



PREPARED: 30 July 2025

Chalcroft Nursery, West Bersted Sound Impact Assessment

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AS13082/SP1	Indicative Site Plan
AS13082/TH1-TH12	Environmental Sound Time Histories
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APPENDIX B	BS4142 Methodology

Project Ref:	AS13082	Project Name:	Chalcroft Nursery, West Bersted
Report Ref:	AS13082.250619.R1	Report Title:	Sound Impact Assessment
Client Name:	Henry Adams LLP		
Project Manager:	Daniel Saunders		
Report Author:	Andrew Nesbitt		
Clarke Saunders Acoustics Winchester SO22 5BE		This report has been prepared in response to the instructions of our client. It is not intended for and should not be relied upon by any other party or for any other purpose.	

1.0 EXECUTIVE SUMMMARY

- 1.1 Outline planning consent has been granted by Arun District Council (ADC), for a mixed-use residential and commercial development at Chalcroft nurseries, Chalcroft Lane, Bognor Regis, PO21 5TS.
- 1.2 Reserved matters relating to the commercial and residential aspects of the development are being addressed separately, where this report addresses requirements relating to commercial sound impact only.
- 1.3 Clarke Saunders Acoustics (CSA) has been commissioned by Henry Adams LLP to assess the potential sound impact of commercial activity at nearby sensitive receptors, addressing the requirements of Condition 12 attached to BE/13/24/S73 and amended by BE/77/25/NMA.
- 1.4 CSA has undertaken an environmental sound survey at site and subsequent sound impact assessment of commercial vehicle movements following procedures in BS4142¹.
- 1.5 Accounting for the proposed mitigation measures and context of the proposal, the assessment has determined that sound emissions from commercial vehicle movements should be controlled to a low impact at nearby sensitive dwellings, satisfying the requirements of Condition 12.

2.0 INTRODUCTION & BACKGROUND

2.1 INTRODUCTION

- 2.2 Clarke Saunders Acoustics (CSA) has been commissioned by Henry Adams LLP to assess the potential sound impact of the proposed commercial development at Chalcroft Nurseries, Chalcroft Lane, Bognor Regis, PO21 5TS.
- 2.3 Arun District Council's sound impact requirements for the commercial development are addressed in Condition 12, attached to the outline planning consent and detailed further in Section 4.1 of this report.
- 2.4 CSA has undertaken an environmental sound survey and subsequent sound impact assessment of commercial activity to address the requirements of the condition.
- 2.5 A list of Acoustic Terminology can be seen in Appendix A.

2.6 BACKGROUND

- 2.7 The proposed commercial development forms part of a wider mixed-use scheme at this site, including both residential and commercial spaces.
- 2.8 The associated planning history is summarised as follows:

¹ BS4141:2014+A.1:2019 *Methods for rating and assessing industrial and commercial sound*

Outline Planning Consent

- 2.9 Outline planning consent was granted by Arun District Council under planning application reference BE/81/20/OUT – *Outline application with all matters, except for access, reserved for the development of up to 20 residential dwellings, 2,240 sqm of commercial space (Use Class A1, B1(b) B1(c) and B8), landscaping, access, parking and associated infrastructure.*
- 2.10 Following The Town and Country Planning (Use Classes) (Amendment) (England) Regulations 2020 coming into effect, the intended commercial uses are classified as E(a), E(g) and B8.

Non-Material Amendment – Phasing Plan

- 2.11 A non-material amendment (NMA) was approved by ADC, planning reference BE/85/23/NMA, to introduce a phasing plan into the development, thereby separating the commercial and residential aspects of the development.

Reserved Matters – Commercial Development

- 2.12 ADC granted approval of reserved matters for the commercial development, under application BE/26/24/RES.
- 2.13 The application and approval included the proposed layout, scale and appearance of the commercial development along with associated landscaping and area for biodiversity gain.

Section 73 & NMA

- 2.14 Arun DC approved a Section 73 application, BE/13/24/S73, to consolidate imprecise wording relating to a number of pre-commencement conditions of the outline planning permission. Further amendments to this application, were approved in the subsequent NMA, reference BE/77/25/NMA.
- 2.15 This report therefore addresses the requirements of Condition 12 attached to BE/13/24/S73 as amended by BE/77/25/NMA. The requirements of Condition 12 are detailed further in Section 4.1.

3.0 SITE DESCRIPTION

- 3.1 The site is located in West Bersted on the outskirts of Bognor Regis and is currently occupied by Chalcroft Nurseries, a garden centre.
- 3.2 Other existing commercial premises located adjacent to the nursery, include St Wilfrid's Hospice Furniture Outlet, Lightweight Hire Sussex (plant and machinery hire), Reef Aquatics (aquarium shop), and Bark 'n' Bath dog grooming. The application boundary covers Chalcroft Nursery and the associated access road only, and does not affect the other existing commercial premises.
- 3.3 The proposal will rationalise and develop underutilised space at Chalcroft Nurseries. New residential dwellings will be constructed to the west of site, new commercial premises will be constructed toward the centre of the site, and existing buildings associated with Chalcroft Nurseries will be retained towards the east of site where the applicant will continue to operate the nursery.

- 3.4 In the reserved matters application, ADC approved the construction of 8no. commercial units within the central portion of the site. A block of 4no. commercial units will be constructed to the centre of the site, with 2 additional blocks of 2no. commercial units to the north and south.
- 3.5 The commercial buildings will measure approximately 8m x 8m and will feature a toilet, a kitchenette and a mezzanine floor above. The units are to be approximately 5m to eaves level and 7m to ridge level. A personnel door and delivery entrance will be located on the front elevation of each unit.
- 3.6 There are currently no targeted tenants or businesses associated with the proposed commercial development, but permitted classes include E(a), E(g) and B8. As detailed in Section 6.0, the primary noise considerations regarding these uses are commercial vehicle movements.
- 3.7 The existing soundscape generally consists of road traffic from Chalcraft Lane and localised vehicle movements on site.
- 3.8 A new access road will be formed from the main access off Chalcraft Lane to be delivered by Barratt Homes in connection with the strategic development to the west. It will extend northwards across the site providing access to the new commercial units. Commercial traffic will enter via the new access road, subsequently minimising impact on existing residential dwellings situated on either side of Ffairfach Close, the current access road.
- 3.9 ADC have also restricted the hours in which commercial vehicles can access the site and undertake loading/delivery activities as follows:
- 07:00 – 19:00 (Monday – Friday);
 - 08:00 – 18:00 (Saturday);
 - Not at any time on Sunday or Public or Bank Holidays
- 3.10 The proposed operating hours are restricted to daytime hours only, aligning with the operating hours of the existing commercial premises.
- 3.11 The nearest residential receptors are understood to be 92 – 98 Chalcraft Lane (adjacent to the south-eastern boundary of the site) and Chalcraft Hall Care Home (adjacent to the north-eastern boundary of the site).
- 3.12 As part of a separate planning proposal, a large residential development has been granted planning consent in the agricultural land bounding the west of the site. Consideration will also be given to potential sound impact at these dwellings.
- 3.13 The site and its surroundings are shown in site plan AS13082/SP1.

4.0 RELEVANT GUIDANCE

4.1 LOCAL AUTHORITY REQUIREMENTS

- 4.1.1 Condition 12 as attached to BE/13/24/S73 and amended by BE/77/25/NMA is given as follows:

Condition 12 (ref. BE/77/25/NMA)

“Construction work on each phase shall not commence unless and until an impact assessment of the noise from the development on occupants of existing nearby residential properties and future occupants of the new residential properties has been completed and submitted to and approved in writing by the Local Planning Authority. The impact assessment shall include noise from deliveries and operation of the development and shall include a noise mitigation scheme. The assessment shall have regard to the principles of BS 4142:2014.”

4.2 BS4142:2014+A.1:2019

4.2.1 BS4142:2014+A.1:2019 *Methods for rating and assessing commercial and industrial sound* (BS4142) provides a methodology to assess the likelihood of adverse impact arising from sound generated by industrial and commercial sound sources. Context forms an important part of the Standard.

4.2.2 A summary of the BS4142 assessment methodology is provided at Appendix B.

5.0 ENVIRONMENTAL SOUND SURVEY

5.1 PROCEDURES & EQUIPMENT

5.1.1 A survey of existing background and ambient sound levels was conducted at the positions shown in the appended site plan, AS13082/SP1.

5.1.2 Measurements of consecutive 5-minute L_{Aeq} , L_{Amax} , L_{A10} and L_{A90} sound pressure levels were taken between 12:00 hours on Thursday 22nd May and 12:00 hours on Wednesday 28th May 2025, following procedures in BS7445:1991 (ISO 1996 2:1987) *Description and measurement of environmental noise Part 2: Acquisition of data pertinent to land use* and BS4142.

5.1.3 The following equipment was used during the course of the survey:

- 1 no. Rion data logging sound level meter type NL53;
- 1 no. Svantek data logging sound level meter type 958;
- 1 no. Rion sound level calibrator type NC74;
- 1 no. Norsonic sound level meter type 1251.

5.1.4 Calibration of the sound level meters was verified before and after use. The calibration drift was within the accepted limits given in the Association of Noise Consultants (ANC) Green Book: Environmental Sound Measurement Guide and BS4142:2014+A.1:2019.

5.1.5 The weather during the survey was generally dry with light winds. These meteorological conditions are suitable for the measurement of environmental sound.

5.2 SURVEY RESULTS

5.2.1 Figures AS13082/TH1-TH5, TH6-TH10 and TH11 present the L_{Aeq} , L_{Amax} , L_{A10} and L_{A90} sound pressure levels as time histories at monitoring positions LT1, LT2 and LT3 respectively.

