ARUP

Amazon Data Services UK Ltd

Hemel Hempstead Data Centre - Emergency Back-up Generation Facility

Acoustic Assessment

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1. Introduction

This report details the assessment of noise from the proposed data centre, which includes an assessment of noise emissions from generators associated with emergency power systems. Information contained within this report will be used to inform permitting decisions to be taken by the Environment Agency. The content and findings of this report are the same as that submitted during the planning application, but the report has been ordered to give prominence to the assessment of noise from the generators.

1.1 Site location and context

The Proposed Development is situated in the Prologis Industrial Park, located in a light industrial and commercial area in Hemel Hempstead. The Proposed Development site location is shown in Figure 1.

The data centre is located at 3A Blossom Way, Hemel Hempstead in Borough of Dacorum, Hertfordshire. The northern boundary of the Proposed Development site consists of a Costa Coffee drive thru and a fitness centre with its adjoining multi-deck car park. There are warehouses to the east; to the west there is a self-storage facility; and to the southwest there is a Travelodge Hotel, a car park and open space. Residential properties are located further to the west and south, approximately 100m from the Proposed Development site boundary. Several major roads are located in proximity to the Proposed Development site, including the A414 (Breakspear Way) to the south, the A4147 (Maylands Avenue) to the west. The M1 motorway is located 1.2km to the east.

Figure 1: Site Location

1.2 Purpose and Structure

Arup has carried out a noise impact assessment for a proposed data centre facility with regard to: emergency backup generators; the main building containing the servers and heat rejection plant; and three hybrid coolers located externally along the east façade.

A glossary of acoustic terminology used in this report is in Appendix A.

2. Baseline Conditions

2.1 Site Description and Noise Sensitive Receptors

The site is located to the north of Breakspear Way and Maylands Avenue bounds the site on its western edge. It is bordered on its northern boundary by existing commercial premises by industrial units to the east (see Figure 2).

The noise environment on and around site is dominated by road noise arising from the A414 which runs along the southern boundary of site, Maylands Avenue immediately to the west and the M1 which lies approximately 1,200 m to the east of the site.

Three residential areas are located approximately 100m to 150m from the development site, as follows:

- Hales Park to the northeast of the site, beyond the neighbouring commercial and industrial buildings;
- The Flags, New Park Mews & Arundel Close to the west, separated by Maylands Avenue (A4147) and intervening office blocks; and
- Datchworth Turn and Barley Croft to the south, separated by the A414.

There is also a Travelodge Hotel located to the southwest of the site on the opposite side of Maylands Avenue and a Nuffield Health Fitness & Wellbeing Gym located adjacent to the site to the north.

Figure 2: Proposed Data Centre site relative to the surrounding environment and nearest residential areas

2.2 Environmental Noise Survey Results

An environmental noise survey has been carried out by Arup, the details of which can be found in Appendix B.

Sound levels at nearby noise sensitive receptors will vary throughout the day and night mostly dictated by traffic flow on the nearby roads.

In accordance with BS4142, the 'typical' background ($L_{A90,15min}$) sound level (i.e. not just the lowest background sound level) at sensitive receptors should be established for assessment purposes.

The Department for Environment, Food and Rural Affairs (DEFRA) have published the Environmental Noise Directive (END) strategic noise mapping of agglomerations in England based on modelled road traffic (http://www.extrium.co.uk/noiseviewer.html). The noise contours shown in the Defra noise maps for the Prologis Industrial Park indicate that the day and night time influence of road traffic noise is similar for all the nearby residential receptors that have been assessed. Therefore, given that the noise climate around the site is dominated by road traffic, the background noise levels measured at the northern logger location (representative of the Hales Park area) can also be considered representative of the minimum background sound levels experienced at the residential receptors to the west and south.

It is possible that the typical background sound levels at the receptors being assessed to the south of the site may be higher than the proposed sound levels, given that these receptors are closer to the main roads in the area. However, in the absence of more detailed measured data specifically in these locations, this is considered to be at the very least a robust, if not a worst-case assessment approach.

In summary, based on statistical analysis to determine the typically regular occurring background (L_{A90}) sound level at the northern logger location (L1 as described in Appendix B), the proposed background sound levels for assessment purposes for each of the receptors is detailed in Table 1.

Area	*Time Period*	*$L_{A90,15min}$ (dB)*
Hales Park (north of the site) The Flags New Park Mews Arundel Close (west of the site) Barley Croft Datchworth Turn (south of the site)	07:00 – 23:00 (daytime)	44
	23:00 – 07:00 (night time)	43

Table 1: Baseline sound levels applied to each receptor for assessment purposes

3. Assessment criteria

3.1 National Planning Policy

Relevant guidance on national planning policy is contained within the Noise Policy Statement for England[1] (NPSE), the National Planning Policy Framework[2] (NPPF) and the Planning Practice

[1] Department for Environment, Food and Rural Affairs. Noise Policy Statement for England. Defra. 2010.

[2] Ministry of Housing, Communities and Local Government. National Planning Policy Framework, 2021.

Guidance on Noise[3] (PPGN) and relevant British Standards in particular British Standard BS 4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound* (BS4142). However, these policy documents do not contain guidance in terms of numerical noise levels. Guidance is provided descriptively, which may be transposed to numerical noise levels for site-specific situations, using the methods contained within British Standards and other appropriate guidance. However, there is no specific guidance on this.

Relevant experience and professional judgment are fundamental to all stages of the assessment that leads to the determination of the significance of a noise effect.

The non-numeric guidance contained within the PPG, based upon the initial advice in the NPSE, is summarised in Table 2 below.

Perception	Examples of Outcomes	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	
Lowest Observed Adverse Effect Level (LOAEL)			
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. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level (SOAEL)			
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 harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

Table 2: Summary of guidance from NPSE and PPGN

3.2 Residential Dwellings - Local Planning Policy and BS4142 criteria

Arup has received correspondence from Dacorum Borough Council Environmental Health (DBC) advising that predicted plant noise emission should be assessed at residential receptors in accordance with BS 4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound* (BS4142).

BS4142 explains that typically, the greater level of difference between the plant noise rating level (i.e. the specific sound level plus any adjustment for the characteristic features of the sound, $dBL_{Ar,Tr}$) and background sound level at the receptor, the greater the magnitude of the impact. In summary, BS4142 states:

[3] Ministry of Housing, Communities and Local Government. National Planning Practice Guidance.

