Appendix 9.1
Baseline Noise Monitoring Survey

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Noise Monitoring Locations

RPS has undertaken a noise monitoring survey in relation to the planning application for the Proposed Development, comprising of 6 no. two storey data centre buildings, an administration / management building, car parking, landscaping, gas storage and gas turbines, energy storage and other associated works.

To be representative of existing noise-sensitive receptors, RPS have undertaken unattended noise monitoring at three noise monitoring locations (NMLs) from 2nd February to 9th February 2023 and at two noise monitoring locations from 12th to 20th June 2023.

The five noise monitoring locations (NML1 – NML5) are shown in Figure 9.A.1, with survey dates and Irish Grid co-ordinates for each NML detailed in Table 9A.1.

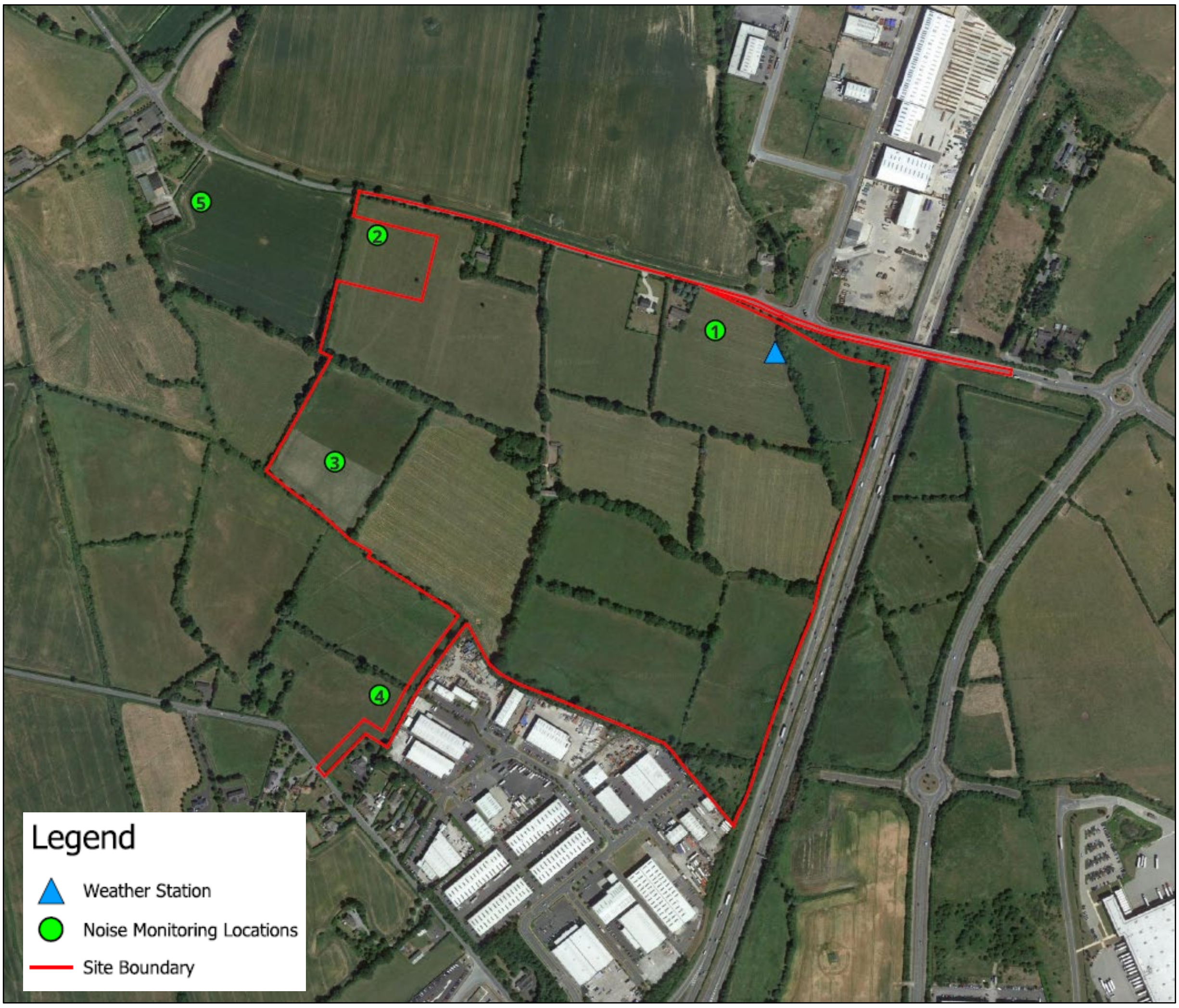

Figure 9.A.1: Background Noise Monitoring Locations

The details of the unattended noise monitoring surveys including a description of the noise monitoring locations, date, time and sound level meter used are summarised in Table 9A.1.

Table 9A.1: Unattended Noise Monitoring Summary

Noise Monitoring Location	Description of Noise Monitoring Location	Survey Dates	IG Easting	IG Northing
NML 1	In a field at the northern side of the site boundary, to the east of 2 houses on Carragh Road.	02/02/2023 – 09/02/2023	286636	219803
NML 2	In a field at the north western corner of the site boundary, close to Carragh Road.	02/02/2023 – 09/02/2023	286194	219927
NML 3	In a field at the south western boundary of the site	02/02/2023 – 09/02/2023	286139	219631
NML4	In a field to the south west of the site boundary, adjacent a residential property located on the L2030 Newhall Road	12/06/2023 – 20/06/2023	286197	219325
NML5	In a field to the west of the site boundary, adjacent a farming/residential property on the R409 Road	12/06/2023 – 20/06/2023	285964	219971

Methodology

Noise Data

The sound level meter specifications for the noise survey equipment used at NML1 – NML5 are detailed in Table 9A.2 – Table 9.A.6.

The baseline noise monitoring survey at NML 1 was carried out using a Norsonic 140 Class 1 Sound Level Analyser in conjunction with the following:

- Norsonic 1211 Outdoor Microphone System and Storage Case;
- Norsonic 1212 – Microphone Dehumidifier Unit;
- CA 1317 – Weather Protection Kit – Type L; and
- Brüel & Kjær 4231 Calibrator.

Table 9A.2: NML1 SLM Instrument Records

Norsonic 140 Sound Level Meter				
Equipment	**Model / Type**	**Serial Number**	**Calibration Certificate Number**	**Last Calibration Date**
Sound Level Meter	Norsonic 140	1402992	UCRT21/2344	01/11/2021
Preamplifier	Norsonic 1209	12364	UCRT21/2344	01/11/2021
Microphone	GRAS 40AF	102675	UCRT21/2344	01/11/2021
Calibrator	Brüel & Kjær 4231	2445560	UCRT22/2199	10/10/2022

The baseline noise monitoring survey at NML 2 was carried out a Rion NL-52 Class 1 Sound Level Analyser in conjunction with the following:

- Outdoor kit enhanced NL-32;
- Rion WS-03SO1 Windscreen head assembly (inc WS-03051);
- Rion EC-04 2m Extension Cable (7 Pin); and
- Brüel & Kjær 4231 Calibrator.

Table 9A.3: NML2 SLM Instrument Records

Equipment	**Model / Type**	**Serial Number**	**Calibration Certificate Number**	**Last Calibration Date**
Sound Level Meter	Rion NL- 52	00687041	UCRT21/1244	19/02/2021
Preamplifier	Rion NH-25	87196	UCRT21/1244	19/02/2021
Microphone	Rion UC-59	13559	UCRT21/1244	19/02/2021
Calibrator	Brüel & Kjær 4231	2445560	UCRT22/2199	10/10/2022

The baseline noise monitoring survey at NML 3 was carried out using a Norsonic 140 Class 1 Sound Level Analyser in conjunction with the following:

- Norsonic 1211 Outdoor Microphone System and Storage Case;
- Norsonic 1212 – Microphone Dehumidifier Unit;
- CA 1317 – Weather Protection Kit – Type L; and
- Brüel & Kjær 4231 Calibrator.

Table 9.A.4: NML3 SLM Instrument Records

Norsonic 140 Sound Level Meter				
Equipment	**Model / Type**	**Serial Number**	**Calibration Certificate Number**	**Last Calibration Date**
Sound Level Meter	Norsonic 140	1407884	4712339005	16/09/2022
Preamplifier	Norsonic 1209	23500	4712339005	16/09/2022
Microphone	Norsonic 1225	505496	4712339005	16/09/2022
Calibrator	Brüel & Kjær 4231	2445560	UCRT22/2199	10/10/2022

The baseline noise monitoring survey at NML4 was carried out using a SoundExpert® LxT Sound Level Analyser in conjunction with the following:

- PCB Microphone; and
- Larson Davis Calibrator.

Table 9.A.5: NML4 SLM Instrument Records

SoundExpert® LxT Sound Level Meter				
Equipment	**Model / Type**	**Serial Number**	**Calibration Certificate Number**	**Last Calibration Date**
Sound Level Meter	SoundExpert® LxT	LXT4832	36214	02/09/2021
Preamplifier	Larson Davis PRMLxT1L	055819	36214	
Microphone	PCB 377B02	316329	36214	
Calibrator	Larson Davis CAL200	9175	36214	

The baseline noise monitoring survey at NML5 was carried out using a SoundExpert® LxT Sound Level Analyser in conjunction with the following:

- PCB Microphone; and
- Larson Davis Calibrator.

Table 9.A.6: NML5 SLM Instrument Records

SoundExpert® LxT Sound Level Meter				
Equipment	**Model / Type**	**Serial Number**	**Calibration Certificate Number**	**Last Calibration Date**
Sound Level Meter	SoundExpert® LxT	LXT5662	36205	02/09/2021
Preamplifier	Larson Davis PRMLxT1L	055659	36205	
Microphone	PCB 377B02	175331	36205	
Calibrator	CAL200	9175	36205	

The noise monitoring instrumentation conforms to the requirements for integrating averaging sound level meters (Type 1) as specified in BS EN 60804. The sound level meter was accurately calibrated before and after use. The microphone was placed at a height of 1.2 - 1.5m above ground level. The sound level meter was accurately calibrated before and after use with no drift observed. Noise measurements were undertaken in 15-minute durations. noise measurements were undertaken in 15 minute durations.

Weather conditions throughout the noise monitoring surveys were suitable for the surveys to be completed, typically with dry and still conditions throughout.

The following acoustic parameters were recorded during the survey periods:

L_{Aeq} The continuous equivalent A-weighted sound pressure level. This is an "average" of the sound pressure level

L_{Amax} This is the maximum A-weighed sound level measured during the sample period

L_{Amin} This is the minimum A-weighted sound level measured during the sample period

L_{A10} This is the A-weighted sound level that is exceeded for noise for 10% of the sample period

L_{A90} This is the A-weighted sound level that is exceeded for 90% of the sample period

The calibration certificates of the sound level meters used in the noise monitoring survey are shown in Figure 9.A.2 - Figure 9.A.4 and photographs from the noise monitoring survey are displayed in Table 9.A.7 - Table 9.A.11

Meteorological Data

In addition to the noise monitoring equipment a weather station was also deployed to record rainfall and wind speed in 15-minute measurements for the same periods as the noise measurements.

The following meteorological weather station was employed at a single location during each of the unattended noise surveys.

- Davis Vantage Pro 2;
- Weatherlink Data Logger;
- Outdoor enhanced weather case; and
- Stainless steel pole.

The noise surveys were conducted in accordance with BS7445: Description and Measurement of Environmental Noise. Measurements were made at a height of 1.2 – 1.5m above ground level. All measurements were conducted under the appropriate weather conditions as described in BS7445.

Photographs of the weather station type used in the noise monitoring survey can be found in Table 9.A.9.

Subjective Survey Notes

The background noise monitoring locations were situated in a rural environment, with all NMLs within approximately 500m of the M7 motorway. It was noted during set up and collection of all noise monitoring surveys that the dominant noise source was road traffic noise, most notably from the M7 motorway, with noise contributions also from local roads.

ANV MEASUREMENT SYSTEMS

CERTIFICATE OF CALIBRATION

ilac-MRA UKAS CALIBRATION 0653

Date of Issue: 01 November 2021

Certificate Number: UCRT21/2344

Calibrated at & Certificate issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Page 1 of 3 Pages
Approved Signatory K. Mistry

CUSTOMER	RPS Consulting Belfast Elmwood House 74 Boucher Road Belfast Co. Antrim BT12 6RZ
ORDER No	ENV281021 Job No UKAS21/10712
DATE OF RECEIPT	29 October 2021
PROCEDURE	Calibration Engineer's Handbook, section 25: periodic testing of sound level meters to IEC 61672-3:2006 (BS EN 61672-3:2006) as modified by UKAS TPS 49 Edition 2:June 2009
IDENTIFICATION	Sound level meter Norsonic type 140 serial No 1402992 connected via a preamplifier type 1209 serial No 12364 to a half-inch microphone type GRAS 40AF serial No 102675. Associated calibrator Rion type NC-74 serial No 35105042 with a one-inch housing and adapter type NC-74-002 for half-inch microphone.
CALIBRATED ON	01 November 2021
PREVIOUS CALIBRATION	Calibrated on 03 October 2019, Certificate No. U33023 issued by a UKAS accredited calibration laboratory No. 0789

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

Figure 9.A.2: Calibration Certificate of Norsonic 140 at NML 1

MEASUREMENT SYSTEMS

CERTIFICATE OF CALIBRATION

UKAS CALIBRATION 0653

Date of Issue: 19 February 2021

Certificate Number: UCRT21/1244

Calibrated at & Certificate issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

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Approved Signatory

B. Giles

Customer	RPS Planning & Environment Elmwood House 74 Boucher Road Belfast Co. Antrim BT12 6RZ
Order No.	R52180221
Description	Sound Level Meter / Pre-amp / Microphone / Associated Calibrator

Identification

Manufacturer	*Instrument*	*Type*	*Serial No. / Version*
Rion	Sound Level Meter	NL-52	00687041
Rion	Firmware		2.0
Rion	Pre Amplifier	NH-25	87196
Rion	Microphone	UC-59	13559
Rion	Calibrator	NC-74	34536109
	Calibrator adaptor type if applicable		NC-74-002

Performance Class 1

Test Procedure TP 2.SLM 61672-3 TPS-49

Procedures from IEC 61672-3:2006 were used to perform the periodic tests.

Type Approved to IEC 61672-1:2002 YES Approval Number 21.21 / 13.02

If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2003

Date Received 18 February 2021 ANV Job No. UKAS21/02125

Date Calibrated 19 February 2021

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

Previous Certificate	*Dated*	*Certificate No.*	*Laboratory*
	20 February 2020	UCRT20/1213	0653

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

Figure 9.A.3: Calibration Certificate of Rion NL-52 at NML 2

RECEIVED: 13/08/2024

Certificate of Calibration

Certificate No.: 4712339005

Object:	Sound Analyser Nor140
Supplier:	Norsonic AS
Type:	Nor140
Serial number:	1407884
Client:	RPS Ireland Ltd

This instrument is tested and calibrated in accordance to the Norsonic production standard set for Nor140, ensuring that the instrument conforms to the following standards;

IEC 61672-1:2002 class 1
IEC 61260-1 class 1 Ed 1.0 2014-02
ANSI S1.4-1983 (R2001) with amd. S1.4A-1985 class 1
ANSI S1.43-1997 (R2002) class 1
ANSI S1.11-2004 class 1
DIN 45 657, Applicable parts
IEC 61094 part 4

Instrumentation used for calibration traceable to:

Electrical Parameters: IKM, Norway
Acoustical Parameters: PTB, Germany
Environmental Parameters: Justervesenet, Norway

Adjustments: None

Comments: None

Date of calibration: 2022-09-16

Calibration interval recommended 2 years

The environmental parameters applicable to this calibration are kept well within limits ensuring negligible deviation on obtained measurement results.

Calibrated by:

Sign.

Norsonic

Norsonic AS, P.B 24, 3421 Lierskogen. Visitor address: Gunnersbråtan 2, Tranby, Norway.
Phone +47 32858900 Fax.: +47 32852208, email: info@norsonic.com

Figure 9.A.4: Calibration Certificate of Norsonic 140 (NML 3)

MTS Calibration

MTS Calibration Ltd,
The Grange Business Centre,
Belasis Avenue,
Billingham TS23 1LG,
England
Telephone: 01642 876 410

RECEIVED: 13/08/2024

CERTIFICATE OF CALIBRATION

Page 1 of 11 pages

Approved Signatory:

Tony Sherris

Issued by: MTS Calibration Ltd

Date of Issue: 02 September 2021 Certificate Number: 36214

Sound Level Meter

Sound Level Meter Periodic Tests to EN 61672-3: 2013 Class 1

Client: Environmental Measurements
Unit 12, Tallaght Business Centre
Whitestown Business Park
Co.Dublin 24, Ireland

Instrument Make: Larson Davis
Instrument Model: LxT1L
Serial Number: 0004832

Associated Equipment	Make	Model	Serial number
Preamplifier	Larson Davis	PRMLxT1L	055819
Microphone	PCB	377B02	316329
Calibrator	Larson Davis	CAL200	9175
Calibrator supplied by	MTS for this calibration		

Test results summary, detailed results are shown on subsequent pages.

Periodic tests were performed in accordance with procedures from IEC 61672-3:2013 Class 1

Tests performed	Section	Results of test	Page	Comments
Calibration Certificate	22		1	
Additional information			2	
Indication with Calibrator Supplied	10	No Limit	3	
Self-Generated Noise	11	No Limit	3	
Frequency and Time-weightings at 1kHz	14	Complies	3	
Long term stability	15	Complies	3	
High stability	21	Complies	3	
Acoustic Tests	12	Complies	4	
Frequency Weighting A	13	Complies	5	
Frequency Weighting C	13	Complies	6	
Frequency Weighting Z	13	Complies	7	
Level Linearity	16	Complies	8	
Level Linearity Range Control	17	-	n/a	SLM only has one range
Tone-burst Response	18	Complies	9	
Peak C sound level	19	Complies	10	
Overload Indication	20	Complies	11	

The instrument was within the above specification as received - no modifications were made

The sound level meter submitted for testing has successfully completed the periodic tests of IEC 61672-3: 2013 for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2: 2013, to demonstrate that the model of sound level meter fully conformed to the Class 1 specifications in IEC 61672-1: 2013, the sound level meter submitted for testing conforms to the Class 1 specifications of IEC 61672-1: 2013

Additional tests performed	Reference	
Microphone full frequency response	36216	See additional certificate
Filter calibration, third octave or octave	36214F	See additional certificate

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

Figure 9.A.5: Calibration Certificate of SoundExpert® LxT (NML 4)

RECEIVED: 13/08/2024

MTS Calibration Ltd,
The Grange Business Centre,
Belasis Avenue,
Billingham TS23 1LG,
England
Telephone: 01642 876 410

CERTIFICATE OF CALIBRATION

Page 1 of 11 pages

Issued by: **MTS Calibration Ltd**

Approved Signatory:

Tony Sherris

Date of Issue: 02 September 2021 **Certificate Number:** 36205

Sound Level Meter

Sound Level Meter Periodic Tests to EN 61672-3: 2013 Class 1

Client: Environmental Measurements
Unit 12, Tallaght Business Centre
Whitestown Business Park
Co.Dublin 24, Ireland

Instrument Make: Larson Davis
Instrument Model: LxT1L
Serial Number: 0005662

Associated Equipment	Make	Model	Serial number
Preamplifier	Larson Davis	PRMLxT1L	055659
Microphone	PCB	377B02	175331
Calibrator	Larson Davis	CAL200	9175
Calibrator supplied by	MTS for this calibration		

Test results summary, detailed results are shown on subsequent pages.

Periodic tests were performed in accordance with procedures from IEC 61672-3:2013 Class 1

Tests performed	Section	Results of test	Page	Comments
Calibration Certificate	22		1	
Additional information			2	
Indication with Calibrator Supplied	10	No Limit	3	
Self-Generated Noise	11	No Limit	3	
Frequency and Time-weightings at 1kHz	14	Complies	3	
Long term stability	15	Complies	3	
High stability	21	Complies	3	
Acoustic Tests	12	Complies	4	
Frequency Weighting A	13	Complies	5	
Frequency Weighting C	13	Complies	6	
Frequency Weighting Z	13	Complies	7	
Level Linearity	16	Complies	8	
Level Linearity Range Control	17	-	n/a	SLM only has one range
Tone burst Response	18	Complies	9	
Peak C sound level	19	Complies	10	
Overload indication	20	Complies	11	

The instrument was within the above specification as received - no modifications were made

The sound level meter submitted for testing has successfully completed the periodic tests of IEC 61672-3: 2013 for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2: 2013, to demonstrate that the model of sound level meter fully conformed to the Class 1 specifications in IEC 61672-1: 2013, the sound level meter submitted for testing conforms to the Class 1 specifications of IEC 61672-1: 2013

Additional tests performed	Reference	
Microphone full frequency response	36207	See additional certificate
Filter calibration, third octave or octave	36205F	See additional certificate

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

Figure 9.A.6: Calibration Certificate of SoundExpert® LxT (NML5)

Table 9.A.7: Photographs of Norsonic 140 Sound Level Meter at NML 1 from Northern, Southern, Easterly and Westerly Directions (02/02/2023)

North	East
	
South	**West**
	

Table 9.A.8: Photographs of Norsonic 140 Sound Level Meter at NML 2 from Northern, Southern, Easterly and Westerly Directions (02/02/2023)

North	East
	
South	**West**
	

Table 9.A.9: Photographs of Norsonic 140 Sound Level Meter and the Weather Station at NML 3 from Northern, Southern, Easterly and Westerly Directions (02/02/2023)

North	East
	
South	**West**
	

Table 9.A.10: Photographs of SoundExpert® LxT Sound Level Meter at NML 4 (12/06/2023)

SoundExpert® LxT at NML4


Table 9.A.11: Photographs of SoundExpert® LxT Sound Level Meter and Weather Station at NML 5 (12/06/2023)

SoundExpert® LxT at NML5


Noise Monitoring Survey Results

The unattended noise monitoring survey was undertaken at NML 1 – NML 5 from 2nd February 2023 to 20th June 2023 to include daytime and night time noise data, recorded in 15-minute intervals.