5.2.2 Measurements undertaken at Position LT1 are representative of receptors at Chalcraft Hall. Measurements at Position LT2 are representative of the existing residential dwellings at 92 – 98 Chalcraft Lane. Measurements at Position LT3 are representative of

the residential dwellings proposed at this site as part of the wider scheme, as well as the new residential development under construction to the west of the site.

- 5.2.3 The ambient, background and typical maximum sound pressure levels during the daytime and proposed operating hours are shown in Table 5.1. No night-time operation is proposed and this is enforced by planning condition, however, night-time noise levels are presented for reference.

Position	Monitoring Period	Ambient $L_{Aeq,T}$	Typical Lowest Background* L_{A90}	Typical Maximum** L_{AFmax}
LT1	Daytime (07:00 – 23:00)	51dB	40dB	70dB
	Operating Hours (07:00 – 19:00)	52dB	42dB	72dB
	Night-time (23:00 – 07:00)	43dB	27dB	63dB
LT2	Daytime (07:00 – 23:00)	52dB	42dB	68dB
	Operating Hours (07:00 – 19:00)	53dB	44dB	68dB
	Night-time (23:00 – 07:00)	45dB	27dB	62dB
LT3	Daytime (07:00 – 23:00)	53dB	42dB	70dB
	Operating Hours (07:00 – 19:00)	54dB	44dB	70dB
	Night-time (23:00 – 07:00)	52dB	35dB	67dB

Table 5.1: Typical measured ambient, background and typical maximum sound levels

*derived as the 10th percentile of the relevant L_{A90} dataset

**derived as the 90th percentile of the relevant L_{AFmax} dataset

[dB ref. 20μPa]

6.0 SOUND IMPACT ASSESSMENT

- 6.1 There are no targeted tenants or businesses associated with the proposed commercial development, but permitted use classes include E(a), E(g) and B8, as follows:

- **E(a) – Commercial, Business and Service:** Display or retail sale of goods, other than hot food.
- **E(g) – Commercial, Business and Service:** Uses which can be carried out in a residential area without detriment to the amenity of that area by reason of noise, vibration, smell, fumes, smoke, soot, ash, dust or grit.
- **B8 – Storage and Distribution:** Premises used for storage and/or distribution, including warehousing and open-air storage.

- 6.2 Class E is a broad use class covering a wide range of commercial activities. There are no specific sound sources common to all class E(a) developments, where commercial activity associated with the display or retail sale of goods does not generally result in high levels of noise. Similarly, by definition, activities falling under use class E(g) can be carried out in residential areas without detriment to the amenity, including noise. Should tenants to

generate noise levels that would result in the loss of amenity, Arun District Council would pursue the tenant to cease the noise generating activity.

- 6.3 Whilst activities related to class E generally do not result in high levels noise impact, consideration is given to the increase in ambient sound conditions owed to varying levels of goods vehicles and private vehicles visiting the site. Sound emissions from loading and unloading of goods as well as that from vehicle movements will form an intrinsic part of the soundscape.
- 6.4 It is anticipated that the primary noisy activities associated with the proposed B8 use, will also be from localised vehicle movements and unloading and loading activity.

6.5 COMMERCIAL VEHICLE ASSESSMENT

- 6.6 The primary sound sources associated with the commercial development will be commercial vehicles accessing the site, undertaking loading/unloading activity, then leaving the site.
- 6.7 CSA has reviewed the transport statements undertaken for the outline application and reserved matters application for commercial development, undertaken by i-Transport and ABHM Civils Ltd respectively.
- 6.8 The transport statement for the outline application (report ref. AI/IN/ITB14224-011) has determined the trip rate for OGV vehicles as derived from the TRICS database on the basis of a proposed commercial area of 1471m². From commercial usage, this would result in a peak hour of 17no. two-way movements.
- 6.9 The commercial area was subsequently rationalised at reserved matters stage, reducing to a commercial area of 736m² as identified in the subsequent transport statement (report ref. FC2921/MH/RM). A revised peak hour of 9no. two-way movements has been determined.
- 6.10 The transport statements also identified that the site can allow for turning and maneuvers from an articulated 16.5m Heavy Goods Vehicle (HGV), however, the scale and nature of the development is such that smaller vehicles, such as rigid HGVs of 11m in length are more realistic.
- 6.11 CSA has undertaken a sound impact assessment of the commercial vehicle movements and loading/unloading activity following procedures in BS4142 and using measured library data. The library data has been used in conjunction with the revised trip generation data to determine resultant sound impact levels for a peak hour, using the following assumptions:
- 9no. trip movements occur in total during the peak hour (11:00 – 12:00);
 - The movements are subdivided as follows:
 - 4 no. Ordinary Goods Vehicle 1 (OGV1) enter the site, 3no. OGV1 exit the site;
 - 1 no. Ordinary Goods Vehicle 2 (OGV2) enters and exits the site.
 - The OGV movements and loading/unloading activity are split equally between the access bays at Units 01 – 04 and Units 05-08;
 - The OGV2 vehicle parks in the HGV layby and unloads/loads from this bay.
 - Loading/unloading activity is undertaken by forklifts and occurs for five minutes for OGV1, and 10 minutes for OGV2.
 - The majority of commercial vehicles make use of tonal reversing alarms and reversing maneuvers take longer than forward maneuvers.

6.12 It is acknowledged that vehicle movements can cover a wide range of sound levels. To enable a robust evaluation, values at the upper end of CSA's measurement data library have been used for the assessment.

6.13 A summary of the library sound levels used in the assessment is given in Table 6.1.

Sound Source	Measurement Unit	63	125	250	500	1k	2k	4k	8k	dB(A)
OGV1 (forwards)	L _p @ 10m	71	65	63	63	60	56	54	46	65
OGV1 (reverse, with alarm)	L _p @ 10m	71	65	63	63	68*	79*	54	46	80
OGV2 (forwards)	L _p @ 5m	75	73	68	65	64	63	59	55	69
OGV2 (reverse, with alarm)	L _p @ 5m	75	74	68	63	74*	85*	63	54	86
Forklift loading/unloading	L _p @ 3m	70	61	56	53	50	47	50	43	57

Table 6.1: Summary of library data used in commercial vehicle assessment [dB ref. 20µPa]
**incl. tonal reversing alarms*

6.14 The nearest affected existing residential receptors are understood to be those at 92-98 Chalcraft Lane. Measured background sound levels at position LT2 are representative of those experienced at these receptors.

6.15 As the existing commercial premises to the north-east of the site will not be affected by the development, activity levels near to receptors at Chalcraft Hall are not anticipated to vary significantly. These receptors are likely to be less impacted by the new commercial development due to acoustic screening losses from the retained commercial buildings. Where commercial sound is controlled to appropriate levels at 92-98 Chalcraft Lane, it is also expected to be controlled to reasonable levels at Chalcraft Hall.

6.16 A layout for the proposed residential phase of the development is still to be confirmed. On the basis of the access road requirements, however, subsequent calculations have assumed that new dwellings will be set back at least 15m from the boundary shared with the commercial premises. Following preliminary calculations and design input, the shared boundary should comprise a solid 2.4m high imperforate barrier with a minimum specific mass of 10kg/m². As the peak hour for commercial movements has been determined to be between 11:00 and 12:00, the assessment has been undertaken to ground floor receptors of the proposed dwellings which are more likely to be occupied during this period.

6.17 The representative background sound levels for the BS4142 assessments have been determined as the 10th percentile of the corresponding L_{A90} datasets during the operational hours. In layman's terms, this is the background sound level which is exceeded for 90% of the time and therefore forms a robust representation of quieter periods at nearby receptors.

6.18 BS4142 assessments should account for acoustic feature corrections which are distinguishable at the receptor. The assessment has pessimistically assumed that the majority of commercial vehicles will make use of tonal reversing alarms. The specific sound level of such activity has been considered and compared to the spectral characteristics of the ambient sound climate. When tonal reversing alarms are audible at nearby receptors, despite significant propagation and screening losses, it is anticipated that the tonality characteristic will be 'just perceptible' against the residual sound climate. A tonality correction of +2dB has therefore been applied².

6.19 On the basis of the environmental noise survey data, no intermittent, impulsive or other acoustic features are expected to be more distinguishable than existing commercial activity which will be retained within the residual sound climate

6.20 A summary of the sound impact predictions is provided in Table 6.2.

Parameter	Chalcroft Lane	New residential development
Specific Sound Level (L _{eq,1hr})	44dB	42dB
Acoustic Character Corrections	+2dB Tonality – just perceptible	+2dB Tonality – just perceptible
Rating Level (L _{A,r,T,r})	46dB	44dB
Typical Background (L _{A90})	44dB	44dB
Assessment Level	+2dB	+0dB

Table 6.2: BS4142 initial impact assessment summary

6.21 The initial BS4142 numerical assessment has determined that the proposed mitigation measures and acoustic screening effects offered by the retained commercial building massing will control resultant sound levels from commercial activity during the peak period towards a '*low impact, depending on the context*'.

6.22 The background sound levels used in the assessment tends towards the lower end of those measured during operational hours. Background sound levels are, therefore, generally expected to exceed the level used in the assessment, and the relative numerical assessment level will be lower still.

7.0 DISCUSSION

7.1 CONTEXT

7.1.1 As part of BS4142, the context surrounding the assessment should be considered with as much regard as the numerical assessment.

