210 Euston Road
London

Environmental Noise Survey and Plant Noise Assessment Report

25451/PNA1

28 June 2018

For:

Wellcome Trust
215 Euston Road
London

Hann Tucker Associates
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Hann Tucker Associates

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Document Control

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Hann Tucker Associates

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Attachments

1.0 Introduction

This report has been commissioned in support of the full planning application made on behalf of The Wellcome Trust (the Applicant) for the refurbishment and single storey extension of the existing office building at 210 Euston Road.

Hann Tucker Associates have therefore been commissioned to undertake a detailed environmental noise survey to determine the currently prevailing noise climate at two locations around the site, the results of which will be used in future design assessments.

2.0 Objectives

To establish by means of a detailed survey (fully covering both daytime and night-time periods) the existing environmental noise levels around the development site. The survey data will form the basis of any subsequent analysis to establish the sound reduction performance specification for the external building fabric elements.

The survey data will also be used, with reference to Local Authority requirements, to recommend noise emission limits for building services plant operation.

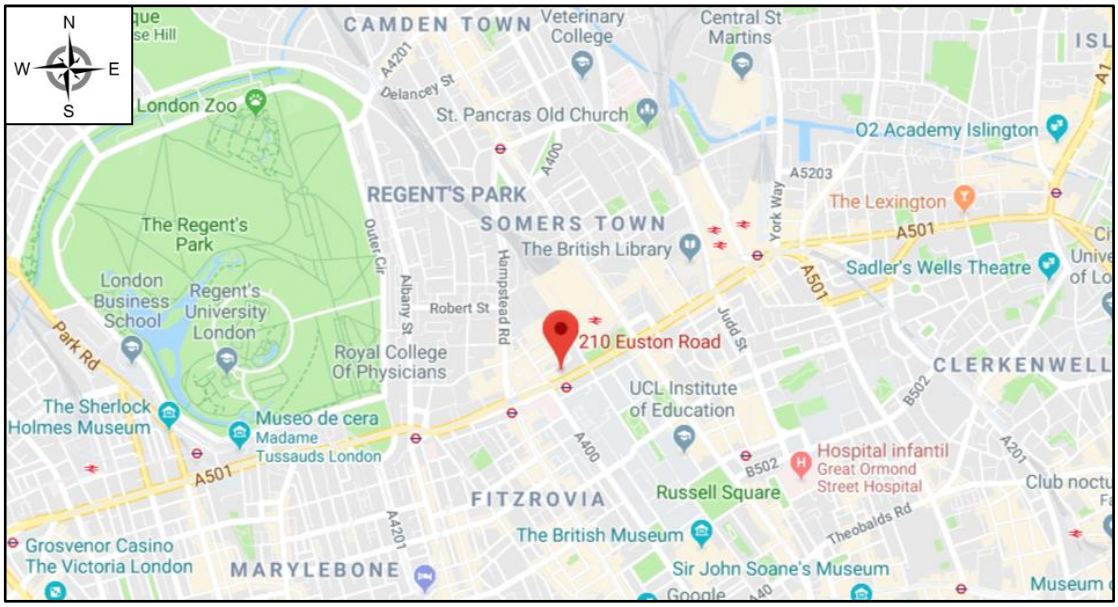
To assess the noise emissions from the proposed plant, based upon data with which we are provided, and comment upon the acceptability.

To advise on noise control measures if required with reference to the requirements of the Local Authority.

3.0 Site Description

3.1 Location

The site is located at 210 Euston Road, London, and falls within the London Borough of Camden's jurisdiction. See following Location Map.



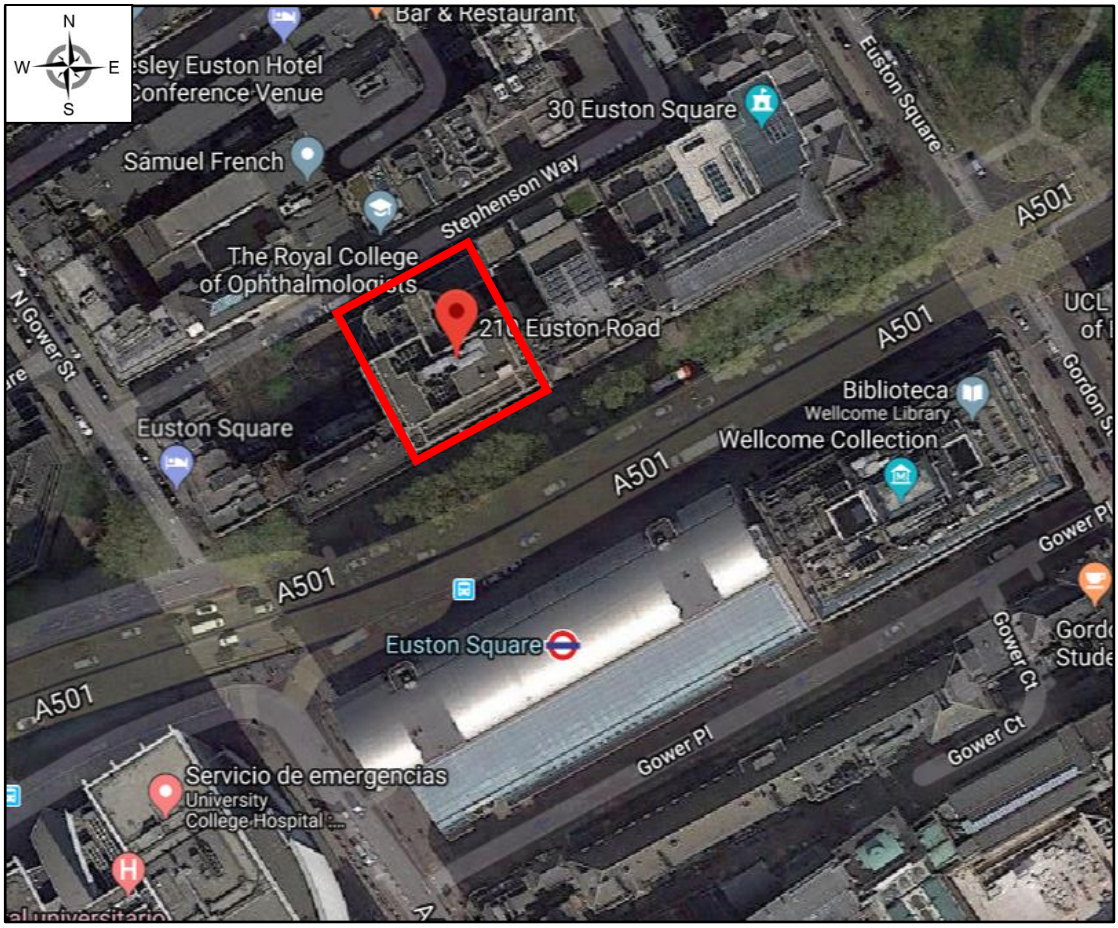
Location Map (maps.google.co.uk)

3.2 Description

The existing office building comprises two basement levels plus ground floor, six upper storeys and a plantroom located at roof level.

The site is bounded by Euston Road to the south and Euston Square Tube Station is located opposite the road (with an entrance on the north side of Euston Road). Stephenson Way is to the north and the buildings opposite road are of similar height and nature to 210 Euston Road. To the east is IQ Bloomsbury (200 Euston Road), which is a student accommodation building comprising ground floor plus five upper stories. The building to the west (222 Euston Road) is UCL Farr Institute, which comprises ground floor plus four upper stories office space.

See Site Plan below.



Site Plan (maps.google.co.uk)

4.0 Acoustic Terminology

For an explanation of the acoustic terminology used in this report please refer to Appendix A enclosed.

