PO Box 1030, Warrington, Cheshire WA4 9FJ
t. 01925 723333 www.adcacoustics.co.uk

ARR/PPN/C/2217.64 Rev A

3rd November 2020
Rev A 7th December 2020

One Stop

Assessment of External Plant Noise for
Proposed Store at Shoreham-by-Sea

Prepared for :-

One Stop
Apex Road
Brownhills,
Walsall
WS8 7TS

Prepared by :-

Andrew Raymond

ADC Acoustics is a trading name of Acoustic Design & Control Limited
Registered Office: One City Place, Queens Road, Chester, CH1 3BQ Registered in England and Wales 5117653

CONTENTS

1.0 SUMMARY

2.0 INTRODUCTION

3.0 ASSESSMENT STANDARDS

3.1 NPPF
3.2 BS8233
3.3 BS4142
3.4 Local Authority

4.0 BASIC APPROACH TO MODELLING

5.0 SURVEY DETAILS

5.1 Site times and Personnel
5.2 Instrumentation
5.3 Survey Conditions
5.4 Measurement Positions

6.0 RESULTS AND DISCUSSIONS

6.1 Background Noise and Design Targets
6.2 Manufacturers' Noise Data
6.3 Predicted Noise Levels, Assessments and Discussions
6.4 Mitigation
6.5 Overall Assessment
6.6 Discussion of Uncertainty

7.0 CONCLUSIONS/RECOMMENDATIONS

Appendix 1: Definition of Acoustic Terms
Appendix 2: Example Acoustic Enclosure Used by One Stop

1.0 SUMMARY

During the late evening, the area was dominated by local traffic. As the evening progressed into the night time, the steady, underlying noise was mainly influenced by the sea, as well as sporadic vehicles.

Based on an assumption of all equipment running without any mitigation and on full load throughout the night, the predicted noise from the external mechanical plant is likely to be above background noise levels at the most affected residential location. However, we understand that it is One Stop's intension to fit all units within acoustic enclosures. With such measures in place, the predicted noise should be significantly below background levels and the and the impact should be essentially zero.



A R Raymond



P J Durell

2.0 INTRODUCTION

ADC was asked to carry out an independent assessment of the plant area of the proposed new One Stop store and predict the overall impact at the nearest noise-sensitive positions.

This report begins by discussing the various assessment criteria applicable to this situation. We follow by describing in simple terms our basic approach to calculations and modelling. After a short description of survey details, we discuss our results and present our conclusions and recommendations.

3.0 ASSESSMENT STANDARDS

3.1 NPPF, NPSE and NPPG

The National Planning Policy Framework (NPPF), the Noise Policy Statement for England (NPSE) and the National Planning Practice Guidance (NPPG) provide nothing in the way of quantitative criteria but instead provide general policy aims and statements and some guidance on how certain situation can be interpreted.

The NPPF's main statement on noise is to be found in paragraph 180:-

180 Planning policies and decisions should also ensure that 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(footnote here refers to NPSE – see below);

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; and

c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.

Paragraph 180 is also relevant:-

182 Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed.

The NPPF refers to the NPSE which sets out the following aims:-

1. avoid significant adverse impacts on health and quality of life;

2. mitigate and minimise adverse impacts on health and quality of life; and

3. where possible, contribute to the improvement of health and quality of life.

It also introduces the concepts of:

- NOEL – No Observed Effect Level. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

- LOAEL – Lowest Observed Adverse Effect Level. This is the level above which adverse effects on health and quality of life can be detected.

- SOAEL – Significant Observed Adverse Effect Level. This is the level above which significant adverse effects on health and quality of life occur.

SOAEL is clearly something the policy seeks to avoid in aim 1. Aim 2 represents situations between SOAEL and LOAEL, and seeks to minimise and mitigate the effects.

The NPPG section on noise adds some further detail, much of it reproducing the NPPF and NPSE, but some useful qualitative guidance is provided in a table as reproduced below.

