GILLIERON SCOTT
ACOUSTIC DESIGN

Report No:
ASL – Noise Impact Assessment 12012021

Date:
12th January 2021

For:
American School of London

AMERICAN SCHOOL OF LONDON
PLANT NOISE IMPACT ASSESSMENT

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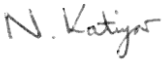
REVISION SCHEDULE

Document Revision	Date	Document Title	Details	Prepared by	Approved by
00	27th March 2020	ASL – Noise Impact Assessment 27032020	DRAFT FOR COMMENT	Andrea Cicero 	Tim Scott 
01	18th November 2020	ASL – Noise Impact Assessment 18112020	REVISED DRAFT FOR COMMENT	Nitin Katiyar 	Tim Scott 
02	12th January 2021	ASL – Noise Impact Assessment 12012021	ISSUED	Lucie Zalberg 	Tim Scott 

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Introduction

The American School in London, set in the London Borough of the City of Westminster, is proposing to install a new Air Handling Unit (AHU) and condensing unit, which are to be located adjacent the main entrance to the school at Waverley Place. The nearest residential building has been identified as being Ashley House apartments, about 10.5m away from the proposed plant area.

Gillieron Scott Acoustic Design (GSAD) have been commissioned to undertake a plant noise impact assessment in line with BS4142 and Local Authority adopted noise policy.

GSAD have carried out a background noise survey at one fixed monitoring location from 11:15hrs Friday 13th March to 12:15hrs Monday 16th March 2020. The microphone location was chosen to be representative of the closest residential receptor.

It is understood that the plant will have the facility to operate during daytime (07:00-23:00) Monday to Saturday.

The site location, plant area and nearest residential receptors are indicated in Appendices A, B and C.

1.0 Brief

- Undertake noise measurements at a fixed monitoring location over an extended period.
- Undertake weather measurements.
- Identify noise sensitive dwellings located close to the site and assess the topography of the intervening ground.
- Analyse the site-acquired data and determine the appropriate criteria to adopt from the London Borough of Westminster's noise policy.
- Using representative measured data from the survey and manufacturer's data for the proposed items of plant where possible, verify the impact of the development to satisfy Local Authority's noise policy.
- Provide a technical report detailing findings of the noise survey.

2.0 Context

The American School in London (ASL) is located in proximity of Waverley Place and Loudoun Road, in the London Borough of Westminster. The buildings surrounding the school are predominantly residential premises.

The mechanical plant area is proposed to be installed adjacent to the site main entrance in Waverley Place.

The acoustic environment at the residential receptors located near the building comprises of various typical urban noise sources including road traffic noise, air traffic noise, sirens and noise from the school.

3.0 Summary

A background noise survey was undertaken from 11:15hrs Friday 13th March to 12:15hrs Monday 16th March 2020 at a single fixed monitoring location representative of the nearest residential windows.

It is understood that the plant will have facility to operate during daytime (07:00-23:00 hours), therefore this assessment will be based on the same reference period. Manufacturer supplied noise data is provided in the Appendix.

Using methodology outlined in BS4142:2019, a representative daytime background sound level of 50 dB $L_{A90,15min}$ has been determined over the proposed operational hours.

Noise from mechanical ventilation with all plant operating shall be designed to satisfy the relevant statutory criteria at 1m from the façade of any noise sensitive properties in accordance with Westminster Council's requirements and BS4142 'Rating Industrial Noise Affecting Mixed Residential and Industrial Areas'.

The site location, measurement position and measured results are presented in the following Sections and Appendices.

4.0 Plant Noise Assessment Criteria

4.1 BS4142:2019 "Methods for rating and assessing industrial and commercial sound"

It is understood that the London Borough of Westminster Council's standard noise policy requires an assessment in line with British Standard BS4142:1997 to be undertaken, stating that *"noise emissions, as predicted at a location one metre outside the affected façade of a premises, will be 10 dB below the lowest measured background value (LA90)".*

However, BS4142:2019 has formally superseded the 1997 standard therefore, the most updated version of the standard will be considered in this assessment.

BS4142:2019 provides methods for rating and assessing industrial and commercial sound. The standard is used to rate sound from fixed installations. The standard requires a "Specific Sound Level", in terms of L_{Aeq}, is determined either by measurement or calculation at a receptor location. This Specific Sound Level may then be corrected for the character of sound and is then termed the "Rating Level".

Once the Rating Level has been determined, the background sound level is subtracted from it and the greater the difference, the greater the likelihood of an '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. The standard advocates that each site and situation should take the context of the scenario into consideration and that "not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact".

The standard provides reference periods over which the assessment should take place which have been reproduced in the table below.

Table 1 – Reference Periods

Period	Hours
Typical Daytime	07:00 – 23:00
Typical Night-time	23:00 – 07:00

5.0 Survey Details and Results

A background noise survey was undertaken from 11:15hrs Friday 13th March to 12:15hrs Monday 16th March 2020 at a single fixed monitoring location that was located at the border of the site in close proximity to the nearest noise sensitive windows. The microphone position is shown in Appendix C.

The levels were recorded in octave bands as L_{eq}, L_{max} and L_{90} with Fast time-weighting along with their respective A-weighted single-figure values. The clock on the sound level meter was synchronised to the correct time before deployment. The meter was then set to integrate sound levels over 15-minute periods in synchronisation mode. A list of the measurement equipment is reported in Appendix H.

The equipment was calibrated at the beginning and end of the survey period and a 0.1 dB drift in calibration was noted.

Weather history has also been recorded as part of the assessment to ensure that all data used in the determination of the representative background sound level occurred during conditions that are considered conducive to acoustic measurements. Weather data is available on request.

Full survey results to one decimal place are presented in Appendix G. Graphical representations of the results are presented in Appendices D and E.

Table 2 – Summary of representative background noise level

Representative Background Noise Level L_{A90} (07:00-23:00)	50 dB(A)

The typical daytime background sound level of 50 dB(A) L_{A90} has been determined and will be used in the assessment of the newly proposed plant item in the following section.

6.0 Plant Noise Assessment

It is proposed 1x Daikin D-AHU Professional Air Handling Unit (AHU) and 1x Daikin 125AW1 Condensing Unit is installed on school grounds. Manufacturer supplied noise data is provided in the Appendix. It is understood the AHU and condensing unit will be installed on school grounds adjacent to the entrance to the school. The proposed plant location and the units associated manufacturer supplied noise data is shown in the Appendix. The nearest residential building has been identified as being Ashley House apartments, about 10.5m away from the proposed plant area. Refer to Appendices.

The plant noise impact assessment for the nearest/most affected residential window has been carried out in the following tables. Table 3 shows calculation of the rating level for the AHU, Table 4 for the Condensing Unit and Table 5 shows the cumulative noise impact assessment for all newly proposed plant.

