

**Report VA5446.240801.NIA**

**Durrington Bridge House, Barrington  
Road, Goring-by-sea, Worthing**

**Noise Impact Assessment**

**05 August 2024**

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| VA5446/TH1-TH8 | Environmental Noise Time Histories |
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| Report Version | Author         | Approved      | Changes | Date       |
|----------------|----------------|---------------|---------|------------|
| NIA            | Steven Liddell | Ben Alexander | -       | 02/08/2024 |

The interpretations and conclusions summarised in this report represent Venta Acoustics' best technical interpretation of the data available to us at the time of assessment. Any information provided by third parties and referred to in this report has not been checked or verified by Venta Acoustics, unless otherwise expressly stated in the document. Venta Acoustics cannot accept any liability for the correctness or validity of the information provided. Due to a degree of uncertainty inherent in the prediction of all parameters, we cannot, and do not guarantee the accuracy or correctness of any interpretation and we shall not, except in the case of gross or wilful negligence on our part, be liable for any loss, cost, damages or expenses incurred or sustained by anyone resulting from any interpretations, predictions of conclusions made by the company or employees. The findings and conclusions are relevant to the period of the site survey works, and should not be relied upon to represent site conditions at later dates. Where additional information becomes available which may affect the findings of our assessment, the author reserves the right to review the information, reassess the findings and modify the conclusions accordingly.

## 1. Introduction

An application is to be submitted for the conversion of Durrington Bridge House, Barrington Road, Goring-by-sea, Worthing from commercial (office) to residential use under Class MA of the General Permitted Development Order.

Venta Acoustics has been commissioned by Brooks Murray Architects to undertake an assessment of the current environmental noise impact on the site and provide recommendations of acoustic mitigation, where required, in support of an application for planning permission.

An environmental noise survey has been undertaken to determine the noise levels incident on the site. These levels are then used to undertake an assessment of the likely impact in accordance with relevant standards and guidance.

## 2. Guidance and Legislation

### 2.1 Permitted Development – Class MA

Class MA of the General Permitted Development Order provides the following requirements.

#### **Conditions**

**MA.2.** (1) *Development under Class MA is permitted subject to the conditions*

(2) *Before beginning development under Class MA, the developer must apply to the local planning authority for a determination as to whether the prior approval of the authority will be required as to—*

- (a) transport impacts of the development, particularly to ensure safe site access;*
- (b) contamination risks in relation to the building;*
- (c) flooding risks in relation to the building;*
- (d) impacts of noise from commercial premises on the intended occupiers of the impacts of noise from commercial premises on the intended occupiers of the development;*
- (e) (e)where—*
  - (i) the building is located in a conservation area, and*
  - (ii) the development involves a change of use of the whole or part of the ground floor,**the impact of that change of use on the character or sustainability of the conservation area;*
- (f) the provision of adequate natural light in all habitable rooms of the dwellinghouses;*

*(g) the impact on intended occupiers of the development of the introduction of residential use in an area the authority considers to be important for general or heavy industry, waste management, storage and distribution, or a mix of such uses; and*

*(h) where the development involves the loss of services provided by—*

*(i) a registered nursery, or*

*(ii) a health centre maintained under section 2 or 3 of the National Health Service Act 2006(4), the impact on the local provision of the type of services lost.*

*(3) An application for prior approval for development under Class MA may not be made before 1 August 2021.*

*(4) The provisions of paragraph W (prior approval) of this Part apply in relation to an application under this paragraph as if in the introductory words in sub-paragraph (5), for “and highways impacts of the development” there were substituted “impacts of the development, particularly to ensure safe site access”.*

*(5) Development must be completed within a period of 3 years starting with the prior approval date.*

*(6) Any building permitted to be used as a dwellinghouse by virtue of Class MA is to remain in use as a dwellinghouse within the meaning of Class C3 of Schedule 1 to the Use Classes Order and for no other purpose, except to the extent that the other purpose is ancillary to the use as a dwellinghouse.”.*

Part 3, paragraph W(10)(b) of the GPDO states that the local planning authority must, when determining an application, have regard to the National Planning Policy Framework so far as relevant to the subject matter of the prior approval as if the application were a planning application.

## 2.2 The National Planning Policy Framework (2023)

The revised *National Planning Policy Framework* (NPPF), published in December 2023, sets out the Government’s planning policies for England, superseding all previous planning policy statements and guidance.

In respect of noise, the NPPF states that the planning system should contribute to and enhance the natural and local environment by preventing both new and existing developments from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of noise pollution.

Hence, Paragraph 191 states that *planning policies and decisions should also ensure new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:*

- a) *mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life*
- b) *identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason*

In regards to the term adverse impact, reference is made to the Noise Policy for England:

## 2.3 Noise Policy Statement for England (2010)

The Noise Policy Statement for England (NPSE) sets out the long term vision of Government noise policy: to promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.

This vision is supported by the following aims:

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

The terms “significant adverse” and “adverse” are related to the following concepts:

- No Observed Effect Level (NOEL) - the level below which no effect on health and quality of life can be detected.
- Lowest Observed Adverse Effect Level (LOAEL) - the level above which adverse effects on health and quality of life can be detected.
- Significant Observed Adverse Effect Level (SOAEL) - the level above which significant adverse effects on health and quality of life occur.

The guidance acknowledges that it is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations, but will be different for different noise sources, receptors and times.

In order to enable assessment of impacts in line with these requirements, reference should be made to other currently available guidance.

## 2.4 BS4142:2014+A1:2019

British Standard BS4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound* describes a method for rating and assessing sound of an industrial and/or commercial nature, which includes sound from fixed installations comprising mechanical and/or electrical plant and equipment;

The assessment methodology considers the Specific Sound Level, as measured or calculated at a potential noise sensitive receptor, due to the source under investigation. A correction factor is added to this level to account for the acoustic character of the sound as follows:

**Tonality** – A correction of up to 6dB depending on the prominence of tones;

**Impulsivity** - A correction of up to 9dB depending on the prominence of impulsivity;

**Other sound characteristics** - A 3dB correction may be applied where a distinctive acoustic character is present that is neither tonal nor impulsive;

**Intermittency** - A 3dB correction may be applied where the specific sound has identifiable on/off conditions.

An estimate of the impact of the source is obtained by subtracting the typical background noise level from the corrected Specific Sound Level.