- *A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.*
- *A difference of around +5 dB 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.*

It is therefore recommended that fixed plant noise arising from the proposed data centre should generally not exceed the background noise levels when assessed at free-field locations representative of the nearest residential properties to the site. As such the proposed noise emission limits are as follows:

- 44dB$L_{Ar,Tr}$ during any 1-hour period of the daytime (07:00 - 23:00)
- 43dB$L_{Ar,Tr}$ during any 15-minute period of the night time (23:00 - 07:00)

3.3 Hotel – BS8233 criteria

Table H3 in British Standard BS8233:2014 *Guidance on sound insulation and noise reduction for buildings* (BS8233) suggests 30-40dB$L_{Aeq,T}$ as a suitable internal noise limit for daytime and 25-35dB$L_{Aeq,T}$ for night time in hotel bedrooms (likely to be the most sensitive internal spaces).

Given the proximity to the A414, it has been assumed that the hotel will not be naturally ventilated and therefore a sealed façade system can be assumed. A modern sealed façade is conservatively estimated to provide around 32dB level difference, which indicates that an external sound level of 62-72dB$L_{Aeq,T}$ during daytime and 57-67dB$L_{Aeq,T}$ during night time is acceptable outside the hotel windows.

In order to avoid having a material effect upon internal noise levels, an external noise threshold is proposed which is 5dB lower. Accordingly, an external noise limit at the hotel façade of 57dB$L_{Aeq,T}$ during daytime and 52dB$L_{Aeq,T}$ during night time is proposed, assuming sealed windows or solid façade.

3.4 Fitness and wellbeing gym criteria

Fitness centres / gyms are generally vibrant environments with a noticeable amount of occupational noise arising from fitness activities and equipment operation, however they may also include therapy and treatment spaces. Therefore, a design target (for assessment purposes) that is considered reasonable for intrusive noise from external sources is 40dBL_{Aeq}.

It is understood there is also a crèche space located within the fitness centre to support the users of the gym. The crèche is also expected to experience a reasonable level of occupation noise due to the inherent activities likely to be taking place. However, given that creche spaces are generally more acoustically sensitive than gym spaces, an intrusive noise limit (for assessment purposes) of 35dBL_{Aeq} is considered appropriate.

The fitness and wellbeing gym is only expected to be occupied during the daytime and therefore night time (23:00-07:00) noise limits and assessments are not considered necessary.

It is assumed that the fitness and wellbeing gym will not be naturally ventilated and therefore a sealed façade system can be assumed. A modern sealed façade is conservatively estimated to provide around 32dB level difference, which indicates that external sound levels during the daytime

of 72dB$L_{Aeq,T}$ for gym spaces, and 67dB$L_{Aeq,T}$ for the crèche space would be compatible outside the fitness and wellbeing gym facade.

However, BS8233 (section 7.7.3.2) provides guidance on external noise limits as follows:

For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50dB$L_{Aeq,T}$, with an upper guideline value of 55dB$L_{Aeq,T}$ which would be acceptable in noisier environments.

Whilst there is not an amenity space such as a public park or gardens immediately adjacent to the Data Centre site, there are publicly accessible spaces and a walkway to the fitness and wellbeing gym car park. It is therefore considered appropriate to limit external noise to 55dB$L_{Aeq,T}$ at the façade of the nearby fitness and wellbeing gym in accordance with BS8233. Assessment

3.5 Noise Receptor Locations Considered

Based on Google maps the nearest noise sensitive receptors have been identified as follows:

- Hales Park to the northeast of the site, separated by the Maylands Gateway logistics facility (R1-R3 in Figure 3);
- New Park Mews, The Flags and Arundel Close to the west, separated by Maylands Avenue (R8-R9 in Figure 3);
- Datchworth Turn and Barley Croft, to the south, separated by the A414 (R4 – R6 in Figure 3);
- A Travelodge Hotel to the south west (R7 in Figure 3); and
- Fitness and wellbeing gym (and crèche) to the north (R10 in Figure 3).

The locations of the receiver locations listed above relative to the proposed datacentre site are shown in Figure 3 below.

Figure 3: Overview of the proposed data centre site relative to the nearest noise sensitive receptors used for assessment purposes

All noise receivers are considered to be representative of the nearest (noise sensitive) residential dwellings, with the exception of the hotel location at position R7 and the Fitness and wellbeing gym at position R10.

Upper floor receiver locations have been used as these are likely to be where bedrooms are located (potentially representing worst case scenarios).

3.6 Plant Layout

The proposed data centre layout consists of one building with an approximate rooftop height of 18m.

The most relevant plant equipment included in the acoustic modelling are as follows, and shown in Figure 4 below:

- 33 containerized emergency generators located externally at ground level (30 of which are double stacked) along the east facade.
- 62 Air handling units (AHU) supply ducts (each containing 24 fans) for the cooling of the data halls (located inside the building on the ground floor served by louvred openings in the east and west facade).
- 76 Exhaust ducts (each containing 9 fans) extracting air from the data halls (located within the building at the east and west façades at gantry level).

- 3 Hybrid coolers located externally at south-east corner of the building above the first three generators.
- 2 transformers located externally at ground level at the north façade.