Table 3 – AHU Rating Level Calculation

Element(s)	Adjustment	Level(s)	Comments
Daikin Air Handling Unit, D-AHU Professional	-	54 dB(A)	AHU Supply casing breakout 52 dB(A) @ 1m, AHU Extract casing breakout 49 dB(A) @ 1m, AHU Cumulative supply and extract casing breakout 54 dB(A) @ 1m. Manufacturer supplied noise data in Appendix
Reflective surfaces	+3	57 dB(A)	AHU positioned on acoustically hard ground
Distance attenuation	-20	37 dB(A)	Point source distance attenuation $-20 \log_{10}$ (r). 9.5m at 1m from nearest receptor
Specific sound level	-	37 dB(A)	Specific sound level before acoustic feature corrections
Acoustic feature correction	+2	39 dB(A)	2 dB for Tonality. See Appendix I for details.
Rating level	-	39 dB(A)	Rating level, including acoustic feature corrections
Assessment indication	Shown in Cumulative Assessment Table 5		

Table 4 – Condenser Rating Level Calculation

Element(s)	Adjustment	Level(s)	Comments
Daikin 125AW1 Condensing Unit	-	54 dB(A)	Condensing Unit breakout 54 dB(A) @1m, Manufacturer supplied noise data in Appendix
Reflective surfaces	+3	57 dB(A)	Condenser positioned on acoustically hard ground
Distance attenuation	-20	37 dB(A)	Point source distance attenuation $-20 \log_{10}$ (r). 9.5m at 1m from nearest receptor
Acoustic screening	-5	32 dB(A)	No line of sight from condensing unit to nearest/most affected residential window
Specific sound level	-	32 dB(A)	Specific sound level before acoustic feature corrections
Acoustic feature correction	+2	34 dB(A)	2 dB for Tonality. See Appendix I for details.
Rating level	-	34 dB(A)	Rating level, including acoustic feature corrections
Assessment indication	Shown in Cumulative Assessment Table 5		

Table 5 – Cumulative Noise Impact Assessment

Element(s)	Adjustment	Level(s)	Comments
Rating Level of AHU at nearest/most affected residential window	-	39 dB(A)	AHU Rating level, including acoustic feature corrections
Rating Level of Condensing Unit at nearest/most affected residential window	-	34 dB(A)	Condenser Rating level, including acoustic feature corrections
Cumulative Rating Level from AHU and Condensing Unit	-	40 dB(A)	Cumulative Rating Level from AHU 39 dB(A) + condensing unit 34 dB(A)
Background Sound Level L_{A90}	-	50 dB L_{A90}	From background noise survey
Excess of Rating Level over Background Sound Level	-10 dB		The Rating level is 10 dB below the Background sound level over the proposed hours of operation
Assessment indication	The assessment is indicative of a low impact on all nearby residential dwellings. The assessment outcome also demonstrates compliance with the City of Westminster adopted noise policy		

As can be seen from Table 5 above, the cumulative assessment of noise breakout from the AHU and condensing unit results in a rating level at the nearest/most affected receptor of 40 dB L_{Aeq}, which is 10 dB below the representative background sound level of 50 dB L_{A90}. A rating level that is 10 dB below the background sound level is a positive indication of a low impact on all nearby residential dwellings. The assessment also demonstrates compliance with the City of Westminster's adopted noise policy.

Atmosphere side inlets/outlets

Atmosphere side inlets and outlets serving the AHU should also be attenuated to ensure the City of Westminster's adopted noise policy continues to be met. Required attenuator Insertions Losses (ILs) are summarised in the table below.

Table 6 – Calculated Attenuator Insertion Losses (dB)

Unit reference	Supply or Extract	63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz
AHU 1	E	13	30	28	20	30	36	43	50
AHU 1	S	4	23	28	13	18	22	31	38

The final schedule of attenuation is to be submitted to GSAD for approval.

7.0 Uncertainty

The sound level meter was checked at the beginning and end of the survey and the field calibration a 0.1 dB drift. In the context of this environmental noise survey this level of drift it is considered insignificant.

Weather conditions during the noise survey were recorded near the microphone and it was noted that the wind speed was within the acceptable limits of the windshield's self-noise generation, except for peaks during which recorded level have been excluded from the assessment. Precipitation was absent. Overall, the weather conditions are considered conducive to acoustic measurements.

Overall, the uncertainty within the survey procedure is deemed not to have significant influence on the outcome of the assessment.

8.0 Conclusion

GSAD has undertaken a background noise survey at the site and the survey results are presented within this report, together with the BS4142:2019 plant noise assessment for the proposed unit.

A representative background sound level of 50 dB $L_{A90,15min}$ has been determined over the proposed operational hours of the plant items (daytime 07:00-23:00).

The plant noise impact assessment has determined that the cumulative rating level from all newly proposed plant will be 10 dB below the representative background sound level, which is a positive indication of a low impact on nearby residential dwellings. The assessment also demonstrates compliance with the City of Westminster's adopted noise policy.

Attenuator insertion loss requirements have also been calculated to ensure noise from inlets and outlets serving the AHU will be suitably treated to ensure the City of Westminster's adopted noise policy continues to be met.