- Typically, the greater this difference, the greater the magnitude of the impact.
- 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 could 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 there will be an adverse impact. 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.

## 2.5 NANR45 Proposed Criteria for the Assessment of Low Frequency Noise Disturbance

The guidance in this document offers a method for the assessment of low frequency noise, including the provision of a spectral reference curve. Where measured levels exceed the 1/3 octave band values in the reference curve, the document states that this “*may indicate a source of LFN that could cause disturbance.*”

The values of the reference curve are reproduced in Table 2.1

| Frequency (Hz) | 10 | 12.5 | 16 | 20 | 25 | 31.5 | 40 | 50 | 63 | 80 | 100 | 125 | 160 |
|----------------|----|------|----|----|----|------|----|----|----|----|-----|-----|-----|
| dB, Leq        | 92 | 87   | 83 | 74 | 64 | 56   | 49 | 43 | 42 | 40 | 38  | 36  | 34  |

Table 2.1 – NANR45 LFN reference curve

## 2.6 WHO Guidelines for Community Noise (1999)

The guidance in this document details suitable noise levels for various activities within residential and commercial buildings.

The relevant sections of this document are shown in Table 2.2.

| Criterion   | Environment | Design range $L_{Aeq,T}$ dB |
|---|-------------|-----------------------------|
| Maintain speech intelligibility and avoid moderate annoyance, daytime and evening | Living Room | 35 dB                       |
| Prevent sleep disturbance, night time   | Bedrooms    | 30 dB                       |

**Table 2.2 – Excerpt from WHO**

[dB ref. 20μPa]

This guidance also states:

*For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45dB  $L_{Amax}$  more than 10-15 times a night (Vallet & Vernet 1991).*

## 2.7 BS8233:2014

BS8233 *Guidance on sound insulation and noise reduction for buildings* provides guidance as to desirable internal ambient noise levels for different areas within residential buildings.

The relevant section of the standard is shown below in Table 2.3.

| Activity                   | Location    | 07:00 to 23:00                   | 23:00 to 07:00                  |
|----------------------------|-------------|----------------------------------|---------------------------------|
| Resting                    | Living Room | 35 dB $L_{Aeq, 16 \text{ hour}}$ | -                               |
| Dining                     | Dining Room | 40 dB $L_{Aeq, 16 \text{ hour}}$ | -                               |
| Sleeping (daytime resting) | Bedroom     | 35 dB $L_{Aeq, 16 \text{ hour}}$ | 30 dB $L_{Aeq, 8 \text{ hour}}$ |

**Table 2.3 – Excerpt from BS8233:2014 - Indoor ambient noise levels for dwellings**

[dB ref. 20μPa]

## 3. Site Description

As illustrated on attached site plan VA5446/SP1, the site is currently a multistorey office building with associated parking to the south. The site is bounded by Shaftesbury Avenue to the east and Durrington-on-Sea railway station to the north. To the east of the site is a new multi-home residential development currently under construction.

Commercial noise sources in the area are limited. To the east, on the opposite side of Shaftesbury Avenue, is the Worthing Leisure Centre, with two churches to the southeast. Commercial noise from these sources was not evident during the site visits or from the survey data.

To the north, on the opposite side of the railway, is an NHS office with a power substation facing towards the site.

The surrounding area is otherwise residential in nature, with existing dwellings near all commercial premises. This supports the suitability of the locality for residential use.



## 4. Environmental Noise Survey

### 4.1 Survey Procedure & Equipment

In order to establish the noise levels at the site, a noise survey was carried out between Friday 19<sup>th</sup> and Tuesday 23<sup>rd</sup> July 2024, at first floor level at the locations shown in site plan VA5446/SP1. These locations were chosen to be representative of the noise level at the front and rear of the building.

Continuous 5-minute samples of the  $L_{Aeq}$ ,  $L_{Amax}$ ,  $L_{A10}$  and  $L_{A90}$  sound pressure levels were undertaken at each of the measurement locations.

The weather during the survey period was generally dry with light winds. The background noise data is not considered to have been compromised by these conditions.

Measurements were made generally in accordance with ISO 1996 2:2017 *Acoustics - Description, measurement and assessment of environmental noise – Part 2: Determination of sound pressure levels*.

The following equipment was used in the course of the survey:

| Manufacturer                | Model Type | Serial No    | Calibration     |         |
|-----------------------------|------------|--------------|-----------------|---------|
|                             |            |              | Certificate No. | Date    |
| NTi Class 1 Integrating SLM | XL2        | A2A-12202-E0 | UCRT23/1146     | 1/2/23  |
| NTi Class 1 Integrating SLM | XL2        | A2A-15993-E0 | 1504971-2       | 28/3/23 |
| Larson Davis calibrator     | CAL200     | 19816        | 1509201-5       | 19/7/24 |

**Table 4.1 – Equipment used for the survey**

The calibration of the sound level meters was verified before and after use with no significant calibration drift observed.

### 4.2 Results

The measured sound levels are shown as time-history plots on the attached charts VA5446/TH1-4 for position 1 and VA5446/TH5-8 for position 2.

At position 1 (north), the sound levels are dominated by train pass-by events. The background sound level is determined by a source with a 100Hz tone, assumed to be from the substation across the railway line.

At position 2 (southeast), the sound levels are primarily determined by traffic on Shaftesbury Road.

The average noise levels for the Daytime and Night-time periods, as measured at the automated monitoring position were:

| Monitoring Period | L <sub>Aeq, T</sub>   |                       | Typical <sup>1</sup> L <sub>A90,5min</sub> |                       |
|-------------------|-----------------------|-----------------------|--|-----------------------|
|                   | Position 1<br>(North) | Position 2<br>(South) | Position 1<br>(North)                      | Position 2<br>(South) |
| 07:00 – 23:00     | 56 dB                 | 50 dB                 | 46 dB                                      | 36 dB                 |
| 23:00 – 07:00     | 51 dB                 | 43 dB                 | 44 dB                                      | 27 dB                 |

**Table 4.2 – Average ambient and typical background noise levels**

<sup>1</sup> The typical L<sub>A90</sub> value is taken as the 10<sup>th</sup> percentile of all L<sub>A90</sub> values measured during the relevant period.

## 5. Commercial Noise Impact Assessment

The noise sources impacting the site are traffic, rail and infrastructure noise (substation). Class MA is concerned with commercial noise impacts only and it is not clear that any of these sources would be applicable.

