

Report VA4894.231127.NIA2

30-32a Queens View, Netley

Noise Impact Assessment

28 November 2023

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Report Version Number	Author	Approved	Changes	Date
NIA	Jamie Duncan	Ben Alexander	-	21/9/23
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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

It is proposed to redevelop 30-32a Queens View, Netley, creating 18 new residential apartments, with a single commercial unit to be used as a convenience store/news agent.

Venta Acoustics has been commissioned by Eastleigh Borough Council to undertake an assessment of the potential noise impact of the proposed new use on the nearby noise sensitive receivers, as requested by Eastleigh Borough Council Environmental Health.

An environmental noise survey was undertaken to determine the background noise levels at the site. These levels were then used to undertake an assessment of the likely impact with reference to the methodology in BS4142:2014 *Methods for rating and assessing industrial and commercial sound*, BS8233: 2014 *Guidance on sound insulation and noise reduction for buildings*.

This report also compares the measured levels for the new dwellings with the aims and intents of the National Planning Policy Framework (2023), Noise Policy Statement for England (2010), Planning Policy Guidance and the World Health Organisation Guidelines for Community Noise (1999).

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. Site Description

As illustrated on attached site plan VA4894/SP1, the site is located in a residential area, with Netley Recreational Ground to the east. The site currently has a convenience store at ground floor with two apartments above.

The most affected noise sensitive receivers are expected to be the apartments on Robin Place.

3. Design Criterion and Assessment Methodology

3.1 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 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 +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 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 $LA90$ 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.

3.2 The National Planning Policy Framework (2023)

The revised *National Planning Policy Framework* (NPPF), published in September 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 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 for England:

3.3 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.

3.4 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 3.1.

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 3.1 – 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).

For outdoor living areas, it is stated that:

To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55dB L_{Aeq} on balconies, terraces and in outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50dB L_{Aeq} . Where it is practical and feasible, the lower outdoor sound level should be considered the maximum desirable sound level for new development.

For sleep disturbance, i.e. in bedrooms at night, the NOEL can, therefore, be taken as anything below 30dB(A), whilst the onset of the LOAEL occurs at 30dB(A) and above. The SOAEL cannot be inferred from this information.

During daytime periods, for avoidance of annoyance, the NOEL relates to anything up to 50dB(A) (typically applied to external areas, such as gardens), whilst the onset of the LOAEL occurs at 50dB(A) and above.

3.5 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 3.2.

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 3.2 – Excerpt from BS8233:2014 - Indoor ambient noise levels for dwellings

[dB ref. 20μPa]

For external areas the standard states the following:

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

However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.

4. Environmental Noise Survey

4.1 Survey Procedure & Equipment

In order to establish the existing background noise levels at the site, a noise survey was carried out between Wednesday 13th and Sunday 17th September 2023 at the location shown in site plan VA4894/SP1. This location was chosen to be representative of the noise levels in the local area.

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

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-15993-E0	1504971-2	28/3/23
Larson Davis calibrator	CAL200	13049	1504971-3	28/3/23

Table 4.1 – Equipment used for the survey

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

5. Results

The measured sound levels are shown as time-history plots on the attached charts VA4894/TH1-4.

The noise levels in the area are determined by distant traffic.

Monitoring Period	$L_{Aeq, T}$	Typical ¹ $L_{A90, 5min}$
07:00 – 23:00	49 dB	34 dB
23:00 – 07:00	42 dB	33 dB

Table 5.1 – Average ambient and typical background noise levels

¹The typical L_{A90} value is taken as the 10th percentile of all L_{A90} values measured during the relevant period.

The typical night time L_{Amax} events were recorded to be in the order of 59 dB $L_{Amax, fast}$.

6. Commercial Noise Impact Assessment

As previously highlighted, the site currently houses a convenience store, which has been operating on the site for a long time.

The ground floor of the proposed scheme includes a commercial unit which is proposed for Class E use but it has been agreed that this will be limited to retail use, i.e. Class E(a). The proposed convenience store, which is intended to be run by the same operator as the current store, will be located slightly nearer to the apartments at Robin Place.

