

Apex Plaza
Forbury Road
Reading
RG1 1AX

Plant Noise Impact Assessment
Blocks A to D External Plant

On behalf of

Charles D. Smith & Associates Ltd

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1.0 Introduction

- 1.1. Noise Solutions Ltd (NSL) has been commissioned to provide a noise impact assessment of proposed new external plant to be installed on the roof of Apex Plaza, Reading.
- 1.2. An environmental sound survey has been undertaken to establish the prevailing background sound pressure levels at a location representative of the sound levels outside the nearest noise sensitive receptors to the site.
- 1.3. Plant noise levels have been predicted at the nearest noise-sensitive receptors and assessed against the local authority's usual requirements and other recognised standards and guidance.
- 1.4. To assist with the understanding of this report a glossary of acoustic terms can be found in [Appendix A](#). An in-depth glossary of acoustic terms can be viewed online at www.acoustic-glossary.co.uk.

2.0 Details of development proposals

- 2.1. As part of the fit-out of the offices at Apex Plaza, it is proposed to install new heat pumps on the roof of each Block.
- 2.2. Aerial views of the site and surrounding area and the noise monitoring location used in this assessment are presented in [Appendix B](#).
- 2.3. The proposed plant layout is shown in [Appendix D](#). Plant noise data is given in [Appendix E](#). Plant will operate at the maximum duty during the daytime (07.00 to 23.00 hours) but at night-time set-back at all other times.

3.0 Nearest noise-sensitive receptors

- 3.1. Apex Plaza is in a predominantly commercial area, to the east of Reading railway station and immediately to the south of the railway lines.
- 3.2. The closest windows to the plant are within Apex Plaza itself (Receptor R1), and there are external terrace areas on the south side of the building, on the level below the plant (Receptor R2). All windows, and the terraces, are screened from the plant by the building envelope.
- 3.3. The nearest windows of neighbouring office buildings are to the south (Receptor R3), approximately 30m from the nearest plant. The closest windows are two-storeys lower than the roof of Apex Plaza and are therefore also screened from the majority of the new plant.

- 3.4. The nearest residential property to the proposed plant is the staff accommodation above the Blagrave Arms public house on Blagrave Street (Receptor R4), approximately 55m to the south of the closest plant, and also screened from the majority of the plant by the Apex Plaza building envelope.
- 3.5. The above are indicated in [Appendix B](#).

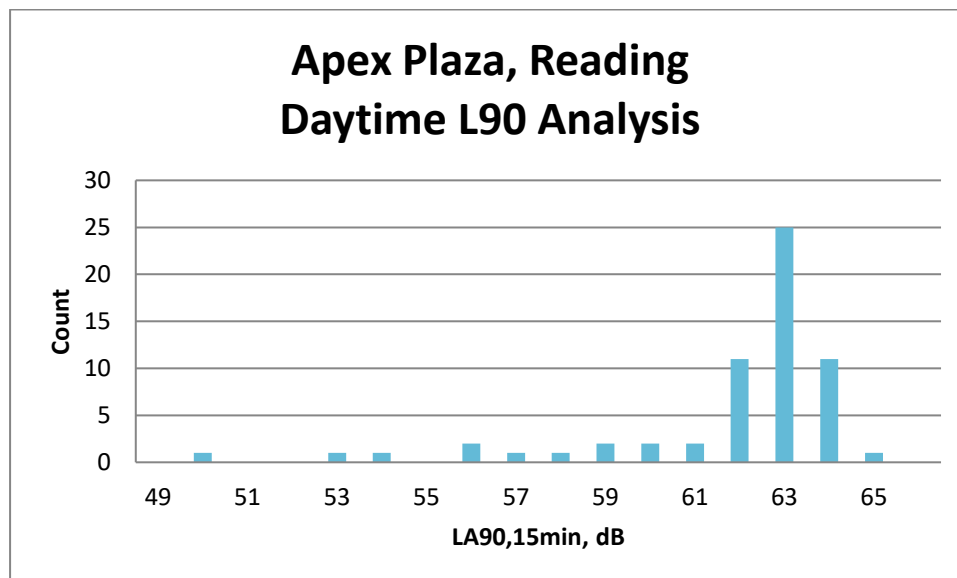
4.0 Existing noise climate

- 4.1. An environmental noise survey was undertaken to establish the typical background sound levels at a location representative of the noise climate outside the façades of the nearest noise sensitive receptors to the proposed plant area during the quietest times at which the plant will operate.
- 4.2. The results of the environmental sound survey are summarised in Table 1 below. The full set of measurement results and details of the survey methodology are presented in [Appendix C](#).

Table 1 Summary of survey results

Measurement period	Range of recorded sound pressure levels (dB)			
	L _{Aeq} (15mins)	L _{Amax} (15mins)	L _{A10} (15mins)	L _{A90} (15mins)
Daytime (07.00 – 23.00 hours)	64-74	75-98	67-73	50-65
Night-time (23.00 – 07.00 hours)	53-70	67-89	57-72	41-63

Figure 1 Histogram of daytime L_{A90} background sound pressure levels



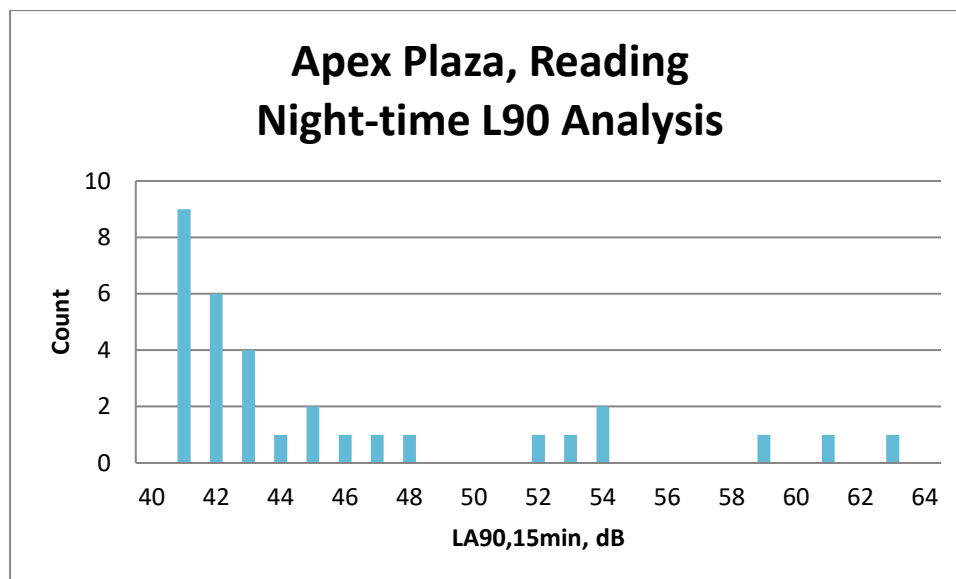
- 4.3. Further statistical analysis has been carried out on the data, and the mean and median values are shown in Table 2 below.

Table 2 Statistical analysis of $L_{A90,15min}$ levels during the daytime period

dB, L_{A90} daytime period	
mean	62
modal	63
median	63

- 4.4. From the histogram analysis, 56dB has been selected to be a robust representation of the background noise level during the daytime period.

Figure 2 Histogram of night-time L_{A90} background sound pressure levels



- 4.5. Further statistical analysis has been carried out on the data and the mean and median values are shown in Table 3 below.

Table 3 Statistical analysis of $L_{A90,15min}$ levels during the night-time period

dB, L_{A90} night-time period	
mean	46
modal	41
median	43

- 4.6. Again, from the histogram analysis, 41dB has been selected to be a robust representation of the background sound level during the night-time period.
- 4.7. Therefore, the following values are considered representative of the existing background sound pressure levels at nearby noise sensitive premises:
- 56dB L_{A90} during the daytime period; and
 - 41dB L_{A90} during the night-time period.

Covid-19

- 4.8. It should be noted that the environmental noise survey discussed in this report was undertaken in April 2021, at a time when the coronavirus pandemic was causing a disruption to typical working patterns and other activity. It is therefore likely that recorded sound levels are slightly lower than would otherwise be expected where dominated by road or air traffic. While the data should therefore be treated with an element of caution, where it has been used to establish background sound levels it is likely to understate the more-usual background sound levels and therefore result in a robust assessment.

5.0 Plant noise design criteria

Reading Borough Council

- 5.1. For similar plant installations, Reading Borough Council usually seeks to impose the following Condition:

The rating level of the plant/equipment hereby approved, $L_{A,T}$ (specific sound level plus any adjustment for the characteristic features of the sound) as measured at a point 1 metre external to sensitive facades, shall be at least 10dB below the existing background sound level, $L_{A90,T}$ when all plant/equipment (or any part of it) is in operation.