5.0 Project Proposals

5.1 Proposed Plant

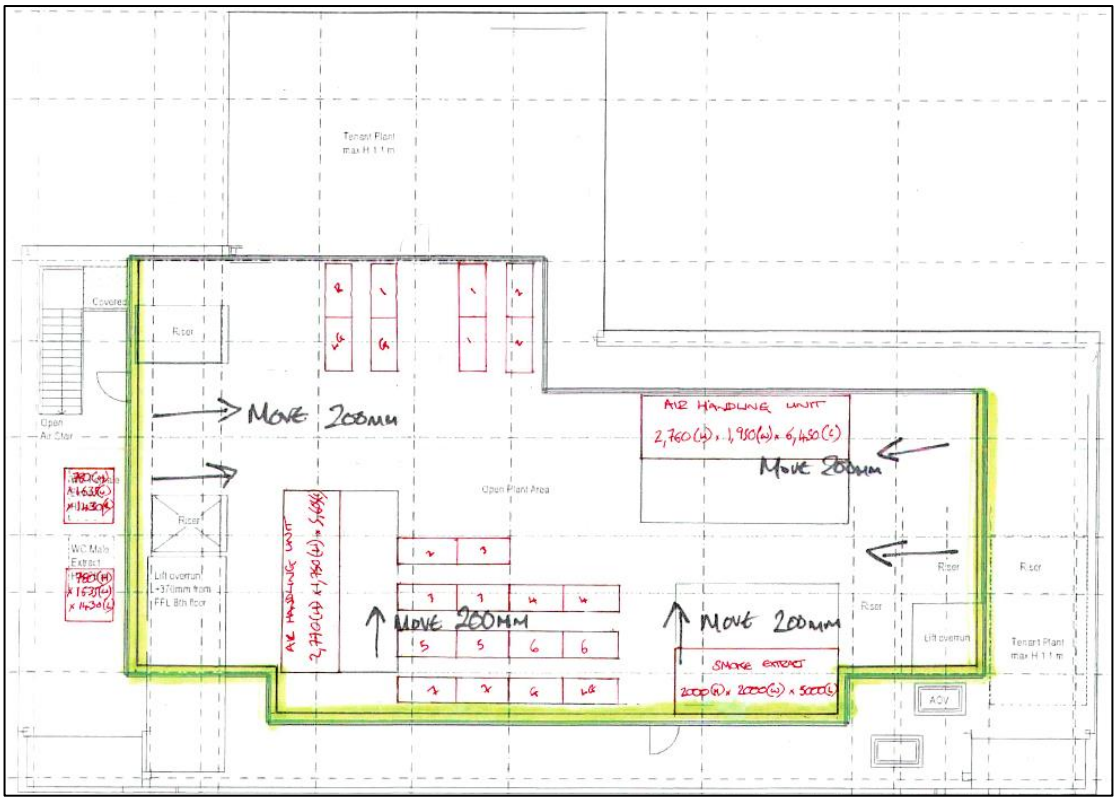
We understand it is proposed to install on the rooftop 22No. condenser units, 2No. air handling units (AHUs 1&2), 1No. smoke extract fan and 2No. WC extract fans.

5.2 Operating Hours

We understand that these fans could operate during daytime and night-time hours.

5.3 Location of Plant

It is proposed to install the above building services plant on the top of the roof, as illustrated in the following sketch courtesy of WPP Group:



Rooftop plant layout courtesy of WPP Group

6.0 Acoustic Standards and Guidelines

6.1 Noise Policy Statement for England

The Noise Policy Statement for England (NPSE) was published in March 2010. The NPSE is the overarching statement of noise policy for England and applies to all forms of noise other than occupational noise, setting out the long term vision of Government noise policy which is to:

"Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development."

That vision is supported by the following aims which are reflected in three of the four aims for planning policies and decisions in paragraph 123 of the NPPF (see paragraph 8.2 (b) below):

"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life."*

The Explanatory Note to the NPSE has three concepts for the assessment of noise in this country:

NOEL – No Observed Effect Level
This is the level below which no effect can be detected and below which there is no detectable effect on health and quality of life due to noise.

LOAEL – Lowest Observable Adverse Effect Level
This is the level above which adverse effects on health and quality of life can be detected.

SOAEL – Significant Observed Adverse Effect Level
This is the level above which significant adverse effects on health and quality of life occur.

None of these three levels are defined numerically and for the SOAEL the NPSE makes it clear that the noise level is likely to vary depending upon the noise source, the receptor and the time of day/day of the week, etc. The need for more research to investigate what may represent an SOAEL for noise is acknowledge in the NPSE and the NPSE asserts that not stating specific SOAEL levels provides policy flexibility in the period until there is further evidence and guidance.

The NPSE concludes by explaining in a little more detail how the LOAEL and SOAEL relate to the three aims listed in paragraph (b) above. It starts with the aim of avoiding significant adverse effects on health and quality of life, then addresses the situation where the noise impact falls between the LOAEL and the SOAEL when *"all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development."* The final aim envisages pro-active management of noise to improve health and quality of life, again taking into account the guiding principles of sustainable development which include the need to minimise travel distance between housing and employment uses in an area.

6.2 National Planning Policy Framework (NPPF)

The National Planning Policy Framework (NPPF) was published in March 2012 and replaced the previous national planning guidance document Planning Policy Guidance 24: *Planning and Noise* (PPG24).

The main reference to noise within the NPPF is at paragraph 123, reproduced below:

> *"123. Planning policies and decisions should aim to:*
>
> - *Avoid noise from giving rise to significant adverse impacts[27] on health and quality of life as a result of new development;*
> - *Mitigate and reduce to a minimum other adverse impacts[27] on health and quality of life arising from noise from new development, including through the use of conditions;*
> - *Recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established;[28] and*
> - *Identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason."*

The reference numbers 27 and 28 point respectively to the Explanatory Note to the NPSE and the provisions of the Environmental Protection Act 1990 *"and other relevant law".*

The spirit of the Localism Act and the NPPF would suggest that of the guidelines cited, it is guidelines adopted as policy by the Local Planning Authority (if such exist) that should prevail, at least until the Government publishes relevant technical guidance under the NPPF.

6.3 Planning Practice Guidance on Noise

Planning Practice Guidance (PPG) under the NPPF has been published by the Government as a web based resource at http://planningguidance.planningportal.gov.uk/blog/guidance/. This includes specific guidance on Noise although, like the NPPF and NPSE the PPG does not provide any quantitative advice. It seeks to illustrate a range of effect levels in terms of examples of outcomes as set out in the following table:

Perception	Examples of Outcomes	Increasing effect level	Action
Not noticeable	No effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
		Lowest Observed Adverse Effect Level	
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance.	Observed Adverse Effect	Mitigate and reduce to a minimum
		Significant Observed Adverse Effect Level	
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable hard, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

6.4 Local Authority Requirements

The site lies within London Borough of Camden's jurisdiction. Their advice regarding criteria for atmospheric noise emissions from building service plant is contained within their Local Plan, version June 2017 as follows:

Industrial and Commercial Noise Sources

A relevant standard or guidance document should be referenced when determining values for LOAEL and SOAEL for non-anonymous noise. Where appropriate and within the scope of the document it is expected that British Standard 4142:2014 'Methods for rating and assessing industrial and commercial sound' (BS 4142) will be used. For such cases a 'Rating Level' of 10 dB below background (15dB if tonal components are present) should be considered as the design criterion).

Table C: Noise levels applicable to proposed industrial and commercial developments (including plant and machinery)

Existing Noise sensitive receptor	Assessment Location	Design Period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAL (Red)
Dwellings**	Garden used for main amenity (free field) and Outside living or dining or bedroom window (façade)	Day	'Rating level' 10dB* below background	'Rating level' between 9dB below and 5dB above background	'Rating level' greater than 5dB above background
Dwellings**	Outside bedroom window (façade)	Night	'Rating level' 10dB* below background and no events exceeding 57dBL_{Amax}	'Rating level' between 9dB below and 5dB above background or noise events between 57dB and 88dB L_{Amax}	'Rating level' greater than 5dB above background and/or events exceeding 88dBL_{Amax}

*10dB should be increased to 15dB if the noise contains audible tonal elements. (day and night). However, if it can be demonstrated that there is no significant difference in the character of the residual background noise and the specific noise from the proposed development then this reduction may not be required. In addition, a frequency analysis (to include, the use of Noise Rating (NR) curves or other criteria curves) for the assessment of tonal or low frequency noise may be required.

**levels given are for dwellings, however, levels are use specific and different levels will apply dependent on the use of the premises.

The periods in Table C correspond to 0700 hours to 2300 hours for the day and 2300 hours to 0700 hours for the night. The Council will take into account the likely times of occupation for types of development and will be amended according to the times of operation of the establishment under consideration.