Currently, the shop gets a delivery of papers at approximately 5:45am from a small van, which is the event which would have the potential for the greatest impact, with other van deliveries taking place later in the day. The delivery is to the front of the store, approximately 18m from the nearest apartment in Robin Place. The new delivery bay is located to the front of the new shop and is located approximately 12m from the apartments in Robin Place.

On the southern façade of the store is the retail space's waste bin storage area. The waste collections are understood to occur once every two weeks, at around 05:45. Waste collections would be louder than deliveries, but much shorter in duration, and would be expected to be commensurate in level and character with the noise generated during waste collections for the existing (and proposed new) apartments, and hence would not be considered an unusual or 'new' type of noise source. To reduce the potential of early morning impact, it is recommended that the collections are organised to later in the day, after 07:00. As the collections are infrequent in nature,

and of the same character to those for the existing shop and houses/apartments, impact is expected to be maintained at an acceptable level from waste collections.

The new store will have dedicated parking spaces located 19m from the receiver, which is same distance as to the existing spaces outside the convenience store, and hence the impact would be expected to remain the same.

As this is the case, an assessment of noise from the paper delivery has been undertaken to the nearby apartments, along with a comparison to the current situation.

Due to the early stages of the scheme design, it is not known if there will be any plant associated with the shop, and no selections have been made. To allow for future assessment of noise from plant, a plant noise criterion has been set in section 8, against which future plant selections can be designed, assessed and presented to the Council to show compliance with planning requirements.

6.1 Source Noise Levels

Interrogation of the recorded noise data during the deliveries in the morning shows noise levels of typically $L_{Aeq, 5 \text{ mins}}$ 57dB at a distance of 8m, which has been used as the basis of this assessment.

6.2 Acoustic Character Correction

The subjective method of allocating corrections to the sound source has been used following the methodology provided in BS4142:2014 and as summarised in section 3.1.

Noise Source	Subjective Description	Allocated Corrections
Delivery	Door slam, diesel engine broadband	Tonality: 0dB Impulsivity: +2dB Intermittency: +3dB

Table 6.1 – Acoustic character corrections

These penalties are applied to the specific noise level in section 6.3 to obtain the rating noise level.

6.3 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.

Table 6.2 shows the assessment for deliveries on the most affected façade of dwellings on Robin Place for the new scheme.

Results		Relevant Clause	Commentary
Source Sound Levels (5 mins)	57dB @ 8m	7.3.4	As measured on site
Distance Loss (12m)	-4dB	7.3.5	Assumed a point source
Specific Sound Level	L _{Aeq} 53dB		
Time correction	-5dB	7.2	Correction from 5 minute to 15 minute
Acoustic feature correction	+5 dB	9.2	+2 dB for impulsivity, +3dB for intermittency
Rating level	L _{Ar} 53 dB	9.2	
Night time background sound level	L _{A90} 33 dB	8	
Excess of rating over background sound level	+20 dB	11	
Assessment indicates adverse impact		11	Depending on context

Table 6.2 – BS4142 Assessment – New Scheme

Table 6.3 shows a comparative assessment for deliveries on the most affected façade of dwellings on Robin Place for the current situation.

Results		Relevant Clause	Commentary
Source Sound Levels (5 mins)	57dB @ 8m	7.3.4	As measured on site
Distance Loss (19m)	-8dB	7.3.5	Assumed a point source
Specific Sound Level	L _{Aeq} 49dB		
Time correction	-5dB	7.2	Correction from 5 minute to 15 minute
Acoustic feature correction	+5 dB	9.2	+2 dB for impulsivity, +3dB for intermittency
Rating level	L _{Ar} 49 dB	9.2	
Night time background sound level	L _{A90} 33 dB	8	
Excess of rating over background sound level	+16 dB	11	
Assessment indicates adverse impact		11	Depending on context

Table 6.3 – BS4142 Assessment – Current Situation

6.4 Context

The site is located in a residential area, with the convenience store being a long established use.

The convenience store has had deliveries at this time of day for a long time, and is not understood to be generating any complaints, or adversely impacting the existing residents in the area. Indeed, a local convenience store would typically be considered as a positive element within a local community, and noise from short duration deliveries would not be expected to unreasonable in such a setting.