- 5.2. Please note that in this context, the offices within Apex Plaza, and the nearby commercial premises, would not be considered “sensitive”, and alternative acoustic criteria would be appropriate.

BS 4142:2014 Methods for Rating and Measuring Industrial and Commercial Sound'

- 5.3. British Standard (BS) 4142:2014 describes a method for rating and assessing sound of an industrial or commercial nature, which includes sound from fixed installations which comprise mechanical and electrical plant and equipment.
- 5.4. The industrial or commercial sound is assessed outside a dwelling or premises used for residential purposes, upon which sound is incident.
- 5.5. The procedure contained in BS 4142 is to quantify the “specific sound level”, which is the measured or predicted level of sound from the source in question over a one-hour period for the daytime and a 15-minute period for the night-time. Daytime is defined in the standard as 07:00 to 23:00 hours, and night-time as 23:00 to 07:00 hours.

- 5.6. The specific sound level is converted to a rating level by adding penalties on a sliding scale to account for either potentially tonal or impulsive elements. The standard sets out objective methods for determining the presence of tones or impulsive elements, but notes that it is acceptable to subjectively determine these effects.
- 5.7. The penalty for tonal elements is between 0dB and 6dB, and the standard notes: "Subjectively, this can be converted to a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible, and 6 dB where it is highly perceptible."
- 5.8. The penalty for impulsive elements is between 0dB and 9dB, and the standard notes: "Subjectively, this can be converted to a penalty of 3 dB for impulsivity which is just perceptible at the noise receptor, 6 dB where it is clearly perceptible, and 9 dB where it is highly perceptible."
- 5.9. The background sound level should be established in terms of the L_{A90} noise index. The standard states that the background sound level should be measured over a period of sufficient length to obtain a representative value. This should not normally be less than 15-minute intervals. The standard states that: "A representative level ought to account for the range of background sound levels and ought not automatically to be assumed to be either the minimum or modal value."
- 5.10. The assessment outcome results from a comparison of the rating level with the background sound level. The standard states:

Typically, the greater this difference, the greater the magnitude of the impact.

b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.

c) A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.

d) 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.

Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact."

- 5.11. The standard goes on to note that: "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."
- 5.12. In addition to the margin by which the Rating Level of the specific sound source exceeds the Background Sound Level, the 2014 edition places emphasis upon an appreciation of the context, as follows:

"An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context."

- 5.13. BS 4142 requires uncertainties in the assessment to be considered, and where the uncertainty is likely to affect the outcome of the assessment, steps should be taken to reduce the uncertainty.

Noise to commercial premises

- 5.14. Offices and similar commercial premises are not as sensitive to noise as residential properties and, therefore, emissions criteria are generally relaxed at these locations.
- 5.15. However, it is considered appropriate to control plant noise levels within offices to meet the recommended internal noise levels provided in BS 8233:2014 'Guidance on sound insulation and noise reduction for buildings'. The standard states a range of noise levels for various spaces used for 'study and work requiring concentration' between 35 and 50 dB L_{Aeq} .
- 5.16. In addition, BS 8233 provides general guidance on the expected sound insulation performance of a given building façade, with details of how various elements can affect the overall performance. Concerning windows, it states that:

If partially open windows were relied upon for background ventilation, the insulation would be reduced to approximately 15 dB."

- 5.17. This implies that should windows on a noise affected façade be openable, a sound insulation value of 15 dB should be applied to the whole façade to an internal room being assessed. It should be noted that a sound insulation performance of much greater than 15 dB is expected for non-openable standard double-glazed windows. However, in order to assess the worst-case scenario, this report assumes that windows may be opened if desired.
- 5.18. Based on the above and assuming a worst-case internal criterion of 35dB L_{Aeq} , it is recommended that cumulative plant noise levels at the façade of the nearest office premises should not exceed 50dB L_{Aeq} .

Summary of criteria

- 5.19. From the local authority's usual requirements and the above recommendations, the proposed plant limits are therefore as shown in Table 4.

Table 4 Proposed plant noise emissions level limits at nearest residential receptors

Period	Plant rating level	Plant specific sound level
	Residential dB L _{Ar,Tr}	Offices façades dB L _{Aeq}
Daytime (07.00 – 23.00 hours)	46	50
Night-time (23.00 – 07.00 hours)	31	50

6.0 Plant noise assessment

- 6.1. Plant noise levels have been predicted at the nearest and most affected receptors as identified in Section 3.0. Calculations include corrections for distance, surface directivity and acoustic screening provided by the building envelope.
- 6.2. It should be noted that the proposed plant is not anticipated to exhibit any tonal or impulsive characteristics provided it is well maintained. All proposed plant will be inverter driven and, therefore, will gently ramp up and down depending on the demands on the various systems. Since the predicted plant sound level at the nearest residential receptor is below the background sound level, and the proposed plant replaces existing plant at Apex Plaza, it is considered that no BS 4142:2014 feature correction is applicable.
- 6.3. Table 5 summarises the results of the plant noise impact assessment. A series of calculations can be found in [Appendix F](#).

Table 5 Plant noise impact assessment

Receptor	Period	Predicted sound / rating level at receptor window (dB)	Plant noise criterion at receptor (dB)	Difference (dB)
R1	Daytime (07.00 - 23.00 hours)	47	50	-3
	Night-time (23.00 – 07.00 hours)	42	50	-8
R2	Daytime (07.00 - 23.00 hours)	48	50	-2
	Night-time (23.00 – 07.00 hours)	38	50	-12

Receptor	Period	Predicted sound / rating level at receptor window (dB)	Plant noise criterion at receptor (dB)	Difference (dB)
R3	Daytime (07.00 - 23.00 hours)	49	50	-1
	Night-time (23.00 – 07.00 hours)	39	50	-11
R4	Daytime (07.00 - 23.00 hours)	35	46	-11
	Night-time (23.00 – 07.00 hours)	29	31	-2

- 6.4. The predictions demonstrate that cumulative noise emissions from the proposed equipment will comply with the proposed limits.

Context and uncertainties

- 6.5. As BS 4142:2014 advises, the impact must be considered within the context of the site and the surrounding acoustic environment. The following must, therefore, also be taken into consideration when determining the potential impact that may be experienced:

- The assessment is undertaken at the most-affected windows. The impact on all other nearby windows will be lower due to screening and distance attenuation.

- 6.6. Where possible uncertainty in this assessment has been minimised by taking the following steps:

- The measurement of the background sound levels was undertaken over a period including the quietest times of the day and night.
- The sound level meter and calibrator used have a traceable laboratory calibration and the meter was field calibrated before and after the measurements.
- Uncertainty in the calculated impact has been reduced by the use of a well-established calculation method.
- Care was taken to ensure that the measurement position was representative of the noise climate outside the nearby residential dwellings and not at a position where higher noise levels are present.

7.0 Summary

- 7.1. Noise Solutions Ltd has been commissioned to provide a noise impact assessment of proposed roof-mounted heat pumps to be installed at Apex Plaza, Reading.

-
- 7.2. An environmental noise survey has been undertaken to establish the existing prevailing noise levels at a location representative of the noise climate outside the nearest noise sensitive receptors to the proposed site.
- 7.3. The assessment shows that, when attenuated as detailed in this report, noise from the proposed plant will comply with the local authority's usual requirements and other recognised standards and guidance and should therefore be acceptable.

