

Report VA3600.210729.PDA1.4

**6 – 8 Market Place
Reading**

Noise Impact Assessment

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Contents

1. Introduction.....	1
2. Guidance and Legislation	1
2.1 Permitted Development – Class O.....	1
2.2 BS4142:2014	2
2.3 The National Planning Policy Framework (2021)	3
2.4 Noise Policy Statement for England (2010).....	4
2.5 BS8233:2014	4
2.6 WHO Guidelines for Community Noise (1999).....	5
3. Site Description.....	5
4. Environmental Noise Survey	6
4.1 Survey Procedure & Equipment	6
4.2 Results	6
5. BS4142 Noise Impact Assessment	8
5.1 Source Noise Levels	8
5.2 Acoustic Character Correction	8
5.3 Rating Noise Level and Assessment	9
5.3.1 Plant Noise – Location 1, North Area.....	9
5.3.2 Plant Noise – Location 2, Middle	9
5.3.3 Kitchen Extract – Location 4	10
5.3.4 Delivery Noise – Location 4	10
5.4 Context	10
5.5 Uncertainty	11
6. Internal Noise Assessment	11
6.1 Sound Reduction Performances of Building Elements	12
6.2 Sound Reduction Performance of Windowsets	12
6.3 Ventilation	14
7. Mitigation at Source.....	15
8. Sound Insulation From Ground Floor.....	15
8.1 Current Sound Insulation Performance	15
8.2 Test Results.....	16
9. Sound Insulation Design Review	16

9.1	Party Floor – Commercial to Residential	16
9.2	Party Floor – Residential to Residential.....	17
9.3	Party Walls.....	17
10.	Conclusion.....	17

Attachments

VA3600/SP1	Indicative Site Plan
VA3600/TH1-TH15	Environmental Noise Time Histories
Appendix A	Acoustic Terminology

1. Introduction

An application is to be made for the change of use of the offices at 6 – 8 Market Place, Reading from office to residential use under Class O of the General Permitted Development Order to create 93 new residential units.

Venta Acoustics has been commissioned by Tene Living (Reading) UK Ltd to undertake an assessment of the current environmental noise impact on the site and provide recommendations of acoustic mitigation where required in support of the application.

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 impacts of noise from commercial premises on the intended occupiers of the development in accordance with Class O of the GPDO.

Outline mitigation measures are considered and an appraisal of the requirements of external building fabric elements are provided where appropriate.

All staff at Venta Acoustics are fully qualified and members of the Institute of Acoustics, the recognised UK professional body for acoustics, noise and vibration professionals and are fully competent to undertake BS4142 assessments.

2. Guidance and Legislation

2.1 Permitted Development – Class O

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

Conditions

O.2. (1) *Development under Class O is permitted subject to the condition that before beginning the development, 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 and highways impacts of the development,*
- (b) contamination risks on the site,*
- (c) flooding risks on the site,*
- (d) impacts of noise from commercial premises on the intended occupiers of the development, and*
- (e) the provision of adequate natural light in all habitable rooms of the dwellinghouses.*

and the provisions of paragraph W (prior approval) apply in relation to that application.

(2) Development under Class O is permitted subject to the condition that it must be completed within a period of 3 years starting with the prior approval date.

Interpretation of Class O

O.3. For the purposes of Class O, “commercial premises” means any premises normally used for the purpose of any commercial or industrial undertaking which existed on the date of application under paragraph O.2(1), and includes any premises licensed under the Licensing Act 2003(1) or any other place of public entertainment.

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 BS4142:2014

British Standard BS4142:2014 *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 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.

The Standard is therefore suited to this assessment.

The assessment methodology considers the Specific Sound Level, as measured or calculated at a potential noise sensitive receptor, due to the source under investigation in terms of a L_{Aeq} value over a one-hour period during daytime operation (07:00-23:00 hours) and a fifteen-minute period during night-time operation (23:00-07:00 hours).

A correction factor is added to this level to account for the acoustic character of the sound. This is determined as follows when using the subjective assessment methodology:

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 noise receptor, 4 dB where it is clearly perceptible and 6 dB where it is highly perceptible.

Impulsivity - A correction of up to +9 dB 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 3 dB for impulsivity which is just perceptible at the receiver, 6 dB where it is clearly perceptible and 9 dB 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 +3 dB 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 +3 dB can be applied.

An initial estimate of the impact of the source is then obtained by subtracting the typical background noise level, in terms of a L_{A90} value over the relevant period of operation, 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.

The initial estimate of the impact may then be modified by taking consideration of the context in which the sound occurs.

2.3 The National Planning Policy Framework (2021)

The revised *National Planning Policy Framework* (NPPF), published in July 2021, 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 185 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 Statement for England:

2.4 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.

2.5 BS8233:2014

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

The relevant section of the standard is shown below in Table 2.1.

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 2.1 - Excerpt from BS8233: 2014

[dB ref. 20μPa]

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]

The guidance provided in this document with regard to internal noise levels is the same as that provided in BS8233, but it also provides advice regarding maximum noise levels inside during the night-time period.

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).

3. Site Description

As illustrated on attached site plan VA3600/SP1, the building overlooks Market Place at the front, with some of the rear of the building overlooking Abbey Square, and the rest overlooking internal courtyards and a rear access road that is accessed via Abbey Square.

The internal courtyards have cooling plant located at ground floor roof level, with further plant located at 4th floor level on the adjacent building, and a kitchen extract system servicing the adjacent building to the south.

At ground floor of the building there is a small Tesco supermarket, which has deliveries to the rear, in the covered underground car park at lower ground/basement level, which is accessed via Abbey Square.

Market Place is predominantly commercial and retail in nature with some residential uses in the area overlooking Market Place.

4. Environmental Noise Survey

4.1 Survey Procedure & Equipment

In order to establish the existing noise levels at the site, a noise survey was carried out between Thursday 11th and Monday 15th March 2021 in various locations around the building. These locations were chosen to be representative of the noise level at the proposed new noise sensitive receivers.

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-11461-E0	UCRT20/1699	27/7/20
NTi Class 1 Integrating SLM	XL2	A2A-11586-E0	UCRT20/1565	29/6/20
NTi Class 1 Integrating SLM	XL2	A2A-12202-E0	UCRT21/1102	21/1/21
Svante Class 1 Integrating SLM	958A	59177	UCRT21/1107	21/1/21
Larson Davis calibrator	CAL200	13049	UCRT19/1501	18/4/19

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 VA3600/TH1-4 for position 1, VA3600/TH5-8 for position 2, VA3600/TH9-11 for position 3 and VA3600/TH12-15 for position 4.

The background noise level is determined by road traffic noise on Market Place and Abbey Square, and plant noise on the internal courtyard areas, which are shown on the attached site plan VA3600/SP1.

Sound level meters were located in the positions shown in Figure 4.1.



Figure 4.1 – Meter locations

The typical background noise levels measured are shown in Table 4.2. For positions 1 and 2 (denoted with the asterisk), the minimum background noise level has been reported in a lull when the equipment was not operational.

Monitoring Period	Typical ^a $L_{A90,T}$			
	Position 1*	Position 2*	Position 3	Position 4
07:00 – 23:00 hours	45 dB	41 dB	46 dB	49 dB
23:00 – 07:00 hours	41 dB	41 dB	40 dB	42 dB

Table 4.2 – Typical background and ambient noise levels

^a The typical L_{A90} value is taken as the 10th percentile of all L_{A90} values measured during the relevant period

A similar application for this site has previously been undertaken. In that assessment, at position 2, overlooking the central courtyard, the daytime L_{A90} previously reported the minimum background to be L_{A90} 33dB. However, interrogation of the time histories has shown that this was an anomalous final measurement captured at the end of the survey as the measurement was being stopped. The figure of L_{A90} 41B was the minimum background noise level captured during the survey once this anomalous result was omitted and has been used as the basis for the assessment.

Although Class O of the GPDO only covers commercial noise, which area assessed against the background (L_{A90}), the average (L_{Aeq}) noise levels, which would be used as the basis for a full application, are reported in Table 4.3 as an informative.

Monitoring Period	L _{Aeq,T}			
	Position 1	Position 2	Position 3	Position 4
07:00 – 23:00 hours	54 dB	57 dB	65 dB	60 dB
23:00 – 07:00 hours	53 dB	56 dB	59 dB	48 dB

Table 4.3 – Average ambient noise levels at measurement locations

[dB ref. 20µPa]

5. BS4142 Noise Impact Assessment

Windows overlooking the plant areas, as shown in VA3600/SP1, are affected by plant noise.

The plant noise from the kitchen extract can be seen in the time histories to operate between 10:00 and 22:45.

The windows around position 4 are affected by noise from the kitchen extract system on the building to the south, and would also occasionally experience noise from lorries manoeuvring into the ground/lower ground floor parking area to access the rear of Tesco, which is located in the covered area of the carpark, with relatively long periods in between deliveries.

Windows to the front on Market Place, and rear on Abbey Square are not affected by the plant noise.

5.1 Source Noise Levels

The following source noise levels have been used for the assessment.

Noise Source	Measurement Location	Measured L _{Aeq}	Notes
Plant Noise – North	At façade	56 dB	Plant operational 24 hours
Plant Noise – Middle	At façade	58 dB	
Kitchen Extract	At façade	62 dB	Operated 10:00 – 22:45
Lorry manoeuvring	8m	73dB	

Table 5.1 – Noise sources used for assessment

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 2.2.

Noise Source	Subjective Description	Allocated Corrections
Lorry Manoeuvring	Intermittent deliveries, diesel engine broadband, not tonal and not impulsive	Tonality: 0dB Impulsivity: 0dB Intermittency: +3dB
Building Services Plant	Operates intermittently. Survey data indicated some tones	Tonality: +2dB Impulsivity: 0dB Intermittency: +3dB
Kitchen Extract	Constant operation when in use, some tonality	Tonality: +2dB Impulsivity: 0dB Intermittency: 0dB

Table 5.2 – Acoustic character corrections

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

5.3 Rating Noise Level and Assessment

The rating noise levels at the assessment locations are compared against the relevant background noise levels to assess the notional significance of the noise impact as follows. Operations are adjusted to the appropriate on times.

5.3.1 Plant Noise – Location 1, North Area

It is understood that the tenant in the ground floor has confirmed that their plant should be turned off at night, although this was not the case during the noise survey. The impact has been based upon the night-time noise level to ensure a robust assessment. However, should this be based against the opening hours of the dentist's then the level of impact would be reduced by approximately 11dB.

Results		Relevant Clause	Commentary
Building Services Plant	L _{Aeq} 56dB	7.3.4	
Distance Loss	0 dB	7.3.5	Measured at façade
Specific Sound Level	L _{Aeq} 56 dB		
Continuous Operation	0 dB	7.2	
Acoustic feature correction	+5 dB	9.2	+3dB for intermittency, +2 dB for tonality
Rating level	L _{Ar} 61 dB	9.2	
Background sound level	L _{A90} 41 dB	8	Night-time
Excess of rating over background sound level	+20 dB	11	
Assessment indicates a significant impact		11	Depending on context
Uncertainty and Context	The survey indicated that the plant operates consistently through day and night-time.		

Table 5.3 – BS4142 Assessment – Plant

5.3.2 Plant Noise – Location 2, Middle

Results		Relevant Clause	Commentary
Building Services Plant	L _{Aeq} 58dB	7.3.4	
Distance Loss	0 dB	7.3.5	Measured at façade
Specific Sound Level	L _{Aeq} 58 dB		
Continuous Operation	0 dB	7.2	
Acoustic feature correction	+5 dB	9.2	+3dB for intermittency, +2 dB for tonality
Rating level	L _{Ar} 63 dB	9.2	
Background sound level	L _{A90} 41 dB	8	Night-time
Excess of rating over background sound level	+22 dB	11	
Assessment indicates a significant impact		11	Depending on context
Uncertainty and Context	The survey indicated that the plant operates consistently through day and night-time.		

