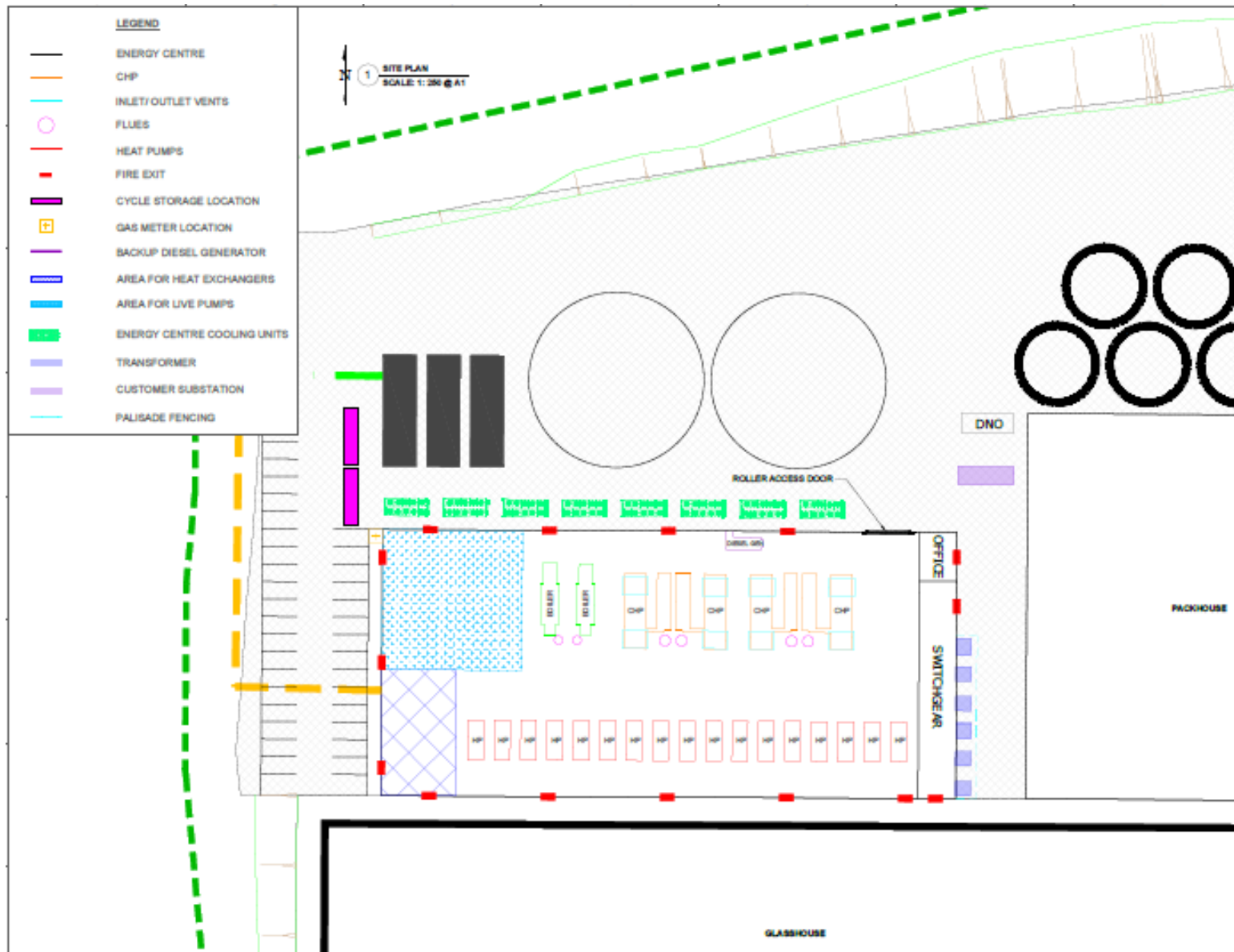


Table B.3 – BS 4142:2104 Daytime Assessment at SSR 1 (north)

Results		Relevant Clause	Commentary
Predicted level at SSR 1 (first floor)	$L_{Aeq} = 44\text{dB}$	7.3.2	Predicted using manufacturers data and BS 5228 methodology
Residual sound level	$L_{Aeq} = 0\text{dB}$	7.3.3	Not included as using predicted level
Background sound level (daytime)	$L_{A90(0700-2300\text{hrs})} = 42\text{dB}$	8.1.1 8.1.3 8.3	Background sound level measured at Position A
Assessment made during the daytime so the reference time interval is 1hr.		7.2	
Specific sound level calculated by correcting the ambient sound level to remove the contribution of the residual sound level.	$L_{Aeq,1hr} = 44\text{dB}$	7.3.4	
Acoustic feature correction	3dB	9.2	HGV noise dominates daytime - neither tonal nor impulsive, though otherwise may be readily distinctive, a penalty of 3dB can be applied
Rating Level	$(44 + 3) = 47\text{dB}$		
Background sound level (daytime)	$L_{A90(0700-2300\text{hrs})} = 42\text{dB}$	8.3	
Excess of rating over background sound level	$(47 - 42) \text{ dB} = 5\text{dB}$	11	
Assessment indicates adverse impact depending on context. Taking context into consideration, we would advise an adverse impact is unlikely.		11	At 5dB above background, BS 4142:2014 advises: "is an indication of an adverse impact, depending on the context" The context here is low absolute levels (44dB L_{Aeq}) outside during the daytime.
Uncertainty of assessment		10	Uncertainty in background noise measurements is considered low.

Table B.4 – BS 4142:2104 Daytime Assessment at SSR 2 (east)

Results		Relevant Clause	Commentary
Predicted level at SSR 2 (first floor)	$L_{Aeq} = 39\text{dB}$	7.3.2	Predicted using manufacturers data and BS 5228 methodology
Residual sound level	$L_{Aeq} = 0\text{dB}$	7.3.3	Not included as using predicted level
Background sound level (daytime)	$L_{A90(0700-2300\text{hrs})} = 42\text{dB}$	8.1.1 8.1.3 8.3	Background sound level measured at Position A
Assessment made during the daytime so the reference time interval is 1hr.		7.2	
Specific sound level calculated by correcting the ambient sound level to remove the contribution of the residual sound level.	$L_{Aeq,1hr} = 39\text{dB}$	7.3.4	
Acoustic feature correction	3dB	9.2	HGV noise dominates daytime - neither tonal nor impulsive, though otherwise may be readily distinctive, a penalty of 3dB can be applied
Rating Level	$(39 + 3) = 42\text{dB}$		
Background sound level (daytime)	$L_{A90(0700-2300\text{hrs})} = 42\text{dB}$	8.3	
Excess of rating over background sound level	$(42 - 42) \text{ dB} = 0\text{dB}$	11	
Assessment indicates adverse impact is unlikely depending on context.		11	With no excess over background, BS 4142:2014 advises an adverse impact is unlikely, depending on the context. The context here is low absolute levels (42dB L_{Aeq}) outside during the daytime.
Uncertainty of assessment		10	Uncertainty in background noise measurements is considered low.

Table B.5 – BS 4142:2104 Daytime Assessment at SSR 3 (east)

Results		Relevant Clause	Commentary
Predicted level at SSR 3 (first floor)	$L_{Aeq} = 32\text{dB}$	7.3.2	Predicted using manufacturers data and BS 5228 methodology
Residual sound level	$L_{Aeq} = 0\text{dB}$	7.3.3	Not included as using predicted level
Background sound level (daytime)	$L_{A90(0700-2300\text{hrs})} = 38\text{dB}$	8.1.1 8.1.3 8.3	Background sound level measured at Position C
Assessment made during the daytime so the reference time interval is 1hr.		7.2	
Specific sound level calculated by correcting the ambient sound level to remove the contribution of the residual sound level.	$L_{Aeq,1hr} = 32\text{dB}$	7.3.4	
Acoustic feature correction	3dB	9.2	HGV noise dominates daytime - neither tonal nor impulsive, though otherwise may be readily distinctive, a penalty of 3dB can be applied
Rating Level	$(32 + 3) = 35\text{dB}$		
Background sound level (daytime)	$L_{A90(0700-2300\text{hrs})} = 38\text{dB}$	8.3	
Excess of rating over background sound level	$(35 - 38) \text{ dB} = -3\text{dB}$	11	
Assessment indicates adverse impact is unlikely depending on context.		11	At 3dB below background, BS 4142:2014 advises an adverse impact is unlikely, depending on the context.
Uncertainty of assessment		10	Uncertainty in background noise measurements is considered low.

Table B.6 – BS 4142:2104 Daytime Assessment at SSR 4 (south)

Results		Relevant Clause	Commentary
Predicted level at SSR 4 (first floor)	$L_{Aeq} = 33\text{dB}$	7.3.2	Predicted using manufacturers data and BS 5228 methodology
Residual sound level	$L_{Aeq} = 0\text{dB}$	7.3.3	Not included as using predicted level
Background sound level (daytime)	$L_{A90(0700-2300\text{hrs})} = 38\text{dB}$	8.1.1 8.1.3 8.3	Background sound level measured at Position C
Assessment made during the daytime so the reference time interval is 1hr.		7.2	
Specific sound level calculated by correcting the ambient sound level to remove the contribution of the residual sound level.	$L_{Aeq,1hr} = 33\text{dB}$	7.3.4	
Acoustic feature correction	3dB	9.2	HGV noise dominates daytime - neither tonal nor impulsive, though otherwise may be readily distinctive, a penalty of 3dB can be applied
Rating Level	$(33 + 3) = 36\text{dB}$		
Background sound level (daytime)	$L_{A90(0700-2300\text{hrs})} = 38\text{dB}$	8.3	
Excess of rating over background sound level	$(36 - 38) \text{ dB} = -2\text{dB}$	11	
Assessment indicates adverse impact is unlikely depending on context.		11	At 2dB below background, BS 4142:2014 advises an adverse impact is unlikely, depending on the context.
Uncertainty of assessment		10	Uncertainty in background noise measurements is considered low.