Appendix A Acoustic terminology

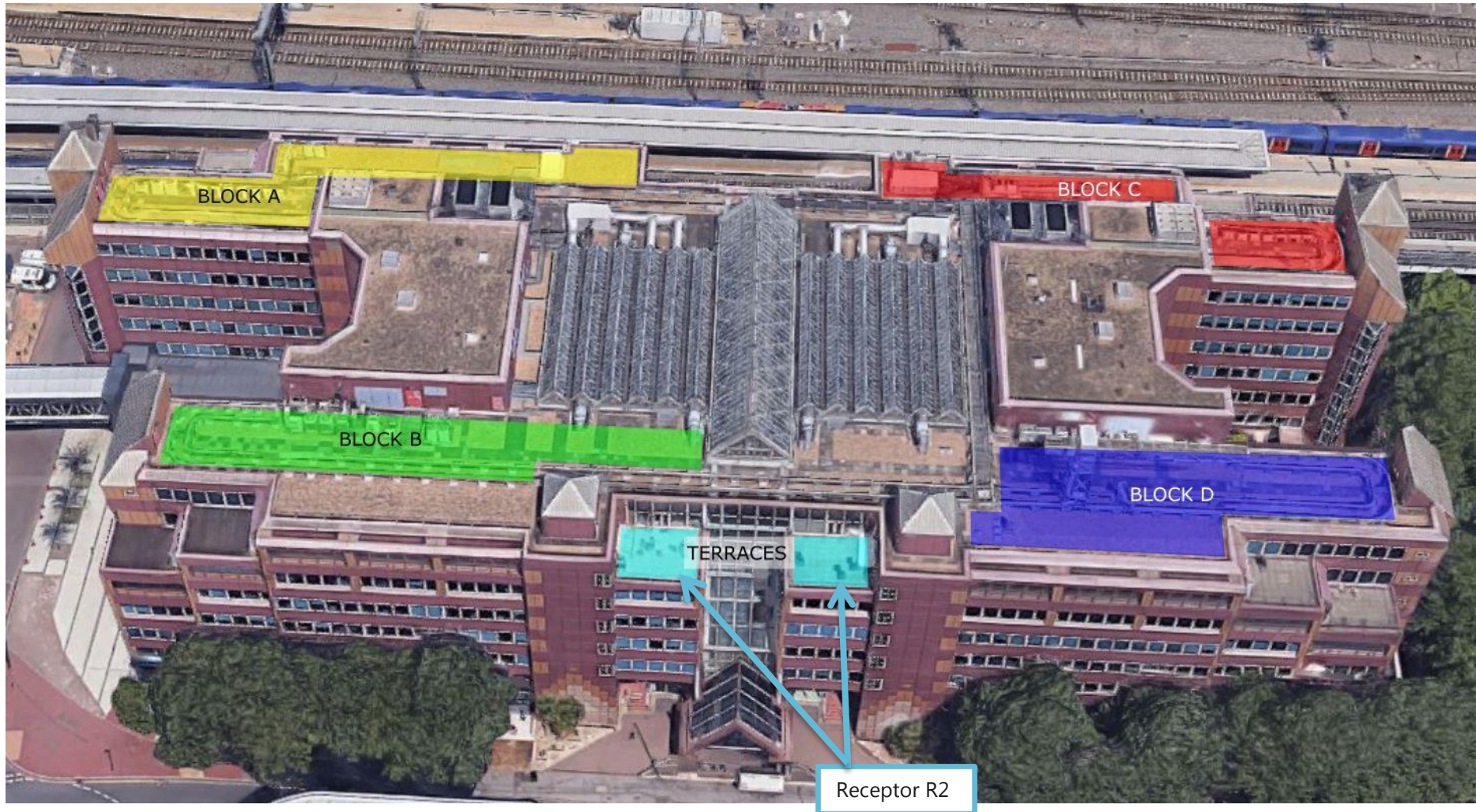
Parameter	Description
Ambient Noise Level	The totally encompassing sound in a given situation at a given time, usually composed of a sound from many sources both distant and near ($L_{Aeq,T}$).
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s_1 and s_2 is given by $20 \log_{10} (s_1/s_2)$. The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is $20\mu\text{Pa}$. The threshold of normal hearing is in the region of 0 dB and 140 dB is the threshold of pain. A change of 1 dB is only perceptible under controlled conditions.
dB(A), L_{Ax}	Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness. A change of 3 dB(A) is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds roughly to halving or doubling the loudness of a sound. The background noise in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; heavy road traffic about 80 dB(A) at 10 metres; the level near a pneumatic drill about 100 dB(A).
Fast Time Weighting	Setting on sound level meter, denoted by a subscript F, that determines the speed at which the instrument responds to changes in the amplitude of any measured signal. The fast time weighting can lead to higher values than the slow time weighting when rapidly changing signals are measured. The average time constant for the fast response setting is 0.125 (1/8) seconds.
Free-field	Sound pressure level measured outside, far away from reflecting surfaces (except the ground), usually taken to mean at least 3.5 metres
Façade	Sound pressure level measured at a distance of 1 metre in front of a large sound reflecting object such as a building façade.
$L_{Aeq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level recorded during a noise event with a period T. L_{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{10,T}$	A noise level index. The noise level exceeded for 10% of the time over the period T. L_{10} can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise. $L_{A10,18h}$ is the A-weighted arithmetic average of the 18 hourly $L_{A10,1h}$ values from 06:00-24:00.
$L_{90,T}$	A noise level index. The noise level exceeded for 90% of the time over the period T. Generally used to describe background noise level.

Appendix B Photographs of site showing areas of interest



Note: Receptor R1 are windows at Apex Plaza

Aerial view from south showing plant and terrace locations



Appendix C Environmental sound survey

Details of environmental sound survey

- C.1 Measurements of the existing background sound levels were undertaken from 10.00 hours on Monday 19th April to 09.15 hours on Tuesday 20th April 2021.
- C.2 The sound level meter was programmed to record the A-weighted L_{eq} , L_{90} , L_{10} and L_{max} noise indices for consecutive fifteen-minute sample periods for the duration of the survey.

Measurement position

- C.3 The sound level meter was positioned on a lamppost on Forbury Road. The approximate location of the microphone is indicated on the plan in [Appendix B](#).
- C.4 In accordance with BS 7445-2:1991 '*Description and measurement of environmental noise – Part 2: Guide to the acquisition of data pertinent to land use*', the measurements were undertaken under free-field conditions.

Equipment

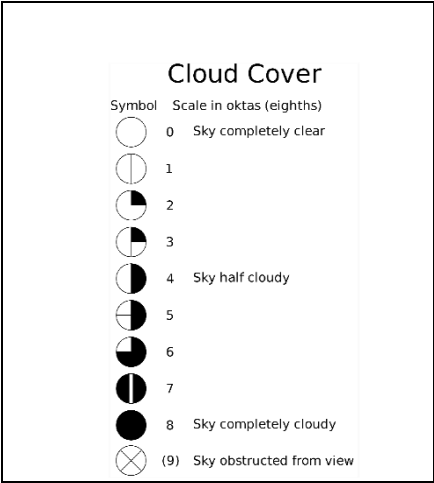
- C.5 Details of the equipment used during the survey are provided in the table below. The sound level meter was calibrated before and after the survey; no significant change (+/-0.2 dB) in the calibration level was noted.

Environmental noise survey

Description	Model / serial no.	Calibration date	Calibration certificate no.
Class 1 Sound level meter	Svantek 977/ 81301	31/10/2019	14013747-01
Condenser microphone	ACO Pacific 7052E / 74660		
Preamplifier	Svantek SV12L / 86561		
Calibrator	Svantek SV 33B / 83850	23/10/2020	14016290

Weather conditions

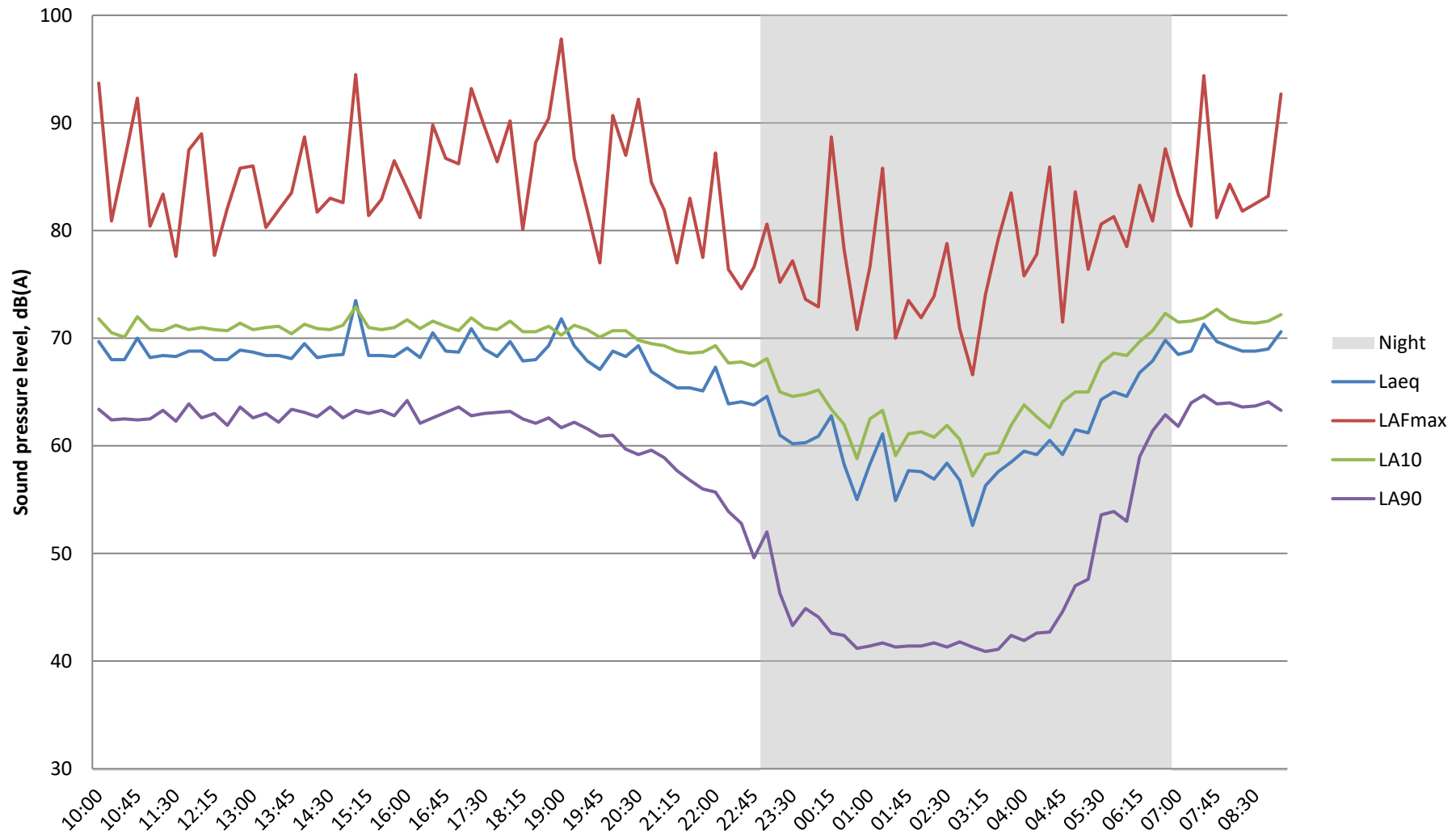
- C.6 Weather conditions were determined both at the start and on completion of the survey. It is considered that the meteorological conditions were appropriate for environmental noise measurements. The table below presents the weather conditions recorded on site at the beginning and end of the survey.

