Eden Project International

EDEN PROJECT NORTH, MORECAMBE

Noise and Vibration Report – Appendix 12.1

70083611-NV-APP
AUGUST 2021

PUBLIC

Eden **Project International**

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TYPE OF DOCUMENT (VERSION) PUBLIC

PROJECT NO. 70083611

OUR REF. NO. 70083611-NV-APP

DATE: AUGUST 2021

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QUALITY CONTROL

Issue/revision	First issue	Revision 1
Remarks	Draft for internal review	Minor updates
Date	18/08/21	01/09/21
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Project number	70083611	70083611
Report number	70083611-NV-APP	70083611-NV-APP

1. GLOSSARY OF ACOUSTIC TERMINOLOGY

dB (decibel): The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure ($2x10^{-5}$Pa).

dB(A): A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.

***L*$_{Aeq,T}$:** Defined as the notional steady sound level which, over a stated period of time (T), would contain the same amount of acoustical energy as the A-weighted fluctuating sound measured over that period.

***L*$_{Amax}$:** The maximum A-weighted sound pressure level recorded over a particular period. L_{Amax} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall $L_{Aeq,T}$ noise level, but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response, denoted L_{AFmax} or $L_{Amax,F}$.

L_{10} and L_{90}: If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The L_n indices are used for this purpose, and 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 the L_{90} is the level exceeded for 90% of the time. Unless described otherwise, they are measured using the 'fast' sound level meter response, denoted L_{AF10} and L_{AF90}.

Free-field Level: A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other reflective surfaces. Generally as measured outside and at least 3.5m away from buildings.

Façade Level: A sound field determined at a distance of 1 m in front of a large sound reflecting object such as a building façade.

Ambient Noise Level: The all-encompassing noise level measured in $L_{Aeq,T}$. The Ambient Noise Level incorporates background sounds as well as the industrial source noise under consideration (BS 4142).

Background Noise Level: The noise level exceeded for 90% of the time, the L_{A90} noise index, in the absence of sound of an industrial and/or commercial nature (BS 4142).

Specific Sound Level, L_s = $L_{Aeq,T}$: The term used in BS 4142 to describe the equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given time period.

Rating Level, $L_{Ar,Tr}$: The term used in BS 4142 to describe the specific sound level plus any adjustment for the characteristic features of the sound.

VIBRATION

Vibration is defined as a repetitive oscillatory motion. Vibration can be transmitted to the human body through the supporting surfaces; the feet of a standing person, the buttocks, back and feet of a

seated person or the supporting area of a recumbent person. In most situations, entry into the human body will be through the supporting ground or through the supporting floors of a building.

Vibration is often complex, containing many frequencies, occurring in many directions and changing over time. There are many factors that influence human response to vibration. Physical factors include vibration magnitude, vibration frequency, vibration axis, duration, point of entry into the human body and posture of the human body. Other factors include the exposed persons experience, expectation, arousal and activity.

Experience shows that disturbance or annoyance from vibration in residential situations is likely to arise when the magnitude of vibration is only slightly in excess of the threshold of perception.

VIBRATION TERMINOLOGY

Peak Particle Velocity (PPV): The maximum instantaneous velocity of a particle at a point during a given time interval, usually stated in mm/s.

Peak Component Particle Velocity: The maximum value of any one of three orthogonal component particle velocities measured during a given time interval.

2. LEGISLATION, POLICY AND GUIDANCE

Environmental Protection Act 1990

Section 79 of the EPA presents a number of matters which may be statutory nuisances, including noise. Under the provisions of the EPA, the Local Authority is required to inspect its area periodically to detect any nuisance and, where a valid complaint of a statutory nuisance is made by a person living within its area, to take such steps as are reasonably practicable to investigate the complaint.

Section 80 of the EPA (Summary proceedings for statutory nuisances) provides Local Authorities with powers to serve an abatement notice requiring the abatement of a nuisance or requiring works to be executed to prevent their occurrence.

Control of Pollution Act 1974

Sections 60 and 61 of the COPA give local authorities special powers for controlling noise arising from construction and demolition works, regardless of whether a statutory nuisance has been caused or is likely to be caused. These powers may be exercised either before works start (Section 61) or after they have started (Section 60). Section 61 is a prior consent process whereby approval is sought for the completion of construction works following prescribed methods, whilst Section 60 affords Local Authorities means of control of construction noise where a Section 61 has not previously been agreed.

NATIONAL PLANNING POLICY

Noise Policy Statement for England (NPSE)

The NPSE was published on 15 March 2010. It sets out the long-term vision for government noise policy, to promote good health and a good quality of life through the management of noise.

The policy ensures that noise issues are considered at the right-time during the development of policy and decision making, and not in isolation. It highlights the underlying principles on noise management already found in existing legislation and guidance. The NPSE should apply to all forms of noise, including environmental noise. It sets out the long-term vision of Government noise policy as follows:

> "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 long-term vision is supported by the following aims:

> "Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:
>
> - 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."

To assist in the understanding of the terms "significant adverse" and "adverse", the NPSE acknowledges that there are two concepts being applied to noise impacts, for example, by the World Health Organization. They are:

- NOEL - No Observed Effect Level - This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise; and
- LOAEL - Lowest Observed Adverse Effect Level - This is the level above which adverse effects on health and quality of life can be detected.

The NPSE introduces a third concept:

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

However, the NPSE goes on to state 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. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available."