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
		Lowest Observed Adverse Effect Level	
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
		Significant Observed Adverse Effect Level	
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

It also makes the point that the subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation, including the level of the noise in absolute terms and how it might compare with the underlying background noise, the impulsiveness or intermittence pattern of the noise, its spectral content, and the time of day. It discusses in very general terms the issues to consider when introducing noise sources to existing noise sensitive area, new residential development in areas affected by existing noise

sources (most of which have their own specific guidance, such as BS4142, BS8233, etc.) and the potential impact on wildlife.

3.2 BS8233/WHO Guide

BS8233 was updated in March 2014. Quantitatively, however, the design criteria are little changed – just expressed differently to reduce ambiguity in certain situations. The criteria are very similar to those of the WHO Guide to Community Noise

Table 4 of BS8233 gives the desirable criteria for indoor ambient noise levels for dwellings as follows:-

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB $L_{Aeq,16hour}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,16hour}$

Note that the standard accepts the widely used rule of thumb that, for a partly open window, the levels just outside will be 15dB higher than those just inside. This brings us to an external equivalent of the above table, as follows:-

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	50 dB $L_{Aeq,16hour}$	-
Dining	Dining room/area	55 dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	50 dB $L_{Aeq,16hour}$	45 dB $L_{Aeq,16hour}$

It goes on to state that, where necessary, the criteria can be relaxed by up to 5 dB and still achieve reasonable conditions. Note that the new version does not explicitly state criteria for bedroom noise in terms of dB L_{Amax}.

Garden area criteria are unchanged with 50 dB L_{Aeq} and 55 dB L_{Aeq} being considered desirable and reasonable respectively.

Note that the new version of BS8233 more explicitly specifies the assessment periods as 16 hour and 8 hour for daytime and night time respectively.

3.3 BS4142

BS 4142 was updated in November 2014. The standard is very complicated but, basically, it describes methods for rating and assessing sound of an industrial and/or commercial nature, which includes:

a) sound from industrial and manufacturing processes

b) sound from fixed installations which comprise mechanical and electrical plant and equipment

c) sound from the loading and unloading of goods and materials at industrial and/or commercial premises

d) sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train or ship movements on or around an industrial and/or commercial site.

The methods described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

Characteristics and Context

Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, we need to add a character correction to the specific sound level to obtain the rating level.

These features can include tonality, impulsivity and intermittency with corrections typically ranging potentially from 0dB to 9 dB. Corrections at the higher end would represent characteristics which are highly perceptible in the context of the ambient noise as a whole. Corrections at the lower end would represent characteristics which are just perceptible in the presence of the ambient noise as a whole,

The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs. An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context.

Assessment

We obtain an initial estimate of the impact of the specific sound by subtracting the measured background sound level from the rating level and considering the following.

a) Typically, the greater this difference, the greater the magnitude of the impact.

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

c) A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.

d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an

indication of the specific sound source having a low impact, depending on the context.

Where the initial estimate of the impact needs to be modified due to the context, pertinent factors need to be taken into consideration, including the following.

1) The absolute level of sound.

   For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.

   Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.

   Where residual sound levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts, and the margin by which the rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse.

2) The character and level of the residual sound compared to the character and level of the specific sound.

   We need to consider whether it would be beneficial to compare the frequency spectrum and temporal variation of the specific sound with that of the ambient or residual sound, to assess the degree to which the specific sound source is likely to be distinguishable and will represent an incongruous sound by comparison to the acoustic environment that would occur in the absence of the specific sound. Any sound parameters, sampling periods and averaging time periods used to undertake character comparisons should reflect the way in which sound of an industrial and/or commercial nature is likely to be perceived and how people react to it.

3) The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions.

3.4 Local Authority

We are not aware of any criteria proposed by the Local Authority.