Table B.7 – BS 4142:2104 Daytime Assessment at SSR 5 (south)

Results		Relevant Clause	Commentary
Predicted level at SSR 5 (first floor)	$L_{Aeq} = 33\text{dB}$	7.3.2	Predicted using manufacturers data and BS 5228 methodology
Residual sound level	$L_{Aeq} = 0\text{dB}$	7.3.3	Not included as using predicted level
Background sound level (daytime)	$L_{A90(0700-2300\text{hrs})} = 37\text{dB}$	8.1.1 8.1.3 8.3	Background sound level measured at Position B
Assessment made during the daytime so the reference time interval is 1hr.		7.2	
Specific sound level calculated by correcting the ambient sound level to remove the contribution of the residual sound level.	$L_{Aeq,1hr} = 33\text{dB}$	7.3.4	
Acoustic feature correction	3dB	9.2	HGV noise dominates daytime - neither tonal nor impulsive, though otherwise may be readily distinctive, a penalty of 3dB can be applied
Rating Level	$(33 + 3) = 36\text{dB}$		
Background sound level (daytime)	$L_{A90(0700-2300\text{hrs})} = 37\text{dB}$	8.3	
Excess of rating over background sound level	$(36 - 37) \text{ dB} = -1\text{dB}$	11	
Assessment indicates adverse impact is unlikely depending on context.		11	At 1dB below background, BS 4142:2014 advises an adverse impact is unlikely, depending on the context.
Uncertainty of assessment		10	Uncertainty in background noise measurements is considered low.

Table B.8 – BS 4142:2104 Night-time Assessment at SSR 1 (north) at 20°C

Results		Relevant Clause	Commentary
Predicted level at SSR 1 (first floor)	$L_{Aeq} = 35\text{dB}$	7.3.2	Predicted using manufacturers data and BS 5228 methodology
Residual sound level	$L_{Aeq} = 0\text{dB}$	7.3.3	Not included as using predicted level
Background sound level (night-time)	$L_{A90(2300-0700\text{hrs})} = 32\text{dB}$	8.1.1 8.1.3 8.3	Background sound level measured at Position A
Assessment made during the night-time so the reference time interval is 15min.		7.2	
Specific sound level calculated by correcting the ambient sound level to remove the contribution of the residual sound level.	$L_{Aeq,15\text{min}} = 35\text{dB}$	7.3.4	
Acoustic feature correction	2dB	9.2	At source, tonal characteristics may be displayed. Given distance and screening loss, +2dB for tonality just perceptible has been included
Rating Level	$(35 + 2) = 37\text{dB}$		
Background sound level (night-time)	$L_{A90(2300-0700\text{hrs})} = 32\text{dB}$	8.3	
Excess of rating over background sound level	$(37 - 32) \text{ dB} = 5\text{dB}$	11	
Assessment indicates adverse impact depending on context. Taking context into consideration, we would advise an adverse impact is unlikely.		11	At 5dB above background, BS 4142:2014 advises: "is an indication of an adverse impact, depending on the context" The context here is low absolute levels (35dB L_{Aeq}) outside during the night-time.
Uncertainty of assessment		10	Uncertainty in background noise measurements is considered low.

Table B.9 – BS 4142:2104 Night-time Assessment at SSR 2 (east) at 20°C

Results		Relevant Clause	Commentary
Predicted level at SSR 2 (first floor)	$L_{Aeq} = 33\text{dB}$	7.3.2	Predicted using manufacturers data and BS 5228 methodology
Residual sound level	$L_{Aeq} = 0\text{dB}$	7.3.3	Not included as using predicted level
Background sound level (night-time)	$L_{A90(2300-0700\text{hrs})} = 32\text{dB}$	8.1.1 8.1.3 8.3	Background sound level measured at Position A
Assessment made during the night-time so the reference time interval is 15min.		7.2	
Specific sound level calculated by correcting the ambient sound level to remove the contribution of the residual sound level.	$L_{Aeq,15\text{min}} = 32\text{dB}$	7.3.4	
Acoustic feature correction	2dB	9.2	At source, tonal characteristics may be displayed. Given distance and screening loss, +2dB for tonality just perceptible has been included
Rating Level	$(32 + 2) = 34\text{dB}$		
Background sound level (night-time)	$L_{A90(2300-0700\text{hrs})} = 32\text{dB}$	8.3	
Excess of rating over background sound level	$(34 - 32) \text{ dB} = 2\text{dB}$	11	
Assessment indicates adverse impact unlikely depending on context		11	At 2dB above background, BS 4142:2014 advises an adverse impact is unlikely, depending on the context"
Uncertainty of assessment		10	Uncertainty in background noise measurements is considered low.

Table B.10 – BS 4142:2104 Night-time Assessment at SSR 3 (east) at 20°C

Results		Relevant Clause	Commentary
Predicted level at SSR 3 (first floor)	$L_{Aeq} = 26\text{dB}$	7.3.2	Predicted using manufacturers data and BS 5228 methodology
Residual sound level	$L_{Aeq} = 0\text{dB}$	7.3.3	Not included as using predicted level
Background sound level (night-time)	$L_{A90(2300-0700\text{hrs})} = 33\text{dB}$	8.1.1 8.1.3 8.3	Background sound level measured at Position C
Assessment made during the night-time so the reference time interval is 15min.		7.2	
Specific sound level calculated by correcting the ambient sound level to remove the contribution of the residual sound level.	$L_{Aeq,15\text{min}} = 26\text{dB}$	7.3.4	
Acoustic feature correction	2dB	9.2	At source, tonal characteristics may be displayed. Given distance and screening loss, +2dB for tonality just perceptible has been included
Rating Level	$(26 + 2) = 28\text{dB}$		
Background sound level (night-time)	$L_{A90(2300-0700\text{hrs})} = 28\text{dB}$	8.3	
Excess of rating over background sound level	$(28 - 33) \text{ dB} = -5\text{dB}$	11	
Assessment indicates adverse impact unlikely depending on context		11	At 5dB below background, BS 4142:2014 advises an adverse impact is unlikely, depending on the context"
Uncertainty of assessment		10	Uncertainty in background noise measurements is considered low.

Table B.11 – BS 4142:2104 Night-time Assessment at SSR 4 (south) at 20°C

Results		Relevant Clause	Commentary
Predicted level at SSR 4 (first floor)	$L_{Aeq} = 30\text{dB}$	7.3.2	Predicted using manufacturers data and BS 5228 methodology
Residual sound level	$L_{Aeq} = 0\text{dB}$	7.3.3	Not included as using predicted level
Background sound level (night-time)	$L_{A90(2300-0700\text{hrs})} = 33\text{dB}$	8.1.1 8.1.3 8.3	Background sound level measured at Position C
Assessment made during the night-time so the reference time interval is 15min.		7.2	
Specific sound level calculated by correcting the ambient sound level to remove the contribution of the residual sound level.	$L_{Aeq,15\text{min}} = 30\text{dB}$	7.3.4	
Acoustic feature correction	2dB	9.2	At source, tonal characteristics may be displayed. Given distance and screening loss, +2dB for tonality just perceptible has been included
Rating Level	$(30 + 2) = 32\text{dB}$		
Background sound level (night-time)	$L_{A90(2300-0700\text{hrs})} = 33\text{dB}$	8.3	
Excess of rating over background sound level	$(32 - 33) \text{ dB} = -1\text{dB}$	11	
Assessment indicates adverse impact unlikely depending on context		11	At 1dB below background, BS 4142:2014 advises an adverse impact is unlikely, depending on the context"
Uncertainty of assessment		10	Uncertainty in background noise measurements is considered low.

Table B.12 – BS 4142:2104 Night-time Assessment at SSR 5 (south) at 20°C

Results		Relevant Clause	Commentary
Predicted level at SSR 5 (first floor)	$L_{Aeq} = 29\text{dB}$	7.3.2	Predicted using manufacturers data and BS 5228 methodology
Residual sound level	$L_{Aeq} = 0\text{dB}$	7.3.3	Not included as using predicted level
Background sound level (night-time)	$L_{A90(2300-0700\text{hrs})} = 31\text{dB}$	8.1.1 8.1.3 8.3	Background sound level measured at Position B
Assessment made during the night-time so the reference time interval is 15min.		7.2	
Specific sound level calculated by correcting the ambient sound level to remove the contribution of the residual sound level.	$L_{Aeq,15\text{min}} = 29\text{dB}$	7.3.4	
Acoustic feature correction	2dB	9.2	At source, tonal characteristics may be displayed. Given distance and screening loss, +2dB for tonality just perceptible has been included
Rating Level	$(29 + 2) = 31\text{dB}$		
Background sound level (night-time)	$L_{A90(2300-0700\text{hrs})} = 31\text{dB}$	8.3	
Excess of rating over background sound level	$(31 - 31) \text{ dB} = 0\text{dB}$	11	
Assessment indicates adverse impact unlikely depending on context		11	With no excess over background, BS 4142:2014 advises an adverse impact is unlikely, depending on the context"
Uncertainty of assessment		10	Uncertainty in background noise measurements is considered low.