National Planning Policy Framework (NPPF)

Last updated in July 2021, the NPPF sets out the Government's planning policies for England and how these are expected to be applied. The NPPF superseded Planning Policy Guidance Note (PPG) 24: Planning and noise amongst other PPG's and Planning Policy Statements (PPS's). In contrast to PPG 24, reference to noise is scant within the NPPF. Noise is referenced within the document as follows:

> *"174. Planning policies and decisions should contribute to and enhance the natural and local environments by:…[a number of points including]…*

- preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans;"

> *"185. 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[65];
- 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;…"

Reference number 65 of the above quotation points to the Explanatory Note to the Noise Policy Statement for England (NPSE).

Additional reference is made to noise with respect to mineral extraction Sites but this is not applicable to this assessment.

The NPPF also includes the following statement:

> "*187. 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.*"

Whilst this paragraph does not explicitly reference noise, being 'overarching' in nature, in previous versions of the NPPF, similar text was included within the noise related paragraphs of the document.

PLANNING PRACTICE GUIDANCE (PRACG)

Last updated on 22 July 2019, this web-based resource was issued for use by the Department for Communities and Local Government (DCLG). The purpose of the guidance is to complement the NPPF and provide advice on how to deliver its policies

The section on noise was published on 06 March 2014, but was last updated 22 July 2019. The guidance includes a table which summarises "the noise exposure hierarchy based on the likely average response of those affected" and which offers "examples of outcomes" relevant to the NOEL, LOAEL and SOAEL effect levels described in the NPSE. The term Unacceptable Adverse Effect (UAE) level is introduced which equates to noise perceived as "present and very disruptive". It is stated that UAEs should be prevented.

These outcomes are in descriptive form and there is still no numerical definition of the NOEL, LOAEL and SOAEL (or UAE), or detailed advice regarding methodologies for their determination. There is also no reference to the further research that is identified as necessary in the NPSE. There is reference to a number of other information sources, including British Standards, and it is confirmed that 'Some of these documents contain numerical criteria.' (albeit not that seek to define to the NOEL, LOAEL or SOAEL), and it is then advised that 'These values are not to be regarded as fixed thresholds and as outcomes that have to be achieved in every circumstance'.

The noise exposure hierarchy table is duplicated below Table 2-1.

Table 2-1 - Noise exposure hierarchy based on the likely average response

Response	Examples of outcomes	Increasing effect level	Action
No Observed Effect Level			
Not present	No effect	No Observed Effect	No specific measures required
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, 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 small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows	Significant Observed Adverse Effect	Avoid

Response	Examples of outcomes	Increasing effect level	Action
	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.		
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

LOCAL PLANNING POLICY

The applicable local planning policy is as follows:

- **Lancaster Local Plan Part One – Strategic Polices and Land Allocations DPD (2020)** – which provides the overarching policy approach to the location and control of development, sustainability and mitigating environmental impacts;
- **Lancaster Local Plan Part Two – Development Management Policies DPD (2020)** – provides more granular policy guidance relating to key design principles, sustainable design and mitigation of impacts; and
- **Morecambe Area Action Plan (2014)** – drills down further, containing planning policies tailored to specific sites in Morecambe.

GUIDANCE

Design Manual for Roads and Bridges (DMRB): LA 111, 'Noise and vibration'

This document sets out procedures for undertaking the environmental assessment of new road schemes, including the assessment of noise impacts from road traffic. In undertaking a DMRB assessment, the calculation of traffic noise levels uses the methodology contained within the CRTN document as described below.

Although the DMRB strictly applies to new road schemes, the principles can also be applied to the assessment of noise from road traffic in general. The Proposed Development has the potential to affect road traffic noise levels along existing roads, hence the need for this assessment.

The significance of effect depends upon a number of factors, including the magnitude of change, the sensitivity of the receptor, the absolute noise level and the acoustic context.

The DMRB categorises operational road traffic noise into magnitude of change bands. The short and long term classification scales are provided in Table 2-2 and Table 2-3 below.

Table 2-2 - Magnitude of change – short term

Short term magnitude	Short term noise change (dB $L_{A10,18h}$ or L_{night})
Major	Greater than or equal to 5.0
Moderate	3.0 to 4.9
Minor	1.0 to 2.9
Negligible	Less than 1.0

Table 2-3 - Magnitude of changes – long term

Long term magnitude	Long term noise change (dB $L_{A10,18h}$ or L_{night})
Major	Greater than or equal to 10.0
Moderate	5.0 to 9.9
Minor	3.0 to 4.9
Negligible	Less than 3.0

Calculation of Road Traffic noise (CRTN) memorandum

Published by the Department of Transport and the Welsh Office in 1988, CRTN sets out standard procedures for calculating noise levels from road traffic. The calculation methods use a number of input variables, including traffic flow volume, average vehicle speed, percentage of heavy duty vehicles (HDVs), type of road surface, site geometry and the presence of noise barriers or acoustically absorbent ground. CRTN predicts the $L_{A10,18h}$ or $L_{A10,1h}$ noise level for any receptor point at a given distance, up to 300m, from the road.