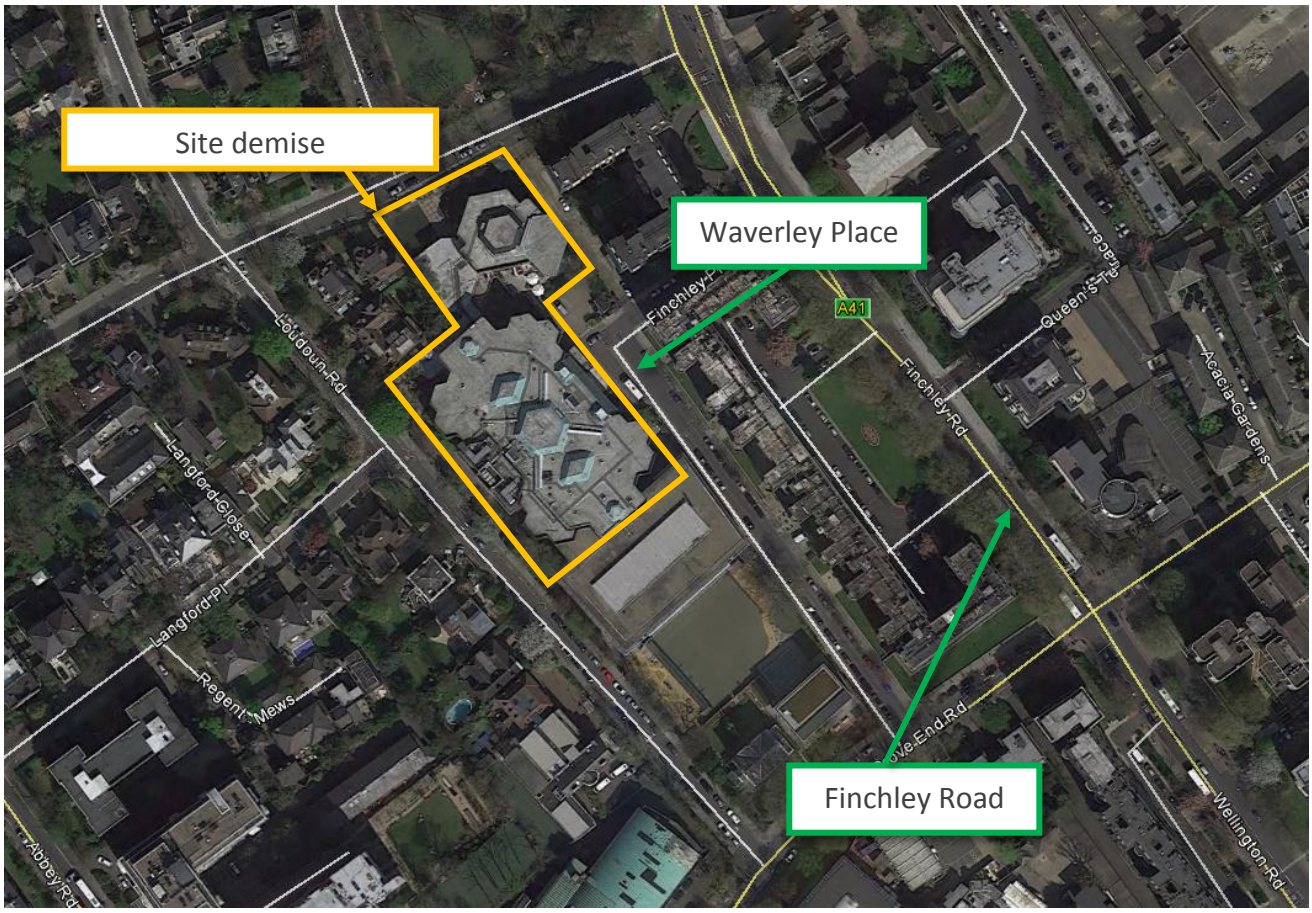
9.0 Statement of Competence

The assessment has been undertaken by the author of this report: Lucie Zalberg, BSc(Physics) MSc(Architectural Acoustics) MIOA. The author is Associate Director of Gillieron Scott Acoustic Design with 12+ years' experience since completing a degree at Pierre et Marie University in Paris and Bath University. The author has undertaken numerous noise assessments according to the 1997 revision of the British Standard and the most recent 2014 revision of the standard.

The assessment has been checked by: Tim Scott BSc (Hons.), MIOA a Director of Gillieron Scott Acoustic Design with 18+ years' experience since completing a degree in Audio Technology at the University of Salford in the late 1990's who has undertaken numerous assessments according to the 1997 revision of the British Standard and the most recent 2014 revision of the Standard.