4.0 BASIC APPROACH TO MODELLING

We have used the well-established CadnaA modelling software which calculates noise propagation based on the processes of *ISO 9613 : Acoustics – Attenuation of sound during propagation outdoors*. Obviously, modelling software is reliant on the inputs and assumptions. The key ones are:-

1. The ground is mainly reflective (coefficient of 0.25 assumed).

2. The proposed site buildings and the surrounding buildings are assumed to be mainly reflective (0.5 dB loss on reflection assumed).

3. Where acoustic fences are used, they are also assumed to be reflective the same as the buildings.

4. The source data is based on manufacturers' literature. This is entered into the model along with the conditions under which the data was established (eg. free field, over hard ground, etc.) and tested to ensure the manufacturers' figure are faithfully reproduced in the model. When enclosures or silencers are specified, these are built into the figures.

5. All units are assumed to run continuously on full load.

6. The receiver heights are set at ground floor, first floor, and second floor window levels of the hotel. The software automatically selects the most affected floor level for each position.

5.0 SURVEY DETAILS

5.1 Site Times and Personnel

The site surveys were carried out on 19th September 2020 by Mark Pickering of ADC Acoustics from approximately 18:00 on 19th October 2020 through to approximately 06:30 the following morning. The times were chosen to represent evening opening times of the store, and through the quietest times of the night.

5.2 Instrumentation

Instrumentation used was a Rion NL-52. This is a Class I sound level meter which holds a current calibration certificate and which was field-calibrated as required. It was set up to measure continuous 5 minute samples in terms of dB L_{eq}, L_{max} and L_{90} in overall dB(A) terms and in octave bands across the frequency range. See Definitions of Acoustic terms in Appendix 1.

5.3 Survey Conditions

The general noise climate was assumed to be normal and representative.

Weather conditions were as follows :-

Rain	:	dry until 03:00 then some very light rain
Wind	:	generally negligible, occasionally up to 4m/s
Cloud	:	50 to 90%
Temperature	:	9 to 12 Celsius

5.5 Measurement Positions

The main measurement position was as shown by the yellow star on the following plan.



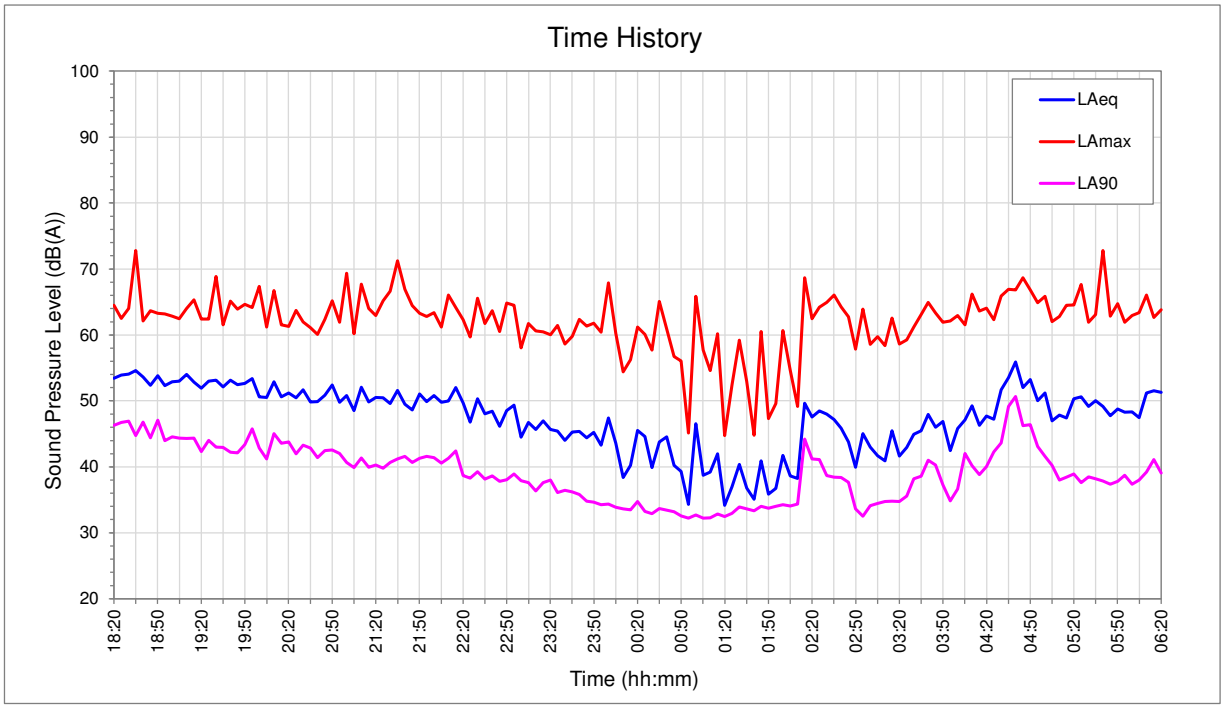
The position was on the balcony just above the proposed site of the mechanical equipment. The microphone was 1.3 m above floor level, similar to the residential window on the first floor level above the store.