For completeness, the impact of noise from the substation is assessed on the north façade of the building. No commercial noise sources are noted on the south façade.

In addition to the surveys and investigations undertaken during this assessment, the noise assessment report submitted as part of the application for the neighbouring large scale residential development has been reviewed and it was noted that no existing or proposed commercial noise sources are identified.

### 5.1 Source Noise Levels

The tonal noise is approximately L<sub>Aeq</sub> 45dB at the monitoring location, corresponding to a level of 39dB at the building façade. This will be compared against the night time background sound level

### 5.2 Acoustic Character Correction

The subjective method of allocating corrections to the sound source has been used following the methodology provided in BS4142:2014 and summarised in section 2.4.

| Noise Source | Subjective Description | Allocated Corrections                                   |
|--------------|------------------------|---|
| Substation   | Clearly tonal element  | Tonality: 6dB<br>Impulsivity: 0dB<br>Intermittency: 0dB |

**Table 5.1 – Acoustic character corrections**

These penalties are applied to the specific noise level in section 5.3 to obtain the rating level.

### 5.3 Rating Level and Assessment

The rating level at the assessment location is compared against the relevant background noise level to assess the notional significance of the noise impact as follows. This applies outside the building.

Table 5.2 shows the assessment for the unloading on the most affected façade of the new dwellings.

| Results                                      |                 | Relevant Clause | Commentary            |
|--|-----------------|-----------------|-----------------------|
| Specific Sound Level                         | $L_{Aeq}$ 39dB  |                 |                       |
| Acoustic feature correction                  | +6 dB           | 9.2             | +6 dB for tonality    |
| Rating level                                 | $L_{Ar}$ 45 dB  | 9.2             |                       |
| Night time background sound level            | $L_{A90}$ 27 dB | 8               | Measured to the south |
| Excess of rating over background sound level | +18 dB          | 11              |                       |
| Assessment indicates adverse impact          |                 | 11              | Depending on context  |

**Table 5.2 – BS4142 Assessment**

## 5.4 Context

The site is located adjacent to the railway line and the tonal sound was not noted to be clearly prominent during the day.

The BS4142 standard aims to cover a wide variety of situations under the same base assessment methodology and so has some inherent shortcomings. To allow for this, the guidance encourages consideration of the site context as a means of adapting the base assessment to specific scenarios.

The base assessment methodology is considered to be weighted towards the more sensitive case of assessing industrial noise upon an existing residential receiver. The introduction of a new residential use provides an opportunity to provide appropriate mitigation against the noise sources. This would allow appropriate internal noise levels to be achieved such that the commercial noise source is not considered to be disruptive.

## 6. Internal Noise Assessment

To control sound from the substation, the sound insulation performance of the building glazing will be specified to control the Rating level (including BS4142 penalties) to below the recommended values in BS8233. This hybrid approach of assessing commercial noise with a BS4142 penalty against the BS8233 criteria (over a shortened assessment period) is endorsed in the ProPG (Professional Practice Guidance on Planning and Noise prepared by the Institute of Acoustics, the Chartered Institute of Environmental Health and the Association of Noise Consultants).

The internal levels will also be assessed against the NANR 45 criteria curve.

### 6.1 Internal Noise Assessment

A review of the architectural drawings for the proposed scheme has been undertaken with the intent of achieving the internal noise levels from average and maximum noise levels stated in BS8233 and the WHO Guidelines.

### 6.1.1 Sound Reduction Performances of Building Elements

It has been assumed that all the non-glazed elements, i.e. walls and roof systems, will be capable of providing the following minimum sound insulation performance, when tested in accordance with BS EN ISO 10140-2:2021 *Acoustics - Laboratory measurement of sound insulation of building elements – Part 2: Measurement of airborne sound insulation*.

| Building Element | Single figure weighted sound reduction index, dB |
|------------------|--|
| Masonry          | R <sub>w</sub> 51                                |

**Table 6.1 – Assumed sound reductions performances of non-glazed elements**

### 6.1.2 Sound Reduction Performance of Windowsets and Vents

The monitoring data along with the architectural drawings have been used to calculate the required sound insulation performance for the windowsets (glazing and frame combination) and open ventilators for the building. These are summarised in Table 6.2 below.

| Glazing Reference | Required Glazing SRI, dB         | Ventilator Performance, dB |
|-------------------|----------------------------------|----------------------------|
| North Façade      | R <sub>w</sub> 24                | D <sub>n,e,w</sub> 31      |
| Other Facades     | N/A – No commercial noise source |                            |

**Table 6.2 – Required minimum sound reduction indices for glazing and ventilators**

The above sound insulation performances as expected to be achieved with standard building elements.

With the above recommendations implemented, the noise levels due to the substation are expected to be around 16dB, with the 100Hz tone attenuated to around 22dB, well below the corresponding limit in the NANR45 curve.

A low impact is therefore expected.

## 7. Conclusion

A baseline noise survey has been undertaken by Venta Acoustics to establish the prevailing noise climate in the locality of Durrington Bridge House, Barrington Road, Goring-by-sea, Worthing in support of a Class MA prior approval application for the proposed development of new residential dwellings.

The site is amongst other residential elements, both new and well-established.

Noise levels in the area are controlled by the railway line to the north and Shaftesbury Road to the east. There is no commercial noise noted at the site. However, the tonal sound from a substation to the north is assessed and it is found that with standard building elements internal noise levels would meet the recommendations of BS8233 and be below the low frequency NANR45 curve, indicating a low impact.

The proposed scheme is not expected to experience a significant adverse noise impact and the site is considered acceptable for the proposed residential use.