Recorded noise data was analysed and visualised using RPS in house software. The software is written in Python and uses advanced statistical and visualisation libraries.

The approach to analysing the recorded noise data involved compiling all observations into a single dataset for the noise monitoring location using their respective time stamps before reading into the software.

The main steps the software takes are described below:

- Total precipitation and average wind speed are used to remove instances of noise data where total precipitation, or the average wind speed exceeded 0mm and 5m/s respectively;
- Before any further analysis, all monitoring data is visualised, and any dubious records are highlighted and removed;
- Data was divided into 2 sets daytime (07:00 – 23:00hrs) and night-time (23:00- 07:00hrs)
- For day and night-time periods the noise monitoring parameter distributions were plotted for L_{Aeq} and L_{A90}.

Complete noise and weather graphs were plotted for the noise monitoring results at NML 1 – NML 5 including L_{A90} and L_{Aeq} and shown in Figure 9.A.7 - Figure 9.A.16.

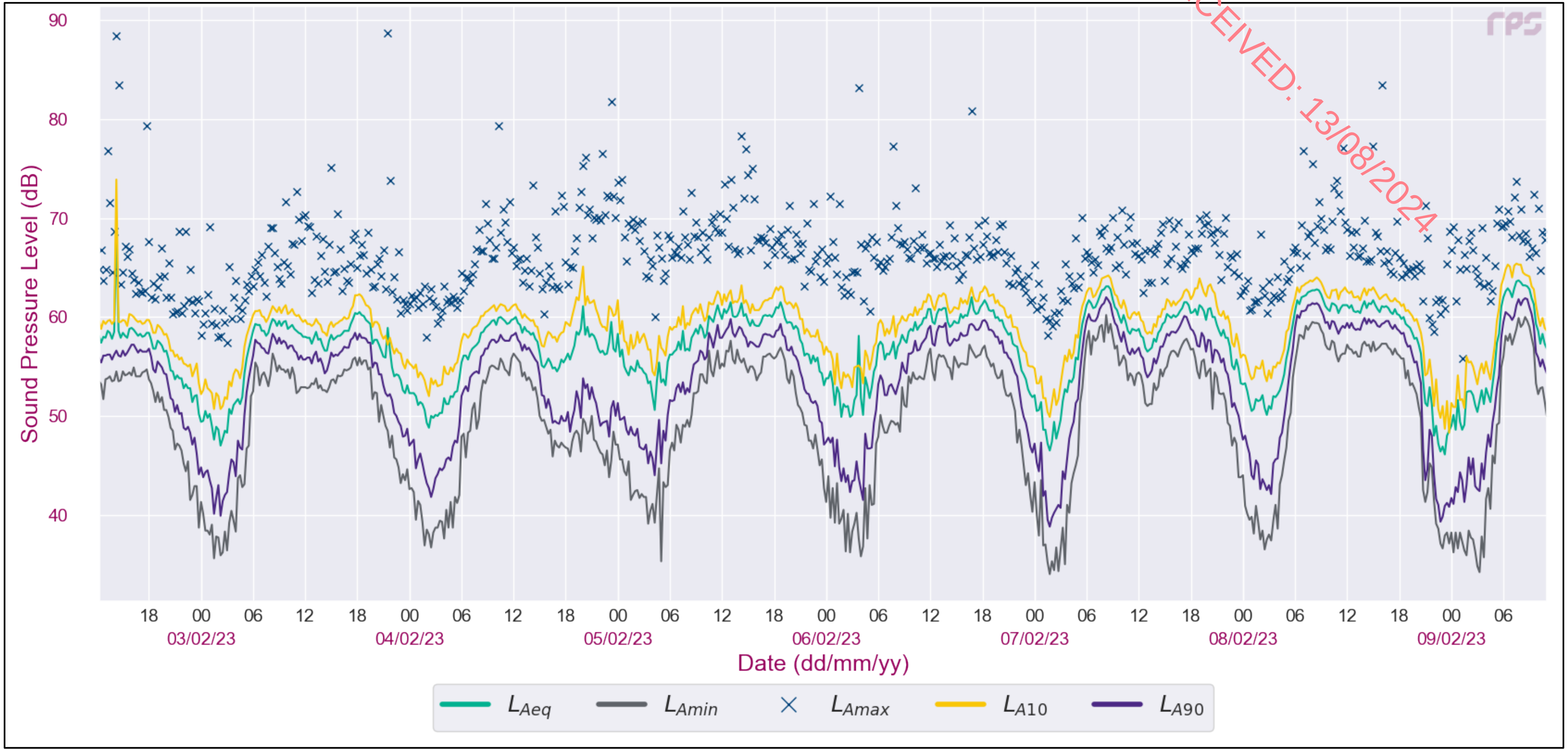

Figure 9.A.7: NML1 Complete Noise Data (02/02/2023 – 09/02/2023)

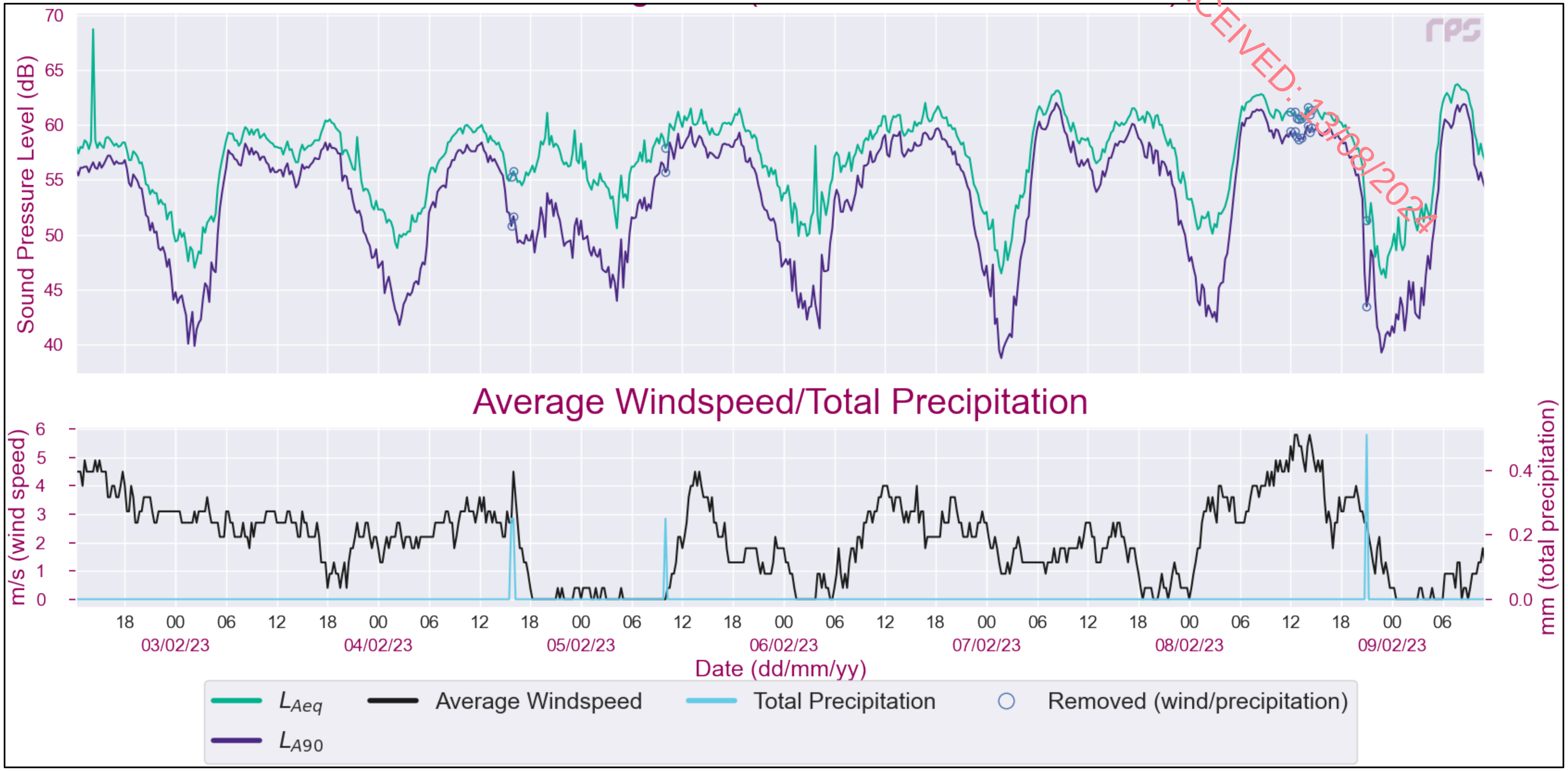

Figure 9.A.8: NML1 Complete Weather Data (02/02/2023 – 09/02/2023)

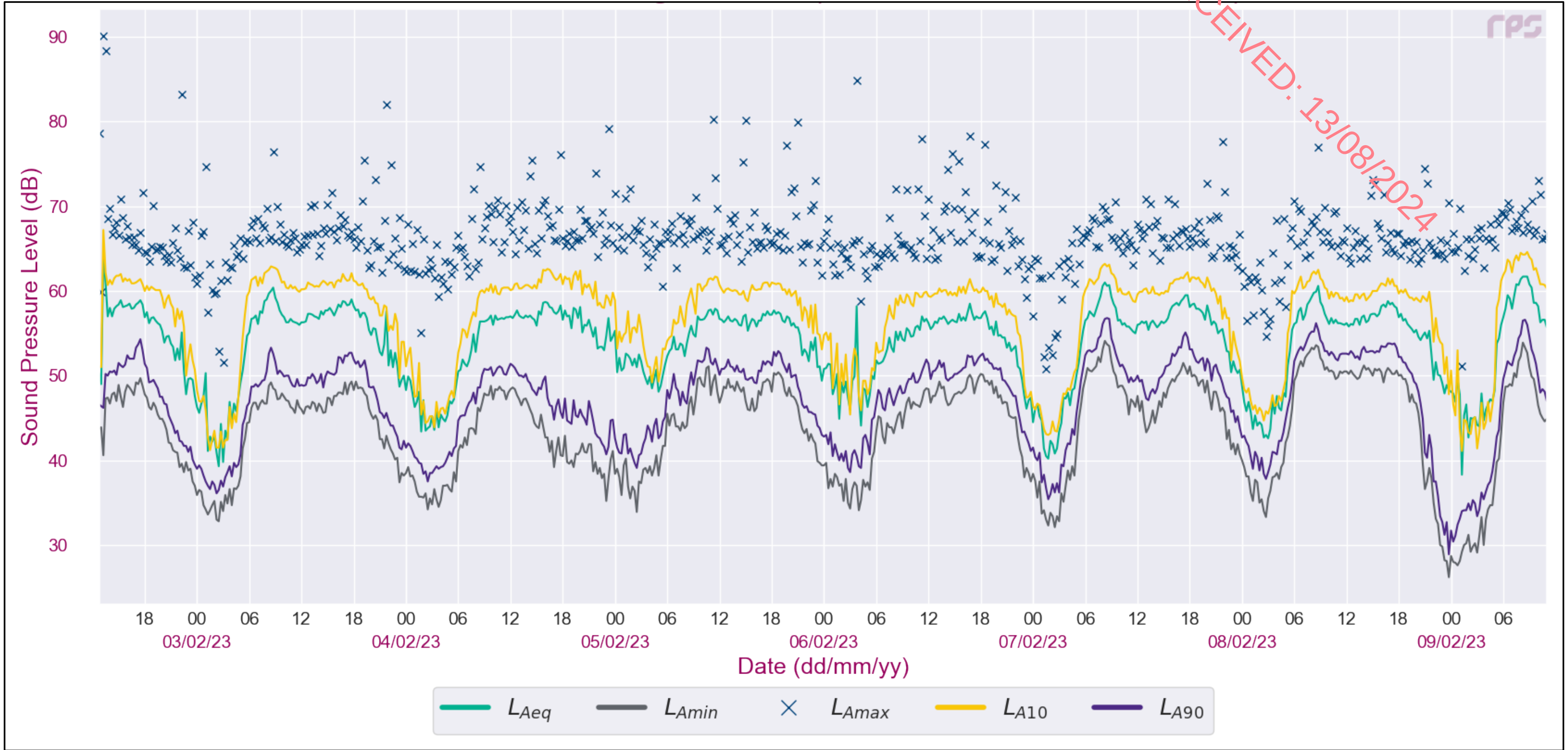

Figure 9.A.9: NML2 Complete Noise Data (02/02/2023 – 09/02/2023)

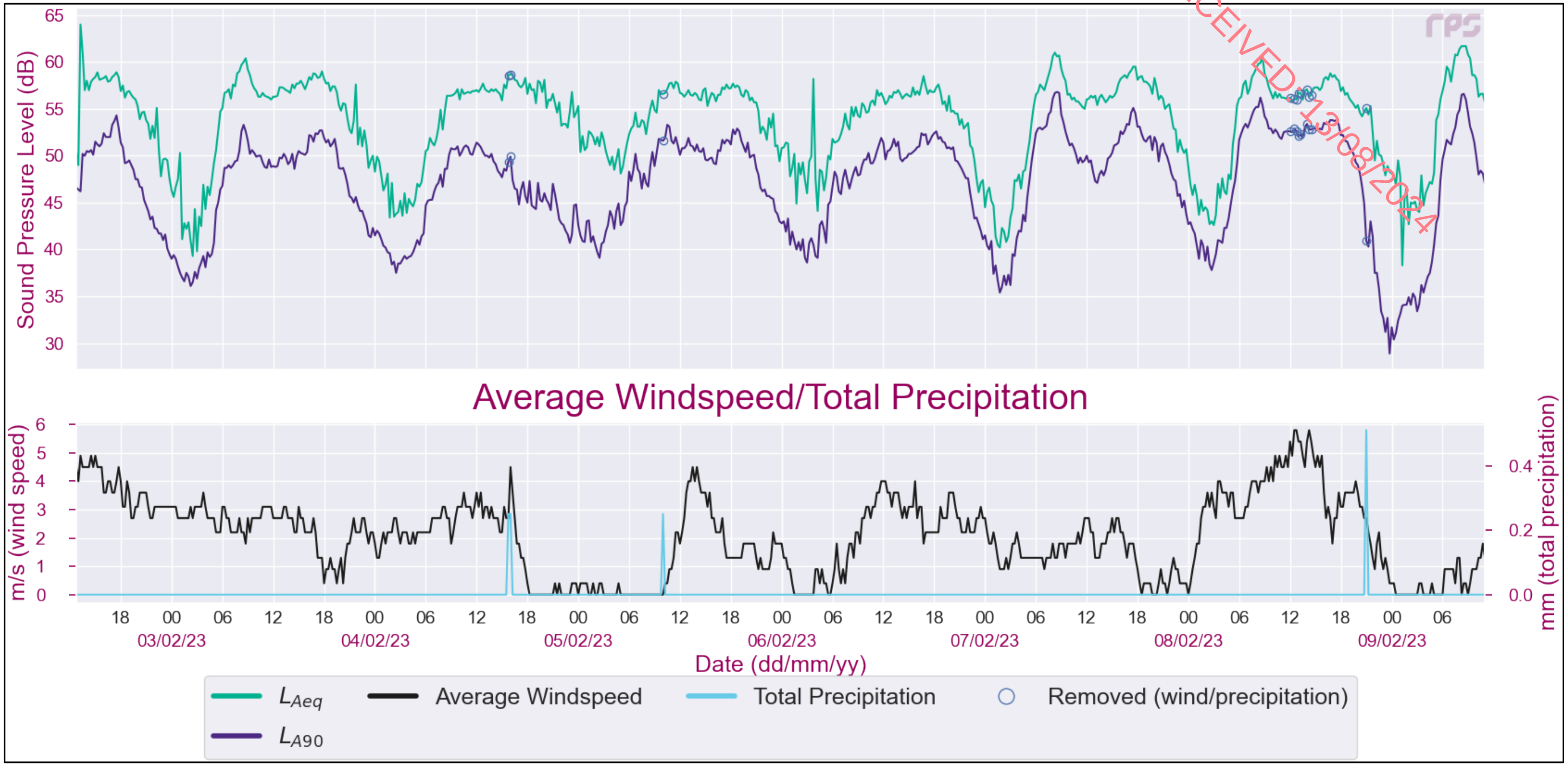

Figure 9.A.10: NML2 Complete Weather Data (02/02/2023 – 09/02/2023)

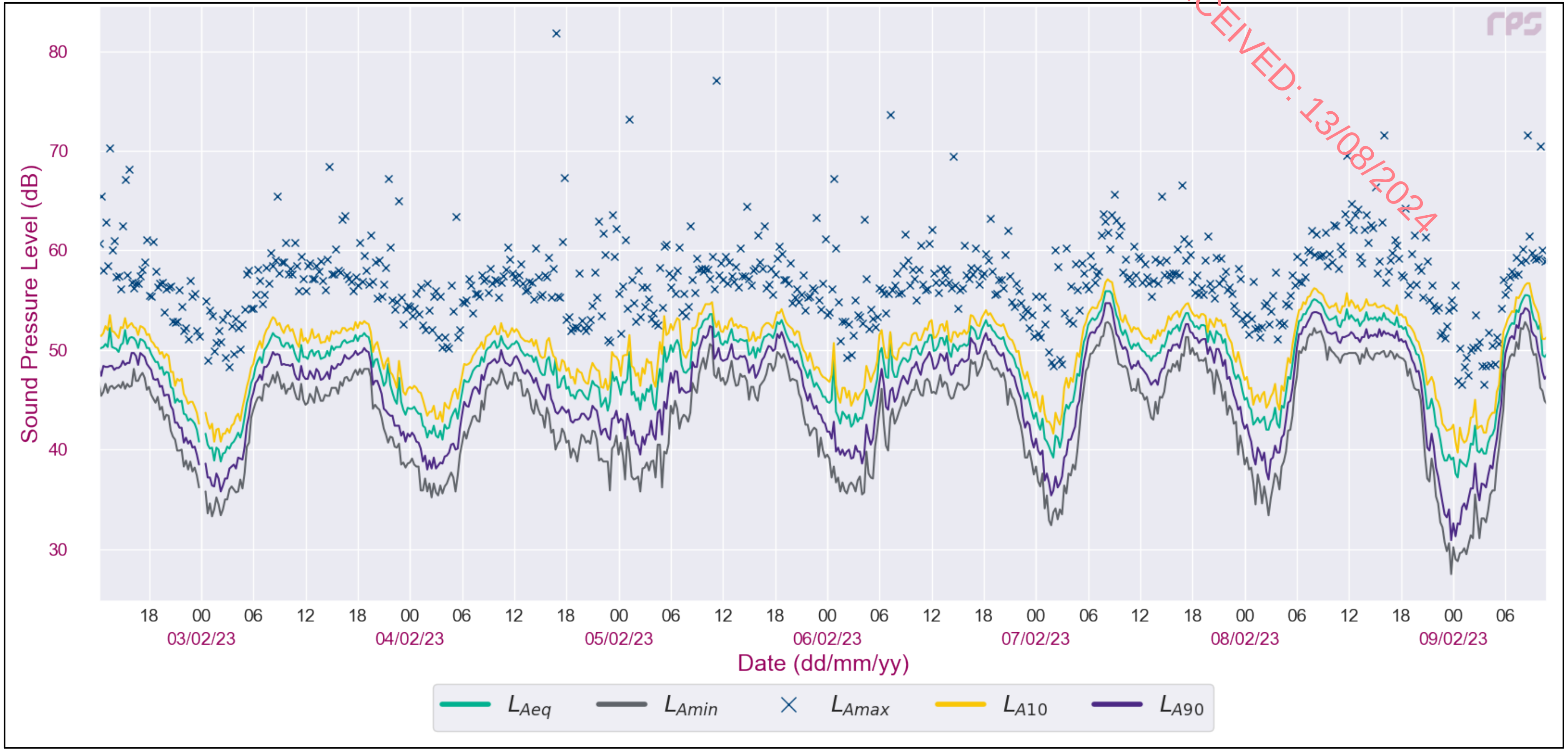

Figure 9.A11: NML3 Complete Noise Data (02/02/2023 – 09/02/2023)