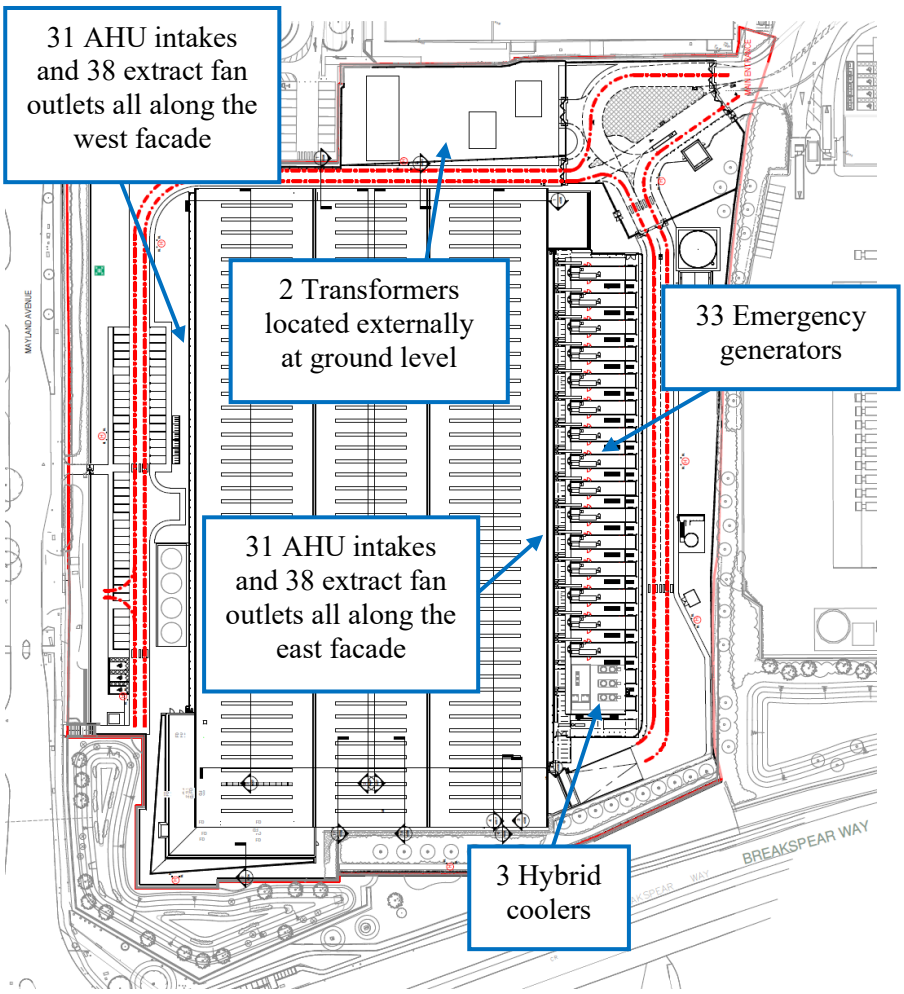

Figure 4: Proposed data centre roof plan showing the general plant layout

It should be noted that there is a sprinkler pump room located at the north east corner of the site that will contain two diesel-powered sprinkler pumps (one which is for redundancy only) and an electric jockey pump.

As this building design and plant specification is still under development, Arup has considered indicative acoustic data to establish the likely noise levels within the pump room and therefore predicted noise levels at the nearest residential receptors.

In summary, based on an anticipated highest reverberant noise level inside the sprinkler pump room of 95dB(A) when a single diesel-powered pump is being tested or operating during an emergency scenario, the noise levels radiating out from the enclosure towards the nearest receptors are expected to be sufficiently low such that there is minimal influence on the predicted noise results presented in section 3.9. Therefore, the sprinkler pump room and associated plant has not been included in the acoustic model.

3.7 Plant Noise Levels

The following sections summarise the plant noise sources based on a series of workshops carried out.

On average, the plant will operate at 80% duty for most of the time and is only expected to operate at 100% duty for approximately 40 hours during a year. However, in the absence of manufacturer's acoustic data for lower operational duties, the noise levels presented are based on 100% duty and therefore represent a worst case scenario. Furthermore, it is unlikely that all mechanical plant will ever operate at 100% duty simultaneously.

All plant and equipment has been specified to a high standard and will be regularly maintained by the operator's on-site maintenance team. Furthermore, due to number of different sources operating simultaneously over a 24 hour period, no acoustic characteristics are envisaged for the heat rejection plant. Noise level corrections in accordance with BS4142 for acoustic characteristics (i.e. tonality, impulsivity or intermittency) have not been included for the various plant sources.

3.7.1 Emergency backup generators

The emergency generators will be provided with acoustic enclosures.

There will be 30 emergency generators; 2 redundancy generators; and 1 smaller ('house') generator supporting ancillary loads.

The acoustic data provided by the generator manufacturer is shown in Figure 5 and Figure 6 below. It is understood the exhaust flues will have a sound pressure level of 75dB(A) at 1m (i.e. same as the house generator).

Octave Band Frequencies	62.5	125	250	500	1000	2000	4000	8000	Hz	SPL2 @ 1m	Hz
Inlet	72	70	57	53	55	53	47	56	dBA	74.60	dBA
Outlet	73	61	57	65	67	65	59	54	dBA	75.30	dBA
Wall	63	69	66	64	58	49	35	35	dBA	72.40	dBA

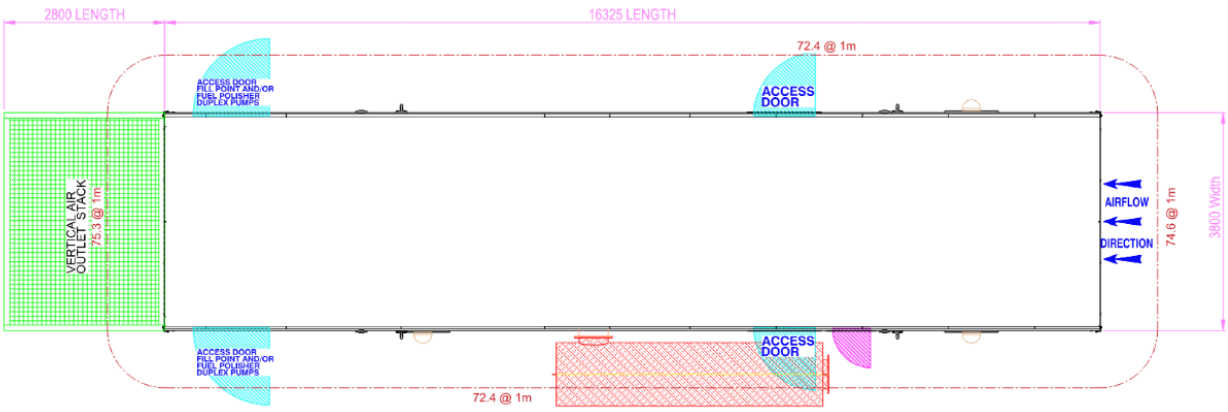

Figure 5: Acoustic data for each of the 30 emergency and 2 redundancy generators

It should be noted that besides testing, the redundancy generators will only operate in an idling state (during a full emergency scenario) unless they are taking over (providing load) for another failed generator. However, for acoustic modelling purposes, the redundancy generators have been modelled based on 'typical operating duty' noise levels therefore representing a worst case scenario.