6.0 RESULTS AND DISCUSSIONS

6.1 Background Noise and Design Targets

During the late evening, the area was dominated by local traffic. As the evening progressed into the night time, the steady, underlying noise was mainly influenced by the sea, as well as sporadic vehicles.

Full results are shown in Appendix 2. They are summarised graphically below.



We have used the lowest 15 minute periods for the evening and night time measurements in the assessments (lowest in terms of the dB L_{A90} index). BS4142 does not require us to use the lowest periods but it is a means mitigating against potential uncertainty of varying conditions, for instance on different days of the week. The levels for these periods are as follows:-

Lowest 15 min Periods	*Index*	***dB(A)***
Opening Times	Leq	**48**
	Lmax	**64**
	L90	**38**
Through the Night	Leq	**40**
	Lmax	**58**
	L90	**32**

6.2 Manufacturer's Noise Data

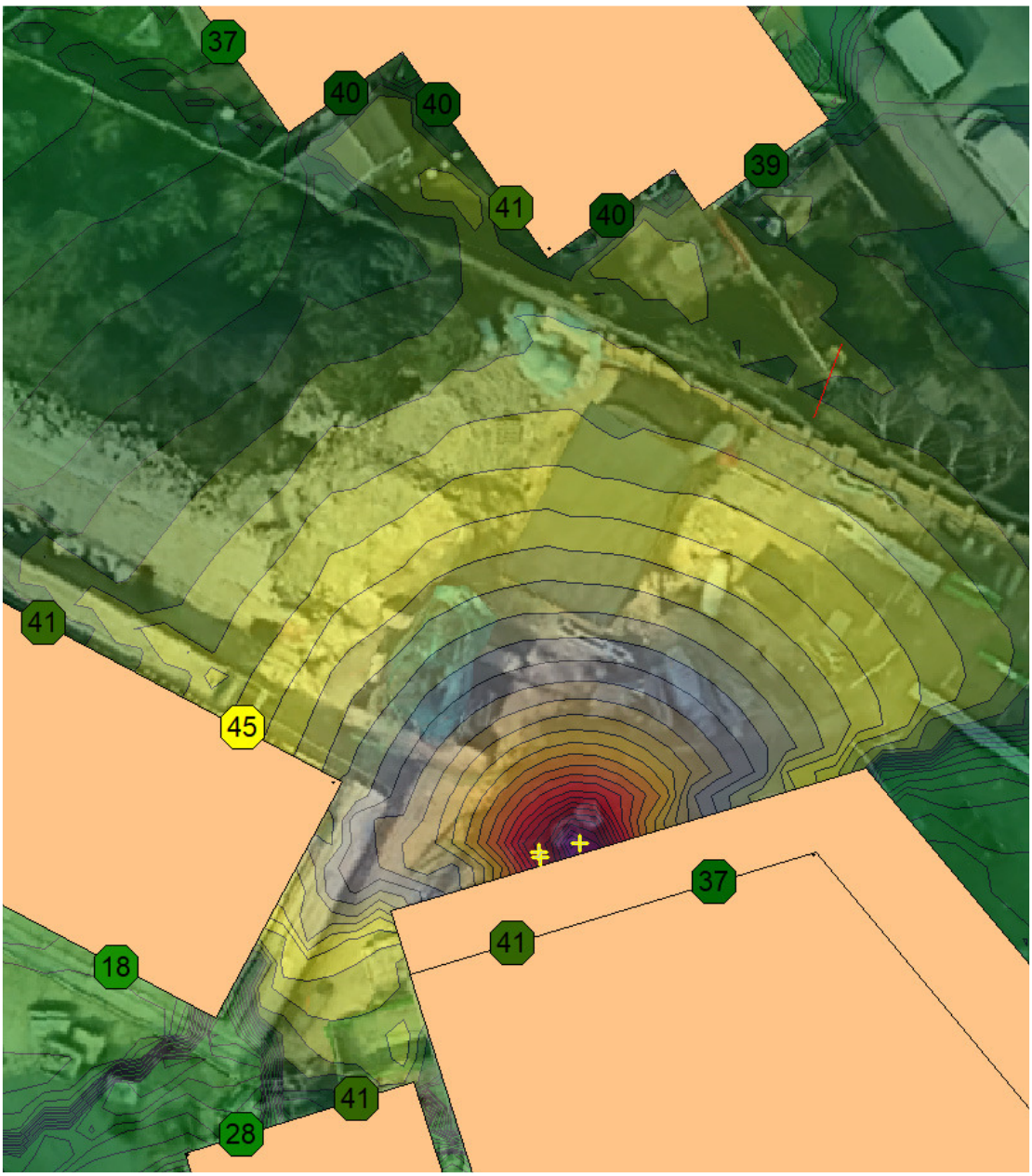
The following data was provided:-

Unit A	Daikin RXYSQ10TY1	55 dB(A) @ 1 m
Unit B	Daikin AZAS71MV1	47 dB(A) @ 1 m
Unit C	Danfoss OP-MPPM028VV LP01	45 dB(A) @ 10 m

Where only the single figure (dB(A) or dB L_A) are available but no octave band data (spectral shape or noise levels across the frequency range), for calculation purposes we have assumed a spectral shape based on similar units.

6.3 Predicted Noise Levels, Assessments and Discussions

Based on all items operating on full load throughout the night, the predicted levels at the residential windows, without any mitigation are as shown below:-