CRTN also documents procedures for the measurement of road traffic noise. Three methods of road traffic noise measurement are described, the first entitled ‘The Measurement Method’, for direct measurement of the $L_{A10,18hr}$ noise level, the second entitled the ‘Shortened Measurement Procedure’, for measurement of the $L_{A10,3hr}$ noise level from which the $L_{A10,18hr}$ level can be derived and the third entitled ‘Comparative Measurements’ which is a procedure to establish noise levels from a single road traffic route at various points, provided that the route remains the dominant

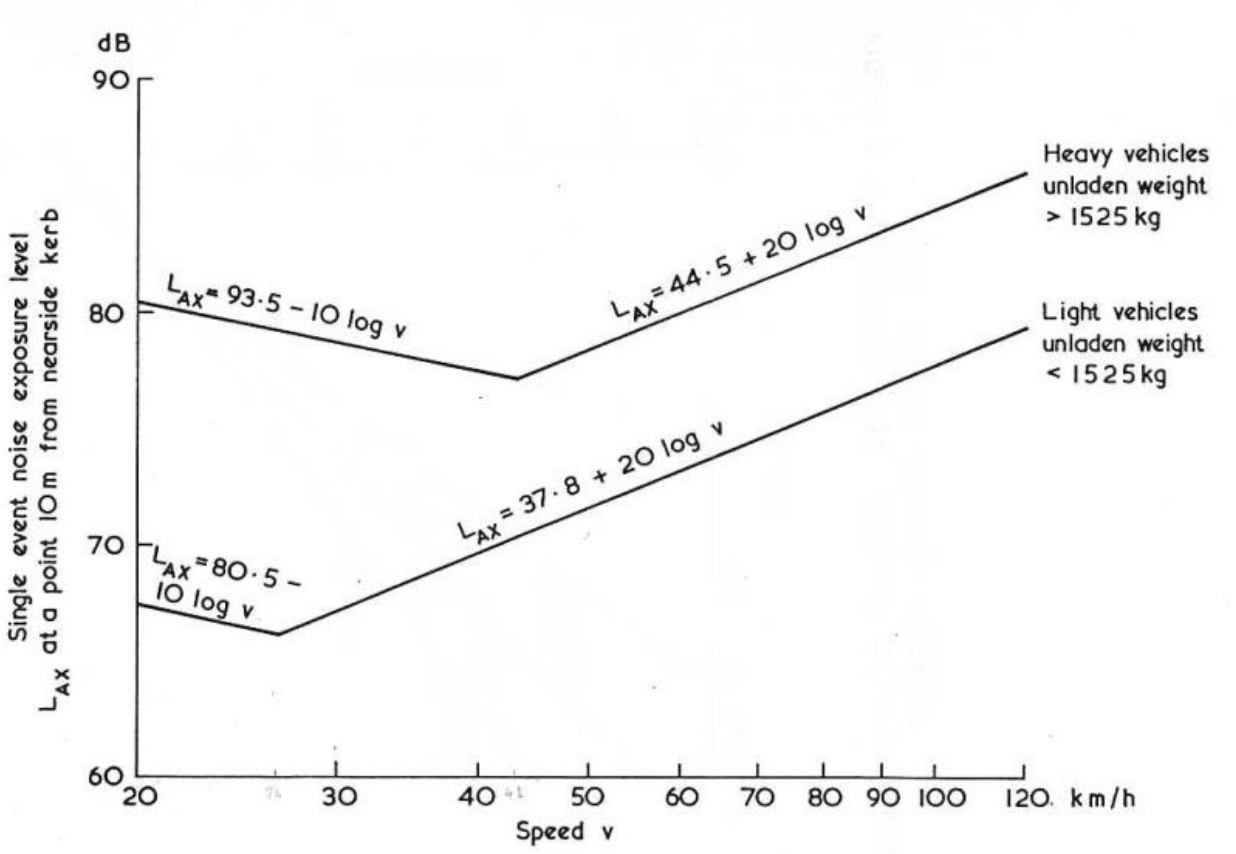
source. CRTN states that if the Shortened Measurement Procedure is followed, a correction of -1dB can be applied to the determined $L_{A10,3hr}$ noise level to approximate the $L_{A10,18hr}$ noise level.

Noise Advisory Council. A Guide to Measurement and Prediction of the Equivalent Continuous Sound Level L_{eq} (NAC)

The NAC presents general procedures to be followed for the measurement and prediction of L_{eq} noise levels from a number of different sources. Section 2.5 of the document details a method for calculating the L_{eq} noise level from the combined effect of a number of events (e.g. HGV pass-bys) with their own single event noise exposure level (L_{AX}, also commonly referenced as the SEL).

The calculation is used in conjunction with Fig 4.1.4 of the document, duplicated in the diagram below, to determine the L_{AX} (SEL) at a distance of 10m from the nearside kerb edge, for heavy and light vehicles travelling at different speeds.

Figure 2-1 – Relationship between L_{AX} (at 10m) and speed



Bavarian State Agency for the Environment (Bayerisches Landesamt Fur Umwelt - LfU) Parking Area Noise (PAN)

The PAN describes a method for calculating sound emission from of parking areas and bus stations, as well as multi storey and underground car parks. It adopts a reference value for the movement frequency of each car park space for each type of parking area, the source sound power level for each complete parking process (e.g. arriving, manoeuvring, door slams) and the total number of parking spaces to arrive at an area emission value. Corrections are typically applied for the car park road surface and impulse characteristics.

The prediction method has been adopted internationally and is implemented in multiple sound engineering calculation programs.

Code of Practice for Environmental Noise Control at Concerts, 1995

This national Code of Practice (CoP) was issued by the Noise Council in 1995 and provides guidance on the control of noise from concerts or events where amplified music is a component, in order to reduce the risk of complaints from occupants at nearby noise sensitive premises. The CoP provides measurement, assessment and rating methods specifically relating to outdoor music noise, using the concepts of noise level, duration/frequency of exposure, comparison with ambient conditions and an upper absolute level. It is often cited by local authorities during the planning and execution of outdoor entertainment events.