Table B.13 – BS 4142:2104 Night-time Assessment at SSR 1 (north) at 15°C

Results		Relevant Clause	Commentary
Predicted level at SSR 1 (first floor)	$L_{Aeq} = 35\text{dB}$	7.3.2	Predicted using manufacturers data and BS 5228 methodology
Residual sound level	$L_{Aeq} = 0\text{dB}$	7.3.3	Not included as using predicted level
Background sound level (night-time)	$L_{A90(2300-0700\text{hrs})} = 32\text{dB}$	8.1.1 8.1.3 8.3	Background sound level measured at Position A
Assessment made during the night-time so the reference time interval is 15min.		7.2	
Specific sound level calculated by correcting the ambient sound level to remove the contribution of the residual sound level.	$L_{Aeq,15\text{min}} = 35\text{dB}$	7.3.4	
Acoustic feature correction	2dB	9.2	At source, tonal characteristics may be displayed. Given distance and screening loss, +2dB for tonality just perceptible has been included
Rating Level	$(35 + 2) = 37\text{dB}$		
Background sound level (night-time)	$L_{A90(2300-0700\text{hrs})} = 32\text{dB}$	8.3	
Excess of rating over background sound level	$(37 - 32) \text{ dB} = 5\text{dB}$	11	
Assessment indicates adverse impact depending on context. Taking context into consideration, we would advise an adverse impact is unlikely.		11	At 5dB above background, BS 4142:2014 advises: "is an indication of an adverse impact, depending on the context" The context here is low absolute levels (35dB L_{Aeq}) outside during the night-time.
Uncertainty of assessment		10	Uncertainty in background noise measurements is considered low.

Table B.14 – BS 4142:2104 Night-time Assessment at SSR 2 (east) at 15°C

Results		Relevant Clause	Commentary
Predicted level at SSR 2 (first floor)	$L_{Aeq} = 35\text{dB}$	7.3.2	Predicted using manufacturers data and BS 5228 methodology
Residual sound level	$L_{Aeq} = 0\text{dB}$	7.3.3	Not included as using predicted level
Background sound level (night-time)	$L_{A90(2300-0700\text{hrs})} = 32\text{dB}$	8.1.1 8.1.3 8.3	Background sound level measured at Position A
Assessment made during the night-time so the reference time interval is 15min.		7.2	
Specific sound level calculated by correcting the ambient sound level to remove the contribution of the residual sound level.	$L_{Aeq,15\text{min}} = 35\text{dB}$	7.3.4	
Acoustic feature correction	2dB	9.2	At source, tonal characteristics may be displayed. Given distance and screening loss, +2dB for tonality just perceptible has been included
Rating Level	$(35 + 2) = 37\text{dB}$		
Background sound level (night-time)	$L_{A90(2300-0700\text{hrs})} = 32\text{dB}$	8.3	
Excess of rating over background sound level	$(37 - 32) \text{ dB} = 5\text{dB}$	11	
Assessment indicates adverse impact depending on context. Taking context into consideration, we would advise an adverse impact is unlikely.		11	At 5dB above background, BS 4142:2014 advises: "is an indication of an adverse impact, depending on the context" The context here is low absolute levels (35dB L_{Aeq}) outside during the night-time.
Uncertainty of assessment		10	Uncertainty in background noise measurements is considered low.

Table B.15 – BS 4142:2104 Night-time Assessment at SSR 3 (east) at 15°C

Results		Relevant Clause	Commentary
Predicted level at SSR 3 (first floor)	$L_{Aeq} = 28\text{dB}$	7.3.2	Predicted using manufacturers data and BS 5228 methodology
Residual sound level	$L_{Aeq} = 0\text{dB}$	7.3.3	Not included as using predicted level
Background sound level (night-time)	$L_{A90(2300-0700\text{hrs})} = 33\text{dB}$	8.1.1 8.1.3 8.3	Background sound level measured at Position C
Assessment made during the night-time so the reference time interval is 15min.		7.2	
Specific sound level calculated by correcting the ambient sound level to remove the contribution of the residual sound level.	$L_{Aeq,15\text{min}} = 28\text{dB}$	7.3.4	
Acoustic feature correction	2dB	9.2	At source, tonal characteristics may be displayed. Given distance and screening loss, +2dB for tonality just perceptible has been included
Rating Level	$(28 + 2) = 30\text{dB}$		
Background sound level (night-time)	$L_{A90(2300-0700\text{hrs})} = 28\text{dB}$	8.3	
Excess of rating over background sound level	$(30 - 33) \text{ dB} = -3\text{dB}$	11	
Assessment indicates adverse impact unlikely depending on context		11	At 3dB below background, BS 4142:2014 advises an adverse impact is unlikely, depending on the context"
Uncertainty of assessment		10	Uncertainty in background noise measurements is considered low.

Table B.16 – BS 4142:2104 Night-time Assessment at SSR 4 (south) at 15°C

Results		Relevant Clause	Commentary
Predicted level at SSR 4 (first floor)	$L_{Aeq} = 31\text{dB}$	7.3.2	Predicted using manufacturers data and BS 5228 methodology
Residual sound level	$L_{Aeq} = 0\text{dB}$	7.3.3	Not included as using predicted level
Background sound level (night-time)	$L_{A90(2300-0700\text{hrs})} = 33\text{dB}$	8.1.1 8.1.3 8.3	Background sound level measured at Position C
Assessment made during the night-time so the reference time interval is 15min.		7.2	
Specific sound level calculated by correcting the ambient sound level to remove the contribution of the residual sound level.	$L_{Aeq,15\text{min}} = 31\text{dB}$	7.3.4	
Acoustic feature correction	2dB	9.2	At source, tonal characteristics may be displayed. Given distance and screening loss, +2dB for tonality just perceptible has been included
Rating Level	$(31 + 2) = 33\text{dB}$		
Background sound level (night-time)	$L_{A90(2300-0700\text{hrs})} = 33\text{dB}$	8.3	
Excess of rating over background sound level	$(33 - 33) \text{ dB} = 0\text{dB}$	11	
Assessment indicates adverse impact unlikely depending on context		11	With no excess over background, BS 4142:2014 advises an adverse impact is unlikely, depending on the context"
Uncertainty of assessment		10	Uncertainty in background noise measurements is considered low.

Table B.17 – BS 4142:2104 Night-time Assessment at SSR 5 (south) at 15°C

Results		Relevant Clause	Commentary
Predicted level at SSR 5 (first floor)	$L_{Aeq} = 30\text{dB}$	7.3.2	Predicted using manufacturers data and BS 5228 methodology
Residual sound level	$L_{Aeq} = 0\text{dB}$	7.3.3	Not included as using predicted level
Background sound level (night-time)	$L_{A90(2300-0700\text{hrs})} = 31\text{dB}$	8.1.1 8.1.3 8.3	Background sound level measured at Position B
Assessment made during the night-time so the reference time interval is 15min.		7.2	
Specific sound level calculated by correcting the ambient sound level to remove the contribution of the residual sound level.	$L_{Aeq,15\text{min}} = 30\text{dB}$	7.3.4	
Acoustic feature correction	2dB	9.2	At source, tonal characteristics may be displayed. Given distance and screening loss, +2dB for tonality just perceptible has been included
Rating Level	$(30 + 2) = 32\text{dB}$		
Background sound level (night-time)	$L_{A90(2300-0700\text{hrs})} = 31\text{dB}$	8.3	
Excess of rating over background sound level	$(32 - 31) \text{ dB} = 1\text{dB}$	11	
Assessment indicates adverse impact unlikely depending on context		11	At 1dB above background, BS 4142:2014 advises an adverse impact is unlikely, depending on the context"
Uncertainty of assessment		10	Uncertainty in background noise measurements is considered low.

Table B.18 – BS 4142:2104 Night-time with Staff Arrival Assessment at SSR 1 (north)

Results		Relevant Clause	Commentary
Predicted level at SSR 1 (first floor)	$L_{Aeq} = 37\text{dB}$	7.3.2	Predicted using manufacturers data and BS 5228 methodology
Residual sound level	$L_{Aeq} = 0\text{dB}$	7.3.3	Not included as using predicted level
Background sound level (night-time)	$L_{A90(0530-0600\text{hrs})} = 42\text{dB}$	8.1.1 8.1.3 8.3	Background sound level measured at Position A
Assessment made during the night-time so the reference time interval is 15min.		7.2	
Specific sound level calculated by correcting the ambient sound level to remove the contribution of the residual sound level.	$L_{Aeq,15\text{min}} = 37\text{dB}$	7.3.4	
Acoustic feature correction	2dB	9.2	At source, tonal characteristics may be displayed. Given distance and screening loss, +2dB for tonality just perceptible has been included
Rating Level	$(37 + 2) = 39\text{dB}$		
Background sound level (night-time)	$L_{A90(0530-0600\text{hrs})} = 42\text{dB}$	8.3	
Excess of rating over background sound level	$(39 - 42) \text{ dB} = -3\text{dB}$	11	
Assessment indicates adverse impact unlikely depending on context.		11	At 3dB below background, BS 4142:2014 advises an adverse impact is unlikely, depending on the context"
Uncertainty of assessment		10	Uncertainty in background noise measurements is considered low.