The buildings, including the proposed store itself and other surrounding buildings, are entered as described in section 4 and shown as the beige blocks in the image above. The coloured numbers are the noise levels at the building facades.

The levels outside the most affected residential location is 41 dB L_{Aeq}, with no mitigation. This is above the lowest evening levels and significantly above the lowest night time levels.

6.4 Mitigation

We understand that it is One Stop's intension to fit all units within acoustic enclosures. One Stop has used acoustic enclosures on condensers in the past. Their stated acoustic performance is shown in Appendix 2.

Based on all items operating on full load throughout the night, the predicted levels at the residential windows *with* simple acoustic

enclosures are as shown below. We can see that levels are reduced by 24 dB at the most affected positions.



6.5 Overall Assessment

The BS4142 assessment is shown below for outside the most affected residential location.

Note that in all cases there should be no need for any feature corrections. The units are not tonal or impulsive and, although they will turn on and off thermostatically, the predicted level are far lower than the existing residual noise and they are unlikely to be audible at all.

Specific Sound Level:	18 dB L_{Aeq}
Feature Corrections	
tonality:	0 dB L_{Aeq}
impulsivity:	0 dB L_{Aeq}
intermittency:	0 dB L_{Aeq}
other:	0 dB L_{Aeq}
Rating Level:	18 dB L_{Ar}
Background Sound Level: (lowest night time)	32 dB L_{A90}

Rating Level Excess re. Background -14 dB

This is significantly below what BS 4142 rates as *"low impact depending on the context".*

The context is a mixed use development and does not change the assessment.