There are certain smaller pieces of equipment on commercial premises, such as extract ventilation, air conditioning units and condensers, where achievement of the rating levels (ordinarily determined by a BS:4142 assessment) may not afford the necessary protection. In these cases, the Council will generally also require a NR curve specification of NR35 or below, dependant on the room (based upon measured or predicted Leq,5mins noise levels in octave bands) 1 metre from the façade of affected premises, where the noise sensitive premise is located in a quiet background area.

On 26 June 2016 London Borough of Camden sent us an email confirming the following windows should be considered noise sensitive, *"housing, schools, hospitals, offices, workshops"*.

6.5 BS 4142:2014

When setting plant noise emission criteria reference is commonly made to BS 4142: 2014 "*Methods for rating and assessing industrial and commercial sound".*

BS 4142 states that: *"The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs". An estimation of the impact of the specific noise can be obtained by the difference of the rating noise level and the background noise level and considering the following:*

• *"Typically, the greater this difference, the greater the magnitude of the impact."*

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

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

• *"The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context."*

The determination of the "rating level" and the "background level" are both open to interpretation, depending on the context.

In summary it is not possible to set plant noise emission criteria purely on the basis of BS 4142:2014. It is reasonable to infer from the above, however, that a difference of around -5dB corresponds to "No Observed Effect Level" as defined in the Noise Policy Statement for England.

6.6 World Health Organisation Guidelines on Community Noise

BS8233:2014 is based upon the current World Health Organisation (WHO) guidance "*Guidelines on Community Noise".* A summary of the noise guidelines relevant to the proposed scheme is presented in the table below.

Residential Environment	Critical Health Effect(s)	L_{Aeq}	L_{AFmax}	Time Base
Outdoor living area	Serious annoyance, daytime and evening	55	-	07:00-23:00
	Moderate annoyance, daytime and evening	50	-	07:00-23:00
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	-	07:00-23:00
Inside bedrooms	Sleep disturbance, night-time	30	45	23:00-07:00
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	60	23:00-07:00

These WHO guidelines are based, in almost all cases, on the lower threshold below which the occurrence rates of any particular effect can be assumed to be negligible.

6.7 British Standard BS8233: 2014

British Standard 8233: 2014 “Guidance on sound insulation and noise reduction for buildings” provides guidance for the control of noise in and around buildings.

BS8233:2014 Section 7.7.2 titled “Internal ambient noise levels for dwellings” states:

“In general for steady external noise sources, it is desirable that internal ambient noise levels do not exceed the following guideline values:

Activity	*Location*	*Desirable Internal Ambient Criteria*	
		07:00 – 23:00	*23:00 to 07:00*
Resting	*Living Rooms*	*35 dB $L_{Aeq,16hour}$*	-
Dining	*Dining Room/Area*	*40 dB $L_{Aeq,16hour}$*	-
Sleeping (Daytime Resting)	*Bedroom*	*35 dB $L_{Aeq,16hour}$*	*30 dB $L_{Aeq,8hour}$*

6.8 Statutory Noise Nuisance

There is no quantitative definition of statutory noise nuisance. It is generally accepted however, that if the plant noise level is at least 5dB (or 10dB if tonal) below the minimum background $L_{90(15minutes)}$ at 1m from the nearest noise sensitive window, then the risk of a statutory noise nuisance is avoided. By adopting this as a design criterion the guidance contained in BS 4142:2014 should also be complied with.

7.0 Plant Noise Emission Criteria

On the basis of the aforementioned acoustic standards and guidance, together with the results of the environmental noise survey, we propose that the following plant noise emission criteria be achieved at in the nearest garden 'used for main amenity' or at 1 metre from the nearest living room, dining room, or bedroom in the daytime, and at 1 metre from the nearest bedroom window at night-time with all plant operating simultaneously.

Position	Plant Noise Emission Criteria (dB re $2x10^{-5}$ Pa)	
	Daytime (07:00 – 23:00 hours)	Night-time (23:00 – 07:00 hours)
1	55dBA	50dBA
2	43dBA / NR35*	41dBA / NR35*
3	41dBA / NR35*	40dBA / NR35*

*NR35 criterion applies to 'smaller pieces of equipment on commercial premises, such as extract ventilation, air conditioning units, and condensers….where noise sensitive premises are located in a quiet background area' as per Camden's Local Plan.

If plant contains tonal or impulsive characteristics the external design criteria should be reduced by 5dBA.

The above criteria are based on a level of 10dB below background in order to fall into Camden's 'Green' criteria for **dwellings**. Whilst we understand that Camden considers other uses noise sensitive, the Local plan states that the criteria is use dependent but does not define criteria that correspond to 'Green', 'Amber', or 'Red' for these other uses. We request that Camden clarify their policy in this respect. The criteria could be relaxed by 5dB in line with the 'Amber' criteria in Camden's Local Plan, which may be acceptable to Camden depending on 'the context of other merits of the development'.

It should be noted that the above are subject to the final approval of the Local Authority.

8.0 Methodology

The survey was undertaken by Rodrigo Espinosa-Garcia MSc, BEng(Hons) AMIOA.

8.1 Procedure

Fully automated environmental noise monitoring was undertaken from approximately 13:00 hours on Thursday 19 April 2018 to approximately 13:00 hours on Tuesday 24 April 2018.

Owing to the nature of the survey, i.e. unmanned, it is not possible to accurately comment on the weather conditions throughout the entire survey period. However at the beginning and end of the survey period the wind conditions were moderate. The sky was generally patchy cloud. We understand that generally throughout the survey period the weather conditions were similar to this.

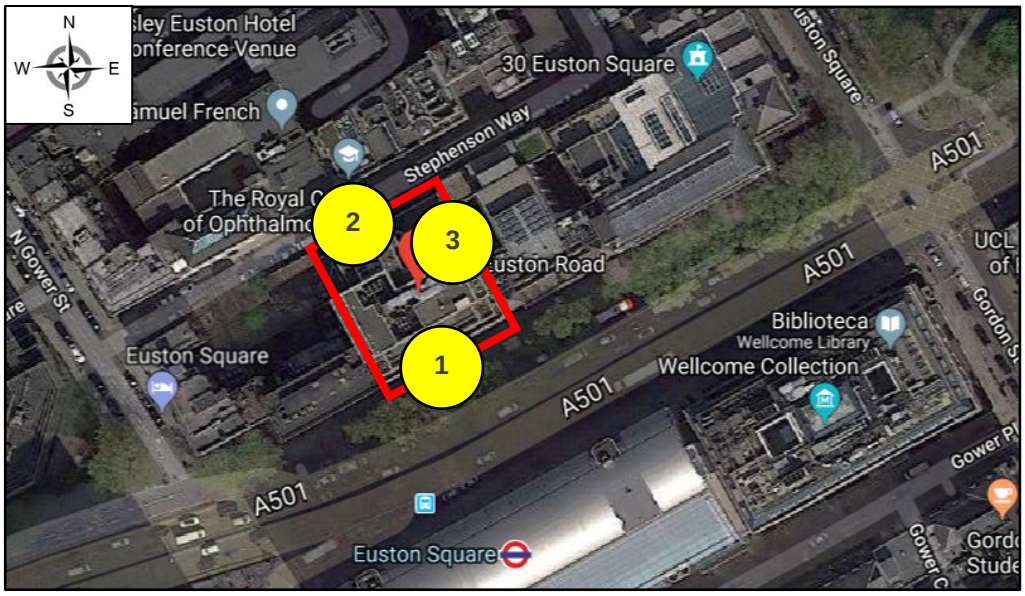
Measurements were taken continuously of the A-weighted (dBA) L_{90}, L_{eq} and L_{max} sound pressure levels over 15 minute periods.

8.2 Measurement Positions

The noise level measurements were undertaken at two positions around the development site. The measurement positions are described in the table below.

Position No	Description
1	The sound level meter was located at the five floor balcony to the south of the development site. The microphone was attached to a pole and this to the secure guard, overlooking Euston Road, approximately one metre from the façade and approximately sixteen metres from street level.
2	The sound level meter was located at the third floor balcony to the north of the development site. The microphone was attached to a pole and this to the secure guard, overlooking Stephenson Way, approximately one metre from the façade and approximately ten metres from street level.
3	The sound level meter was located at the fourth floor balcony at the centre of the development site. The microphone was attached to a pole and this to the secure guard, overlooking the residential windows of student accommodation building and the common lightwell approximately one metre from the façade and approximately thirteen metres from ground level of the lightwell.