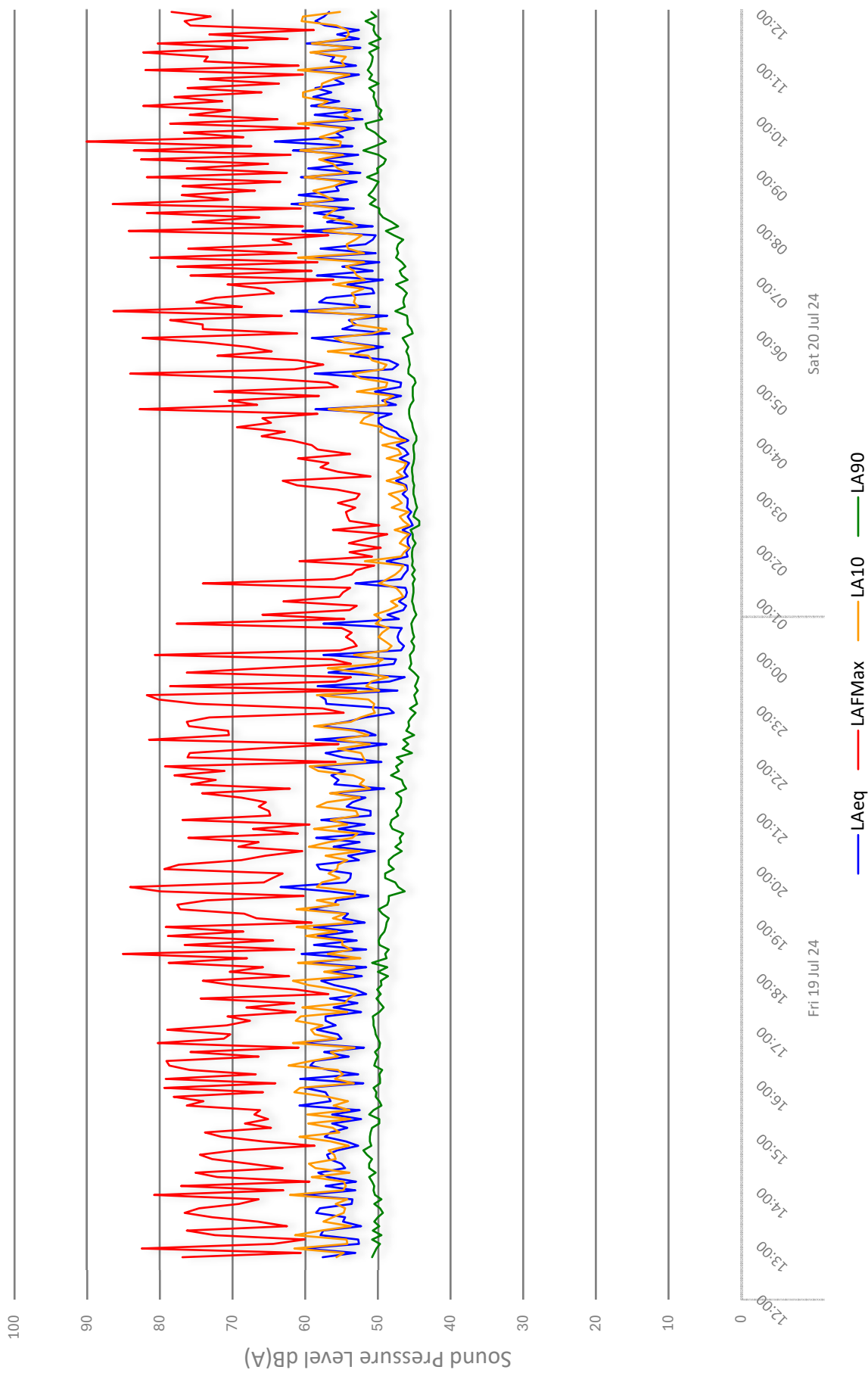
**Steven Liddell MIOA**





Figure VA5446/TH1

North







North