6.6 Discussion of Uncertainty

BS4142 requires us to

"Consider the level of uncertainty in the data and associated calculations. Where the level of uncertainty could affect the conclusion, take reasonably practicable steps to reduce the level of uncertainty".

The measurements of Background/Residual Sound were taken at times regarded as representing what are likely to be the worst case (quietest) parts of the opening times and into the night. BS 4142 does not state what would be a representative background noise but there is certainly no suggestion that it should be the lowest and practices vary. However, in order to allow for the possibility of variation in levels, we have used the lowest 15 minute period.

Source data is assumed to be reliable. Where uncertainty may exist for this we have mitigated it assuming that all equipment is running on full load all of the time, which would in our experience would rarely occur, if ever.

Calculations are based on the processes of *ISO 9613 : Acoustics – Attenuation of sound during propagation outdoors*. We know of no concerns within our industry as to the basic reliability of these methods and it is cited in BS4142 as *"a validated method of calculating sound levels"*. The CadnaA software uses this standard and the input assumptions err on the side of caution and are stated in Section 4.

Varying meteorological conditions are unlikely to have a significant impact on results as the distances involved are small.

The coronavirus situation is likely to have affected traffic noise, but this would be to make the assessment *more* robust (quieter background level make the assessment harsher for new sources). In any case the lowest underlying levels were mainly affected by the sea.

7.0 CONCLUSIONS/RECOMMENDATIONS

Based on an assumption of all equipment running without any mitigation and on full load throughout the night, the predicted noise from the external mechanical plant is likely to be above background noise levels at the most affected residential location.

However, we understand that it is One Stop's intension to fit all units within acoustic enclosures. With such measures in place, the predicted noise should be significantly below any reasonable criteria and the impact should be essentially zero.

Appendix 1

Definition of Acoustic Terms

The Decibel

The decibel is the basic unit of noise measurement and is denoted dB. Technically, it is a means of expressing the difference in noise level between the measured noise and a standard level of noise. Most often the threshold of human hearing is used as the standard reference but is really should be stated. The threshold of human hearing is a sound pressure of 20μPa or a sound power of 1pW.

A sound pressure level or SPL should be expressed in dB(re. 20μPa). A sound power level or SWL should be expressed in dB(re. 1pW). If the reference levels are omitted, it will often (but not always) be safe to assume that they are referenced to the threshold of human hearing.

A-Weighting and dB(A)

The human hearing system responds differently to different frequencies. The A-weighting system takes account of this by emphasising mid and high frequencies more than low frequencies to give an overall level. An A-Weighted noise level, therefore, reflects the way normal, healthy hearing would perceive the overall level of the noise. The basic unit is dB(A), although other systems of expressing an A-weighted levels are discussed below.

Other weighting systems, such as C-Weighting, denoted dB(C), reflect the human hearing system's response at higher noise levels.

NR and NC Levels

NR curves and NC curves are a series of curves representing noise levels across the frequency range. A given noise climate has an NR level or NC level if it equals a point on the curve at any frequency. They are particularly, although by no means exclusively, used as a means of specifying noise limits in an indoor environment, for instance from mechanical services or traffic noise break-in from the outside. They are typically expressed as NR or NC followed by a number, e.g. NR40, NC55, etc.

Equivalent Continuous Sound Level, L_{eq}

This can be simplistically described as a way of expressing the average noise level.

The unit is dB L_{eq}. For A-weighted levels the unit is dB(A) L_{eq} or, in more modern units, dB L_{Aeq}.

Maximum Level, L_{max}

This is the maximum level reached (usually for a fraction of a second) in the measurement period.

The unit is dB L_{max}. For A-weighted levels the unit is dB(A) L_{max} or, in more modern units, dB L_{Amax}.

