200 Gray's Inn Road

Planning Noise Assessment

GlobeCast

Project number: A20180469

December 2018

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position

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1. Introduction

A new emergency generator is proposed to be installed at 200 Gray's Inn Road, London, replacing the existing DRUPS (Diesel Rotary Uninterruptable Power Supply).

The noise emission levels emitted from the existing DRUPS, as well as the prevailing ambient and background noise levels need to be assessed in order to determine the required noise specification for the new equipment, which is to be located in the same location as a like for like plant replacement for the purposed of planning.

To this end, the following sections of this report detail the methodology and findings of an external noise survey that was undertaken at the site. The results of the survey have been used to determine typical background noise levels and current noise levels emitted by the existing DRUPS, which have been used to set plant noise emission requirements for the new equipment to be installed in place of the current plant item.

A glossary of acoustic terminology used in this report is presented in Appendix A and the full noise measurement results are included in Appendix B.

All noise levels are, unless stated otherwise, sound pressure levels in dB re 20 µPa.

2. Site Description

The site is located on the corner of Elm Street and Gough Street. The site adjoins a construction site to the East, offices buildings to the North and West and residential buildings to the South.

The noise climate on site at the time of the attended measurements and during the day time period was heavily dominated by the noise from the nearby construction site. In addition, the site Goods Entrance was located close to the measurement points, therefore vehicle noise was also present. Although this will not have affected the ambient measurements taken in close proximity to the plant.

The nearest noise sensitive receivers (NNSR's) in the vicinity of the site are the residential properties located to the south of the site. The NNSR is shown in relation to the site in figure 2.1, along with the measurement locations.

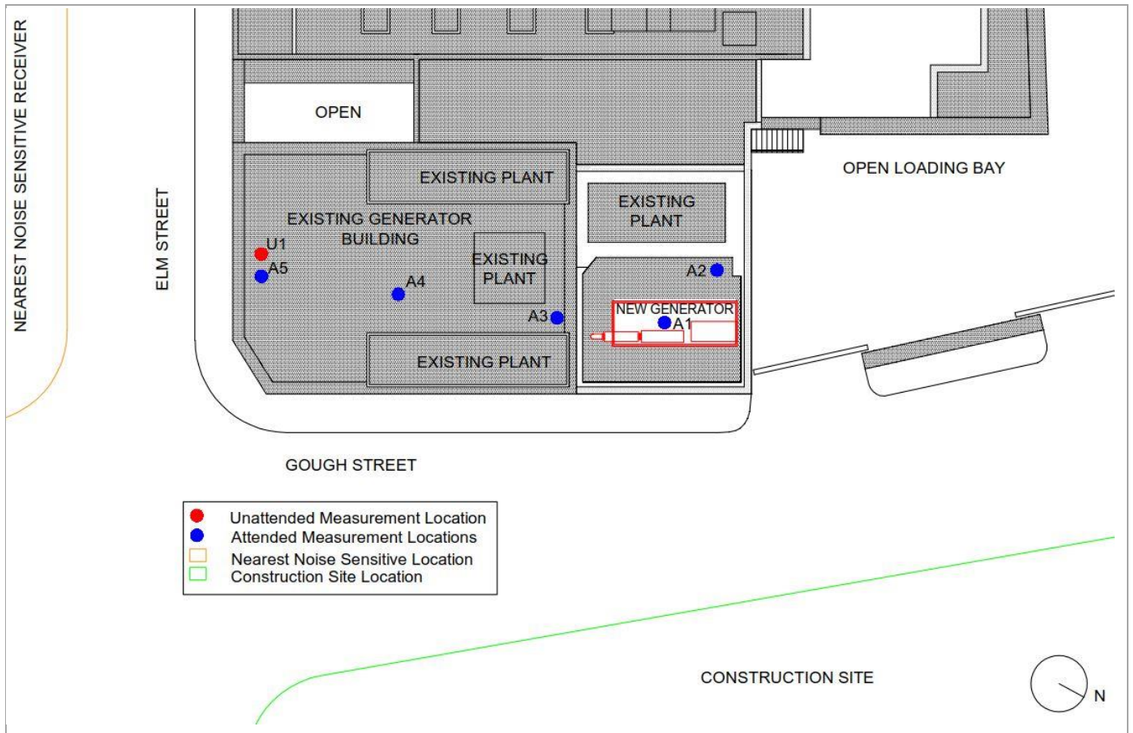


Figure 2.1. 200 Gray's Inn Site and Surrounding Area Showing Measurement Locations and Nearest Noise Sensitive Receiver's

3. Measurement Methodology

Unattended noise measurements were undertaken between 16:35 on the 5th December and 12:00 on the 6th December 2018.

The sound level meter was attached to a tripod and positioned on the roof of the existing generator building approximately 2m above the roof level, as shown in figure 3.1. The measurements were therefore considered to be taken under free field conditions.

The noise levels measured are considered to be representative of the ambient and background noise levels incident on the northern façade of the nearest noise sensitive receptors as marked up in orange in Figure 2.1.

The unattended noise logging equipment was set to continuously monitor noise levels in 15-minute sample periods. For each measurement period, the octave band dB L_{A90} was measured (typically used to assess the background noise) along with the overall dB L_{eq} and L_{max} values for information.

Attended noise measurements were undertaken between 17:00 and 17:10 on the 5th December. The noise levels measured at the different locations shown in blue in Figure 2.1 are representative of the noise levels produced by the existing DRUPS (Diesel Rotary Uninterruptable Power Supply) at said positions.

The attended noise logging equipment was set to monitor noise levels in 30 seconds sample periods. For each measurement period the third-octave bands dB L_{eq} and L_{max} values were recorded.

The following equipment was used to undertake the noise measurements:

Table 3.1. Measurement Equipment

Attended/Unattended	Equipment	Type	Serial No.
Unattended	Integrating average sound level meter	Norsonic 140	1404740
	Weatherproof microphone enclosure	Norsonic 1212	N/A
Attended	Integrating average sound level meter	Norsonic 140	1402919
All	Calibrator	Norsonic 1251	31432

The noise analysers and their associated microphones were checked against the calibrator at the beginning and end of the measurement period, in accordance with recommended practice. No significant drift in calibration was observed. The accuracy of the calibrator and meter calibration can be traced to the National Physical Laboratory Standards.