7.1.2 The operational hours of the proposed commercial development is restricted by condition and include daytime hours only. Periods of peak commercial activity will commonly coincide with periods in which nearby sensitive dwellings are least occupied

² BS4142:2014+A.1:2019 Section 9.2, *Tonality*, Page 13.

and when receptors are more likely to be in ground floor spaces, where acoustic screening effects from barriers and building massing is generally greater.

- 7.1.3 On the basis of the transport statement, the majority of commercial vehicles are expected to visit the site in the late morning, where background sound levels are generally higher than those used in the assessment. When background sound levels are lower in the morning and evening periods, sound emissions from commercial activity will also be lower.
- 7.1.4 The assessment has assumed the use of tonal reversing alarms by the majority of the commercial vehicles accessing the site. It is increasingly common practice for vehicles to use broadband reversing alarms which would be less distinguishable within the residual sound scape.
- 7.1.5 The predicted level is based on a worst-case scenario calculated for the peak level of commercial vehicle activity. In likelihood, resultant sound emissions from commercial activity will be lower.
- 7.1.6 The representative background sound levels are also relatively onerous within the assessment where they were determined from the 10th percentile of the corresponding L_{A90} datasets. By definition, this tends towards the lower end of existing background sound levels measured. In likelihood, background sound levels will be higher during the peak period identified in the transport statement, 11:00hrs to 12:00hrs, and the relative impact will be lower.
- 7.1.7 Commercial activity, including that from vehicles accessing the site and undertaking loading/unloading, is an existing part of the residual soundscape. Introduction of the specific sound source would therefore be congruous with the existing ambient noise climate.
- 7.1.8 As detailed in Section 8.0, the proposed development includes mitigation measures to reduce specific sound levels at nearby sensitive receptors.
- 7.1.9 Consideration of the context is supportive of the numerical assessment outcome, and the resultant BS4142 sound impact from commercial vehicle operations, inclusive of mitigation measures, would be low at nearby sensitive receptors.

7.2 UNCERTAINTY

- 7.2.1 As per the requirements of BS4142:2014+A.1:2019, the uncertainty in the assessment is considered and reported. This is not an indication of error, but an acknowledgement of possible variability of the factors contributing to this assessment.
- 7.2.2 Use of calibrated Class 1 sound level meters reduces measurement instrumentation error to insignificant levels as compared to environmental variations.
- 7.2.3 Sound levels associated with the typical operation of the proposed uses have been based on CSA library data and publicly available measured data.
- 7.2.4 The representative background sound levels used for the assessment tend toward the low end of those measured across the operational period. Uncertainty in relation to the assessment outcome is therefore minimised in this respect. The relative impact is generally expected to be lower than that calculated.

8.0 MITIGATION

8.1 Condition 12 requires the impact assessment to include noise from both deliveries and operation of the development and include details of a noise mitigation scheme. Noise mitigation has been implemented within the proposal as follows:

- Commercial vehicles may only access the site during the permitted daytime operational hours, restricted by planning condition;
- The site layout of the commercial development maximises separation distance to existing residential receptors;
- A 2.4m high acoustic barrier has been included in the design of the western boundary shared with the proposed residential development;
- An OGV2 (larger goods vehicle) layby has been included towards the centre of the site, maximising distance to both groups of sensitive receptors, i.e. existing and new. The layby allows OGV2 vehicles to park and unload, thus reducing time spent undertaking complicated maneuvers within the site;
- A new access road is provided to the commercial development to minimise impact from noise, pollution and traffic on existing dwellings.

9.0 CONCLUSIONS

9.1 An assessment of predicted sound impact as caused by commercial vehicles at Chalcroft Nurseries, Chalcroft Lane, Bognor Regis, PO21 5TS, has been undertaken by Clarke Saunders Acoustics.

9.2 The assessment was carried out following procedures set out in BS4142:2014+A.1:2019, accounting for potential distinguishable sound features associated with the operations.

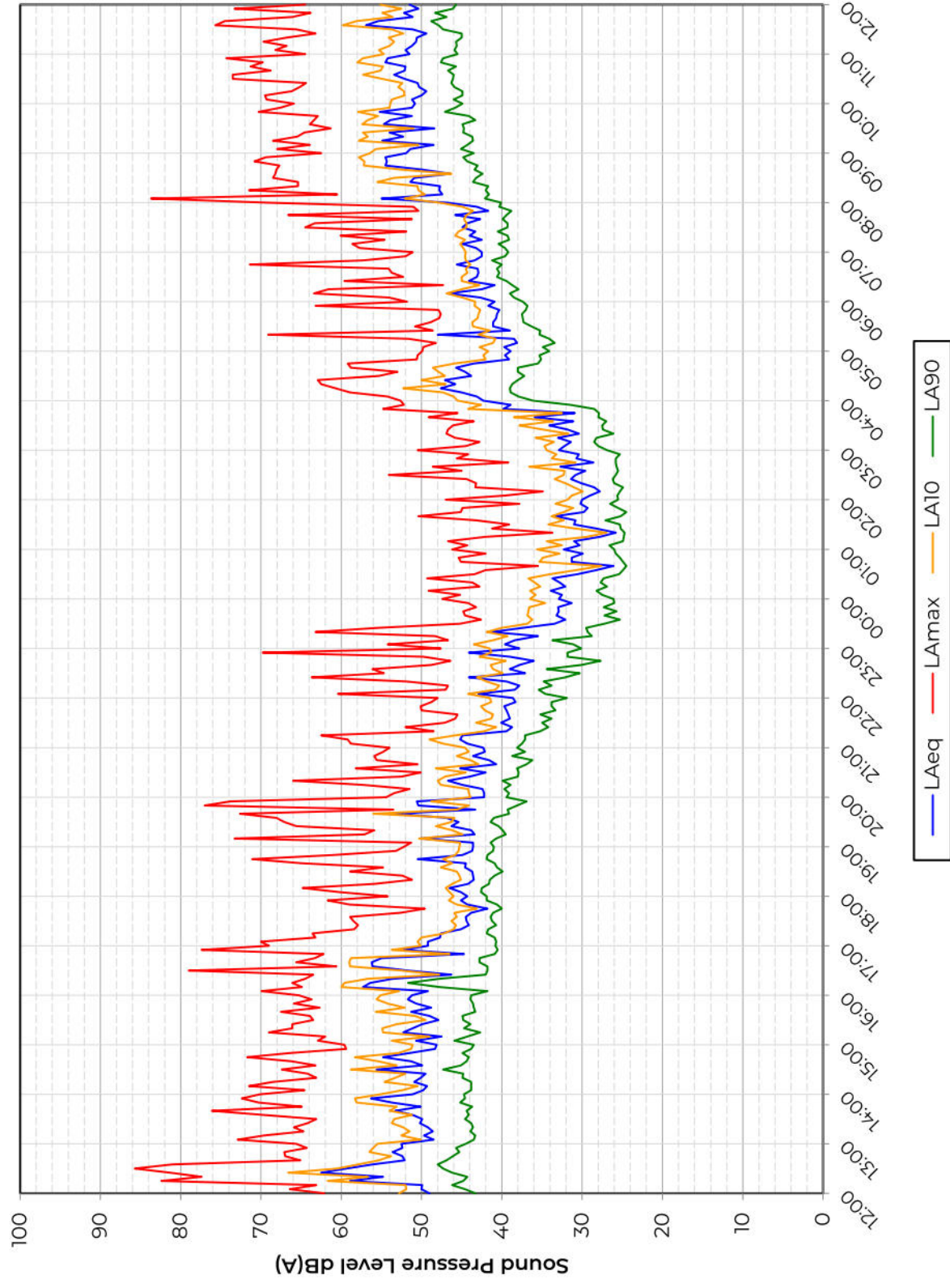
9.3 Based upon the proposed site layout and a peak hour of commercial activity, the BS4142 assessment has demonstrated that the proposed mitigation measures are expected to control sound emissions levels to those indicative of a low impact. The context supports the assessment outcome, and the assessment is, therefore, expected to satisfy the requirements of Condition 12 attached to BE/13/24/S73 and amended by BE/77/25/NMA.