Figure VA5446/TH2

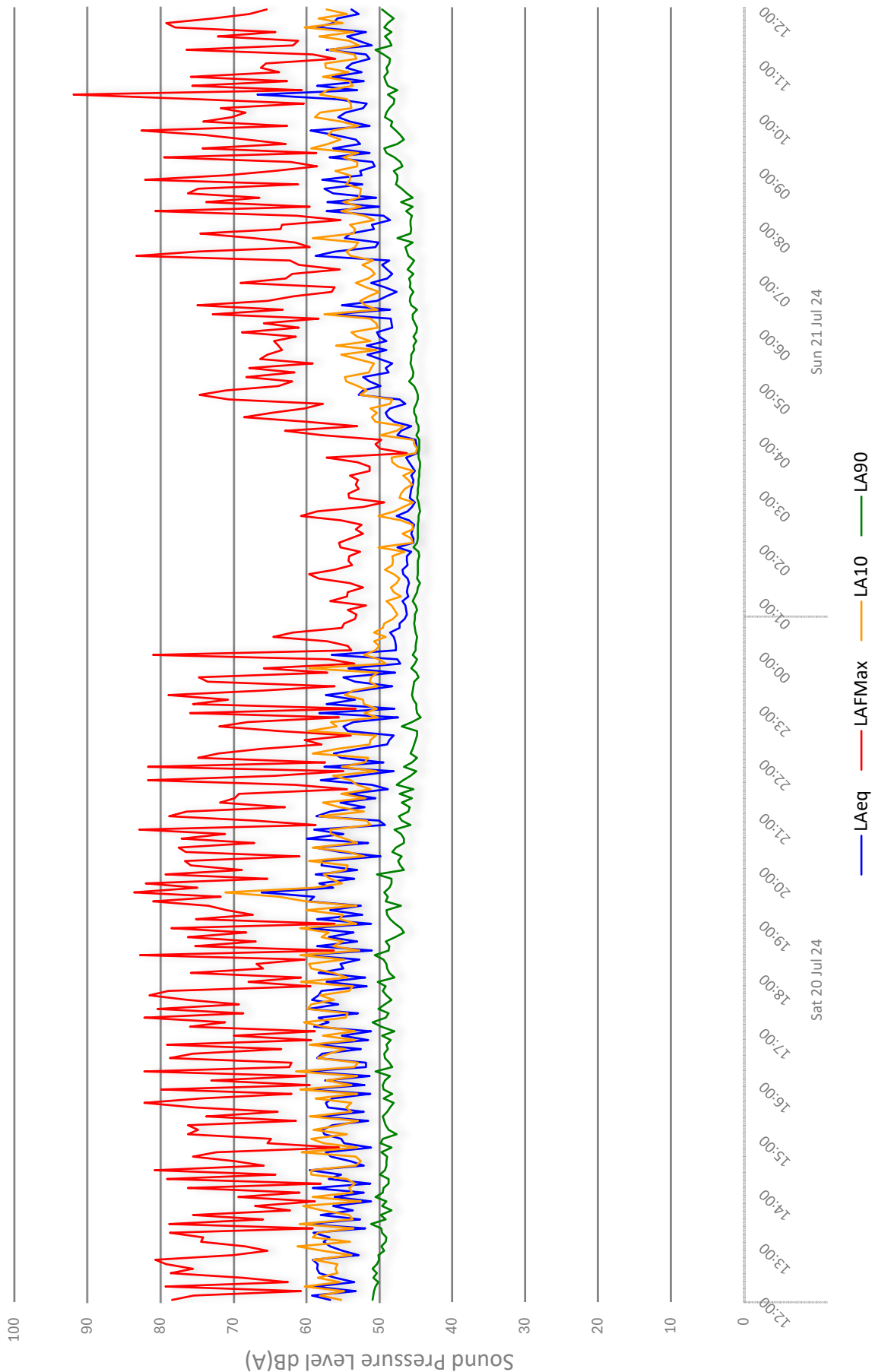




Figure VA5446/TH3

North