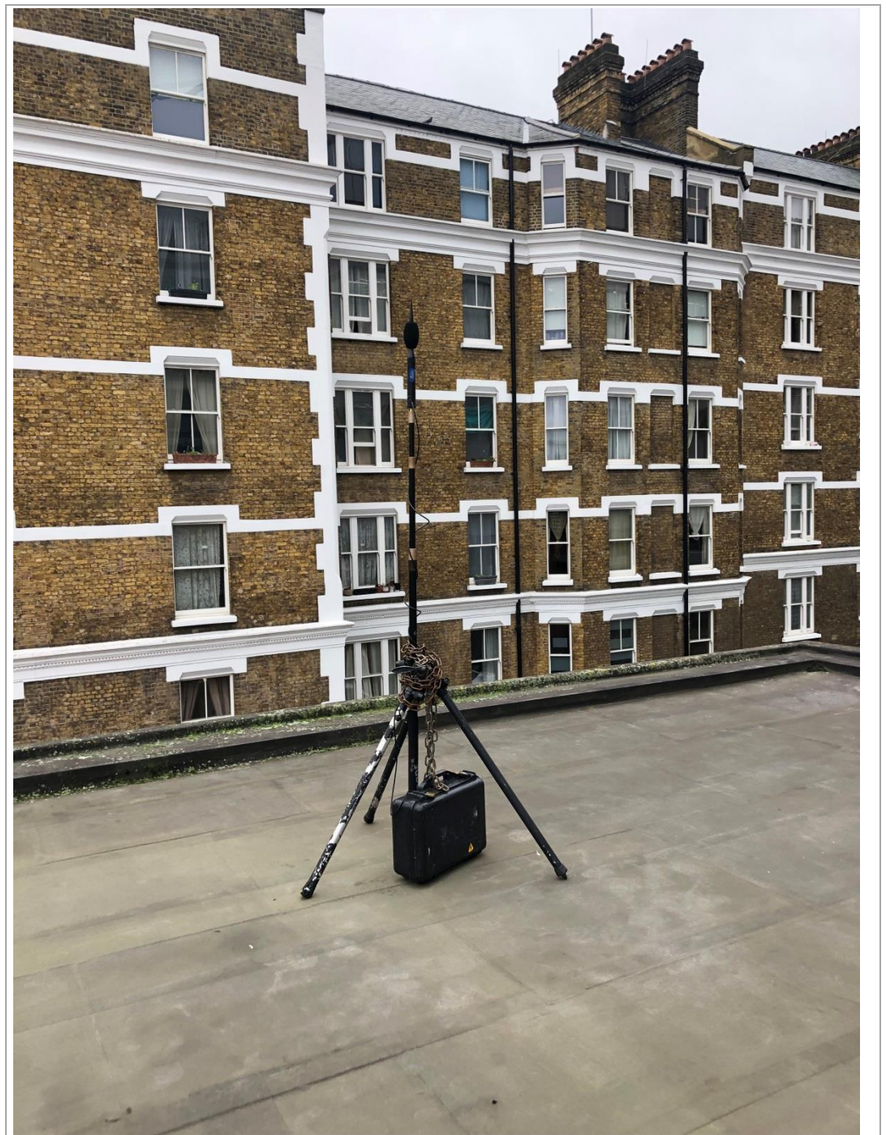


Figure 3.1. Example of Measurement Equipment

Weather conditions during the attended measurement period on site are presented in Table 3.2. The weather conditions were considered suitable for external noise level measurements.

Table 3.2. Weather Conditions during Measurements

Date	Wind m/s	Temperature (°C)	Humidity (%)	Typical Cloud Cover
05/12/18	4	14.9	100	100%
06/12/18	1.3	16.3	81.2	100%

4. Measurement Results

The full spectral noise measurements are presented in Appendix B.

The following table presents the typically lowest background noise levels at the measurement location which are considered to represent those expected at the closest noise sensitive properties. The values selected have been based on the typical lowest measured levels for the daytime (07:00-23:00), and night-time (23:00-07:00) periods and with the existing plant in operation.

Table 4.1. Typical Lowest Measured Background Levels

Measurement Location	DRUPS On	Index	Daytime (07:00 – 23:00)	Night-Time (23:00 – 07:00)
U1	No	dB $L_{A90(15min)}$	53	48
A5	Yes	dB $L_{A90(30s)}$	62	-

The measured noise levels emitted from the current equipment when running at full power at different distances are presented in Table 4.2 below.

Table 4.2. Measured Noise Levels from existing DRUPS

Location	Distance from Source (m)	Time Period	Index	Octave Band Centre Frequency (Hz)								dBA
				63	125	250	500	1K	2K	4K	8K	
A1	0.2 (Inside Casing)	17:02:38 17:03:08	dB $L_{eq(30s)}$	89	100	99	101	96	95	90	82	102
A2	1 (Outside Casing enclosure)	17:03:57 17:04:27	dB $L_{eq(30s)}$	87	91	78	69	67	62	57	50	78

5. Plant Noise Assessment

This section of the report presents the noise limits for the plant equipment to replace the current DRUPS and discusses the plant noise requirements which have been set based on the criteria put forward below and measured survey results.

5.1 Criteria

5.1.1 BS 4142: 2014

British Standard BS 4142: 2014 'Methods for rating and assessing industrial and commercial sound' provides a methodology for assessing whether noise from industrial and commercial activities is likely to give rise to complaints from nearby noise-sensitive premises. This method compares the noise level from the source in question (called the 'specific noise level') with the background noise level in the absence of the noise source, taking into account the character and type of noise. Unusual acoustic features associated with tonality, impulsivity, intermittency, and other sound characteristics, where present, are accounted for under BS 4142 by the addition of a rating penalty to the specific sound level for each source. The corrected specific sound level is the 'rating level'.

The Standard notes that the lower the rating noise level is relative to the measured background 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. A difference of around +5 dB is likely to be an indication of an adverse impact whilst a difference of around +10 dB is likely to be an indication of a significant adverse impact.

5.1.2 Environmental Protection Act 1990

Under the provisions of the Environmental Protection Act, occupants of neighbouring properties could take direct action if they believe they have been subjected to a noise nuisance. Achievement of a BS 4142 Rating Level of between 5 and 10 dB below the lowest background noise level at the façade of the nearest neighbouring noise sensitive development is considered a robust approach to minimising the risk of such action being upheld.

5.1.3 Local Authority Guidance: London Borough of Camden

The Camden Local Plan (2017) provides guidance on new developments with a view to maintain the environmental assets and unique character of the borough.

Policy A4 of the Camden Local Plan 'Noise and Vibration' states that:

It is expected that British Standard 4142:2014 'Methods for rating and assessing industrial and commercial sound' (BS 4142) will be used to control industrial and commercial noise emission so that there is likely to be no adverse effects on neighbouring properties.

'Emergency equipment such as generators which are only to be used for short periods of time will be required to meet the noise criteria of no more than 10dB above the background level (L90 15 minutes)'.

5.2 Plant Location

It is understood that the new generator plant is going to replace the current DRUPS unit occupying the exact same location. Figure 5.1 shows the location of new generator. Full site plans showing the location of the replacement unit are included within Appendix C.

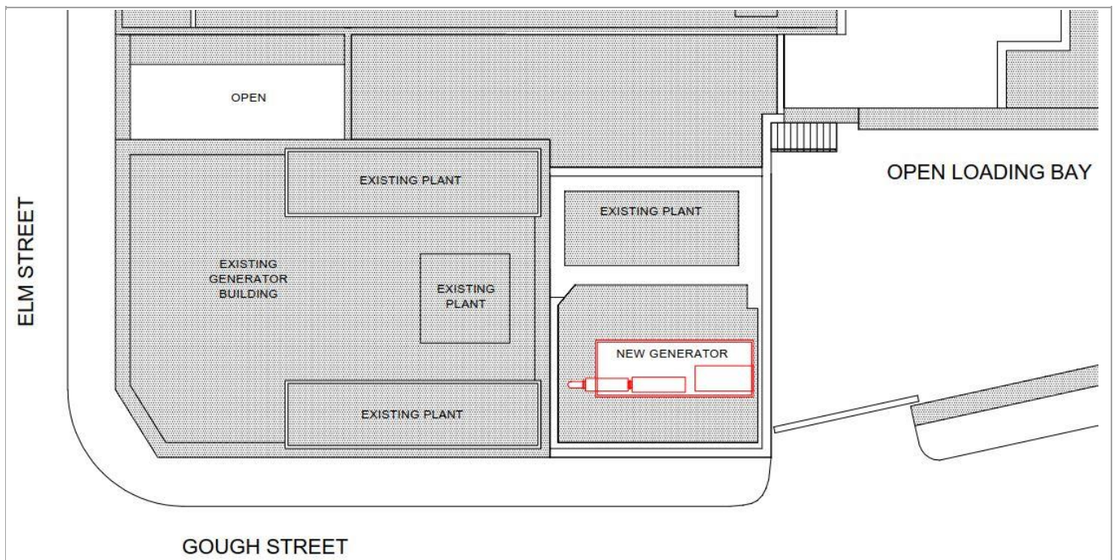


Figure 5.1. Proposed Location of the New Generator

5.3 Noise Emission Limits

In line with the criteria set above, the noise emission limit for the new emergency generator should be no greater than 10 dB above the background level at 1m from the nearest noise sensitive receiver stated in Table 4.2.

Based on the measured noise levels emitted from the current DRUPS unit which is to be replaced, noise levels from the new emergency generator unit should be controlled to achieve the noise level limit stated in Table 5.1 below. Assuming this value is achieved as a maximum output, the noise breakout from the generator will be no worse than currently experienced such that the unit would be a direct like for like replacement.