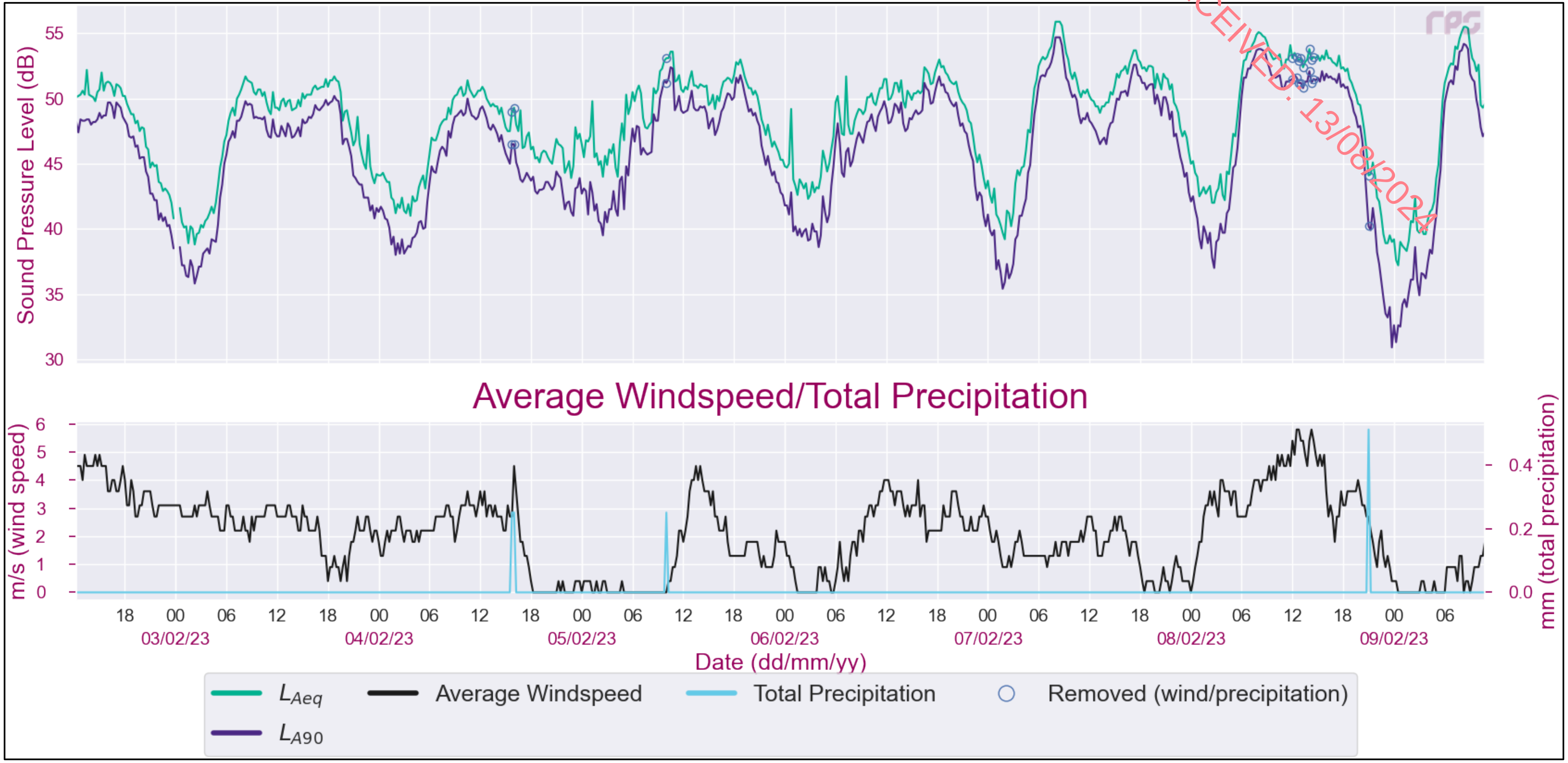

Figure 9.A.12: NML3 Complete Weather Data (02/02/2023 – 09/02/2023)

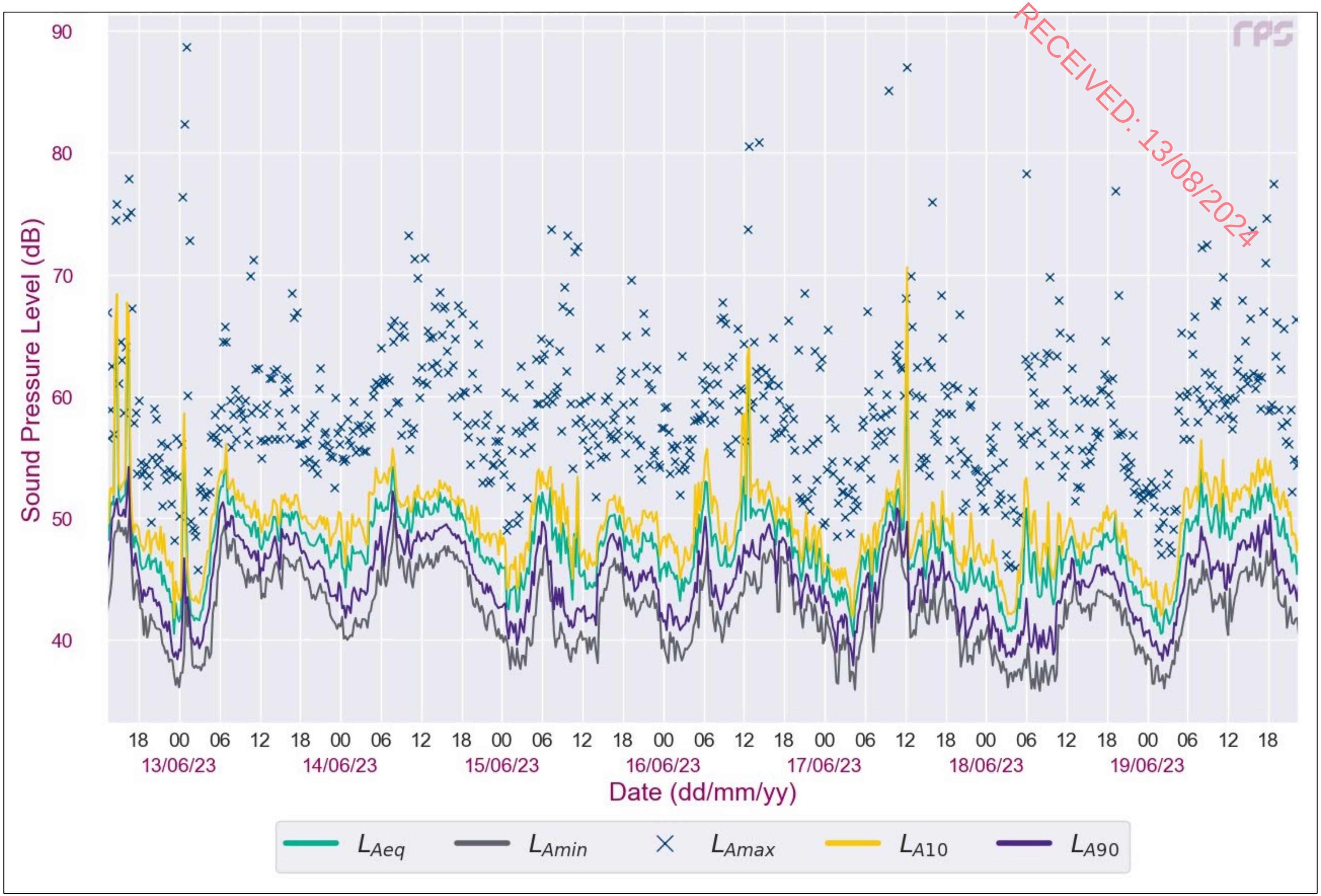

Figure 9.A.13: NML4 Complete Noise Data (12/06/2023 – 20/06/2023)

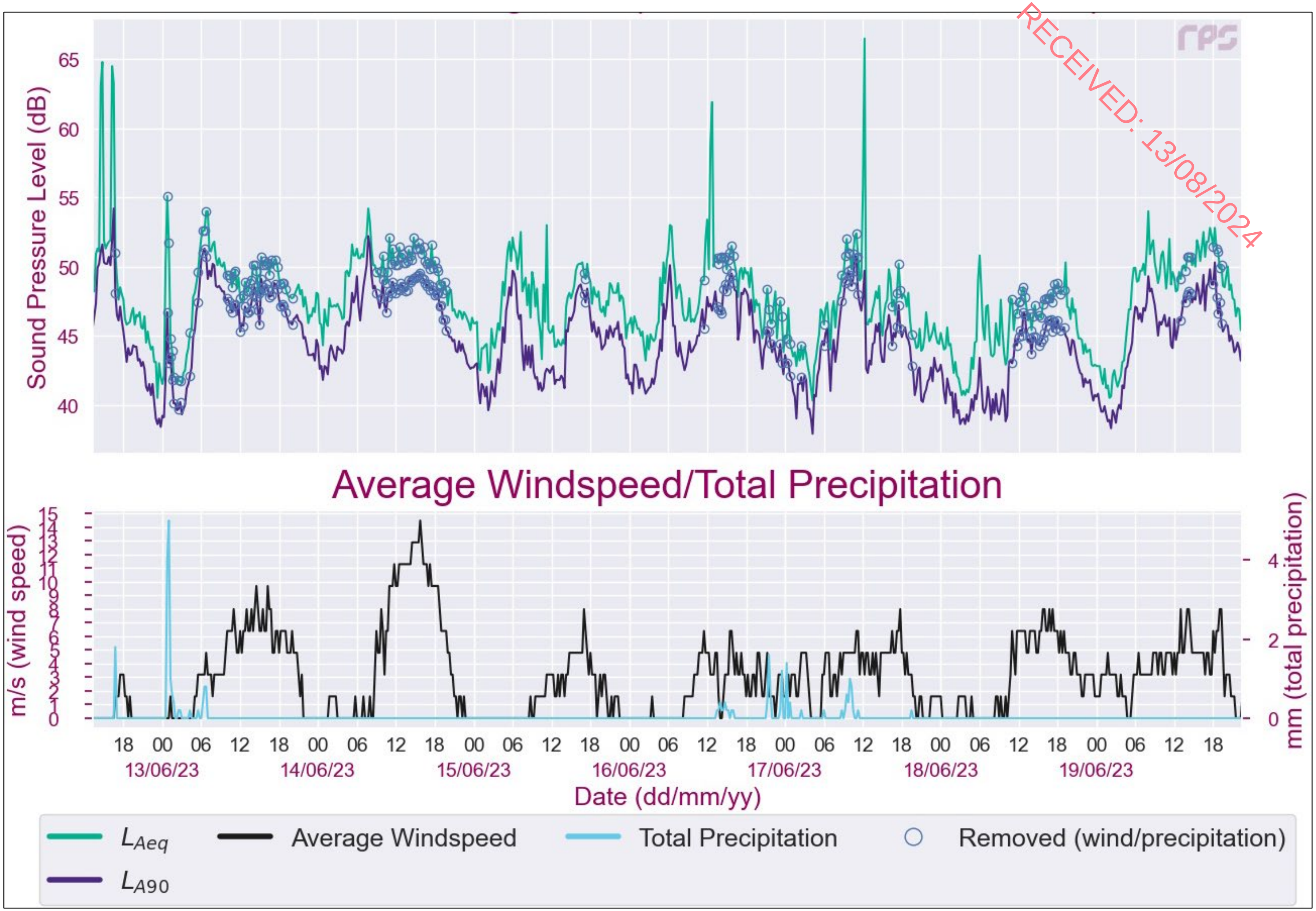

Figure 9.A.14: NML4 Complete Weather Data (12/06/2023 – 20/06/2023)

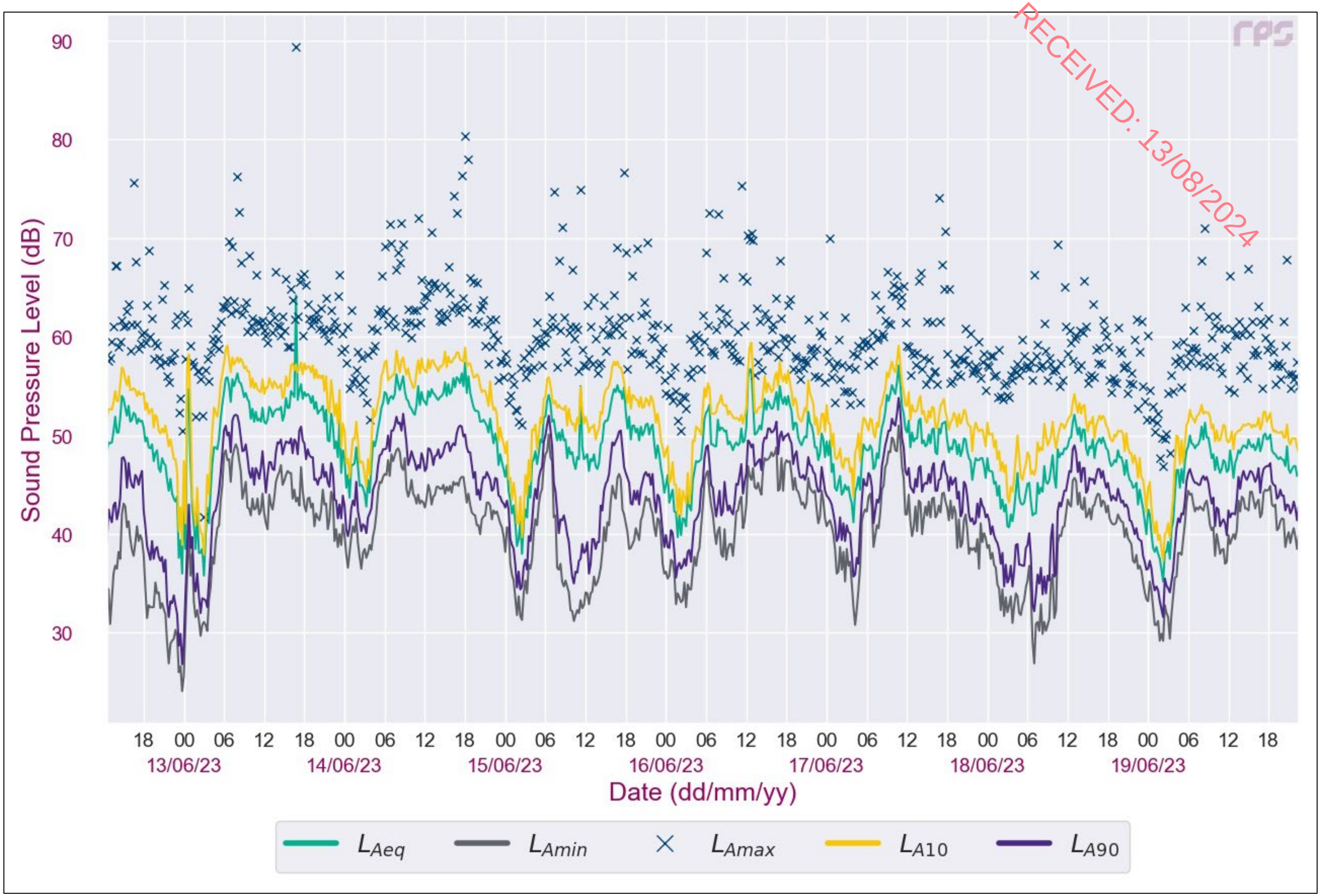

Figure 9.A.15: NML5 Complete Noise Data (12/06/2023 – 20/06/2023)

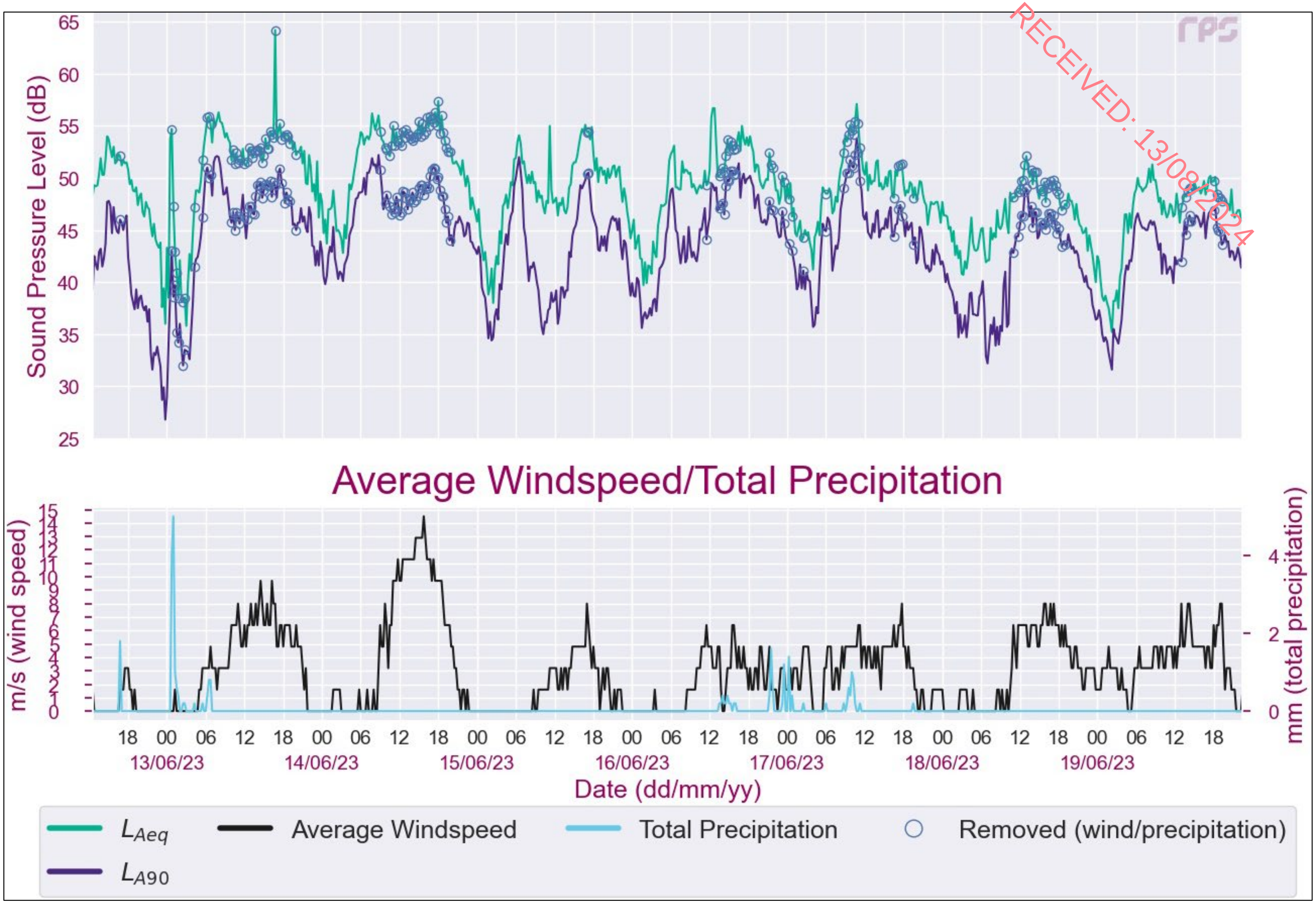

Figure 9.A.16: NML5 Complete Weather Data (12/06/2023 – 20/06/2023)

Survey Results Statistical Analysis

Noise monitoring results from NML1 – NML 5 were statistically analysed to determine the appropriate 'typical' background sound levels from both daytime and night-time noise monitoring periods.

Figure 9.A.17 and Figure 9.A.18 below show histograms of L_{Aeq} and L_{A90} results, for daytime and night-time data, from the noise monitoring survey at NML1.

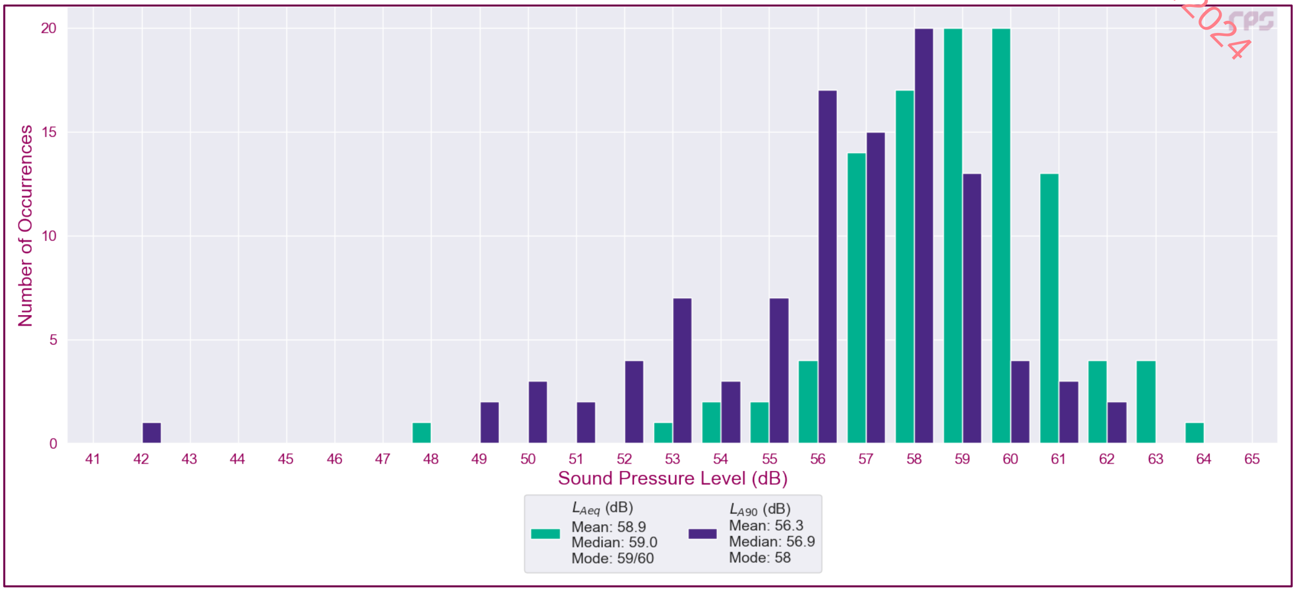

Figure 9.A.17: Histogram of Daytime $L_{Aeq,\ 1hr}$ and $L_{A90\ 1hr}$ at Noise Monitoring Location 1 (02/02/2023 – 09/02/2023)

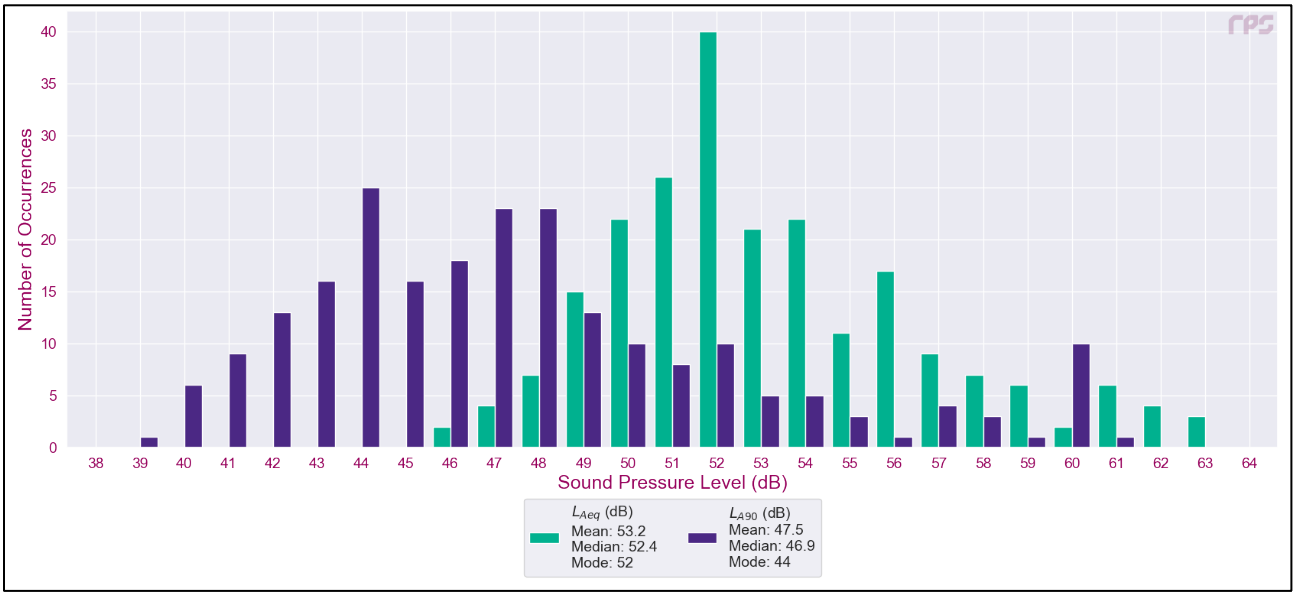

Figure 9.A.18: Histogram of Night-time $L_{Aeq,\ 15mins}$ and $L_{A90\ 15mins}$ at Noise Monitoring Location 1 (02/02/2023 – 09/02/2023)

Figure 9.A.19 and Figure 9.A.20 below show histograms of L_{Aeq} and L_{A90} results, for daytime and night-time data, from the noise monitoring survey at NML2.