Table B.19 – BS 4142:2104 Night-time with Staff Arrival Assessment at SSR 2 (east)

Results		Relevant Clause	Commentary
Predicted level at SSR 2 (first floor)	$L_{Aeq} = 34\text{dB}$	7.3.2	Predicted using manufacturers data and BS 5228 methodology
Residual sound level	$L_{Aeq} = 0\text{dB}$	7.3.3	Not included as using predicted level
Background sound level (night-time)	$L_{A90(0530-0600\text{hrs})} = 42\text{dB}$	8.1.1 8.1.3 8.3	Background sound level measured at Position A
Assessment made during the night-time so the reference time interval is 15min.		7.2	
Specific sound level calculated by correcting the ambient sound level to remove the contribution of the residual sound level.	$L_{Aeq,15\text{min}} = 34\text{dB}$	7.3.4	
Acoustic feature correction	2dB	9.2	At source, tonal characteristics may be displayed. Given distance and screening loss, +2dB for tonality just perceptible has been included
Rating Level	$(34 + 2) = 36\text{dB}$		
Background sound level (night-time)	$L_{A90(0530-0600\text{hrs})} = 42\text{dB}$	8.3	
Excess of rating over background sound level	$(36 - 42) \text{ dB} = -6\text{dB}$	11	
Assessment indicates adverse impact unlikely depending on context		11	At 6dB below background, BS 4142:2014 advises an adverse impact is unlikely, depending on the context
Uncertainty of assessment		10	Uncertainty in background noise measurements is considered low.

Table B.20 – BS 4142:2104 Night-time with Staff Arrival Assessment at SSR 3 (east)

Results		Relevant Clause	Commentary
Predicted level at SSR 3 (first floor)	$L_{Aeq} = 27\text{dB}$	7.3.2	Predicted using manufacturers data and BS 5228 methodology
Residual sound level	$L_{Aeq} = 0\text{dB}$	7.3.3	Not included as using predicted level
Background sound level (night-time)	$L_{A90(0530-0600\text{hrs})} = 38\text{dB}$	8.1.1 8.1.3 8.3	Background sound level measured at Position C
Assessment made during the night-time so the reference time interval is 15min.		7.2	
Specific sound level calculated by correcting the ambient sound level to remove the contribution of the residual sound level.	$L_{Aeq,15\text{min}} = 27\text{dB}$	7.3.4	
Acoustic feature correction	2dB	9.2	At source, tonal characteristics may be displayed. Given distance and screening loss, +2dB for tonality just perceptible has been included
Rating Level	$(27 + 2) = 29\text{dB}$		
Background sound level (daytime)	$L_{A90(0530-0600\text{hrs})} = 38\text{dB}$	8.3	
Excess of rating over background sound level	$(29 - 38) \text{ dB} = -9\text{dB}$	11	
Assessment indicates adverse impact unlikely depending on context		11	At 9dB below background, BS 4142:2014 advises an adverse impact is unlikely, depending on the context
Uncertainty of assessment		10	Uncertainty in background noise measurements is considered low.

Table B.21 – BS 4142:2104 Night-time with Staff Arrival Assessment at SSR 4 (south)

Results		Relevant Clause	Commentary
Predicted level at SSR 4 (first floor)	$L_{Aeq} = 30\text{dB}$	7.3.2	Predicted using manufacturers data and BS 5228 methodology
Residual sound level	$L_{Aeq} = 0\text{dB}$	7.3.3	Not included as using predicted level
Background sound level (night-time)	$L_{A90(0530-0600\text{hrs})} = 38\text{dB}$	8.1.1 8.1.3 8.3	Background sound level measured at Position C
Assessment made during the night-time so the reference time interval is 15min.		7.2	
Specific sound level calculated by correcting the ambient sound level to remove the contribution of the residual sound level.	$L_{Aeq,15\text{min}} = 30\text{dB}$	7.3.4	
Acoustic feature correction	2dB	9.2	At source, tonal characteristics may be displayed. Given distance and screening loss, +2dB for tonality just perceptible has been included
Rating Level	$(30 + 2) = 32\text{dB}$		
Background sound level (daytime)	$L_{A90(0530-0600\text{hrs})} = 38\text{dB}$	8.3	
Excess of rating over background sound level	$(32 - 38) \text{ dB} = -6\text{dB}$	11	
Assessment indicates adverse impact unlikely depending on context		11	At 6dB below background, BS 4142:2014 advises an adverse impact is unlikely, depending on the context
Uncertainty of assessment		10	Uncertainty in background noise measurements is considered low.

Table B.22 – BS 4142:2104 Night-time with Staff Arrival Assessment at SSR 5 (south)

Results		Relevant Clause	Commentary
Predicted level at SSR 5 (first floor)	$L_{Aeq} = 29\text{dB}$	7.3.2	Predicted using manufacturers data and BS 5228 methodology
Residual sound level	$L_{Aeq} = 0\text{dB}$	7.3.3	Not included as using predicted level
Background sound level (night-time)	$L_{A90(0530-0600\text{hrs})} = 37\text{dB}$	8.1.1 8.1.3 8.3	Background sound level measured at Position B
Assessment made during the night-time so the reference time interval is 15min.		7.2	
Specific sound level calculated by correcting the ambient sound level to remove the contribution of the residual sound level.	$L_{Aeq,15\text{min}} = 29\text{dB}$	7.3.4	
Acoustic feature correction	2dB	9.2	At source, tonal characteristics may be displayed. Given distance and screening loss, +2dB for tonality just perceptible has been included
Rating Level	$(29 + 2) = 31\text{dB}$		
Background sound level (daytime)	$L_{A90(0530-0600\text{hrs})} = 37\text{dB}$	8.3	
Excess of rating over background sound level	$(31 - 37) \text{ dB} = -6\text{dB}$	11	
Assessment indicates adverse impact unlikely depending on context		11	At 6dB below background, BS 4142:2014 advises an adverse impact is unlikely, depending on the context
Uncertainty of assessment		10	Uncertainty in background noise measurements is considered low.

APPENDIX C – NOISE MAP MODELS

Figure C.1 – Daytime $L_{Aeq,1hr}$ Noise Levels at First Floor Level (4.5m above local ground height)

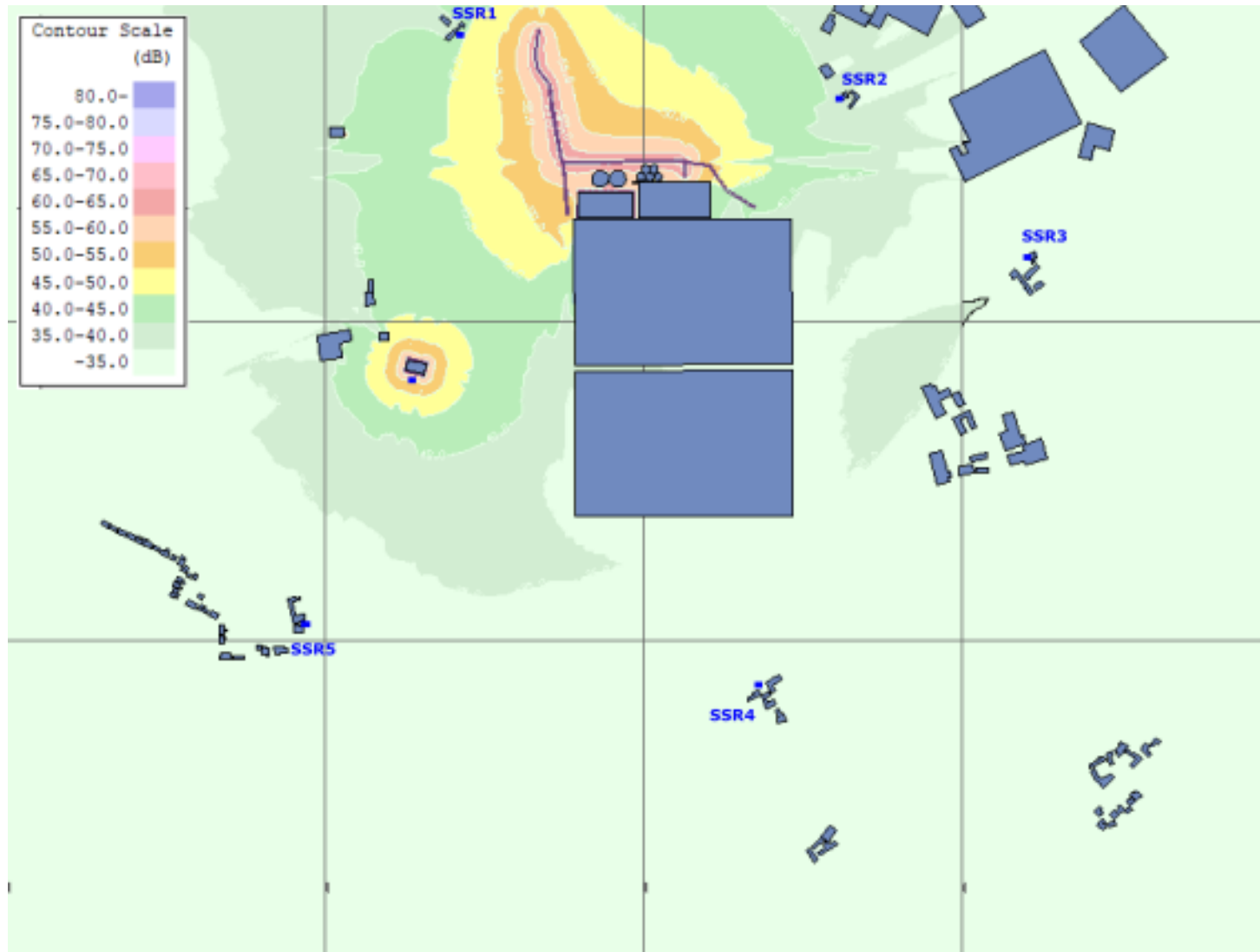


Table C.1 – Daytime Acoustic Model, Critical SSR1 (north) at 4.5m above Local Ground