These positions are shown on the following plan.



Plan Showing Unmanned Measurement Positions (maps.google.co.uk)

8.3 Instrumentation

The instrumentation used during the survey is presented in the table below:

Description	Manufacturer	Type	Serial Number
Type 1 ½" Condenser Microphone	PCB	377B02	153843
Type 1 Preamp	Larson Davis	LXT1L	36051
Type 1 Data Logging Sound Level Meter	Larson Davis	LXT	4634
Type 1 ½" Condenser Microphone	PCB	377B02	107427
Type 1 Preamp	Larson Davis	PRM902	4154
Type 1 Data Logging Sound Level Meter	Larson Davis	824	3155
Type 1 ½" Condenser Microphone	Bruel & Kjaer	4189	2470596
Type 1 Preamp	Larson Davis	PRM902	4214
Type 1 Data Logging Sound Level Meter	Larson Davis	824	3803
Type 1 Calibrator	Larson Davis	CAL200	3082

Each sound level meter, including the extension cable, was calibrated prior to and on completion of the surveys. No significant changes were found to have occurred (no more than 0.1 dB).

Each sound level meter was located in an environmental case with the microphone connected to the sound level meter via an extension cable.

Each microphone was fitted with a manufacturer windshield.

9.0 Results

The results have been plotted on Time History Graphs 25451/TH1 to 25451/TH3 enclosed presenting the 15 minute A-weighted (dBA) L_{90}, L_{eq} and L_{max} levels at each measurement position throughout the duration of the survey.

9.1 Measured L_{eq} Noise Levels

The measured daytime $L_{Aeq(16\text{-}hour)}$ and night-time $L_{Aeq(8\text{-}hour)}$ noise levels for each position are presented in the table below.

Daytime (07:00 to 23:00 hours) and Night-time (23:00 to 07:00 hours) Measured L_{Aeq} Noise Levels (dBA re 2.0 x 10^{-5} Pa)			
Date	**Position**	**Daytime $L_{Aeq(16\text{-}hour)}$**	**Night-Time $(LAeq(8\text{-}hour)$**
19/04/2018 to 20/04/2018	1	75	72
	2	60	57
	3	56	55
20/04/2018 to 21/04/2018	1	74	73
	2	61	55
	3	55	52
21/04/2018 to 22/04/2018	1	74	73
	2	58	56
	3	55	54
22/04/2018 to 23/04/2018	1	74	72
	2	59	57
	3	55	52
23/04/2018 to 24/04/2018	1	74	73
	2	61	57
	3	56	53

9.2 Lowest Measured L_{90} Noise Levels

The following table presents the lowest measured L_{A90} background noise levels during the survey:

Daytime (07:00 to 23:00 hours) and Night-time (23:00 to 07:00 hours) Lowest Measured L_{A90} Background Noise Level (dB re 2 x 10^{-5} Pa)			
Date	**Position**	**Daytime $L_{Aeq(16\text{-}hour)}$**	**Night-Time $_{(LAeq(8\text{-}hour)}$**
19/04/2018 to 20/04/2018	1	67	64
	2	53	52
	3	53	52
20/04/2018 to 21/04/2018	1	67	62
	2	53	51
	3	51	51
21/04/2018 to 22/04/2018	1	65	64
	2	53	52
	3	51	51
22/04/2018 to 23/04/2018	1	67	60
	2	53	52
	3	52	50
23/04/2018 to 24/04/2018	1	68	62
	2	54	52
	3	51	51

9.3 Incident Noise Levels

The following table presents the typical worst-case incident noise levels for each façade. The data may be used in subsequent analysis to establish sound performance specifications for each of the external building fabric elements.

Position	**Period**	**L_{eq} Sound Pressure Level (dB) @ Octave Band Centre Frequency (Hz)**								**dBA**
		63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	
1	Daytime	79	73	70	69	71	69	61	49	75
	Night-time	74	67	66	66	70	67	59	48	73
2	Daytime	64	61	57	57	56	54	50	40	61
	Night-time	61	57	55	54	53	49	43	33	57

9.4 Discussion

During our site visit and inspection undertaken on Tuesday 13 March 2018, street level manned measurements were taken at Positions 1 and 2 while the unmanned noise monitoring equipment installed at the two balconies was recording. The following table presents the results:

Position	Time	Unnamed $L_{Aeq, 15min}$ result	Manned (street level) $L_{Aeq, 15min}$ result
1	11:30 to 11:45 hours	77	73
2	11:45 to 12:00 hours	60	58

10.0 Discussion Of Noise Climate

Due to the nature of the survey, i.e. unmanned, it is not possible to accurately describe the dominant noise sources, or specific noise events throughout the entire survey period. However at the beginning and end of the survey period the dominant noise sources were noted to be road traffic from the road network and existing plant located at the nearby development sites.

11.0 Plant Noise Impact Assessment

We understand that a total of 22No. condenser units, 2No. air handling units (AHUs 1&2), 1No. smoke extract fan and 2No. WC extract fans are to be installed at the rooftop of 210 Euston Road.

Plant Description	Location	Qty	Plant Make	Model Number
Condenser	Rooftop	3	Daykin	REYQ10T
Condenser		4	Daykin	REYQ12T
Condenser		4	Daykin	REYQ16T
Condenser		5	Daykin	REYQ18T
Condenser		6	Daykin	REYQ20T
Air Handling Unit 1		1	Barkell	AHU 1
Air Handling Unit 2		1	Barkell	AHU 2
WC Extract Fan		2	Nuare	EST19H/ EST19H-X
Smoke Extract Fan		1	TBC	TBC

In Sections 11.2 and 11.3 it is made reference to plant areas A, B and C. Each area comprises the following amount of condenser units:

- Plant area A: 1No. REYQT12T, 2No. REYQT16T and 1No. REYQT18T.
- Plant area B: 1No. REYQT10T, 1No. REYQT18T, 2No. REYQT20T.
- Plant area C: 2No. REYQT10T, 3No. REYQT12T, 2No. REYQT16T, 3No. REYQT18T, 4No. REYQT20T.

The plant mentioned on the above table could operate 24hours.

11.1 Plant Noise Data

We understand the manufacturer's noise data of the condensers to be as follows:

Plant Description	Sound Pressure Level (dB re $2x10^{-5}$ Pa) at 1m at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
REYQ10T	66	63	60	56	52	45	38	34	58
REYQ12T	69	66	63	59	55	48	41	37	61
REYQ16T	72	69	66	62	58	51	44	40	64
REYQ18T	73	72	67	63	59	52	45	41	65
REYQ20T	74	71	68	64	60	53	46	42	66

The manufacturer noise data was available as a single figure number. A typical condenser noise spectrum has therefore been used and equally increased in order to achieve the manufacturer single figure numbers presented above.

The cumulative plant noise emissions of the plant areas A, B and C above mentioned are shown in the following table.

Plant Description	Cumulative Sound Pressure Level (dB re $2x10^{-5}$ Pa) at 1m at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
Plant area A	80	78	74	70	66	59	52	48	72
Plant area B	79	76	73	69	65	58	51	47	71
Plant area C	84	81	78	74	70	63	56	52	75

We understand the manufacturer's noise data of the Air Handling Units 1&2 (atmospheric side with the manufacturer’s induct attenuator fitted) to be as follows:

Plant Description	Sound Power Level (dB re 10^{-12} Watts) or Sound Pressure Level (dB re $2x10^{-5}$ Pa) at Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
AHU1, intake (in-duct sound power level)	54	54	45	21	11	8	15	16
AHU1, discharge (in-duct sound power level)	59	60	50	35	24	25	35	37
AHU1, casing breakout (sound pressure level measured at 3m)	35	44	27	18	15	15	8	9
AHU2, intake (in-duct sound power level)	54	54	45	21	12	8	15	17
AHU2, discharge (in-duct sound power level)	59	59	49	35	24	25	35	37
AHU2, casing breakout (sound pressure level measured at 3m)	35	44	27	18	16	16	9	9

We understand the manufacturer's noise data of the WC male/female extract fans (atmospheric side) to be as follows:

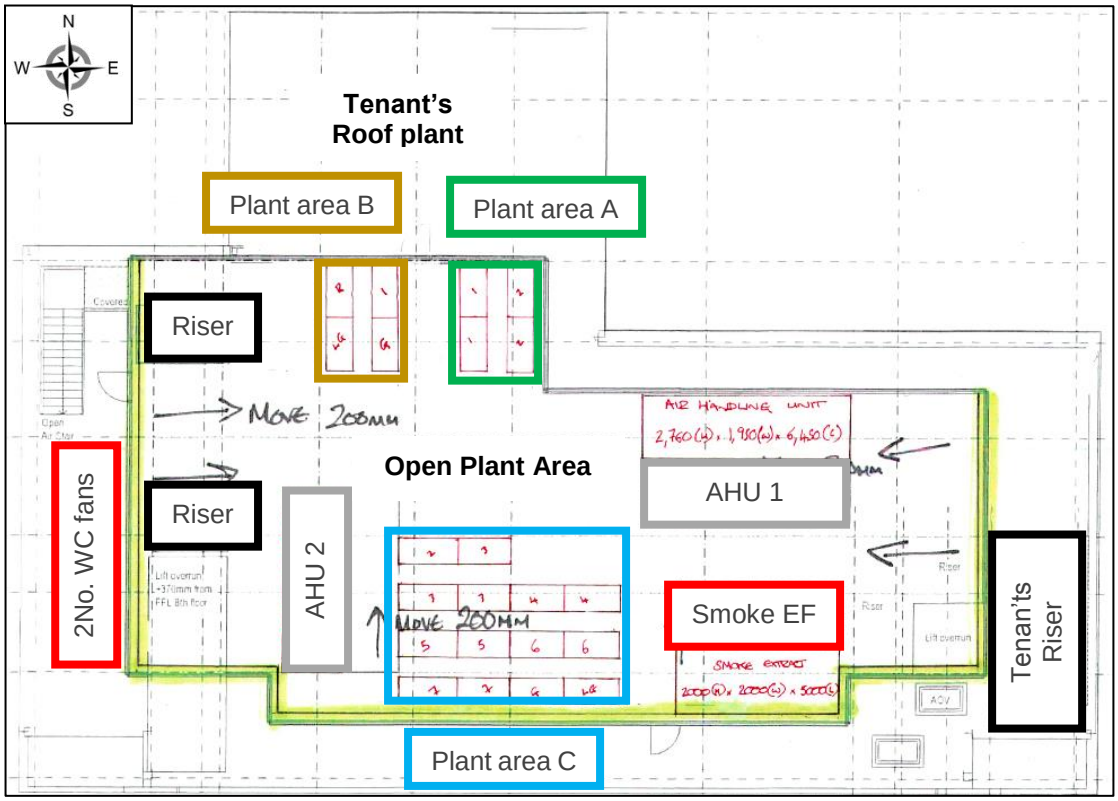
Plant Description	Sound Power Level (dB re 10^{-12} Watts) at Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
WC fan, intake (in-duct)	94	89	92	88	86	85	79	75
WC fan, discharge (in-duct)	96	92	96	93	93	89	82	76
WC fan, casing breakout	83	76	89	83	83	77	68	60

11.2 Plant Layout and screening

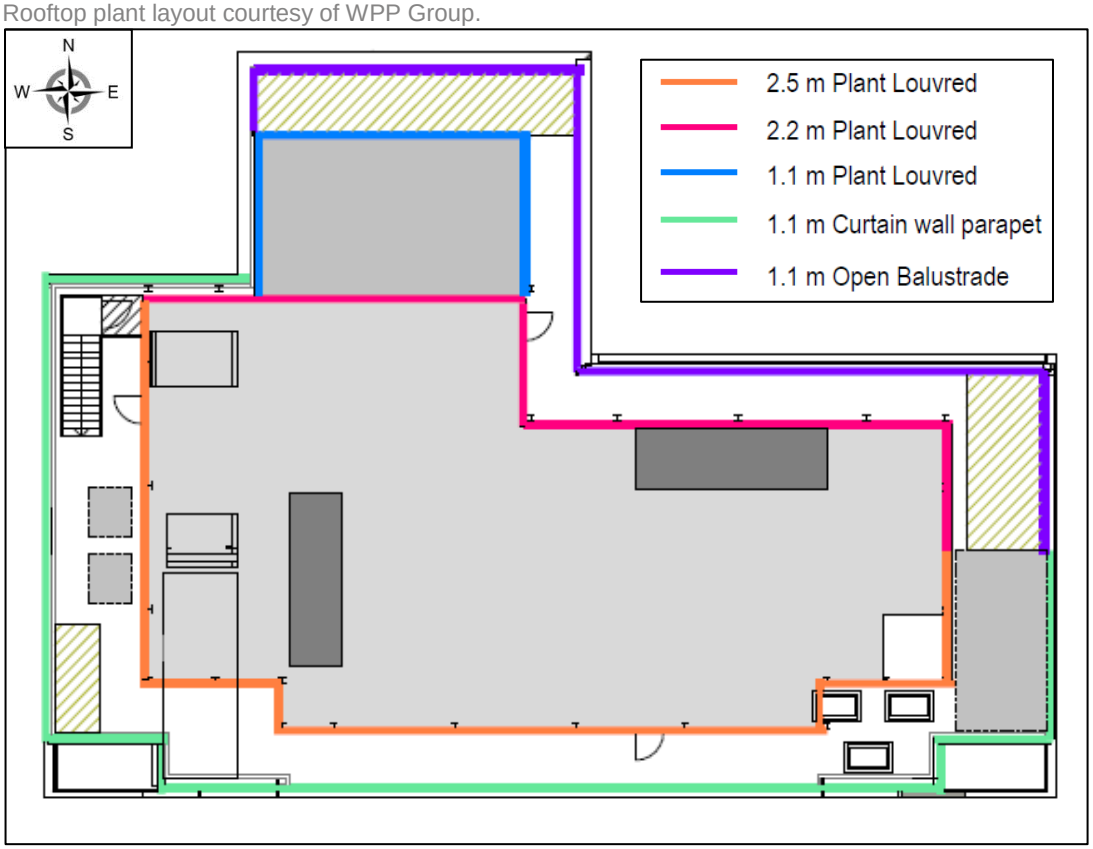
Our calculations presented in the following section have been based in accordance with the latest roof floor ventilation services sketch (Section 5.3), the noise data presented above and the proposed louvre screening arrangement shown in the second drawing below.

For our calculations, we have assumed this screening to be an imperforate acoustic barrier which should be installed as per our acoustic screening specification attached within this report.

Our calculations for the condenser units have been grouped in 3No. areas: A (blue colour), B (green colour) and C (brown colour). These are shown in the roof floor plant layout below alongside the additional items of plant located at roof level (fans in red colour, AHUs in grey colour and risers in black colour):



Rooftop plant layout courtesy of WPP Group.



Drawing no. A-(03)-108 Rev 014 - Rooftop screening layout courtesy of Tatehindle (Louvre screen to be made acoustically, maintaining the above indicated heights, in accordance with our acoustic barrier specification attached).

11.3 Plant Noise Impact Assessment

The following table presents our noise impact assessment for the items of plant that will be installed at roof level area of the development, as indicated in the previous layout, with the above acoustic screen installed in accordance with our specification attached, at the nearest residential property, which we understand is located approximately ten metres horizontal distance away from the edge of the screening, and two storeys lower, to the east of 210 Euston Road.