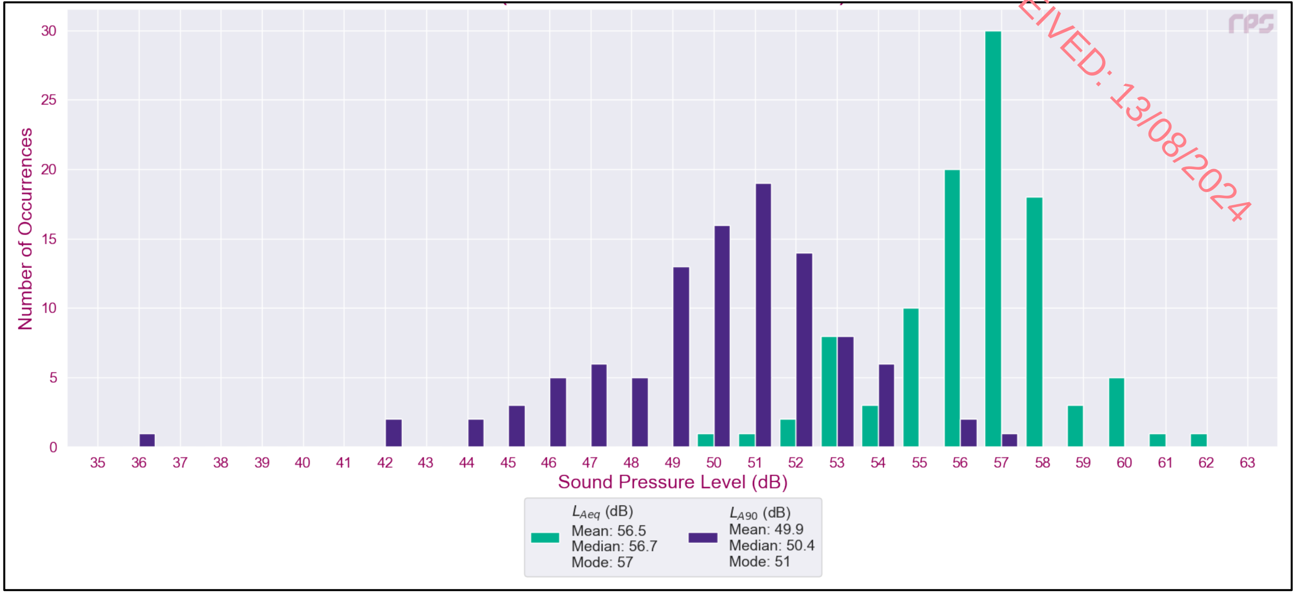

Figure 9.A.19: Histogram of Daytime $L_{Aeq,\ 1hr}$ and $L_{A90\ 1hr}$ at Noise Monitoring Location 2 (02/02/2023 – 09/02/2023)

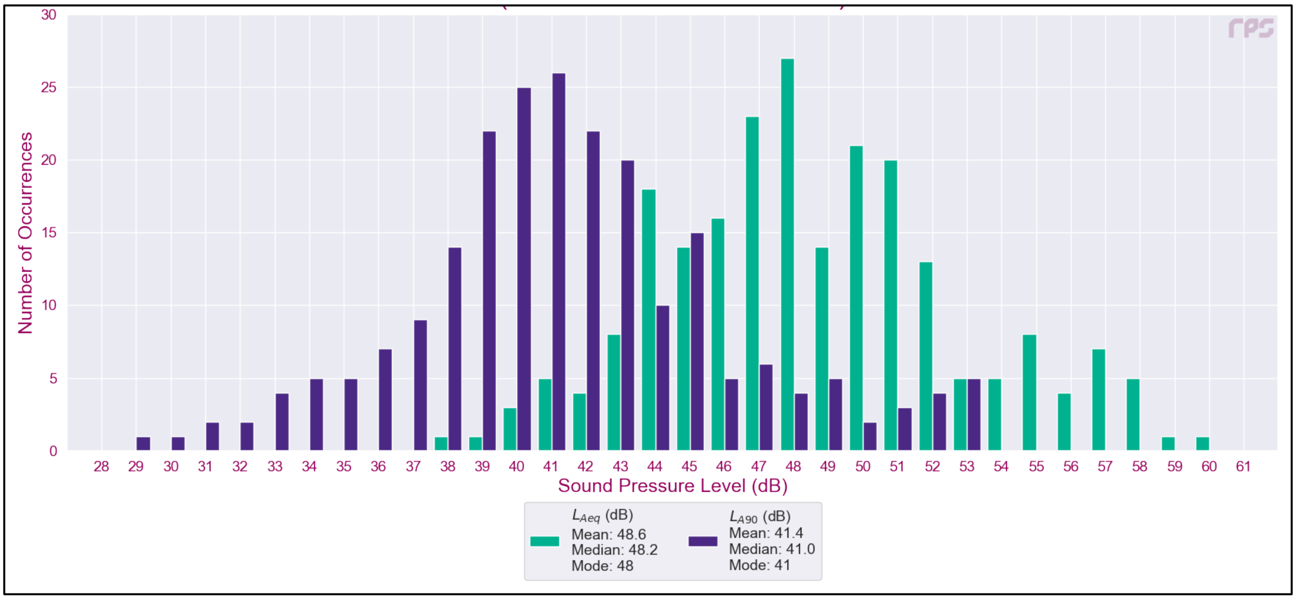

Figure 9.A.20: Histogram of Night-time $L_{Aeq,\ 15mins}$ and $L_{A90\ 15mins}$ at Noise Monitoring Location 2 (02/02/2023 – 09/02/2023)

Figure 9.A.21 and Figure 9.A.22 below show histograms of L_{Aeq} and L_{A90} results, for daytime and night-time data, from the noise monitoring survey at NML3.

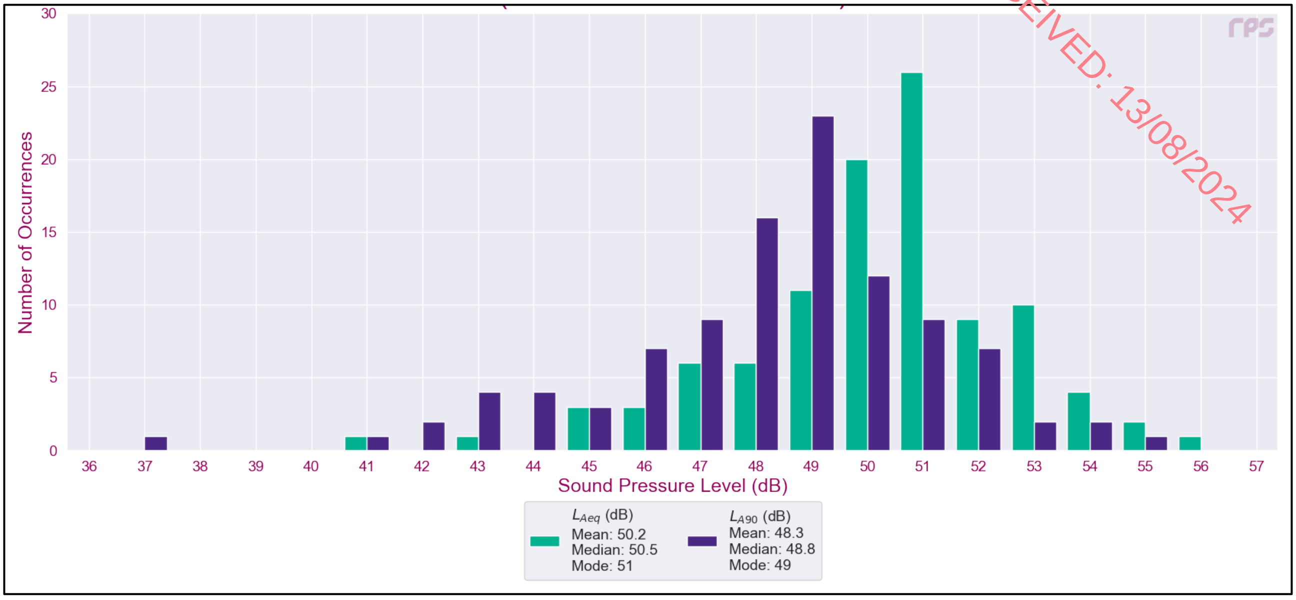

Figure 9.A.21: Histogram of Daytime $L_{Aeq,\ 1hr}$ and $L_{A90\ 1hr}$ at Noise Monitoring Location 3 (02/02/2023 – 09/02/2023)

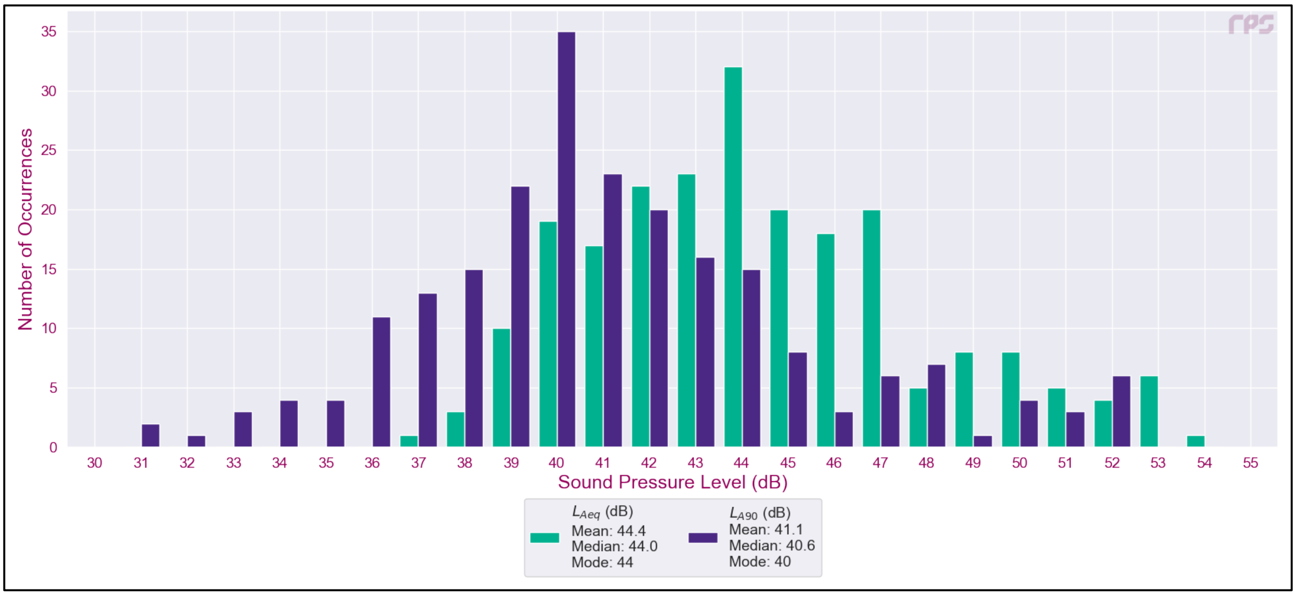

Figure 9.A.22: Histogram of Night-time $L_{Aeq,\ 15mins}$ and $L_{A90\ 15mins}$ at Noise Monitoring Location 3 (02/02/2023 – 09/02/2023)

Figure 9.A.23 and Figure 9.A.24 below show histograms of L_{Aeq} and L_{A90} results, for daytime and night-time data, from the noise monitoring survey at NML4.

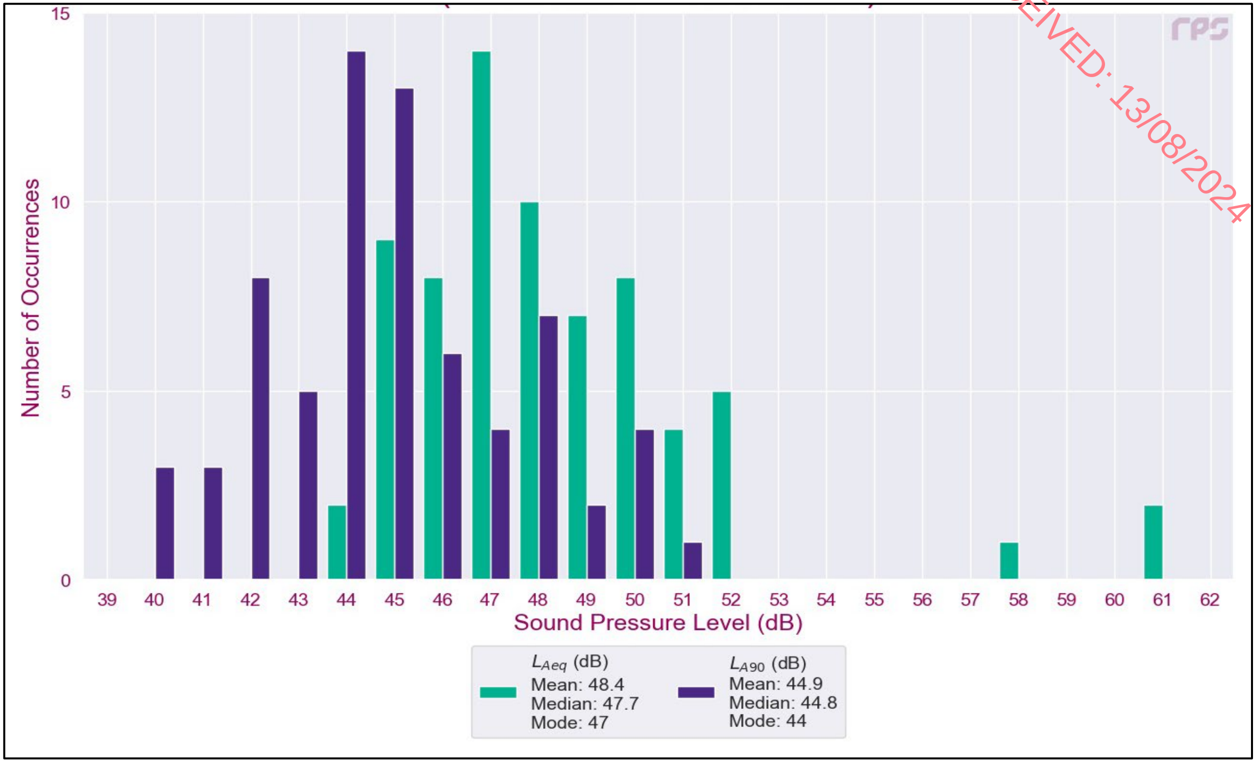

Figure 9.A.23: Histogram of Daytime $L_{Aeq,\ 1hr}$ and $L_{A90\ 1hr}$ at Noise Monitoring Location 4 (12/06/2023 – 20/06/2023)

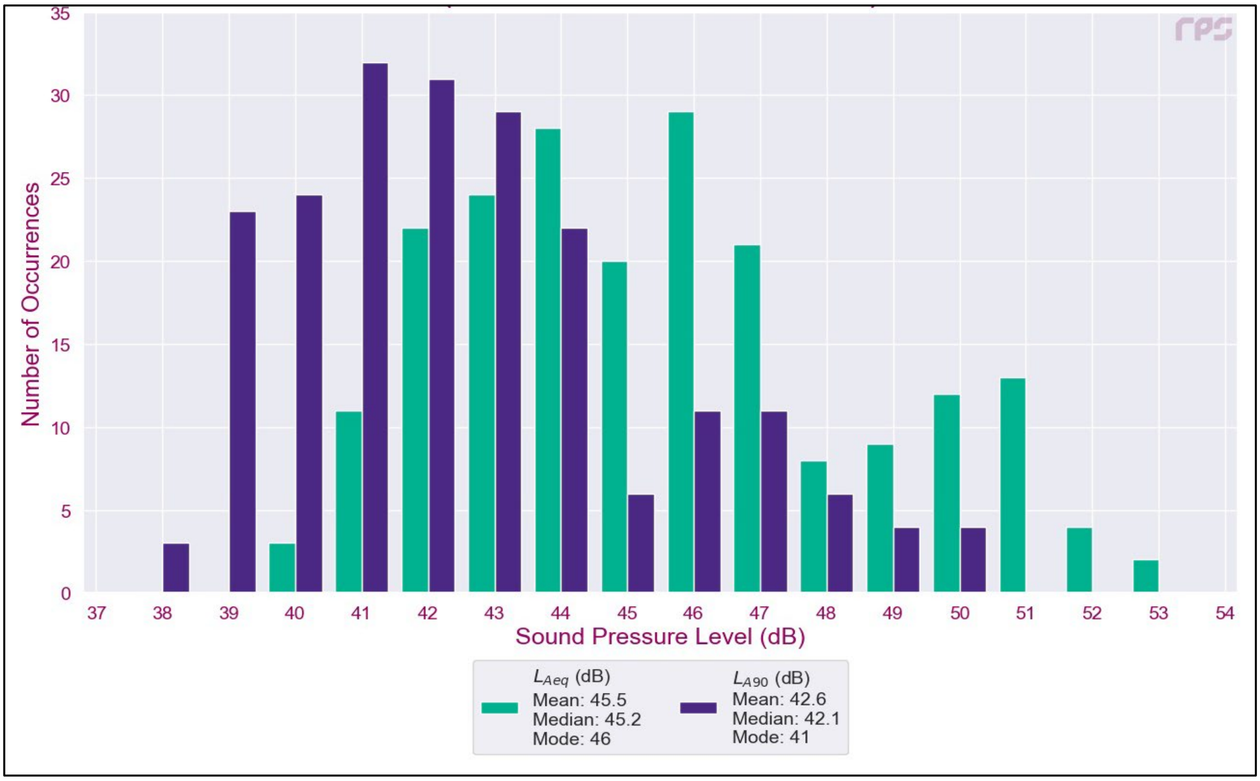

Figure 9.A.24: Histogram of Night-time $L_{Aeq,\ 15mins}$ and $L_{A90\ 15mins}$ at Noise Monitoring Location 4 (12/06/2023 – 20/06/2023)

Figure 9.A.25 and Figure 9.A.26 below show histograms of L_{Aeq} and L_{A90} results, for daytime and night-time data, from the noise monitoring survey at NML5.