APPENDICES

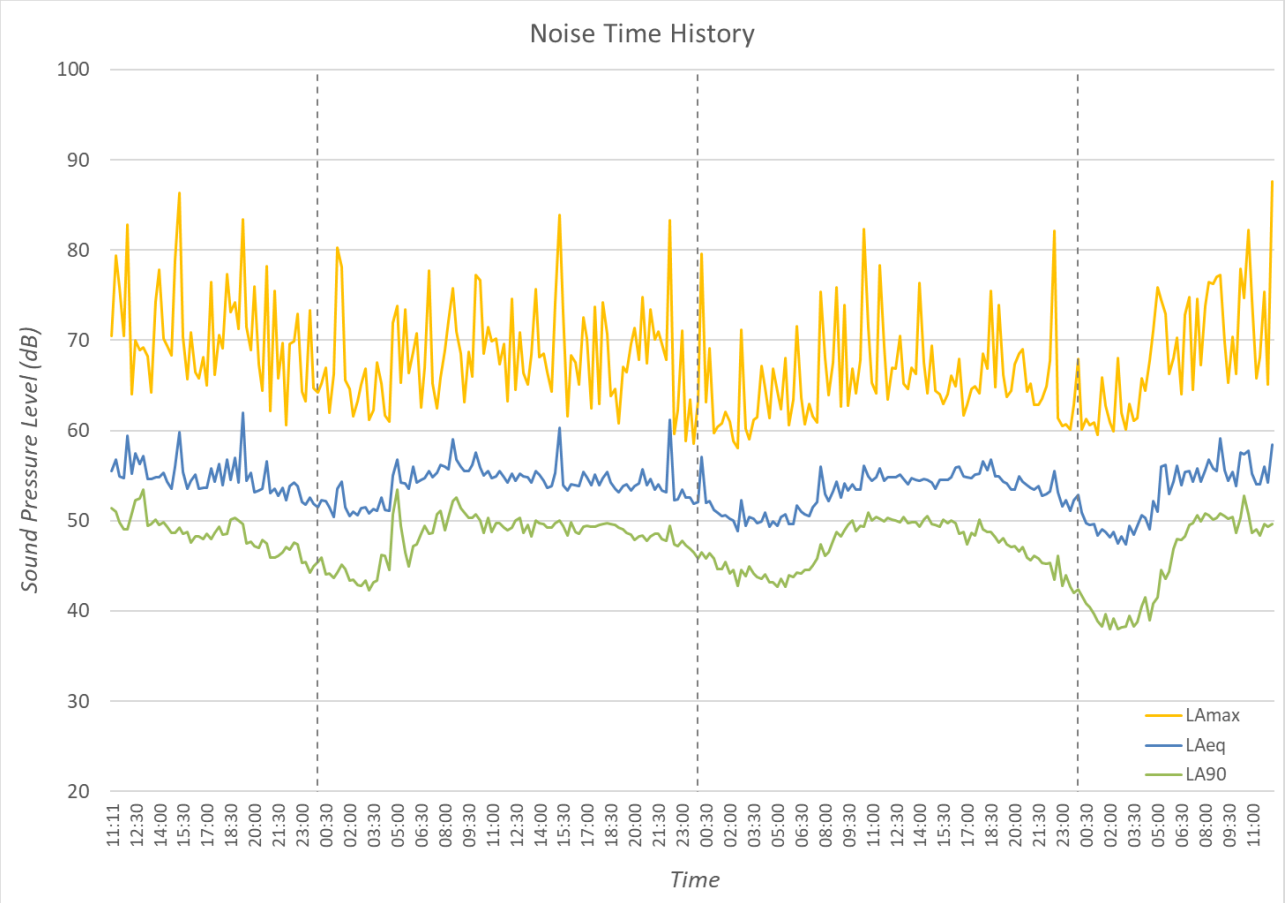
APPENDIX A: Site Overview



APPENDIX B: Survey Arrangement

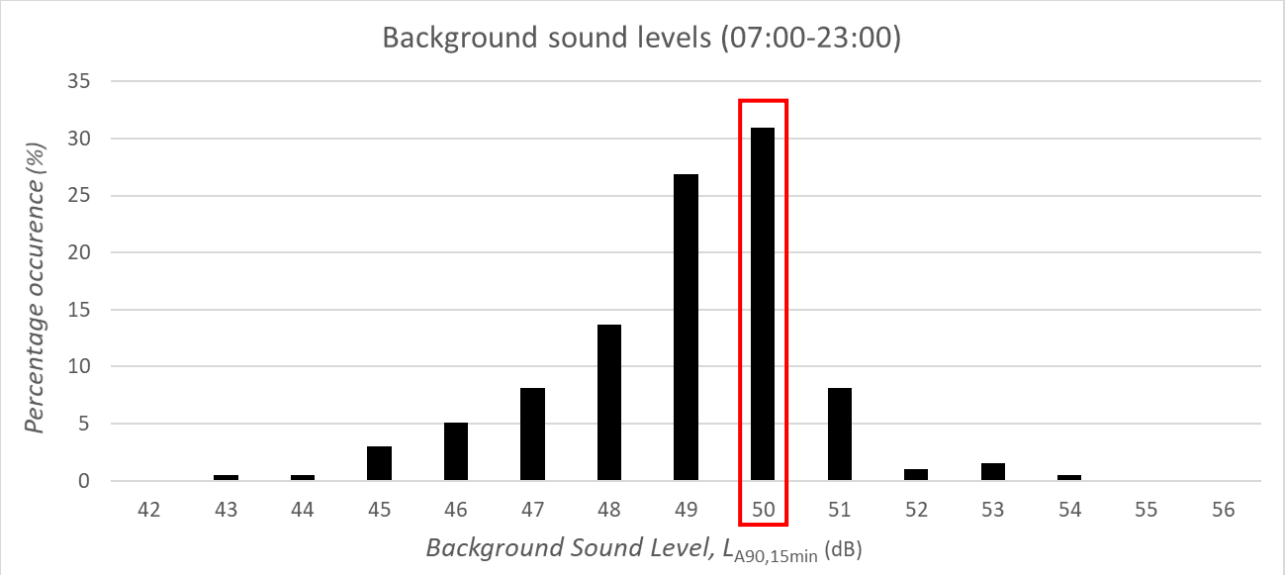
APPENDIX C: Measurement Position

APPENDIX D: Time Series Graph

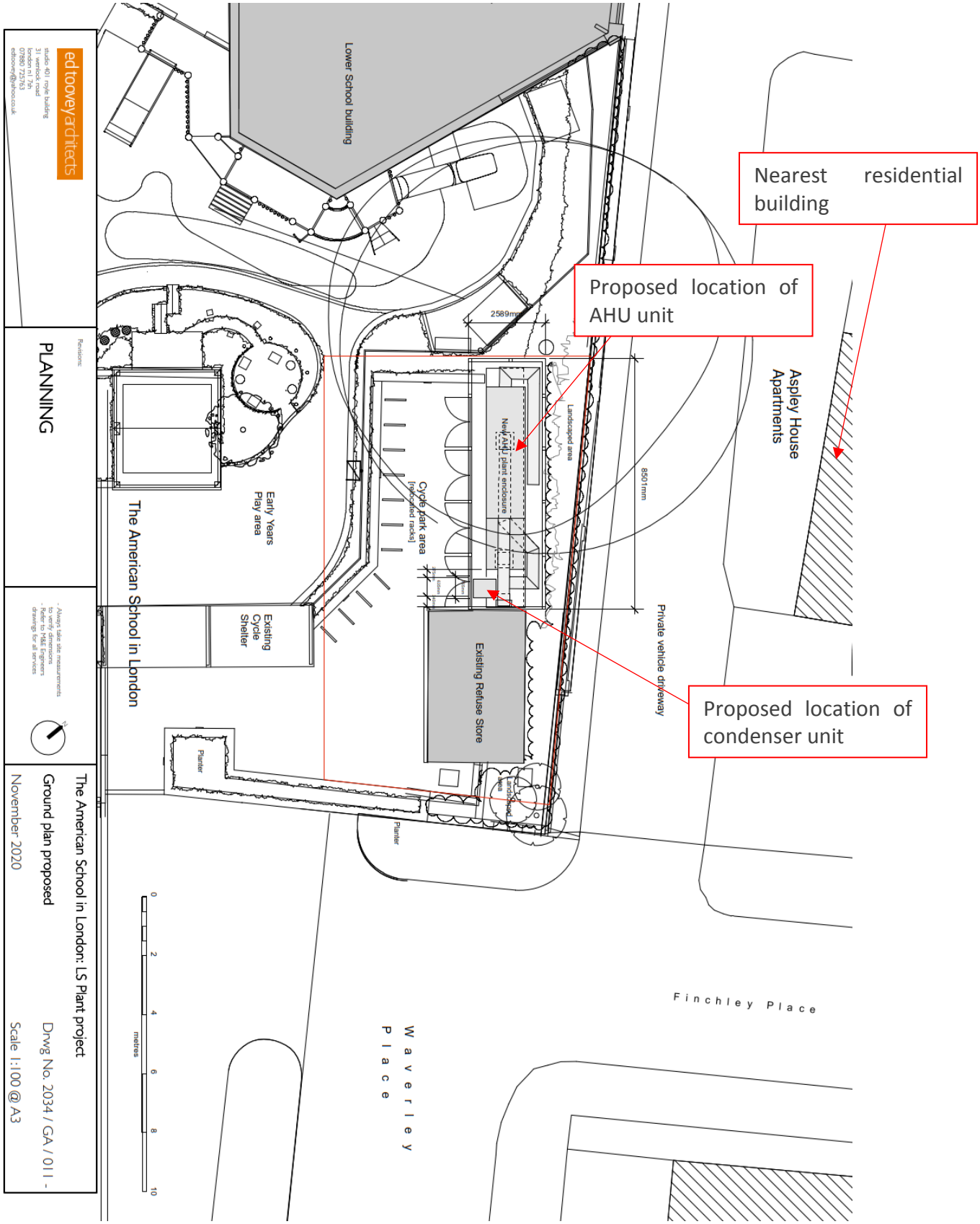


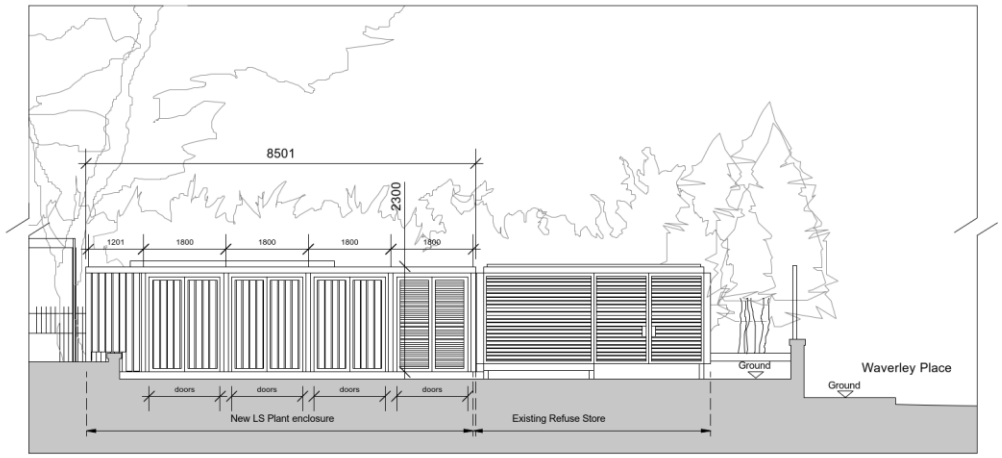
APPENDIX E: Histogram Plot

Representative Background Noise Level calculated according to BS4142:2019

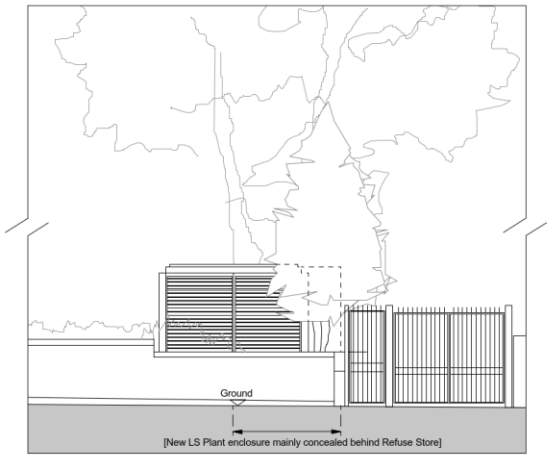


APPENDIX F: Proposed Mechanical Layout

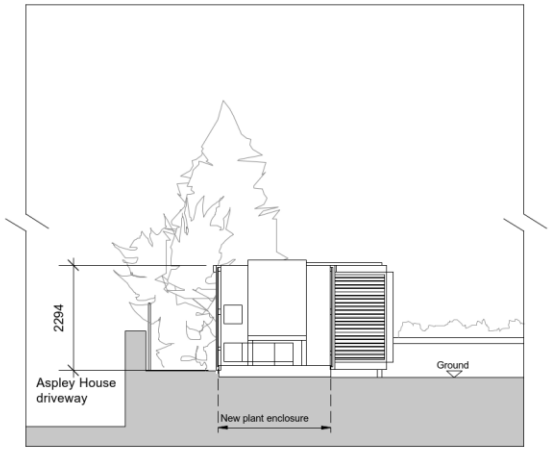




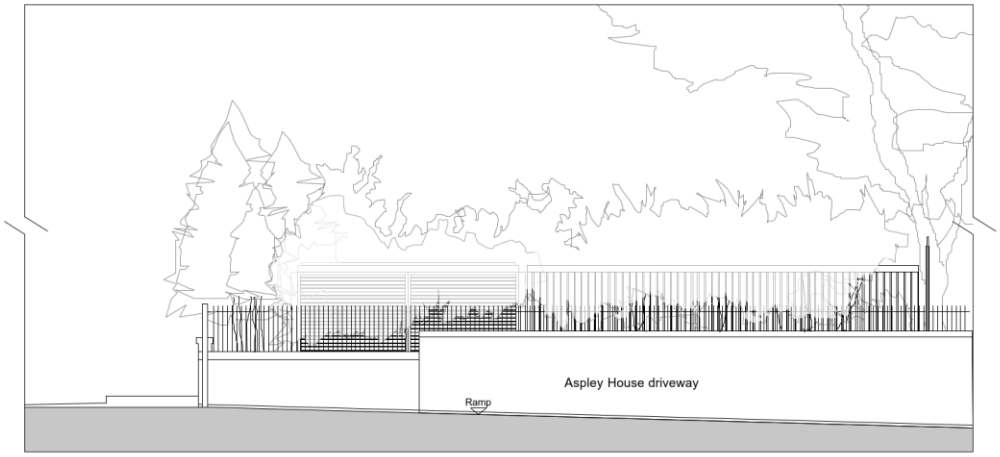
South elevation proposed



East elevation proposed



West section proposed



North elevation proposed

[New LS Plant enclosure mainly concealed behind wall, railing & landscaping

2 4 6 8 10
metres

ed toovey architects
dio 401 royle building
wenlock road
don n1 7sh
380 725763
:oovey@yahoo.co.uk

Revisions:

PLANNING ISSUE

- Always take site measurements to verify dimensions
- Refer to M&E Engineers drawings for all services

The American School in London : Mechanical Plant project

Elevations proposed

Drwg No. 2034 / GE / 011 -

November 2020

Scale 1:100 @ A3

APPENDIX G: Survey Results

Date	Time	L_{Aeq}	L_{Amax}	L_{A10}	L_{A90}
13/03/2020	11:11	55.5	70.5	57.8	51.4
13/03/2020	11:15	56.8	79.4	58.8	51.0
13/03/2020	11:30	54.9	75.9	57.0	49.8
13/03/2020	11:45	54.7	70.5	56.9	49.1
13/03/2020	12:00	59.4	82.8	58.9	49.1
13/03/2020	12:15	55.2	64.0	57.5	50.8
13/03/2020	12:30	57.5	70.0	60.2	52.3
13/03/2020	12:45	56.3	68.9	58.5	52.5
13/03/2020	13:00	57.2	69.2	59.3	53.5
13/03/2020	13:15	54.6	68.2	57.2	49.4
13/03/2020	13:30	54.6	64.2	57.2	49.6
13/03/2020	13:45	54.8	74.3	57.0	50.1
13/03/2020	14:00	54.8	77.8	57.0	49.5
13/03/2020	14:15	55.3	70.2	57.8	49.8
13/03/2020	14:30	54.3	69.4	56.3	49.3
13/03/2020	14:45	53.6	68.3	55.8	48.7
13/03/2020	15:00	56.0	78.8	56.9	48.7
13/03/2020	15:15	59.8	86.3	57.2	49.2
13/03/2020	15:30	55.4	70.4	58.0	48.6
13/03/2020	15:45	53.6	65.7	56.3	48.8
13/03/2020	16:00	54.4	70.9	56.5	47.6
13/03/2020	16:15	55.1	66.5	57.7	48.3
13/03/2020	16:30	53.6	65.8	56.3	48.3
13/03/2020	16:45	53.7	68.1	55.9	48.0
13/03/2020	17:00	53.7	65.0	56.1	48.6
13/03/2020	17:15	55.8	76.5	57.0	48.0
13/03/2020	17:30	54.3	66.2	56.7	48.7
13/03/2020	17:45	56.3	70.6	58.0	49.3