Table 5.1. Plant Noise Emission Limits at 1m from the unit

Measurement Location	Distance from unit (m)	Index	dBA
A2	1	dB $L_{Aeq,30s}$	78

The above limits should be met with the plant operating at full power.

The new plant equipment should be controlled such that it does not produce any "distinguishable, discrete or continuous note (whine, hiss, screech, hum, etc.) or distinct impulses (bangs, clicks, clatters or thumps)" at any noise sensitive façade. Where it does contain such features, reduced rating level corrections will apply.

It should however be noted that the new unit is an emergency generator and therefore will only operate during an emergency and when tested. Therefore, the impact will generally be less than currently experienced from the current DRUPS unit which is being replaced.

It is recommended that testing ideally takes place between Monday-Friday, during daytime hours and for no more than one hour.

On the basis of the above the measured noise levels at the nearest noise sensitive receptor as a result of noise from the DRUPS unit when in operation, as outlined in Table 4.2, were in line with achieving the Local Authority guideline of no greater than 10 dB above the existing measured background level during the day time.

By meeting the above plant noise emission limits, the noise from operation of the new emergency generator will be no worse that experienced currently when the existing DRUPS unit is operating. It is anticipated that noise emission from the new emergency generator plant equipment will therefore suitably reduce the likelihood of noise complaints and achieve the Local Authority requirements.

Appendix A Glossary of Acoustic Terminology

Sound

This is a description of the physical phenomena of the transmission of energy through gaseous or liquid media via rapid fluctuations in pressure.

Sound Pressure Level

This is the basic measure of how much sound there is at a given location. It is a measure of the size of the pressure fluctuations in the air, that we perceive as sound.

Sound Pressure Level is expressed in decibels with a reference level of 20 mPa (*L*p in dB re 20 mPa).

Sound Power Level

This is the total amount of sound produced by a source. It cannot be measured directly but it can be calculated from Sound Pressure Level measurements in known conditions. It can be used to predict the Sound Pressure Level at any point.

Sound Power Level is expressed in decibels with a reference level of 1 pW (L_W in dB re 1 pW). In the US a reference of 100 fW is sometimes used.

L_p L_{pA} (or L_A)

The instantaneous sound pressure level (L_p).

The A-weighted instantaneous sound pressure level (L_{pA} or L_A).

This is the root mean square size of the pressure fluctuations in the air. This level can fluctuate wildly even for seemingly steady sounds. To make sound level meters easier to read the values on the display are smoothed or damped out. This is effectively done by taking a rolling average of the previous 0.125 s (FAST time constant) or the previous 1 s (SLOW time constant).

L_{max} L_{Amax}

The (A-weighted) maximum instantaneous sound pressure level (L_{Amax}).

$L_{Aeq,T}$

The A-weighted equivalent continuous sound pressure level over period, T.

This is effectively the average sound pressure level over a given period. As the decibel is a logarithmic quantity the L_{eq} is not a simple arithmetic mean value.

The L_{eq} is calculated from the raw sound pressure data. It is not appropriate to include a reference to the FAST and SLOW time constants in the notation.

L_{Ar}

Plant rating level as defined under British Standard BS4142:2014.

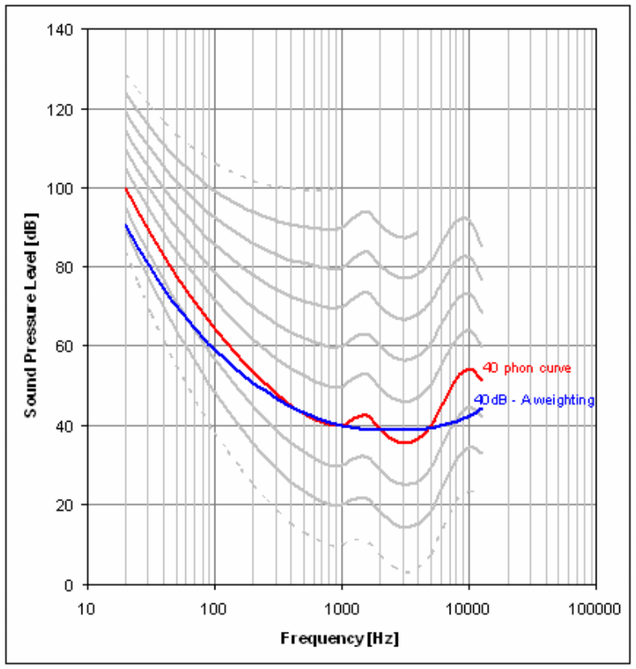
This is the specific sound level generated by the plant items inclusive of any adjustment for the characteristic features of the source.

A-Weighting

The human ear does not sense all frequencies of sound equally. Our sensitivity is at a maximum at around 2 kHz and steadily decreases above and below. Below 20 Hz and above about 20 kHz we can't hear at all.

Within its operating limits a precision measurement microphone measures all frequencies the same so the output it produces does not reflect what we would actually hear. The A-weighting is an electronic filter that matches the response of a sound level meter to that of the human ear. When A-weighted the Sound Pressure Level L_p becomes L_{pA} (or L_A) and the Sound Power Level L_W becomes L_{WA}.

It used to be common to identify that a level was A-weighted by writing dB(A) or dBA instead of dB. These terms are now obsolete and should not be used as they conflict with other, non-acoustic, uses of decibels.



Percentiles

To describe the time-varying character of environmental noise, statistical noise descriptors were developed:

L_{A10} is the A-weighted sound level equalled or exceeded during only 10% of the measurement time. The L_{A10} provides a good measure of the maximum sound levels caused by intermittent or intrusive noise.

L_{A50} is the A-weighted sound level that is equalled or exceeded 50% of the measurement time period; it represents the median sound level.

L_{A90} is the A-weighted sound level equalled or exceeded 90% of the time. Since this represents 'most' of the time, L_{A90} generally has been adopted as a good measure of the ambient baseline noise of the measurement site. Therefore, the baseline noise is defined as L_{A90} of the overall background noise.