Table 5.4 – BS4142 Assessment – Plant

5.3.3 Kitchen Extract – Location 4

Results		Relevant Clause	Commentary
Kitchen Extract Plant	L _{Aeq} 62dB	7.3.4	
Distance Loss	0 dB	7.3.5	Measured at façade
Specific Sound Level	L _{Aeq} 62 dB		
Continuous Operation	0 dB	7.2	
Acoustic feature correction	+2 dB	9.2	+2 dB for tonality
Rating level	L _{Ar} 64 dB	9.2	
Background sound level	L _{A90} 49 dB	8	Daytime
Excess of rating over background sound level	+15 dB	11	
Assessment indicates a significant impact		11	Depending on context
Uncertainty and Context	The survey indicated that the plant operates consistently during the daytime.		

Table 5.5 – BS4142 Assessment – Extract Fan

5.3.4 Delivery Noise – Location 4

Results		Relevant Clause	Commentary
Lorry Manoeuvring	73dB @ 8m	7.3.4	
Distance Loss (6m)	+6 dB	7.3.5	Assumed a point source
Specific Sound Level	L _{Aeq} 79 dB		
2 minute per 60 minutes	-15 dB	7.2	Time correction for vehicle reversing into loading area
Acoustic feature correction	+3 dB	9.2	+3dB for intermittency
Rating level	L _{Ar} 67 dB	9.2	
Background sound level	L _{A90} 49 dB	8	Daytime
Excess of rating over background sound level	+18 dB	11	
Assessment indicates a significant impact		11	Depending on context
Context	Deliveries understood to occur during the daytime. Long periods of respite between deliveries.		

Table 5.6 – BS4142 Assessment – Deliveries

5.4 Context

The site is located in a town centre location in Central Reading.

Within this context, the estimated impact of the sound sources is expected to remain valid.

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 to an area with existing sources of commercial noise provides an opportunity to provide appropriate mitigation against the noise sources.

The redevelopment of the site provides an opportunity to provide mitigation in the form of appropriately specified external building fabric elements. This would allow appropriate internal noise levels to be achieved such that the commercial noise source is not considered to be disruptive.

This allows the impact to be significantly reduced for occupants within the dwellings and is considered in section 6. The new dwellings are not proposed to have any external amenity areas and hence internal noise levels are how future residents would experience the noise.

5.5 Uncertainty

This section considers the variable in the assessment that may cause variations within the final results and describes how these have been addressed.

- Use of a Class 1 sound level meter is considered to reduce instrument error to insignificant levels as compared with environmental variations. The calibration of the instrumentation was confirmed before and after the noise surveys.
- The background measurements were undertaken under suitable weather conditions over a period designed to include reasonable temporal variations in background noise levels, including a weekend period. Multiple monitoring locations were selected to minimise local acoustic phenomenon that may affect a single measurement location, including the noise from the nearby road. These measurement locations were selected to be representative of the background noise levels expected to be experienced by the proposed dwellings without being unduly influenced by extraneous noise sources.
- Source data of particular noise sources was measured on site at the receiver, where possible. These measurements were undertaken in a manner that best represented noise emissions from the source to the assessment locations without being unduly influenced by extraneous noise sources. This methodology minimised the uncertainty introduced in sound propagation calculations.
- Where library data has been used, propagation calculations have been used to correct noise levels to the relevant distance at the receiver.

Overall, the uncertainty is considered to have been minimised to a suitable range so as not to risk significant variations in the impact assessment of typical operations.

6. Internal Noise Assessment

To control sound from the commercial uses, the sound insulation performance of the building glazing will be specified to control the Rating noise 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).

This will result in actual noise levels from the external plant being lower than the recommended levels in BS8233, as the acoustic penalties have been applied, but are obviously an assessment tool, and so are not audible.

The apartments include no external amenity areas and so the internal space is how future residents would experience noise. As the scheme would be viewed as the agent of change in the context of the NPPF, recommendations as to measures which could be taken to mitigate the noise are included.

The approach of controlling external noise sources through the use of the building envelope and ventilation is very common, for both road noise, and also commercial noise, especially in vibrant areas, such as town centres. This is even highlighted in the Reading Borough Local Plan where it is stated for Central Reading that: *'... in order for the internal noise levels to be reasonable and not adversely affect health it would be necessary to provide a system of ventilation that entirely removes the necessity to open windows, even in very hot weather.'*

Although Class O of the GPDO does not require assessment of traffic noise or ventilation requirements, the following includes the glazing requirement to control external noise levels, including traffic, to BS8233 levels internally as an informative. The front (Market Place) and rear (Abbey Square) were affected by traffic noise rather than commercial noise.

It is understood that the applicant will fit fully attenuated MVHR systems to the apartments to provide sufficient levels of ventilation and cooling during summer overheating.

In addition to this, the layout of the new apartments have been optimised, so that apartments affected by plant noise in the central area comprise two rooms. This would allow residents to have one window open whilst using the other room.

6.1 Sound Reduction Performances of Building Elements

For the purposes of the calculations, 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 10140-2:2010 *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 _w 51

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

6.2 Sound Reduction Performance of Windowsets

The following minimum glazing specification would be required to ensure that internal noise levels achieve the required levels for average and maximum events.

Glazing Location	Required Glazing SRI, dB
Area 1 - Yellow	R _w 29 dB
Area 2 - Blue	R _w 31 dB
Area 3 - Green	R _w 40 dB
Area 4 - Purple	R _w 38 dB

Table 6.2 – Required minimum sound reduction indices for glazing

Figure 6.1 shows the locations where each glazing type would be required, with the solid line denoting areas affected by plant noise, which are part of the consideration of the Class O application, and the dashed areas being related to traffic noise, as an advisory to the developer.

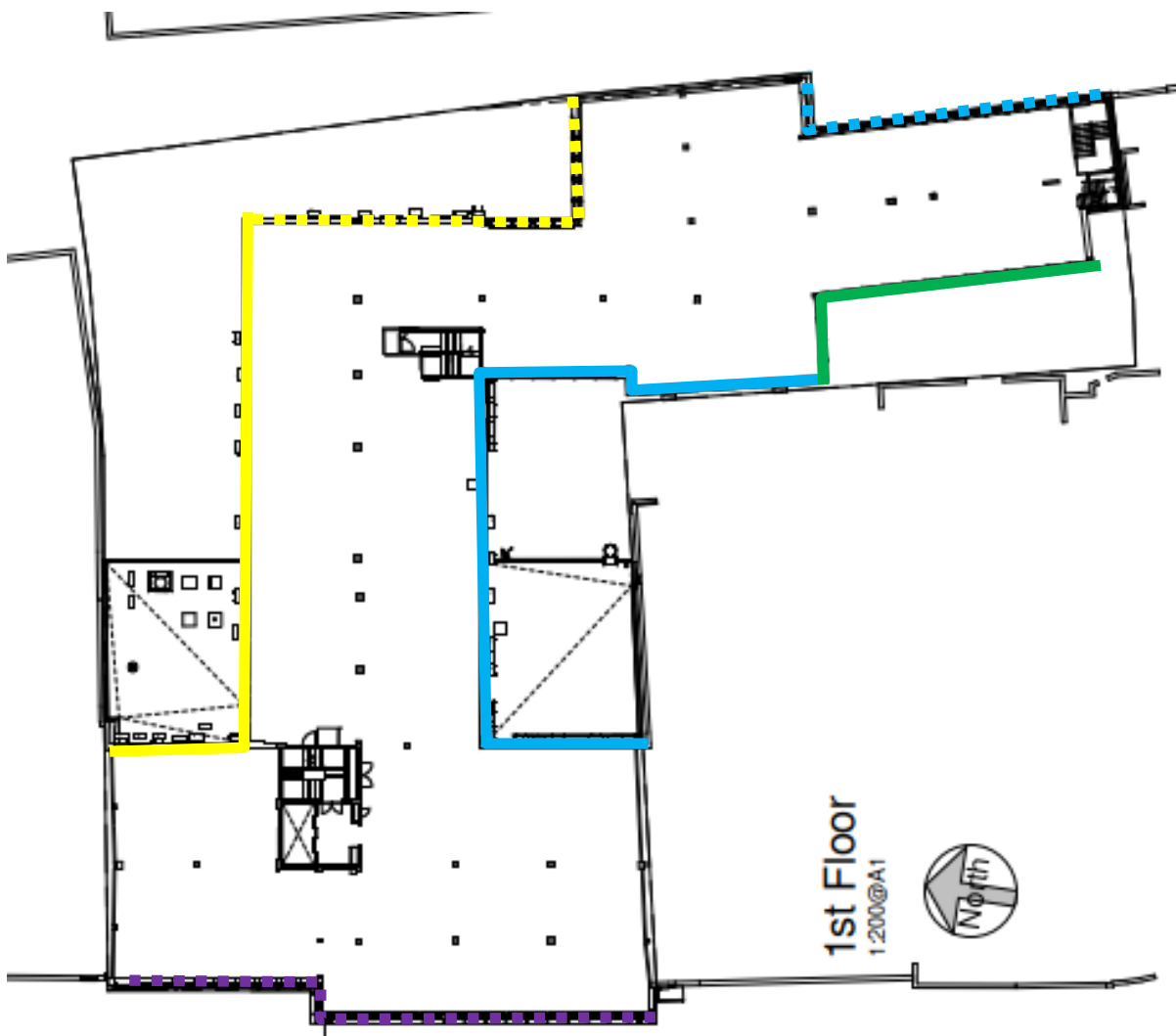


Figure 6.1 - Different locations for glazing types

It is important that the performance shown in Table 6.2 are achieved by the entire windowset including frames, seals, etc. Glass performance alone would not be likely to show compliance with the specification as the other elements typically provide the weakest noise transmission path.

6.3 Ventilation

As is typical in urban environments, with the windows open, internal noise levels would exceed the recommended levels.

Ventilation will be achieved using a Mechanical Ventilation with Heat Recovery (MVHR) system, fitted with a cooling module. MVHR is a continuous source of ventilation that extracts stale, moisture-laden air from a building and resupplies fresh, filtered air back in, resulting in a comfortable and condensation free environment all year round.

MVHR meets Building Regulations for new properties under System Four of Building Regulations Part F.

The system will simulate an open window, enabling windows to remain shut.

The system will continuously extract moist, stale air from the units. This air is passed over a heat exchange cell which recovers and retains the heat that would otherwise be lost from the extracted air. This heat is then transferred to incoming fresh, filtered air that the unit is resupplying back into the units resulting in well ventilated units with minimal heat losses in winter and cool rooms in summer.

MVHR systems are commonplace in locations where the surrounding noise levels are such that windows need to remain shut. This is recognised in the Reading Borough Local Plan where it is stated for Central Reading and in relation to specific developments sites (including this site) that: *'... in order for the internal noise levels to be reasonable and not adversely affect health it would be necessary to provide a system of ventilation that entirely removes the necessity to open windows, even in very hot weather.'* (paragraphs 5.3.25 and 5.4.35)

The Planning Practice Guidance also advocates the use of ventilation systems where windows have to be kept closed because of noise arising from existing businesses.

The Reading Borough Local Plan also confirms that where necessary, the details of the ventilation system can be secured via planning condition.