Weather Conditions				
Measurement Location	Date/Time	Description	Beginning of Survey	End of Survey
As indicated on Appendix B	10.00 19 Apr to 09.15 20 Apr 2021	Temperature (°C)	8	10
 Cloud Cover Symbol Scale in oktas (eighths) 0 Sky completely clear 1 2 3 4 Sky half cloudy 5 6 7 8 Sky completely cloudy (9) Sky obstructed from view		Precipitation:	No	No
		Cloud cover (oktas - see guide)	1	0
		Presence of fog/snow/ice	No	No
		Presence of damp roads/wet ground	No	No
		Wind Speed (m/s)	<1	<1
		Wind Direction	No	No
		Conditions that may cause temperature inversion (i.e. calm nights with no cloud)	No	No

Results

- C.7 The results of the environmental survey are considered to be representative of the background sound pressure levels at the façades of the nearest noise sensitive receptors during the quietest times at which the plant will operate. The main noise source affecting the area was local road traffic. The results of the survey are presented in a time history graph overleaf.

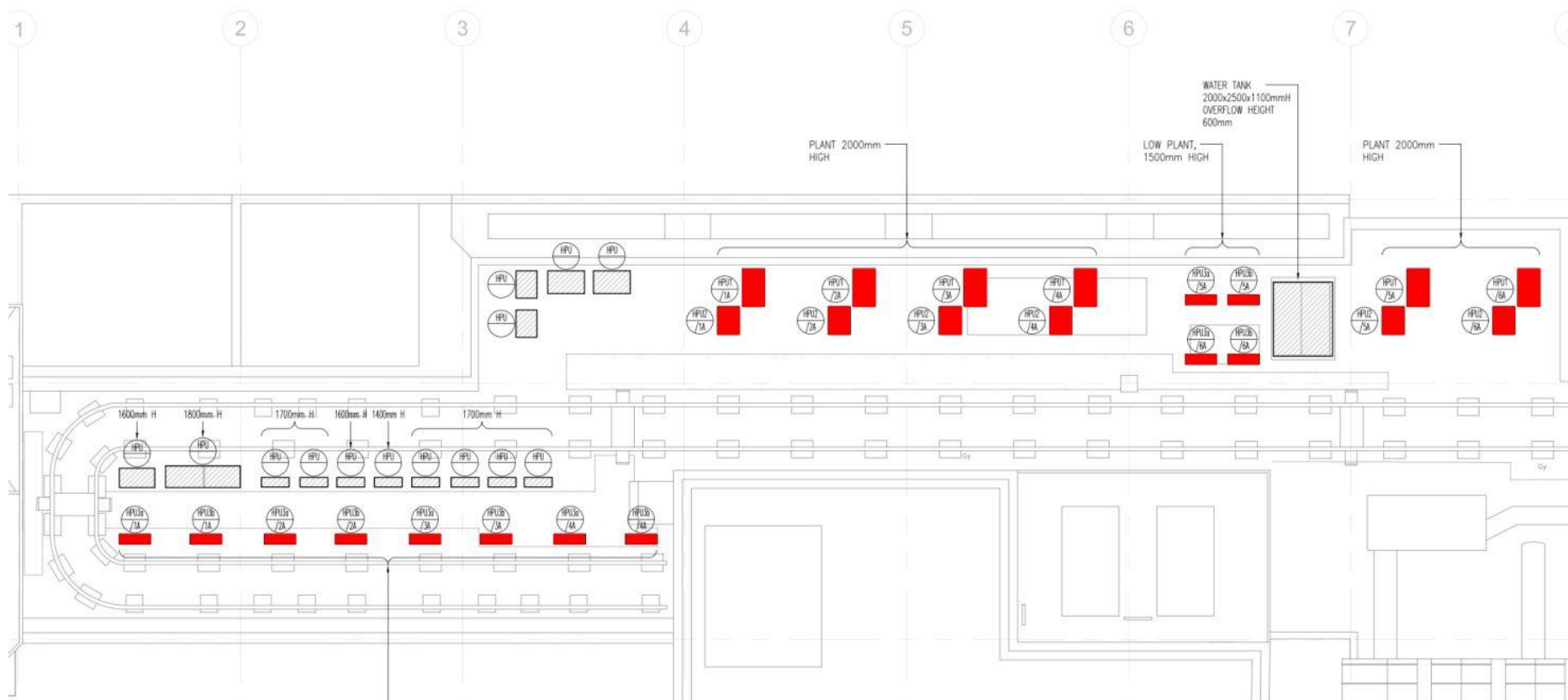
Apex Plaza, Reading Monday 19 - Tuesday 20 Apr 2021