Appendix B Noise Survey Measurement Graphs and Tables

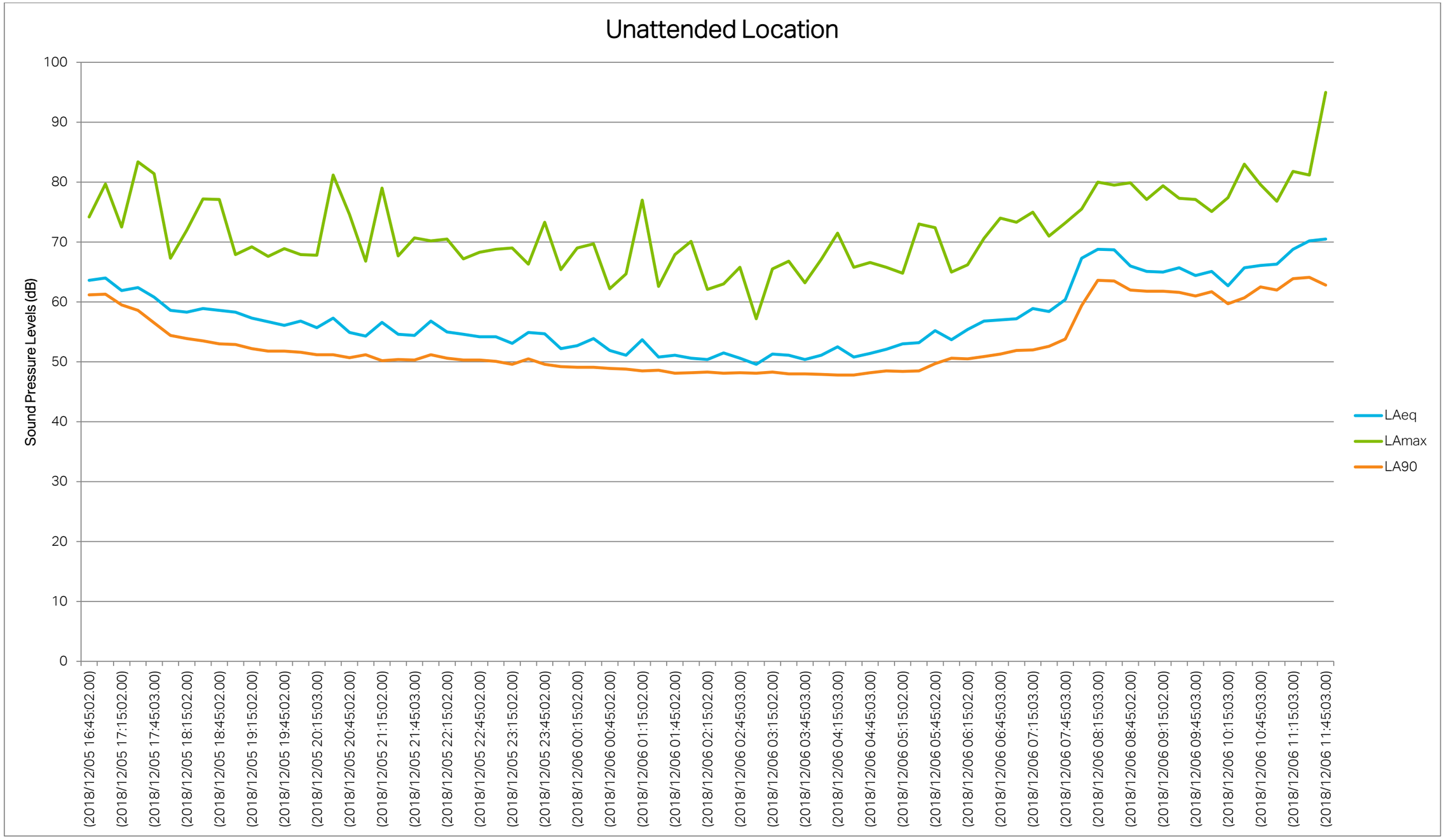


Figure A 1. Unattended Location Noise Survey Measurement Results

Spectral results are tabulated below. All the data are sound pressure levels in dB re 20 µPa.

Table A1. L_{Aeq} Measurement Results (dB)

			L_{eq} (dB) at each Third-Octave-band Centre Frequency (Hz)							
Time	Location	L_{Aeq}	63 Hz	125 Hz	250 Hz	500 Hz	1.0 kHz	2.0 kHz	4.0 kHz	8.0 kHz
16:45 - 17:00	U1	63.6	70.5	68.7	64.6	60.1	58.1	55.4	50.4	41.5
17:00 - 17:15	U1	64	70.5	68.7	65.2	58.9	58.6	57	50.4	42.5
17:15 - 17:30	U1	61.9	69.9	67.6	63.9	57.1	56.3	54	49.7	41.6
17:30 - 17:45	U1	62.4	69.2	68	61.2	56.6	56.4	54.3	54.7	44.4
17:45 - 18:00	U1	60.8	68.1	67.5	59.6	57.3	55.4	52.5	48.6	40.9
18:00 - 18:15	U1	58.6	66.4	62.2	57.3	54.2	54.4	50.8	45.5	37.6
18:15 - 18:30	U1	58.3	65.8	59.7	55.6	54.2	54.1	51.2	45.4	38.6
18:30 - 18:45	U1	58.9	65.2	60.5	57.1	54.5	55	51.2	45.8	37.4
18:45 - 19:00	U1	58.6	64.9	61.6	57.6	54.4	54.3	51.1	44.5	36.7
19:00 - 19:15	U1	58.3	64.5	59	55.4	53.7	54.6	50.8	45.1	37.1
19:15 - 19:30	U1	57.3	63.5	58.8	54.7	53	53.6	49.5	43.6	35.8
19:30 - 19:45	U1	56.7	63.6	58.8	54.7	52.5	52.8	49	42.6	34.2
19:45 - 20:00	U1	56.1	62.9	57.8	54.2	51.7	52.2	48.6	41.6	33.4
20:00 - 20:15	U1	56.8	64.2	59.1	54.8	52.7	52.6	49.3	43.8	35.7
20:15 - 20:30	U1	55.7	62	57	53.7	51.5	51.8	48.3	41.4	34.7
20:30 - 20:45	U1	57.3	61.2	56.7	53.4	51.7	53.5	51.2	42.1	32.6
20:45 - 21:00	U1	54.9	61.3	56.4	53.2	51.2	50.9	47.3	40.4	32.5
21:00 - 21:15	U1	54.3	61.8	56.8	53.7	50.4	49.8	46.5	41.4	32.2
21:15 - 21:30	U1	56.6	59.5	55.5	52.3	49.6	52.2	50.7	46.8	36.7
21:30 - 21:45	U1	54.6	60.7	55.8	52.5	50.7	50.7	46.8	40.5	32.6
21:45 - 22:00	U1	54.4	60.9	55.8	52.5	50.3	50.3	47.1	40.6	31.3
22:00 - 22:15	U1	56.8	63.6	57.5	54	52.5	53	49.5	43.2	35.1
22:15 - 22:30	U1	55	60.9	55.7	52.9	50.9	51	47.7	39.8	31.2
22:30 - 22:45	U1	54.6	62.4	55.3	52.1	50.1	51.3	46.6	38.5	30.1
22:45 - 23:00	U1	54.2	60.7	55.4	52.3	50.1	50.3	46.6	39.4	30.9
23:00 - 23:15	U1	54.2	59.8	55.4	52.3	50.4	50.3	46.6	39.2	30.1
23:15 - 23:30	U1	53.1	60.1	54.8	51.7	49.5	49.2	44.9	37.6	29.5
23:30 - 23:45	U1	54.9	60.2	55.4	52.7	50.8	50.9	47.9	40	31.7
23:45 - 00:00	U1	54.7	59.6	54.6	52	51	51.3	46.9	38	28.3
00:00 - 00:15	U1	52.2	59.1	54.1	51.2	48.6	47.8	44.4	37.7	32
00:15 - 00:30	U1	52.7	59.6	54.8	51.5	49.1	48.7	44.5	37.1	29.6
00:30 - 00:45	U1	53.9	60.6	54.6	51.3	49.6	50.3	46.5	37.3	28.7
00:45 - 01:00	U1	51.9	58.1	53.8	50.8	48.4	48	43.7	35.7	26.8