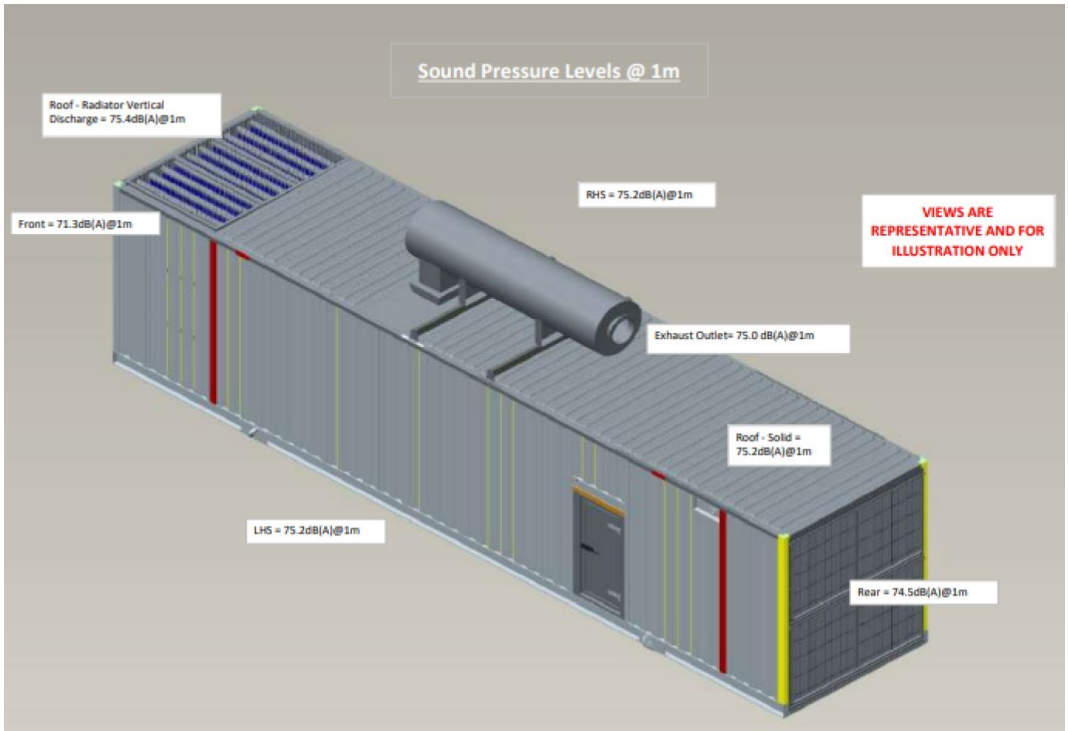

Figure 6: Acoustic data for the single house generator

3.7.2 Air handling units (AHUs)

Each of the 62 AHUs connected to a façade louvre contain 24 individual fans. The source sound power for a given AHU supply louvre is as shown in Table 3.

Description	Total sound power, dB(A)	Octave band centre frequency, Hz, dB							
		63	125	250	500	1k	2k	4k	8k
Sound power (L_w) for a single AHU supply louvre	68	75	83	71	53	47	41	36	30

Table 3: Source sound power level (L_w) for each AHU louvre

3.7.3 Extract fans

Each of the 76 extract fans connected to a façade louvre contain 9 individual fans. The source sound power for a given extract fan louvre as shown in Table 4

Description	Total sound power, dB(A)	Octave band centre frequency, Hz, dB							
		63	125	250	500	1k	2k	4k	8k
Sound power (L_w) for a single (unattenuated) extract fan	64	85	72	58	57	57	52	48	51

Table 4: Source sound power level (L_w) for each extract fan louvre

3.7.4 Hybrid coolers

The sound power level for each of the 3 hybrid coolers located above the house generator at the south-east corner of the building is shown in Table 5.

Description	Total sound power, dB(A)	Octave band centre frequency, Hz, dB							
		63	125	250	500	1k	2k	4k	8k
Sound power (L_W) for a single hybrid cooler	88	91	91	88	86	83	78	71	62

Table 5: Source sound power level (L_W) for each hybrid cooler

3.7.5 Transformers

The sound power level for each of the 2 transformers located at ground level at the north facade of the building is shown in Table 6.

Description	Total sound power, dB(A)	Octave band centre frequency, Hz							
		63	125	250	500	1k	2k	4k	8k
Sound power (L_W) for a single transformer	83	79	90	87	83	70	62	63	65
Note: As spectral data has not been provided by the manufacturer, spectral data for similar plant have been adopted and adjusted to meet the overall level as shown.									

Table 6: Source sound power level (L_W) for each transformer

3.8 Datacentre Operational Plant Scenarios Modelled

The acoustic modelling has been based on the information, drawings, sketches and noise data provided by the manufacturer.

Furthermore, the source sound power levels described in section 3.7 have been included as necessary in each of the modelled scenarios as follows:

- **Scenario 1, normal operation** - Heat rejection plant and transformers operating 24 hours per day (no generators in operation).
- **Scenario 2, north generator testing** - Heat rejection plant and transformers operating 24 hours per day plus the single, northern most generator operating during the daytime only.
- **Scenario 3, south generator testing** - Heat rejection plant and transformers operating 24 hours per day plus the single, southernmost generator operating during the daytime only.
- **Scenario 4, full emergency** - Heat rejection plant and transformers operating 24 hours per day plus all generators operating during the daytime and night time.

3.9 Results

3.9.1 Scenario 1 – normal plant operation only

Predicted plant noise levels for normally operating plant during the daytime and night time periods when assessed at the nearest sensitive receptors are shown in Table 7.