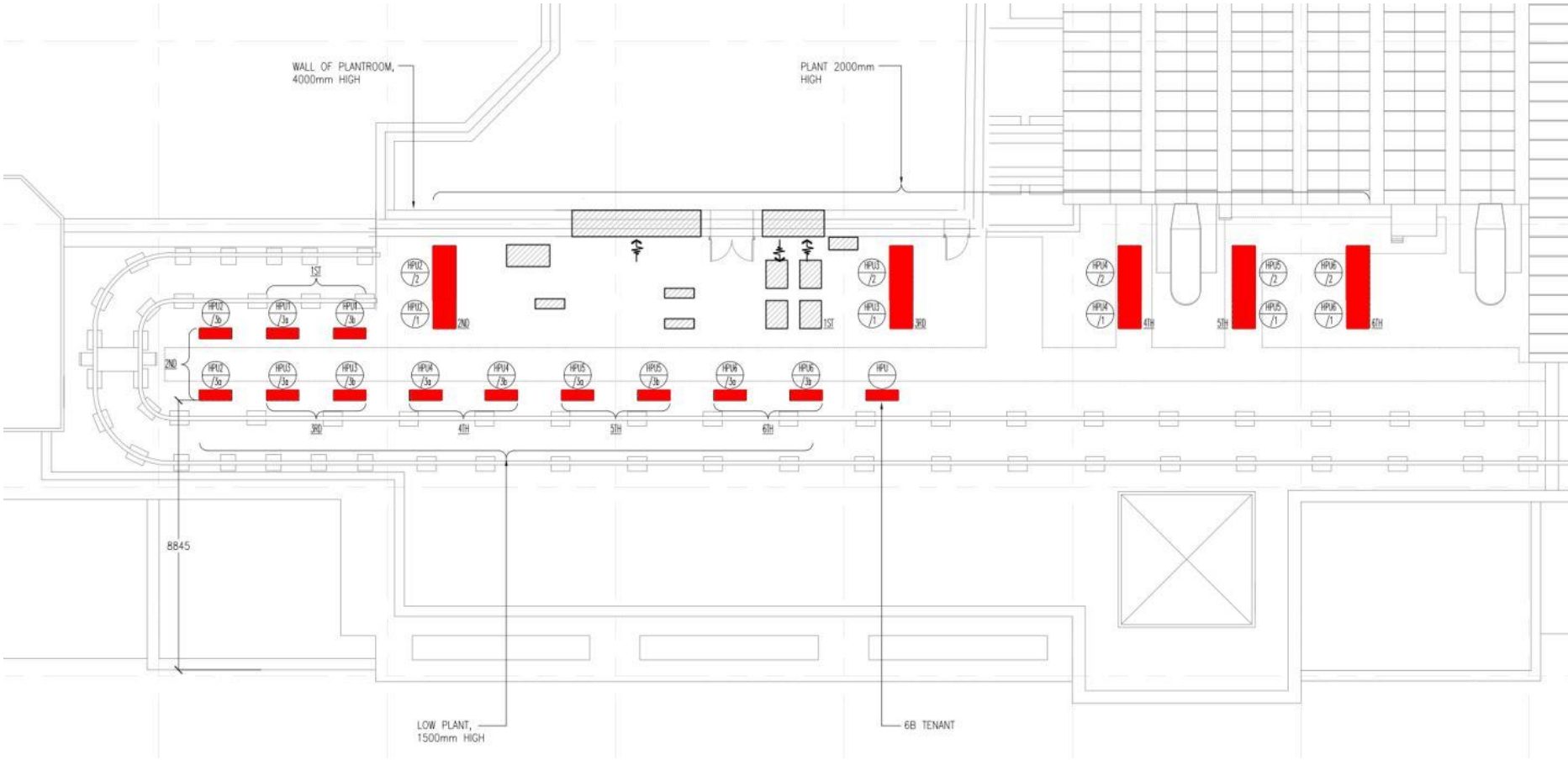
Appendix D Proposed plant layout

New plant assessed indicated in red

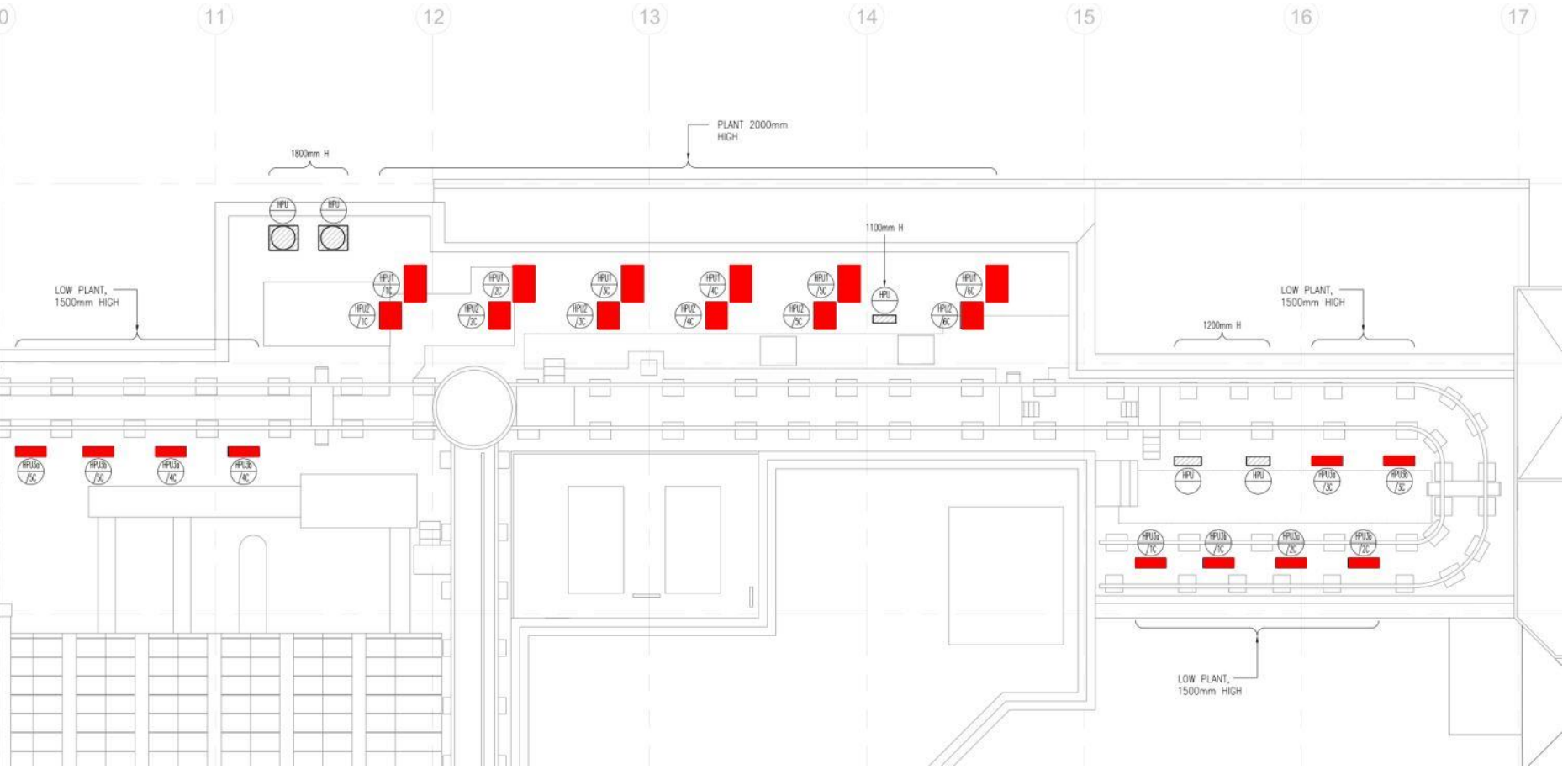
Block A



Block B



Block C



Appendix E Plant noise data

Plant reference	Make/Model	Quantity	Operating Period	Sound Pressure Level, dB(A)
1A/1, 2A/1, 3A/1, 4A/1, 5A/1, 6A/1 1C/1, 2C/1, 3C/1, 4C/1, 5C/1, 6C/1 1D/1, 2D/1, 3D/1, 4D/1, 5D/1, 6D/1	Mitsubishi PURY EM400 YNW-A	18	Daytime	69dBA at 1m (each)
			Night-time	58dBA at 1m (each)
HPU2/1, HPU3/1, HPU4/1, HPU5/1, HPU6/1	Mitsubishi PURY EM500 YNW-A	5	Daytime	65dBA at 1m (each)
			Night-time	54dBA at 1m (each)
1A/2, 2A/2, 3A/2, 4A/2, 5A/2, 6A/2 2/2, 3/2, 4/2, 5/2, 6/2 1C/2, 2C/2, 3C/2, 4C/2, 5C/2, 6C/2 1D/2, 2D/2, 3D/2, 4D/2, 5D/2, 6D/2	Mitsubishi PURY EM300 YNW-A	23	Daytime	67dBA at 1m (each)
			Night-time	51dBA at 1m (each)
HPU1A/3a, 3b; HPU2A/3a, 3b; HPU3A/3a, 3b; HPU4A/3a, 3b; HPU5A/3a, 3b; HPU6A/3a, 3b HPU1/3a, 3b; HPU2/3a, 3b; HPU3/3a, 3b; HPU4/3a, 3b; HPU5/3a, 3b; HPU6/3a, 3b; Tenant's 6B HPU1C/3a, 3b; HPU2C/3a, 3b; HPU3C/3a, 3b; HPU4C/3a, 3b; HPU5C/3a, 3b HPU1D/3a, 3b; HPU2D/3a, 3b; HPU3D/3a, 3b; HPU4D/3a, 3b; HPU5D/3a, 3b; HPU6D/3a, 3b	Mitsubishi PUZ ZM250 YKAR-1	47	Daytime	62dB at 1m (each)
			Night-time	59dBA at 1m (each)

Appendix F Plant noise calculations

To Receptor R1 (Worst-affected windows in Apex Plaza)