			L_{eq} (dB) at each Third-Octave-band Centre Frequency (Hz)							
Time	Location	L_{Aeq}	63 Hz	125 Hz	250 Hz	500 Hz	1.0 kHz	2.0 kHz	4.0 kHz	8.0 kHz
01:00 - 01:15	U1	51.1	57.7	53.7	50.8	47.8	47	42.6	34.4	23.7
01:15 - 01:30	U1	53.7	57.4	53.4	50.8	48.1	49.8	47.2	41.2	29.8
01:30 - 01:45	U1	50.8	57.6	53.9	50.4	47.7	46.8	42.1	33	24.5
01:45 - 02:00	U1	51.1	57.2	53.7	50.8	48.3	46.7	42.2	35.3	27.6
02:00 - 02:15	U1	50.6	57.3	53.9	50.6	47.9	46.2	41.5	33	22.1
02:15 - 02:30	U1	50.4	56.8	53.6	50.9	47.5	46	41.4	32.8	23.9
02:30 - 02:45	U1	51.5	58.6	53.9	51.2	48.4	46.9	43.5	35.9	27.3
02:45 - 03:00	U1	50.6	57.6	53.4	50.5	47.6	46.1	42.1	34.6	28.6
03:00 - 03:15	U1	49.6	58.1	53	50	46.7	44.9	40.6	31.8	21.8
03:15 - 03:30	U1	51.3	57.5	53.7	51.1	48.1	46.9	42.9	35.6	26.5
03:30 - 03:45	U1	51.1	57.4	53.3	50.5	47.5	47.1	42.8	34	25.9
03:45 - 04:00	U1	50.4	56.6	53.5	50.5	47.2	45.9	41.7	34.3	25.1
04:00 - 04:15	U1	51.1	56.9	53.7	51	47.8	46.9	42.4	35.5	28
04:15 - 04:30	U1	52.5	59.9	55.6	52	49	47.8	44.4	37.7	30.2
04:30 - 04:45	U1	50.8	57.1	53.7	50.9	47.4	46.3	42.3	34.8	27.7
04:45 - 05:00	U1	51.4	58.5	53.5	51.1	48	47.1	42.8	36.1	27.8
05:00 - 05:15	U1	52.1	58.2	54.2	51.3	48.6	47.8	44	37.4	29
05:15 - 05:30	U1	53	60.4	56.2	52.5	49.6	48.5	44.6	38.5	30.4
05:30 - 05:45	U1	53.2	60.1	59.2	53.1	49.9	48.5	44.6	38.7	31.5
05:45 - 06:00	U1	55.2	61.7	56.4	54.2	50.8	50.5	48.3	41.4	33.5
06:00 - 06:15	U1	53.7	60.9	56.2	53.6	50.4	49.2	45.4	37.7	28.6
06:15 - 06:30	U1	55.4	62.2	56.4	53.9	51.5	51.4	47.6	40.8	32.9
06:30 - 06:45	U1	56.8	64.6	58.6	55.4	53	52.5	49	43.5	36
06:45 - 07:00	U1	57	65.2	61.5	58	52.8	52.1	48.9	42.9	34.7
07:00 - 07:15	U1	57.2	65.5	58.2	55.4	53.2	53	49.6	43.2	36.2
07:15 - 07:30	U1	58.9	65.9	59.7	56.5	54.4	54.6	52.2	45.8	38.5
07:30 - 07:45	U1	58.4	65.3	59.6	56	54.2	54.3	51	45	37.6
07:45 - 08:00	U1	60.4	65.5	62.5	58.9	56.2	55.8	53.4	47.5	38.6
08:00 - 08:15	U1	67.3	68.9	63.8	63	62.5	62.6	61.5	56.1	46.4
08:15 - 08:30	U1	68.8	74.9	65.4	64.7	64	63.7	63.1	58.1	48.7
08:30 - 08:45	U1	68.7	73.8	66.3	65	63.5	63.5	62.7	59	50.4
08:45 - 09:00	U1	66	73.7	65.4	63.8	62.3	61	59.1	54.6	45.7
09:00 - 09:15	U1	65.1	73.2	64.7	62.7	61.1	60.4	58	53.3	44.2
09:15 - 09:30	U1	65	73.9	66.2	63.3	61.5	59.8	57.7	53.9	45.4
09:30 - 09:45	U1	65.7	75.4	66.4	63.7	61.1	60.6	58.6	55.3	50.3
09:45 - 10:00	U1	64.4	72.4	64.5	62.1	60.4	59.6	57.3	52.7	44.2
10:00 - 10:15	U1	65.1	70.8	64.1	62.7	61.6	60.2	58.1	53.3	42.9

			L_{eq} (dB) at each Third-Octave-band Centre Frequency (Hz)							
Time	Location	L_{Aeq}	63 Hz	125 Hz	250 Hz	500 Hz	1.0 kHz	2.0 kHz	4.0 kHz	8.0 kHz
10:15 - 10:30	U1	62.7	71.8	64.9	62.1	59.1	57.8	55.2	49.9	44
10:30 - 10:45	U1	65.7	74.3	65.4	63.6	61.8	60.8	58.5	54.2	47.9
10:45 - 11:00	U1	66.1	76.3	65.5	64.3	62.1	61	59.1	55.3	47.2
11:00 - 11:15	U1	66.3	75.3	66.2	63.7	62	61.3	59.6	55.4	46.5
11:15 - 11:30	U1	68.8	74	68	64.9	63.9	63.6	62.4	59.1	50.9
11:30 - 11:45	U1	70.2	74.4	68.1	65.3	64.1	64.8	64.4	61.6	53.7
11:45 - 12:00	U1	70.5	74.2	68.4	65.7	65.4	64.5	63.3	60.2	63.6

Table A2. L_{Amax} Measurement Results (dB)

			L_{max} (dB) at each Third-Octave-band Centre Frequency (Hz)							
Time	Location	L_{Amax}	63 Hz	125 Hz	250 Hz	500 Hz	1.0 kHz	2.0 kHz	4.0 kHz	8.0 kHz
16:45 - 17:00	U1	74.2	81.3	84.6	78.6	72.9	68.4	70.5	65	59.6
17:00 - 17:15	U1	79.7	80.9	76.1	73.6	70	71.6	78.4	63.4	61.1
17:15 - 17:30	U1	72.5	84.1	75.3	71.9	67.1	67.4	67.8	62.8	58.4
17:30 - 17:45	U1	83.4	79.7	81.8	69.7	66.8	73.4	73.5	81.8	67.2
17:45 - 18:00	U1	81.4	79.9	73.3	75.6	81.5	75.6	65.8	64.3	56.9
18:00 - 18:15	U1	67.3	81.7	77.5	71.1	64.9	65.1	61.9	64.7	55.5
18:15 - 18:30	U1	72	78.3	75.8	68.6	70.9	66	67.9	62.2	59.5
18:30 - 18:45	U1	77.2	80.2	80.7	78.8	72	77.2	66.3	67.6	54.4
18:45 - 19:00	U1	77.1	78.2	84.8	79.9	73.4	71.7	71.1	62.6	55.7
19:00 - 19:15	U1	67.9	78.2	70	66	65.5	66.4	64	60.1	55.3
19:15 - 19:30	U1	69.2	77.1	73.3	68	66.6	66.7	63.1	59.8	53.5
19:30 - 19:45	U1	67.6	78.9	74	66	64.6	66.1	61.6	57.3	52.4
19:45 - 20:00	U1	68.9	80.7	72.1	65.3	62.1	67.4	64.5	59.4	58.3
20:00 - 20:15	U1	67.9	80.8	77	66.8	64.5	66	63.5	65.2	59.1
20:15 - 20:30	U1	67.8	79.3	68.3	65.2	63.8	64	61.5	56.6	61.3
20:30 - 20:45	U1	81.2	75.3	71.9	67.1	68.4	75.9	79.4	66.4	51.4
20:45 - 21:00	U1	74.6	75.6	74.8	66.3	67.1	69	71.9	58.5	51.4
21:00 - 21:15	U1	66.8	82.4	71.8	69.1	64.5	63	58.9	60.7	55
21:15 - 21:30	U1	79	77.6	67.2	64.4	61.3	74.8	75.8	71.8	62.7
21:30 - 21:45	U1	67.7	76	67	62.9	62.6	63.8	61.3	56.6	51.5
21:45 - 22:00	U1	70.7	74.8	65.8	65.1	66.5	66.7	67.5	62	53
22:00 - 22:15	U1	70.2	83.5	74.3	69.6	66.8	66	65.5	61.2	54.3
22:15 - 22:30	U1	70.5	76.1	71	70	64.2	67.2	69	54.2	44.7
22:30 - 22:45	U1	67.2	81	68.2	62	60.4	67.6	63.2	53	46.2
22:45 - 23:00	U1	68.3	73.5	68	63.3	62.9	66.1	62.2	55	47.5
23:00 - 23:15	U1	68.8	74.7	68.2	63.8	67.3	64.7	61	53.6	47.6
23:15 - 23:30	U1	69	77.4	70	65	69.9	64.6	60.8	56.2	50.5