The new scheme would show an adverse impact when assessed under BS4142, but this is only marginally higher than the current situation. Considering this, we would offer that the actual, real world impact on residents is low from this single daily delivery, hence the lack of issues from the current operations.

As the deliveries are early in the morning, the residents of Robin Place would be expected to experience this noise inside the apartments, and so the actual noise level would be further mitigated by the building fabric, or partially open windows.

6.5 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. The monitoring location was selected to be representative of the background noise levels expected to be experienced by the nearby dwellings without being unduly influenced by extraneous noise sources.
- Source data of particular noise sources was measured on site. 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.

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.

7. Internal Sound Insulation

7.1 Commercial & Residential

The ground floor retail use is shown on the drawings as having the rear storeroom and toilet adjoining the bathroom and bedroom of the adjacent apartment. There are also adjoining apartments at first floor level above the store.

As the proposed use is for a convenience store, internal patron noise is not expected to be significant. It is unlikely that there would be significant noise from people congregating outside the shop, which would be more appropriate if the use were to be a restaurant with outdoor seating, or a takeaway that is regularly serviced by mopeds.

The applicant has confirmed, however, that they are happy to design the floor between the shop and first floor level to provide an airborne sound insulation performance to be 5dB better than Building Regulation requirements, which would be expected to suitably control noise from the shop to the apartments.

For the wall between the store and ground floor apartment, it is recommended that this party construction provides a performance of 10dB better than building regulations, and is independently lined, or of a cavity construction to decouple the two sides of the wall. This would be expected to control noise transmission to the bedroom to acceptable levels unlikely to cause impact on the future residents.

7.2 Residential to Communal Spaces

The internal layout of the apartments has been carefully considered. Where possible, flats have been handed so that similar room types are adjacent to one another, with room types stacked. However, due to the different sizes of the apartments and shape of the building, this has not been possible in all instances, resulting in some noise sensitive rooms (bedrooms/living rooms) being located next to corridors or stairways.

This is a normal occurrence within residential apartment buildings, and the Building Regulations do not recommend against it. However, should the Council have concerns about this, where this situation occurs, the party wall construction could be uprated, again to a performance 5dB better than Building Regulations to provide a higher level of acoustic separation between these specific areas.

8. Plant Noise Emission Criteria

On the basis of the measured noise levels and the planning requirements of Eastleigh Borough Council, and considering that it is not expected that tonal noise will be generated by the proposed plant units, the following plant specific sound levels should not be exceeded at the most affected noise sensitive receivers:

Monitoring Period	Design Criterion (L_{Aeq})
07:00 – 23:00 hours	24 dB
23:00 – 07:00 hours	23 dB

Table 8.1 – Specific sound pressure levels not to be exceeded at most affected noise sensitive receivers

9. Internal Noise Assessment

A review of the MH Architects 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.

It should be noted that the area is quiet in general, and internal noise levels for both L_{Aeq} and L_{Amax} events would be achieved with partially open windows, assuming a 15dB loss for a partially open window, as per BS8233. As this is the case, standard thermal double glazing and standard trickle vents of no specific acoustic performance would be suitable for the site.

10. Areas of External Amenity

External noise levels comply with the World Health Organisation guideline value for external amenity of $L_{Aeq,16hour}$ 55dB. No mitigation measures are deemed necessary in relation to external noise levels.

The outdoor noise levels across the site can therefore be considered to fall between the LOAEL and SOAEL levels, generally being below the level that is expected to cause significant annoyance.

11. Conclusion

A baseline noise survey has been undertaken by Venta Acoustics to establish the noise climate in the locality of 30-32a Queens View, Netley.

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 existing and new noise sensitive receivers.

When assessed using BS4142, noise from morning deliveries on site has been shown to have a potential impact on the receivers. A discussion of the current level of impact, which is near identical to the predicted situation, has been included, which along with the lack of history of complaints, would indicate that the real-world impact on residents is actually low for this single early morning paper delivery.

Appropriate external and internal noise criteria have been considered to minimise adverse impacts on health and quality of life as a result of the new development. Due to the low noise levels in the area, natural ventilation and non-acoustics glazing and trickle ventilators would be suitable.