The CoP advises on appropriate music noise levels (MNLs) which are set out in Table 2-4, below:

Table 2-4 - Guideline Music Noise Levels from Concerts

Concert Days per Calendar Year, per Venue	Venue Category	Guideline
1 to 3	Urban stadia or arenas	The MNL should not exceed 75 dBA over a 15 minute period
1 to 3	Other urban and rural venues	The MNL should not exceed 65 dBA over a 15 minute period
4 to 12	All venues	The MNL should not exceed the background noise level by more than 15 dBA over a 15 minute period

Note: MNL is the music noise level

The above limits are applicable 1m from the façade of any noise sensitive premises for events held between the hours of 09:00 and 23:00. The CoP suggests that music noise between the hours of 23:00 and 09:00 should not be audible within noise-sensitive premises with windows open in a typical manner for ventilation.

The guidance further recommends that for indoor venues used for up to about 30 events per year, the MNL should not exceed the background noise level by 5 dBA over a 15 minute period and should finish no later than 23:00.

BS 4142:2014+A1:2019: Methods for rating and assessing industrial and commercial sound (BS 4142)

BS 4142 describes methods for assessing sound of an industrial and/or commercial nature, including sound from fixed installations (such as mechanical and electrical plant).

It provides a method of determining the 'rating level' for sources of industrial or commercial sound for the purposes of investigating noise impact, assessing sound from new, modified, or additional sources of sound, and assessing sound affecting new residential premises.

BS 4142 uses several terms to define the various parameters / indicators used in assessments, including:

- Specific sound – the commercial / industrial noise source under consideration;
- Residual sound – the sound level at the noise-sensitive receivers in the absence of the specific sound;
- Ambient sound – the sound level at the noise-sensitive receivers in the presence of the specific sound (i.e. ambient = residual + specific);
- Background sound level – the sound pressure level which is exceeded by the residual sound for 90% of the measurement period; and,
- Rating level – the specific sound, corrected for acoustically distinguishing characteristics.

BS 4142 states it is normally possible to carry out a subjective assessment of characteristics, based on the following correction guidelines:

- Tonality: +2dB for a 'just perceptible' tone, +4dB for a 'clearly perceptible' tone, and rising to +6 dB for a 'highly perceptible' tones;
- Impulsivity (rapidity of change and overall change in level): +3dB for 'just perceptible' impulsivity, +6dB for 'clearly perceptible' impulsivity, rising to +9dB for 'highly perceptible' impulsivity; and,
- Intermittency: if the on/off-time of the specific sound is readily distinctive at the noise-sensitive receivers, +3dB.

Typically, the greater the difference between the background and rating level, the greater the magnitude of impact, although BS 4142 emphasises that this is highly context-specific.

BS 4142 states that an initial estimate of the impact can be obtained by subtracting the background sound level from the rating level, and that:

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

This initial estimate of impact can then be modified to take account of context, including reference to factors such as:

- The absolute level of the sound;
- The character and level of the residual sound compared to the character and level of the specific sound;
- The sensitivity of the receptor and whether dwellings or other premises used for residuals purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as:
  - Façade insulation;
  - Ventilation and/or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation; and
  - Acoustic screening.

ISO 9613-2:1996 Acoustics – Attenuation of Sound During Propagation Outdoors – Part 2: General Method of Calculation (ISO 9613-2)

ISO 9613-2 describes a method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous A-weighted sound pressure level under downwind conditions.

BS 5228-1:2009+A1:2014: CODE OF PRACTICE FOR NOISE AND VIBRATION CONTROL ON CONSTRUCTION AND OPEN SITES. PART 1: NOISE

Bs 5228-1 sets out techniques to predict and assess the likely noise effects from construction works, based on detailed information on the type and number of plant being used, their location, and the length of time they are in operation. The noise prediction method is used to establish likely noise levels in terms of the $L_{Aeq,T}$ over the core working day. This Standard also documents a database of information, comprising previously measured sound power levels for a variety of different construction plant undertaking various common activities.

Three example methods are presented for determining the significance of construction noise impacts. In summary, these methods adopt either a series of fixed noise level limits, are concerned with ambient noise level changes as a result of the construction operations or a combination of the two.

With respect to absolute fixed noise limits, BS 5228-1 discusses those included within Committee on the problem of noise – Final Report. These limits are presented according to the nature of the surrounding environment, for a 12-hour working day. The presented limits are:

- 70 dB(A) L_{eq} in rural, suburban and urban areas away from main road traffic and industrial noise; and
- 75 dB(A) L_{eq} in urban areas near main roads and heavy industrial areas.

The above noise level limits are applicable at the façade of the receptor in question (i.e. not free-field).

The Standard goes on to provide methods for determining the significance of construction noise levels by considering the change in the ambient noise level that would arise as a result of the

construction operations. Two example assessment methods are presented, these are the 'ABC method' as summarised within Table 2-5 and the '5 dB(A) change' method under that table.

Table 2-5 - Example threshold of potential significance effect at dwellings - ABC method

Assessment category and threshold value period	Threshold value, in decibels $L_{Aeq,T}$ (dB)		
	Category (A)[A]	Category (B)[B]	Category (C)[C]
Night-time (23:00 – 07:00)	45	50	55
Evenings and weekends [D]	55	60	65
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75

NOTE 1: A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level.

NOTE 2: If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3dB due to site noise.

NOTE 3: Applied to residential receptors only.

[A] Category A: threshold values to use when ambient levels (when rounded to the nearest 5dB) are less than these values.

[B] Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values.

[C] Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category A values.