23:30 - 23:45	U1	66.3	76.5	68.4	66.8	68.9	63.3	61.9	56.1	55.3
23:45 - 00:00	U1	73.3	75.4	66.1	65	69.3	73	65.7	57.3	47.4
00:00 - 00:15	U1	65.4	73.4	65.6	62.8	61.9	60.5	59.1	54.6	58.2
00:15 - 00:30	U1	69	78.8	72.6	64.1	66	64	62.3	56.7	56.5
00:30 - 00:45	U1	69.7	77.1	65.5	62.3	65.4	66.1	68.4	53.6	49.7
00:45 - 01:00	U1	62.2	72	63.2	60.2	58.3	58.5	56.2	55.6	51.3
01:00 - 01:15	U1	64.7	71.8	67.8	63.4	61.7	61.6	56	54.5	46.8
01:15 - 01:30	U1	77	69.7	66.9	60.5	59.3	75.8	73.9	69	57.3
01:30 - 01:45	U1	62.6	76.4	65.4	61.4	58.7	60.5	57.2	51.2	47.1
01:45 - 02:00	U1	67.9	73.5	67.1	64.9	69	62.5	61.2	60.9	54.3
02:00 - 02:15	U1	70.1	72.3	67.4	66.3	70.6	65.9	56.9	46.9	40.7
02:15 - 02:30	U1	62.1	71.3	66.8	62	61.5	59.4	54.3	51.3	47.2
02:30 - 02:45	U1	63	74.7	64.6	62.2	59.4	57.7	57.9	54.8	46.5
02:45 - 03:00	U1	65.8	73.9	64.8	61	65	61.5	59.6	55.2	55.5
03:00 - 03:15	U1	57.2	77.4	60.8	56.9	57.1	55.6	49.5	51	43.7
03:15 - 03:30	U1	65.5	73.9	62.9	68.8	60.9	60.6	58.5	57.1	54.3
03:30 - 03:45	U1	66.8	76.3	63.4	64.3	59.5	64.8	64.5	52.1	45.6
03:45 - 04:00	U1	63.2	72.4	64.9	60.7	58.4	59.9	56.5	52	45.5
04:00 - 04:15	U1	67.1	73.5	66.4	63.5	60.8	62.6	61.8	56.5	51.6
04:15 - 04:30	U1	71.5	79.9	76.3	71.8	66.3	68.2	65.3	59.6	52.5
04:30 - 04:45	U1	65.8	72.9	69.7	61.1	60.1	60.9	61.2	55.5	48.8
04:45 - 05:00	U1	66.6	75.6	67.2	61	59.3	59.2	59.3	62.7	56.8
05:00 - 05:15	U1	65.8	73.8	65.5	60.6	61.3	62.2	60.8	55.3	50
05:15 - 05:30	U1	64.8	78.3	77.3	65.4	64.5	59.8	58.2	54.2	50.9
05:30 - 05:45	U1	73	77.6	83.5	71.8	67.3	66.7	66	65.8	60.2
05:45 - 06:00	U1	72.4	84.8	70.1	68.1	63.1	64.1	70.5	57.3	53.2
06:00 - 06:15	U1	65	77.1	70.6	64.5	61.6	60.1	59.4	55.1	48.8
06:15 - 06:30	U1	66.2	79.6	74.1	65.3	63.6	63.9	59.9	58.6	52.8
06:30 - 06:45	U1	70.6	79	71.8	72.3	69.2	65.8	64.1	66	59.4
06:45 - 07:00	U1	74	85.1	84.8	80.6	71.9	65	65	65.6	51.8
07:00 - 07:15	U1	73.3	84.5	74.1	72.6	69.9	68.9	66.2	62.8	58.1
07:15 - 07:30	U1	75	82	75.8	73.5	70.2	74.1	70.4	62.1	57.5
07:30 - 07:45	U1	71	79.3	76.2	70.4	65.8	67.3	66.7	61.3	59.4
07:45 - 08:00	U1	73.2	79.9	85.7	71.2	71.2	68.7	67.5	68	58.6
08:00 - 08:15	U1	75.5	81.3	79.2	74.4	73	71.8	71	71	63.3
08:15 - 08:30	U1	80	84.9	80.7	79.4	78.6	73.3	73.8	69.6	62.7
08:30 - 08:45	U1	79.5	90.4	85.7	81.9	76.1	75.5	74.4	75.5	65.8
08:45 - 09:00	U1	79.9	83.2	79.4	78.9	79	73.3	72.6	71.3	64.3
09:00 - 09:15	U1	77.1	87.2	78	78.8	73.6	73.3	70.9	70	63.6

09:15 - 09:30	U1	79.4	80.7	80	77.8	81.6	76.2	73.1	71	63.2
09:30 - 09:45	U1	77.3	82	78	76.7	76.5	73.3	69.6	67.7	66.1
09:45 - 10:00	U1	77.1	82.7	78.5	78.7	71.9	73.3	72	68.4	60.4
10:00 - 10:15	U1	75.1	83.7	83	75.4	70.6	69.8	70.4	71.4	59.5
10:15 - 10:30	U1	77.4	82.9	82.8	78.6	70.7	71.1	73.2	71.5	69
10:30 - 10:45	U1	83	94.2	85.7	84.6	81.4	76.1	77.9	71.2	67.9
10:45 - 11:00	U1	79.6	83	77	75.7	73.4	79.4	69	71.6	65.1
11:00 - 11:15	U1	76.8	85.6	81.6	73.9	75.5	71.9	71.2	68.8	62.4
11:15 - 11:30	U1	81.8	83.9	82.7	78.2	79.4	77.4	74.6	73.4	66.5
11:30 - 11:45	U1	81.2	83.1	78.3	73.6	72.9	75.5	75.8	76	70
11:45 - 12:00	U1	95	96.1	90.6	85.1	84.3	78.1	78.4	78.8	96

Table A3. L_{A90} Measurement Results (dB)

			L_{90} (dB) at each Third-Octave-band Centre Frequency (Hz)							
Time	Location	L_{A90}	63 Hz	125 Hz	250 Hz	500 Hz	1.0 kHz	2.0 kHz	4.0 kHz	8.0 kHz
16:45 - 17:00	U1	61.2	67.3	66.8	62.8	57.6	55.3	51.9	46	36
17:00 - 17:15	U1	61.3	67.3	67	63.5	56.5	54.9	52	46.4	36.9
17:15 - 17:30	U1	59.5	66.6	66.4	62.3	54.8	52.9	49.6	44	33.8
17:30 - 17:45	U1	58.6	65.6	66.2	58.8	53.9	52.7	49.5	43.5	33.5
17:45 - 18:00	U1	56.5	63.9	66.2	57.6	51.4	50	46.8	40.8	31
18:00 - 18:15	U1	54.4	59.7	56.9	53.4	50.9	49.5	45.5	39.2	29.6
18:15 - 18:30	U1	53.9	59.9	55.3	52.1	50.2	49.4	45.9	39.3	29.3
18:30 - 18:45	U1	53.5	59.2	55.3	52.2	49.9	48.8	45.3	39.1	28.9
18:45 - 19:00	U1	53	58.6	55.2	51.9	49.4	48.3	44.5	37.7	27.5
19:00 - 19:15	U1	52.9	58.4	54.9	51.6	49.5	48.3	44.8	38.1	27.5
19:15 - 19:30	U1	52.2	57.5	54.6	51.5	49	47.6	43.5	36.3	25.2
19:30 - 19:45	U1	51.8	57.3	54.6	51.3	48.5	47	42.9	35.7	25.1
19:45 - 20:00	U1	51.8	57.4	54.5	51.5	48.4	47	43	35.2	24.3
20:00 - 20:15	U1	51.6	57.6	54.5	50.9	48.4	46.7	42.9	35.7	24.9
20:15 - 20:30	U1	51.2	56.8	54.3	50.5	47.8	46.6	42.6	34.9	24.4
20:30 - 20:45	U1	51.2	57	54	50.5	47.9	46.3	42.2	34.3	23.2
20:45 - 21:00	U1	50.7	56.8	53.5	50.1	47.6	45.9	42.3	34.9	25.4
21:00 - 21:15	U1	51.2	56.9	53.8	50.8	47.8	45.9	42.6	35	25.5
21:15 - 21:30	U1	50.2	55.9	53.3	50.1	47.1	45.1	41.2	33.6	24.9
21:30 - 21:45	U1	50.4	56.7	53.3	50.1	47.4	45.5	41.6	34.1	23.3
21:45 - 22:00	U1	50.3	57.1	53.5	50.2	47.4	45.4	41.4	33.3	22.4
22:00 - 22:15	U1	51.2	57.1	53.5	50.4	47.9	46.8	42.5	34.5	23.4
22:15 - 22:30	U1	50.6	56	53	50.2	47.5	46.1	41.8	33.3	22.2