When considered within the context of the area, the proposed scheme is not expected to generate or experience a significant adverse noise impact and the site is considered acceptable for the proposed use.

Jamie Duncan MIOA

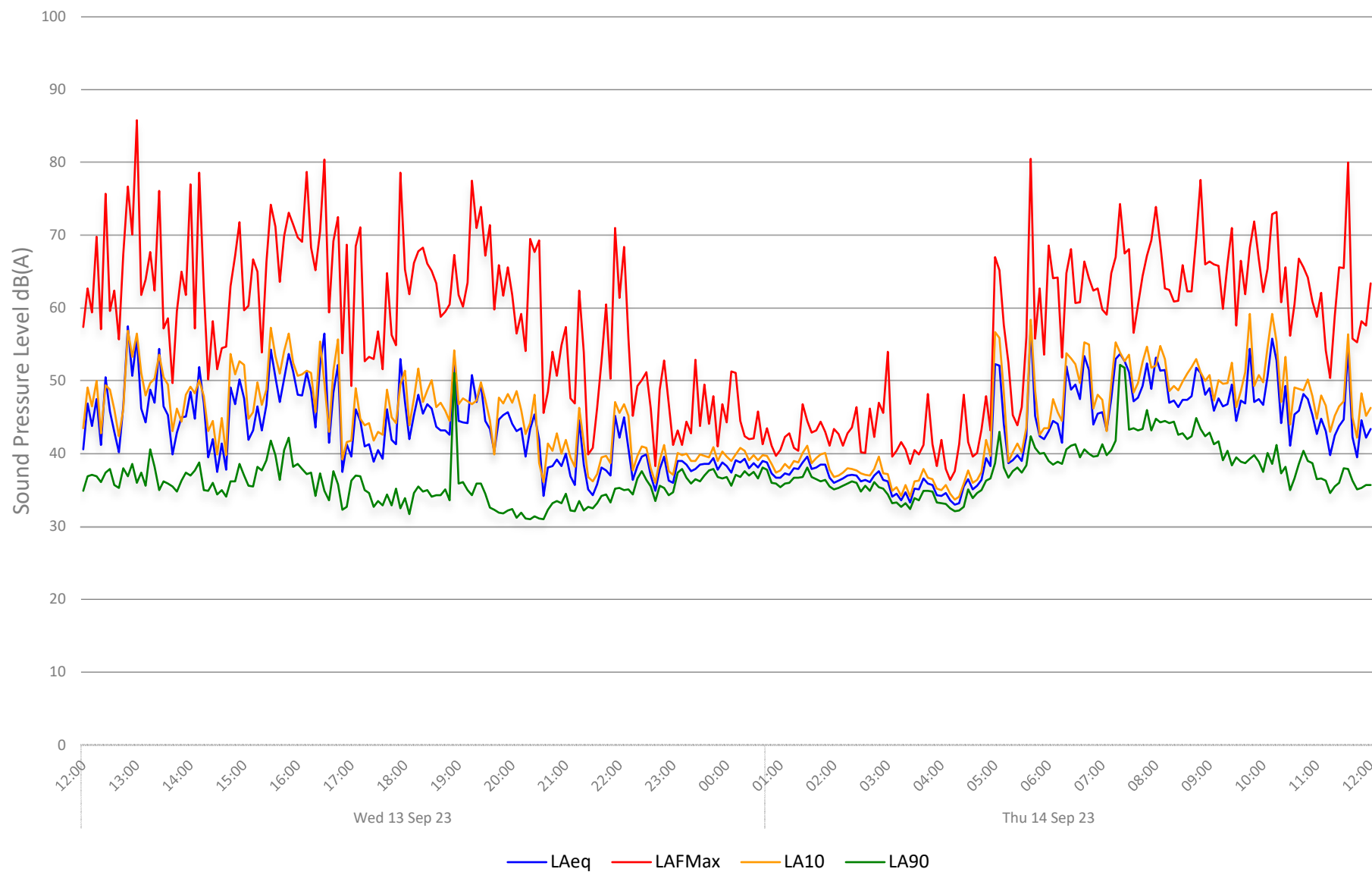