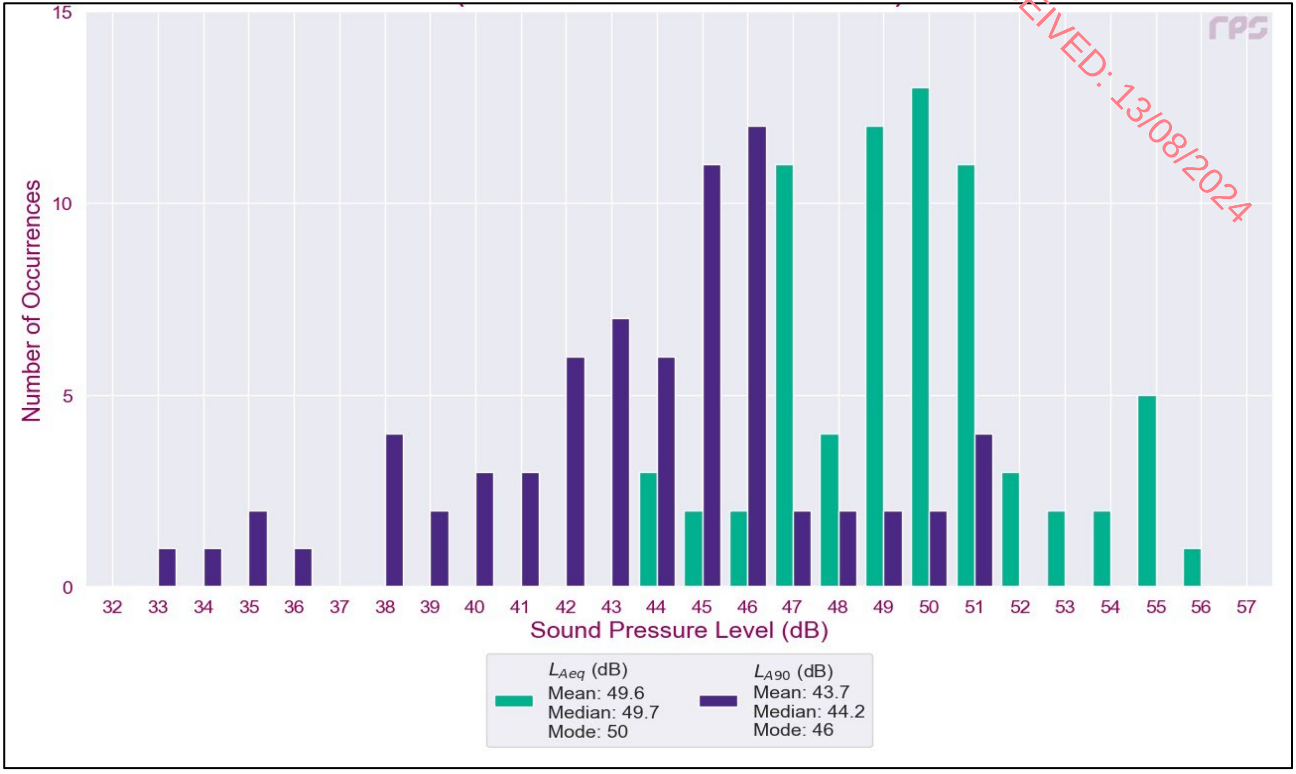

Figure 9.A.25: Histogram of Daytime $L_{Aeq,\ 1hr}$ and $L_{A90\ 1hr}$ at Noise Monitoring Location 5 (12/06/2023 – 20/06/2023)

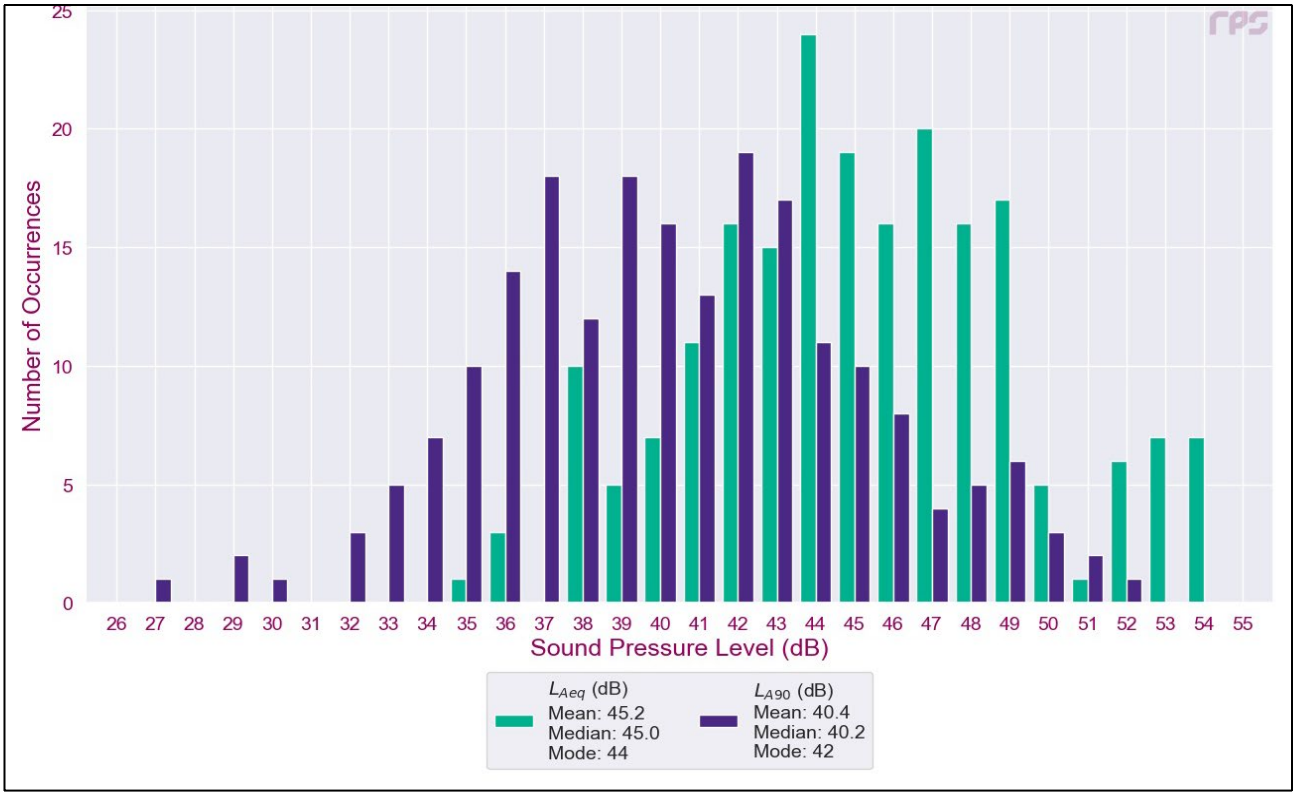

Figure 9.A.26: Histogram of Night-time $L_{Aeq,\ 15mins}$ and $L_{A90\ 15mins}$ at Noise Monitoring Location 5 (12/06/2023 – 20/06/2023)

Background Noise Summary

The histograms of typical background (L_{A90}) and ambient (L_{Aeq}) noise levels for daytime and night-time have been analysed to determine representative values for each noise monitoring location, which are summarised below in Table 9.A.12.

Table 9.A.12: Typical L_{A90} and L_{Aeq} Noise Levels at NML1 - 5

Noise Monitoring Location	L_{A90} Analysis		L_{Aeq} Analysis	
	Daytime (dB)	Night-time (dB)	Daytime (dB)	Night-time (dB)
1	58	44	59	52
2	51	41	57	48
3	49	40	51	44
4	44	41	47	46
5	46	42	50	44

Appendix 9.2

Construction and Operational Noise Sensitive Receptors

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Noise-sensitive receptors in the vicinity of the Project have been identified. The Irish Grid co-ordinates for each of the 42 receptors are shown in Table 9.B.1.

One of the five Noise Monitoring Locations (NMLs) has been assigned to each noise-sensitive receptor. The selection of representative NML has been based on distance from the Project site to the receptor, but also on proximity to existing noise sources, primarily the M7 motorway and industrial developments close to the M7. As such, typically the receptors are represented by the closest NML, however this is not always the case.

A map showing the location of the receptors in the context of the Project Site and the noise monitoring locations (NMLs) can be found in Volume III Figures and Drawings (Figure 9.1).

Table 9.B.1: Residential Receptors within 300m of Development Site

Receptor ID	Irish Grid Easting	Irish Grid Northing	Representative Noise Monitoring Location
1	286706	219893	1
2	287029	219772	1
3	287068	219791	1
4	287098	219791	1
5	287080	219883	1
6	287075	219979	1
7	287121	220007	1
8	285909	220060	5
9	285968	219333	4
10	286171	219231	4
11	286218	219186	4
12	286390	218945	4
13	286405	218835	1
14	285959	219180	4
15	286009	219188	4
16	286055	219209	4
17	286098	219199	4
18	286125	219180	4
19	286131	219155	4
20	286178	219173	4
21	286217	219136	4
22	286155	219029	4
23	285324	219573	5
24	285498	219775	5
25	285521	219808	5
26	285552	219843	5

Receptor ID	Irish Grid Easting	Irish Grid Northing	Representative Noise Monitoring Location
27	285571	219961	5
28	285476	220075	5
29	285579	220030	5
30	285725	220019	5
31	285613	220268	5
32	285677	220246	5
33	285772	220357	5
34	286041	220289	5
35	286069	220311	5
36	286296	220395	2
37	286344	220398	2
38	286394	220405	2
39	286631	220328	2
40	286543	218679	1
41	286520	218592	1
42	286781	218684	1

Appendix 9.3

Construction Noise Assessment

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Construction Phasing Summary

The activities associated with each construction phase are summarised in Table 9.C.1

Table 9.C.1: Construction Phases

Phase	Construction Activities
Phase 1	Enabling works overall construction programme ESB substation overall construction programme AGI building overall construction programme DC1 overall construction programme R409 road improvement works (including the cycle lane, pedestrian walk way to both sides of the road DC2 overall construction programme.
Phase 2	DC 3 overall construction programme DC 5 overall construction programme
Phase 3	Construct external construction compound and remove existing compound DC 6 overall construction programme DC 4 overall construction programme Site wide works overall construction programme

An indicative construction phase programme for key milestones is shown below in Table 9.C.2.

Table 9.C.2: Construction Key Milestones (Indicative)

Phases	Construction Programme	Start Date	End Date
HERBATA DATA CAMPUS OVERALL CONSTRUCTION PROGRAMME		08/01/2024	27/03/2032
Phase 1	Enabling Works Overall Construction Programme	08/01/2024	27/07/2024
	ESB Substation Overall Construction Programme	01/06/2024	28/03/2025
	AGI Building Overall Construction Programme	01/06/2024	28/07/2025
	DC 1 Overall Construction Programme	01/06/2024	17/07/2026
	R409 Road Improvement works that include the cycle lane, pedestrian walkway to both sides of the road.	08/12/2025	17/07/2026
	DC 2 Overall Construction Programme	16/07/2025	01/09/2027
Phase 2	DC 3 Overall Construction Programme	31/08/2026	16/10/2028
	DC 5 Overall Construction Programme	15/10/2027	30/11/2029
Phase 3	Construct Secondary Construction Compound around the site and remove the existing construction carpark	05/10/2029	30/01/2030
	DC 6 Overall Construction Programme	27/11/2028	13/07/2031
	DC 4 Overall Construction Programme	11/01/2030	27/08/2032
	Site Wide Works Overall Construction Programme	01/03/2031	27/09/2032

An overview of the construction phases, including the construction activities in each phase, are detailed below.

Project Phasing

Site phasing is proposed for the construction of the data centres and ancillary buildings over 3 Phases, with individual elements constructed as summarised:

- Existing trees/hedgerows that are to be retained will be protected
- Prior to the commencement of any work, or any materials being brought on site, existing trees to be retained are to be protected with temporary fencing.
- Phase 1 includes Data Centre 1 & 2, the AGI compound, District Heating building, Admin Workshop, Water Treatment Plant, Security House and the main road network through the site.
- Phase 1 also includes Pond 1, 2, 3A & 3B and landscaping surrounding DC 1 & 2, AGI compound and planting along the boundaries of the site.
- The GIS substation located in the north of the site and partial undergrounding of EirGrid's 110 KVA overhead lines will also be completed in Phase 1.
- Phase 2 will include the construction of Data Centre 3 & 5 and the District Heating Building.
- Phase 2 also includes landscaping surrounding DC 3 & 5 and their roads. Pond 5 will also be constructed in Phase 2.
- Phase 3 will include Data Centre 4 & 6, their roads and surrounding landscaping.
- Phase 3 will also include ponds 4, 6A & 6B

The proposed construction programme is an estimated 8 years and 9 months; on the basis of a commencement date of January 2024 (subject to obtaining all necessary consents), anticipated completion date is September/October 2032.

Error! Reference source not found. illustrates the relevant construction phases of the Proposed Development.

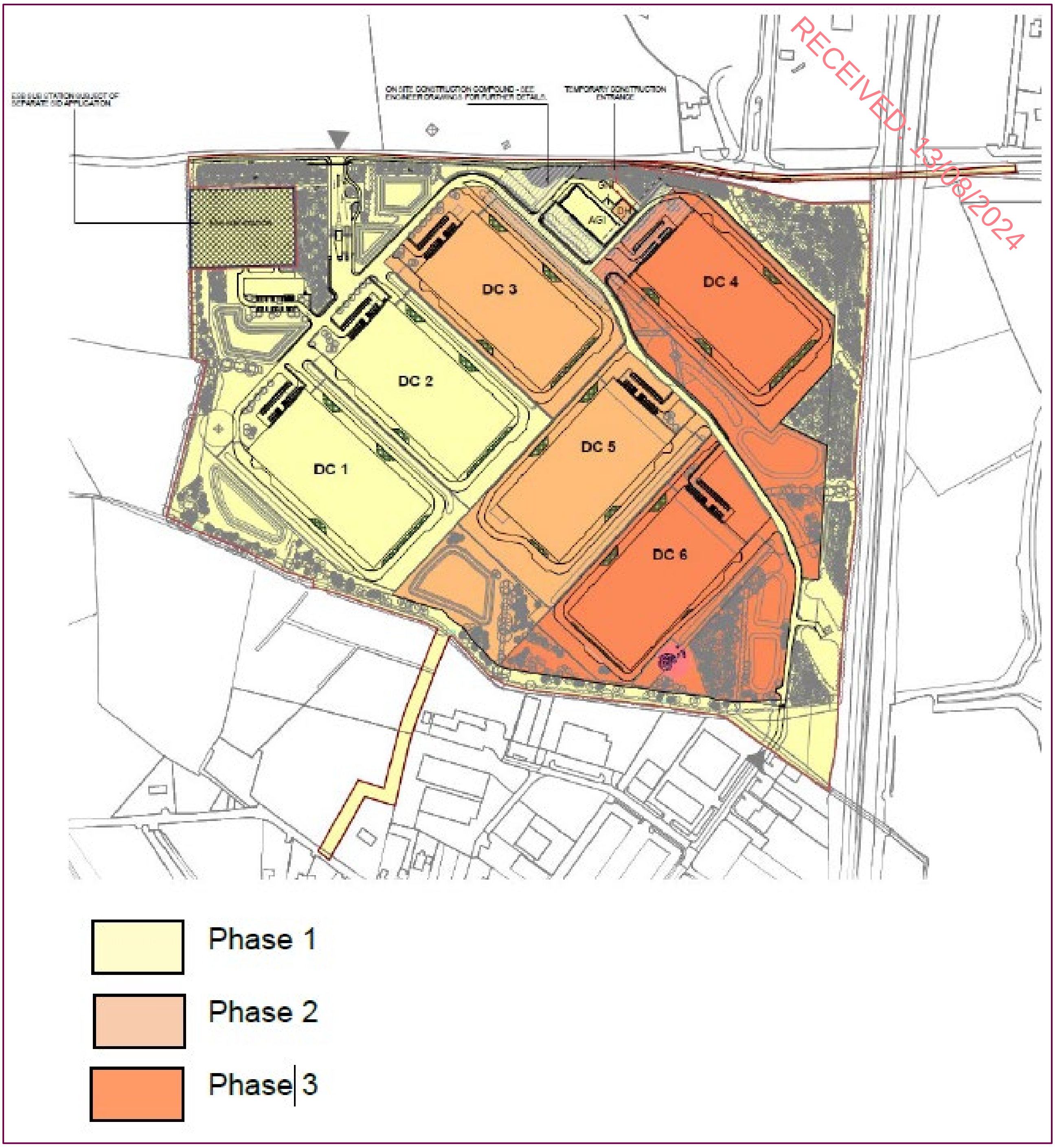

Figure 9.D. 1: Proposed Development Construction Phasing

Construction Noise Receptors and Distances

Construction Noise Receptors

The construction noise receptor locations[1] are detailed in **Error! Reference source not found.** with a list of their identification references (ID's), and location coordinates. The majority of construction noise receptors identified within the noise study area are residential properties.

A visual of noise sensitive receptors is illustrated in Volume III Figure 9.1.

For each construction stage/activity, predictions of received sound pressure level have been carried out for the closest noise-sensitive receptor only. All other receptors would be expected to experience a lower sound pressure level.

[1] (N. B. Addresses of the construction noise receptors have not been included due to General Data Protection Regulations (GDPR) and publication of personal data).

Distances for Phase 1 Construction Activity

The construction noise receptor locations and associated distances in relation to the Phase 1 construction activities are summarised in Table 9.C.3.

Table 9.C.3: Distances from Receptors to Phase 1 Site Preparation Activities

Noise Sensitive Receptor	Distance to DC1 (m)	Distance to DC2 (m)	Distance to AGI (m)
1	70	84	84
2	172	354	355
3	213	393	393
4	243	423	424
5	258	415	415
6	316	442	443
7	368	496	497
8	269	586	758
9	275	698	815
10	215	616	727
11	213	625	732
12	347	787	871
13	416	892	972
14	395	798	914
15	361	757	871
16	317	709	823
17	293	687	800
18	283	685	796
19	295	701	811
20	249	659	767

Noise Sensitive Receptor	Distance to DC1 (m)	Distance to DC2 (m)	Distance to AGI (m)
21	256	669	773
22	380	792	897
23	722	1172	1325
24	567	966	1129
25	555	941	1106
26	539	908	1075
27	571	895	1066
28	692	1007	1179
29	581	897	1069
30	436	751	924
31	623	940	1110
32	556	872	1042
33	544	848	1011
34	333	599	753
35	344	596	745
36	433	546	666
37	447	533	645
38	465	528	629
39	455	458	498
40	500	1037	1102
41	590	1124	1191
42	497	1057	1099

Table 9.C.4: Distances from Receptors to Phase 1 Construction Activities

Noise Sensitive Receptor	Distance to DC1 (m)	Distance to DC2 (m)	Distance to AGI (m)	Distance to ESB SUB (m)	Distance to Underground Services (m)	Distance to Internal Roads and Parking (m)	Distance to R409 Improvement Works(m)
1	502	370	147	443	645	227	52
2	751	625	437	780	657	559	46
3	794	668	476	815	696	595	89
4	823	697	506	845	716	625	118
5	833	702	495	817	776	600	154
6	867	734	516	812	854	604	235
7	921	788	569	860	902	655	280
8	472	489	660	299	1076	313	257
9	330	460	750	574	609	313	681
10	317	413	680	623	390	277	729
11	357	439	691	663	339	313	757
12	622	667	856	916	285	573	934
13	731	778	961	1026	373	683	1031
14	448	571	856	722	597	423	831
15	414	533	816	700	548	386	811
16	374	489	769	668	503	343	780
17	365	474	749	666	460	331	780
18	376	479	748	680	432	339	791
19	399	499	765	704	426	361	813
20	373	464	723	679	379	332	782
21	407	488	735	713	342	363	805
22	518	608	859	825	427	477	926
23	833	952	1236	894	1295	813	928
24	666	768	1036	676	1216	643	690

Noise Sensitive Receptor	Distance to DC1 (m)	Distance to DC2 (m)	Distance to AGI (m)	Distance to ESB SUB (m)	Distance to Underground Services (m)	Distance to Internal Roads and Parking (m)	Distance to R409 Improvement Works(m)
25	651	748	1011	649	1214	626	659
26	629	722	979	615	1206	594	620
27	658	733	968	603	1260	593	585
28	796	863	1081	720	1406	713	684
29	686	751	971	609	1298	602	578
30	561	614	825	465	1179	458	431
31	817	849	1013	657	1431	675	610
32	759	786	945	590	1371	610	543
33	796	801	917	582	1393	620	530
34	615	598	664	371	1188	432	318
35	628	604	659	382	1194	438	330
36	694	625	597	460	1188	473	423
37	704	627	581	475	1179	470	438
38	721	636	571	493	1175	476	456
39	742	627	477	542	1075	461	447
40	922	954	1103	1208	497	873	1143
41	996	1034	1191	1287	585	948	1232
42	1025	1028	1118	1283	535	973	1087

Distances for Phase 2 Construction Activities

The construction noise receptor locations and associated distances in relation to the Phase 2 construction activities are summarised in Table 9.C.5.

Table 9.C.5: Distances from Receptors to Phase 2 Construction Activities

Noise Sensitive Receptor	Distance to DC3 (m)	Distance to DC5 (m)
1	238	313
2	505	500
3	546	543
4	576	571
5	575	598
6	603	645
7	657	699
8	539	712
9	593	506
10	528	391
11	545	389
12	738	545
13	846	653
14	699	592
15	660	546
16	613	496
17	595	467
18	596	459
19	614	471
20	575	425
21	591	429
22	714	552
23	1076	1094
24	880	945

Noise Sensitive Receptor	Distance to DC3 (m)	Distance to DC5 (m)
25	857	931
26	827	910
27	824	937
28	945	1073
29	833	961
30	690	830
31	901	1071
32	834	1008
33	827	1024
34	599	813
35	603	818
36	576	798
37	568	788
38	567	785
39	518	702
40	1006	809
41	1090	894
42	1050	860

Distances for Phase 3 Construction Activities

The construction noise receptor locations and associated distances in relation to the Phase 3 construction activities are summarised in Table 9.C.6.