22:30 - 22:45	U1	50.3	55.7	52.7	49.9	47.3	45.6	41.5	32.9	21.7
22:45 - 23:00	U1	50.3	55.7	52.6	49.8	47.3	45.5	41.5	33.3	22.4
23:00 - 23:15	U1	50.1	55.8	52.8	49.7	47	45.2	41.2	32.8	21.2
23:15 - 23:30	U1	49.6	55.1	52.4	49.7	46.7	44.7	40.4	31.5	20.4
23:30 - 23:45	U1	50.5	55.7	52.8	50.3	47.4	45.6	41.5	32.7	21.6
23:45 - 00:00	U1	49.6	55.2	52.5	50.2	46.8	44.6	40.3	31.3	20.2
00:00 - 00:15	U1	49.2	54.8	52.2	49.7	46.3	44.2	40	31.1	19.8
00:15 - 00:30	U1	49.1	54.8	52.4	49.5	46.5	44.2	39.6	30.3	19.4
00:30 - 00:45	U1	49.1	55	52.1	49	46.2	44.3	40	30.5	19.5
00:45 - 01:00	U1	48.9	54.7	52	49	46.1	44.1	39.7	30.3	19.3
01:00 - 01:15	U1	48.8	54.5	52	49.1	45.9	43.7	39.7	30.6	19.1
01:15 - 01:30	U1	48.5	54.1	51.5	48.9	45.8	43.3	38.8	29.4	18.5
01:30 - 01:45	U1	48.6	54	52.1	49	45.8	43.5	39	29.5	18.9
01:45 - 02:00	U1	48.1	53.4	51.8	49	45.4	42.7	38.5	29.4	18.8
02:00 - 02:15	U1	48.2	54	51.9	49.2	45.5	42.7	38.7	29.8	18.7
02:15 - 02:30	U1	48.3	54	51.9	49.3	45.5	42.8	38.5	29.4	18.6
02:30 - 02:45	U1	48.1	54.1	51.6	49	45.6	42.9	38.5	29.2	18.6
02:45 - 03:00	U1	48.2	53.9	51.7	49.1	45.5	42.6	38.4	29.3	18.8
03:00 - 03:15	U1	48.1	53.9	51.5	48.9	45.3	42.6	38.5	29.4	18.9
03:15 - 03:30	U1	48.3	53.9	51.8	49.3	45.6	42.8	38.7	29.7	19.1
03:30 - 03:45	U1	48	53.6	51.7	48.9	45.3	42.5	38.2	29.3	18.6
03:45 - 04:00	U1	48	53.5	51.7	49.2	45.4	42.5	38.2	29.1	18.5
04:00 - 04:15	U1	47.9	54	51.7	49.2	45.2	42.3	37.7	29.1	18.4
04:15 - 04:30	U1	47.8	53.7	51.9	49.2	45.3	42.2	37.5	28.9	18.3
04:30 - 04:45	U1	47.8	53.8	51.9	49.4	45.3	42.1	37.5	28.8	18.4
04:45 - 05:00	U1	48.2	54.5	51.7	49.1	45.5	42.7	38.1	29.3	18.5
05:00 - 05:15	U1	48.5	54.7	52.2	49.5	45.9	43.1	38.4	29.5	19.2
05:15 - 05:30	U1	48.4	54.7	52	49.8	45.7	43	38.5	29.8	19.4
05:30 - 05:45	U1	48.5	55	52.3	49.9	45.9	43	38.6	29.6	19.2
05:45 - 06:00	U1	49.7	55.7	52.7	51	46.9	44.3	40.2	31.7	21.3
06:00 - 06:15	U1	50.6	56.4	53.1	51.3	47.8	45.3	41.6	32.8	22.2
06:15 - 06:30	U1	50.5	56.2	53.5	51.2	47.6	45.5	41	32.1	21.3
06:30 - 06:45	U1	50.9	57.1	54.1	51.4	47.9	46	41.5	32.7	21.6
06:45 - 07:00	U1	51.3	57.2	54.1	51.7	48.3	46.6	42.1	33.6	22.5
07:00 - 07:15	U1	51.9	59.5	55	52.1	49	46.8	42.9	34.5	23.5
07:15 - 07:30	U1	52	58.3	55.2	52.3	49.2	47	42.7	34.9	24.1
07:30 - 07:45	U1	52.6	58.5	55.1	52.2	49.6	47.8	43.8	36.2	25.2
07:45 - 08:00	U1	53.8	59.7	56.3	52.9	50.5	49.4	45	37.5	26.9
08:00 - 08:15	U1	59.4	64.8	60.2	58.7	55.8	54.9	51.3	44.1	33

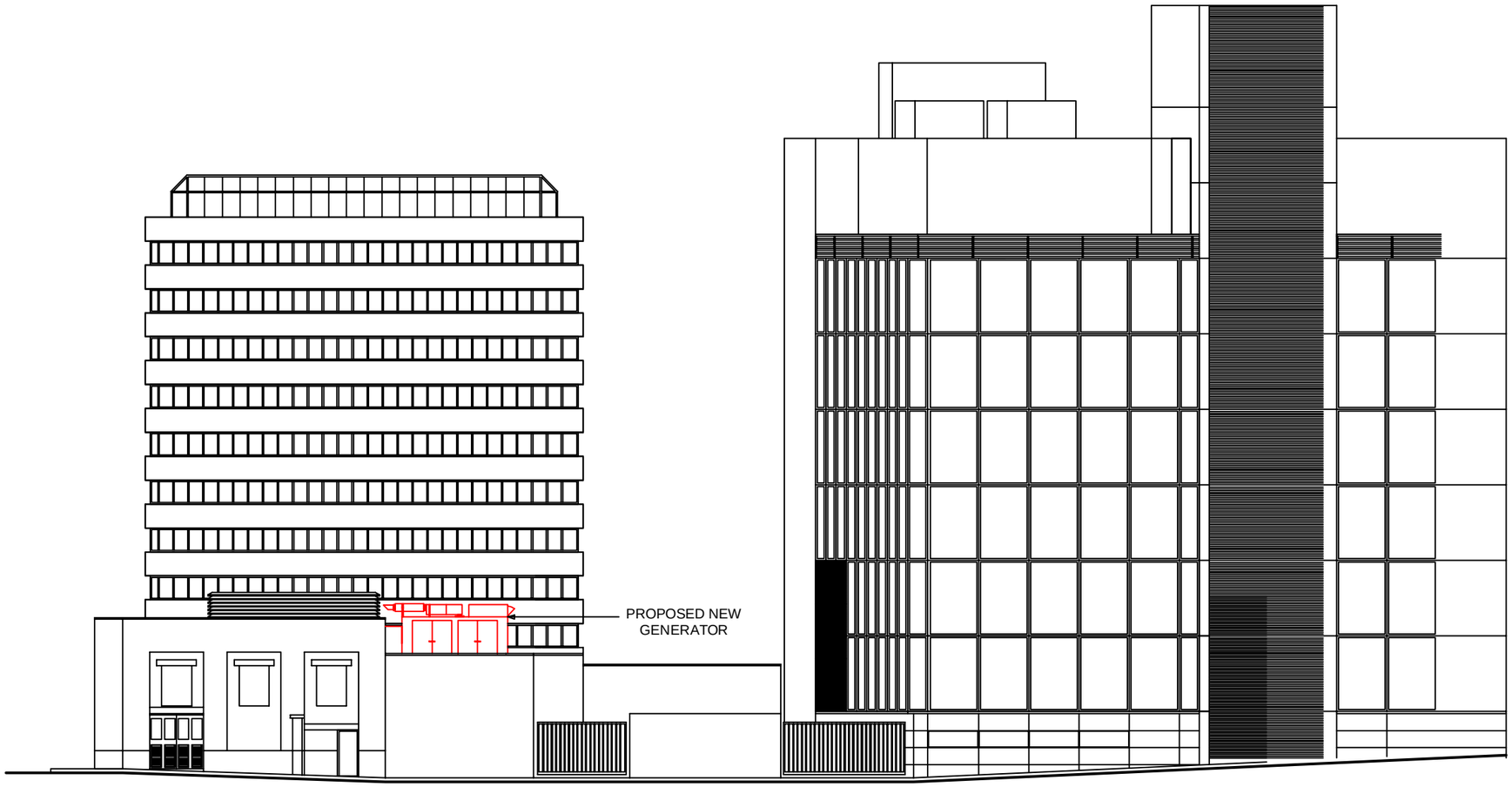
08:15 - 08:30	U1	63.6	69	62.9	62.1	60.1	58.5	56	50.2	39.7
08:30 - 08:45	U1	63.5	67.7	63.4	62.1	59.9	58.3	55.5	49.9	39.9
08:45 - 09:00	U1	62	68	62.2	60.5	58.6	57	53.9	47.8	37.4
09:00 - 09:15	U1	61.8	67.4	62	60.4	58.3	57	53.7	47.4	37.2
09:15 - 09:30	U1	61.8	68.6	63.5	60.7	58.1	56.4	53.3	48.4	38.6
09:30 - 09:45	U1	61.6	70.7	63.4	60.8	57.7	56.7	53.6	47.6	36.8
09:45 - 10:00	U1	61	66.1	61.6	59.8	57.7	56.1	52.6	45.9	34.7
10:00 - 10:15	U1	61.7	66	61.3	60.1	58.5	57	53.3	46.3	35.5
10:15 - 10:30	U1	59.7	68.5	60.7	59.4	56.6	54.6	51	44.2	33.4
10:30 - 10:45	U1	60.7	68.9	61	59.5	57.4	55.7	52.3	46	36.2
10:45 - 11:00	U1	62.5	71.3	63.5	62.3	59	57.2	53.9	48.1	37.8
11:00 - 11:15	U1	62	70.9	63.5	61.6	58.3	57.2	53.5	46.6	35.7
11:15 - 11:30	U1	63.9	70.1	65.8	62.4	60.1	59	56	49.5	38.4
11:30 - 11:45	U1	64.1	70.8	66.1	62.9	60.1	59.1	56.3	50.6	40
11:45 - 12:00	U1	62.8	70.6	65.7	62.1	58.9	57.6	54.6	49.3	40.2