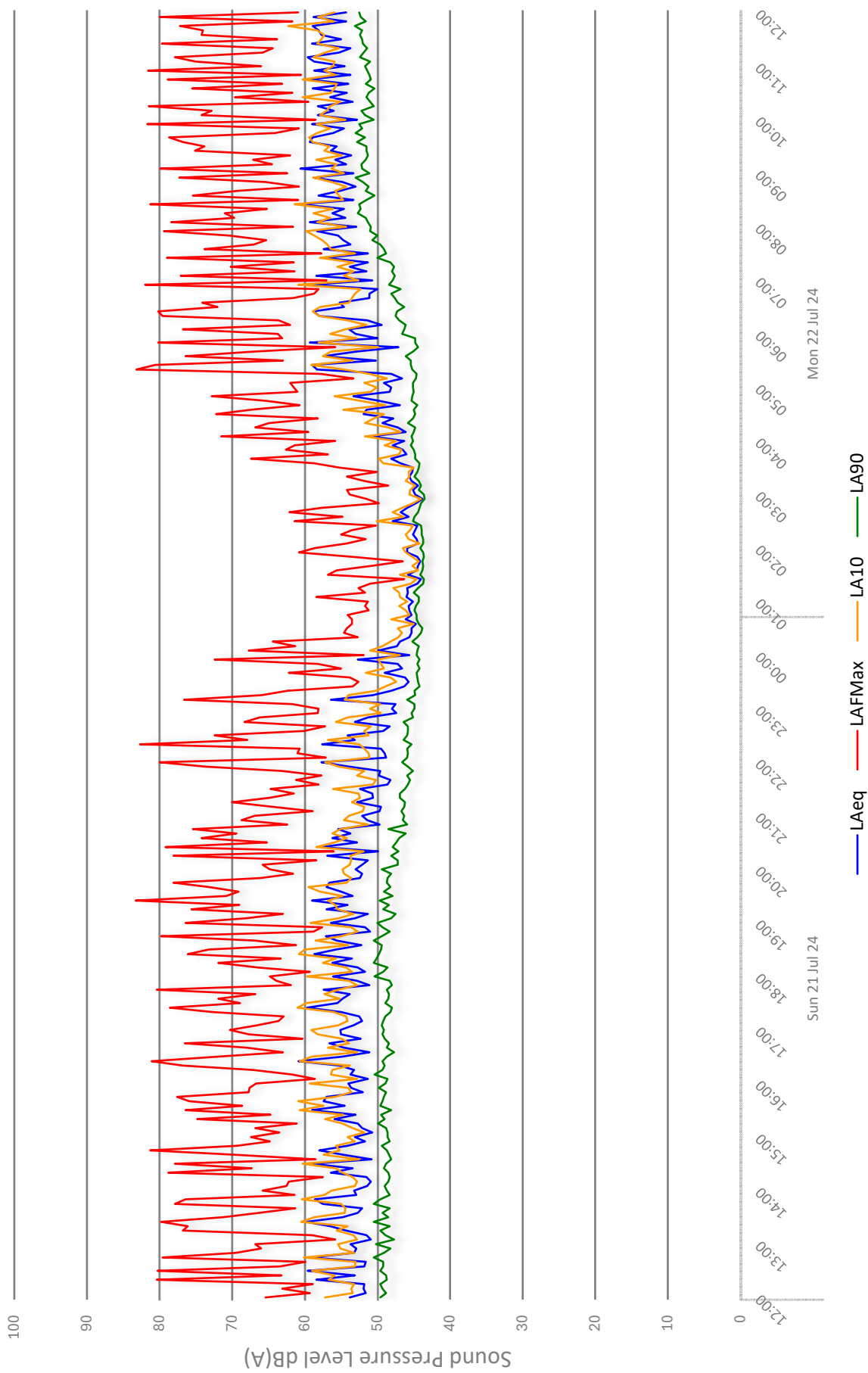




Figure VA5446/TH4

North

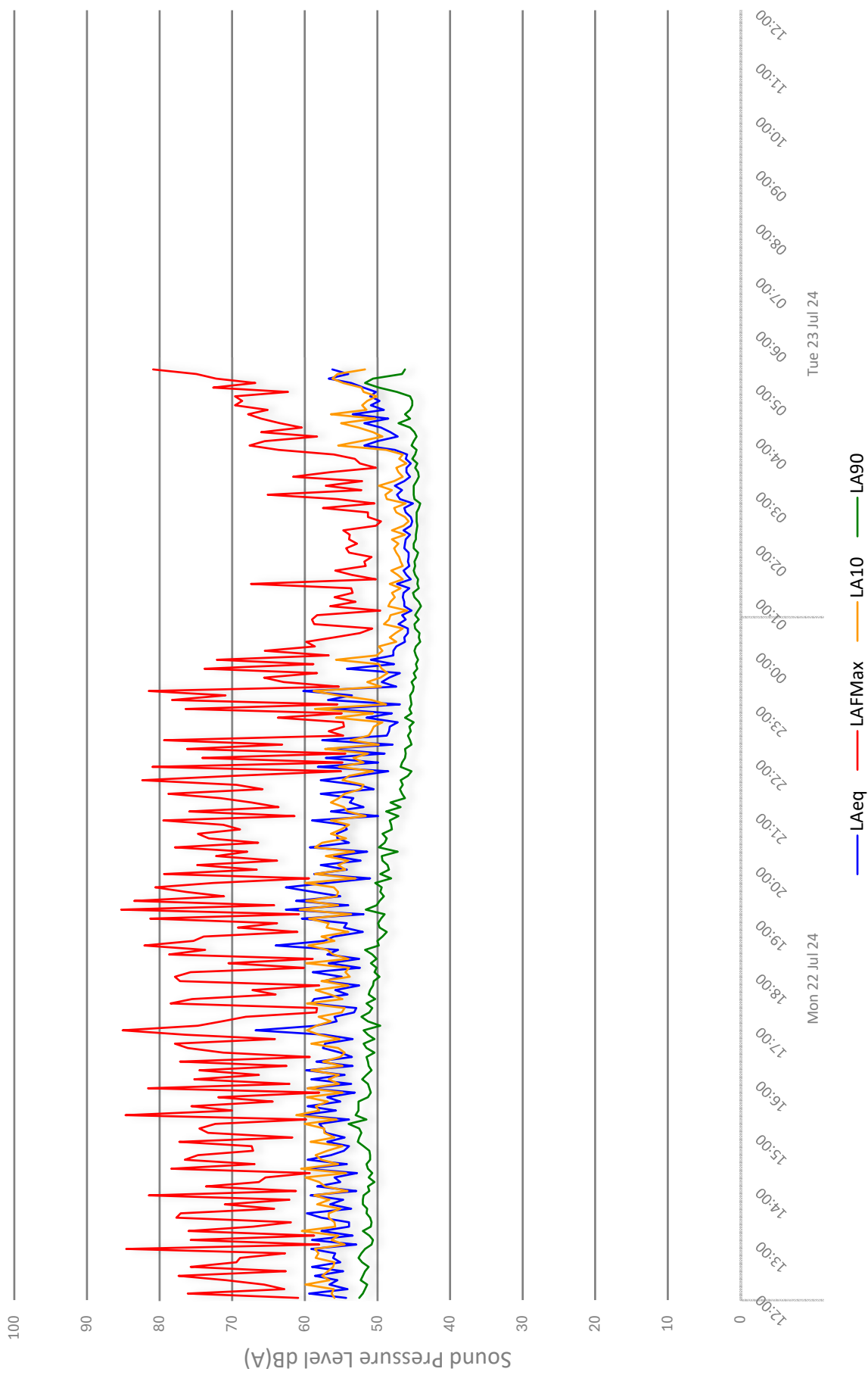