30-32a Queens View, Netley

Environmental Noise Time History: 1



Figure VA4894/TH1

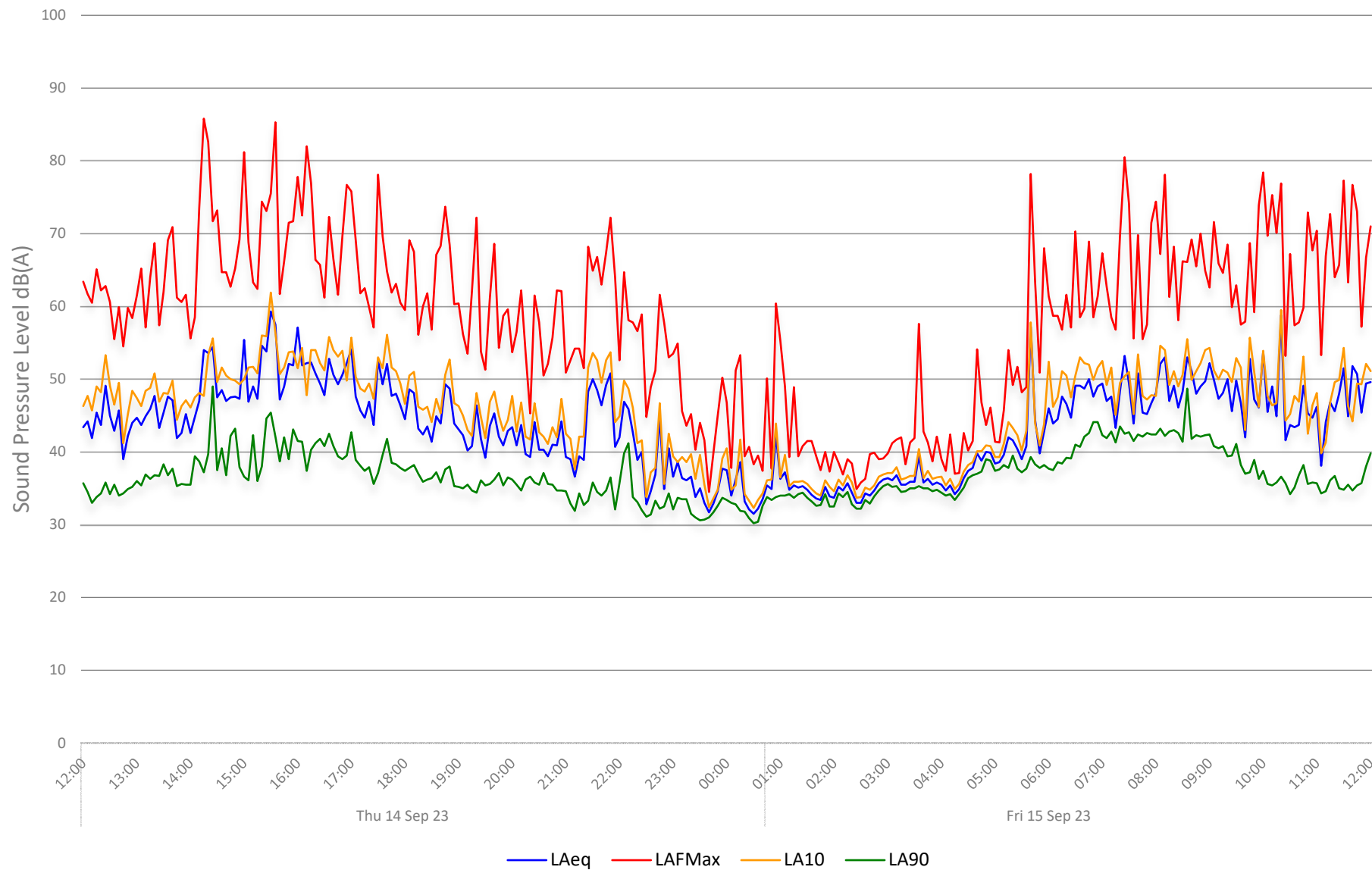


30-32a Queens View, Netley

Environmental Noise Time History: 2



Figure VA4894/TH2

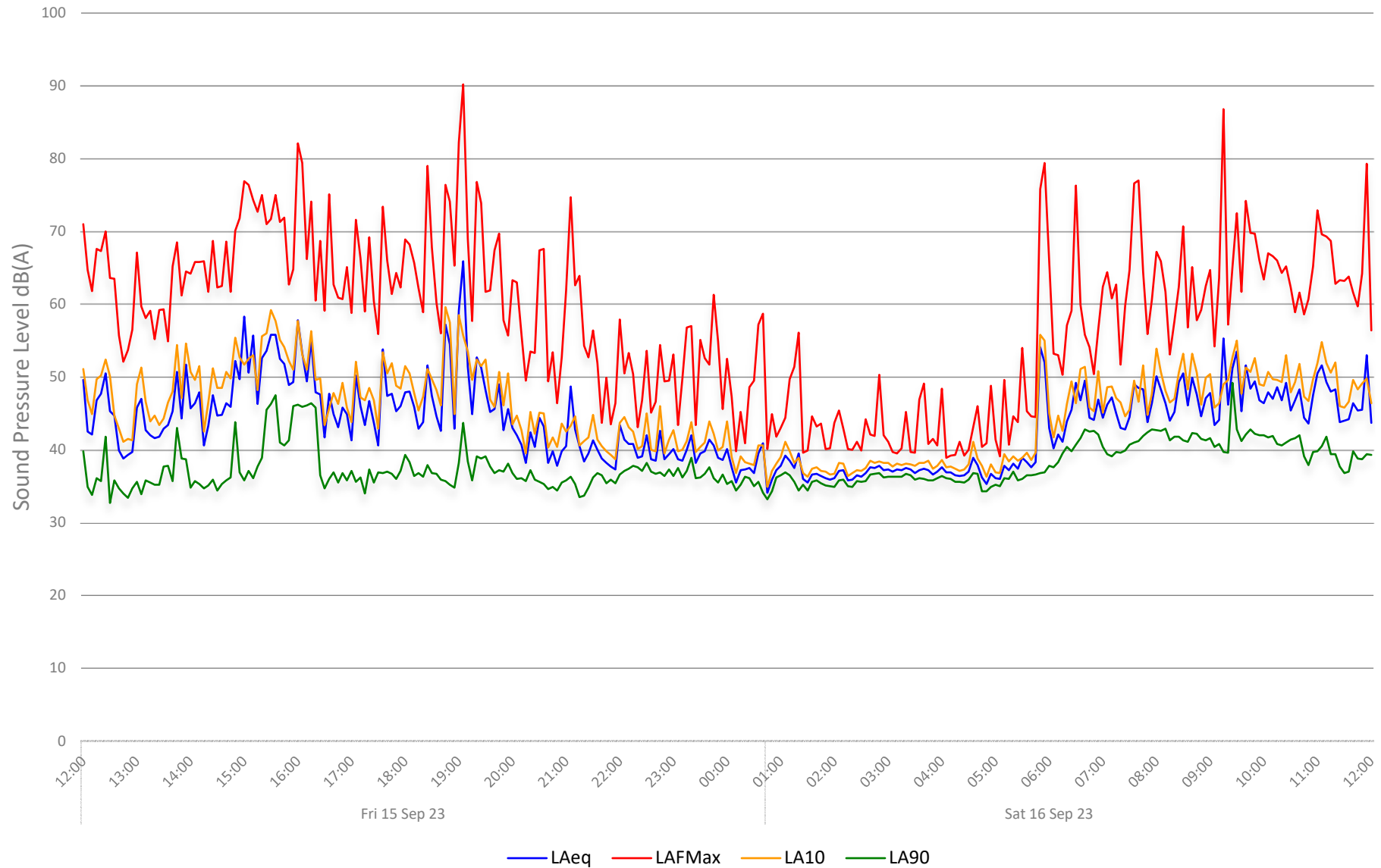