Receiver	Predicted daytime plant noise, $dBL_{Ar,Tr}$	Noise limit, dB(A)	Difference between predicted noise and limit	Predicted night time plant noise, $dBL_{Ar,Tr}$	Noise limit, dB(A)	Difference between predicted noise and limit
R1	25	44	-19	25	43	-18
R2	15		-29	15		-28

R3	16		-28	16		-27
R4	37		-7	37		-6
R5	36		-8	35		-8
R6	30		-14	28		-15
R8	28		-16	28		-15
R9	27		-17	27		-16
R7 (hotel)	29[4]	57	-28	29	52	-23
R10 (gym and crèche)	46	55	-9	n/a	n/a	n/a

Table 7: Predicted plant noise at the nearest sensitive receptors for normally operating plant

3.9.2 Scenario 2 – normal plant operation plus single generator to the north being tested at daytime

The generators are arranged in a line from the north to south (as shown in Figure 3). This scenario considers the northern most generator being tested i.e. representing the worst-case noise assessment (during generator testing) for the nearest residential receptors to the north of the site.

Generator testing will only take place during the daytime. Therefore, night-time results do not consider any noise arising from generator operation. The predicted noise levels when assessed at the nearest sensitive receptors are detailed in Table 8.

Receiver	Predicted daytime plant noise, $dBL_{Ar,Tr}$	Noise Limit, dB(A)	Difference between predicted noise and limit	Predicted night time plant noise, $dBL_{Ar,Tr}$	Noise Limit, dB(A)	Difference between predicted noise and limit
R1	34		-11	25		-18
R2	23		-22	15		-28
R3	22		-23	16		-27
R4	38		-7	37		-6
R5	36	44	-10	35	43	-8
R6	30		-17	28		-15
R8	29		-15	28		-15
R9	27		-17	27		-16
R7 (hotel)	29[5]	57	-28	29	52	-23
R10 (gym and crèche)	48	55	-7	n/a	n/a	n/a

Table 8: Predicted plant noise at the nearest sensitive receptors for normally operating plant plus the single, northern-most generator being tested

3.9.3 Scenario 3 – normal plant operation plus single generator to the south being tested at daytime

The generators are arranged in a line from the north to south (as shown in Table 9). This scenario considers the southern-most generator being tested i.e. representing the worst-case noise assessment (during generator testing) for the nearest residential receptors to the south of the site.

Generator testing will only take place during the daytime. Therefore, night-time results do not consider any noise arising from generator operation. The predicted noise levels when assessed at the nearest sensitive receptors are detailed in Table 9.

[4] Rating noise levels in accordance with BS4142 do not typically apply to commercial receptors, therefore this noise level should be read as dB(A).

[5] Rating noise levels in accordance with BS4142 do not typically apply to commercial receptors, therefore this noise level should be read as dB(A).

Receiver	Predicted daytime plant noise, $dBL_{Ar,Tr}$	Noise Limit, dB(A)	Difference between predicted noise and limit	Predicted night time plant noise, $dBL_{Ar,Tr}$	Noise Limit, dB(A)	Difference between predicted noise and limit
R1	28	44	-16	25	43	-18
R2	17		-27	15		-28
R3	18		-26	16		-27
R4	39		-5	37		-6
R5	39		-5	35		-8
R6	33		-11	28		-15
R8	28		-16	28		-15
R9	27		-17	27		-16
R7 (hotel)	29[5]	57	-28	29	52	-23
R10 (gym and crèche)	46	55	-9	n/a	n/a	n/a

Table 9: Predicted plant noise at the nearest sensitive receptors for normally operating plant plus the single, southern most generator being tested

3.9.4 Scenario 4 – full emergency, all normal plant plus all generators operating

Predicted plant noise levels assessed at the nearest sensitive receptors for a full emergency scenario (i.e. when all heat rejection plant plus all generators would be operating) are shown in Table 10.

Receiver	Predicted daytime plant noise, $dBL_{Ar,Tr}$	Noise Limit, dB(A)	Difference between predicted noise and limit	Predicted night time plant noise, $dBL_{Ar,Tr}$	Noise Limit, dB(A)	Difference between predicted noise and limit
R1	44	44	0	44	43	1
R2	34		-10	34		-9
R3	34		-10	32		-11
R4	46		2	46		3
R5	43		-1	43		0
R6	39		-5	39		-4
R8	35		-9	35		-8
R9	34		-10	34		-9
R7 (hotel)	36[6]	57	-21	36	52	-16
R10 (gym and crèche)	50	55	-5	n/a	n/a	n/a

Table 10: Predicted plant noise at the nearest sensitive receptors for normally operating plant plus all generators operational

3.9.5 Assessment

The results in Table 7 to Table 9 show that for 'normal' and 'generator testing' operational scenarios, the predicted plant noise should not exceed the noise emission limits during the day and night time periods at the nearest sensitive receptors.

During a full emergency scenario, the predicted plant noise levels exceed the noise emission limits at R1 by 1dB during the night time and at R4 by 2dB during the daytime and 3dB during the night time. It is widely accepted that a 3dB change in noise levels is considered 'barely perceptible' and would therefore be below the 'Lowest Observed Adverse Effect Level' described in Table 2. Also, BS4142 notes that the onset of adverse impacts occurs when the plant noise rating level exceeds the

[6] Rating noise levels in accordance with BS4142 do not typically apply to commercial receptors, therefore this noise level should be read as dB(A).

background sound by 5dB. As such, the predicted exceedances described above are below this noise level threshold as well. All generators becoming operational would be in the case of a power outage across the whole site and also potentially neighbouring sites/residential areas. Therefore, given the rarity, marginal exceedance of typical lowest background noise levels at one receptor location, potential scale and assumed short term duration of such an event, plant noise arising from the proposed data centre in this context is not expected to cause an adverse effect at the nearest sensitive receptors.

The assessments overall are considered conservative as all the mechanical plant is unlikely to be operating at 100% duty simultaneously.

In addition, given that the background noise levels used for assessment purposes are considered to be worst case scenario and may potentially be slightly higher at some receptors locations, an increase in background noise would mean the potential for noise impacts is further diminished.

For all scenarios that have been assessed, predicted plant noise is not expected to exceed the proposed limits and/or cause disturbance to the noise sensitive spaces inside the nearby hotel (R7) or the fitness and wellbeing gym (and crèche) (R10) that are assumed to be mechanically ventilated with a sealed façade.

As noted in section 3.7, predicted plant noise levels do not include any corrections for acoustic characteristics (in accordance with BS4142). However, given that the majority of the predicted plant noise is well below the background noise level, any additional acoustic corrections (e.g. +2dB for 'just perceptible' tonality for the majority of the plant or +6dB for 'clearly perceptible' with respect to the transformers) would not change the outcome of this assessment.