The intention to install systems fitted with a cooling module will ensure future residents are protected from summer overheating, allowing them to keep their windows closed.

With the above recommendations implemented, the noise levels within the proposed dwellings would be expected to be in line with recommendations given in the WHO 1999 and BS8233:2014 guidance. Internal noise levels can therefore be considered to be between the NOEL the LOAEL levels.

7. Mitigation at Source

Internal noise levels will be the way the residents experience noise in the new apartments. These have been shown to be capable of being controlled by the use of the external building fabric, glazing and ventilation.

Although not considered necessary in light of the mitigation measures proposed, the applicant has examined the possibility of mitigating the noise at its source, and this is technically possible.

If mitigation at source takes place, it is expected that noise from plant could be reduced to have a low impact on future occupiers.

The applicant is also willing to accept a condition be attached to the planning permission ensuring mitigation of noise at source is performed.

8. Sound Insulation From Ground Floor

8.1 Current Sound Insulation Performance

Investigative sound insulation tests were undertaken on 11th March 2021 in general accordance with BS EN ISO 140 *Acoustics – Measurement of sound insulation in buildings and of building elements Part 4: Field measurements of airborne sound insulation between rooms*.

High volume 'pink' noise was generated from a loudspeaker in the source room, positioned so as to obtain a diffuse sound field within the spaces. A spatial average of the resulting one-third octave band noise levels was obtained within both the source and the receive rooms.

In order to correct for room reverberant characteristics, the reverberation time (RT) was measured in the receive rooms using an interrupted broadband noise source and the RT function of the NTi XL2 sound level meter. Six microphone positions and two loudspeaker positions were used to obtain average results.

Background noise levels were measured in the receive rooms in order to correct the received noise measurements for the influence of the prevailing noise climate as in accordance with BS EN 140 part 4.

The following equipment was used for the sound insulation tests.

Manufacturer	Model Type	Serial No	Calibration	
			Certificate No.	Date
NTi Class 1 Integrating SLM	XL2	A2A-12202-E0	UCRT21/1102	21/1/21
NTi Class 1 Integrating SLM	XL2	A2A-15993-E0	FL-19-122	14/3/19
Larson Davis calibrator	CAL200	13049	UCRT19/1501	18/4/19
Electro Voice	ZLX-12P-EX	095208361761760076	-	-
Unbranded WAV player	-	-	-	-

Table 8.1 – Equipment used for the tests

8.2 Test Results

The results of the test for the airborne sound insulation test is summarised for the proposed commercial to residential elements (ground to first floor level) and the proposed residential to residential elements (first to fourth floor level) in the table below.

Source Room	Receive Room	Partition Type	Test Type	Measured Performance
Commercial	Residential	Floor	Airborne	$D_{nT,w} + C_{tr}$ 53 dB
Residential	Residential	Floor	Airborne	$D_{nT,w} + C_{tr}$ 51-53 dB

Table 8.2 – Airborne Sound Insulation Test Results.

N.B Higher values of $D_{nT,w} + C_{tr}$ represent a better performance.

Table 8.3 shows the current sound insulation requirements for converted dwellings.

Test Type	Test Element	Minimum ADE Requirement
Airborne Sound Insulation	Walls and Floors	$D_{nT,w} + C_{tr} \geq 43$ dB

Table 8.3 – ADE 2003 design values for airborne sound insulation in dwellings formed by conversion

NB Higher values of $D_{nT,w} + C_{tr}$ represent better airborne sound insulation.

As the results show, the sound insulation performance of the floor currently meets the requirements for Building regulations.

The level of performance provided by the floor between the commercial and proposed residential area is 8dB better than the Building Regulations requirements for new build properties and hence would be considered to meet the description of a recommended increase in performance for between a 'normal' retail use and residential to ensure that the retail use would not disturb future residents highlighted in Approved Document E (2003).

9. Sound Insulation Design Review

9.1 Party Floor – Commercial to Residential

The floor between the two areas currently would be expected to provide sufficient sound insulation performance to ensure the future residents are not affected by noise from the current retail use.

Should a future tenant intend to have music or a more lively atmosphere, the ceiling may require upgrading to control noise between the demises, and could be included in the lease requirements.

9.2 Party Floor – Residential to Residential

Although the airborne sound insulation was tested to meet the requirements, impact noise will likely need to be mitigated between the new dwellings.

This could be achieved by the installation of a floating floor on a resilient layer providing a minimum performance of ΔL_w 19dB. Flanking strips should be installed at the perimeter of the floor at the junctions with the walls.

9.3 Party Walls

It is understood that new party walls are to be constructed. A twin stud system is recommended to maximise the sound insulation performance as follows:

- 2 layers 15mm SoundBloc, joints staggered, taped and skimmed
- 60 I 70 'I' studs at 600mm centres
- Cavity (total width between inner faces 190mm), 100mm Isover APR1200 in void
- 60 I 70 'I' studs at 600mm centres
- 2 layers 15mm SoundBloc, joints staggered, taped and skimmed

This should penetrate any raised or subfloor elements, and suspended ceilings.

10. Conclusion

A baseline noise survey has been undertaken by Venta Acoustics to establish the background noise climate in the locality of 6-8 Market Place, Reading.

The measured noise levels have been assessed against BS4142:2014 *Methods for rating and assessing industrial and commercial sound*, BS8233: 2014 *Guidance on sound insulation and noise reduction for buildings* and the World Health Organisation *Guidelines for Community Noise* (1999) to assess potential noise impacts on the new apartments.

When assessed using BS4142, noise from cooling plant, kitchen extract system and HGV noise associated with deliveries have been shown to have a significant impact. A discussion of potential mitigation in the form of building envelope performance, internal layouts and mechanical ventilation with additional cooling has been included and through the use of this, it is considered that internal noise levels due to external sources can be mitigated to acceptable noise levels.

The measured external noise levels have been used to predict internal noise levels in the completed dwellings to ensure that internal amenity is maintained.

The sound insulation between the ground floor retail space and first floor has been measured and recommendations to improve the performance provided, where required.

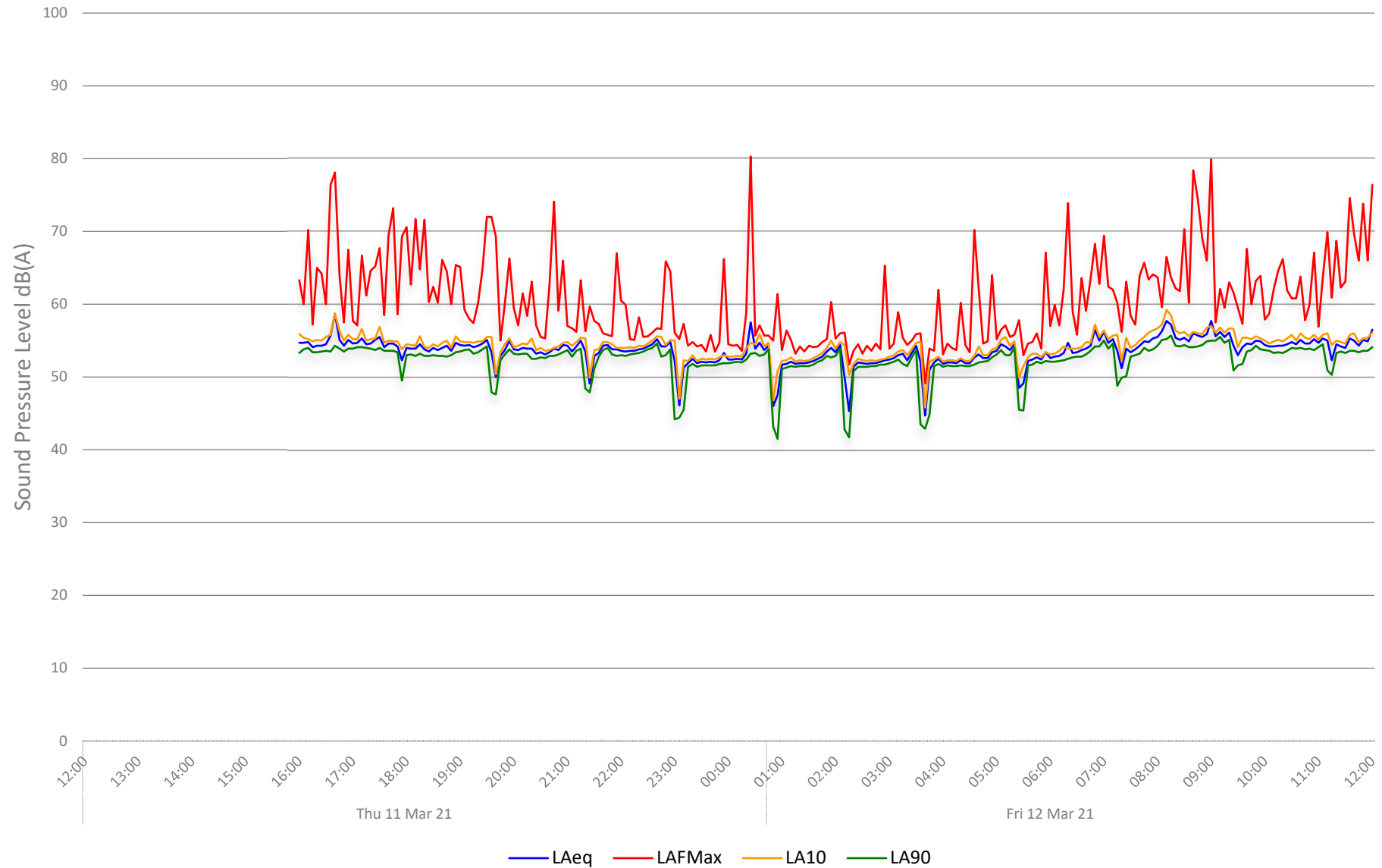
With the recommended measures in place, the proposed scheme is not expected to experience a significant adverse noise impact from commercial premises and the site is considered acceptable for the proposed residential use.