30-32a Queens View, Netley

Environmental Noise Time History: 3



Figure VA4894/TH3

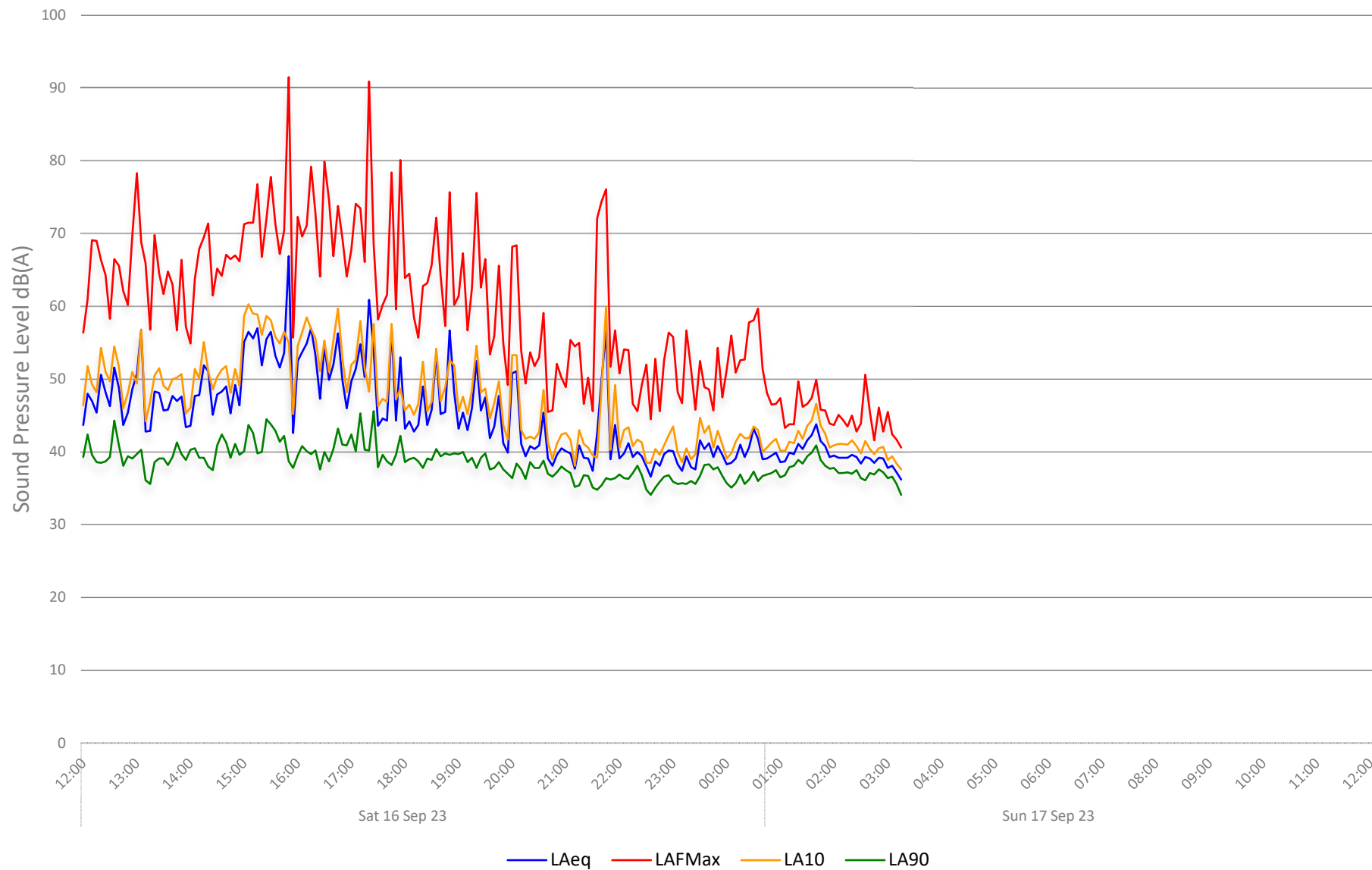


30-32a Queens View, Netley

Environmental Noise Time History: 4



Figure VA4894/TH4



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.

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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APPENDIX A

Acoustic Terminology & Human Response to Broadband Sound

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