Unit Ref	Sound pressure level at 1m, dB(A)		Distance		Screening (dB)	Sound pressure level, dB(A)	
	Day	Night	m	dB		Day	Night
HPU 1A/1	69	58	80.4	-38	-15	16	5
HPU 1A/2	67	51	81.3	-38	-15	14	-2
HPU 1A/3a	62	59	100.6	-40	-15	7	4
HPU 1A/3b	62	59	98.1	-40	-15	7	4
HPU 2A/1	69	58	76.8	-38	-15	16	5
HPU 2A/2	67	51	77.5	-38	-15	14	-2
HPU 2A/3a	62	59	95.6	-40	-15	7	4
HPU 2A/3b	62	59	93.3	-39	-15	8	5
HPU 3A/1	69	58	73.1	-37	-15	17	6
HPU 3A/2	67	51	73.7	-37	-15	15	-1
HPU 3A/3a	62	59	90.7	-39	-15	8	5
HPU 3A/3b	62	59	88.4	-39	-15	8	5
HPU 4A/1	69	58	69.5	-37	-15	17	6
HPU 4A/2	67	51	70.1	-37	-15	15	-1
HPU 4A/3a	62	59	85.9	-39	-15	8	5
HPU 4A/3b	62	59	83.5	-38	-15	9	6
HPU 5A/1	69	58	58.4	-35	-15	19	8
HPU 5A/2	67	51	59.1	-35	-15	17	1
HPU 5A/3a	62	59	65.4	-36	-15	11	8
HPU 5A/3b	62	59	64	-36	-15	11	8
HPU 6A/1	69	58	54.7	-35	-15	19	8
HPU 6A/2	67	51	56.1	-35	-15	17	1
HPU 6A/3a	62	59	65.1	-36	-15	11	8
HPU 6A/3b	62	59	63.7	-36	-15	11	8
HPU 1/3a	62	59	88.5	-39	-15	8	5
HPU 1/3b	62	59	86.4	-39	-15	8	5
HPU 2/1	65	54	83.2	-38	-15	12	1
HPU 2/2	67	51	82.8	-38	-15	14	-2
HPU 2/3a	62	59	91.2	-39	-15	8	5
HPU 2/3b	62	59	90.7	-39	-15	8	5
HPU 3/1	65	54	69	-37	-15	13	2
HPU 3/2	67	51	68.6	-37	-15	15	-1
HPU 3/3a	62	59	89.1	-39	-15	8	5
HPU 3/3b	62	59	87	-39	-15	8	5

Unit Ref	Sound pressure level at 1m, dB(A)		Distance		Screening (dB)	Sound pressure level, dB(A)	
	Day	Night	m	dB		Day	Night
HPU 4/1	65	54	61.9	-36	-15	14	3
HPU 4/2	67	51	61.4	-36	-15	16	0
HPU 4/3a	62	59	84.6	-39	-15	8	5
HPU 4/3b	62	59	82.2	-38	-15	9	6
HPU 5/1	65	54	58.5	-35	-15	15	4
HPU 5/2	67	51	58	-35	-15	17	1
HPU 5/3a	62	59	80	-38	-15	9	6
HPU 5/3b	62	59	77.5	-38	-15	9	6
HPU 6/1	65	54	55.1	-35	-15	15	4
HPU 6/2	67	51	54.6	-35	-15	17	1
HPU 6/3a	62	59	75.1	-38	-15	9	6
HPU 6/3b	62	59	72.8	-37	-15	10	7
HPU 6B	62	59	70.6	-37	-15	10	7
HPU 1C/1	69	58	25.4	-28	-15	26	15
HPU 1C/2	67	51	25.7	-28	-15	24	8
HPU 1C/3a	62	59	4.7	-13	-15	34	31
HPU 1C/3b	62	59	6.4	-16	-15	31	28
HPU 2C/1	69	58	22.2	-27	-15	27	16
HPU 2C/2	67	51	22.3	-27	-15	25	9
HPU 2C/3a	62	59	8.6	-19	-15	28	25
HPU 2C/3b	62	59	10.9	-21	-15	26	23
HPU 3C/1	69	58	19.1	-26	-15	28	17
HPU 3C/2	67	51	19.1	-26	-15	26	10
HPU 3C/3a	62	59	10.8	-21	-15	26	23
HPU 3C/3b	62	59	13	-22	-15	25	22
HPU 4C/1	69	58	16.3	-24	-15	30	19
HPU 4C/2	67	51	16.2	-24	-15	28	12
HPU 4C/3a	62	59	31.6	-30	-15	17	14
HPU 4C/3b	62	59	29.2	-29	-15	18	15
HPU 5C/1	69	58	14	-23	-15	31	20
HPU 5C/2	67	51	13.5	-23	-15	29	13
HPU 5C/3a	62	59	36.4	-31	-15	16	13
HPU 5C/3b	62	59	34.1	-31	-15	16	13
HPU 6C/1	69	58	12	-22	-15	32	21
HPU 6C/2	67	51	11.1	-21	-15	31	15
HPU 1D/1	69	58	36.2	-31	-10	28	17
HPU 1D/2	67	51	37.7	-32	-10	25	9
HPU 1D/3a	62	59	25.7	-28	0	34	31
HPU 1D/3b	62	59	26.1	-28	0	34	31

Unit Ref	Sound pressure level at 1m, dB(A)		Distance		Screening (dB)	Sound pressure level, dB(A)	
	Day	Night	m	dB		Day	Night
HPU 2D/1	69	58	34.3	-31	-10	28	17
HPU 2D/2	67	51	35.7	-31	-10	26	10
HPU 2D/3a	62	59	23.9	-28	0	34	31
HPU 2D/3b	62	59	24.4	-28	0	34	31
HPU 3D/1	69	58	32.7	-30	-10	29	18
HPU 3D/2	67	51	34.1	-31	-10	26	10
HPU 3D/3a	62	59	25.2	-28	0	34	31
HPU 3D/3b	62	59	26.2	-28	0	34	31
HPU 4D/1	69	58	31.5	-30	-10	29	18
HPU 4D/2	67	51	34.1	-31	-10	26	10
HPU 4D/3a	62	59	26.6	-28	0	34	31
HPU 4D/3b	62	59	27.5	-29	0	33	30
HPU 5D/1	69	58	30.6	-30	-10	29	18
HPU 5D/2	67	51	31.8	-30	-10	27	11
HPU 5D/3a	62	59	29.1	-29	0	33	30
HPU 5D/3b	62	59	27.7	-29	0	33	30
HPU 6D/1	69	58	30.2	-30	-10	29	18
HPU 6D/2	67	51	31.3	-30	-10	27	11
HPU 6D/3a	62	59	31.5	-30	0	32	29
HPU 6D/3b	62	59	30.1	-30	0	32	29
Total Sound pressure level at receptor						47	34

To Receptor R2 (Terrace of Apex Plaza)

Unit Ref	Sound pressure level at 1m, dB(A)		Distance		Screening (dB)	Sound pressure level, dB(A)	
	Day	Night	m	dB		Day	Night
HPU 1A/1	69	58	64.3	-36	-15	18	7
HPU 1A/2	67	51	64.3	-36	-15	16	0
HPU 1A/3a	62	59	76.4	-38	-15	9	6
HPU 1A/3b	62	59	74.2	-37	-15	10	7
HPU 2A/1	69	58	61.6	-36	-15	18	7
HPU 2A/2	67	51	61.6	-36	-15	16	0
HPU 2A/3a	62	59	72.1	-37	-15	10	7
HPU 2A/3b	62	59	70.1	-37	-15	10	7
HPU 3A/1	69	58	59.1	-35	-15	19	8
HPU 3A/2	67	51	58.9	-35	-15	17	1
HPU 3A/3a	62	59	67.8	-37	-15	10	7
HPU 3A/3b	62	59	65.9	-36	-15	11	8
HPU 4A/1	69	58	56.7	-35	-15	19	8
HPU 4A/2	67	51	56.5	-35	-15	17	1
HPU 4A/3a	62	59	63.8	-36	-15	11	8
HPU 4A/3b	62	59	61.8	-36	-15	11	8
HPU 5A/1	69	58	50.5	-34	-15	20	9
HPU 5A/2	67	51	50	-34	-15	18	2
HPU 5A/3a	62	59	54	-35	-15	12	9
HPU 5A/3b	62	59	53.2	-35	-15	12	9
HPU 6A/1	69	58	48.8	-34	-15	20	9
HPU 6A/2	67	51	48.6	-34	-15	18	2
HPU 6A/3a	62	59	52.4	-34	-15	13	10
HPU 6A/3b	62	59	51.5	-34	-15	13	10
HPU 1/3a	62	59	53.3	-35	-7	20	17
HPU 1/3b	62	59	51.2	-34	-7	21	18
HPU 2/1	65	54	48.2	-34	-7	24	13
HPU 2/2	67	51	48.5	-34	-7	26	10
HPU 2/3a	62	59	55.2	-35	-7	20	17
HPU 2/3b	62	59	55.5	-35	-7	20	17
HPU 3/1	65	54	33.9	-31	-7	27	16
HPU 3/2	67	51	34.3	-31	-7	29	13
HPU 3/3a	62	59	53	-34	-7	21	18
HPU 3/3b	62	59	50.8	-34	-7	21	18
HPU 4/1	65	54	26.9	-29	-7	29	18
HPU 4/2	67	51	27.4	-29	-7	31	15
HPU 4/3a	62	59	48.4	-34	-7	21	18