Jamie Duncan MIOA



6 – 8 Market Place, Reading
Environmental Noise Time History: 1
Position 1

Figure VA3600/TH1



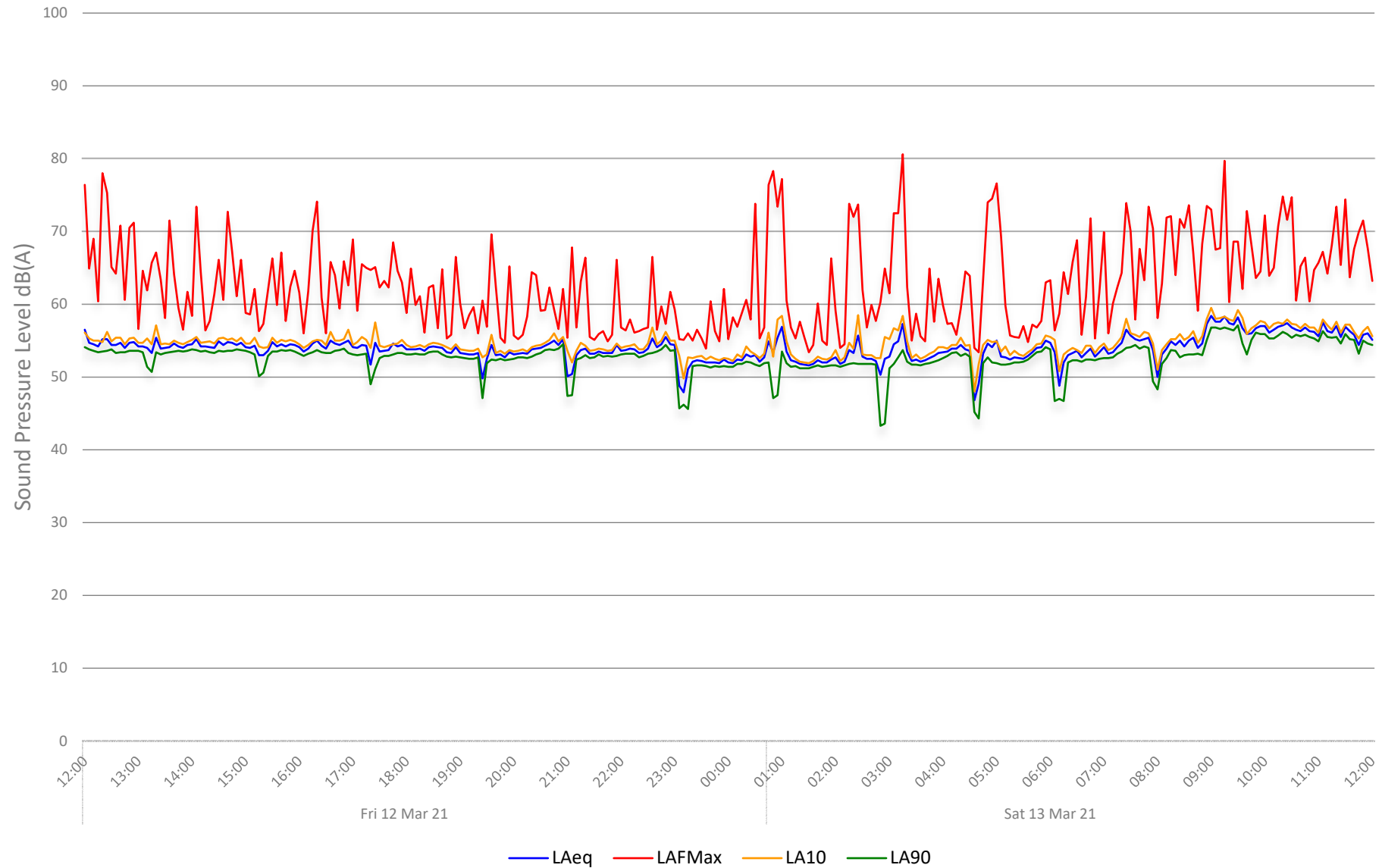
6 – 8 Market Place, Reading

Environmental Noise Time History: 2

Position 1



Figure VA3600/TH2



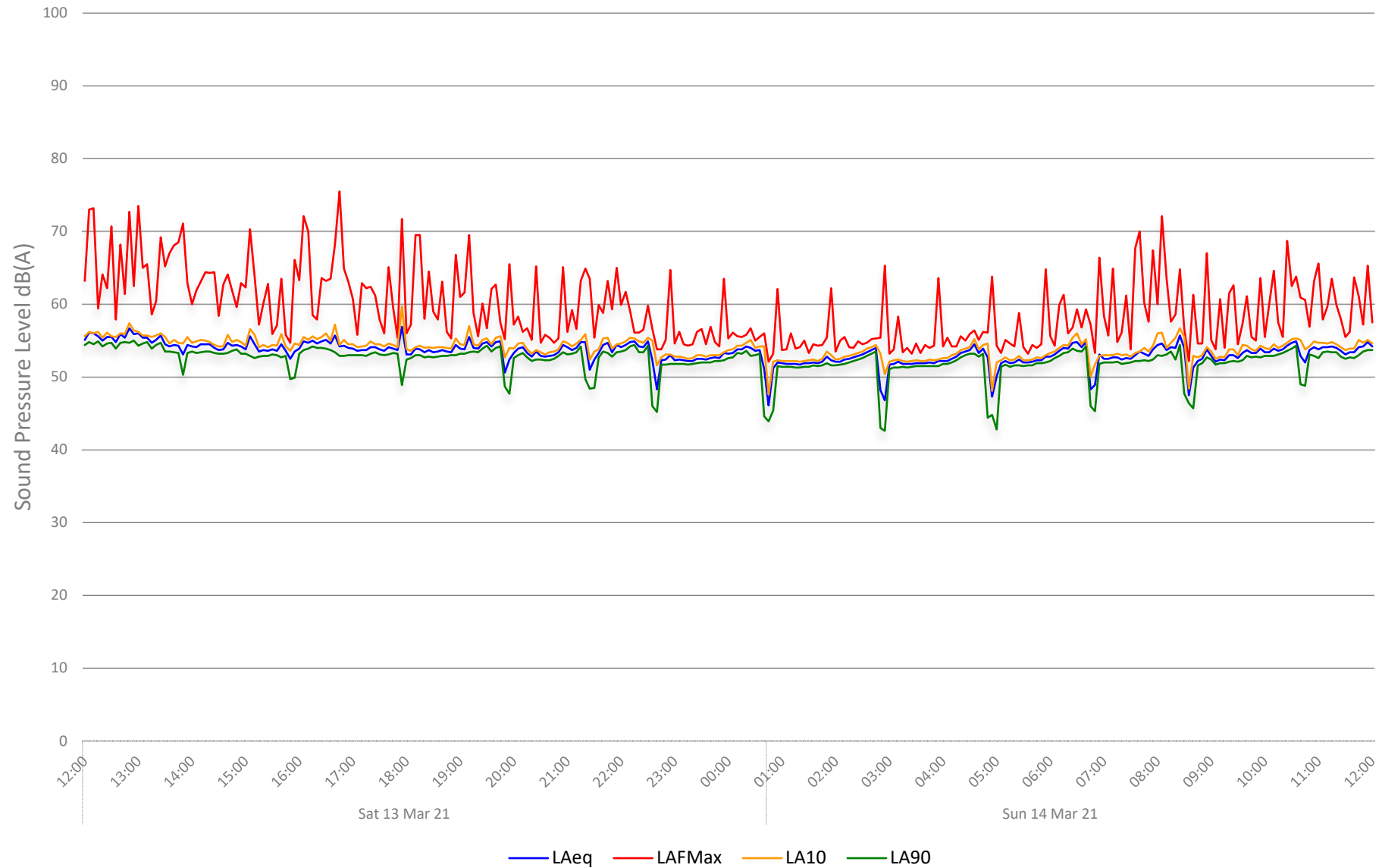
6 – 8 Market Place, Reading

Environmental Noise Time History: 3

Position 1



Figure VA3600/TH3



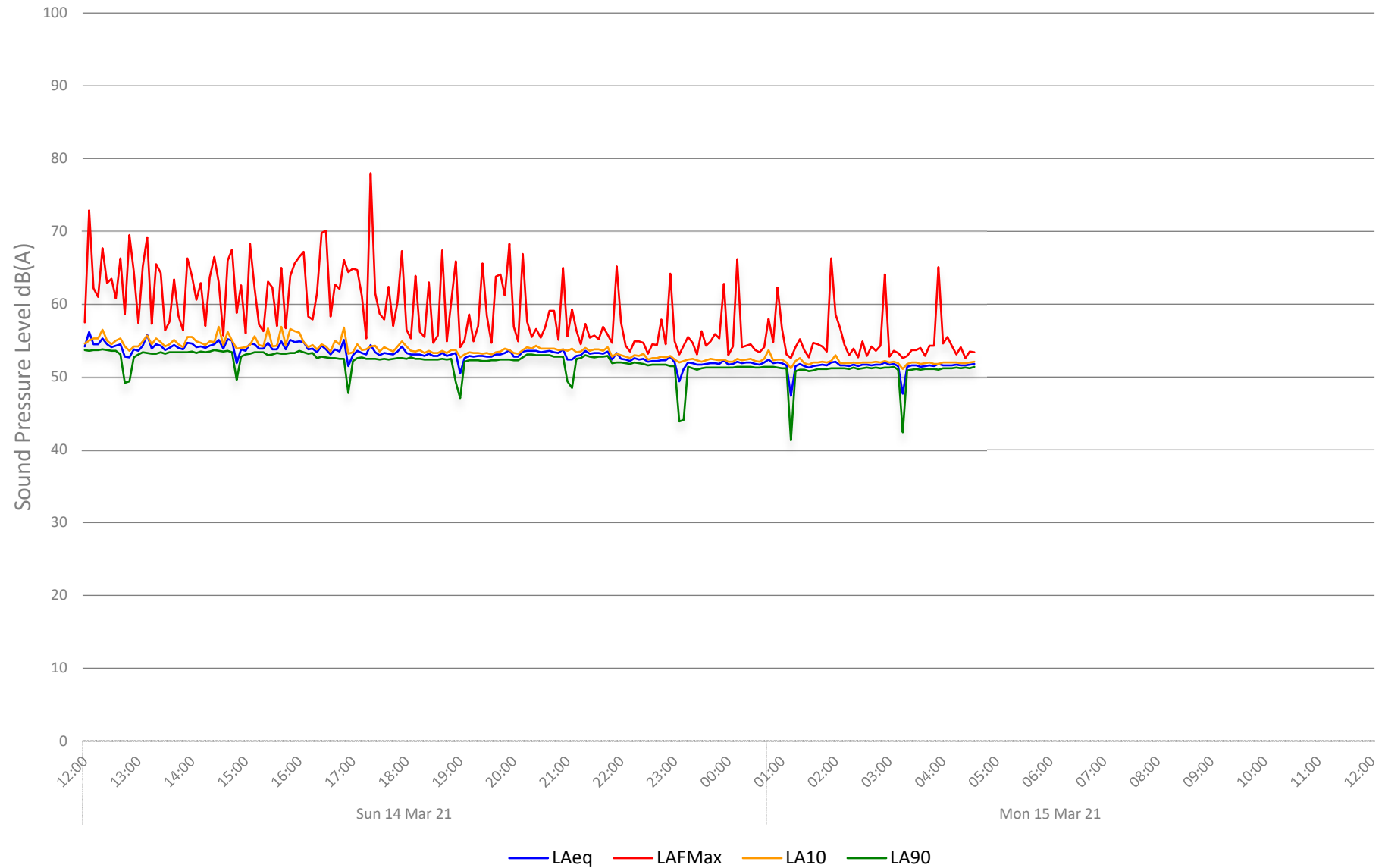
6 – 8 Market Place, Reading

Environmental Noise Time History: 4

Position 1



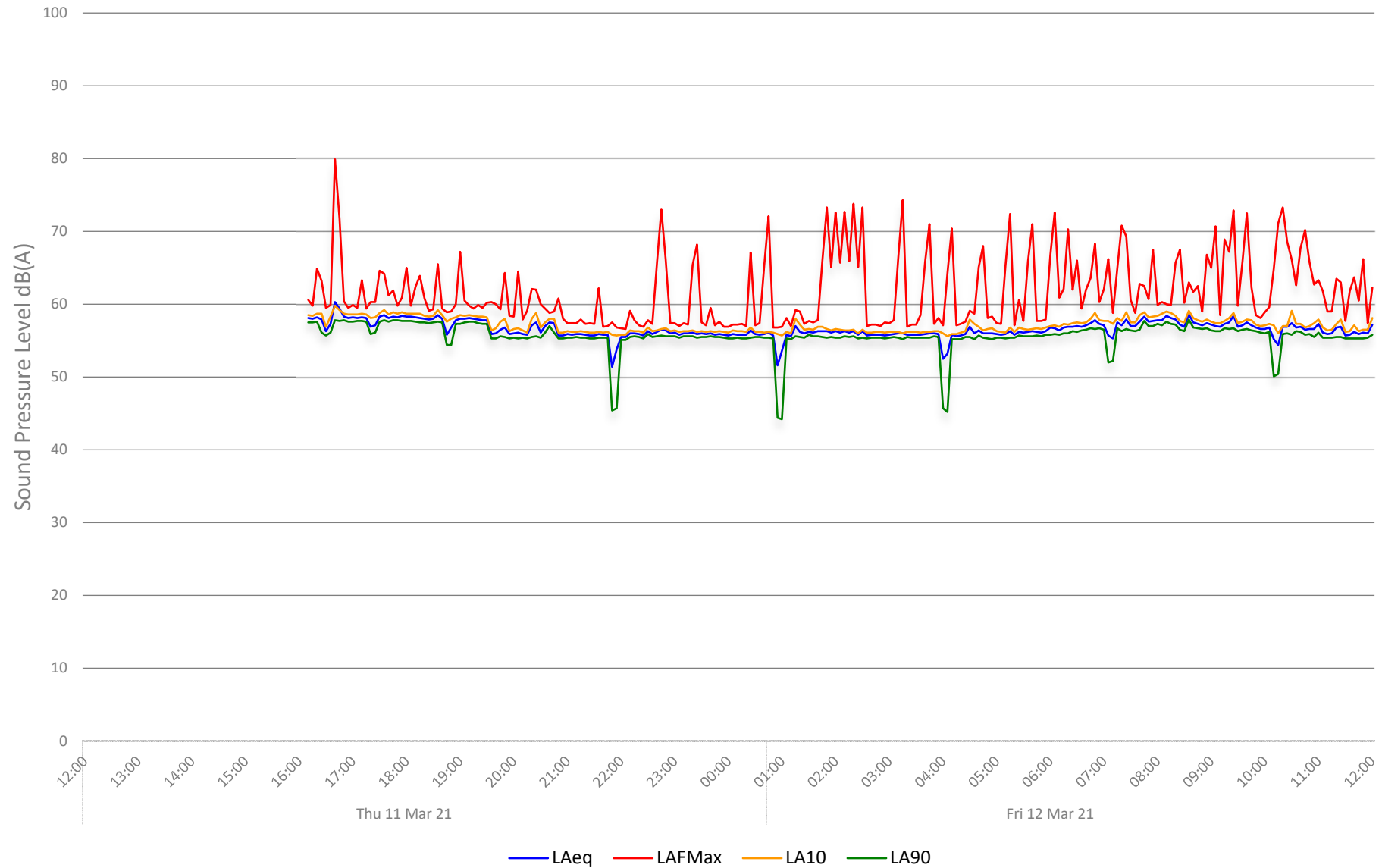