Table A4. L_{Aeq} and L_{A90} Measurement Results (dB)

				L_{eq} (dB) at each Third-Octave-band Centre Frequency (Hz)																				
Time	Location	L_{Aeq}	L_{A90}	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz	1.0 kHz	1.25 kHz	1.6 kHz	2.0 kHz	2.5 kHz	3.15 kHz	4.0 kHz	5.0 kHz	6.3 kHz	8.0 kHz
17:02:38 – 17:03:08	A1	101.6	101.2	78.4	88.1	94.5	91	98.1	91.5	92.2	96.8	99.8	88.9	90.9	91.3	91.4	90	90.2	91.5	86.3	85.3	86.2	81.6	79.4	77.6
17:03:57 – 17:04:27	A2	77.7	77	77.7	79.2	79.8	81.2	89.7	76.9	68.1	67.1	64.9	62.5	65	63.6	61.5	59.5	58.9	57.6	55.7	54.3	52.5	49.9	47.8	44.7

Appendix C New Generator Plans

ROOF PLAN INDICATION LOCATION OF NEW GENERATOR



ELEVATION FROM GOUGH STREET - INDICATING PROPOSED NEW GENERATOR

AECOM

PROJECT

Annex Building
200 Gray's Inn Road
London
WC1X 8XZ

CLIENT

GLOBECAST
Hatfield, Herts

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER
A20180469

SHEET TITLE
PROPOSED
ROOF PLAN

SHEET NUMBER

Project Management Initials: ____ Designer: ____ Checked: ____ Approved: ____ ISO A1 594mm x 841mm

Last saved by: JONAS.LOPEZ (2018-12-17) Last Plotted: 2018-12-17
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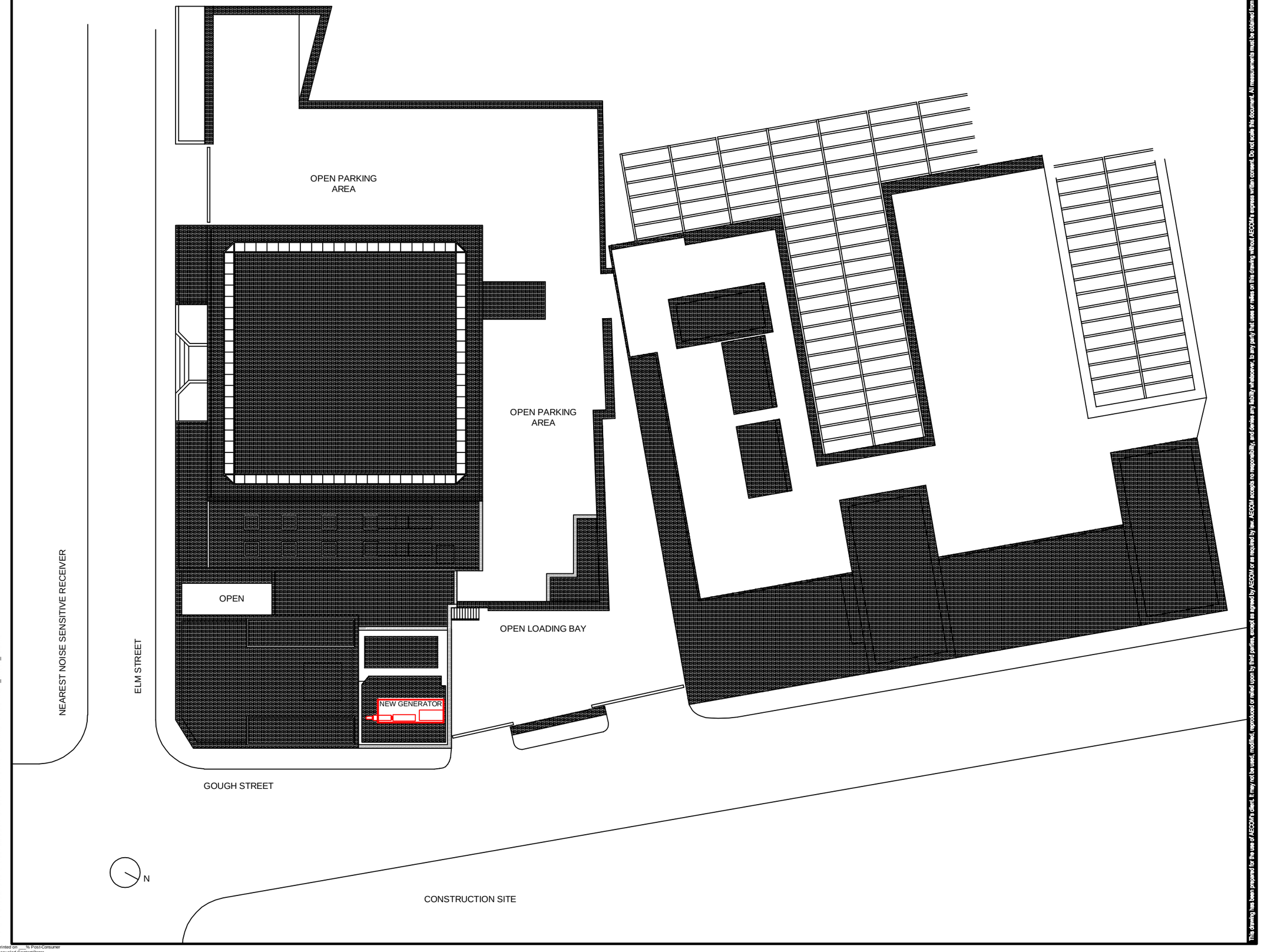

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Annex Building
200 Gray's Inn Road
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CLIENT

GLOBECAST
Hatfield, Herts

ISSUE/REVISION

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KEY PLAN

PROJECT NUMBER

A20180469

SHEET TITLE

PROPOSED
ROOF PLAN

SHEET NUMBER

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