4. Conclusion

Arup has carried out a baseline environmental noise survey around the site that has informed the noise emission limits as part of a noise impact assessment for the data centre facility. The limits are considered to be robust based on other publicly available information and the expectation is that background noise levels at some of the receptors will potentially be higher than what has been proposed. As such, the proposed baseline and therefore noise emission limits are representing a reasonable worst-case scenario.

For 'normal' (scenario 1) and 'generator testing' (scenarios 2 and 3) operational scenarios, the results show that predicted plant noise would not exceed the noise emission limits during the day and night time periods at the nearest sensitive receptors.

During a full emergency scenario (scenario 4), the predicted plant noise levels marginally exceed the noise emission limits at two receptor locations. However, given the small magnitude of the exceedance (it is widely accepted that a 3dB change in noise levels is considered 'barely perceptible') and the rarity of this event (i.e. a total utility power failure combined with maximum cooling needs) and assumed short term duration of such an emergency event, this is not expected to cause an adverse effect at the nearest sensitive receptors.

For all scenarios that have been assessed, predicted plant noise is not expected to exceed the proposed limits and/or cause disturbance to the noise sensitive spaces inside the nearby hotel or fitness and wellbeing gym.

Appendix A

Acoustic Terminology

Decibel (dB)

The ratio of sound pressures which we can hear is a ratio of 10^6:1 (one million:one). For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the 'sound pressure level' (L_p) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply.

dB(A)

The unit used to define a weighted sound pressure level, which correlates well with the subjective response to sound. The 'A' weighting follows the frequency response of the human ear, which is less sensitive to low and very high frequencies than it is to those in the range 500Hz to 4kHz.

In some statistical descriptors the 'A' weighting forms part of a subscript, such as L_{A10}, L_{A90}, and L_{Aeq} for the 'A' weighted equivalent continuous noise level.

Equivalent continuous sound level

An index for assessment for overall noise exposure is the equivalent continuous sound level, L_{eq}. This is a notional steady level which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period. Hence fluctuating levels can be described in terms of a single figure level.

Frequency

Frequency is the rate of repetition of a sound wave. The subjective equivalent in music is pitch. The unit of frequency is the hertz (Hz), which is identical to cycles per second. A 1000Hz is often denoted as 1kHz, eg 2kHz = 2000Hz. Human hearing ranges approximately from 20Hz to 20kHz. For design purposes the octave bands between 63Hz to 8kHz are generally used. The most commonly used frequency bands are octave bands, in which the mid frequency of each band is twice that of the band below it. For more detailed analysis, each octave band may be split into three one-third octave bands or in some cases, narrow frequency bands.

Sound power level

The sound power level (L_w) of a source is a measure of the total acoustic power radiated by a source. The sound power level is an intrinsic characteristic of a source (analogous to its volume or mass), which is not affected by the environment within which the source is located.

Sound pressure level

The sound power emitted by a source results in pressure fluctuations in the air, which are heard as sound.

The sound pressure level (L_p) is ten times the logarithm of the ratio of the measured sound pressure (detected by a microphone) to the reference level of 2 x 10^{-5}Pa (the threshold of hearing).

Thus L_p (dB) = 10 log $(P1/P_{ref})^2$ where P_{ref}, the lowest pressure detectable by the ear, is 0.00002 pascals (ie 2x10^{-5} Pa).

The threshold of hearing is 0dB, while the threshold of pain is approximately 120dB. Normal speech is approximately 60dBL_A and a change of 3dB is only just detectable. A change of 10dB is subjectively twice, or half, as loud.

Statistical noise levels

For levels of noise that vary widely with time, for example road traffic noise, it is necessary to employ an index which allows for this variation. The L_{10}, the level exceeded for 10% of the time period under consideration, and can be used for the assessment of road traffic noise (note that L_{Aeq}

is used in BS 8233 for assessing traffic noise). The L_{90}, the level exceeded for 90% of the time, has been adopted to represent the background noise level. The L_1, the level exceeded for 1% of the time, is representative of the maximum levels recorded during the sample period. A weighted statistical noise levels are denoted L_{A10}, dBL_{A90} etc. The reference time period (T) is normally included, e.g. $dBL_{A10,\ 5min}$ or $dBL_{A90,\ 8hr}$.

Typical levels

Some typical dB(A) noise levels are given below:

Noise Level, dB(A)	Example
130	Threshold of pain
120	Jet aircraft take-off at 100m
110	Chain saw at 1m
100	Inside disco
90	Heavy lorries at 5m
80	Kerbside of busy street
70	Loud radio (in typical domestic room)
60	Office or restaurant
50	Domestic fan heater at 1m
40	Living room
30	Theatre
20	Remote countryside on still night
10	Sound insulated test chamber

Appendix B

Environmental Sound Survey

B.1 Introduction

An environmental sound survey has been carried out by Arup to determine the existing noise climate in and around the Prologis Industrial Park development. This appendix details the baseline sound survey and results.

B.2 Instrumentation

The sound level meters and microphones are Class 1 conforming to BS EN 61672-1:2013. All equipment is calibrated annually as required according to international standards, with traceable records. Calibration certificates can be provided upon request. Onsite calibration checks were conducted, and no significant drift was recorded.

The RION NL-32 and RION NL-52 sound level meters used for the long term (unattended) measurements were fitted with environmental wind shields.

B.3 Measurement Locations

Attended (A1-A5) and unattended (L1-L2) sound level measurements were carried out at the locations shown in Figure B1.

Figure B1: Environmental sound survey locations relative to the site and surrounding area

B.3.1 Attended measurements

The attended day time measurements were carried out by Arup on Thursday 16 October 2021.

The sound level meter was mounted on a tripod, with the microphone set approximately 1.2 - 1.5m above ground level. A windshield was fitted to the microphone to minimise the effects of wind-induced noise across the microphone diaphragm.

Measurements of fifteen minutes duration were carried out at all locations.

All measurements were taken in an acoustically hemispherical 'free field' condition, at least 3.5m away from any vertical reflective surfaces.

During the attended surveys, metrological conditions were dry and calm with wind speeds significantly less than 5m/s.