Item	Sound Level at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
Plant area A Manufacturer's Cumulative Noise Level (L_p)	80	78	74	70	66	59	52	48	72
Acoustic Barrier Loss	-6	-7	-8	-10	-12	-15	-19	-23	-
26m Distance Loss	-22	-22	-22	-22	-22	-22	-22	-22	-
Façade Effect	+3	+3	+3	+3	+3	+3	+3	+3	-
Calculated Noise Level at Window	55	52	47	41	35	25	14	6	43
Plant area B Manufacturer's Cumulative Noise Level (L_p)	79	76	73	69	65	58	51	47	71
Acoustic Barrier Loss	-6	-7	-9	-11	-13	-16	-20	-24	-
30m Distance Loss	-23	-23	-23	-23	-23	-23	-23	-23	-
Façade Effect	+3	+3	+3	+3	+3	+3	+3	+3	-
Calculated Noise Level at Window	53	49	44	38	32	22	11	3	40
Plant area C Manufacturer's Cumulative Noise Level (L_p)	84	81	78	74	70	63	56	52	75
Acoustic Barrier Loss	-9	-12	-14	-17	-20	-23	-25	-25	-
28m Distance Loss	-21	-21	-21	-21	-21	-21	-21	-21	-
Façade Effect	+3	+3	+3	+3	+3	+3	+3	+3	-
Calculated Noise Level at Window	56	51	45	38	31	21	12	8	41
AHU 1 Manufacturer's Noise Data (intake, L_w)	54	54	45	21	11	8	15	16	41
Acoustic Barrier Loss	-5	-4	-4	-3	-	-	-	-	-
15m Distance Loss from Atmospheric duct (L_w to L_p)	-32	-32	-32	-32	-32	-32	-32	-32	-
End Reflection Loss Effect	+7	+4	+1	-	-	-	-	-	-
Directivity Effect	+1	+2	+3	+4	+5	+6	+6	+6	-
Façade Effect	+3	+3	+3	+3	+3	+3	+3	+3	-
Calculated Noise Level at Window	14	20	15	-	-	-	-	-	8

AHU 1 Manufacturer's Noise Data (discharge, L_w)	59	60	50	35	24	25	35	37	47
Acoustic Barrier Loss	-5	-4	-4	-3	-	-	-	-	-
15m Distance Loss from Atmospheric duct (L_w to L_p)	-32	-32	-32	-32	-32	-32	-32	-32	-
End Reflection Loss Effect	+7	+4	+1	-	-	-	-	-	-
Directivity Effect	+1	+2	+3	+4	+5	+6	+6	+6	-
Façade Effect	+3	+3	+3	+3	+3	+3	+3	+3	-
Calculated Noise Level at Window	19	26	20	8	1	3	13	15	19
AHU1 Manufacturer's Noise Data (case breakout, L_p)	35	44	27	18	15	15	8	9	29
Acoustic Barrier Loss	-5	-4	-4	-3	-	-	-	-	-
18m Distance Loss	-12	-12	-12	-12	-12	-12	-12	-12	-
Façade Effect	+3	+3	+3	+3	+3	+3	+3	+3	-
Calculated Noise Level at Window	21	31	14	6	6	6	-	-	17
AHU 2 Manufacturer's Noise Data (intake, L_w)	54	54	45	21	12	8	15	17	41
Acoustic Barrier Loss	-7	-9	-11	-13	-16	-19	-20	-20	-
30m Distance Loss from Atmospheric duct (L_w to L_p)	-38	-38	-38	-38	-38	-38	-38	-38	-
End Reflection Loss Effect	+7	+4	+1	-	-	-	-	-	-
Directivity Effect	+1	+2	+3	+4	+5	+6	+6	+6	-
Façade Effect	+3	+3	+3	+3	+3	+3	+3	+3	-
Calculated Noise Level at Window	6	9	2	-	-	-	-	-	0
AHU 2 Manufacturer's Noise Data (discharge, L_w)	59	59	49	35	24	25	35	37	46
Acoustic Barrier Loss	-7	-9	-11	-13	-16	-19	-20	-20	-
30m Distance Loss from Atmospheric duct (L_w to L_p)	-38	-38	-38	-38	-38	-38	-38	-38	-
End Reflection Loss Effect	+7	+4	+1	-	-	-	-	-	-
Directivity Effect	+1	+2	+3	+4	+5	+6	+6	+6	-
Façade Effect	+3	+3	+3	+3	+3	+3	+3	+3	-
Calculated Noise Level at Window	11	14	6	-	-	-	-	-	1
AHU2 Manufacturer's Noise Data (case breakout, L_p)	35	44	27	18	16	16	9	9	29
Acoustic Barrier Loss	-7	-9	-11	-13	-16	-19	-20	-20	-
30m Distance Loss	-16	-16	-16	-16	-16	-16	-16	-16	-
Façade Effect	+3	+3	+3	+3	+3	+3	+3	+3	-
Calculated Noise Level at Window	15	22	3	-	-	-	-	-	6

Cumulative Noise Level at Window	60	56	50	44	38	28	19	17	47

Our calculations indicate that with the implementation of the proposed acoustic barrier around the perimeter of the plant area, cumulative noise levels from the proposed roof plant items would exceed the requirements of the Local Authority outlined in Section 6.4 by 6 and 7dBA during the daytime and night-time, respectively, and therefore should not be capable of achieving the plant noise emissions requirements at the nearest residential property, which we understand is located approximately ten metres horizontal distance away from the edge of the screening, and two storeys lower, to the east of 210 Euston Road.

12.0 Mitigating Measures

12.1 Acoustic Screen Specification

In order to attenuate the noise from the proposed plant installation to meet the requirements of the Local Authority outlined in Section 6.4, the proposed 22No. condenser units, 2No. AHUs, and 1No. smoke extract fan are be located in an area with perimeter acoustic screen which is shown in drawing no. A-(03)-108 Rev 014 shown in Section 11.2 and to be installed in accordance with Appendix B.

12.2 Atmospheric In-duct Attenuators

In order to attenuate the noise from the proposed plant installation to meet the requirements of the Local Authority outlined in Section 6.4, the AHU 1&2 will be installed with the manufacturer attenuators (specified in the manufacturer noise data sheet) and the 2No. WC extract fans will also be provided with atmospheric in-duct attenuators.

The following table presents the minimum insertion loss values that the proposed atmospheric in-duct attenuators for the WC extract fans should provide.

Item	Insertion Loss (dB re 2 x 10^{-5} Pa) at Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
WC Extract Fans, discharge	20	37	50	50	50	50	50	50

12.3 Condenser Units

Our calculations indicate that in order to meet the Local Authority requirements, in addition to

the above mitigation measures, the noise emissions from each condenser unit should be reduced by at least 8dBA when measured on site in any direction.

Following our discussions with the mechanical engineers on this project (WPP Group), we have been confirmed that should be achievable by providing individual attenuators to all condenser units.

12.4 Discussion

Our calculation indicated that, in addition to the above mitigation measures the following should be implemented in order to meet the Local Authority requirements presented in Section 6.4:

- The cumulative noise levels from the 1No. smoke extract fan and the risers located at roof level within the screening area and discharging to atmosphere, should not exceed 30dBA when measured individually on site at 1m.
- The cumulative plant noise emissions from the future tenant's plant roof and risers should not exceed 30dBA when measured at the nearest residential window, which we understand to be located approximately fourteen metres horizontal distance away from the edge of the associated roof level and riser location and one storey lower, to the east of 210 Euston Road.
- The noise emissions from each condenser unit should be reduced by at least 8dBA when measured on site in any direction.
- Our calculations suggest that, with the above mitigation measures implemented, plant noise emissions should be capable of achieving the requirements of the Local Authority specified in Section 6.4.

13.0 Vibration Isolation

Suitable vibration isolation mounts should be installed as per the manufacturer recommendations such that the Local Authority requirements are achieved.

14.0 Conclusions

A detailed five day daytime and night-time fully automated environmental noise survey has been undertaken in order to establish the currently prevailing environmental noise climate around the site. The results are presented herein.

Plant noise emission criteria have been recommended and a preliminary plant noise emission limit has been set with reference to Local Authority requirements.

With the implementation of the proposed acoustic mitigating measures specified herein, our calculations indicate that based on the manufacturer's noise data provided, the combined noise emissions from the proposed roof plant should be capable of achieving the requirements of the Local Authority during the daytime and night-time hours.

Appendix A

The acoustic terms used in this report are defined as follows:

dB — Decibel - Used as a measurement of sound level. Decibels are not an absolute unit of measurement but an expression of ratio between two quantities expressed in logarithmic form. The relationships between Decibel levels do not work in the same way that non-logarithmic (linear) numbers work (e.g. 30dB + 30dB = 33dB, not 60dB).

dBA — The human ear is more susceptible to mid-frequency noise than the high and low frequencies. The 'A'-weighting scale approximates this response and allows sound levels to be expressed as an overall single figure value in dBA. The $_A$ subscript is applied to an acoustical parameter to indicate the stated noise level is A-weighted

It should be noted that levels in dBA do not have a linear relationship to each other; for similar noises, a change in noise level of 10dBA represents a doubling or halving of subjective loudness. A change of 3dBA is just perceptible.