Figure VA3600/TH4



6 – 8 Market Place, Reading
Environmental Noise Time History: 5
Position 2



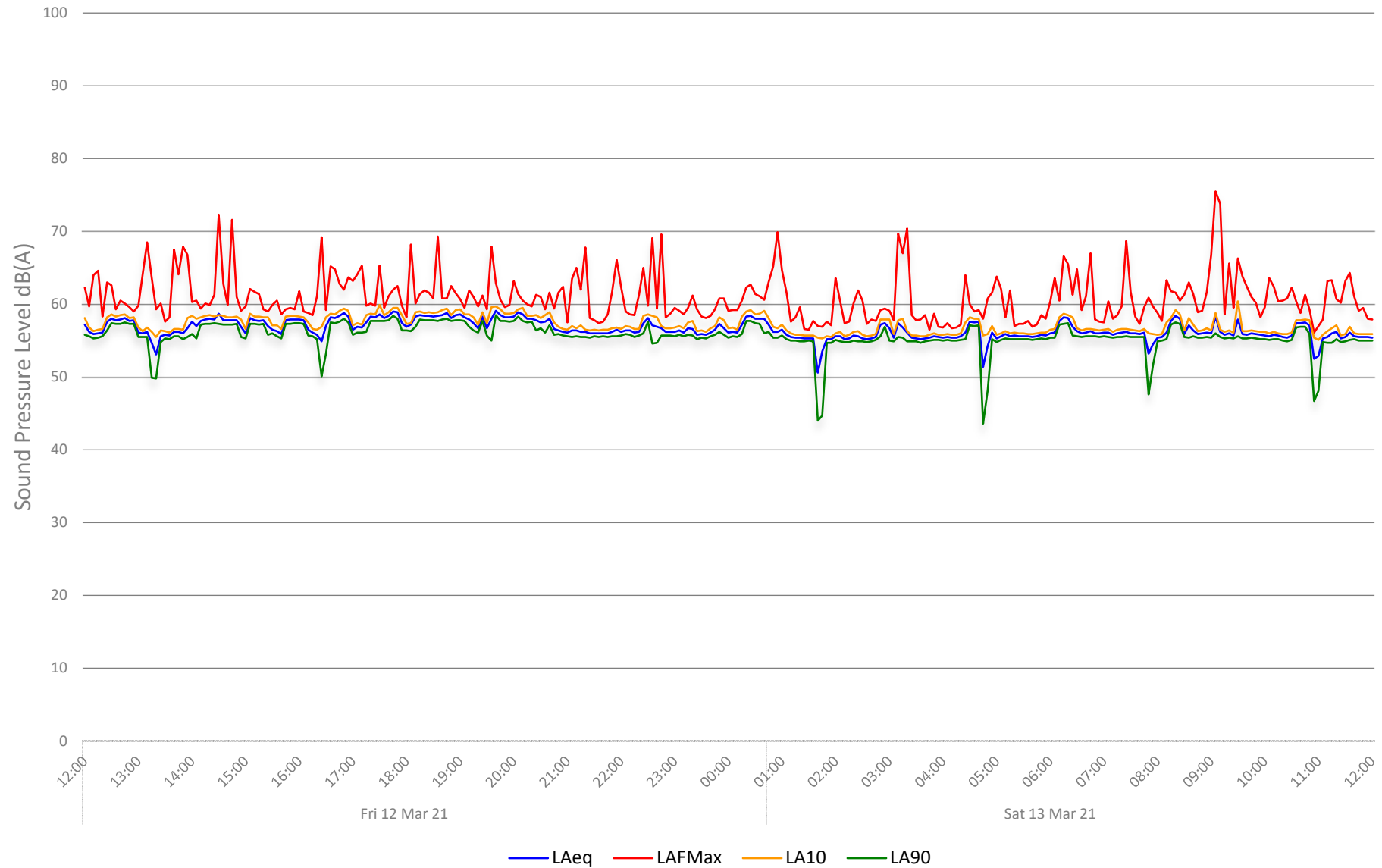
Figure VA3600/TH5



6 – 8 Market Place, Reading
Environmental Noise Time History: 6
Position 2



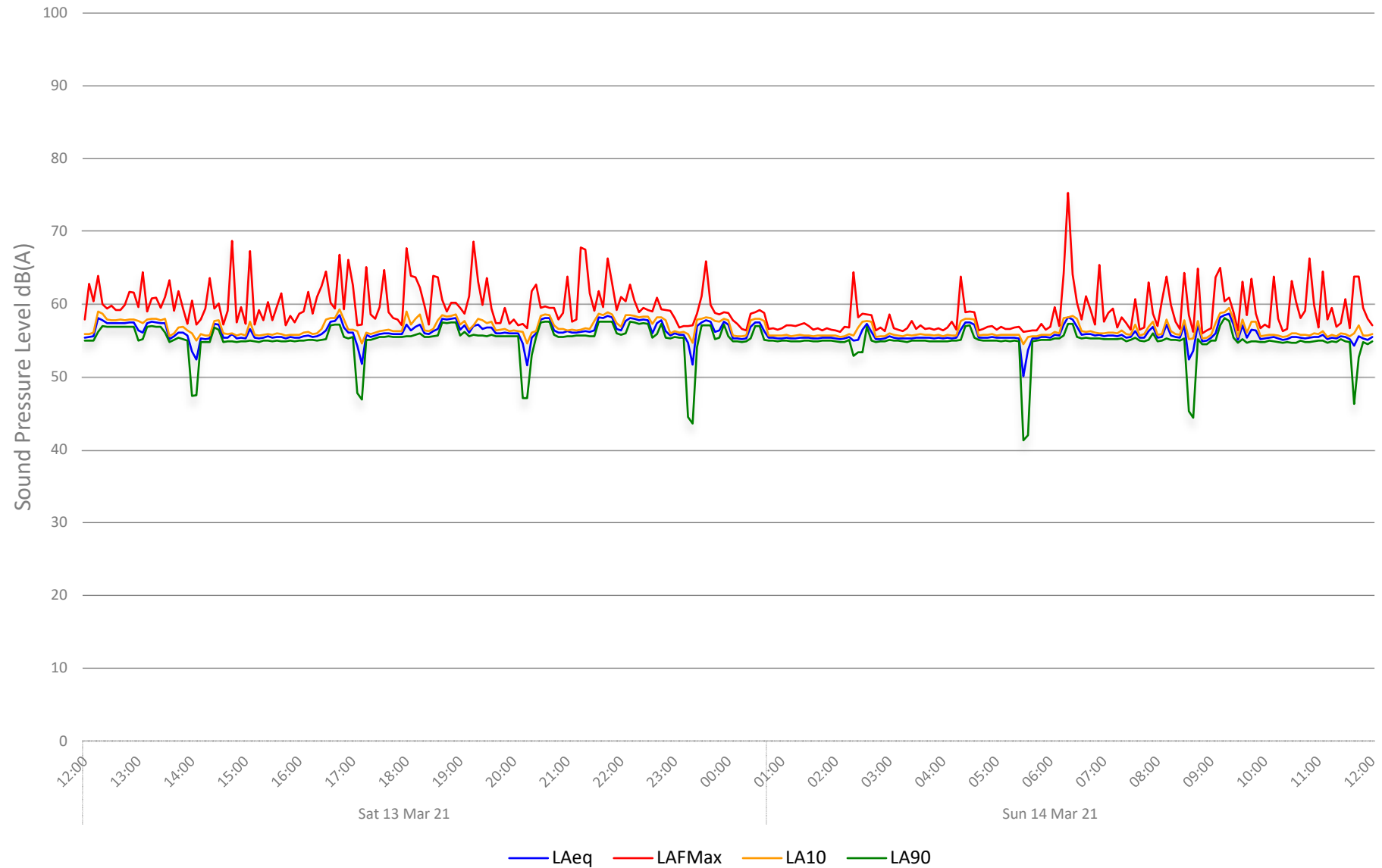
Figure VA3600/TH6



6 – 8 Market Place, Reading
Environmental Noise Time History: 7
Position 2



Figure VA3600/TH7



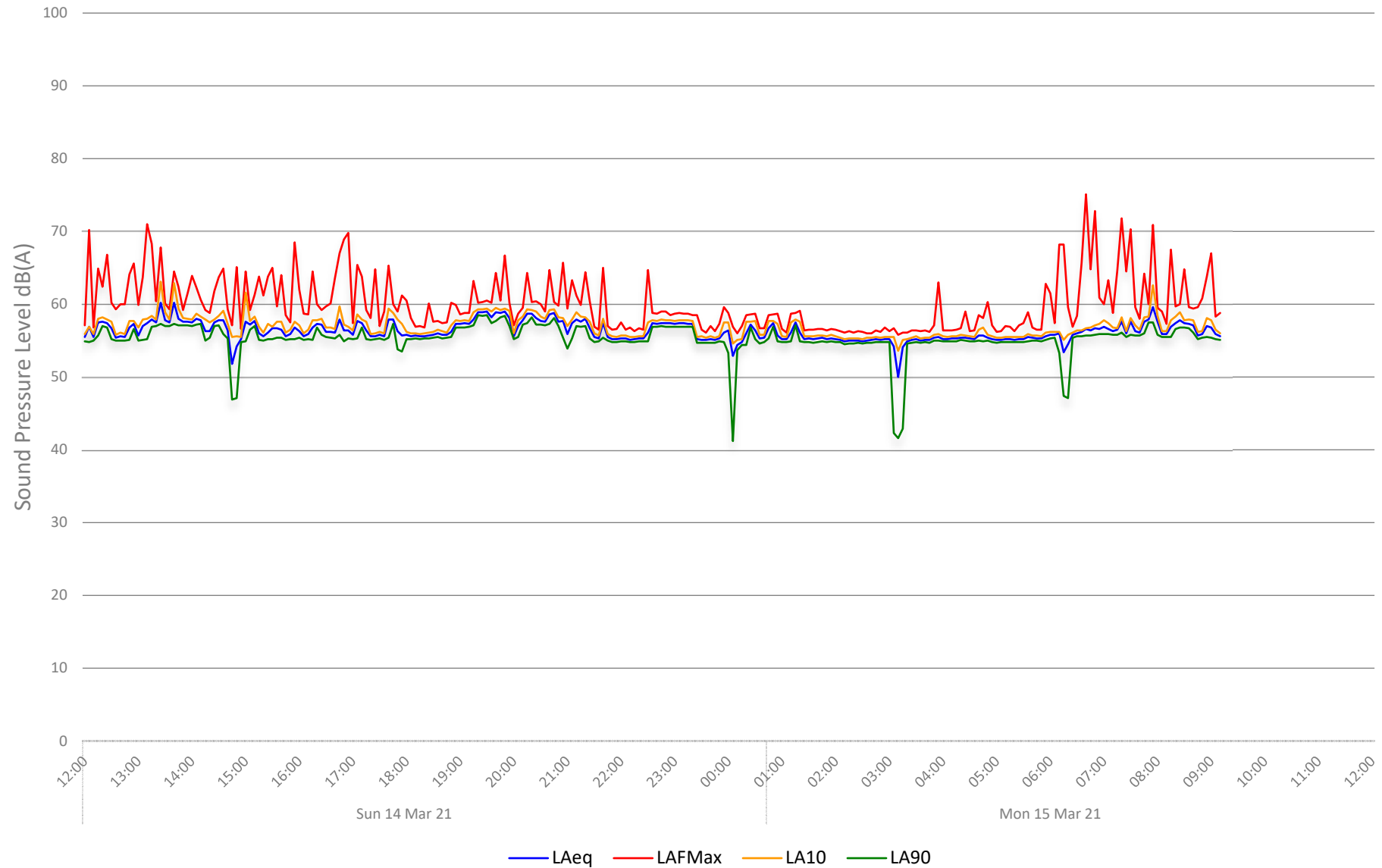
6 – 8 Market Place, Reading

Environmental Noise Time History: 8

Position 2