13/03/2020	18:00	53.9	69.1	56.2	48.5
13/03/2020	18:15	56.8	77.3	57.9	48.6
13/03/2020	18:30	54.5	73.1	56.5	50.1
13/03/2020	18:45	57.0	74.2	57.8	50.3
13/03/2020	19:00	54.2	71.3	56.4	50.0
13/03/2020	19:15	62.0	83.4	59.1	49.6
13/03/2020	19:30	54.4	71.5	57.0	47.5
13/03/2020	19:45	55.3	68.9	57.4	47.7
13/03/2020	20:00	53.2	76.0	55.4	47.2
13/03/2020	20:15	53.4	67.4	56.1	47.0
13/03/2020	20:30	53.6	64.4	56.4	47.9
13/03/2020	20:45	56.6	78.2	57.8	47.5
13/03/2020	21:00	53.1	62.2	56.0	45.9
13/03/2020	21:15	53.6	75.5	56.3	45.9
13/03/2020	21:30	52.8	65.8	55.6	46.1
13/03/2020	21:45	53.7	69.7	56.6	46.5

Date	Time	L_{Aeq}	L_{Amax}	L_{A10}	L_{A90}
13/03/2020	22:00	52.3	60.6	55.2	47.1
13/03/2020	22:15	53.8	69.6	55.9	46.8
13/03/2020	22:30	54.2	69.9	55.9	47.6
13/03/2020	22:45	53.8	72.9	55.9	47.4
13/03/2020	23:00	52.1	64.3	55.4	45.3
13/03/2020	23:15	51.8	63.2	54.8	45.4
13/03/2020	23:30	52.6	73.3	55.3	44.3
13/03/2020	23:45	51.9	64.7	54.9	44.9
14/03/2020	00:00	51.5	64.2	54.3	45.4
14/03/2020	00:15	52.3	65.2	55.2	45.9
14/03/2020	00:30	52.2	67.0	55.2	44.1
14/03/2020	00:45	51.5	62.0	54.4	44.2
14/03/2020	01:00	50.4	66.3	53.7	43.7
14/03/2020	01:15	53.6	80.3	54.8	44.3
14/03/2020	01:30	54.3	78.1	54.8	45.1
14/03/2020	01:45	51.5	65.6	54.8	44.6
14/03/2020	02:00	50.5	64.6	54.2	43.4
14/03/2020	02:15	51.0	61.6	54.6	43.5
14/03/2020	02:30	50.6	63.2	54.5	42.9
14/03/2020	02:45	51.4	65.1	55.0	42.8
14/03/2020	03:00	51.5	66.9	55.1	43.4
14/03/2020	03:15	50.8	61.2	54.3	42.3
14/03/2020	03:30	51.3	62.3	54.9	43.2
14/03/2020	03:45	51.1	67.6	54.5	43.4
14/03/2020	04:00	52.6	65.2	55.8	46.2
14/03/2020	04:15	51.2	61.7	54.0	46.1
14/03/2020	04:30	51.1	61.0	54.9	44.5
14/03/2020	04:45	55.0	72.0	58.0	50.7
14/03/2020	05:00	56.8	73.8	59.1	53.5
14/03/2020	05:15	54.2	65.3	57.0	49.4
14/03/2020	05:30	54.1	73.4	57.3	46.5
14/03/2020	05:45	53.6	66.4	57.1	44.9
14/03/2020	06:00	56.0	68.7	59.1	47.2
14/03/2020	06:15	54.2	70.8	57.3	47.4
14/03/2020	06:30	54.5	62.6	57.6	48.6
14/03/2020	06:45	54.7	67.0	57.7	49.4
14/03/2020	07:00	55.5	77.7	58.5	48.6
14/03/2020	07:15	54.8	65.2	57.8	48.7
14/03/2020	07:30	55.3	62.5	57.9	50.7
14/03/2020	07:45	56.2	65.9	58.8	51.1
14/03/2020	08:00	56.0	68.9	59.2	49.0
14/03/2020	08:15	55.7	72.2	58.3	50.4
14/03/2020	08:30	59.0	75.8	60.5	52.2
14/03/2020	08:45	56.8	71.0	59.2	52.6