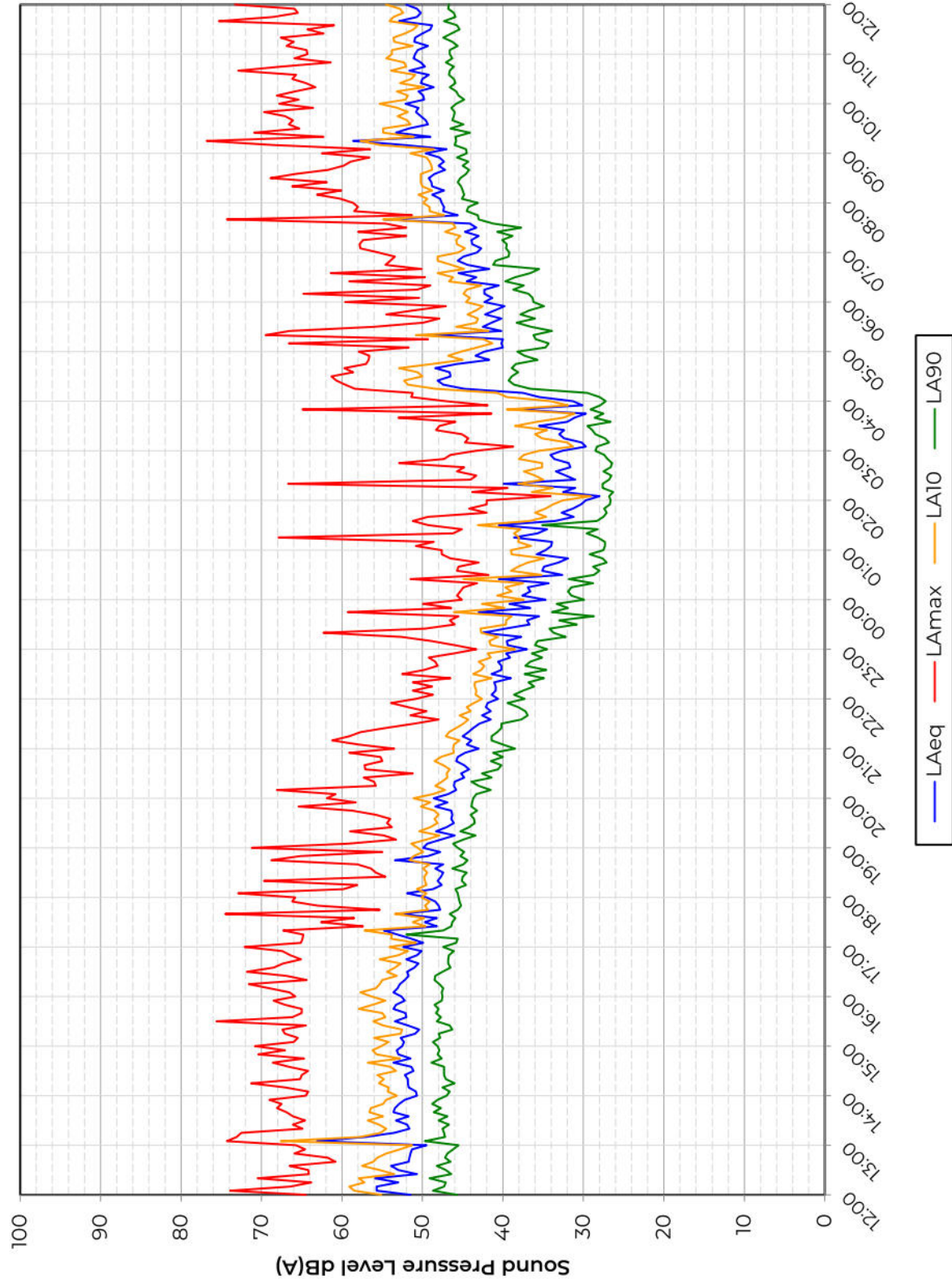
Andrew Nesbitt MIOA
CLARKE SAUNDERS ACOUSTICS