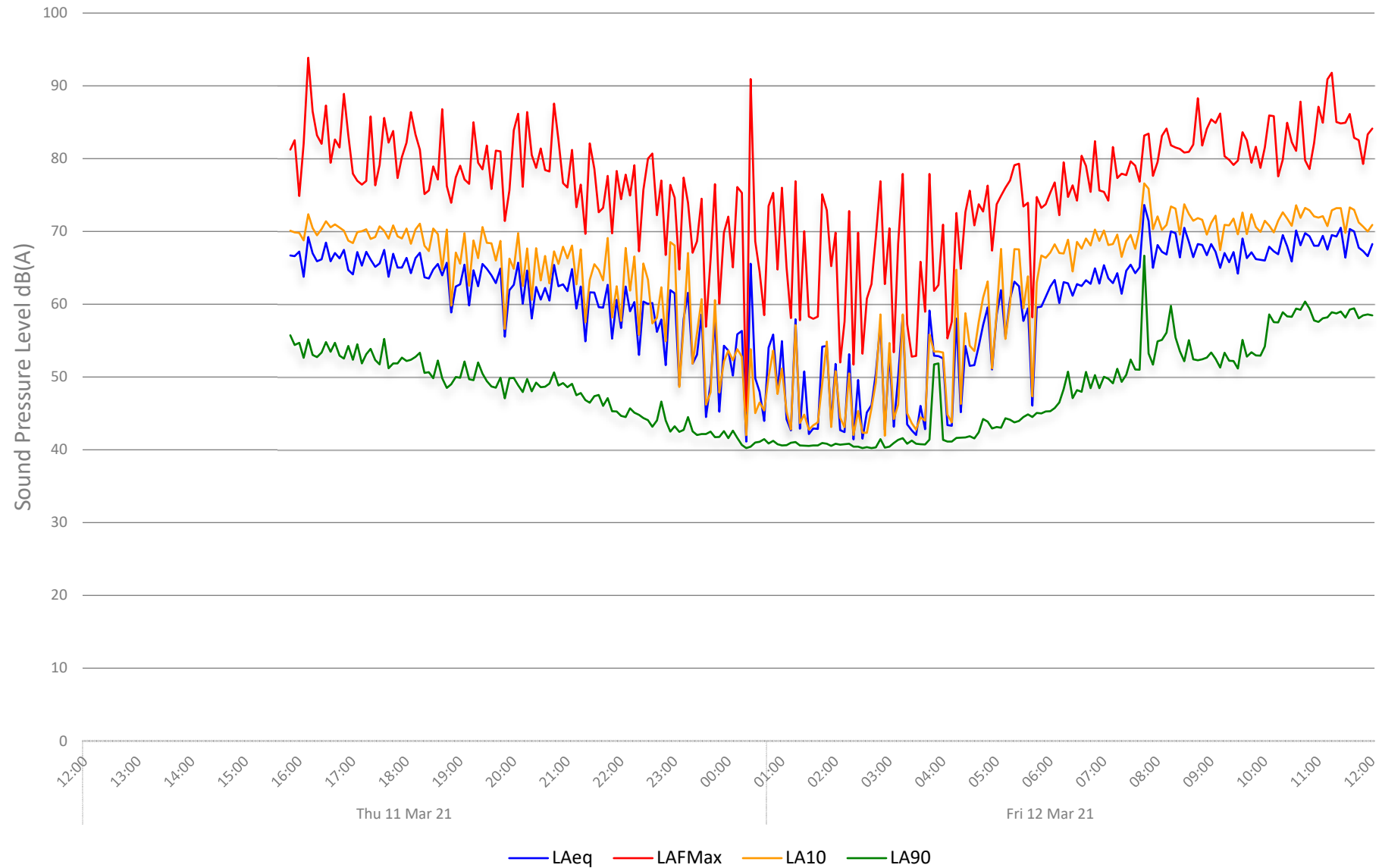


Figure VA3600/TH8



6 – 8 Market Place, Reading
Environmental Noise Time History: 8
Position 3

Figure VA3600/TH8



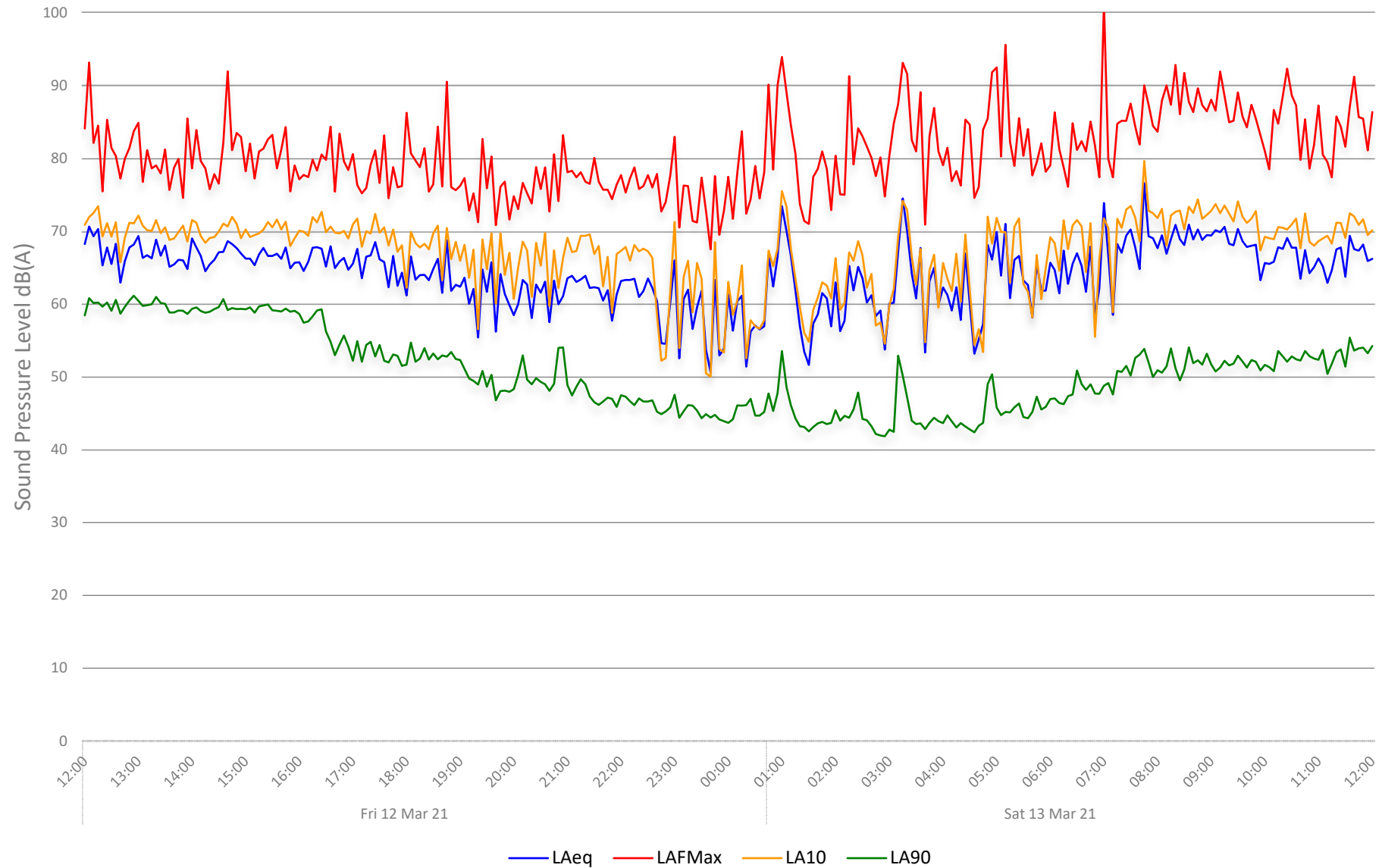
6 – 8 Market Place, Reading

Environmental Noise Time History: 9

Position 3



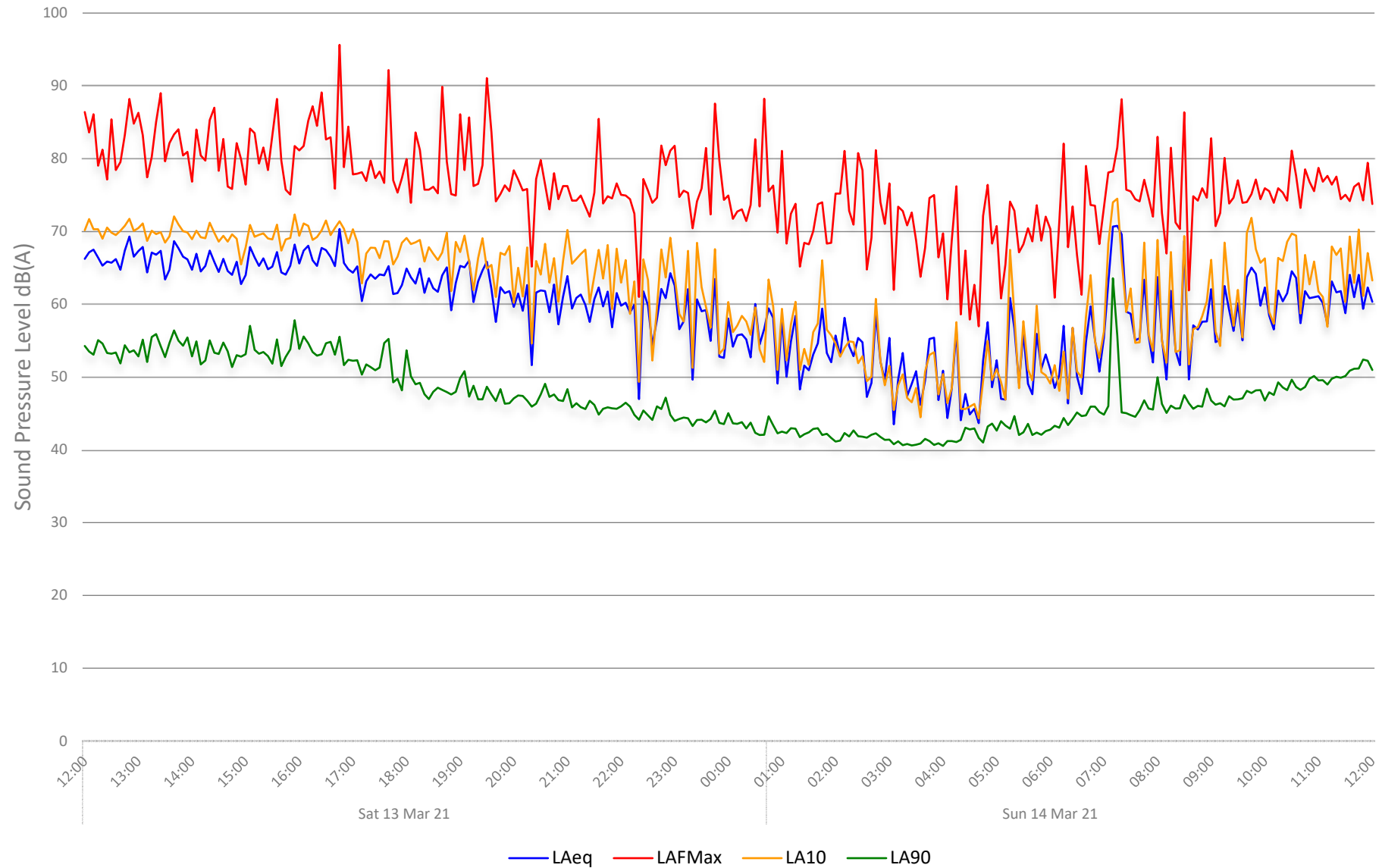
Figure VA3600/TH9



6 – 8 Market Place, Reading
Environmental Noise Time History: 10
Position 3



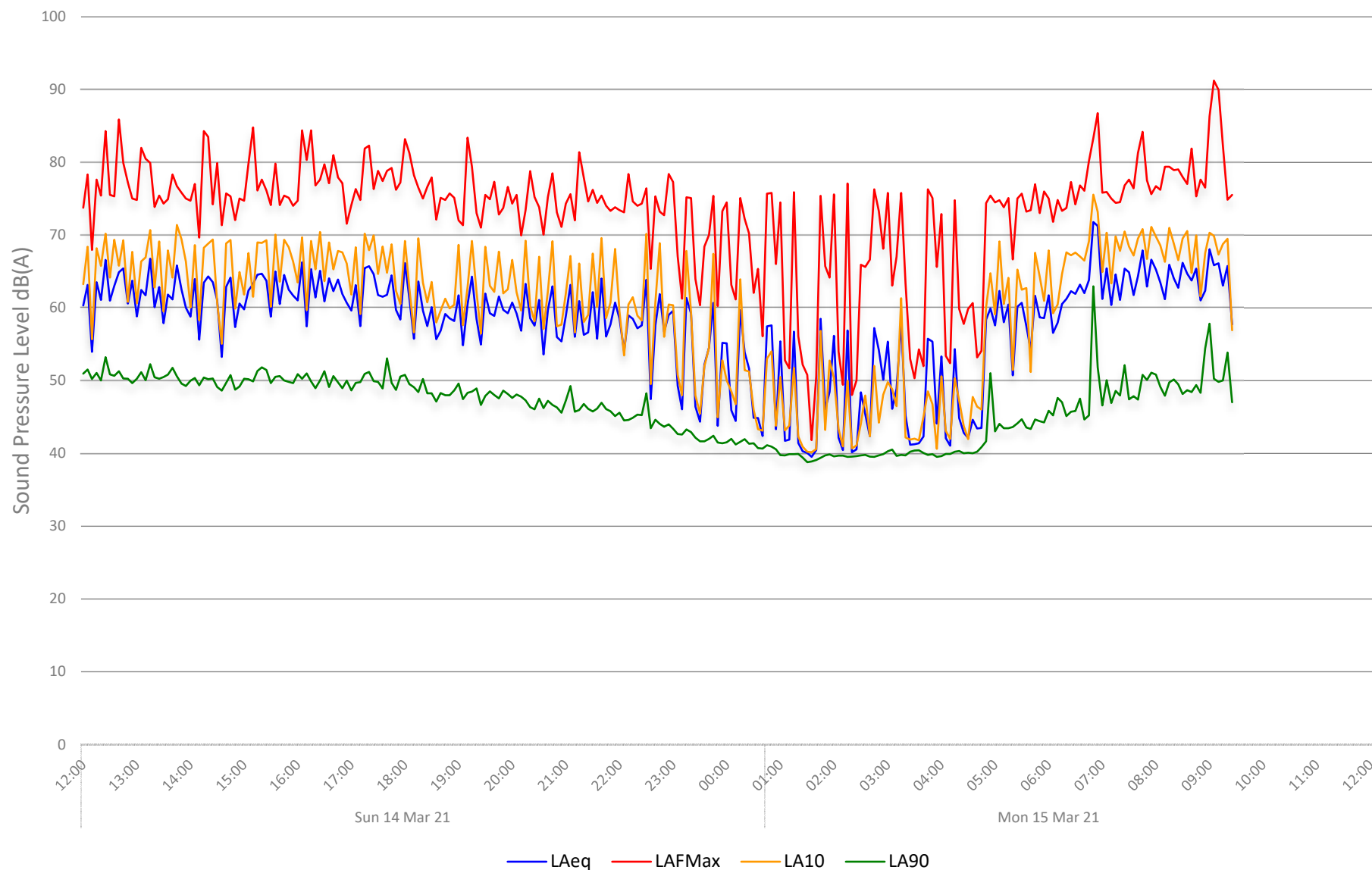
Figure VA3600/TH10



6 – 8 Market Place, Reading
Environmental Noise Time History: 11
Position 3