Date	Time	L_{Aeq}	L_{Amax}	L_{A10}	L_{A90}
14/03/2020	09:00	56.0	68.5	58.5	51.4
14/03/2020	09:15	55.5	63.1	58.0	50.9
14/03/2020	09:30	55.5	68.7	57.9	50.3
14/03/2020	09:45	56.2	66.0	59.2	50.3
14/03/2020	10:00	57.6	77.2	59.7	50.7
14/03/2020	10:15	55.9	76.7	57.5	50.0
14/03/2020	10:30	55.0	68.5	57.9	48.7
14/03/2020	10:45	55.5	71.5	57.2	50.3
14/03/2020	11:00	54.7	69.9	57.5	48.8
14/03/2020	11:15	54.9	70.2	57.5	49.7
14/03/2020	11:30	55.5	67.4	58.0	49.7
14/03/2020	11:45	54.8	69.6	56.9	49.2
14/03/2020	12:00	54.2	63.2	57.0	49.0
14/03/2020	12:15	55.2	74.6	57.5	49.2
14/03/2020	12:30	54.4	64.5	56.8	50.0
14/03/2020	12:45	55.2	70.9	57.4	50.3
14/03/2020	13:00	54.9	66.4	57.7	48.7
14/03/2020	13:15	54.8	65.1	57.3	49.5
14/03/2020	13:30	54.2	68.4	56.9	48.3
14/03/2020	13:45	55.5	75.7	57.6	50.0
14/03/2020	14:00	55.1	68.1	57.8	49.7
14/03/2020	14:15	54.4	68.5	57.0	49.6
14/03/2020	14:30	53.7	66.5	56.0	49.2
14/03/2020	14:45	53.8	64.3	56.0	49.2
14/03/2020	15:00	55.3	74.1	56.5	49.7
14/03/2020	15:15	60.3	83.9	57.2	50.0
14/03/2020	15:30	53.9	73.1	56.3	49.4
14/03/2020	15:45	53.4	61.6	56.4	48.4
14/03/2020	16:00	54.0	68.3	56.2	49.8
14/03/2020	16:15	53.9	67.6	56.5	48.8
14/03/2020	16:30	53.8	65.1	56.6	48.6
14/03/2020	16:45	55.4	72.5	57.1	49.3
14/03/2020	17:00	54.8	70.2	57.4	49.4
14/03/2020	17:15	53.9	62.5	56.3	49.3
14/03/2020	17:30	55.1	73.7	56.4	49.3
14/03/2020	17:45	53.9	63.0	56.6	49.5
14/03/2020	18:00	54.7	74.2	56.6	49.6
14/03/2020	18:15	55.4	70.7	56.7	49.7
14/03/2020	18:30	54.2	63.8	56.6	49.6
14/03/2020	18:45	53.6	64.6	55.8	49.5
14/03/2020	19:00	53.2	60.8	55.9	49.2
14/03/2020	19:15	53.8	67.1	56.0	49.1
14/03/2020	19:30	54.0	66.5	56.1	48.7
14/03/2020	19:45	53.4	69.6	56.1	48.5
14/03/2020	20:00	53.8	71.4	56.1	47.9
14/03/2020	20:15	54.1	67.8	56.7	48.3

Date	Time	L_{Aeq}	L_{Amax}	L_{A10}	L_{A90}
14/03/2020	20:30	55.7	74.8	57.4	48.4
14/03/2020	20:45	53.9	67.5	56.5	47.8
14/03/2020	21:00	54.6	73.4	56.3	48.3
14/03/2020	21:15	53.5	70.1	55.8	48.6
14/03/2020	21:30	54.0	71.0	55.6	48.6
14/03/2020	21:45	53.4	69.6	56.1	48.0
14/03/2020	22:00	53.2	67.8	56.0	47.8
14/03/2020	22:15	61.2	83.3	57.6	49.4
14/03/2020	22:30	52.3	59.6	55.1	47.4
14/03/2020	22:45	52.4	62.3	54.9	47.2
14/03/2020	23:00	53.5	71.1	55.9	47.8
14/03/2020	23:15	52.6	58.8	55.5	47.3
14/03/2020	23:30	52.6	63.4	55.6	46.9
14/03/2020	23:45	51.9	58.5	54.9	46.5
15/03/2020	00:00	52.1	63.3	55.2	45.8
15/03/2020	00:15	57.1	79.6	55.3	46.5
15/03/2020	00:30	52.0	63.1	54.9	45.8
15/03/2020	00:45	52.2	69.1	54.9	46.4
15/03/2020	01:00	51.2	59.7	54.3	45.8
15/03/2020	01:15	50.9	60.4	54.3	44.6
15/03/2020	01:30	50.5	60.8	53.8	44.6
15/03/2020	01:45	50.6	62.1	53.6	45.4
15/03/2020	02:00	50.2	61.0	53.4	44.2
15/03/2020	02:15	50.0	58.8	53.0	44.5
15/03/2020	02:30	48.9	58.1	52.7	42.8
15/03/2020	02:45	52.3	71.2	54.6	44.5
15/03/2020	03:00	49.4	60.2	52.8	43.9
15/03/2020	03:15	50.4	59.0	53.8	44.9
15/03/2020	03:30	50.2	61.2	53.4	44.2
15/03/2020	03:45	49.7	61.5	52.7	43.8
15/03/2020	04:00	49.9	67.2	53.0	43.6
15/03/2020	04:15	50.9	64.7	54.1	44.1
15/03/2020	04:30	49.3	61.4	52.6	43.2
15/03/2020	04:45	49.9	66.9	53.3	43.2
15/03/2020	05:00	49.4	64.3	52.7	42.7
15/03/2020	05:15	50.4	62.4	53.7	43.6
15/03/2020	05:30	50.7	68.0	53.6	42.7
15/03/2020	05:45	49.6	60.6	52.6	44.0
15/03/2020	06:00	49.6	63.4	52.9	43.8
15/03/2020	06:15	51.7	71.6	54.0	44.3
15/03/2020	06:30	51.0	63.6	54.4	44.2
15/03/2020	06:45	50.7	60.7	54.2	44.5
15/03/2020	07:00	50.5	63.0	54.3	44.5
15/03/2020	07:15	51.5	61.6	55.1	45.0
15/03/2020	07:30	52.1	60.9	55.3	45.8
15/03/2020	07:45	56.0	75.4	57.8	47.4