SSR 1 4.5m above local ground height	Activity			Sound Power Level (dB)	% On- time	Equivalent On-time	Source - Receiver Distance (m)	Angle of View	Major Barrier			Leq @ 10m (dB)	Corrections (dB)							Activity Total (dB)
	Num.	Wrk.	Type						Ref. No.	Height (m)	Attenuation (dB)		On- time	Distance	Soft Ground	Atmos	Barrier	Angle	Reflection	
Haul Road	16/	104	HAU	111	100	-	122.1	18	0	0	0	62	0	-10.9	-2.6	0	0	-10	0	38.5
Haul Road	16/	105	HAU	111	100	-	114.7	9	0	0	0	62	0	-10.6	-2.8	0	0	-13	0	35.6
Haul Road	16/	106	HAU	111	100	-	63.1	5.6	0	0	0	62	0	-8	-3.5	0	0	-15.1	0	35.4
Haul Road	16/	108	HAU	111	100	-	123.4	13.1	0	0	0	62	0	-10.9	-4.5	0	0	-11.4	0	35.2
Haul Road	16/	109	HAU	111	100	-	200.7	22.1	0	0	0	62	0	-13	-5.2	0	0	-9.1	0	34.7
Haul Road	16/	107	HAU	111	100	-	133.9	9.3	0	0	0	62	0	-11.3	-3.6	0	0	-12.9	0	34.2
CHP 2 - Air Outlet	12/	92	STA	88	100	-	354.2	-	106	42	0	60	0	-31	-0.4	0	0	-	0	28.6
North EC Façade	19/	99	SIT	87.2	100	1	309.6	-	0	0	0	59.2	0	-29.8	-2.4	0	0	-	0	27
CHP 1 - Air Outlet	4/	91	STA	86	100	-	346.5	-	106	42	0	58	0	-30.8	-0.4	0	0	-	0	26.8
CHP 1 - Air Inlet	3/	95	STA	84	100	-	340.7	-	106	42	0	56	0	-30.6	-0.4	0	0	-	0	25
CHP 2 - Air Inlet	13/	96	STA	88	100	-	348.4	-	103	45	-5	60	0	-30.8	-0.4	0	-5	-	0	24.2
CHP 3 - Air Inlet	13/	97	STA	88	100	-	352.8	-	103	45	-5	60	0	-31	-0.4	0	-5	-	0	24
CHP 3 - Air Outlet	12/	93	STA	88	100	-	358.8	-	103	45	-5	60	0	-31.1	-0.4	0	-5	-	0	23.9
CHP 4 - Air Inlet	13/	98	STA	88	100	-	360.8	-	103	45	-5	60	0	-31.1	-0.4	0	-5	-	0	23.9
CHP 4 - Air Outlet	12/	94	STA	88	100	-	366.6	-	103	45	-5	60	0	-31.3	-0.4	0	-5	-	0	23.7
CHP 2 - Exhaust	6/	88	STA	82	100	-	351.2	-	106	42	0	54	0	-30.9	0	0	0	-	0	23.1
Haul Road	16/	110	HAU	111	100	-	353.8	2.9	-480	35	0	62	0	-15.5	-5.1	0	-5.1	-17.9	0	23
West EC Façade	11/	102	SIT	82.7	100	1	309.6	-	0	0	0	54.7	0	-29.8	-2.4	0	0	-	0	22.5
South EC Façade	2/	101	SIT	83.6	100	1	342.6	-	0	0	0	55.6	0	-30.7	-2.5	0	0	-	0	22.4
CHP 1 - Exhaust	1/	87	STA	80	100	-	349.6	-	106	42	0	52	0	-30.9	0	0	0	-	0	21.1
CO2 Recovery - North	18/	119	SIT	85	100	1	516	-	-691	38.4	0	57	0	-34.3	-3.4	0	0	-	0	19.3
CO2 Recovery - South	18/	117	SIT	85	100	1	535.8	-	-691	38.3	0	57	0	-34.6	-3.7	0	0	-	0	18.7
CHP 3 - Exhaust	6/	89	STA	82	100	-	361.8	-	103	45	-5	54	0	-31.2	0	0	-5	-	0	17.8
CHP 4 - Exhaust	6/	90	STA	82	100	-	363.4	-	103	45	-5	54	0	-31.2	0	0	-5	-	0	17.8
CHP Dry Cooler 1	7/	1	STA	78	100	-	310.9	-	0	0	0	50	0	-29.9	-3.3	0	0	-	0	16.8
CHP Dry Cooler 2	7/	11	STA	78	100	-	316.2	-	0	0	0	50	0	-30	-3.3	0	0	-	0	16.7
CHP Dry Cooler 3	7/	21	STA	78	100	-	321.7	-	0	0	0	50	0	-30.1	-3.3	0	0	-	0	16.6
CHP Dry Cooler 4	7/	31	STA	78	100	-	327.3	-	0	0	0	50	0	-30.3	-3.3	0	0	-	0	16.4
East EC Façade	11/	100	SIT	82.7	100	1	367	-	102	45	-10	54.7	0	-31.3	-2.6	0	-10	-	0	13.4
CHP Dry Cooler 5	7/	41	STA	78	100	-	333	-	103	45	-10	50	0	-30.4	-3.4	0	-10	-	0	9.6
CHP Dry Cooler 6	7/	51	STA	78	100	-	339.1	-	103	45	-10	50	0	-30.6	-3.4	0	-10	-	0	9.4
HE Transformer	8/	103	STA	68	100	-	239.5	-	0	0	0	40	0	-27.6	-3.1	0	0	-	0	9.3
CHP Dry Cooler 7	7/	61	STA	78	100	-	344.8	-	103	45	-10	50	0	-30.8	-3.4	0	-10	-	0	9.2
CHP Dry Cooler 8	7/	71	STA	78	100	-	351.1	-	102	45	-10	50	0	-30.9	-3.4	0	-10	-	0	9.1
Transformer 1	8/	81	STA	68	100	-	379.5	-	102	45	-10	40	0	-31.6	-3.8	0	-10	-	0	-1.6
Transformer 2	8/	82	STA	68	100	-	382.5	-	103	45	-10	40	0	-31.7	-3.8	0	-10	-	0	-1.7
Transformer 3	8/	83	STA	68	100	-	385.3	-	103	45	-10	40	0	-31.7	-3.8	0	-10	-	0	-1.7
Transformer 4	8/	84	STA	68	100	-	388	-	103	45	-10	40	0	-31.8	-3.8	0	-10	-	0	-1.8
Transformer 5	8/	85	STA	68	100	-	391.2	-	103	45	-10	40	0	-31.8	-3.8	0	-10	-	0	-1.8
Transformer 6	8/	86	STA	68	100	-	394.1	-	103	45	-10	40	0	-31.9	-3.8	0	-10	-	0	-1.9
CO2 Recovery - West	18/	116	0.2	ANGLE CUT-OFF																
CO2 Recovery - East	18/	118	0.3	ANGLE CUT-OFF																
													TOTAL AT RECEIVER							44.4

Figure C.2 – Summer Night-time $L_{Aeq,15min}$ Noise Levels at First Floor Level (4.5m above local ground height) at 20°C