[D] 19.00-23.00 weekdays, 13.00-23.00 Saturdays and 07.00-23.00 Sundays

With respect to the '5 dB(A) change' method, the guidance states:

> "*Noise levels generated by site activities are deemed to be potentially significant if the total noise (pre-construction ambient plus site noise) exceeds the pre-construction ambient noise by 5 dB or more, subject to lower cut-off values of 65 dB, 55 dB and 45 dB $L_{Aeq,T}$, from site noise alone, for the daytime, evening and night-time periods, respectively; and a duration of one month or more, unless works of a shorter duration are likely to result in significant effect.*"

BS 5228-2:2009+A1:2014: CODE OF PRACTICE FOR NOISE AND VIBRATION CONTROL ON CONSTRUCTION AND OPEN SITES. PART 2: VIBRATION

This Standard provides recommendations for basic methods of vibration control relating to construction and open sites. The legislative background to vibration control is described and guidance is provided concerning methods of measuring vibration and assessing its effects on the environment.

Guidance criteria are suggested for the assessment of the significance of vibration effects; such criteria are provided in terms of Peak Particle Velocities (PPV) and are concerned with both human and structural responses to vibration. Those applicable to human perception and disturbance are presented within Table 2-6 below.

Table 2-6 - Guidance criteria for the assessment of significance of vibration for human perception and disturbance (from BS 5228-2:2009+A1:2014)

Vibration level [A], [B], [C] (PPV)	Effect
0.14 mms^{-1}	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mms^{-1}	Vibration might be just perceptible in residential environments.
1.0 mms^{-1}	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10 mms^{-1}	Vibration is likely to be intolerable for any more than a very brief exposure to this level in most building environments.

[A] The magnitudes of the values presented apply to a measurement position that is representative of the point of entry into the recipient.

[B] A transfer function (which relates an external level to an internal level) needs to be applied if only external measurements are available.

[C] Single or infrequent occurrences of these levels do not necessarily correspond to the stated effect in every case. The values are provided to give an initial indication of potential effects, and where these values are routinely measured or expected then an assessment in accordance with BS6472-1 or BS6472-2, and/or other available guidance, might be appropriate to determine whether the time varying exposure is likely to give rise to any degree of adverse comment.

The Standard goes on to present guidance criteria applicable to the vibration response limits of buildings in terms of the component PPV. These are presented within Table 2-7. It should be noted that the values presented within Table 2-7 are applicable to cosmetic damage only. It is stated within BS 5228-2 that minor damage is possible at vibration magnitudes which are greater than twice those given in the table.

Table 2-7 - Guidance criteria for the assessment of significance of transient vibration for cosmetic building damage (from BS 5228-2:2009+A1:2014)

Type of Building	Peak component particle velocity in frequency range of predominant pulse	
	4Hz to 16Hz	15Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings.	50mm/s at Hz and above	50mm/s at Hz and above
Unreinforced or light framed structures. Residential or light commercial buildings.	15mm/s at 4Hz increasing to 20mm/s at 15Hz	20mm/s at 15Hz increasing to 50mm/s at 40Hz and above
NOTE 1: Values referred to are at the base of the building. NOTE 2: At frequencies below 4Hz, a maximum displacement of 0.6mm (zero to peak) is not to be exceeded.		

3. BASELINE NOISE SURVEY

A baseline noise survey has been completed, the aim of which was to establish the prevailing noise climate at locations selected as representative of the closest noise sensitive receptors to the Proposed Development. The survey included determination of the ambient ($L_{Aeq,T}$) and background (L_{A90}) sound levels.

Continuous unattended noise measurements were completed at two locations, ML1 and ML2, between Thursday 3 June 2021 and Tuesday 8 June 2021 (ML1) and subsequently between Thursday 10 June 2021 and Friday 18th June (ML2). Measurement location ML1, installed on a tripod on a first floor flat roof of the Midland Hotel, is representative of the Midland Hotel to the west of the Site. Measurement location ML2, located on a second floor balcony of the Winter Gardens on Marine Road Central to the south of the Site approximately 3m from the main façade of the building, is representative of the Winter Gardens and various dwellings and other noise sensitive receptors located along Marine Road Central.

The microphones were positioned in free-field conditions and fitted with a windshield. Real time weather conditions were provided by a public weather station located approximately 2km southwest of the Proposed Development. Average wind speeds were less than 5m/s with the exception of the period between 06.00 and 12.00 on 11 June, when the average wind speed was between 5m/s and 7m/s[1]. The wind direction was predominantly from the west. The temperature range during the period was 10° to 21°C. No rainfall was recorded during this period.

A series of short duration attended measurements was also undertaken at various locations around the Site during daytime and evening periods, including 3 June (daytime only) and 10 June (daytime and evening). Note that the measurement period w/e 6 June coincided with local schools' half term break; measurements taken the following week were during term time. The intention behind the choice of these measurement periods was to include times that may be representative of the Proposed Development's peak operational period (i.e. during school holidays) and interpeak operational period (summer months during term time). Comparisons were subsequently made of the measured road traffic noise levels during these periods and also against predicted road traffic noise levels using 2019 baseline traffic data. It was considered that these comparisons may provide an indication of how representative the measured ambient noise levels were during the Covid-19 pandemic, occurring as they did prior to the easing of all English Covid restrictions on 19 July 2021.

The survey was completed using Class 1 measurement equipment, as detailed in Table 3-1. The measurement systems were calibrated within the previous 24 months, and the calibrators are calibrated within the previous 12 months. No significant calibration drift occurred during the survey.