Statistical (Percentile) Levels, L_n

During a measurement of fluctuating noise, it is often useful to establish the levels exceed for a percentage of the time. L_n is the index representing the level exceeded for n% of the measurement period.

The unit is dB L_n. For A-weighted levels, the unit is dB(A) L_n or, in more modern units, dB L_{An}.

Common examples are as follows :-

dB L_{A90} is the A-weighted level exceeded for 90% of the time and is often used to describe the underlying background noise.

dB L_{A50} is the A-weighted level exceed for 50% of the time. Mathematically, it is the median, another kind of average.

dB L_{A10} is the A-weighted level exceeded for 10% of the time and has traditionally been used to describe the intermittent highs in the noise climate such as passing cars or aircraft.

Frequency Analysis

Here the audible frequency range is divided up into bands and the noise level is expressed in each frequency band from low pitches to high pitches.

Octave Band analysis is where the frequency range is divided into 8 bands from 63 Hz to 8kHz, or sometimes into 10 bands from 31.5 Hz to 16kHz.

1/3 Octave Band analysis provides more detailed subdivision into 24 bands from 50 Hz to 10kHz, or sometimes into 30 bands from 20Hz to 20kHz.

Narrow Band analysis takes this further with the possibility of many thousands of bands, possibly only 1Hz wide, or even less.

In all types of frequency analysis, the level in each band can be expressed in terms of L_{eq}, L_{max}, L_n, etc. as defined above.

Sound Insulation

Sound insulation is best expressed across the frequency range in octave bands or third octave bands. Often, however, in known environments such as domestic sound insulation and speech privacy, it is simpler to express the sound insulation as a single figure. A higher value means better sound insulation.

The most common ways are dB D_{nTw}, dB R_w and dB$_{(mean\ 100\text{-}3150Hz)}$. The first two are ways of expressing average sound insulation, weighted to account for speech frequencies. The third is simply an un-weighted mean value.

The Building Regulations Approved Document E (ADE) routinely refer to $D_{nTw} + C_{tr}$ The C_{tr} term is a negative number which is used to modify the D_{nTw} value for the insulation properties at lower frequencies.

ADE also uses the L_{nTw} index for impact sound transmission. It is a measure of the level of noise in the room below a room in which a standard tapping machine is being used. It represents the impact sound transfer such as footfall noise, scraping chairs, washing machines, etc. A lower value means better insulation.

Reverberation Time

The most common measure of Reverberation Time is, effectively the time taken for sound from a steady source to decay by 60 dB after it has been abruptly cut off. In practice it is often difficult to measure a 60 dB decay and so decays of 30 dB, 20 dB, or even 10 dB are often used and adjusted pro rata, although the exact measure is not quite the same.

Reverberation Time is generally expressed as RT in seconds. We may, if we are being precise, add subscripts 60, 30, etc to show whether the basis of the measure is 60 dB decay, 30 dB decay, etc. E.g. the RT_{60} = 0.52s, the RT_{30} = 0.49s, etc.

RT can be expressed in octave bands or 1/3 octave bands across the frequency range, or at central frequencies such as 500 Hz or 1kHz.

Appendix 2

Example Acoustic Enclosure Used by One Stop

CLASSIC ACOUSTICS LTD

UNIT B6A HALDANE, HALESFIELD 8, TELFORD, SHROPSHIIRE. TF7 4QN

TEL. 01952 587360 FAX. 01952 680102 EMAIL. CLASSICACOUSTICS@HOTMAIL.COM

ACOUSTIC ENCLOSURES

Typical before and after acoustic enclosures





Transmission Loss Data:

Transmission Loss – Classic Standard Enclosure							
Octave Frequency in Hertz (dB ref 2 x 10^{-5} Pascal's)							
63	125	250	500	1K	2K	4K	8K
14	16	23	30	37	39	38	39
Summary Transmission Loss Equates to an Overall Reduction of 26 dB(A)							