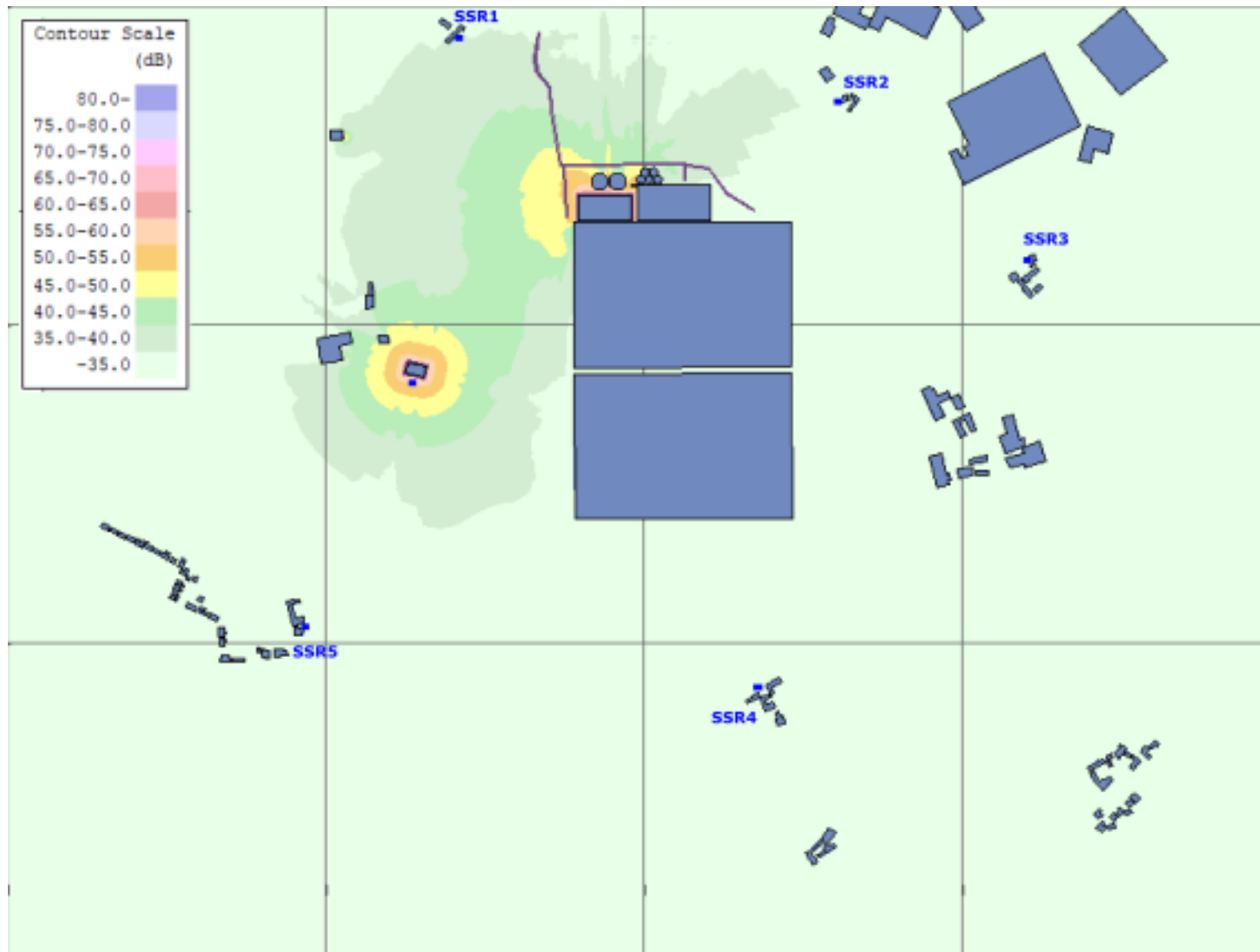


Table C.2 – Summer Night-time Acoustic Model, Critical SSR1 (north) at 4.5m above Local Ground (20°C Ambient Temp)

SSR 1 4.5m above local ground height	Activity			Sound Power Level (dB)	% On- time	Equivalent On-time	Source - Receiver Distance (m)	Angle of View	Major Barrier			Leq @ 10m (dB)	Corrections (dB)							Activity Total (dB)
	Num.	Wrk.	Type						Ref. No.	Height (m)	Attenuation (dB)		On- time	Distance	Soft Ground	Atmos	Barrier	Angle	Reflection	
CHP 2 - Air Outlet	12/	92	STA	88	100	-	354.2	-	106	42	0	60	0	-31	-0.4	0	0	-	0	28.6
North EC Façade	19/	99	SIT	87.2	100	1	309.6	-	0	0	0	59.2	0	-29.8	-2.4	0	0	-	0	27
CHP 1 - Air Outlet	4/	91	STA	86	100	-	346.5	-	106	42	0	58	0	-30.8	-0.4	0	0	-	0	26.8
CHP 1 - Air Inlet	3/	95	STA	84	100	-	340.7	-	106	42	0	56	0	-30.6	-0.4	0	0	-	0	25
CHP 2 - Air Inlet	13/	96	STA	88	100	-	348.4	-	103	45	-5	60	0	-30.8	-0.4	0	-5	-	0	24.2
CHP 2 - Exhaust	6/	88	STA	82	100	-	351.2	-	106	42	0	54	0	-30.9	0	0	0	-	0	23.1
West EC Façade	11/	102	SIT	82.7	100	1	309.6	-	0	0	0	54.7	0	-29.8	-2.4	0	0	-	0	22.5
South EC Façade	2/	101	SIT	83.6	100	1	342.6	-	0	0	0	55.6	0	-30.7	-2.5	0	0	-	0	22.4
CHP 1 - Exhaust	1/	87	STA	80	100	-	349.6	-	106	42	0	52	0	-30.9	0	0	0	-	0	21.1
CO2 Recovery - North	18/	119	SIT	85	100	1	516	-	-691	38.4	0	57	0	-34.3	-3.4	0	0	-	0	19.3
CO2 Recovery - South	18/	117	SIT	85	100	1	535.8	-	-691	38.3	0	57	0	-34.6	-3.7	0	0	-	0	18.7
CHP Dry Cooler 1	7/	1	STA	78	100	-	310.9	-	0	0	0	50	0	-29.9	-3.3	0	0	-	0	16.8
CHP Dry Cooler 2	7/	11	STA	78	100	-	316.2	-	0	0	0	50	0	-30	-3.3	0	0	-	0	16.7
CHP Dry Cooler 3	7/	21	STA	78	100	-	321.7	-	0	0	0	50	0	-30.1	-3.3	0	0	-	0	16.6
CHP Dry Cooler 4	7/	31	STA	78	100	-	327.3	-	0	0	0	50	0	-30.3	-3.3	0	0	-	0	16.4
East EC Façade	11/	100	SIT	82.7	100	1	367	-	102	45	-10	54.7	0	-31.3	-2.6	0	-10	-	0	13.4
CHP Dry Cooler 5	7/	41	STA	78	100	-	333	-	103	45	-10	50	0	-30.4	-3.4	0	-10	-	0	9.6
CHP Dry Cooler 6	7/	51	STA	78	100	-	339.1	-	103	45	-10	50	0	-30.6	-3.4	0	-10	-	0	9.4
HE Transformer	8/	103	STA	68	100	-	239.5	-	0	0	0	40	0	-27.6	-3.1	0	0	-	0	9.3
Transformer 1	8/	81	STA	68	100	-	379.5	-	102	45	-10	40	0	-31.6	-3.8	0	-10	-	0	-1.6
Transformer 2	8/	82	STA	68	100	-	382.5	-	103	45	-10	40	0	-31.7	-3.8	0	-10	-	0	-1.7
Transformer 3	8/	83	STA	68	100	-	385.3	-	103	45	-10	40	0	-31.7	-3.8	0	-10	-	0	-1.7
Transformer 4	8/	84	STA	68	100	-	388	-	103	45	-10	40	0	-31.8	-3.8	0	-10	-	0	-1.8
Transformer 5	8/	85	STA	68	100	-	391.2	-	103	45	-10	40	0	-31.8	-3.8	0	-10	-	0	-1.8
Transformer 6	8/	86	STA	68	100	-	394.1	-	103	45	-10	40	0	-31.9	-3.8	0	-10	-	0	-1.9
CO2 Recovery - West	18/	116	0.2	ANGLE CUT-OFF																
CO2 Recovery - East	18/	118	0.3	ANGLE CUT-OFF																
													TOTAL AT RECEIVER							35.3

Figure C.3 – General Night-time $L_{Aeq,15min}$ Noise Levels at First Floor Level (4.5m above local ground height) at 15°C