Figure VA5446/TH9

South

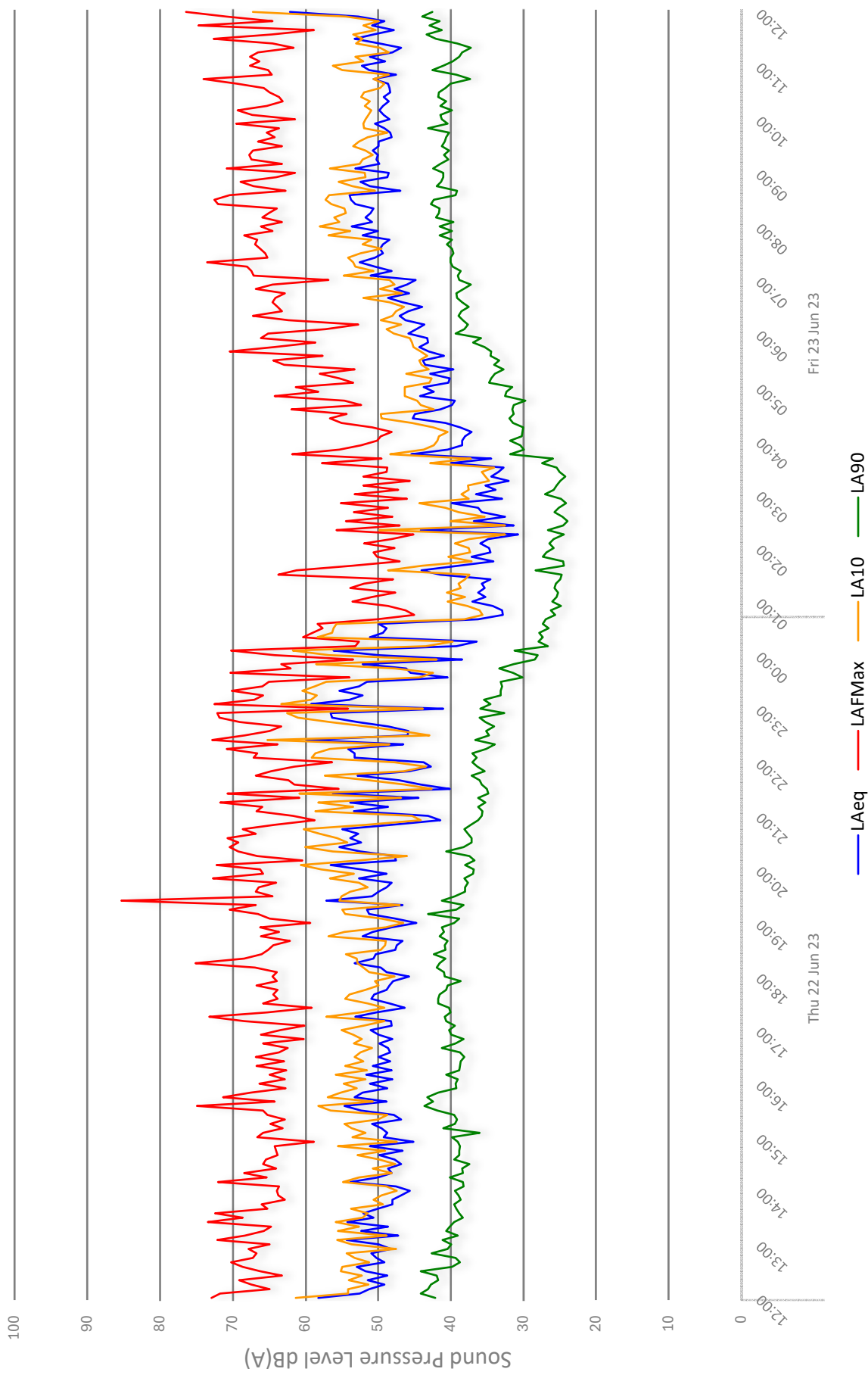
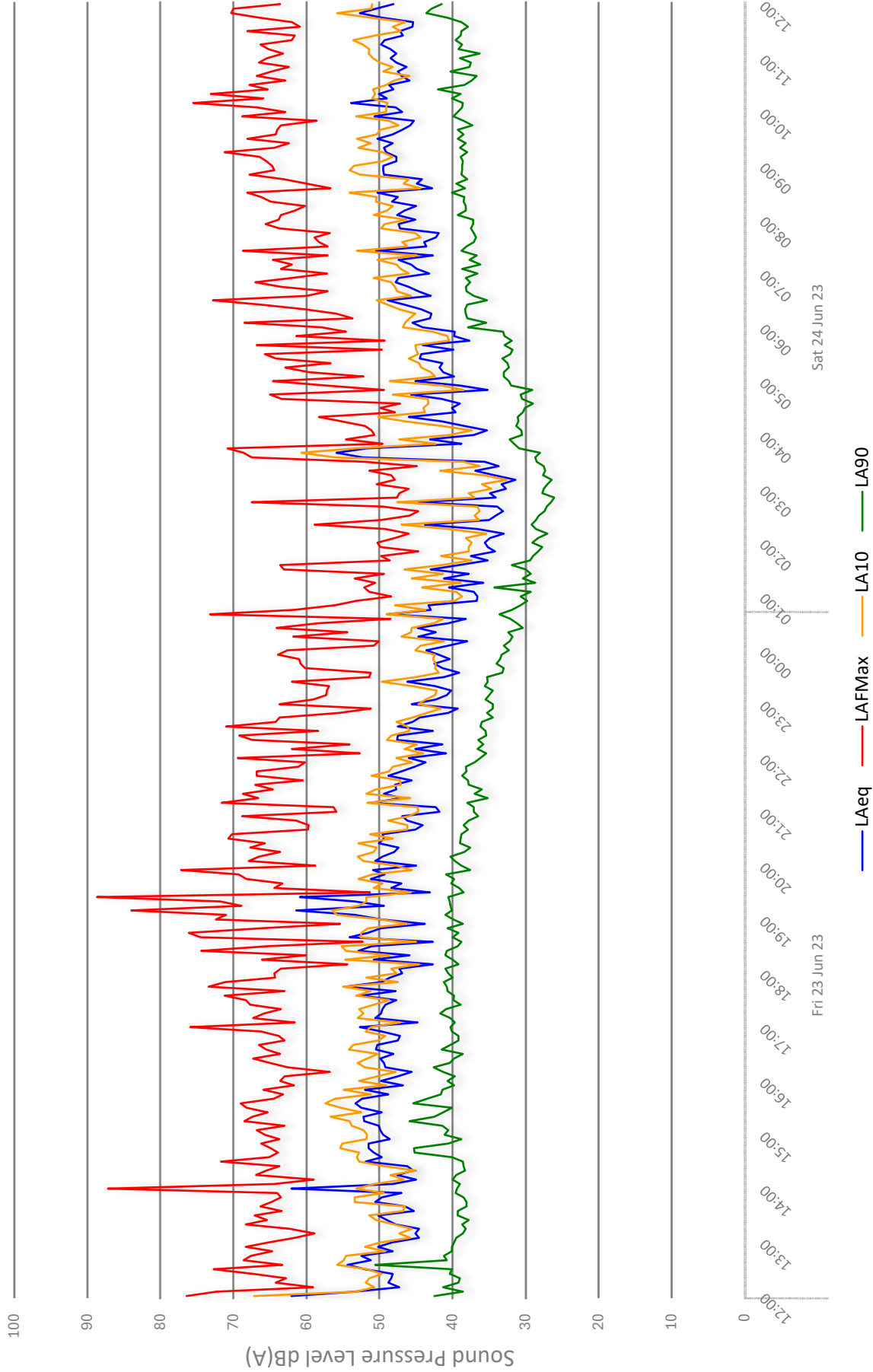