B.3.1.1 Location A1

Location A1 was between the Nile trading building in the Prologis Industrial Park and the residential dwelling located at the south-west corner of Hales Park Close.

The noise climate at this location was dominated by road traffic noise arising from Maylands Avenue and the A414 (Breakspear Way). During the day time, building site construction noise was also noticeable to the north-west and to the south (Prologis construction site).

Figure B2: Attended measurement location A1

B.3.1.2 Location A2

Location A2 was on the north side of the residential dwellings on Datchworth Turn facing the A414 (Breakspear Way).

The noise climate at this location was dominated by road traffic noise arising from the A414. Occasional building site construction noise was noticeable to the north-west (Prologis construction site) as well as lorry shunting noise arising from the Hermes Depot to the north.


Figure B3: Attended measurement location A2

B.3.1.3 Location A3

Location A3 was between the residential dwellings on Barley Croft and the adjacent playpark to the east, approximately in line with the north facing façade of the dwellings most exposed to the A414 (Breakspear Way).

The noise climate at this location was dominated by road traffic noise arising from the A414. Occasional building site construction noise was also noticeable from the Prologis IndustrialPark to the north-west.


Figure B4: Attended measurement location A3

B.3.1.4 Location A4

Location A4 was located on the grass area adjacent to the Travelodge Hotel car park and approximately 30m west of the roundabout.

The noise climate at this location was dominated by road traffic noise arising from the Maylands Avenue and the A414.

Figure B5: Attended measurement location A4

B.3.1.5 Location A5

Location A5 was located on the grass area adjacent to a residential parking area on The Flags.

The noise climate at this location was dominated by road traffic noise arising from the Maylands Avenue to the east, the A414 to the south and local road traffic. Occasional typical neighbourhood sounds e.g. people movements, nearby talking and sound from a local house clearance were noticeable.

Figure B6: Attended measurement location A5

B.3.2 Unattended measurements

The automatic sound level loggers were configured to measure and store data in fifteen minute samples. This enabled the time history information about the ambient and background noise climate to be established at the static measurement location.

Whilst we cannot be certain about the detailed weather conditions throughout the unattended survey duration, metrological conditions during the instillation and removal of the loggers were dry and calm with wind speeds significantly less than 5m/s.

B.3.2.1 Location L1

Date and Time:

Friday 17/09/21 09:57 to Tuesday 21/09/21 08:54

Location description:

The noise logger was positioned approximately 10m south of the closest house on Hales Park Close, and 1.5m above local ground.

Environment and Observations:

The noise climate at location L1 was dominated by road traffic noise arising from Maylands Avenue and the A414 (Breakspear Way). During the day time, building site construction noise was also noticeable to the north-west and to the south (Prologis construction site).

B.3.2.2 Location L2

Date and Time:

Thursday 16/09/21 10:47 to Tuesday 21/09/21 09:45

Location description:

The logger was positioned approximately 30m from the closest kerb of the A414 Breakspear Way and 1.5m above local ground.

Environment and Observations:

The noise climate at location L2 was dominated by road traffic noise arising from A414 (Breakspear Way). During the day time, nearby building site construction noise was also noticeable as the logger was located at the southern end of the Prologis construction site.

B.3.3 Acoustic observations

Attended night time measurements were not carried out during the environmental sound survey. However, the survey team did re-visit the measurement locations L2 and A1-A5 during the night time between 01:00-02:30 to better understand the noise climate without construction noise and reduced road traffic noise. The 'acoustic observations' generally noted that the dominant noise in the area (including at the southern logger location L2 that was located closer to the existing commercial buildings) was still due to local and distant road traffic.

B.4 Measurement Results

The measured data for the attended and unattended surveys are presented in Table B1 and Figures B7 and B8 respectively.

Location	Measurement Time		Measured Sound Level, dB(A)			
	Start	Finish	L_{90}	L_{10}	L_{eq}	$L_{max,F}$
A1	13:36	13:51	45	49	47	58
	15:39	15:54	49	52	51	63
	18:50	19:05	43	48	46	57
A2	14:48	15:03	52	57	55	63
	16:51	17:06	50	54	52	61
	19:56	20:11	53	58	56	67
A3	14:29	14:44	55	58	57	70
	16:33	16:48	53	62	59	73
	19:38	19:53	56	61	59	65
A4	15:13	15:28	59	64	63	79
	17:20	17:35	58	63	62	81
	20:23	20:38	58	62	61	80
A5	14:03	14:18	46	56	57	86
	16:05	16:20	47	51	49	65
	19:13	19:28	48	52	50	62