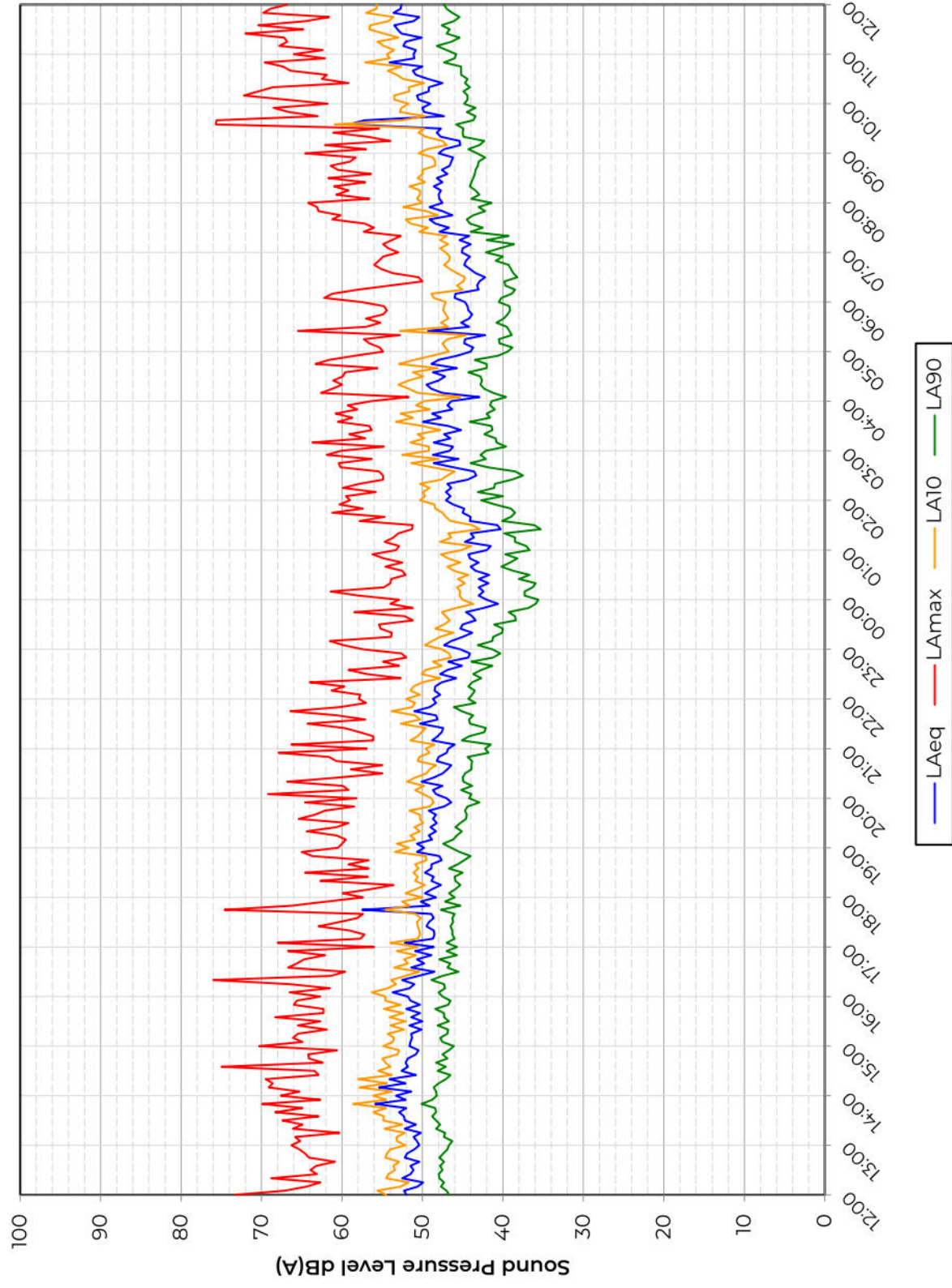
Position LT1



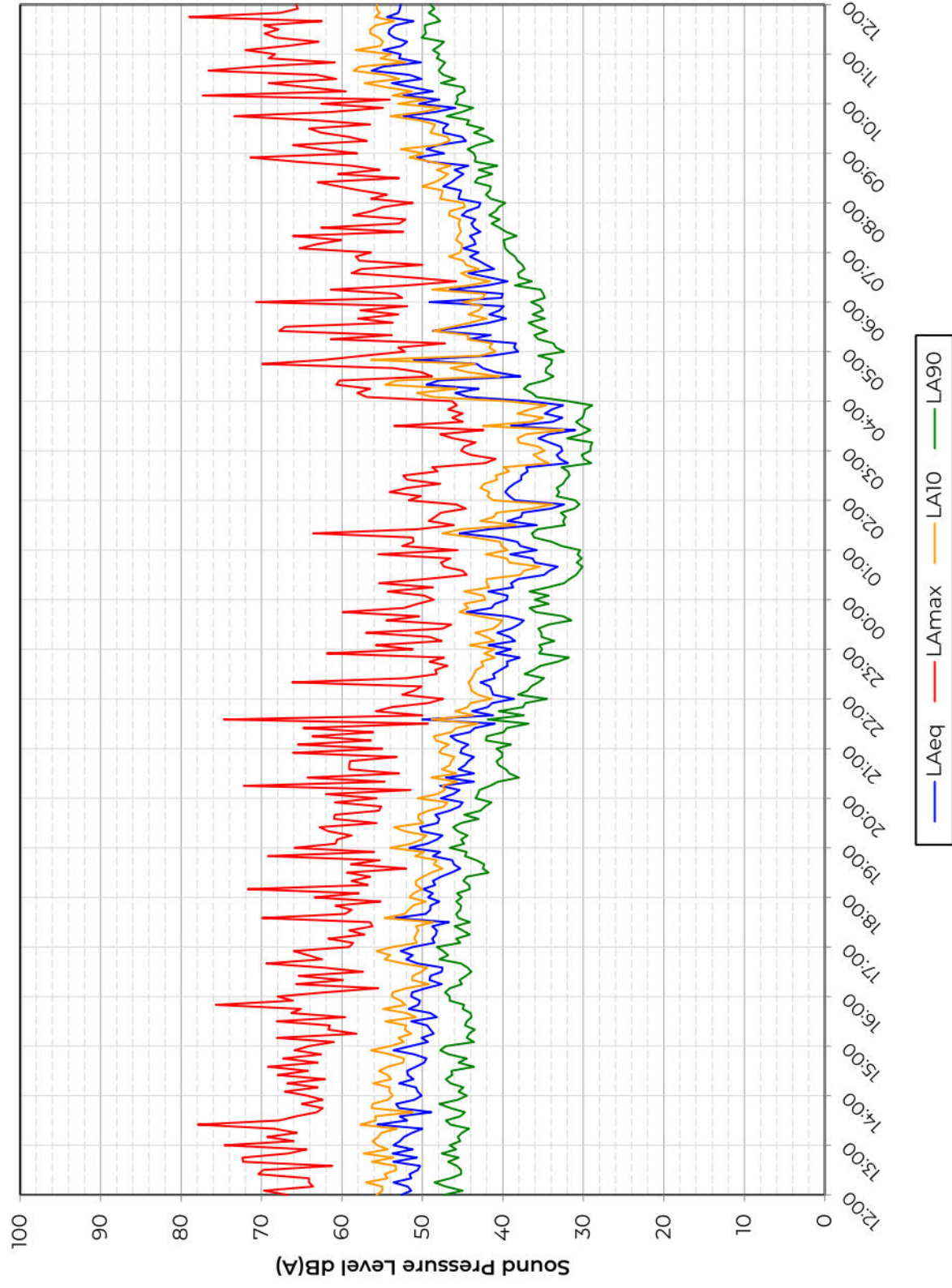
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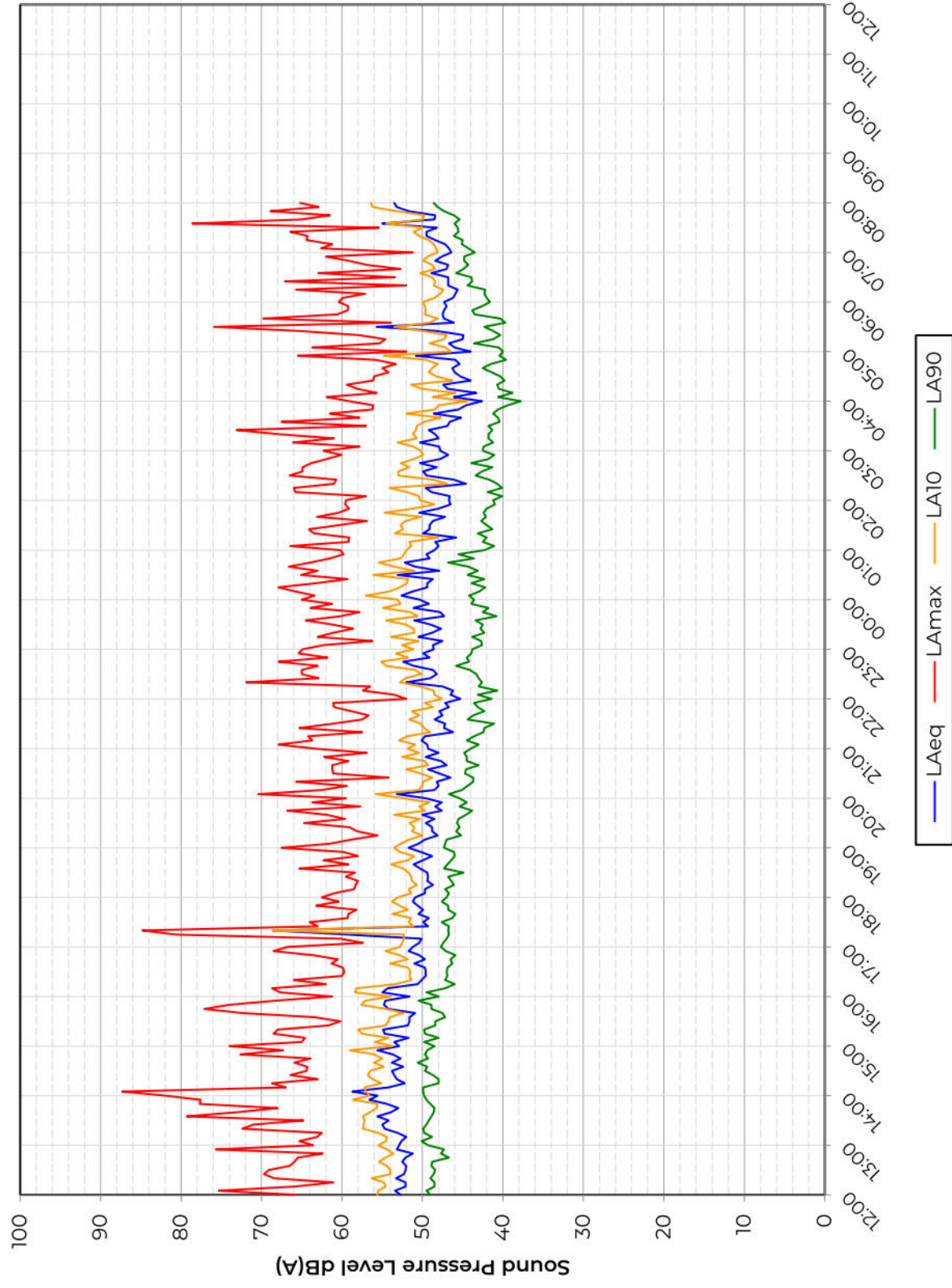