Figure VA5446/TH10

South





South

Figure VA5446/TH11

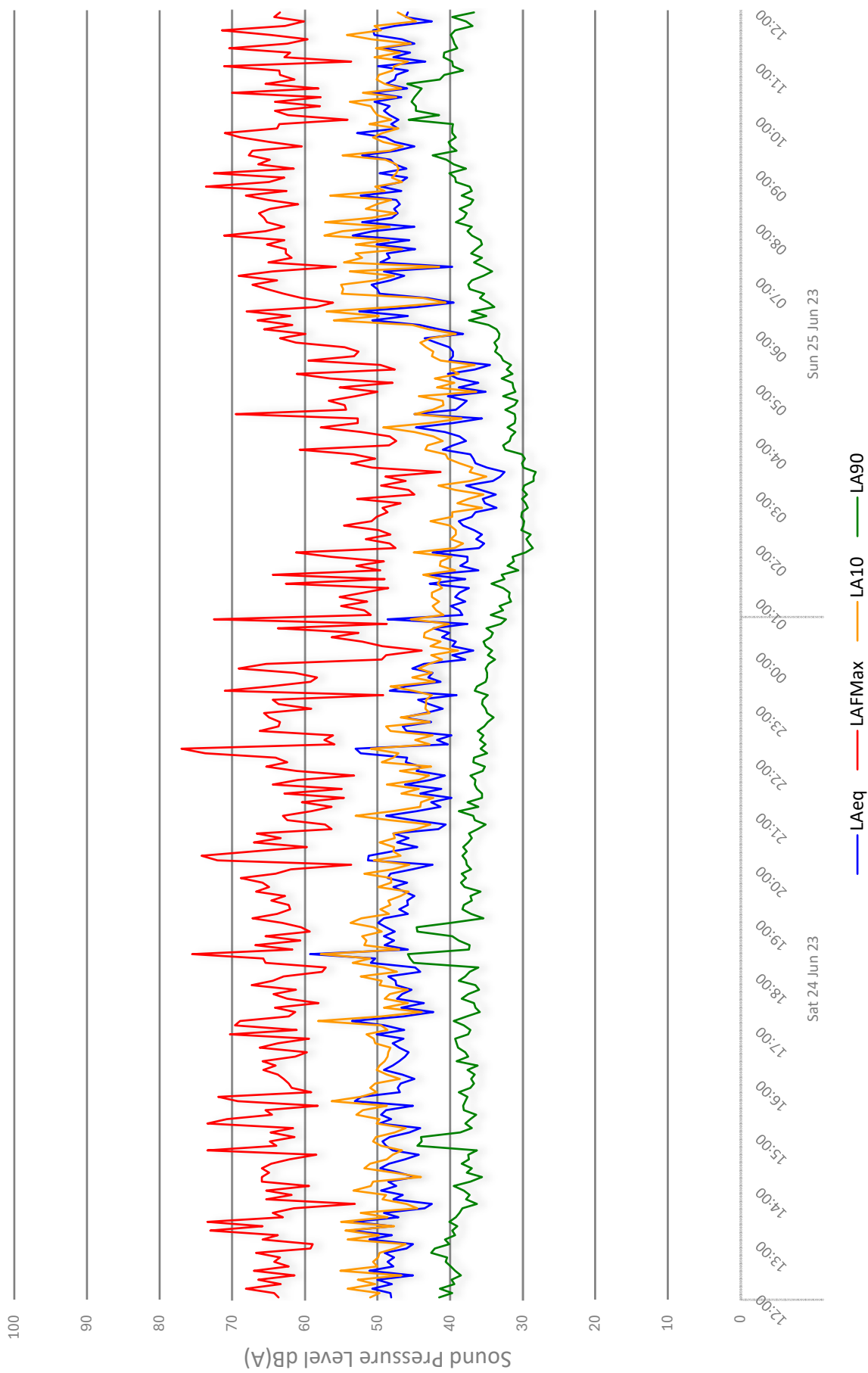
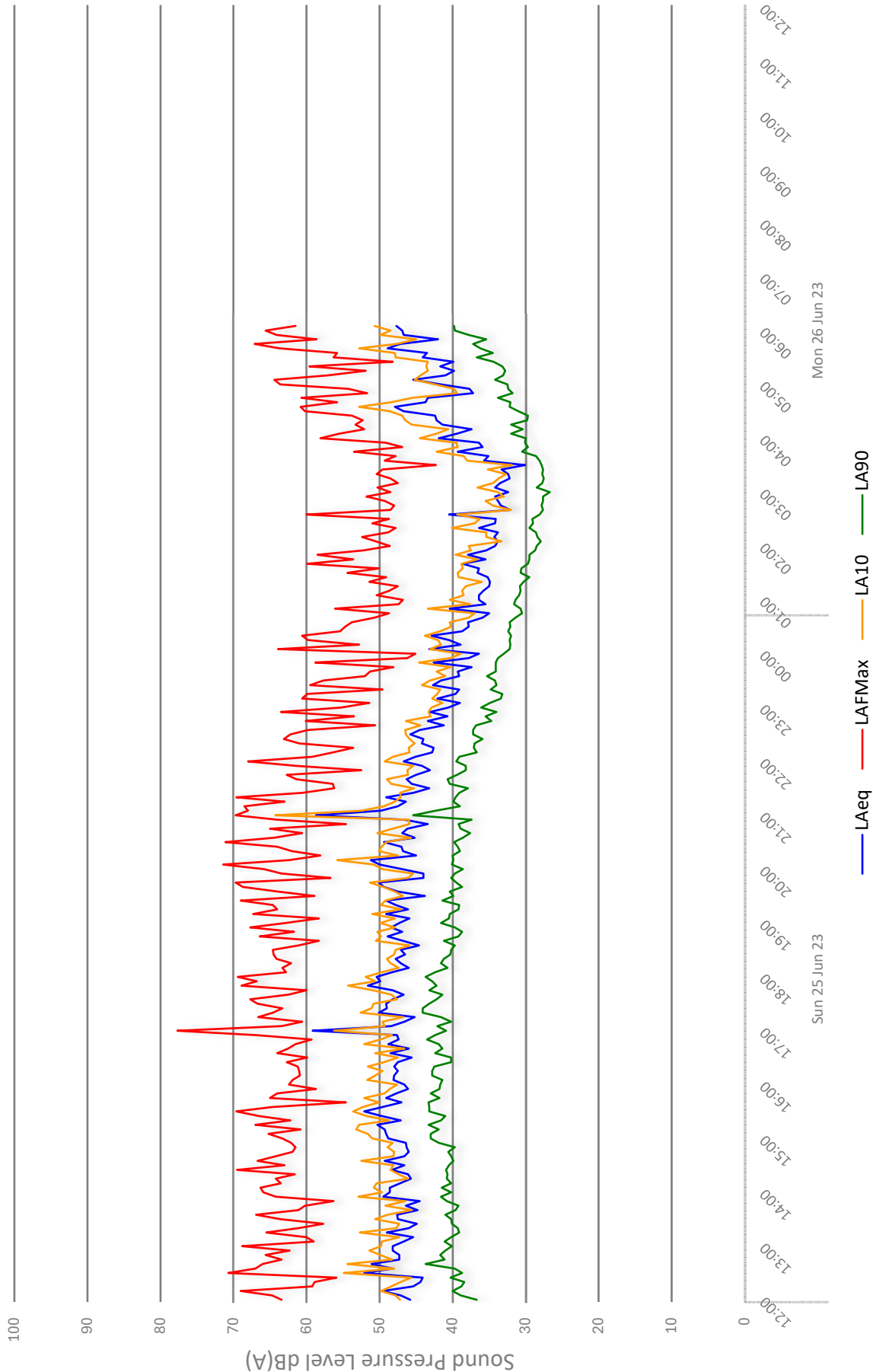


Figure VA5446/TH12

South



# APPENDIX A

## Acoustic Terminology & Human Response to Broadband Sound

### 1.1 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.

|  |   |
|--|---|
| <b>Sound</b>   | Vibrations propagating through a medium (air, water, etc.) that are detectable by the auditory system.  |
| <b>Noise</b>   | Sound that is unwanted by or disturbing to the perceiver.   |
| <b>Frequency</b>                                       | 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'.   |
| <b>dB(A):</b>  | 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 $L_A$ .<br>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).        |
| <b><math>L_{eq}</math> :</b>                           | 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.<br><br>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.  |
| <b><math>L_{10}</math> &amp; <math>L_{90}</math> :</b> | 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.<br>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. |
| <b><math>L_{max}</math> :</b>                          | 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.  |
| <b><math>D_{nT}</math></b>                             | <i>Weighted Standardised Level Difference.</i> As defined in BS EN ISO 717-1, representing the <i>Weighted Level Difference</i> , when standardised for reference receiving room reverberant characteristics.   |
| <b><math>D_{n,e}</math></b>                            | 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.   |
| <b><math>D_{n,f}</math></b>                            | 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   |

### 1.2 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

# APPENDIX A

## Acoustic Terminology & Human Response to Broadband Sound

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

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

| Change in Sound Level<br>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 |

### 1.4 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.