$L_{90,T}$ — L_{90} is the noise level exceeded for 90% of the period *T* (i.e. the quietest 10% of the measurement) and is often used to describe the background noise level.

$L_{eq,T}$ — $L_{eq,T}$ is the equivalent continuous sound pressure level. It is an average of the total sound energy measured over a specified time period, *T*.

L_{max} — L_{max} is the maximum sound pressure level recorded over the period stated. L_{max} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the L_{eq} noise level.

L_p — Sound Pressure Level (SPL) is the sound pressure relative to a standard reference pressure of 2×10^{-5} Pa. This level varies for a given source according to a number of factors (including but not limited to: distance from the source; positioning; screening and meteorological effects).

L_w — Sound Power Level (SWL) is the total amount of sound energy inherent in a particular sound source, independent of its environment. It is a logarithmic measure of the sound power in comparison to a specified reference level (usually 10^{-12} W).

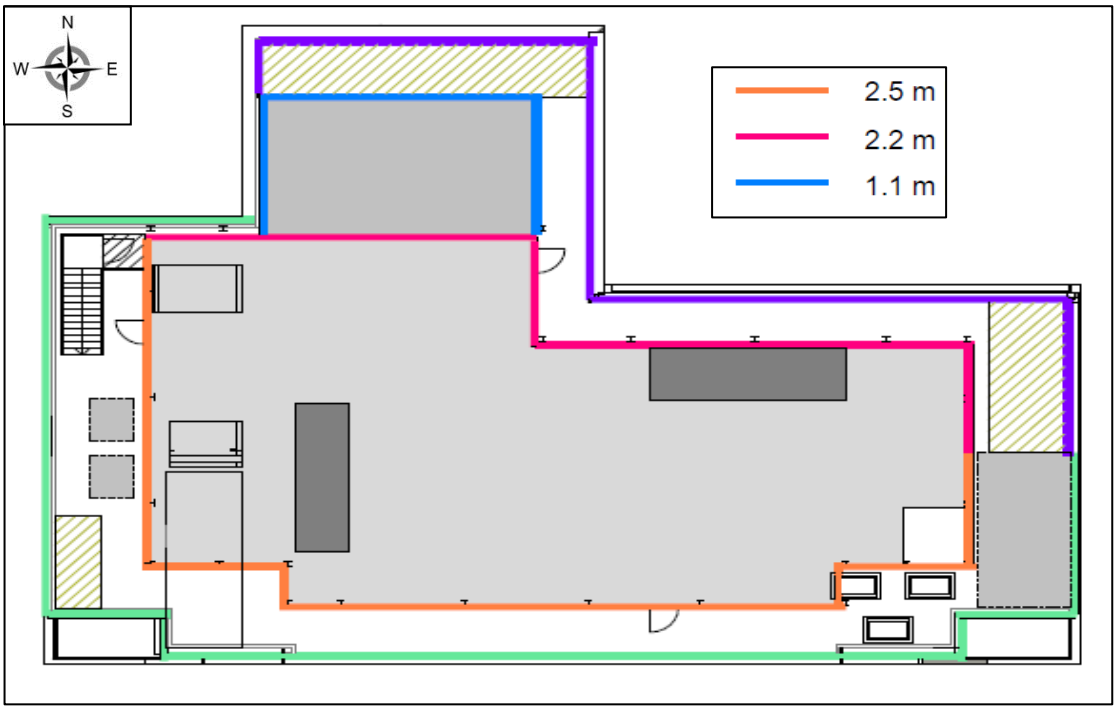
Appendix B

210 Euston Road, London

Acoustic Specification for Acoustic Screen

Acoustic screening shall extend:

- continuously around the perimeter of the roof plant area;
- from roof level to the minimum heights of 2500mm, 2200mm and 1100mm above the roof level as per the following drawing.



The screen shall be imperforate (solid) and have a minimum mass per unit area of at least 10kg/m^2. This could be achieved using two or more layers of a wide range of materials including, for example, plywood or equivalent sheeting board to a suitable thickness required to achieve the mass per unit area. All junctions should be staggered.

Doors, access panels and service penetrations shall be treated so as to maintain the acoustic performance of the assembled screen.

All junctions between the screen and adjacent structures shall be made good and sealed with a heavy grout and/or dense non-hardening mastic.

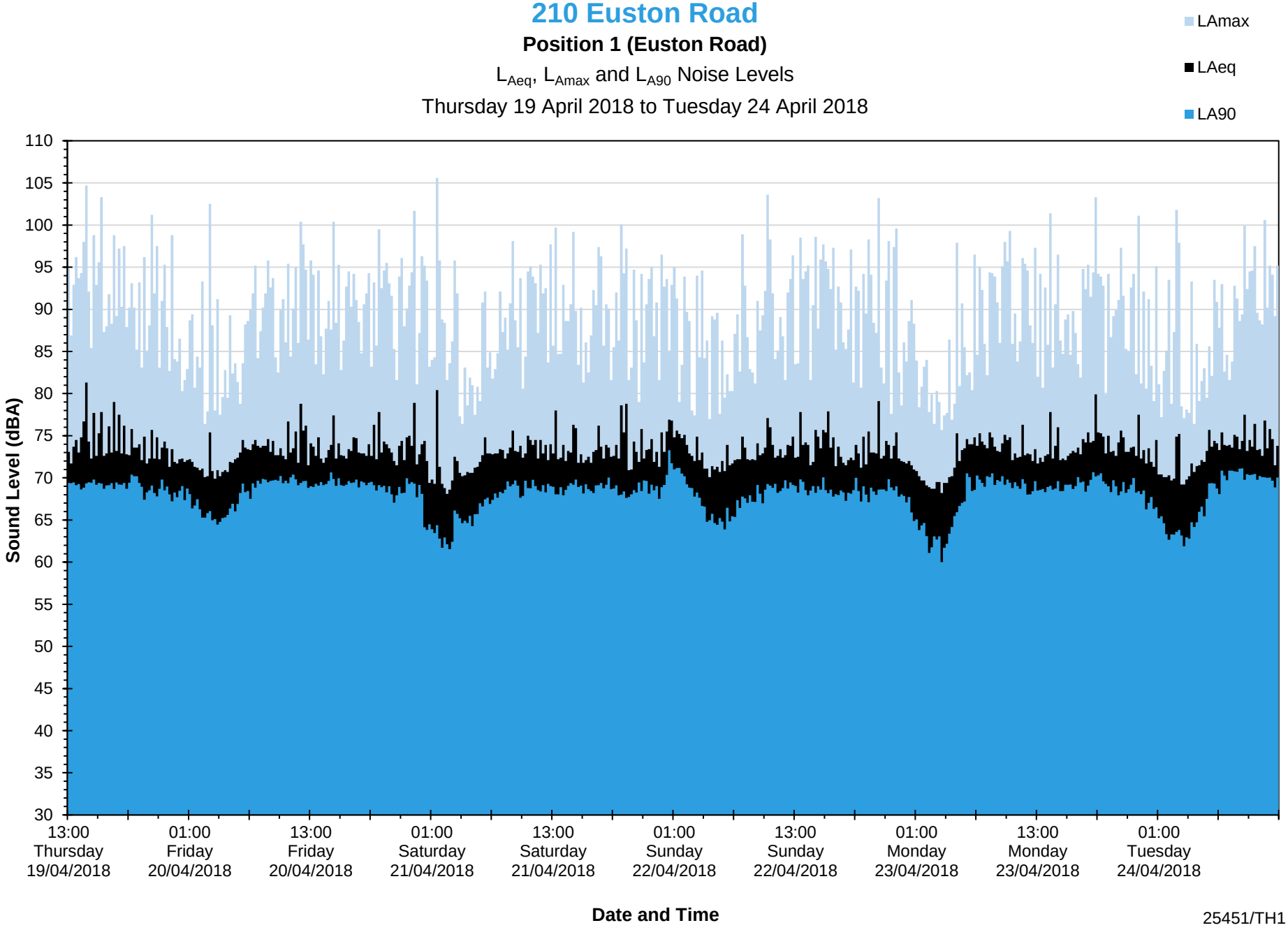
The complete structure shall be wind and weather resistant to standards agreed with the Client. The exact design of the screen will be agreed with and approved by Hann Tucker Associates.