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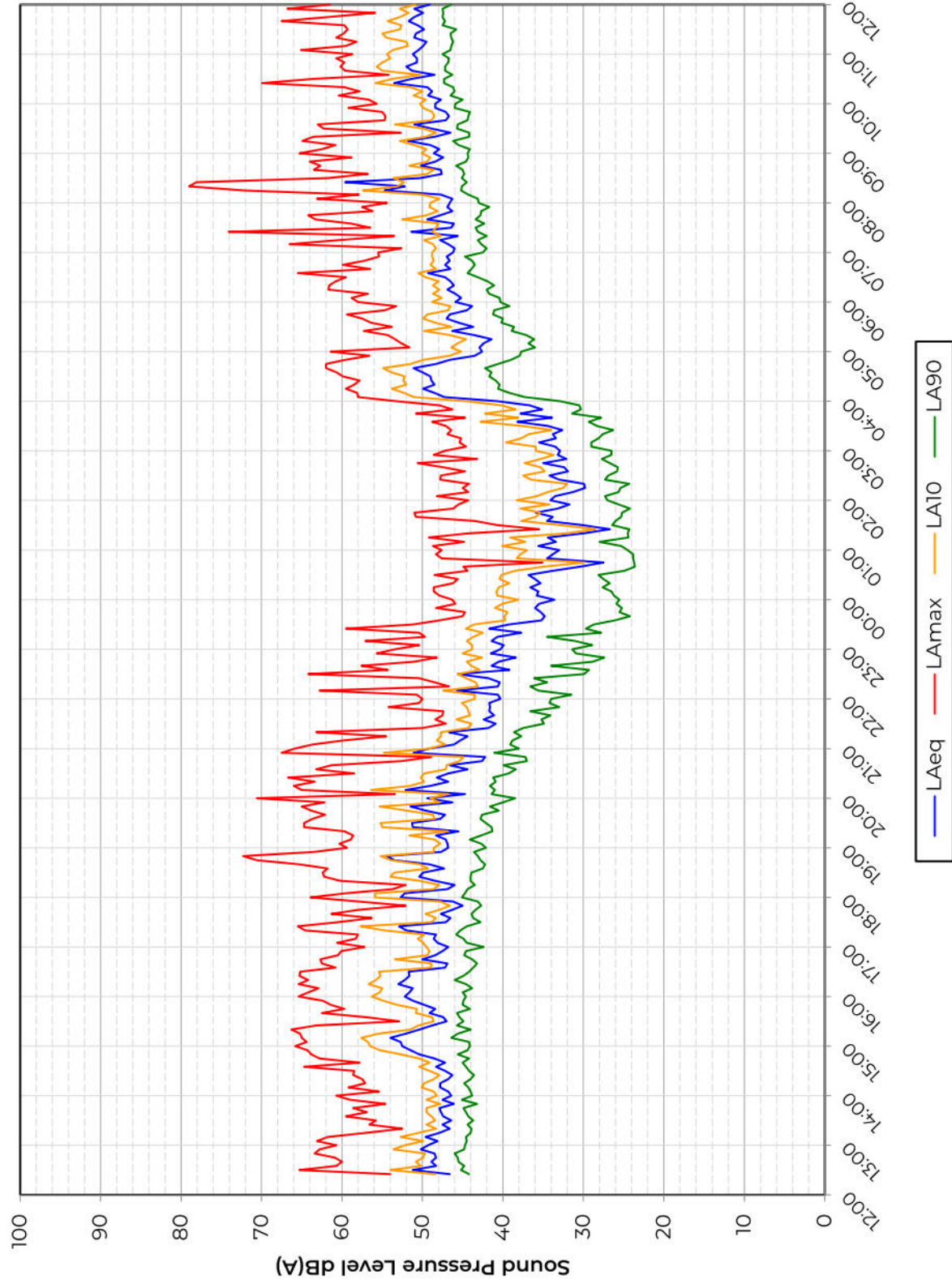
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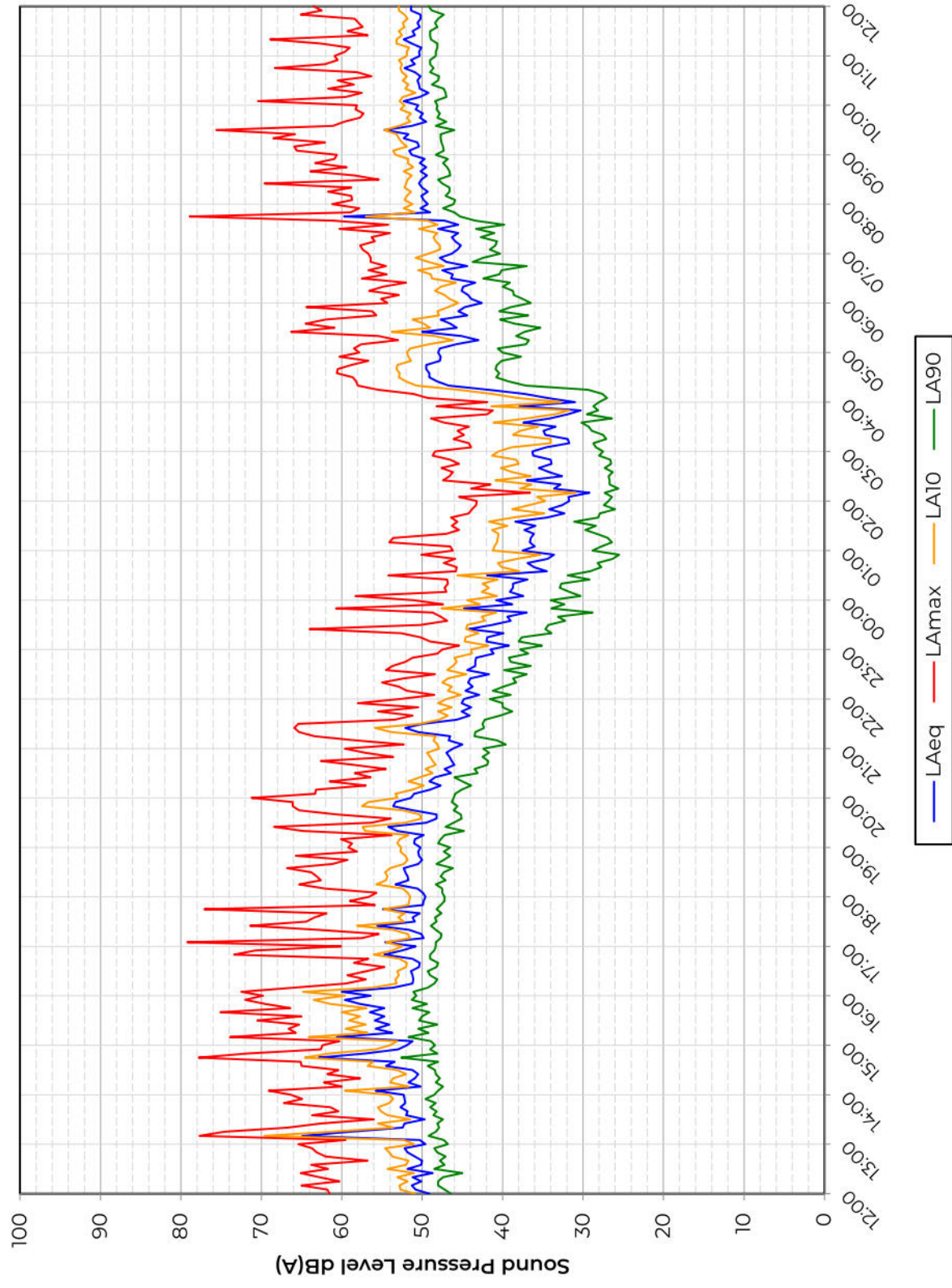
Position LT1