[1] The baseline measurement data during this period was excluded from the analysis at locations ML1 and ML2

Table 3-1 - Measurement equipment

Measurement Location	Description	Manufacturer & Type	Serial number	Calibration Due Date
P1, P2, P3 (Set 1 and 2); P7, P8, P9, P10, P11, P12.	Sound Level Meter	Rion NL52 Sound Level Meter	00242744	21 July 2022
	Pre-amplifier	H25 Preamplifier	32772	
	Microphone	Condenser Microphone	06229	
	Calibrator	Rion NC-74 Sound Calibrator	34246512	21 July 2021
ML1; P4, P5, P6 (Set 2).	Sound Level Meter	01dB-Metravib Fusion Sound Level Meter	10797	28 August 2021
	Pre-amplifier	01dB PRE22 Preamplifier	10870	
	Microphone	GRAS Type 40CD Condenser Microphone	207593	
	Calibrator	01dB-Stell Cal 21	34254631	24 July 2021
ML2; P4, P5, P6 (Set 1).	Sound Level Meter	01dB-Stell Duo 'Datalogging Integrating Sound Level Meter'	10594	13 April 2023
	Pre-amplifier	01dB-Stell PRE 21 S Preamplifier	1507076	
	Microphone	G.R.A.S Type 40CD Condenser Microphone	224313	
	Calibrator	01dB Cal 21	34924020	09 October 2021

Measurement locations are described in Table 3-2 and shown in Figure 3-1. Time histories for the unattended measurement locations ML1 and ML2 are presented in Figure 3.2 and Figure 3.3. A summary of the measured noise levels are presented in Table 3-3 to Table 3-6.

Table 3-2 - Measurement locations

ID	Measurement description	Purpose
ML1	Long-term unattended measurement, start date: 03 June 2021, end date: 08 June 2021. Located on first floor roof of Rotunda Bar immediately adjacent to Midland Hotel and approx. 15m west of Site boundary. Road traffic from the A589 Marine Road Central and nearby building services plant associated with the hotel were the dominant noise sources. Other noise sources include a funfair temporarily located on Proposed Development Site, which operated daily from noon until around 21:00 during the survey period.	To determine background sound levels representative of the Midland Hotel (in absence of noise from funfair)

ID	Measurement description	Purpose
ML2	Long-term unattended measurement, start date: 10 June 2021, end data: 18 June 2021. Located at 2nd floor balcony of Winter Gardens, 25m south of the Site boundary on the A589 Marine Road Central. Road traffic from the A589 Marine Road Central is dominant. Other noise sources include the funfair temporarily located on Proposed Development Site, which operated during weekend periods from around 16:00 until around 21:00.Noise from the funfair also evident during weekend afternoon and evening periods.	To determine background sound levels representative of both the Winter Gardens and of noise sensitive receptors located along the A589 Marine Road Central
P1	Short-term daytime attended measurements completed on 3 June and 10 June 2021. Located 8m from roadside in vicinity of RNLI shop facing Marine Road Central. Road traffic from the A589 Marine Road Central is dominant. Road traffic accident along Marine Road Central during survey on 10 June impacted measurements due to road closures and subsequent standing traffic. Not all measurements could be undertaken.	Short duration CRTN measurement to predict $L_{A10,18hr}$
P2	Short-term daytime attended measurements completed on 3 June and 10 June 2021. Located 7m from roadside facing Marine Road Central opposite junction with Queen Street. Road traffic from the A589 Marine Road Central is dominant with additional contributions from pedestrians. Noise from PA announcements at funfair just audible during 3 June survey (not present during 10 June survey). Road traffic accident along Marine Road Central during survey on 10 June impacted measurements due to road closures and subsequent standing traffic. Not all measurements could be undertaken.	Short duration CRTN measurement to predict $L_{A10,18hr}$
P3	Short-term daytime attended measurements completed on 3 June and 10 June 2021. Located 7m from roadside facing Marine Road Central opposite junction with Northumberland Street. Road traffic from the A589 Marine Road Central is dominant with additional contributions from pedestrians. Noise from PA announcements at funfair clearly audible during 3 June survey (not present during 10 June survey).	Short duration CRTN measurement to predict $L_{A10,18hr}$

ID	Measurement description	Purpose
	Road traffic accident along Marine Road Central during survey on 10 June impacted measurements due to road closures and subsequent standing traffic. Not all measurements could be undertaken.	
P4	Short-term daytime attended measurements completed on 3 June and 10 June 2021. Located 4m from roadside on grassy verge facing Euston Road. Road traffic along Euston Road dominant.	Short duration CRTN measurement to predict $L_{A10,18hr}$
P5	Short-term daytime attended measurements completed on 3 June and 10 June 2021. Located 4m from roadside on land adjacent to library facing Central Drive. Road traffic along Central Drive dominant.	Short duration CRTN measurement to predict $L_{A10,18hr}$
P6	Short-term daytime attended measurements completed on 3 June and 10 June 2021. Located 4m from roadside close to bus stop on Central Drive, west of Hilmore way roundabout. Road traffic along Central Drive dominant.	Short duration CRTN measurement to predict $L_{A10,18hr}$
P7	Short-term daytime attended measurements completed on 3 June June 2021. Located at foot of slipway onto beach. No dominant noise source, quiet, with occasional contribution from pedestrians along jetty. Occasional noise from overhead gulls.	To establish noise from any ecological receptor activity on beach
P8	Short-term daytime attended measurements completed on 3 June 2021. Located on pavement at adjacent dwelling on Northumberland Street, opposite the Bath Hotel public house.	To establish ambient and background sound levels at locations away from Marine Road Central
P9	Short-term evening attended measurements completed on 10 June 2021. Located in car park on Northumberland Street 5m from roadside, opposite the Bath Hotel public house.	To establish ambient and background sound levels at locations away from Marine Road Central
P10	Short-term evening attended measurements completed on 10 June 2021. Located on Edward Street on the corner of Chapel Street	To establish ambient and background sound levels at locations away from Marine Road Central