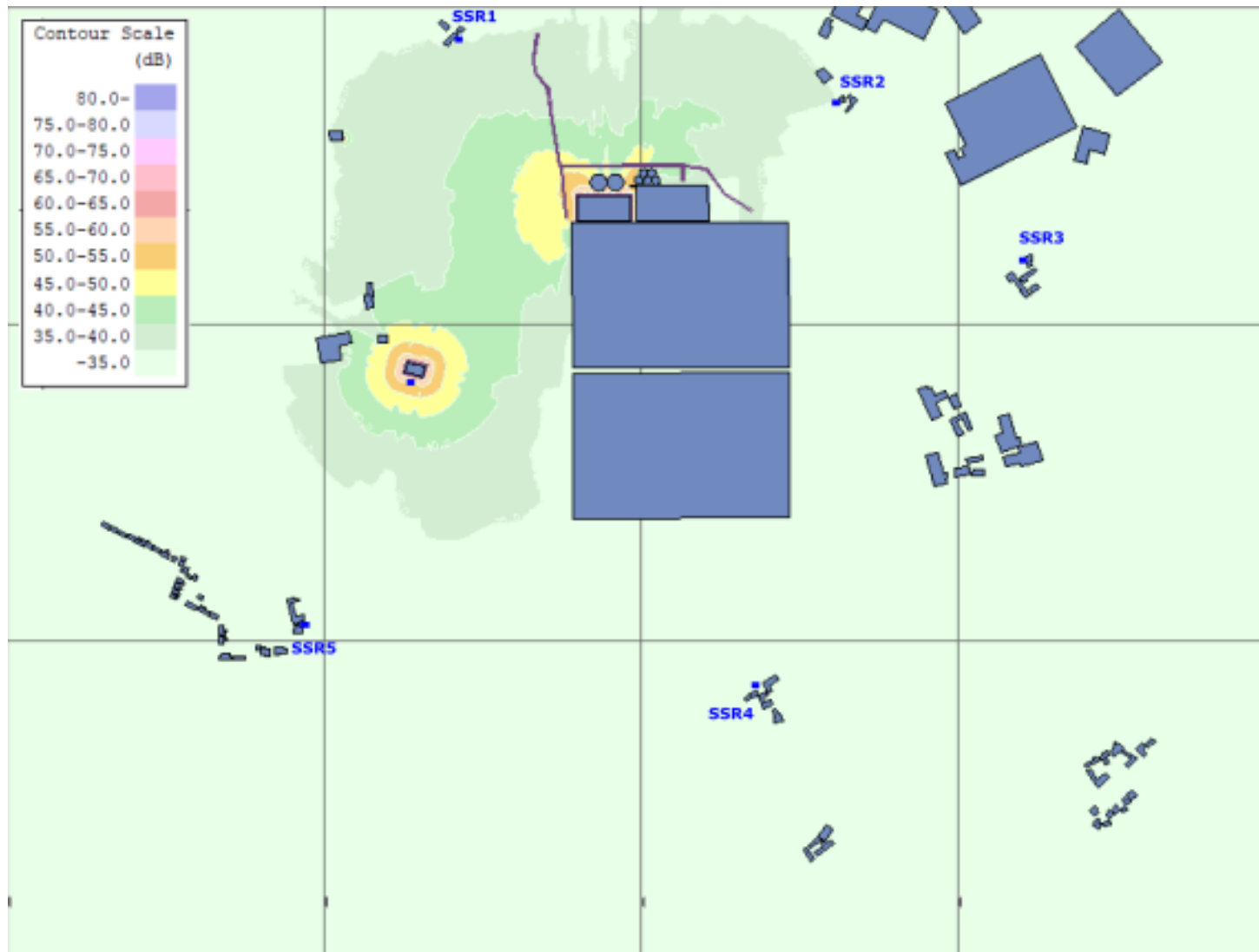


Table C.3 – General Night-time Acoustic Model, Critical SSR1 (north) at 4.5m above Local Ground

SSR 1 4.5m above local ground height	Activity			Sound Power Level (dB)	% On- time	Equivalent On-time	Source - Receiver Distance (m)	Angle of View	Major Barrier			Leq @ 10m (dB)	Corrections (dB)							Activity Total (dB)
	Num.	Wrk.	Type						Ref. No.	Height (m)	Attenuation (dB)		On- time	Distance	Soft Ground	Atmos	Barrier	Angle	Reflection	
CHP 2 - Air Outlet	23/	92	STA	88	100	-	354.2	-	106	42	0	60	0	-31	-0.4	0	0	-	0	28.6
North EC Façade	19/	99	SIT	87.2	100	1	309.6	-	0	0	0	59.2	0	-29.8	-2.4	0	0	-	0	27
CHP 3 - Air Outlet	23/	93	STA	88	100	-	358.8	-	103	45	-5	60	0	-31.1	-0.4	0	-5	-	0	23.9
CHP 4 - Air Outlet	23/	94	STA	88	100	-	366.6	-	103	45	-5	60	0	-31.3	-0.4	0	-5	-	0	23.7
CHP 2 - Exhaust	6/	88	STA	82	100	-	351.2	-	106	42	0	54	0	-30.9	0	0	0	-	0	23.1
West EC Façade	11/	102	SIT	82.7	100	1	309.6	-	0	0	0	54.7	0	-29.8	-2.4	0	0	-	0	22.5
South EC Façade	2/	101	SIT	83.6	100	1	342.6	-	0	0	0	55.6	0	-30.7	-2.5	0	0	-	0	22.4
CHP 1 - Air Outlet	21/	91	STA	81	100	-	346.5	-	106	42	0	53	0	-30.8	-0.4	0	0	-	0	21.8
CHP 1 - Exhaust	1/	87	STA	80	100	-	349.6	-	106	42	0	52	0	-30.9	0	0	0	-	0	21.1
CHP 1 - Air Inlet	20/	95	STA	79	100	-	340.7	-	106	42	0	51	0	-30.6	-0.4	0	0	-	0	20
CO2 Recovery - North	18/	119	SIT	85	100	1	516	-	-691	38.4	0	57	0	-34.3	-3.4	0	0	-	0	19.3
CO2 Recovery - South	18/	117	SIT	85	100	1	535.8	-	-691	38.3	0	57	0	-34.6	-3.7	0	0	-	0	18.7
CHP 3 - Exhaust	6/	89	STA	82	100	-	361.8	-	103	45	-5	54	0	-31.2	0	0	-5	-	0	17.8
CHP 4 - Exhaust	6/	90	STA	82	100	-	363.4	-	103	45	-5	54	0	-31.2	0	0	-5	-	0	17.8
CHP 2 - Air Inlet	22/	96	STA	81	100	-	348.4	-	103	45	-5	53	0	-30.8	-0.4	0	-5	-	0	17.2
CHP 3 - Air Inlet	22/	97	STA	81	100	-	352.8	-	103	45	-5	53	0	-31	-0.4	0	-5	-	0	17
CHP 4 - Air Inlet	22/	98	STA	81	100	-	360.8	-	103	45	-5	53	0	-31.1	-0.4	0	-5	-	0	16.9
CHP Dry Cooler 1	7/	1	STA	78	100	-	310.9	-	0	0	0	50	0	-29.9	-3.3	0	0	-	0	16.8
CHP Dry Cooler 2	7/	11	STA	78	100	-	316.2	-	0	0	0	50	0	-30	-3.3	0	0	-	0	16.7
CHP Dry Cooler 3	7/	21	STA	78	100	-	321.7	-	0	0	0	50	0	-30.1	-3.3	0	0	-	0	16.6
CHP Dry Cooler 4	7/	31	STA	78	100	-	327.3	-	0	0	0	50	0	-30.3	-3.3	0	0	-	0	16.4
East EC Façade	11/	100	SIT	82.7	100	1	367	-	102	45	-10	54.7	0	-31.3	-2.6	0	-10	-	0	13.4
CHP Dry Cooler 5	7/	41	STA	78	100	-	333	-	103	45	-10	50	0	-30.4	-3.4	0	-10	-	0	9.6
CHP Dry Cooler 6	7/	51	STA	78	100	-	339.1	-	103	45	-10	50	0	-30.6	-3.4	0	-10	-	0	9.4
HE Transformer	8/	103	STA	68	100	-	239.5	-	0	0	0	40	0	-27.6	-3.1	0	0	-	0	9.3
CHP Dry Cooler 7	7/	61	STA	78	100	-	344.8	-	103	45	-10	50	0	-30.8	-3.4	0	-10	-	0	9.2
CHP Dry Cooler 8	7/	71	STA	78	100	-	351.1	-	102	45	-10	50	0	-30.9	-3.4	0	-10	-	0	9.1
Transformer 1	8/	81	STA	68	100	-	379.5	-	102	45	-10	40	0	-31.6	-3.8	0	-10	-	0	-1.6
Transformer 2	8/	82	STA	68	100	-	382.5	-	103	45	-10	40	0	-31.7	-3.8	0	-10	-	0	-1.7
Transformer 3	8/	83	STA	68	100	-	385.3	-	103	45	-10	40	0	-31.7	-3.8	0	-10	-	0	-1.7
Transformer 4	8/	84	STA	68	100	-	388	-	103	45	-10	40	0	-31.8	-3.8	0	-10	-	0	-1.8
Transformer 5	8/	85	STA	68	100	-	391.2	-	103	45	-10	40	0	-31.8	-3.8	0	-10	-	0	-1.8
Transformer 6	8/	86	STA	68	100	-	394.1	-	103	45	-10	40	0	-31.9	-3.8	0	-10	-	0	-1.9
CO2 Recovery - West	18/	116	0.2	CUT-OFF																
CO2 Recovery - East	18/	118	0.3	CUT-OFF																
TOTAL AT RECEIVER																			35.2	

Figure C.4 – Summer Night-time $L_{Aeq,15min}$ Noise Levels at First Floor Level (4.5m above local ground height) at 20°C with Staff Arrivals