Table 9.C.6: Distances from Receptors to Phase 3 Construction Activities

Noise Sensitive Receptor	Distance to DC6 (m)	Distance to Phase DC4 (m)	Distance to external construction compound (m)
1	413	118	187
2	529	298	67
3	572	341	100
4	598	369	129
5	633	394	100
6	692	439	152
7	745	493	203
8	837	769	998
9	503	749	1011
10	353	631	894
11	336	624	887
12	425	727	970
13	528	824	1060
14	561	835	1095
15	514	789	1050
16	463	738	1000
17	431	709	971
18	419	699	962
19	426	710	973
20	377	663	926
21	364	660	923
22	480	781	1043
23	1146	1289	1560

Noise Sensitive Receptor	Distance to DC6 (m)	Distance to Phase DC4 (m)	Distance to external construction compound (m)
24	1023	1107	1372
25	1014	1086	1349
26	998	1057	1319
27	1037	1058	1310
28	1177	1179	1423
29	1067	1068	1313
30	942	924	1167
31	1192	1127	1342
32	1131	1060	1274
33	1154	1040	1222
34	948	792	949
35	954	788	933
36	937	728	791
37	927	707	757
38	922	690	726
39	829	553	519
40	675	945	1156
41	761	1034	1246
42	722	938	1100

Construction Noise Predictions

The noise sources associated with construction activities have been identified for each construction phase and are detailed in Table 9.C.7. The assumed construction plant shown is generally representative of the type of plant that will be in use for the construction phase of the Proposed Scheme. The sound pressure level at 10m is shown for each item,

Table 9.C.7: Construction Plant Noise Levels (REF: BS 5228:2009+A1:2014)

Construction Activity	Plant	Reference from Annex C & D BS5228	Sound Pressure Level at 10m dB(A)
Site Establishment and Clearance	Chainsaws for vegetation clearance	D.2.14	86
	Breaker on Wheeled Backhoe	C.1.2	92
	Pneumatic Breaker	C.5.6	95
	Rock Breaker	C.9.12	93
	Excavator	C.2.3	80
	Tipper Truck	C.2.30	85
	Dozer	C.2.1	79
	Tractor and Trailer	C.4.75	93
	Dump Truck	C.4.5	63
	Water Pump	C.4.88	68
Foundations	Rotary Bore Piling	C.3.14	83
	Concrete Pump	C.3.25	78
	Tracked excavator (inserting cylindrical metal cage)	C.3.24	78
	Cement Poker Vibrator	C.4.33	78
Building Construction	Tower Crane	C.4.48	76
	Lorry	D.3.59	87
	Diesel Generator (Welding)	C.4.85	66
	Diesel Generator (Lighting)	C.4.86	65
	Angle Grinder	C.4.93	80
	Nail Gun	C.4.95	73
	Circular Saw	C.4.73	84
Landscaping	Dozer	C.2.1	77
	Dump Truck	C.4.4	63
	Excavator	C.2.3	75
	Compactor	C.5.25	75

The construction noise predictions are based on the following assumptions:

- Full power operation of each construction activity throughout the daytime period;
- Ground absorption, barrier effects and atmospheric absorption are ignored;
- Construction plant is assumed to be operational at closest point to the closest receptors;

Cumulative sound pressure level during each construction activity has been predicted, based on the distance between the closest point of the construction phase boundary and the nearest receptor. The cumulative sound pressure level has been derived by logarithmically adding the contribution from each of the noise sources identified. As details of construction methodology will not be available until after a contractor has been appointed the number of items of plant and effect of combinations of activities is unknown. As such, it is assumed that only one item of each is operational simultaneously during each activity, operating for 100% of the assessment period.

Predicted Construction Noise Impacts

Predicted Noise Effects Phase 1 Construction Activities

Predicted noise levels due to each activity within Phase 1 are presented in the following tables. The predicted sound pressure levels illustrate the worst-case predicted levels from the various construction activities. These worst-case predicted noise levels assume a level of simultaneous activity of plant/equipment close to the receptor. This is unlikely to occur in practice but the predictions present potential worst-case noise levels that may occur during the construction phase.

A list of all prediction results tables is shown below for reference:

Phase 1

Phase 2

Phase 3

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Table 9.C.8: Predicted Noise Levels of Construction Phase 1 at Closest Receptor (Assumes 1 of Each Item of Plant)

Description of Activity	Closest Receptor	Item Of Plant	Distance Attenuation, dB	Sound Pressure Level @ 10m, dB $L_{Aeq,\,T}$		Predicted Sound Pressure Level at Receptor, dB $L_{Aeq,\,T}$		Predicted Cumulative Sound Pressure Level at Receptor, dB $L_{Aeq,\,T}$	
				100% Utilisation	50% Utilisation	100 % Utilisation	50 % Utilisation	100 % Utilisation	50 % Utilisation
Site Clearance and Preparation	1	Chainsaws for vegetation clearance	17	86	83	69	66	83	80
		Breaker on Wheeled Backhoe		92	89	75	89		
		Pneumatic Breaker		95	92	78	92		
		Rock Breaker		93	90	76	90		
		17T Excavator		80	77	63	77		
		Tipper Truck		85	82	68	82		
		Dozer		79	76	62	76		
		Tractor and Trailer		93	90	76	90		
		Dumper		63	60	46	60		
Construction of DC1	10	Rotary Bore Piling	30	83	80	53	50	61	58
		Concrete Pump		78	75	48	45		
		Tracked excavator (inserting cylindrical metal cage)		78	75	48	45		
		Cement Poker Vibrator		78	75	48	45		
		Tower Crane		76	73	46	43		
		Lorry		87	84	57	54		
		Diesel Generator (Welding)		66	63	36	33		
		Diesel Generator (Lighting)		65	62	35	32		
		Angle Grinder		80	77	50	47		
		Nail Gun		73	70	43	40		
		Circular Saw		84	81	54	51		

Description of Activity	Closest Receptor	Item Of Plant	Distance Attenuation, dB	Sound Pressure Level @ 10m, dB $L_{Aeq, T}$ 100% Utilisation	Sound Pressure Level @ 10m, dB $L_{Aeq, T}$ 50% Utilisation	Predicted Sound Pressure Level at Receptor, dB $L_{Aeq, T}$ 100 % Utilisation	Predicted Sound Pressure Level at Receptor, dB $L_{Aeq, T}$ 50 % Utilisation	Predicted Cumulative Sound Pressure Level at Receptor, dB $L_{Aeq, T}$ 100 % Utilisation	Predicted Cumulative Sound Pressure Level at Receptor, dB $L_{Aeq, T}$ 50 % Utilisation
Construction of DC2	1	Rotary Bore Piling	31	83	80	52	49	60	57
		Concrete Pump		78	75	47	44		
		Tracked excavator (inserting cylindrical metal cage)		78	75	47	44		
		Cement Poker Vibrator		78	75	47	44		
		Tower Crane		76	73	45	42		
		Lorry		87	84	56	53		
		Diesel Generator (Welding)		66	63	35	32		
		Diesel Generator (Lighting)		65	62	34	31		
		Angle Grinder		80	77	49	46		
		Nail Gun		73	70	42	39		
		Circular Saw		84	81	53	50		
Construct AGI	1	Rotary Bore Piling	23	83	80	60	57	68	65
		Concrete Pump		78	75	55	52		
		Tracked excavator (inserting cylindrical metal cage)		78	75	55	52		
		Cement Poker Vibrator		78	75	55	52		
		Tower Crane		76	73	53	50		
		Lorry		87	84	64	61		
		Diesel Generator (Welding)		66	63	43	40		
		Diesel Generator (Lighting)		65	62	42	39		
		Angle Grinder		80	77	57	54		
		Nail Gun		73	70	50	47		
		Circular Saw		84	81	61	58		

Description of Activity	Closest Receptor	Item Of Plant	Distance Attenuation, dB	Sound Pressure Level @ 10m, dB $L_{Aeq, T}$		Predicted Sound Pressure Level at Receptor, dB $L_{Aeq, T}$		Predicted Cumulative Sound Pressure Level at Receptor, dB $L_{Aeq, T}$	
				100% Utilisation	50% Utilisation	100 % Utilisation	50 % Utilisation	100 % Utilisation	50 % Utilisation
Construct ESB SUB	8	Rotary Bore Piling	30	83	80	53	50	61	58
		Concrete Pump		78	75	48	45		
		Tracked excavator (inserting cylindrical metal cage)		78	75	48	45		
		Cement Poker Vibrator		78	75	48	45		
		Tower Crane		76	73	46	43		
		Lorry		87	84	57	54		
		Diesel Generator (Welding)		66	63	36	33		
		Diesel Generator (Lighting)		65	62	35	32		
		Angle Grinder		80	77	50	47		
		Nail Gun		73	70	43	40		
		Circular Saw		84	81	54	51		
Construct Underground Services	12	Rotary Bore Piling	29	83	80	54	51	62	59
		Concrete Pump		78	75	49	46		
		Tracked excavator (inserting cylindrical metal cage)		78	75	49	46		
		Cement Poker Vibrator		78	75	49	46		
		Tower Crane		76	73	47	44		
		Lorry		87	84	58	55		
		Diesel Generator (Welding)		66	63	37	34		
		Diesel Generator (Lighting)		65	62	36	33		
		Angle Grinder		80	77	51	48		
		Nail Gun		73	70	44	41		
		Circular Saw		84	81	55	52		

Description of Activity	Closest Receptor	Item Of Plant	Distance Attenuation, dB	Sound Pressure Level @ 10m, dB $L_{Aeq, T}$		Predicted Sound Pressure Level at Receptor, dB $L_{Aeq, T}$		Predicted Cumulative Sound Pressure Level at Receptor, dB $L_{Aeq, T}$	
				100% Utilisation	50% Utilisation	100 % Utilisation	50 % Utilisation	100 % Utilisation	50 % Utilisation
Construct Internal Roads and Parking	1	Rotary Bore Piling	27	83	80	56	53	64	61
		Concrete Pump		78	75	51	48		
		Tracked excavator (inserting cylindrical metal cage)		78	75	51	48		
		Cement Poker Vibrator		78	75	51	48		
		Tower Crane		76	73	49	46		
		Lorry		87	84	60	57		
		Diesel Generator (Welding)		66	63	39	36		
		Diesel Generator (Lighting)		65	62	38	35		
		Angle Grinder		80	77	53	50		
		Nail Gun		73	70	46	43		
		Circular Saw		84	81	57	54		
R409 Improvement Works	2	Rotary Bore Piling	13	83	80	70	67	78	75
		Concrete Pump		78	75	65	62		
		Tracked excavator (inserting cylindrical metal cage)		78	75	65	62		
		Cement Poker Vibrator		78	75	65	62		
		Tower Crane		76	73	63	60		
		Lorry		87	84	74	71		
		Diesel Generator (Welding)		66	63	53	50		
		Diesel Generator (Lighting)		65	62	52	49		
		Angle Grinder		80	77	67	64		
		Nail Gun		73	70	60	57		
		Circular Saw		84	81	71	68		

Description of Activity	Closest Receptor	Item Of Plant	Distance Attenuation, dB	Sound Pressure Level @ 10m, dB $L_{Aeq, T}$		Predicted Sound Pressure Level at Receptor, dB $L_{Aeq, T}$		Predicted Cumulative Sound Pressure Level at Receptor, dB $L_{Aeq, T}$	
				100% Utilisation	50% Utilisation	100 % Utilisation	50 % Utilisation	100 % Utilisation	50 % Utilisation

Table 9.C.9: Predicted Noise Levels of Construction Phase 2 at Closest Receptor (Assumes 1 of Each Item of Plant)

Description of Activity	Closest Receptor	Item Of Plant	Distance Attenuation, dB	Sound Pressure Level @ 10m, dB $L_{Aeq, T}$		Predicted Sound Pressure Level at Receptor, dB $L_{Aeq, T}$		Predicted Cumulative Sound Pressure Level at Receptor, dB $L_{Aeq, T}$	
				100% Utilisation	50% Utilisation	100 % Utilisation	50 % Utilisation	100 % Utilisation	50 % Utilisation
Construction of DC3	1	Rotary Bore Piling	28	83	80	55	28	63	60
		Concrete Pump		78	75	50	28		
		Tracked excavator (inserting cylindrical metal cage)		78	75	50	28		
		Cement Poker Vibrator		78	75	50	28		
		Tower Crane		76	73	48	28		
		Lorry		87	84	59	28		
		Diesel Generator (Welding)		66	63	38	28		
		Diesel Generator (Lighting)		65	62	37	28		
		Angle Grinder		80	77	52	28		
		Nail Gun		73	70	45	28		
		Circular Saw		84	81	56	28		
	1	Rotary Bore Piling	30	83	80	53	50	61	58
		Concrete Pump		78	75	48	45		
		Tracked excavator (inserting cylindrical metal cage)		78	75	48	45		
		Cement Poker Vibrator		78	75	48	45		

Description of Activity	Closest Receptor	Item Of Plant	Distance Attenuation, dB	Sound Pressure Level @ 10m, dB $L_{Aeq, T}$ 100% Utilisation	Sound Pressure Level @ 10m, dB $L_{Aeq, T}$ 50% Utilisation	Predicted Sound Pressure Level at Receptor, dB $L_{Aeq, T}$ 100 % Utilisation	Predicted Sound Pressure Level at Receptor, dB $L_{Aeq, T}$ 50 % Utilisation	Predicted Cumulative Sound Pressure Level at Receptor, dB $L_{Aeq, T}$ 100 % Utilisation	Predicted Cumulative Sound Pressure Level at Receptor, dB $L_{Aeq, T}$ 50 % Utilisation
Construction of DC5		Tower Crane		76	73	46	43		
		Lorry		87	84	57	54		
		Diesel Generator (Welding)		66	63	36	33		
		Diesel Generator (Lighting)		65	62	35	32		
		Angle Grinder		80	77	50	47		
		Nail Gun		73	70	43	40		
		Circular Saw		84	81	54	51		

Table 9.C.10: Predicted Noise Levels of Construction Phase 3 at Closest Receptor (Assumes 1 of Each Item of Plant)

Description of Activity	Closest Receptor	Item Of Plant	Distance Attenuation, dB	Sound Pressure Level @ 10m, dB $L_{Aeq, T}$ 100% Utilisation	Sound Pressure Level @ 10m, dB $L_{Aeq, T}$ 50% Utilisation	Predicted Sound Pressure Level at Receptor, dB $L_{Aeq, T}$ 100 % Utilisation	Predicted Sound Pressure Level at Receptor, dB $L_{Aeq, T}$ 50 % Utilisation	Predicted Cumulative Sound Pressure Level at Receptor, dB $L_{Aeq, T}$ 100 % Utilisation	Predicted Cumulative Sound Pressure Level at Receptor, dB $L_{Aeq, T}$ 50 % Utilisation
Construction of DC6	11	Rotary Bore Piling	31	83	80	52	49	60	57
		Concrete Pump		78	75	47	44		
		Tracked excavator (inserting cylindrical metal cage)		78	75	47	44		
		Cement Poker Vibrator		78	75	47	44		
		Tower Crane		76	73	45	42		
		Lorry		87	84	56	53		
		Diesel Generator (Welding)		66	63	35	32		
		Diesel Generator (Lighting)		65	62	34	31		
		Angle Grinder		80	77	49	46		
		Nail Gun		73	70	42	39		

Description of Activity	Closest Receptor	Item Of Plant	Distance Attenuation, dB	Sound Pressure Level @ 10m, dB $L_{Aeq, T}$ 100% Utilisation	Sound Pressure Level @ 10m, dB $L_{Aeq, T}$ 50% Utilisation	Predicted Sound Pressure Level at Receptor, dB $L_{Aeq, T}$ 100 % Utilisation	Predicted Sound Pressure Level at Receptor, dB $L_{Aeq, T}$ 50 % Utilisation	Predicted Cumulative Sound Pressure Level at Receptor, dB $L_{Aeq, T}$ 100 % Utilisation	Predicted Cumulative Sound Pressure Level at Receptor, dB $L_{Aeq, T}$ 50 % Utilisation
		Circular Saw		84	81	53	50		
Construction of DC4	1	Rotary Bore Piling	21	83	80	62	59	70	67
		Concrete Pump		78	75	57	54		
		Tracked excavator (inserting cylindrical metal cage)		78	75	57	54		
		Cement Poker Vibrator		78	75	57	54		
		Tower Crane		76	73	55	52		
		Lorry		87	84	66	63		
		Diesel Generator (Welding)		66	63	45	42		
		Diesel Generator (Lighting)		65	62	44	41		
		Angle Grinder		80	77	59	56		
		Nail Gun		73	70	52	49		
		Circular Saw		84	81	63	60		
Complete Site Wide Works	1	Dozer	17	77	74	60	57	64	61
		Dump Truck		63	60	46	43		
		Excavator		75	72	58	55		
		Compactor		75	72	58	55		

Appendix 9.4

Noise Propagation Modelling Inputs and Results

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OPERATIONAL NOISE MODELLING INPUTS AND ASSUMPTIONS

Prediction of operational noise was carried out using CadnaA noise propagation software. Assumptions and model inputs are detailed below. Further details of noise propagation modelling methodology can be found in EIAR Chapter 9: Noise and Vibration.

CadnaA Noise Model Set Up

CadnaA (Computer Aided Noise Abatement) is a leading proprietary software for environmental noise propagation calculation, presentation and assessment. The CadnaA noise modelling software package was set up to use ISO9613 “Attenuation of Sound during Propagation Outdoors Part 2 General Method of Calculation” prediction methodology along with a range of topographical and ordnance data collected on the surrounding area to build up a picture of the noise environment in the vicinity of noise sources. The ISO 9613-2 propagation model is a light downwind model, which assumes that weather conditions are favourable for sound propagation. Where conditions are less favourable to sound propagation occur, such as when the assessment locations are crosswind or upwind of the Proposed Development, the sound levels would be expected to be lower and the downwind predictions presented would be regarded as conservative i.e. greater than those experienced in practice.

The software was used to build a 3-dimensional model of all features which may affect the generation and propagation of noise in the vicinity of the Proposed Development and to predict the specific sound levels due to the Proposed Development at nearby residential properties (receptors).

The propagation model takes account of sound attenuation due to geometric spreading and atmospheric absorption. The assumed temperature and relative humidity are 10 ˚C and 70 % respectively. Ground effects are also taken into account by the propagation model, with ground effects surrounding noise sources and receptors being of particular significance. CadnaA allows definition of ground absorption across a whole site or with a map of ground absorption. Hard ground is represented by Ground Absorption G=0, G=1 for soft ground and G=0.5 is typically adopted to reflect a mix of hard and porous ground. For this project G=0.5 has been applied within the Proposed Development site boundary to represent the mix of hard and soft ground within the site. For the area surrounding the site, hard ground (G=0) has been applied to larger areas of hard standing, for example the M7 industrial estate and surrounding agricultural lands have been assumed to comprise primarily soft ground and have been assigned G=1.

Where buildings have been included in the model, reflections have been included, with a reflection loss of 0 dB unless otherwise stated.

Noise-sensitive receptors have been included in the model at a height of 1.5m above ground level for daytime predictions and 4m above ground level for night-time predictions.

Unless otherwise stated, noise sources have been assumed to have a 100% ‘on-time’.

Sound pressure levels were predicted at all 42 representative noise-sensitive receptors for both daytime (07:00 – 23:00) and night-time (23:00 – 07:00) periods. Receptor height for daytime predictions was 1.5m above ground level, with 4m above ground level assumed for night-time predictions.

Plant and Equipment Noise Source Data

A review of the Proposed Development has identified the following key items of plant and equipment which have the potential for significant noise emissions are:

- Data centre cooling system for each of the 6 buildings;
- Data external plant compound;
- Substation.

Plant and equipment source sound levels have been provided in manufacturer datasheets and acoustic testing reports. Where sound pressure levels have been provided, these have been converted to sound power levels, with dimensions of equipment obtained from manufacturer datasheets and project general arrangement and section drawings. It should be noted that manufacturer datasheets are typical for the type of plant and equipment to be installed, and are subject to final equipment selection. Installed plant and equipment will achieve the same noise levels (or lower) than those indicated within this assessment. A summary of the model inputs is shown in the sections that follow. The number of sources etc are per building, with all six data centre buildings having identical layouts and noise sources.

Data Centre Cooling System

The data centre cooling system for each building comprises 56no. duplex Air Handling Units (AHUs). Each duplex unit has 12no. supply fans and 8no. return fans, with a total of 672 supply fans and 448 return fans per data centre building.

Supply fans will draw fresh air through louvres along the sides of the data centre building. The AHU air intakes are located behind the long facades of each Data Centre, with large louvered sections sitting within the façade to provide ventilation to the AHUs internally. The location of the supply air louvred sections are illustrated in the elevation drawings within Volume II: Figures and Drawings. Each long façade has been modelled with four vertical area sources for the louvred areas, each with an overall sound power level representative of 1/8 of the AHU air intake fans within the Data Centre building.

AHU exhaust noise is generated by the extract fans, which are located within the AHU itself and ducted to the penthouse louvres at roof level. Each duplex AHU comprises 8 extract fans.

Return fans from either 2no. or 4no. duplex AHU units will direct exhaust air to one of 16no. common penthouse louvre above roof level. Each data hall will have 12 exhaust shafts serving 4no. duplex units and 4 exhaust shafts serving 2no. duplex units. The general arrangement and section drawings for the data halls can be found in Volume II Figures and Drawings.

Typical arrangement of a group of 4no. duplex AHU units and the associated exhaust ‘penthouse louvres’ is shown in Figure 9D.2 and Figure 9D.3.