ID	Measurement description	Purpose
P11	Short-term evening attended measurements completed on 10 June 2021. Located on Green Street opposite Central Methodist Church	To establish ambient and background sound levels at locations away from Marine Road Central
P12	Short-term evening attended measurements completed on 10 June 2021. Located in Marine Road car park opposite the Best Western Lothersdale Hotel	To establish ambient and background sound levels at location farther along Marine Road Central

Figure 3-1 - Noise measurement locations



Table 3-3 – Summary of unattended measured noise levels at ML1 (excluding funfair[2]), dB(A)

Date	Period	dB $L_{Aeq,T}$	dB $L_{Amax,f}$	Typical[3] dB L_{A90}	Average dB L_{A10}
Thu 3 June	Day	54(55)	78(78)	53(53)	56(56)
	Evening	54(54)	69(69)	52(52)	55(55)
	Night	52	69	51	53
Fri 4 June	Day	55(57)	80(80)	55(55)	57(57)
	Evening	53(57)	73(73)	55(55)	57(57)
	Night	52	67	50	53
Sat 5 June	Day	51(57)	82(82)	54(54)	57(57)
	Evening	55(58)	84(84)	52(52)	59(59)
	Night	52	77	49	53
Sun 6 June	Day	50(57)	81(81)	53(53)	56(56)
	Evening	53(60)	84(84)	52(52)	60(60)
	Night	51	67	50	52
Mon 7 June	Day	52	80	49	53
	Evening	53	70	51	53
	Night	52	74	51	53
Tue 8 June	Day	54	80	50	54
	Evening	55	79	51	54
Overall log average	$L_{Aeq,0700 - 1900}$	53(56)			
	$L_{Aeq,1900 – 2300}$	54(57)			
	$L_{Aeq,2300 – 0700}$	52			

[2] Values in brackets include contribution of noise from funfair for reference

[3] Typical value of $L_{A90,15min}$ determined from modal value during period in question.

Date	Period	dB $L_{Aeq,T}$	dB $L_{Amax,f}$	Typical[3] dB L_{A90}	Average dB L_{A10}
Weekday only log average daytime	$L_{Aeq,0700 – 1900}$	54			

The measurement data was considered to be affected by noise from the funfair on the site of the Proposed Development and was excluded from the main dataset. However, data with the funfair included is provided in brackets for reference, where relevant. The following periods were considered to be affected by funfair noise: 13:00 to 20:30 on 03 June; 12:30 to 21:00 on 04 June; 12:00 to 21:00 on 05 June; and 16:00 to 21:00 on 06 June.

The background sound level at ML1 was affected by nearby building services plant associated with the hotel. However, the measured noise levels are still considered to be representative of the noise climate at bedrooms with windows facing the Proposed Development.

Table 3-4 – Summary of unattended measured noise levels at ML2 (excluding funfair[2]), dB(A)

Date	Period	dB $L_{Aeq,T}$	dB $L_{Amax,f}$	Typical[3] dB L_{A90}	Average dB L_{A10}
Thu 10 Jun	Day	60	88	51	62
	Evening	62	101	47	61
	Night	52	76	45	54
Fri 11 June	Day	62(62)	87(92)	52(53)	63(64)
	Evening	61(66)	89(111)	45(61)	62(64)
	Night	56	90	41	56
Sat 12 June	Day	61(65)	100(100)	50(63)	63(66)
	Evening	60(61)	89(89)	50(60)	62(63)
	Night	54	87	34	54
Sun 13 June	Day	60(63)	92(92)	52(61)	62(64)
	Evening	60(61)	95(95)	40(59)	61(62)
	Night	55	88	35	52
Mon 14 June	Day	61	90	52	64
	Evening	64	100	50	62
	Night	54	83	33	52
Tue 15 June	Day	62	102	50	63

Date	Period	dB $L_{Aeq,T}$	dB $L_{Amax,f}$	Typical[3] dB L_{A90}	Average dB L_{A10}
	Evening	58	89	45	61
	Night	52	77	35	51
Wed 16 June	Day	60	88	51	63
	Evening	60	90	47	61
	Night	54	87	36	51
Thu 1 June	Day	61	95	53	63
	Evening	63	102	51	62
	Night	54	81	35	52
Fri 18 June	Day	60(62)	86(92)	51(51)	63(64)
	Evening	58(62)	89(90)	45(61)	61(63)
	Night	56	95	32	54
Overall log average	$L_{Aeq,0700 - 1900}$	61(62)			
	$L_{Aeq,1900 - 2300}$	61(63)			
	$L_{Aeq,2300 - 0700}$	54			
Weekday only log average daytime	$L_{Aeq,0700 – 1900}$	61			

The measurement data was considered to be affected by noise from the funfair on the site of the Proposed Development and was excluded from the main dataset. However, data with the funfair included is provided in brackets for reference, where relevant. The following periods were considered to be affected by funfair noise: 16:00 to 21:00 on 11 June; 12:00 to 20:30 on 12 June; 12:00 to 20:00 on 13 June; and 16:00 to 21:00 on 18 June.