Table B 1: Summary of attended environmental noise measurement results

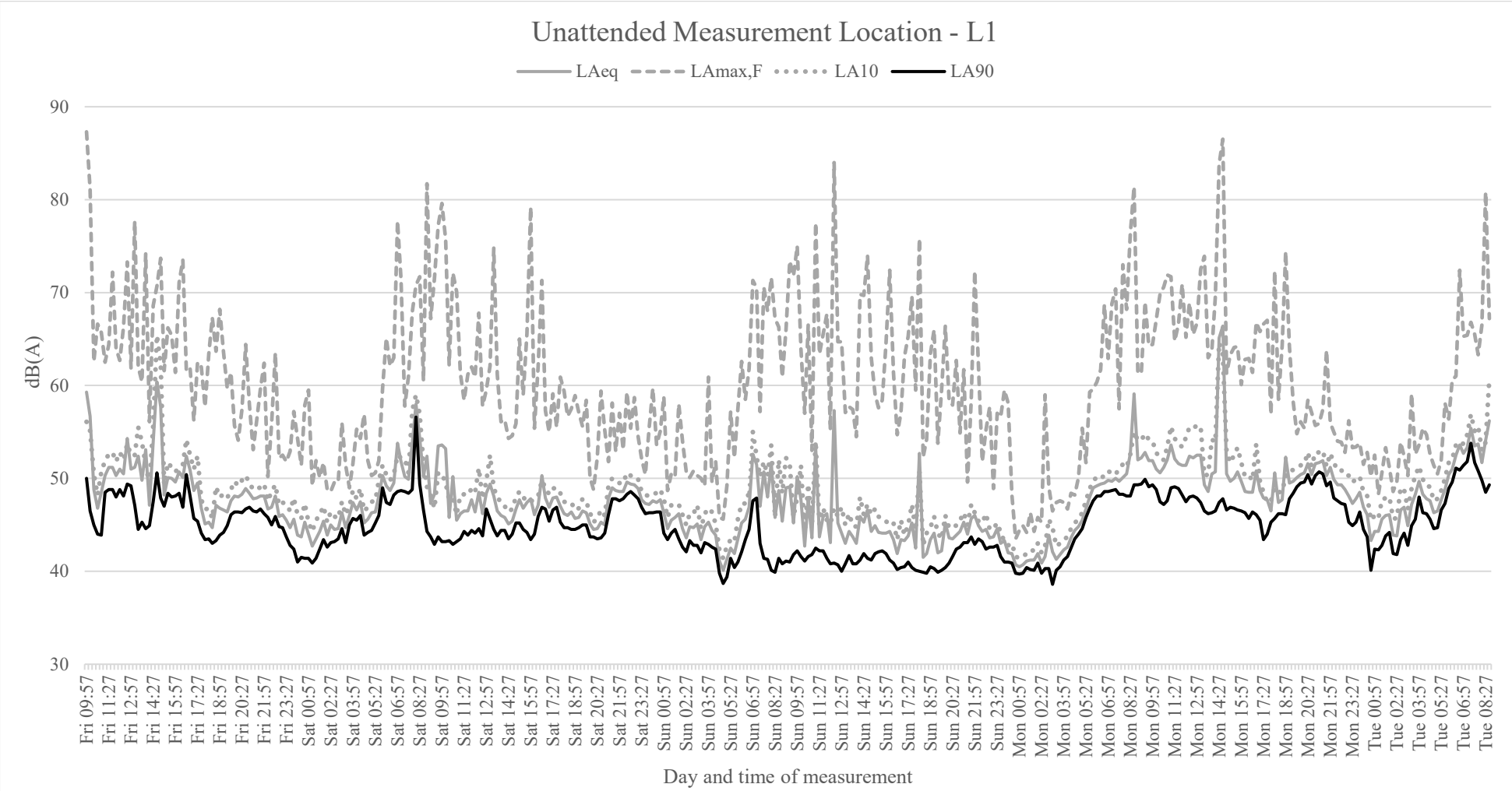

Figure B7: L1 measurement results

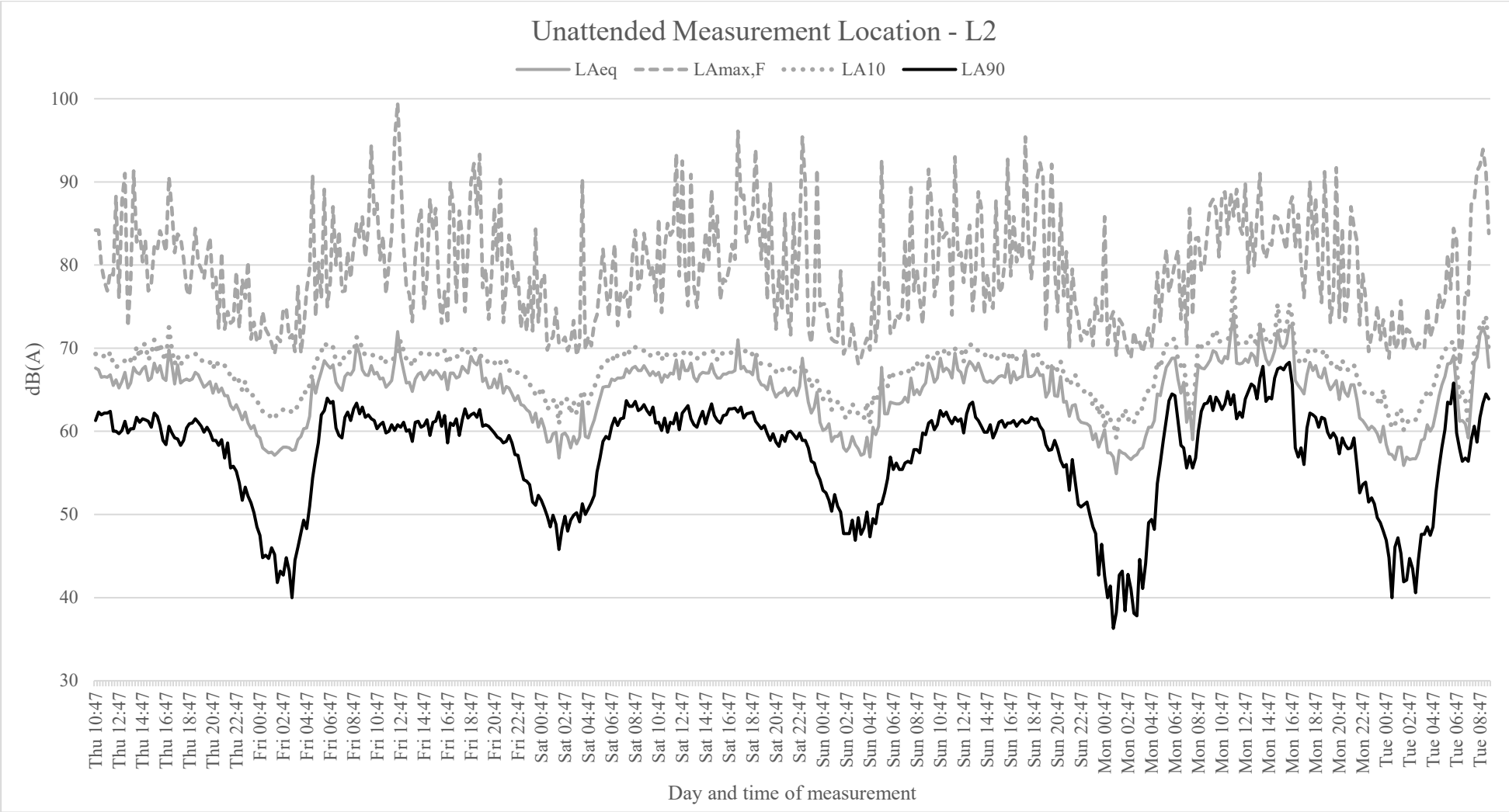

Figure B8: L2 measurement results