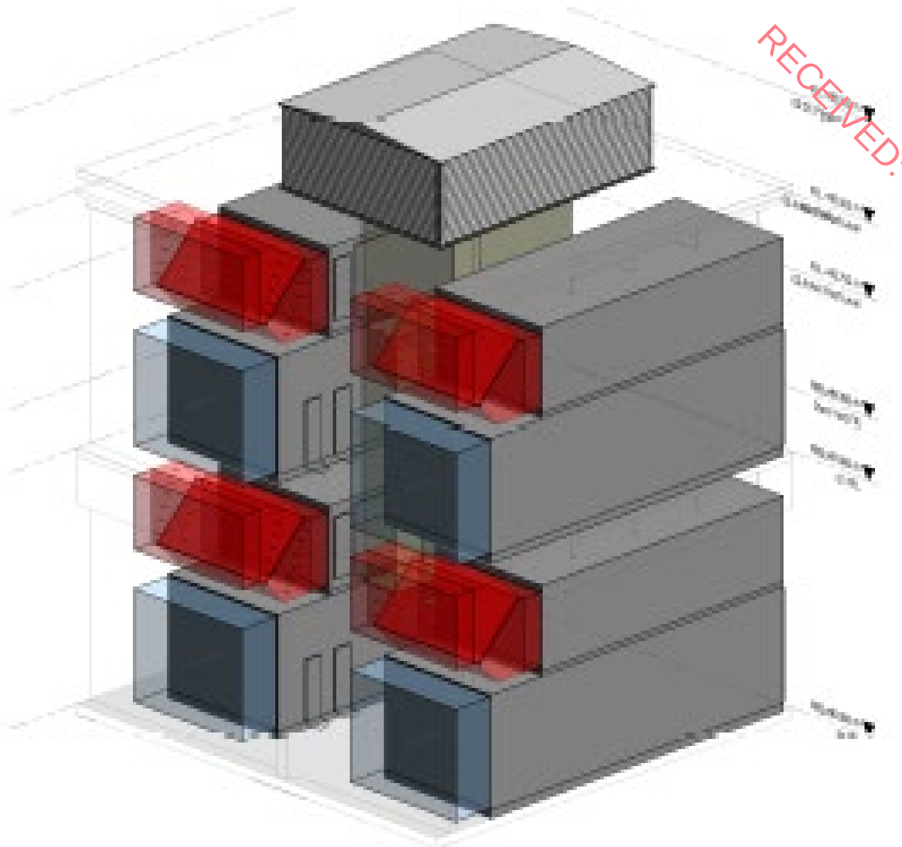

Figure 9D. 1: Figure 9D.1: 3D Image of Group of 4no. Duplex AHUs and Associated Common Exhaust Arrangement

Figure 9D.2: 3D Image of Group of 4no. Duplex AHUs and Associated Common Exhaust Arrangement

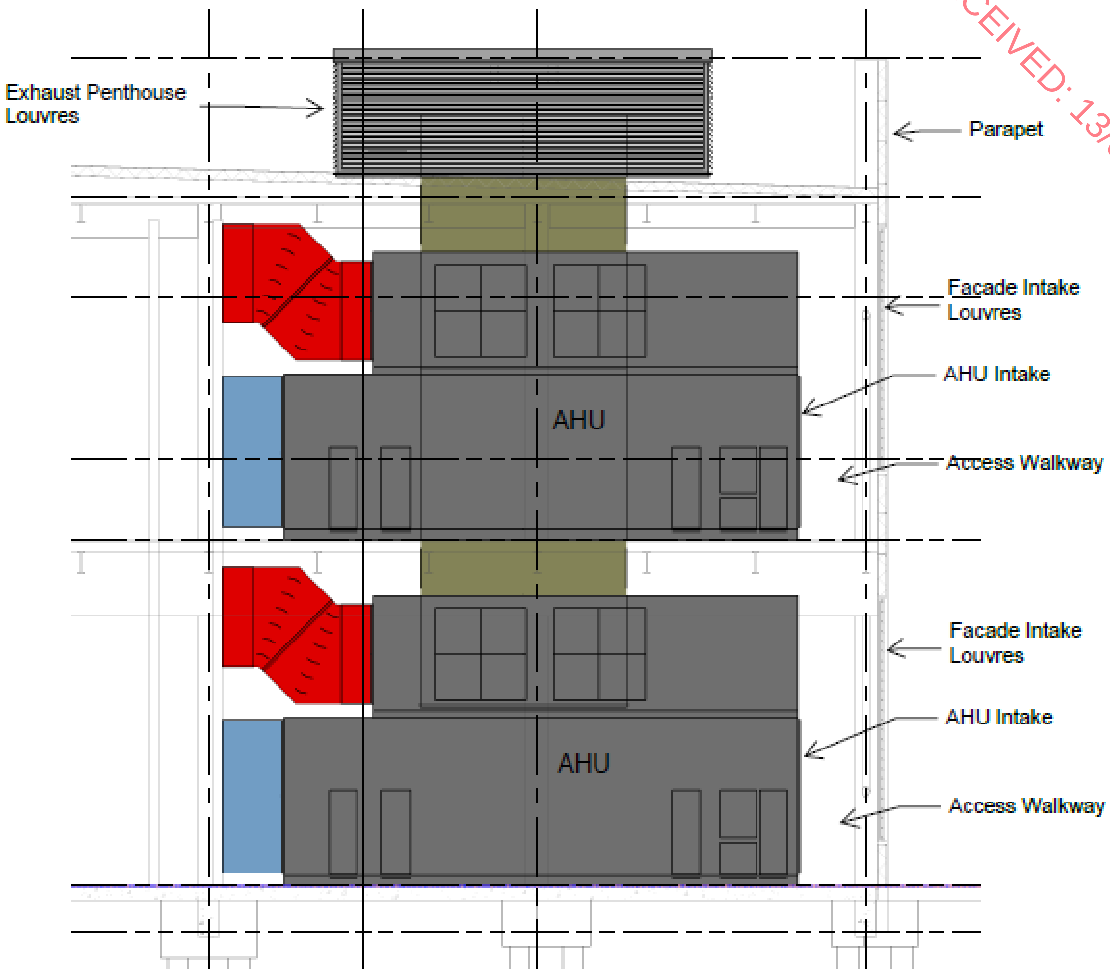

Figure 9D.3: Section Through Group of 4no. Duplex AHU and Associated Common Exhaust Arrangement

AHU Sound Power Level Source Data

The manufacturer acoustic data was provided for the AHU supply and extract fans, but for different duty flow rates from the Proposed Development. Sound power level data was supplied for a bank of the proposed fans with a volumetric flow rate of 42.9 m^3/s.

The Proposed Development will comprise 56 duplex AHUs, each with a total volumetric flow rate of 40.44 m3/s.

Fan noise is roughly proportional to the fifth power of fan speed (and therefore volumetric flow rate). As such, adjustment for the difference in duty was calculated using the following equation (9D.1):

$$dB\ Duty\ Adjustment = 50 \times \log_{10}\left(\frac{D}{D_0}\right) \qquad (9D.1)$$

Where D is the new fan duty and D_0 is the reference fan duty, both in m^3/s.

Sound power levels were also adjusted as required for number of fans using the calculation (9D.2):

$$dB\ No.Fans\ Adjustment = 10 \times \log_{10}\left(\frac{N}{N_0}\right) \qquad (9D.2)$$

Where N is the desired number of fans and N_0 is the reference number of fans.

SOUND CALCULATION SHEET

	63	125	250	500	1k	2k	4k	8k	Total	Total
Customer:									Rev G	11.01.19
Project:	Mid-frequency Octave Band (Hz)									
AHU Tag: **MAIN AHU**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**Total**	**Total**
Duty m3/s: **Colo 1 - Normal - (42.9m³/s)**	db	db	db	db	db	db	db	db	db	db(A)
(Single Fan, SWL)	**71**	**78**	**80**	**74**	**74**	**73**	**82**	**78**	**87**	**85**
System: **Supply Inlet (Fresh)** ***(12x Fans)***	**82**	**89**	**90**	**85**	**85**	**84**	**93**	**89**	**98**	**96**
Internal Losses (From FWT Testing)	0	1	15	12	12	18	33	41		
A-Weight: Yes	-26.2	-16.1	-8.6	-3.2	0	1.2	1	-1.1		
At AHU Supply Inlet (db(A), SWL):	**56**	**71**	**67**	**69**	**73**	**67**	**61**	**47**		**77**
At AHU Supply Inlet (db(A), SPL @ 1m):	**41**	**56**	**52**	**54**	**57**	**52**	**46**	**32**		**62**
At AHU Supply Inlet (db(A), SPL @ 3m):	**31**	**46**	**42**	**44**	**47**	**42**	**36**	**22**		**52**
(Single Fan, SWL)	**81**	**72**	**67**	**74**	**70**	**65**	**60**	**58**	**82**	**75**
System: **Extract Outlet** ***(8x Fans)***	**90**	**81**	**76**	**83**	**79**	**74**	**69**	**67**	**91**	**84**
Fan Instalation Correction Factor	-4	-13	-15	-4	-8	-8	-6	-3		
Fan Inlet Accoustic Grid	1	8	5	3	0	-2	-1	0		
Attenuator - 600mm Deep - 150mm Spacing	5	7	11	17	24	20	13	11		
A-Weight: Yes	-26.2	-16.1	-8.6	-3.2	0	1.2	1	-1.1		
At AHU Exhaust Outlet (db(A), SWL):	**61**	**63**	**66**	**64**	**63**	**65**	**64**	**58**		**73**
At AHU Exhaust Outlet (db(A), SPL @ 1m):	**46**	**48**	**51**	**49**	**48**	**50**	**49**	**43**		**58**
At AHU Exhaust Outlet (db(A), SPL @ 3m):	**36**	**38**	**41**	**39**	**38**	**40**	**39**	**33**		**48**

Figure 9D.4: AHU Noise Source Reference Data

AHU Air Intake Noise Data

Normal Operation

For 'normal operation' of each data hall, each of the 8 vertical area sources represents 7 duplex AHUs, each duplex AHU with a volumetric flow rate of 40.44 m³/s. All AHUs are in operation and each vertical area source represents a total of 84 supply fans. Calculation of the sound power attributed to each vertical area source is detailed in Table 9D.1.

Table 9D.1 Calculation of AHU Supply Fan Sound Power Levels (Normal Operation)

	Un-Weighted L_W Spectrum Centre Frequency, Hz								Over all
	63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**L_W, dBA**
AHU 12 Supply Fans @ 42.9 m³/s duty Reference Sound Power Level, dB	82	89	90	85	85	84	93	89	96
Internal Losses, dB	0	-1	-15	-12	-12	-18	-33	-41	
Correction from 42.9 m³/s to 40.44 m³/s, dB	-1	-1	-1	-1	-1	-1	-1	-1	
Correction from 1no. to 7no. Duplex AHUs, dB	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	
AHU 7no. Duplex AHUs @ 40.44 m³/s duty Supply Fans Sound Power Level, dB	89	95	82	80	80	73	67	55	85

Emergency Operation

'Emergency operation' refers to a situation where 4 of the duplex AHUs across one data centre building (one duplex AHU in 4 different data halls) are out of service (e.g. for maintenance) and the duty on the remaining AHUs is increased to compensate. In practice, this means that, across each data hall, 24 supply fans are not in operation and the remaining 624 supply fans will operate with an increased duty. Each of the 52 remaining operational duplex AHUs will operate with an increased duty of 43.6 m^3/s.

The specific AHUs which will be out of service will vary as required, and it has been assumed that the increase in sound power level associated with the remaining fans has been evenly spread across the 8 vertical area sources which represent the fresh air supply louvres, with a total of 78 supply fans contributing to the sound power level of each louvred area/vertical area source.

The adjustments made to the supply fan source sound power data to represent the emergency operation scenario are shown in Table 9D.2 along with the total sound power level (L_W) for the 78 supply fans.

Table 9D.2: Calculation of AHU Supply Fan Sound Power Levels (Emergency Operation)

	Un-Weighted L_W Spectrum Centre Frequency, Hz								Overall
	63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**L_W, dBA**
AHU 12 Supply Fans @ 42.9 m^3/s duty Reference Sound Power Level, dB	82	89	90	85	85	84	93	89	96
Internal Losses, dB	0	-1	-15	-12	-12	-18	-33	-41	
Correction from 42.9 m^3/s to 43.6 m^3/s, dB	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	
Correction from 12 to 78 fans, dB	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	
78 supply fans 43.6 m3/s duty Sound Power Level, dB	90.5	96.5	83.5	81.5	81.5	74.5	68.5	56.5	86

AHU Exhaust Noise Data

Exhaust penthouse louvres were modelled as point sources at a height of 3m above roof level. As shown in Figure 9D.5, each exhaust point/penthouse louvre serves either 2no. or 4no. duplex AHUs across the ground and first floors. Each point source represents either 16no. or 32no. individual extract fans.

Normal Operation

For normal operational conditions, the penthouse louvre point sources represent the exhaust fan noise from 2no. or 4no. duplex AHUs, with a duty of 40.44 m^3/s per duplex AHU. This equates to 16no. or 32no. individual extract fans per point source.

The reference extract fan sound power level (L_W) shown in Table 9D.3 already includes the installation correction factor, fan inlet acoustic grid and attenuator, which are detailed in the reference source data within Figure 9D.4.

Table 9D.3: Calculation of AHU Extract Fan Sound Power Levels (Normal Operation)

	Un-Weighted L_W Spectrum Centre Frequency, Hz								
	63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**L_W, dBA**
AHU 8 Extract Fans 42.9 m^3/s duty (includes installation correction factor, fan inlet acoustic grid and attenuator)	88	79	75	67	63	64	63	59	72.7
Correction to 40.44 m3/s	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	
Correction to 2 Duplex (16 fans)	3	3	3	3	3	3	3	3	
Correction to 4 Duplex (32 fans)	6	6	6	6	6	6	6	6	
Extract Outlet for 2 Duplex (16 Fans)	89.7	80.7	76.7	68.7	64.7	65.7	64.7	60.7	74.4

Extract Outlet for 4 Duplex (32 Fans)	92.7	83.7	79.7	71.7	67.7	68.7	67.7	63.7	77.4

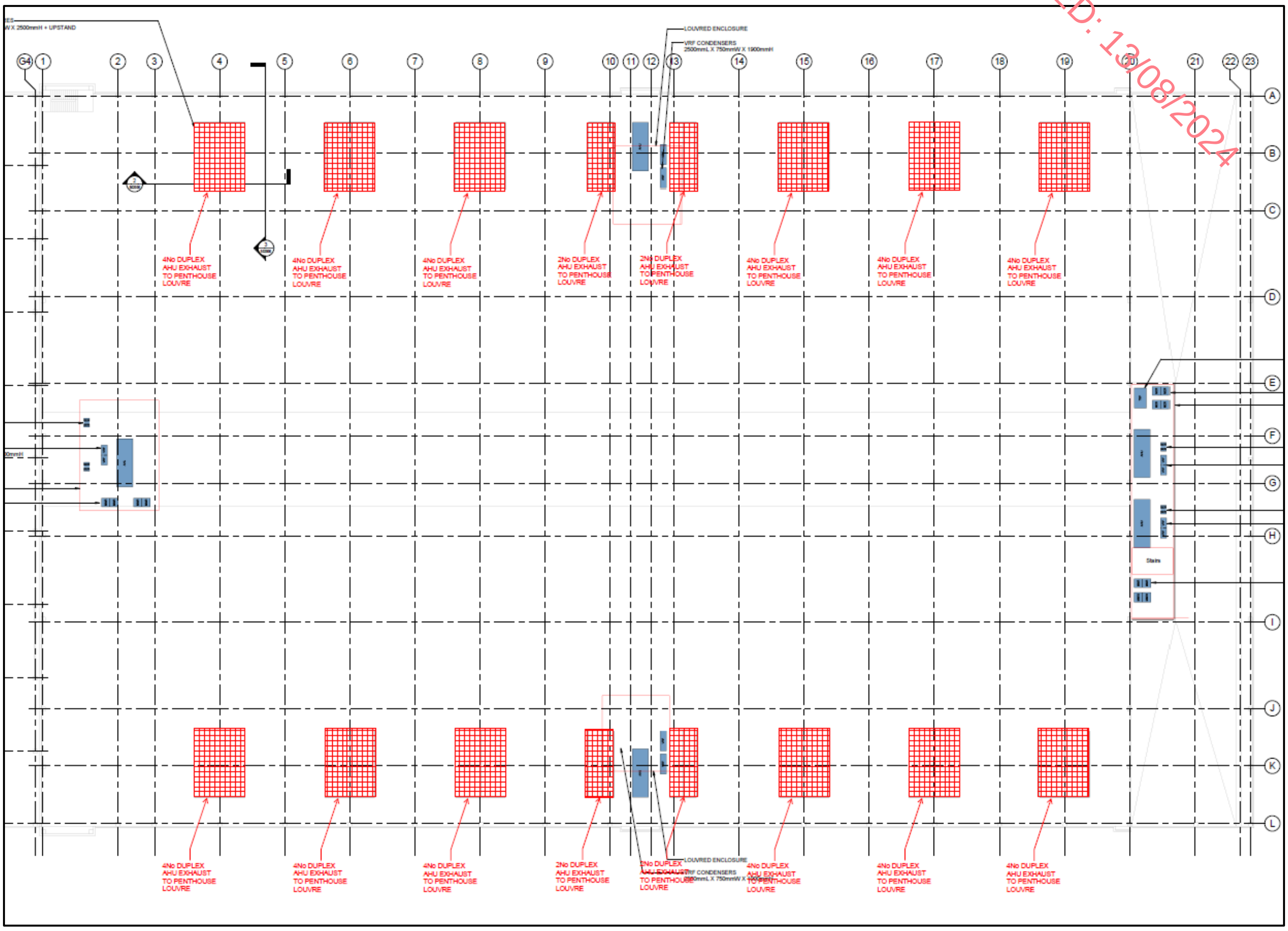

Figure 9D.5: AHU Exhaust Penthouse Louvre Arrangement

Emergency Operation

For the emergency operational scenario, 4 duplex AHUs are assumed to be out of service. The location of the non-operational AHUs will vary. For the purposes of the model, an average location has been assumed and 2 of the central AHUs on each of the long facades have been assumed to be out of service. The remaining AHUs operate with an increased duty of 43.6 m^3/s.

The sound power level (L_W) of each penthouse louvre has been calculated as per Table 9D.4 for the emergency operation scenario.

Table 9D.4: Calculation of AHU Extract Fan Sound Power Levels (Emergency Operation)

	Un-Weighted L_W Spectrum Centre Frequency, Hz								
	63	125	250	500	1k	2k	4k	8k	L_W, dBA
AHU 8 Extract Fans 42.9 m^3/s duty (includes installation correction factor, fan inlet acoustic grid and attenuator)	88	79	75	67	63	64	63	59	72.7
Correction to 40.44 m3/s	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	
Correction to 2 Duplex (16 fans)	3	3	3	3	3	3	3	3	
Correction to 4 Duplex (32 fans)	6	6	6	6	6	6	6	6	

Extract Outlet for 2 Duplex (16 Fans)	91.4	82.4	78.4	70.4	66.4	67.4	66.4	62.4	76.1
Extract Outlet for 4 Duplex (32 Fans)	94.4	85.4	81.4	73.4	69.4	70.4	69.4	65.4	79.1

With 56 AHUs across the Proposed Development, it is expected that the 'emergency scenario' may apply to a significant proportion of the time, particularly during the day when scheduled maintenance will take place. As such, it has been assumed that 'emergency mode' will apply to the AHUs in all of the modelling scenarios for all data halls.

Data Centre External Plant Compounds

Power generation and battery storage plant and equipment are located in an external plant compound adjoining each data centre building. The roof of the plant area will be open, to allow for ventilation and cooling. One side of the plant area will adjoin the main data centre external wall, The plant area will be enclosed with IAC FS/S Noishield Barrier panels (or a similar), including all external walls and the internal treatment of the wall that abuts the data centre building. The proposed barrier type is shown in Figure 9D.7. The assumed sound transmission loss and absorbency coefficient for the IAC FS/S panels have been taken from the manufacturer datasheet, as shown in Figure 9D.6.

Sound Transmission Loss Data, dB

1/1 Octave Band Centre Frequency, Hz	63	125	250	500	1k	2k	4k	8k	STC
FS/S and SFS/S	18	20	32	39	32	31	28	35	30
FSt/S	21	23	36	40	32	33	30	33	33
FS/A and SFS/A	17	23	30	44	51	51	39	39	43

Sound Absorptive Coefficients

1/1 Octave Band Centre Frequency, Hz	125	250	500	1k	2k	4k	8k	NRC
FS/S FS/A & FSt/S	1.12	1.12	1.10	1.01	0.89	0.76	0.57	1.05
SFS/S & SFS/A	0.49	1.04	1.14	1.05	0.96	0.95	0.87	1.05
C12/S & C12/A	0.48	1.08	1.10	0.99	0.92	0.83	0.78	1.00
C38/S & C38/A	0.68	1.19	1.10	1.03	0.90	0.81	0.76	1.05

Figure 9D.6: IAC Noishield Barrier Acoustic Performance

Figure 9D.7: IAC Noishield Barriers

The external plant area has been modelled as a semi-reverberant space with an open roof. The model has been calibrated to determine the reverberant sound pressure level at the internal facades and free-field sound pressure level at the 'roof' level. The façade sound pressure levels were calculated using the sound power levels for plant and equipment within the plant area. Absorption and sound transmission loss were applied to the model where appropriate, as per the values in Figure 9D.6.

The external plant area walls were modelled as vertical area sources and an area source was used for the open roof. In addition to this 'break-out' noise from the plant area, exhaust ducting and stack tip noise were modelled as line sources and point sources respectively.

The plant and equipment source data included in the acoustic model are detailed in the following sections. Note that the plant shown is per data centre, with identical layout and equipment for each of the six data centre plant areas.

Gas Turbine Generators

Each data centre external plant area contains 8no. gas turbine generators.

The primary noise sources associated with gas turbines are:

- Turbine casing;
- Pipework/ductwork to exhaust;
- Exhaust stack tip.

An indicate gas turbine package elevation is shown in Figure 9D.8.