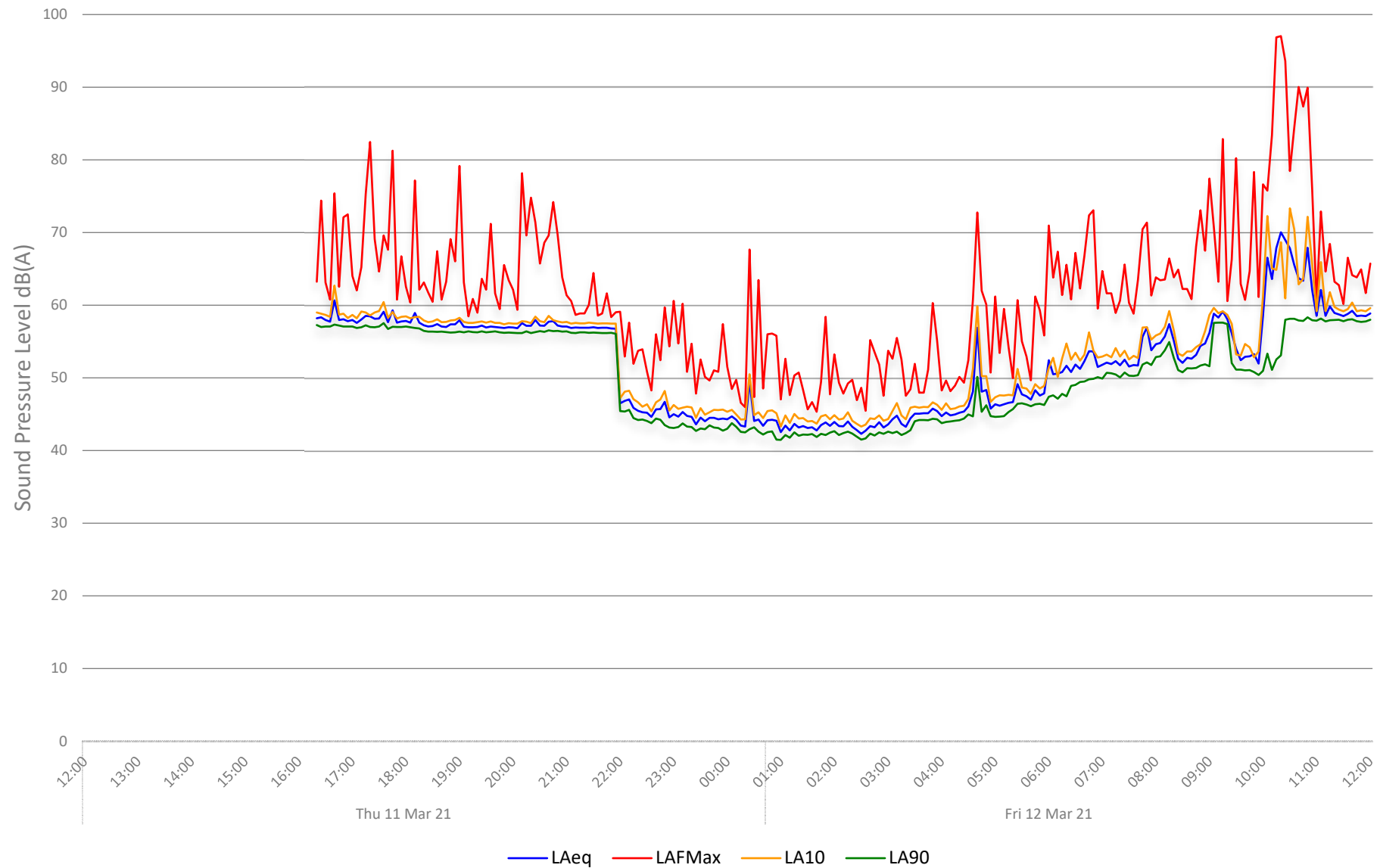
Figure VA3600/TH11



6 – 8 Market Place, Reading
Environmental Noise Time History: 12
Position 4



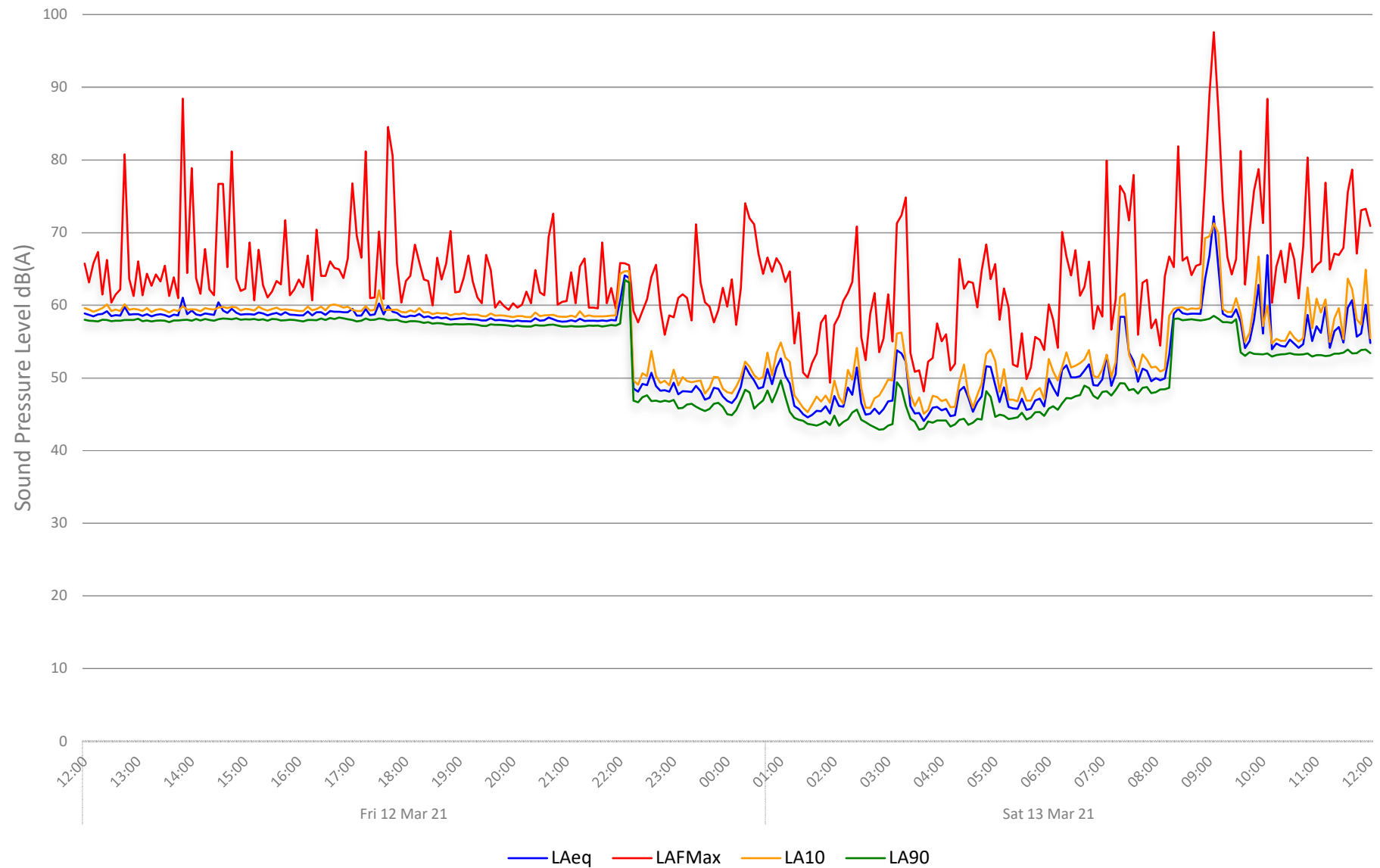
Figure VA3600/TH12



6 – 8 Market Place, Reading
Environmental Noise Time History: 13
Position 4



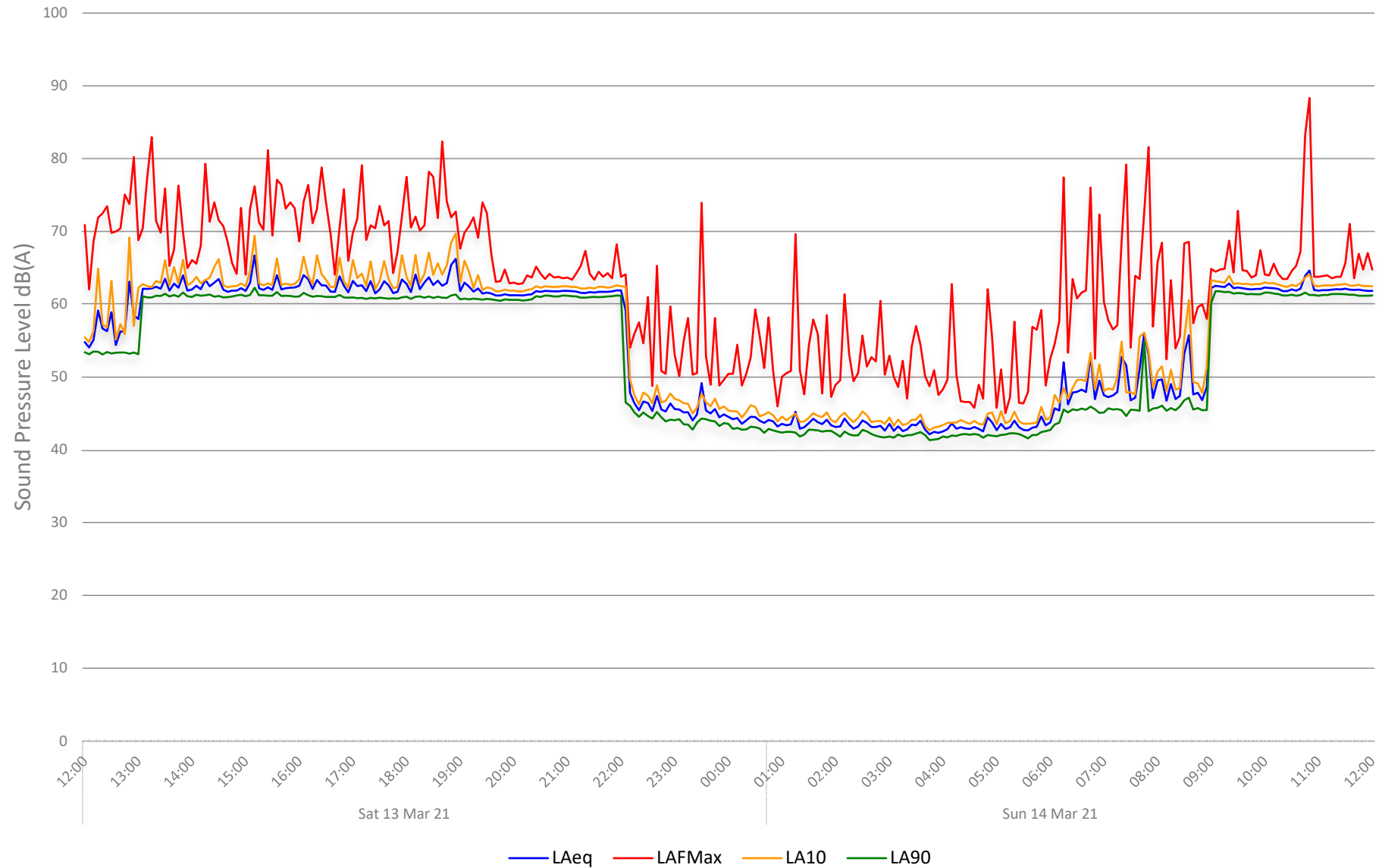
Figure VA3600/TH13



6 – 8 Market Place, Reading
Environmental Noise Time History: 14
Position 4



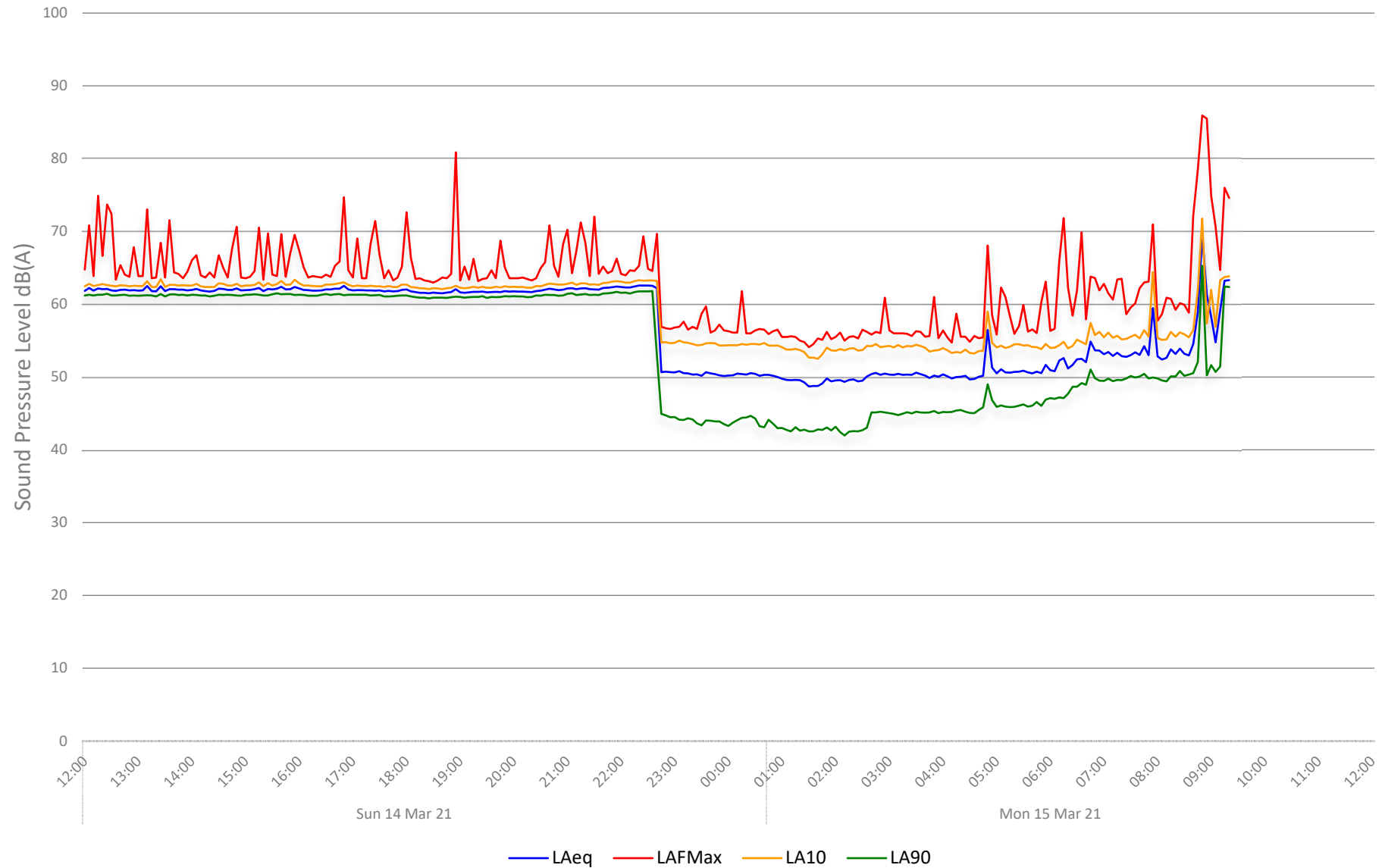
Figure VA3600/TH14



6 – 8 Market Place, Reading
Environmental Noise Time History: 15
Position 4



Figure VA3600/TH15



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.

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 . 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).
L_{eq} :	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.

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 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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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 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.