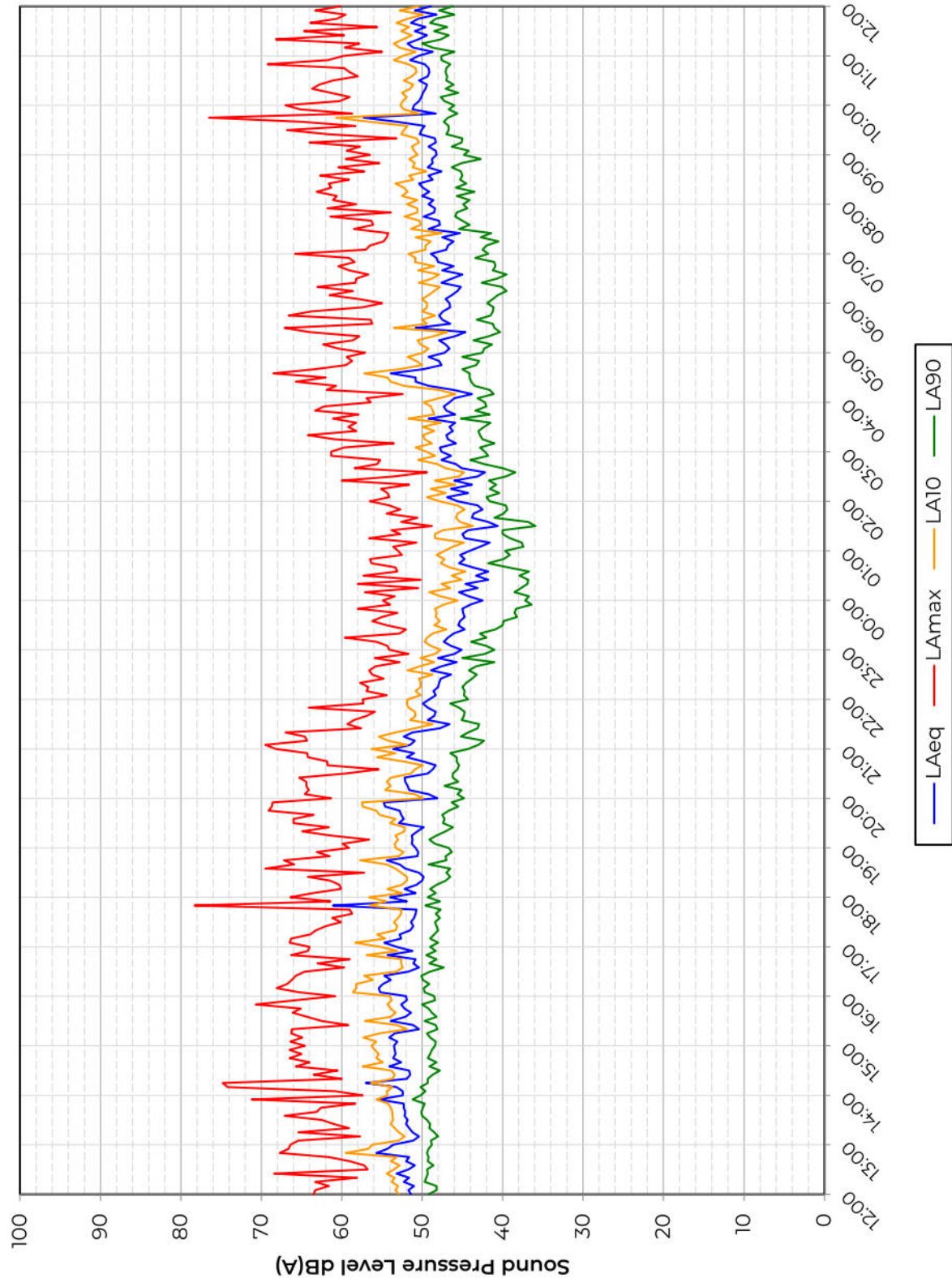
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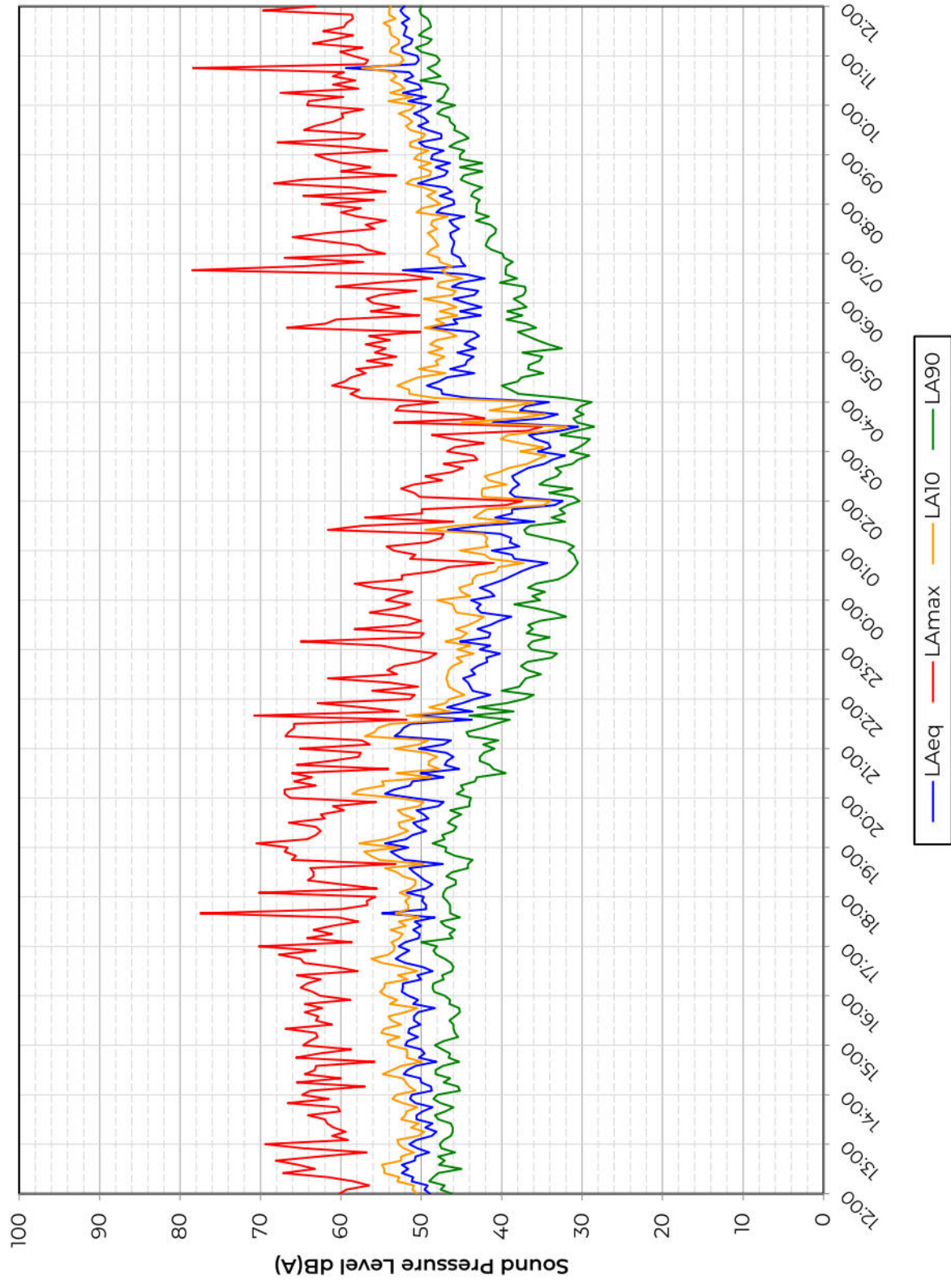
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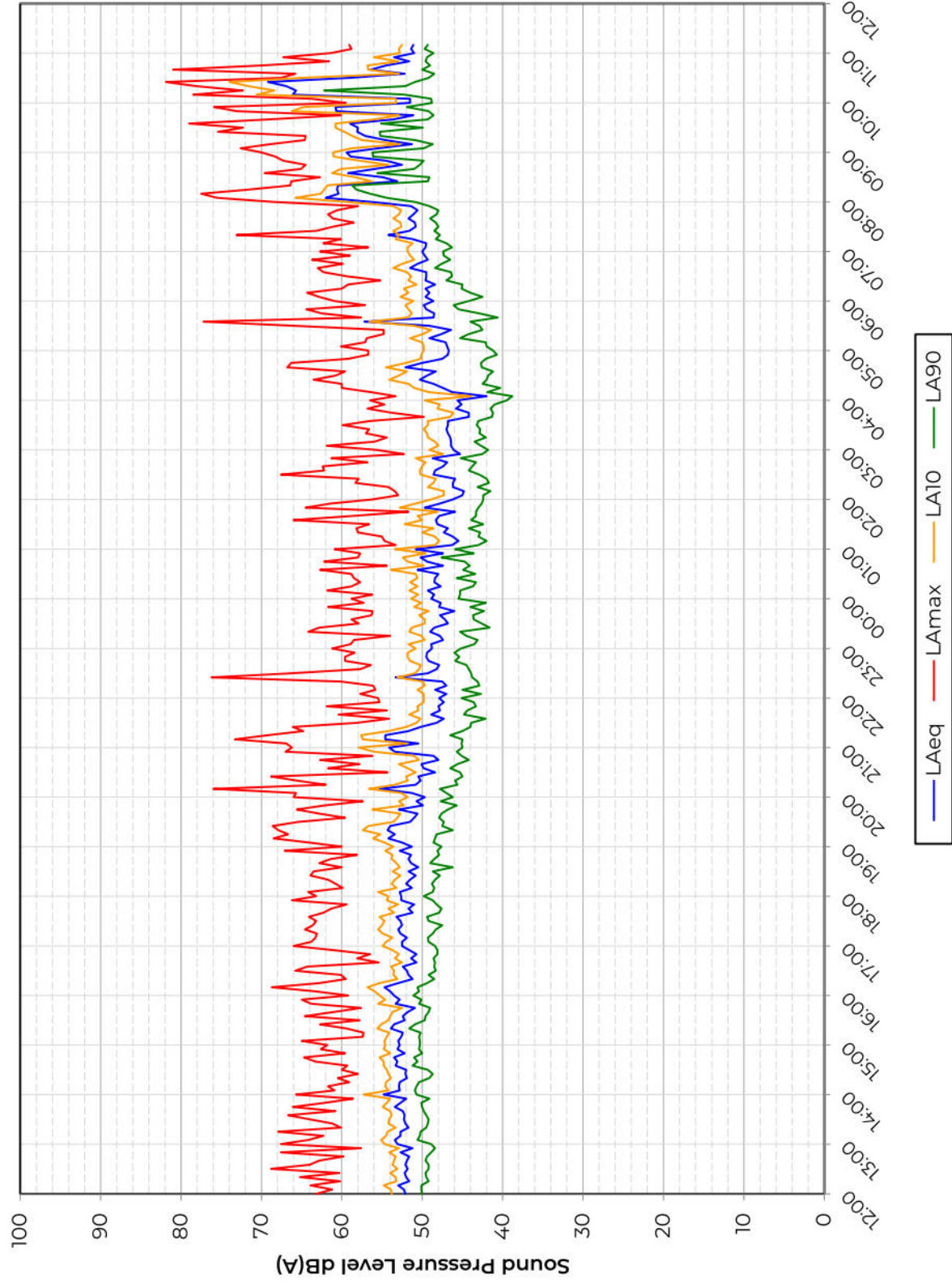
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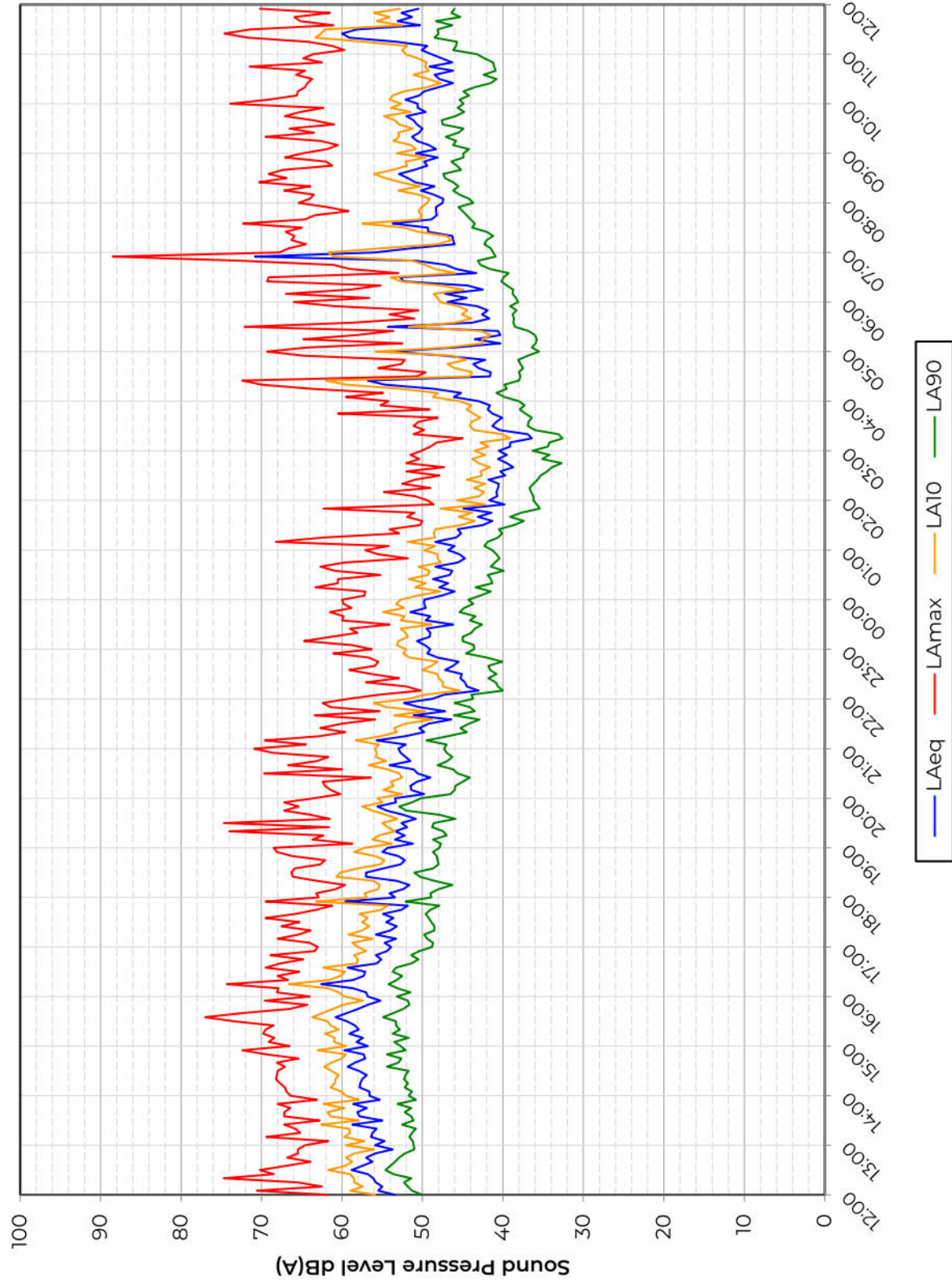
Position LT2