Date	Time	L_{Aeq}	L_{Amax}	L_{A10}	L_{A90}
15/03/2020	08:00	53.0	68.0	55.6	46.1
15/03/2020	08:15	52.2	63.9	55.3	46.5
15/03/2020	08:30	53.3	67.6	55.9	47.8
15/03/2020	08:45	54.3	75.9	56.8	48.8
15/03/2020	09:00	52.6	62.7	55.5	48.3
15/03/2020	09:15	54.1	73.9	56.8	49.0
15/03/2020	09:30	53.4	62.8	55.9	49.5
15/03/2020	09:45	54.0	66.9	56.4	50.0
15/03/2020	10:00	53.5	64.1	56.3	48.9
15/03/2020	10:15	53.5	67.8	55.9	49.4
15/03/2020	10:30	56.1	82.3	56.7	49.3
15/03/2020	10:45	54.9	71.5	57.2	50.9
15/03/2020	11:00	54.4	65.3	56.9	50.0
15/03/2020	11:15	54.8	64.1	57.6	50.4
15/03/2020	11:30	55.8	78.3	57.5	50.2
15/03/2020	11:45	54.4	69.3	57.2	49.9
15/03/2020	12:00	54.8	63.4	57.4	50.3
15/03/2020	12:15	54.8	67.0	57.3	50.1
15/03/2020	12:30	54.8	66.9	57.2	50.0
15/03/2020	12:45	55.1	70.5	57.5	49.8
15/03/2020	13:00	54.6	65.2	57.1	50.4
15/03/2020	13:15	54.0	64.6	56.5	49.7
15/03/2020	13:30	54.7	67.0	57.2	49.8
15/03/2020	13:45	54.5	66.3	56.8	49.8
15/03/2020	14:00	54.4	76.4	56.7	49.3
15/03/2020	14:15	54.6	67.6	57.1	50.1
15/03/2020	14:30	54.5	64.1	57.0	50.5
15/03/2020	14:45	54.2	69.4	56.3	49.6
15/03/2020	15:00	53.6	64.4	55.9	49.5
15/03/2020	15:15	54.5	64.0	57.2	49.3
15/03/2020	15:30	54.5	63.0	57.1	50.1
15/03/2020	15:45	54.5	64.0	57.0	49.7
15/03/2020	16:00	54.8	66.1	57.4	50.0
15/03/2020	16:15	55.9	64.9	58.7	49.7
15/03/2020	16:30	56.0	67.9	59.0	48.6
15/03/2020	16:45	54.9	61.7	57.7	48.8
15/03/2020	17:00	54.8	62.9	58.0	47.4
15/03/2020	17:15	54.7	64.6	57.4	48.7
15/03/2020	17:30	55.1	64.9	58.1	48.4
15/03/2020	17:45	55.2	64.1	58.1	50.1
15/03/2020	18:00	56.6	68.5	58.9	49.1
15/03/2020	18:15	55.6	66.9	58.7	48.8
15/03/2020	18:30	56.8	75.5	58.8	48.8
15/03/2020	18:45	54.9	64.8	57.7	48.2
15/03/2020	19:00	54.9	73.9	57.0	47.6
15/03/2020	19:15	54.3	66.2	57.1	48.1

Date	Time	L_{Aeq}	L_{Amax}	L_{A10}	L_{A90}
15/03/2020	19:30	54.1	63.7	56.9	47.4
15/03/2020	19:45	53.5	64.4	56.3	47.1
15/03/2020	20:00	53.5	67.4	56.5	47.2
15/03/2020	20:15	54.9	68.5	57.7	46.6
15/03/2020	20:30	54.3	69.0	56.9	47.1
15/03/2020	20:45	53.9	64.3	57.1	45.9
15/03/2020	21:00	53.7	65.2	56.9	45.6
15/03/2020	21:15	53.5	62.9	57.0	46.1
15/03/2020	21:30	53.8	62.9	57.4	45.8
15/03/2020	21:45	52.8	63.5	56.3	45.3
15/03/2020	22:00	53.0	64.9	56.3	45.2
15/03/2020	22:15	53.3	67.7	56.3	45.3
15/03/2020	22:30	55.5	82.1	55.6	43.5
15/03/2020	22:45	53.2	61.4	56.5	46.1
15/03/2020	23:00	51.6	60.5	55.4	42.8
15/03/2020	23:15	52.3	60.7	56.1	44.0
15/03/2020	23:30	51.1	60.1	55.0	42.7
15/03/2020	23:45	52.3	62.9	56.1	42.0
16/03/2020	00:00	52.9	67.9	56.2	42.4
16/03/2020	00:15	50.9	60.1	54.7	41.7
16/03/2020	00:30	49.7	61.3	53.9	40.8
16/03/2020	00:45	49.5	60.6	53.4	40.4
16/03/2020	01:00	49.6	60.9	53.9	39.7
16/03/2020	01:15	48.4	59.5	52.6	38.9
16/03/2020	01:30	49.1	65.9	53.2	38.3
16/03/2020	01:45	48.8	62.8	52.9	39.7
16/03/2020	02:00	48.2	60.9	52.3	38.0
16/03/2020	02:15	48.8	59.9	53.3	39.2
16/03/2020	02:30	47.5	68.0	51.6	38.0
16/03/2020	02:45	48.3	62.0	52.9	38.2
16/03/2020	03:00	47.4	60.1	51.8	38.3
16/03/2020	03:15	49.4	63.0	53.5	39.5
16/03/2020	03:30	48.5	61.1	52.8	38.3
16/03/2020	03:45	49.4	61.4	53.8	38.8
16/03/2020	04:00	50.6	65.8	54.5	40.5
16/03/2020	04:15	50.3	64.4	54.4	41.5
16/03/2020	04:30	49.1	67.7	53.2	39.0
16/03/2020	04:45	52.2	71.1	55.9	40.8
16/03/2020	05:00	51.0	75.9	53.9	41.5
16/03/2020	05:15	56.0	74.5	58.3	44.5
16/03/2020	05:30	56.2	72.9	59.7	43.6
16/03/2020	05:45	53.0	66.3	56.5	44.4
16/03/2020	06:00	54.3	68.0	57.6	46.9
16/03/2020	06:15	56.1	70.3	58.7	48.0
16/03/2020	06:30	53.9	64.0	57.3	47.9
16/03/2020	06:45	55.4	72.8	57.6	48.3

Date	Time	L_{Aeq}	L_{Amax}	L_{A10}	L_{A90}
16/03/2020	07:00	55.5	74.8	58.2	49.5
16/03/2020	07:15	54.3	64.5	57.1	49.7
16/03/2020	07:30	55.8	74.6	57.8	50.6
16/03/2020	07:45	54.3	67.3	57.0	49.9
16/03/2020	08:00	55.6	73.8	58.2	50.8
16/03/2020	08:15	56.8	76.5	58.8	50.6
16/03/2020	08:30	55.8	76.3	58.0	50.1
16/03/2020	08:45	55.5	77.0	57.6	50.3
16/03/2020	09:00	59.1	77.2	62.7	50.8
16/03/2020	09:15	55.6	69.8	58.2	50.5
16/03/2020	09:30	54.4	65.3	57.2	50.2