Unit Ref	Sound pressure level at 1m, dB(A)		Distance		Screening (dB)	Sound pressure level, dB(A)	
	Day	Night	m	dB		Day	Night
HPU 4/3b	62	59	45.9	-33	-7	22	19
HPU 5/1	65	54	23.6	-27	-7	31	20
HPU 5/2	67	51	24.1	-28	-7	32	16
HPU 5/3a	62	59	43.6	-33	-7	22	19
HPU 5/3b	62	59	41	-32	-7	23	20
HPU 6/1	65	54	20.4	-26	-7	32	21
HPU 6/2	67	51	21	-26	-7	34	18
HPU 6/3a	62	59	38.6	-32	-7	23	20
HPU 6/3b	62	59	36.2	-31	-7	24	21
HPU 6B	62	59	33.8	-31	-7	24	21
HPU 1C/1	69	58	45.3	-33	-15	21	10
HPU 1C/2	67	51	43.8	-33	-15	19	3
HPU 1C/3a	62	59	49.6	-34	-15	13	10
HPU 1C/3b	62	59	51.3	-34	-15	13	10
HPU 2C/1	69	58	46.3	-33	-15	21	10
HPU 2C/2	67	51	44.8	-33	-15	19	3
HPU 2C/3a	62	59	53.2	-35	-15	12	9
HPU 2C/3b	62	59	55.1	-35	-15	12	9
HPU 3C/1	69	58	47.6	-34	-15	20	9
HPU 3C/2	67	51	46	-33	-15	19	3
HPU 3C/3a	62	59	56.5	-35	-15	12	9
HPU 3C/3b	62	59	58.4	-35	-15	12	9
HPU 4C/1	69	58	49.1	-34	-15	20	9
HPU 4C/2	67	51	47.5	-34	-15	18	2
HPU 4C/3a	62	59	38.3	-32	-15	15	12
HPU 4C/3b	62	59	38.5	-32	-15	15	12
HPU 5C/1	69	58	50.9	-34	-15	20	9
HPU 5C/2	67	51	49.3	-34	-15	18	2
HPU 5C/3a	62	59	38.3	-32	-15	15	12
HPU 5C/3b	62	59	38.2	-32	-15	15	12
HPU 6C/1	69	58	53.7	-35	-15	19	8
HPU 6C/2	67	51	52.1	-34	-15	18	2
HPU 1D/1	69	58	14.3	-23	-7	39	28
HPU 1D/2	67	51	13.3	-22	-7	38	22
HPU 1D/3a	62	59	36.8	-31	-7	24	21
HPU 1D/3b	62	59	39.2	-32	-7	23	20
HPU 2D/1	69	58	17.8	-25	-7	37	26
HPU 2D/2	67	51	16.8	-25	-7	35	19
HPU 2D/3a	62	59	38.4	-32	-7	23	20

Unit Ref	Sound pressure level at 1m, dB(A)		Distance		Screening (dB)	Sound pressure level, dB(A)	
	Day	Night	m	dB		Day	Night
HPU 2D/3b	62	59	40.8	-32	-7	23	20
HPU 3D/1	69	58	21.3	-27	-7	35	24
HPU 3D/2	67	51	20.1	-26	-7	34	18
HPU 3D/3a	62	59	43.3	-33	-7	22	19
HPU 3D/3b	62	59	45.6	-33	-7	22	19
HPU 4D/1	69	58	24.9	-28	-7	34	23
HPU 4D/2	67	51	20.1	-26	-7	34	18
HPU 4D/3a	62	59	41.6	-32	-7	23	20
HPU 4D/3b	62	59	44.1	-33	-7	22	19
HPU 5D/1	69	58	28.6	-29	-7	33	22
HPU 5D/2	67	51	27.7	-29	-7	31	15
HPU 5D/3a	62	59	19.1	-26	-7	29	26
HPU 5D/3b	62	59	21.2	-27	-7	28	25
HPU 6D/1	69	58	32.2	-30	-7	32	21
HPU 6D/2	67	51	31.2	-30	-7	30	14
HPU 6D/3a	62	59	17.1	-25	-7	30	27
HPU 6D/3b	62	59	19.3	-26	-7	29	26
Total Sound pressure level at receptor						48	38

To Receptor R3 (Offices to south)

Unit Ref	Sound pressure level at 1m, dB(A)		Distance		Screening (dB)	Sound pressure level, dB(A)	
	Day	Night	m	dB		Day	Night
HPU 1A/1	69	58	105.2	-40	-15	14	3
HPU 1A/2	67	51	105.2	-40	-15	12	-4
HPU 1A/3a	62	59	115.8	-41	-15	6	3
HPU 1A/3b	62	59	113.8	-41	-15	6	3
HPU 2A/1	69	58	102.6	-40	-15	14	3
HPU 2A/2	67	51	102.5	-40	-15	12	-4
HPU 2A/3a	62	59	111.7	-41	-15	6	3
HPU 2A/3b	62	59	109.9	-41	-15	6	3
HPU 3A/1	69	58	100.1	-40	-15	14	3
HPU 3A/2	67	51	99.9	-40	-15	12	-4
HPU 3A/3a	62	59	107.8	-41	-15	6	3
HPU 3A/3b	62	59	106	-41	-15	6	3
HPU 4A/1	69	58	97.7	-40	-15	14	3
HPU 4A/2	67	51	97.5	-40	-15	12	-4
HPU 4A/3a	62	59	104.1	-40	-15	7	4
HPU 4A/3b	62	59	102.2	-40	-15	7	4
HPU 5A/1	69	58	90.9	-39	-15	15	4
HPU 5A/2	67	51	90.6	-39	-15	13	-3
HPU 5A/3a	62	59	94.8	-40	-15	7	4
HPU 5A/3b	62	59	94	-39	-15	8	5
HPU 6A/1	69	58	88.8	-39	-15	15	4
HPU 6A/2	67	51	88.8	-39	-15	13	-3
HPU 6A/3a	62	59	93.3	-39	-15	8	5
HPU 6A/3b	62	59	92.4	-39	-15	8	5
HPU 1/3a	62	59	89.3	-39	0	23	20
HPU 1/3b	62	59	87.4	-39	0	23	20
HPU 2/1	65	54	84.9	-39	0	26	15
HPU 2/2	67	51	85.5	-39	-5	23	7
HPU 2/3a	62	59	90.4	-39	0	23	20
HPU 2/3b	62	59	91.3	-39	0	23	20
HPU 3/1	65	54	72.2	-37	0	28	17
HPU 3/2	67	51	73	-37	-5	25	9
HPU 3/3a	62	59	88.4	-39	0	23	20
HPU 3/3b	62	59	86.5	-39	0	23	20
HPU 4/1	65	54	66.1	-36	0	29	18
HPU 4/2	67	51	66.9	-37	-5	25	9
HPU 4/3a	62	59	84.2	-39	0	23	20

Unit Ref	Sound pressure level at 1m, dB(A)		Distance		Screening (dB)	Sound pressure level, dB(A)	
	Day	Night	m	dB		Day	Night
HPU 4/3b	62	59	82	-38	0	24	21
HPU 5/1	65	54	63.3	-36	0	29	18
HPU 5/2	67	51	64.1	-36	-5	26	10
HPU 5/3a	62	59	79.9	-38	0	24	21
HPU 5/3b	62	59	77.6	-38	0	24	21
HPU 6/1	65	54	60.5	-36	0	29	18
HPU 6/2	67	51	61.4	-36	-5	26	10
HPU 6/3a	62	59	75.5	-38	0	24	21
HPU 6/3b	62	59	73.3	-37	0	25	22
HPU 6B	62	59	71.3	-37	0	25	22
HPU 1C/1	69	58	76.4	-38	-15	16	5
HPU 1C/2	67	51	75.4	-38	-15	14	-2
HPU 1C/3a	62	59	65.3	-36	-15	11	8
HPU 1C/3b	62	59	65.7	-36	-15	11	8
HPU 2C/1	69	58	75.7	-38	-15	16	5
HPU 2C/2	67	51	74.6	-37	-15	15	-1
HPU 2C/3a	62	59	66.1	-36	-15	11	8
HPU 2C/3b	62	59	66.7	-36	-15	11	8
HPU 3C/1	69	58	75.1	-38	-15	16	5
HPU 3C/2	67	51	74	-37	-15	15	-1
HPU 3C/3a	62	59	69.9	-37	-15	10	7
HPU 3C/3b	62	59	70.4	-37	-15	10	7
HPU 4C/1	69	58	74.8	-37	-15	17	6
HPU 4C/2	67	51	73.6	-37	-15	15	-1
HPU 4C/3a	62	59	73.3	-37	-15	10	7
HPU 4C/3b	62	59	72.4	-37	-15	10	7
HPU 5C/1	69	58	74.6	-37	-15	17	6
HPU 5C/2	67	51	73.3	-37	-15	15	-1
HPU 5C/3a	62	59	75.1	-38	-15	9	6
HPU 5C/3b	62	59	74.2	-37	-15	10	7
HPU 6C/1	69	58	74.6	-37	-15	17	6
HPU 6C/2	67	51	73.3	-37	-15	15	-1
HPU 1D/1	69	58	37.2	-31	0	38	27
HPU 1D/2	67	51	36.5	-31	0	36	20
HPU 1D/3a	62	59	39.4	-32	-5	25	22
HPU 1D/3b	62	59	40	-32	-5	25	22
HPU 2D/1	69	58	35.8	-31	0	38	27
HPU 2D/2	67	51	35.1	-31	0	36	20
HPU 2D/3a	62	59	41.6	-32	-5	25	22