Position LT2



Position LT3



Acoustic Terminology

The human impact of sounds is dependent upon many complex interrelated factors such as 'loudness', its frequency (or pitch) and variation in level. In order to have some objective measure of the annoyance, scales have been derived to allow for these subjective factors.

Sound	Vibrations propagating through a medium (air, water, etc.) that are detectable by the auditory system.
Noise	Sound that is unwanted by or disturbing to the perceiver.
Frequency	The rate per second of vibration constituting a wave, measured in Hertz (Hz), where 1Hz = 1 vibration cycle per second. The human hearing can generally detect sound having frequencies in the range 20Hz to 20kHz. Frequency corresponds to the perception of 'pitch', with low frequencies producing low 'notes' and higher frequencies producing high 'notes'.
dB(A):	Human hearing is more susceptible to mid-frequency sounds than those at high and low frequencies. To take account of this in measurements and predictions, the 'A' weighting scale is used so that the level of sound corresponds roughly to the level as it is typically discerned by humans. The measured or calculated 'A' weighted sound level is designated as dB(A) or L_A .
L_{eq}:	A notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the actual, fluctuating sound measured over that period (e.g. 8 hour, 1 hour, etc). The concept of L_{eq} (equivalent continuous sound level) has primarily been used in assessing noise from industry, although its use is becoming more widespread in defining many other types of sounds, such as from amplified music and environmental sources such as aircraft and construction. Because L_{eq} is effectively a summation of a number of events, it does not in itself limit the magnitude of any individual event, and this is frequently used in conjunction with an absolute sound limit.
L_{10} & L_{90}:	Statistical L_n indices are used to describe the level and the degree of fluctuation of non-steady sound. The term refers to the level exceeded for n% of the time. Hence, L_{10} is the level exceeded for 10% of the time and as such can be regarded as a typical maximum level. Similarly, L_{90} is the typical minimum level and is often used to describe background noise. It is common practice to use the L_{10} index to describe noise from traffic as, being a high average, it takes into account the increased annoyance that results from the non-steady nature of traffic flow.
L_{max}:	The maximum sound pressure level recorded over a given period. L_{max} is sometimes used in assessing environmental noise, where occasional loud events occur which might not be adequately represented by a time-averaged L_{eq} value.
NR	<i>Noise Rating</i> . A single figure noise level rating that takes into account the frequency content of an acoustic environment.
R	<i>Sound Reduction Index</i> . Effectively the Level Difference of a building element when measured in an accredited laboratory test suite in accordance with the procedures laid down in BS EN ISO 10140-2:2010 and corrected for its size and the reverberant characteristics of the receive room.
D	The sound insulation performance of a construction is described in terms of the difference in sound level on either side of the construction in the presence of a sound source on one side and the reverberant characteristics of the adjoining 'receive' space. D is the arithmetic Level Difference in decibels between the

source and receive sound levels when filtered into frequency bands.

D_{nT}	<i>Weighted Standardised Level Difference.</i> As defined in BS EN ISO 717-1, representing the Weighted Level Difference, when standardised for reference receiving room reverberant characteristics.
$D_{n,e}$	Normalised sound insulation of small building elements of fixed dimensions, such as vents, measured in an accredited laboratory test suite in accordance with the procedures laid down in BS EN ISO 10140-2:2010.
$D_{n,f}$	Flanking sound insulation of lightweight elements, such as curtain wall mullions, measured in an accredited laboratory test suite in accordance with the procedures laid down in ISO 10848-2:2006
R_w, D_w $D_{nT,w}, D_{n,e,w}$ $D_{n,f,w}$	Value of parameter, determined as above, but weighted in accordance with the procedures laid down in BS EN ISO 717-1 to provide a single-figure value.
C, C_{tr}	Spectral adaptation terms to be added to a single number quantity such as $D_{nT,w}$, to take account of the sound insulation within frequency ranges of particular interest.
$L'_{nT,w}$	<i>Weighted Standardised Impact Sound Pressure Level</i> as defined in BS EN ISO 717-2, representing the level of sound pressure when measured within a space where the floor above is under excitation from a calibrated tapping machine, standardised for the receiving room reverberant characteristics.
ΔL_w	Change in impact sound pressure level when a floor is fitted with a 'soft' or resilient covering, as measured in an accredited laboratory test suite in accordance with the procedures laid down in BS EN ISO 10140-3:2010.

Octave Band Frequencies

In order to determine the way in which the energy of sound is distributed across the frequency range, the International Standards Organisation has agreed on "preferred" bands of frequency for sound measurement and analysis. The widest and most commonly used band for frequency measurement and analysis is the Octave Band.

In these bands, the upper frequency limit is twice the lower frequency limit, with the band being described by its "centre frequency" which is the average (geometric mean) of the upper and lower limits, e.g. 250 Hz octave band extends from 176 Hz to 353 Hz. The most commonly used octave bands are:

Octave Band Centre Frequency Hz	63	125	250	500	1000	2000	4000	8000
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Human Perception of Broadband Noise

Because of the logarithmic nature of the decibel scale, it should be borne in mind that sound levels in dB(A) do not have a simple linear relationship. For example, 100dB(A) sound level is not twice as loud as 50dB(A). It has been found experimentally that changes in the average level of fluctuating sound, such as from traffic, need to be of the order of 3dB before becoming definitely perceptible to the human ear. Data from other experiments have indicated that a change in sound level of 10dB is perceived by the average listener as a doubling or halving of loudness. Using this information, a

APPENDIX A

ACOUSTIC TERMINOLOGY AND HUMAN RESPONSE TO BROADBAND SOUND

guide to the subjective interpretation of changes in environmental sound level can be given.

INTERPRETATION

Change in Sound Level dB	Subjective Impression	Human Response
0 to 2	Imperceptible change in loudness	Marginal
3 to 5	Perceptible change in loudness	Noticeable
6 to 10	Up to a doubling or halving of loudness	Significant
11 to 15	More than a doubling or halving of loudness	Substantial
16 to 20	Up to a quadrupling or quartering of loudness	Substantial
21 or more	More than a quadrupling or quartering of loudness	Very Substantial

Earth Bunds and Barriers - Effective Screen Height

When considering the reduction in sound level of a source provided by a barrier, it is necessary to establish the "effective screen height". For example if a tall barrier exists between a sound source and a listener, with the barrier close to the listener, the listener will perceive the sound as being louder if he climbs up a ladder (and is closer to the top of the barrier) than if he were standing at ground level. Equally if he sat on the ground the sound would seem quieter than if he were standing. This is explained by the fact that the "effective screen height" is changing with the three cases above. In general, the greater the effective screen height, the greater the perceived reduction in sound level.

Similarly, the attenuation provided by a barrier will be greater where it is aligned close to either the source or the listener than where the barrier is midway between the two.

BS4142 is designed to allow contextual assessment of impact from commercial, or industrial sound on sensitive receptors. Examples covered by the Standard include:

- Sound from industrial and manufacturing processes;
- Sound from fixed installations which comprise mechanical and electrical plant and equipment.
- Sound from the loading and unloading of goods and materials at industrial and/or commercial premises, and
- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes.

In brief, the assessment procedure involves establishing sound levels from the items or processes of interest, (the specific sound source(s)), corrected for any acoustic features to derive the Rating Level, (L_{Ar,T_r}), at the relevant assessment position(s). The Rating Level is compared against the existing Background Sound Level, ($L_{A90,T}$), to provide an initial estimate of impact. The Standard offers the following guidance with regard to the significance of estimated impact:

- Typically, the greater this difference, the greater the magnitude of the impact;*
- A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context;*
- A difference of around +5dB could be an indication of an adverse impact, depending on the context;*
- Where the rating level does not exceed the background sound level, this is an indication of the specific sound having a low impact, depending on the context. The lower the rating level is relative to the background sound level, the less likely it is that the specific sound source will have an adverse impact.*

Where relevant, the initial estimate should then be modified by accounting for contextual aspects of the operation of the specific sound source and / or the context of the character of the area.

Other Assessment Parameters and Guidance on Character Corrections

The Specific Sound Level (L_s) is expressed in terms of an L_{Aeq} for a reference time interval, (T_r) of one-hour during the daytime (07:00 – 23:00 hours) and a fifteen-minute period during the night-time (23:00 – 07:00 hours). The Rating Level is also expressed in terms of the reference time interval, T_r .

The Specific Sound Level can be determined by various means, which can include prediction based on manufacturer's data and accompanying propagation calculations to the assessment position(s). This method could be used, for instance, where the specific sound source is not yet in-situ, or is in-situ but not yet operational.

Where the specific sound source is already operational and in-situ, measurements of the sound climate resulting from both the specific sound source and all other contributing sources, (known as the Ambient Sound Level, $L_a = L_{Aeq,T}$) should be measured over a representative time period, ideally at the assessment position(s).

Depending on the relative contribution of other sources not related to the specific sound, (known as the residual sound), the Specific Sound Level can be derived by logarithmically subtracting the Residual Sound Level, $L_r = L_{Aeq,T}$, from the Ambient Sound Level.

With justification, representative proxy locations can be used for the measurement of the ambient and/or residual sound climate. Where these measurement locations are not fully representative of the assessment position(s), measurement can be supplemented with calculation.

The Background Sound Level should ideally also be measured at the assessment position(s) but can be measured at representative proxy locations where suitable reasons can be provided. The Background Sound Level should be measured over a period which is suitable to characterise the background sound climate during the period of interest and should normally be at least 15 minutes.

When deriving the Rating Level from the Specific Sound Level, consideration is given to the character of the sound. The Standard provides several methods for deriving appropriate character corrections, offering the following advice for subjective assessment:

Tonality

For sound ranging from not tonal to prominently tonal, the Joint Nordic Method gives a correction of between 0 dB and +6 dB for tonality. Subjectively, this can be allocated as a penalty of 2 dB for a tone which is just perceptible at the sound receptor, 4 dB where it is clearly perceptible and 6 dB where it is highly perceptible.

Impulsivity

A correction of up to +9dB can be applied for sound that is highly impulsive considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be allocated as a penalty of 3dB for impulsivity which is just perceptible at the receiver, 6dB where it is clearly perceptible and 9dB where it is highly perceptible.

Other sound characteristics

Where the specific sound contains characteristics that are neither tonal nor impulsive, but are otherwise startling, disturbing or incongruous with the residual acoustic environment, a penalty of +3dB can be applied.

Intermittency

When the specific sound has identifiable on/off conditions, if the intermittency is readily distinctive against the residual acoustic environment, a penalty of +3dB can be applied.