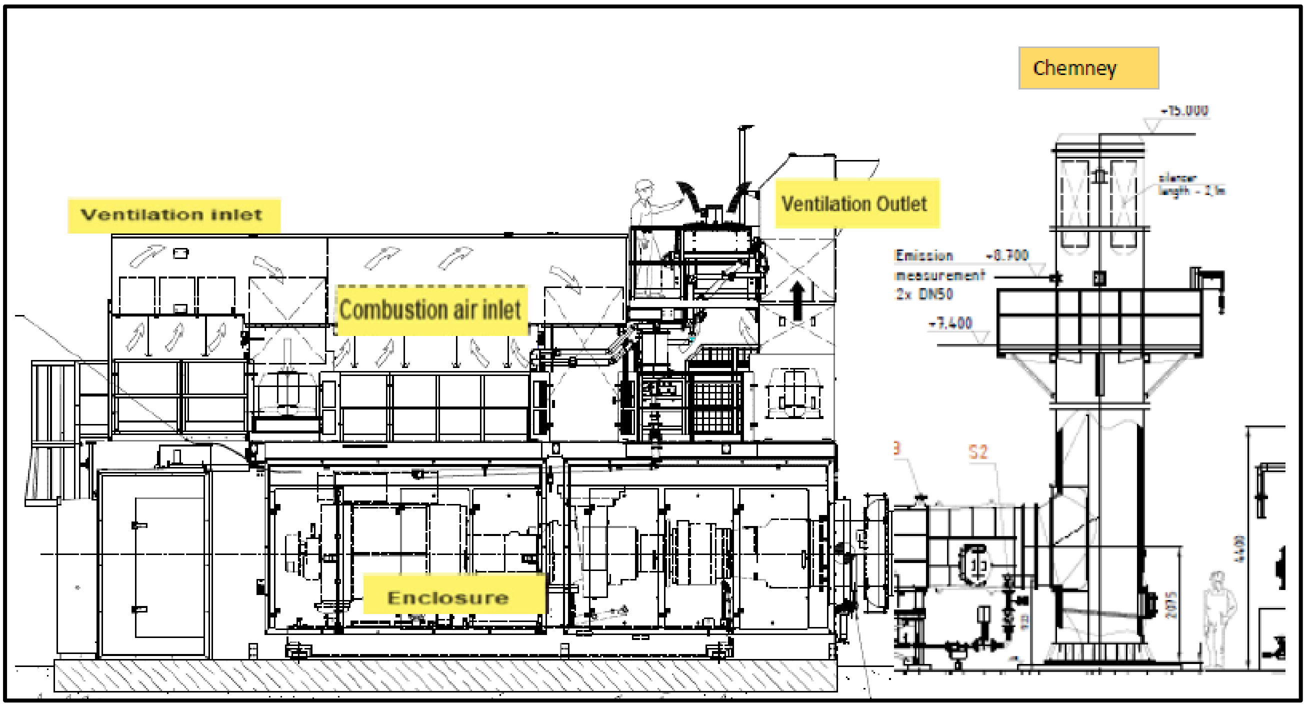

Figure 9D.8: Typical Solar Gas Turbine Elevation

Turbine Enclosure

The proposed turbine type is the Solar Taurus 60 gas turbine package, which will benefit from a bespoke acoustic enclosure which will surround the main turbine casing. The acoustic enclosure will include inspection windows, removable panelling for maintenance and silencers on the ventilation air inlet/outlet and combustion air inlet.

The main package enclosure is expected to achieve a sound pressure level of 69 dBA @1m. These are based on measurements of similar packages and a measurement height of 1.5m above ground level. It is assumed that the same sound pressure level can be assumed at 1m from all facades of the turbine enclosure.

The external dimensions of the turbine enclosure will be approximately 12.5m (L) x 6.5m (W) x 3.5m (H). At a sound pressure level of 69 dBA, this equates to a total sound power level (denoted as L_W for the turbine enclosure of 94.2 dBA.

Exhaust Duct and Stack Tip

Exhaust noise has been considered both in terms of break-out noise from ductwork and noise emission from the stack tip The combustion exhaust will be fitted a silencer which will achieve a sound pressure level of 66 dBA @1m from the exhaust stack ducting and 66 dBA @1m perpendicular to the exhaust stack tip. It is assumed that the exhaust stack will discharge at a height of 20m above external plant room ground level, (1m above the parapet height).

Gas Turbine Model Noise Model Input Summary

A summary of model inputs for the gas turbines is presented in Table 9D.5. Sound power levels were determined for each element of the gas turbine system (enclosure, exhaust stack ducting and exhaust stack tip) using the project-specific sound pressure level at 1m listed below and the physical dimensions of the equipment. The project-specific sound pressure level for each aspect of the gas turbine package have been agreed with the manufacturer, who will provide the appropriate enclosure, silencer and duct lagging specification to achieve the follow sound pressure levels when measured at 1m:

- 69 dBA @ 1m from turbine enclosure
- 66 dBA @ 1m from stack ducting
- 66 dBA @1m from stack tip (at 90°)

The spectral shape for each noise source was provided by the turbine manufacturer based on measurements, and applied to the project-specific sound pressure level for each element of the turbine package.

Table 9D.5: Gas Turbine Sound Power Level Model Inputs

Centre Frequency, Hz:	63	125	250	500	1K	2K	4K	8K	Overall L_W, dBA
	Sound Power Level, L_W dBZ								
Enclosure	99.2	96.2	97.2	91.2	88.2	83.2	83.2	77.2	94.3
Chimney Stack/Duct	92.0	87.0	85.0	80.0	80.0	80.0	81.0	77.0	87.3
Stack Tip	83.0	84.0	80.0	74.0	68.0	65.0	67.0	64.0	77.1

Gas Reciprocating Engines

Each external plant area will have 10 reciprocating gas engines (5 as standby units). It is expected that these 1MW gas engines will achieve a sound pressure level of 69 dBA @ 1m from the main engine package and 69 dBA @ 1m from the exhaust tip. Sound power levels for these items have been calculated based on the anticipated sound pressure levels and the physical dimensions of the packages. The total sound power level for the gas reciprocating engines which have been adopted within the acoustic model are:

Table 9D.6: Reciprocating Gas Engine Sound Power Level Model Inputs

Item	Sound Pressure Level @ 1m, dB L_{Aeq}	Sound Power Level, dB L_{WA}
Gas Engine Enclosure	66	87.3
Gas Engine Stack Tip	66	77.1

Battery Energy Storage System

The Battery Energy Storage System (BESS) will generate noise by way of the cooling fans associated with the inverters.

There will be 40no. Battery Energy Storage Inverters packages within each external plant area. Manufacturer noise data is shown in Figure 9D.9 for the inverters based on maximum fan speed. The typical operating speed for the inverter fans is expected to be 50-70% of the maximum fan speed for these units. As fan noise is roughly proportional to the 5th power of fan speed, actual operational levels are likely to be 8-11 dB lower than at full speed.

Additionally, circular silencers will be installed to the fans cooling the inverters, which will provide further attenuation of inverter fan noise.

A conservative 6 dB overall reduction in manufacturer sound power levels shown in Figure 9D.9 due to fan speed reduction and silencer performance. This resulted in a sound power level of 82 dB being assigned to each battery storage inverter in the noise model.

Table 9D.7: Indicative Noise Reduction with Fan Speed Reduction

Fan Speed Reduction	Noise reduction
10%	2dB
20%	5dB
30%	8dB
40%	11dB
50%	15dB

Sound pressure level measurements were conducted according to IEC 60076-10:2016 in the TVO Olkiluoto BESS site on 2022-10-03.

The operating conditions of the unit during measurements, measurement details and measured A-weighted equivalent noise levels L_{Aeq} [dB] are presented in *Figure 1*.

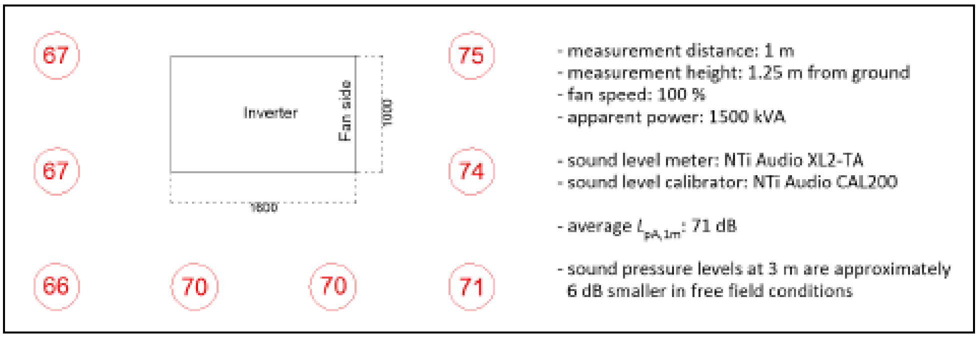

Figure 1. Measured L_{Aeq} [dB] (within red circles), operating condition during the measurements and measurement details.

The sound level meter complies with IEC 61672-1:2013 Class 1 requirements. The sound level calibrator complies with IEC 60942 Class 1 requirements.

The calculated total A-weighted sound power level L_{WA} for this load condition is **88 dB**. The unweighted spectrum of the sound power level in 1/3-octave bands is presented below. The sound power level has been determined according to the spatial average sound pressure level ($L_{pA,1m}$ 71 dB) according to the sound pressure level method defined in IEC 60076-10:2016. The relative sound pressure level differences between the sides shown in *Figure 1* can be used as directivity information in noise mapping.

f [Hz]	50	63	80	100	125	160	200	250	315	400	500	630
L_W [dB]	73.3	70.0	74.2	82.1	76.4	75.7	87.9	79.0	81.2	78.6	78.0	79.3

f [Hz]	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k	6.3k	8k	10k
L_W [dB]	78.0	77.5	75.9	73.4	72.2	75.7	75.7	67.5	73.2	74.5	71.3	69.3

Figure 9D.9: Battery Energy Storage Inverter Noise Data

110 kV Grid Substation

The onsite 110 kV grid substation is subject to a separate SID planning application, however, as both the data centre and the substation are connected and dependent upon planning being granted, it is important that the noise impact from the proposed substation is assessed in conjunction with the operational data centre development.

The SID application includes a new electricity grid substation compound, a medium voltage switchgear and control equipment building, a building housing indoor high voltage (HV), GIS equipment, high voltage busbar connections, and step-down power transformers, and underground cables connecting the proposal to the existing 110kV overhead lines that cross the proposed development site.

A TETRA TECH COMPANY

The substation will be located within a compound of concrete hard standing and surrounded by 2.4 high palisade fencing and will comprise a Gas Insulated Substation (GIS) building with a height of approximately 15.5m above ground level and four Medium Voltage (MV) Switchrooms which will be approximately 5.5m high, enclosed within individual buildings.

Four transformers will be located in the centre of the compound and will comply with the ESB specifications, which require that the sound power level of a transformer, including all cooling fans, measured according to IEC60551, shall not exceed 70dBA. The transformers have been included in the noise model on this basis and modelled as buildings with a height of 5m above ground level with noise propagating from the roof and walls.

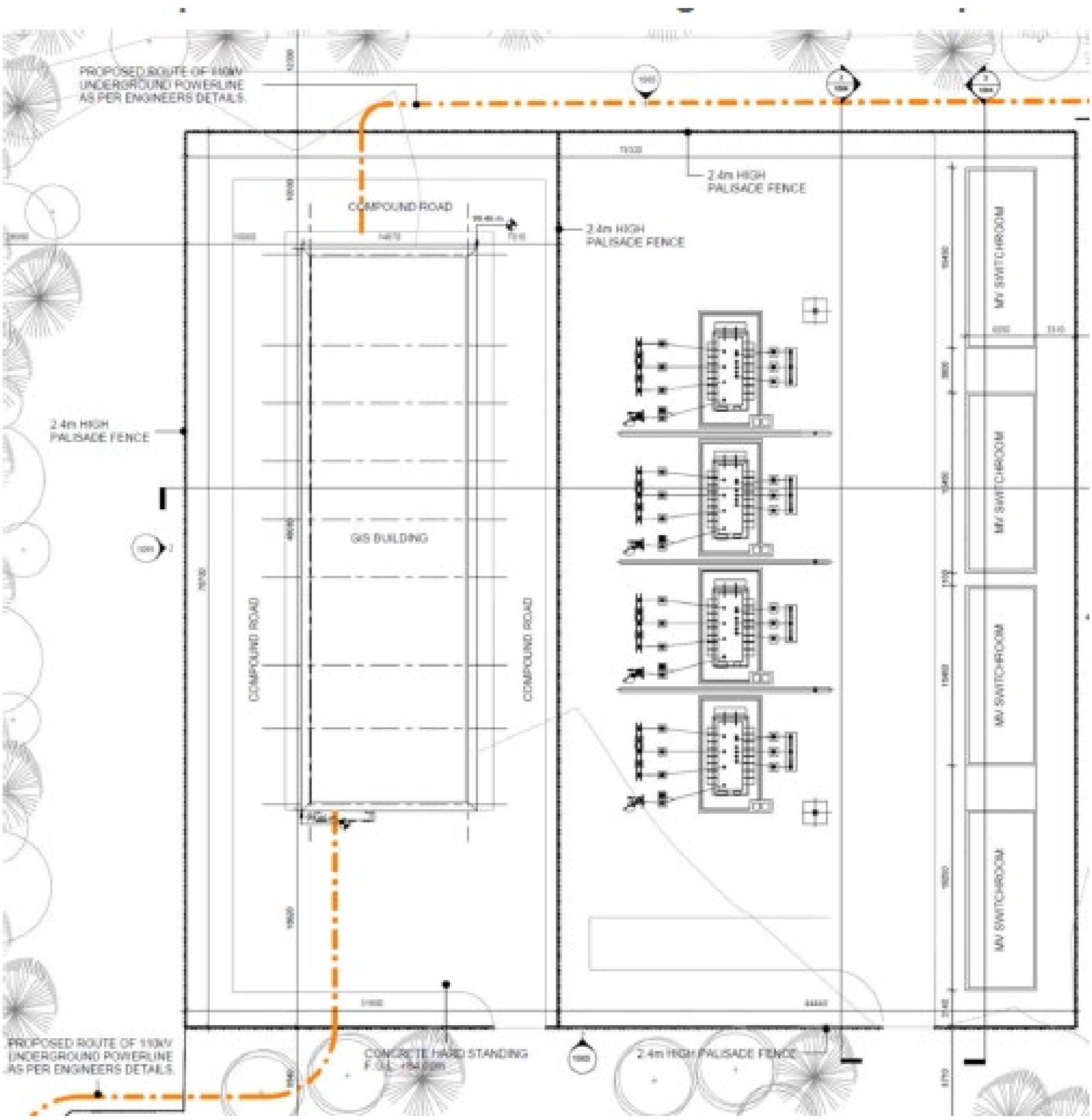

Figure 9D. 10: Proposed Substation Arrangement (Indicative)

Further information regarding the noise impact of the 110 kV grid substation can be found within the Interactions section of Chapter 9: Noise and Vibration.

Operational Power Scenarios

The power requirements of the data centres will typically be met by a minimum of 30% renewable energy from wind/solar farms annually. The remaining energy demands will be fulfilled by a combination of gas turbines and reciprocating gas engines.

Illustrative operational scenarios and associated power sources are shown in Table 9D.8. These will be subject to variability such as power demands from the data centre, availability of renewable energy, availability of fuel and ambient temperature. Scheduled maintenance routines for turbines and engines will be limited to daytime only.

Table 9D.8: Indicative Operational Power Scenarios

No.	Scenario Description	Source Status				Max Source Capacity (MW)				Total Capacity (MW)
	Supply Type	Turbines	Engines	Substation	Solar PV	Turbines	Engines	Substation	Solar PV	
1	Running on turbines only, on gas, no CPPA/PV	8	0	Off	Off	8	0	0.00	0.00	40.00
2	Running on turbines on gas with low level CPPA/PV	7	0	On	Off	7	0	5.00	0.00	40.00
3	Running on turbines and engines on gas with medium level CPPA/PV	6	2	On	Off	6	2	8.00	0.00	40.00
4a	Running on turbines and engines on gas with average level CPPA/PV	5	3	On	Off	5	3	11.75	0.00	39.75
4b	Running on turbines on gas only with available CPPA/PV or grid power	5	0	On	Off	5	0	14.75	0.00	39.75
5	Running with external peak level CPPA/PV, no turbines or engines	0	0	On	On	0	0	65.28	0.50	65.78
6	Running on turbines on gas with low level CPPA/PV, maintenance of one turbine	7	0	On	Off	7	0	5.00	0.00	40.00
7	Running on turbines only, on diesel, no CPPA/PV - test condition	8	0	Off	Off	8	0	0.00	0.00	40.00
8	Running on turbines only, on diesel, no CPPA/PV - emergency condition	8	0	Off	Off	8	0	0.00	0.00	40.00
9	Running on turbines and engines, on diesel with CPPA/PV	5	3	On	On	5	3	11.75	0.09	39.84

The noise modelling results considers the operating conditions for daytime and night-time power scenarios, as per Table 9D.8. Analysis of the power scenarios is shown in the sections that follow, with the most frequently occurring 'typical' scenario and 'worst case' scenario identified for both daytime and night-time.

Daytime Operation

The power sources associated with all daytime operational scenarios are shown in Table 9D.9 along with an approximated percentage of the daytime hours where each power scenario will take place. Scenarios have been grouped where noise variable sources (i.e. number of gas turbines and gas engines are the same).

Table 9D.9: Daytime Operational Noise Model Power Scenarios

	Gas Turbines	Gas Engines	Approximate proportion of daytime hours in this
Power Scenario 4a & 9	5	3	64%
Scenario 3	6	2	19%
Scenario 2 & 6	7	0	11%
Scenario 5	0	0	5%
Scenario 1,7 & 8	8	0	<1%

Daytime typical operation is represented in the noise modelling by the most frequently occurring power scenario; 5 gas turbines and 3 gas engines operating. This accounts for approximately 64% of the daytime operational hours across the year.

Worst-case power scenario for daytime noise is 8 gas turbines operating, however this is expected to occur for less than 1% of the daytime operational hours throughout the year.

Night-Time Operation

The power sources associated with all daytime operational scenarios are shown in Table 9D.10 along with an approximated percentage of the daytime hours where each power scenario will take place.

Scenarios have been grouped where noise variable sources (i.e. number of gas turbines and gas engines are the same).

Table 9D.10: Night-Time Operational Noise Model Power Scenarios

	Gas Turbines	Gas Engines	Approximate % of night-time hours in
Scenario 4b	5	0	74%
Scenario 5	0	0	22%
Scenario 4a & 9	5	3	< 2%
Scenario 3	6	2	< 2%
Scenario 2 & 6	7	0	< 1%

Night-time typical operation will be represented in the noise modelling by the most frequently occurring power scenario; 5 gas turbines and 0 gas engines operating. This accounts for approximately 74% of the night-time operational hours across the year.

Worst-case power scenario for night-time noise is 7 gas turbines operating, however this is expected to occur for less than 1% of the night-time operational hours throughout the year.

Noise Modelling Results

Daytime Noise Modelling Results

Noise modelling results are shown in Table 9D.11 for typical and worst-case daytime operation scenarios. Daytime predicted sound pressure levels are shown for all 42 noise-sensitive receptors which assume a receptor height of 1.5m above ground height.

The daytime noise model assumes that all BESS inverters, data hall AHUs, substation are also operating with a 100% on time.

Typical operation for daytime includes 5 gas turbines and 3 gas engines running with a 100% on-time.

Worst-case operation for daytime has 8 gas turbines operating with a 100% on-time.

Table 9D.11: Typical Daytime Plant and Equipment $L_{Aeq, T}$ Noise Propagation Modelling Results

Receptor Location	Predicted Typical Daytime Sound Pressure Level 1.5 m Receptor Height, dB $L_{Aeq, T}$	Predicted Worst-Case Daytime Sound Pressure Level 1.5 m Receptor Height, dB $L_{Aeq, T}$
1	42.5	42.7
2	38.7	39
3	37.7	38.1
4	37.4	37.8
5	37	37.3
6	36.5	36.9
7	35.7	36
8	35.3	35.6
9	38.8	39.1
10	40.0	40.4
11	38.9	39.3
12	36.9	37.4
13	35.3	35.8
14	36.6	37
15	37.5	37.9
16	38.6	39
17	38.9	39.3
18	38.8	39.2
19	38.5	38.9
20	39.4	39.9
21	39.7	40.1
22	36.8	37.2
23	31.8	32.1
24	33.2	33.5
25	33.8	34.1
26	34.0	34.3
27	33.3	33.6
28	31.3	31.7
29	33.0	33.4
30	34.7	35
31	31.8	32.2

Receptor Location	Predicted Typical Daytime Sound Pressure Level 1.5 m Receptor Height, dB $L_{Aeq, T}$	Predicted Worst-Case Daytime Sound Pressure Level 1.5 m Receptor Height, dB $L_{Aeq, T}$
32	32.6	32.9
33	31.7	32.1
34	34.8	35.1
35	35.0	35.3
36	35.3	35.6
37	35.5	35.8
38	35.4	35.7
39	35.6	36
40	33.0	33.5
41	31.9	32.4
42	32.9	33.3

Night-Time Noise Modelling Results

Noise modelling results are shown in Table 9D.12 for typical and worst-case night-time operation scenarios. Night-time predicted sound pressure levels are shown for all 42 noise-sensitive assuming a receptor height of 4m above ground height, representing the height of a bedroom window.

The daytime noise model assumes that 25 BESS inverters are operational and all data hall AHUs, substation operational, as detailed within this Appendix.

Typical operation for daytime includes 5 gas turbines and 0 gas engines running with a 100% on-time.

Worst-case operation for daytime has 7 gas turbines operating a with 100% on-time.

Table 9D.12: Typical Night-Time Plant and Equipment $L_{Aeq, T}$ Noise Propagation Modelling Results

Receptor Location	Predicted Typical Night-Time Sound Pressure Level 4 m Receptor Height, dB $L_{Aeq, T}$	Predicted Worst-Case Night-Time Sound Pressure Level 4 m Receptor Height, dB $L_{Aeq, T}$
1	43.2	43.6
2	38.8	39.4
3	37.3	38
4	37.0	37.7
5	36.5	37.1
6	36.1	36.6
7	35.3	35.8
8	35.7	36.2
9	39.5	40.1
10	40.0	40.9
11	39.4	40.3
12	36.2	37.1
13	34.6	35.6
14	36.5	37.4
15	37.4	38.2
16	38.4	39.2
17	38.7	39.5
18	38.5	39.4

Receptor Location	Predicted Typical Night-Time Sound Pressure Level 4 m Receptor Height, dB $L_{Aeq, T}$	Predicted Worst-Case Night-Time Sound Pressure Level 4 m Receptor Height, dB $L_{Aeq, T}$
19	38.2	39.1
20	38.9	39.9
21	39.1	40
22	36.7	37.5
23	31.3	32
24	33.2	33.8
25	33.4	34
26	33.7	34.3
27	33.4	34
28	31.5	32.2
29	33.1	33.8
30	34.8	35.4
31	31.6	32.1
32	32.2	32.8
33	31.2	31.9
34	35.4	35.8
35	35.1	35.5
36	35.1	35.6
37	35.4	35.8
38	35.1	35.6
39	35.2	35.7
40	32.3	33.2
41	31.1	32