Unit Ref	Sound pressure level at 1m, dB(A)		Distance		Screening (dB)	Sound pressure level, dB(A)	
	Day	Night	m	dB		Day	Night
HPU 2D/3b	62	59	42.2	-33	-5	24	21
HPU 3D/1	69	58	34.9	-31	0	38	27
HPU 3D/2	67	51	34.1	-31	0	36	20
HPU 3D/3a	62	59	43.1	-33	-5	24	21
HPU 3D/3b	62	59	43.9	-33	-5	24	21
HPU 4D/1	69	58	34.4	-31	0	38	27
HPU 4D/2	67	51	34.1	-31	0	36	20
HPU 4D/3a	62	59	40.7	-32	-5	25	22
HPU 4D/3b	62	59	41.7	-32	-5	25	22
HPU 5D/1	69	58	34.2	-31	0	38	27
HPU 5D/2	67	51	33.1	-30	0	37	21
HPU 5D/3a	62	59	42.1	-32	-5	25	22
HPU 5D/3b	62	59	41.5	-32	-5	25	22
HPU 6D/1	69	58	34.5	-31	0	38	27
HPU 6D/2	67	51	33.3	-30	0	37	21
HPU 6D/3a	62	59	40.6	-32	-5	25	22
HPU 6D/3b	62	59	39.9	-32	-5	25	22
Total Sound pressure level at receptor						49	39

To Receptor R4 (Residential at Blagrove Arms)

Unit Ref	Sound pressure level at 1m, dB(A)		Distance		Screening (dB)	Sound pressure level, dB(A)	
	Day	Night	m	dB		Day	Night
HPU 1A/1	69	58	107.7	-41	-15	13	2
HPU 1A/2	67	51	106.6	-41	-15	11	-5
HPU 1A/3a	62	59	98.7	-40	-11	11	8
HPU 1A/3b	62	59	98.5	-40	-11	11	8
HPU 2A/1	69	58	108.2	-41	-15	13	2
HPU 2A/2	67	51	107.1	-41	-15	11	-5
HPU 2A/3a	62	59	98.4	-40	-11	11	8
HPU 2A/3b	62	59	98.4	-40	-11	11	8
HPU 3A/1	69	58	108.9	-41	-15	13	2
HPU 3A/2	67	51	107.8	-41	-15	11	-5
HPU 3A/3a	62	59	98.4	-40	-11	11	8
HPU 3A/3b	62	59	98.5	-40	-11	11	8
HPU 4A/1	69	58	109.6	-41	-15	13	2
HPU 4A/2	67	51	108.5	-41	-15	11	-5
HPU 4A/3a	62	59	98.6	-40	-11	11	8
HPU 4A/3b	62	59	98.8	-40	-11	11	8
HPU 5A/1	69	58	112.7	-41	-15	13	2
HPU 5A/2	67	51	111.5	-41	-15	11	-5
HPU 5A/3a	62	59	110.2	-41	-15	6	3
HPU 5A/3b	62	59	110.5	-41	-15	6	3
HPU 6A/1	69	58	114	-41	-15	13	2
HPU 6A/2	67	51	112.5	-41	-15	11	-5
HPU 6A/3a	62	59	108.3	-41	-15	6	3
HPU 6A/3b	62	59	108.6	-41	-15	6	3
HPU 1/3a	62	59	72.6	-37	-5	20	17
HPU 1/3b	62	59	72.9	-37	-5	20	17
HPU 2/1	65	54	74.1	-37	0	28	17
HPU 2/2	67	51	75.4	-38	-5	24	8
HPU 2/3a	62	59	70.5	-37	-5	20	17
HPU 2/3b	62	59	72.4	-37	-5	20	17
HPU 3/1	65	54	78.1	-38	-10	17	6
HPU 3/2	67	51	79.3	-38	-10	19	3
HPU 3/3a	62	59	70.7	-37	-5	20	17
HPU 3/3b	62	59	70.9	-37	-5	20	17
HPU 4/1	65	54	81.2	-38	-15	12	1
HPU 4/2	67	51	82.3	-38	-15	14	-2
HPU 4/3a	62	59	71.3	-37	-5	20	17

Unit Ref	Sound pressure level at 1m, dB(A)		Distance		Screening (dB)	Sound pressure level, dB(A)	
	Day	Night	m	dB		Day	Night
HPU 4/3b	62	59	71.8	-37	-5	20	17
HPU 5/1	65	54	82.9	-38	-15	12	1
HPU 5/2	67	51	84	-38	-15	14	-2
HPU 5/3a	62	59	72.3	-37	-5	20	17
HPU 5/3b	62	59	73	-37	-5	20	17
HPU 6/1	65	54	84.7	-39	-15	11	0
HPU 6/2	67	51	85.8	-39	-15	13	-3
HPU 6/3a	62	59	73.7	-37	-5	20	17
HPU 6/3b	62	59	74.5	-37	-5	20	17
HPU 6B	62	59	75.3	-38	-5	19	16
HPU 1C/1	69	58	127.7	-42	-15	12	1
HPU 1C/2	67	51	126.2	-42	-15	10	-6
HPU 1C/3a	62	59	136.2	-43	-15	4	1
HPU 1C/3b	62	59	137.8	-43	-15	4	1
HPU 2C/1	69	58	129.8	-42	-15	12	1
HPU 2C/2	67	51	128.3	-42	-15	10	-6
HPU 2C/3a	62	59	139.6	-43	-15	4	1
HPU 2C/3b	62	59	141.4	-43	-15	4	1
HPU 3C/1	69	58	132	-42	-15	12	1
HPU 3C/2	67	51	130.4	-42	-15	10	-6
HPU 3C/3a	62	59	143	-43	-15	4	1
HPU 3C/3b	62	59	144.8	-43	-15	4	1
HPU 4C/1	69	58	134.2	-43	-15	11	0
HPU 4C/2	67	51	132.7	-42	-15	10	-6
HPU 4C/3a	62	59	118.3	-41	-15	6	3
HPU 4C/3b	62	59	119.6	-42	-15	5	2
HPU 5C/1	69	58	136.6	-43	-15	11	0
HPU 5C/2	67	51	135	-43	-15	9	-7
HPU 5C/3a	62	59	115.8	-41	-15	6	3
HPU 5C/3b	62	59	117	-41	-15	6	3
HPU 6C/1	69	58	139.9	-43	-15	11	0
HPU 6C/2	67	51	138.3	-43	-15	9	-7
HPU 1D/1	69	58	98.3	-40	-15	14	3
HPU 1D/2	67	51	96.9	-40	-15	12	-4
HPU 1D/3a	62	59	118.8	-41	-15	6	3
HPU 1D/3b	62	59	120.8	-42	-15	5	2
HPU 2D/1	69	58	101.1	-40	-15	14	3
HPU 2D/2	67	51	99.7	-40	-15	12	-4
HPU 2D/3a	62	59	120.9	-42	-15	5	2

Unit Ref	Sound pressure level at 1m, dB(A)		Distance		Screening (dB)	Sound pressure level, dB(A)	
	Day	Night	m	dB		Day	Night
HPU 2D/3b	62	59	122.9	-42	-15	5	2
HPU 3D/1	69	58	103.9	-40	-15	14	3
HPU 3D/2	67	51	102.4	-40	-15	12	-4
HPU 3D/3a	62	59	125	-42	-15	5	2
HPU 3D/3b	62	59	127	-42	-15	5	2
HPU 4D/1	69	58	106.8	-41	-15	13	2
HPU 4D/2	67	51	102.4	-40	-15	12	-4
HPU 4D/3a	62	59	122.7	-42	-15	5	2
HPU 4D/3b	62	59	124.9	-42	-15	5	2
HPU 5D/1	69	58	109.8	-41	-15	13	2
HPU 5D/2	67	51	108.6	-41	-15	11	-5
HPU 5D/3a	62	59	104.8	-40	-15	7	4
HPU 5D/3b	62	59	106.7	-41	-15	6	3
HPU 6D/1	69	58	112.8	-41	-15	13	2
HPU 6D/2	67	51	111.5	-41	-15	11	-5
HPU 6D/3a	62	59	102.5	-40	-15	7	4
HPU 6D/3b	62	59	104.4	-40	-15	7	4
Total Sound pressure level at receptor						35	29