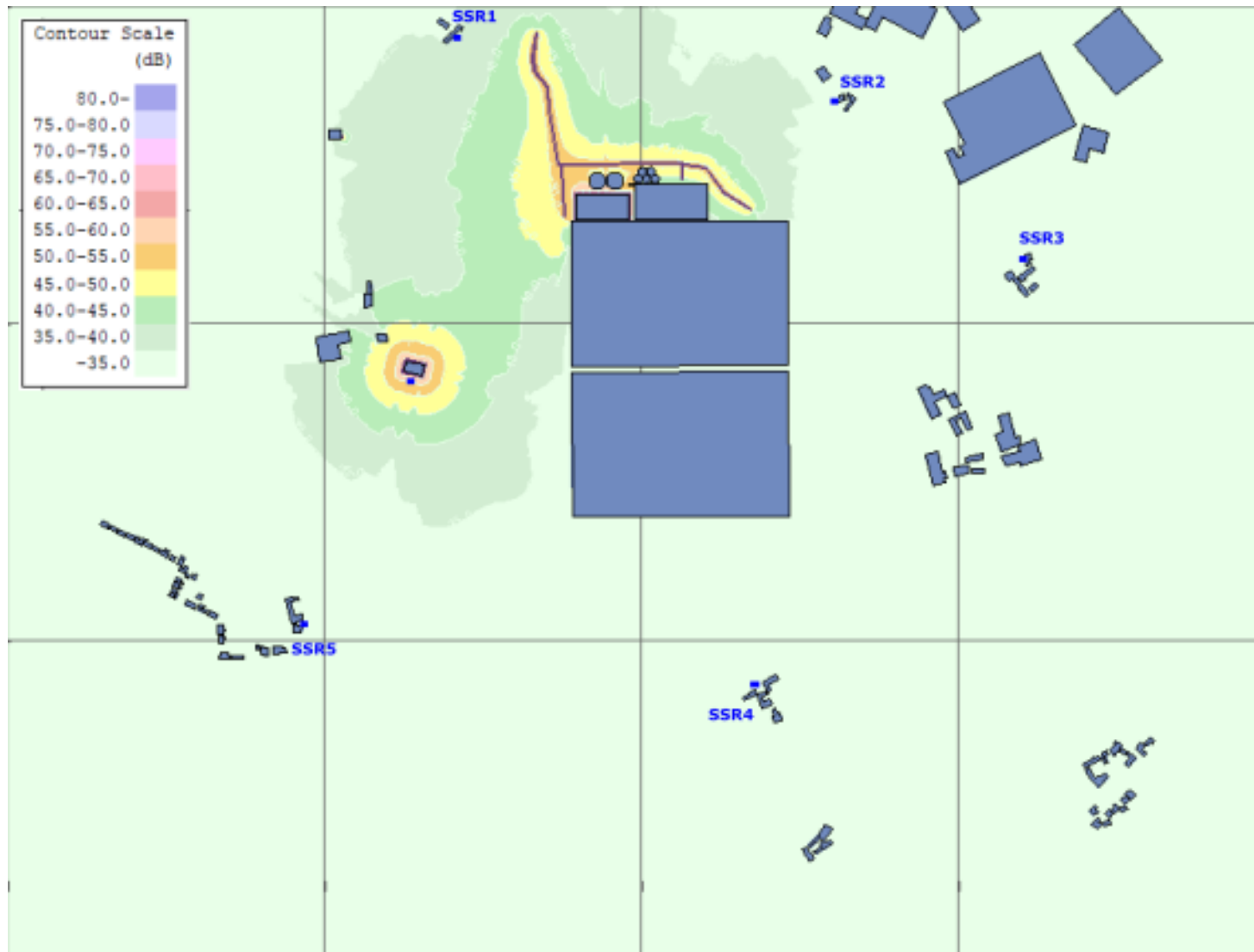


Table C.4 – Summer Night-time with Staff Arrival Acoustic Model, Critical SSR1 (north) at 4.5m above Local Ground

SSR 1 4.5m above local ground height	Activity			Sound Power Level (dB)	% On- time	Equivalent On-time	Source - Receiver Distance (m)	Angle of View	Major Barrier			Leq @ 10m (dB)	Corrections (dB)							Activity Total (dB)
	Num.	Wrk.	Type						Ref. No.	Height (m)	Attenuation (dB)		On- time	Distance	Soft Ground	Atmos	Barrier	Angle	Reflection	
CHP 2 - Air Outlet	12/	92	STA	88	100	-	354.2	-	106	42	0	60	0	-31	-0.4	0	0	-	0	28.6
North EC Façade	19/	99	SIT	87.2	100	1	309.6	-	0	0	0	59.2	0	-29.8	-2.4	0	0	-	0	27
CHP 1 - Air Outlet	4/	91	STA	86	100	-	346.5	-	106	42	0	58	0	-30.8	-0.4	0	0	-	0	26.8
Haul Road	17/	104	HAU	88	100	-	122.1	18	0	0	0	49.7	0	-10.9	-2.8	0	0	-10	0	26
CHP 1 - Air Inlet	3/	95	STA	84	100	-	340.7	-	106	42	0	56	0	-30.6	-0.4	0	0	-	0	25
CHP 2 - Air Inlet	13/	96	STA	88	100	-	348.4	-	103	45	-5	60	0	-30.8	-0.4	0	-5	-	0	24.2
Haul Road	17/	105	HAU	88	100	-	114.7	9	0	0	0	49.7	0	-10.6	-2.9	0	0	-13	0	23.2
CHP 2 - Exhaust	6/	88	STA	82	100	-	351.2	-	106	42	0	54	0	-30.9	0	0	0	-	0	23.1
Haul Road	17/	106	HAU	88	100	-	63.1	5.6	0	0	0	49.7	0	-8	-3.7	0	0	-15.1	0	22.9
Haul Road	17/	108	HAU	88	100	-	123.4	13.1	-479	35	0	49.7	0	-10.9	-4.7	0	-4.7	-11.4	0	22.7
West EC Façade	11/	102	SIT	82.7	100	1	309.6	-	0	0	0	54.7	0	-29.8	-2.4	0	0	-	0	22.5
South EC Façade	2/	101	SIT	83.6	100	1	342.6	-	0	0	0	55.6	0	-30.7	-2.5	0	0	-	0	22.4
Haul Road	17/	107	HAU	88	100	-	133.9	9.3	0	0	0	49.7	0	-11.3	-3.7	0	0	-12.9	0	21.8
CHP 1 - Exhaust	1/	87	STA	80	100	-	349.6	-	106	42	0	52	0	-30.9	0	0	0	-	0	21.1
Haul Road	17/	109	HAU	88	100	-	200.7	22.1	-480	35	0	48.4	0	-13	-5.5	0	-5.5	-9.1	0	20.8
CO2 Recovery - North	18/	119	SIT	85	100	1	516	-	-691	38.4	0	57	0	-34.3	-3.4	0	0	-	0	19.3
CO2 Recovery - South	18/	117	SIT	85	100	1	535.8	-	-691	38.3	0	57	0	-34.6	-3.7	0	0	-	0	18.7
CHP Dry Cooler 1	7/	1	STA	78	100	-	310.9	-	0	0	0	50	0	-29.9	-3.3	0	0	-	0	16.8
CHP Dry Cooler 2	7/	11	STA	78	100	-	316.2	-	0	0	0	50	0	-30	-3.3	0	0	-	0	16.7
CHP Dry Cooler 3	7/	21	STA	78	100	-	321.7	-	0	0	0	50	0	-30.1	-3.3	0	0	-	0	16.6
CHP Dry Cooler 4	7/	31	STA	78	100	-	327.3	-	0	0	0	50	0	-30.3	-3.3	0	0	-	0	16.4
East EC Façade	11/	100	SIT	82.7	100	1	367	-	102	45	-10	54.7	0	-31.3	-2.6	0	-10	-	0	13.4
Haul Road	17/	111	HAU	88	100	-	148.1	8.1	-479	35	0	44.1	0	-11.7	-6	0	-5.9	-13.5	0	12.9
CHP Dry Cooler 5	7/	41	STA	78	100	-	333	-	103	45	-10	50	0	-30.4	-3.4	0	-10	-	0	9.6
CHP Dry Cooler 6	7/	51	STA	78	100	-	339.1	-	103	45	-10	50	0	-30.6	-3.4	0	-10	-	0	9.4
HE Transformer	8/	103	STA	68	100	-	239.5	-	0	0	0	40	0	-27.6	-3.1	0	0	-	0	9.3
Haul Road	17/	114	HAU	88	100	-	195.9	2.5	-480	35	0	48.4	0	-12.9	-8.4	0	-8.4	-18.6	0	8.5
Haul Road	17/	113	HAU	88	100	-	167.2	1.8	-480	35	0	48.4	0	-12.2	-8.4	0	-8.4	-19.9	0	7.9
Transformer 1	8/	81	STA	68	100	-	379.5	-	102	45	-10	40	0	-31.6	-3.8	0	-10	-	0	-1.6
Transformer 2	8/	82	STA	68	100	-	382.5	-	103	45	-10	40	0	-31.7	-3.8	0	-10	-	0	-1.7
Transformer 3	8/	83	STA	68	100	-	385.3	-	103	45	-10	40	0	-31.7	-3.8	0	-10	-	0	-1.7
Transformer 4	8/	84	STA	68	100	-	388	-	103	45	-10	40	0	-31.8	-3.8	0	-10	-	0	-1.8
Transformer 5	8/	85	STA	68	100	-	391.2	-	103	45	-10	40	0	-31.8	-3.8	0	-10	-	0	-1.8
Transformer 6	8/	86	STA	68	100	-	394.1	-	103	45	-10	40	0	-31.9	-3.8	0	-10	-	0	-1.9
Haul Road	17/	115	0.3	ANGLE CUT-OFF																
CO2 Recovery - West	18/	116	0.2	ANGLE CUT-OFF																
CO2 Recovery - East	18/	118	0.3	ANGLE CUT-OFF																
													TOTAL AT RECEIVER							36.7

APPENDIX D – DRAWING & DOCUMENT LISTS

D.1 Low Carbon Farming

The following Low Carbon Farming drawings have been used in our assessment;

Table D.1 – Low Carbon Farming Drawing List

Drawing Title	Drawing Number	Rev	Date
General Location Plan	00165-20-100	01	27/05/2020
General Conceptual Layout	00165-20-101	01	05/06/2020
General Energy Centre Layout	00165-20-104	01	02/06/2020
General Planning Elevations – Glasshouse & Packhouse	00165-20-300	01	08/06/2020
General Planning Elevations – Energy Centre & Palisade	00165-20-301	01	08/06/2020
General Planning Elevations – DNO & Customer Substation	00165-20-302	01	08/06/2020
General Planning Elevations – Transformers & Air Coolers	00165-20-303	01	08/06/2020
General Planning Elevations – Water Tanks	00165-20-304	01	08/06/2020

D.2 Cotswold Transport Planning

The following Cotswold Transport Planning documents have been used in our assessment;

Table D.2 – Cotswold Transport Planning Document List

Document Title	Document Number	Rev	Date
Transport Statement	CTP-20-537	-	June 2020