Date	Time	L_{Aeq}	L_{Amax}	L_{A10}	L_{A90}
16/03/2020	09:45	55.4	70.4	57.6	50.4
16/03/2020	10:00	53.8	66.3	56.7	48.7
16/03/2020	10:15	57.6	77.9	59.5	50.3
16/03/2020	10:30	57.4	74.7	59.7	52.8
16/03/2020	10:45	57.8	82.2	58.7	50.7
16/03/2020	11:00	55.2	74.5	57.3	48.7
16/03/2020	11:15	54.0	65.8	56.7	49.1
16/03/2020	11:30	54.0	68.1	56.7	48.4
16/03/2020	11:45	56.0	75.4	57.3	49.6
16/03/2020	12:00	54.2	65.1	56.7	49.3
16/03/2020	12:15	58.4	87.6	59.0	49.6

APPENDIX H: Equipment

- NTi XL2 Real Time Analyser
- Bruel & Kjaer 4231 Calibrator
- NTi outdoor kit

Calibration certificates are available on request.

APPENDIX I: Acoustic Feature Correction

A rating penalty has been established based on a subjective assessment of characteristics. Penalties have been applied based on GSAD's previous experience of air handling units.

A total rating penalty of 2 dB has been applied.

2 dB penalty for tonality: typical mechanical units can have tonal components that are perceptible. Tonal components may or may not be audible at the nearest receptors located at a distance of about 10.5m, however, a small correction has been applied to adopt a cautious approach.

APPENDIX J: Manufacturer Noise Data

Air Handling Unit Breakout

Daikin Applied (UK) Ltd. Panel Breakout Calculation Sheet.

Project:	ASL Comp Room
AHU Reference:	AHU01-Rev06

Fan Cabinet Dimension	
Length (m):	1
Width (m):	1.14
Height (m):	0.74

Manual Panel SRI Data (if used)							
63	125	250	500	1k	2k	4k	8k
0	0	0	0	0	0	0	0

Supply

Item		Octave Band Centre Frequency (Hz)								Linear	A	NR
		63	125	250	500	1k	2k	4k	8k			
Fan Lw (dB re: 1 x 10 - 12 W)		78	89	88	84	85	83	83	75	94	90	87
Distance from AHU (m)	1											
Panel Type	SD42 F 1.01.0											
Sound Pressure Level (dB re: 2 x 10-5 Pa)		49.0	57.4	53.2	45.8	49.7	38.3	29.5	23.9	60	52	50

Extract

Item		Octave Band Centre Frequency (Hz)								Linear	A	NR
		63	125	250	500	1k	2k	4k	8k			
Fan Lw (dB re: 1 x 10 - 12 W)		77	86	82	81	83	80	76	73	90	87	83
Distance from AHU (m)	1											
Panel Type	SD42 F 1.01.0											
Sound Pressure Level (dB re: 2 x 10-5 Pa)		48.0	54.4	47.2	42.8	47.7	35.3	22.5	21.9	57	49	48

Condensing Unit

Ventilation			ERQ-AV1/ERQ-AW1	100AV1	125AV1	140AV1	125AW1
Capacity range			HP	4	5	6	5
Cooling capacity	Nom.		kW	11.2	14.0	15.5	14.0
Heating capacity	Nom.		kW	12.5	16.0	18.0	16.0
Power input	Cooling	Nom.	kW	2.81	3.51	4.53	3.52
	Heating	Nom.	kW	2.74	3.86	4.57	4.00
EER				3.99		3.42	3.98
COP				4.56	4.15	3.94	4.00
Dimensions	Unit	HeightxWidthxDepth	mm	1,345x900x320			1,680x635x765
Weight	Unit		kg	120			159
Casing	Material			Painted galvanized steel plate			
Fan-Air flow rate	Cooling	Nom.	m^3/min	106			95
	Heating	Nom.	m^3/min	102	105		95
Sound power level	Cooling	Nom.	dBA	66	67	69	
	Nom.		dBA	-			72
Sound pressure level	Cooling	Nom.	dBA	50	51	53	
	Nom.		dBA	-			54
	Heating	Nom.	dBA	52	53	55	
Operation range	Cooling	Min./Max.	°CDB	-5/46			
	Heating	Min./Max.	°CWB	-20/15.5			
	On coil temperature	Heating Min.	°CDB	10			
		Cooling Max.	°CDB	35			
Refrigerant	Type/GWP			R-410A/ 2,087.5			
	Charge		kg/ tCO_2eq	4.0/ 8.4			6.2/ 12.9
	Control			Expansion valve (electronic type)			Electr
Piping connections	Liquid	OD	mm	9.52			
	Gas	OD	mm	15.9		19.1	15.9
	Drain	OD	mm	26x3			
Power supply	Phase/Frequency/Voltage		Hz/V	1N~/50/220-240			
Current	Maximum fuse amps (MFA)		A	32.0			16

Contains fluorinated greenhouse gases

APPENDIX K: Glossary of Acoustic Terms

DECIBEL (dB) - A unit of sound pressure measurement
Sound Pressure Level in dB (*L*p) = 20 log (Measured sound pressure/Reference sound pressure = 20 µPa)

dB(A) - The A -weighted sound pressure level, the weighting network reduces low frequency sound in a similar way to the human ear.

REVERBERATION TIME (RT or *T*) – decay of sound in rooms
The time taken for a sound, once terminated, to fall through 60dB i.e. to one millionth of its original sound intensity. *T*30 – RT for first 30dB of decay. RT_{500} - Mid frequency RT.
HERTZ (Hz) - a unit of frequency measurement. The normal range of hearing is from 20Hz to about 15kHz.

ABSORPTION COEFFICIENT – degree to which a material absorbs sound.
The ratio of absorbed to incident sound energy (perfect absorber = 1)

SOUND REDUCTION INDEX *R* – quantity which describes a material's ability to reduce the sound pressure level across it (e.g. a wall or floor)

$R = L1 - L2 + 10\log (S/A)$

*L*1 - Average sound pressure level in source room (averaged from 100 Hz – 3150 Hz)
*L*2 - Average sound pressure level in receiving room (averaged from 100 Hz – 3150 Hz)
S – Wall Area (m^2)
A – Total absorption in receiving room (m^2 units)

*R*w – weighted sound reduction index

AVERAGE ROOM TO ROOM LEVEL DIFFERENCE – *D*, dB = *L*1 – *L*2, averaged 1/3 octave bands from 100Hz – 3150kHz.

*D*w – weighted value of D (usually 2 - 3dB higher)

*D*nT, w – *D*w corrected for reverberation time of receiving room

NOISE RATING CURVES (NR CURVES) – set of curves used to describe optimum background noise levels for different tasks.

*L*10/90 LEVEL (dB) - The level in dB of a time varying sound pressured level (e.g. traffic) exceeded for 10%/90% of the time of measurement.
*L*90 is usually called the BACKGROUND NOISE LEVEL.

*L*eq AVERAGE SOUND PRESSURE LEVEL – level dB of a time varying sound pressure level with equal amounts of energy above and below it, for the time of measurement.

TONAL NOISE – noise of a single frequency (or a narrow band of frequencies that can be perceived as a tone), audible above the broad band noise background. Noise which is at least 5dB above the average of the 1/3 octave band sound pressure levels immediately on either side of it.