210 Euston Road

Position 1 (Euston Road)

L_{Aeq}, L_{Amax} and L_{A90} Noise Levels

Thursday 19 April 2018 to Tuesday 24 April 2018



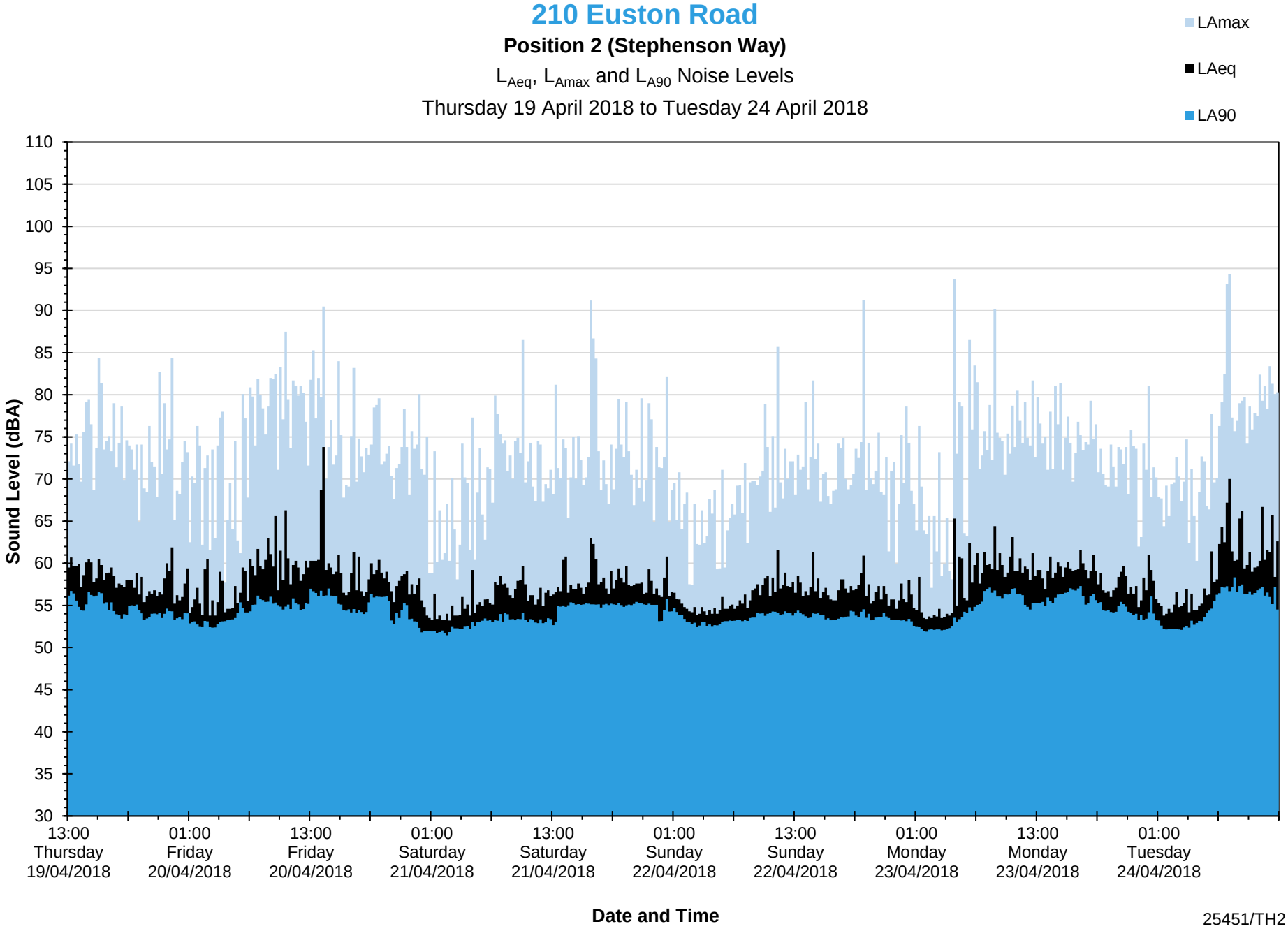
25451/TH1

210 Euston Road

Position 2 (Stephenson Way)

L_{Aeq}, L_{Amax} and L_{A90} Noise Levels

Thursday 19 April 2018 to Tuesday 24 April 2018



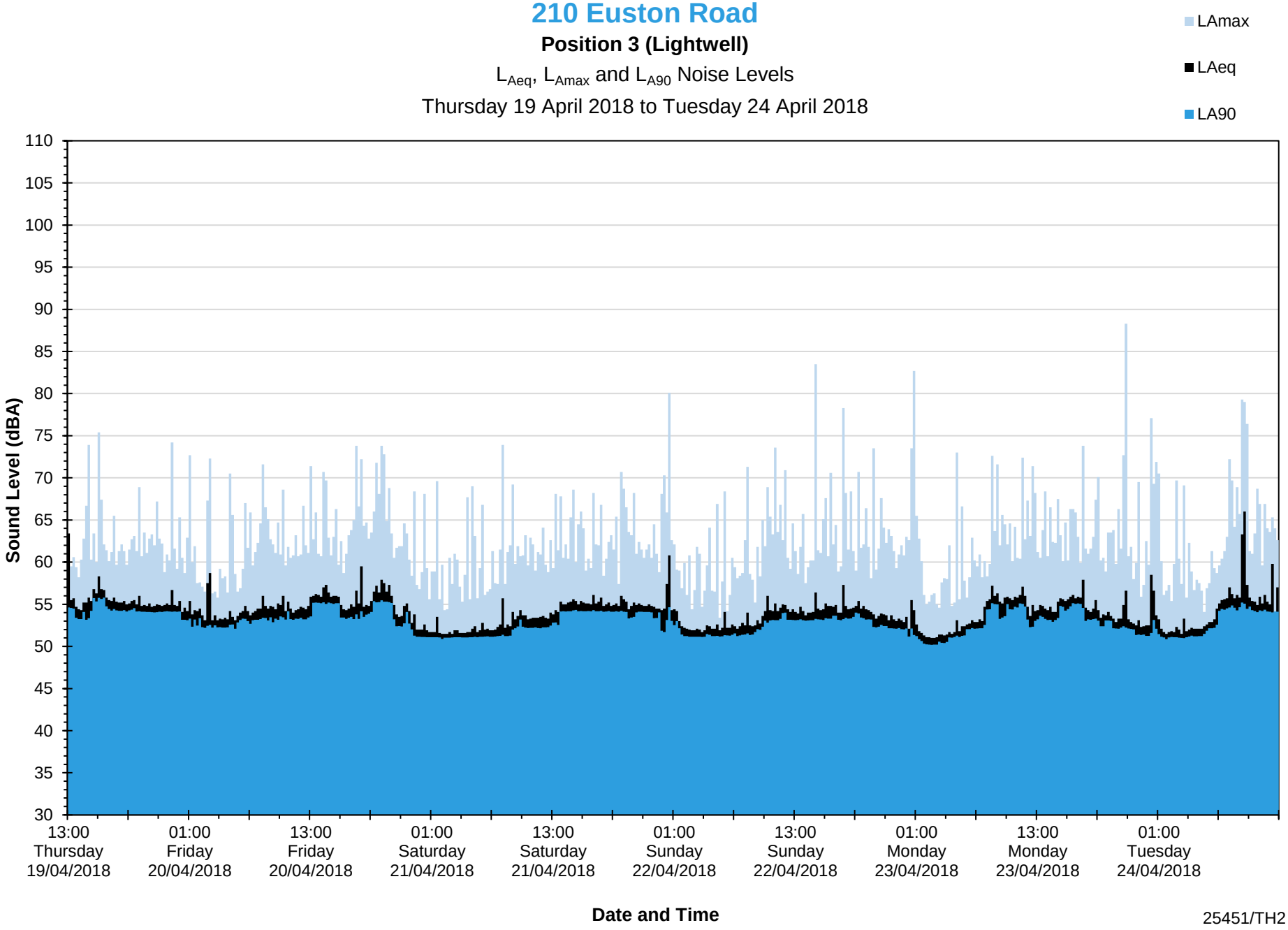
25451/TH2

210 Euston Road

Position 3 (Lightwell)

L_{Aeq}, L_{Amax} and L_{A90} Noise Levels

Thursday 19 April 2018 to Tuesday 24 April 2018



25451/TH2