Table 3-5 – Summary of attended measurements

Date	Start time	Duration	Location	dB $L_{Aeq,T}$	dB L_{Amax}	dB L_{A10}	dB L_{A90}
03/06/2021	11:56	15:00	P1, Set 1, No. 1	63	73	66	57
03/06/2021	13:00	15:00	P1, Set 1, No. 2	63	71	66	58
03/06/2021	14:05	15:00	P1, Set 1, No. 3	63	73	66	58
10/06/2021	11:40	15:00	P1, Set 2, No. 1	63	78	66	56
03/06/2021	12:40	15:00	P2, Set 1, No. 1	64	79	66	58
03/06/2021	13:46	15:00	P2, Set 1, No. 2	64	85	65	58
03/06/2021	14:47	15:00	P2, Set 1, No. 3	62	81	65	58
10/06/2021	14:07	15:00	P2, Set 2, No. 2	63	80	66	54
03/06/2021	12:21	15:00	P3, Set 1, No. 1	64	80	68	57
03/06/2021	13:22	15:00	P3, Set 1, No. 2	64	76	67	58
03/06/2021	14:28	15:00	P3, Set 1, No. 3	65	92	66	59
10/06/2021	12:12	15:00	P3, Set 2, No. 1	67	91	65	55
10/06/2021	13:12	15:00	P3, Set 2, No. 2	62	76	64	55

Date	Start time	Duration	Location	dB $L_{Aeq,T}$	dB L_{Amax}	dB L_{A10}	dB L_{A90}
03/06/2021	14:34[4]	15:00	P4, Set 1, No. 1	-	-	69	59
03/06/2021	15:39[4]	15:00	P4, Set 1, No. 2	-	-	66	57
03/06/2021	16:40[4]	15:00	P4, Set 1, No. 3	-	-	70	60
10/06/2021	12:23	15:00	P4, Set 2, No. 1	76	107	69	59
10/06/2021	13:31	15:00	P4, Set 2, No. 2	65	76	68	58
10/06/2021	14:37	15:00	P4, Set 2, No. 3	65	75	68	57
03/06/2021	14:11[4]	15:00	P5, Set 1, No. 1	-	-	70	59
03/06/2021	15:21[4]	15:00	P5, Set 1, No. 2	-	-	70	57
03/06/2021	16:22[4]	15:00	P5, Set 1, No. 3	-	-	70	56
10/06/2021	12:03	15:00	P5, Set 2, No. 1	72	102	69	56
03/06/2021	13:50[4]	15:00	P6, Set 1, No. 1	-	-	65	56

[4] Faulty sound level meter memory card during attended survey meant data had to be recorded manually during ‘Set 1’ at locations P4, P5 and P6, resulting in limited data set (L_{A10} and L_{A90} only) at these locations.

Date	Start time	Duration	Location	dB $L_{Aeq,T}$	dB L_{Amax}	dB L_{A10}	dB L_{A90}
03/06/2021	15:00[4]	15:00	P6, Set 1, No. 2	-	-	65	54
03/06/2021	16:02[4]	15:00	P6, Set 1, No. 3	-	-	64	53
03/06/2021	15:58	15:00	P7, Set 1	38	57	40	34
03/06/2021	16:35	15:00	P8, Set 1	65	81	69	49
10/06/2021	11:43	15:00	P8, Set 2, No. 1	64	81	67	50
10/06/2021	14:13	15:00	P8, Set 2, No. 2	64	86	68	48
10/06/2021	19:07	15:00	P9, No. 1	60	80	63	50
10/06/2021	20:28	15:00	P9, No. 2	57	83	60	47
10/06/2021	22:08	15:00	P9, No. 3	57	74	61	48
10/06/2021	19:25	15:00	P10, No. 1	49	70	51	43
10/06/2021	20:47	15:00	P10, No. 2	53	76	52	43
10/06/2021	22:27	15:00	P10, No. 3	49	66	52	42
10/06/2021	19:50	15:00	P11, No. 1	53	74	53	41
10/06/2021	21:08	15:00	P11, No. 2	53	71	55	43
10/06/2021	22:50	15:00	P11, No. 3	50	82	50	40

Date	Start time	Duration	Location	dB $L_{Aeq,T}$	dB L_{Amax}	dB L_{A10}	dB L_{A90}
10/06/2021	20:10	15:00	P12, No. 1	59	88	61	45
10/06/2021	21:30	15:00	P12, No. 2	57	76	60	44

Table 3-6 – Attended measurement data analysis

Date	Start time	Location	Distance from road edge (m)	dB L_{A10}	dB L_{A90}	Mean dB LA_{90}	CRTN shortened measurement procedure			Predictions to TRL Method 3 (at measurement location)		
							Mean dB L_{A10}	Estimated dB $L_{A10,18hr}$	dB $L_{A10,18hr}$ corrected to 10m	dB L_{day}	dB L_{eve}	dB L_{night}
03/06/2021	11:56	P1, Set 1, No. 1	8	66	57	57	66	65	64	63	60	55
03/06/2021	13:00	P1, Set 1, No. 2		66	58							
03/06/2021	14:05	P1, Set 1, No. 3		66	58							
10/06/2021	11:40	P1, Set 2, No. 1	8	66	56	56	66	65	64	-	-	-
03/06/2021	12:40	P2, Set 1, No. 1	7	66	58	58	65	64	63	63	60	54
03/06/2021	13:46	P2, Set 1, No. 2		65	58							
03/06/2021	14:47	P2, Set 1, No. 3		65	58							
10/06/2021	14:07	P2, Set 2, No. 1	7	66	54	54	66	65	64	-	-	-
03/06/2021	12:21	P3, Set 1, No. 1	7	68	57	58	67	66	64	64	61	55

Date	Start time	Location	Distance from road edge (m)	dB L_{A10}	dB L_{A90}	Mean dB LA_{90}	CRTN shortened measurement procedure			Predictions to TRL Method 3 (at measurement location)		
							Mean dB L_{A10}	Estimated dB $L_{A10,18hr}$	dB $L_{A10,18hr}$ corrected to 10m	dB L_{day}	dB L_{eve}	dB L_{night}
03/06/2021	13:22	P3, Set 1, No. 2		67	58							
03/06/2021	14:28	P3, Set 1, No. 3		66	59							
10/06/2021	12:12	P3, Set 2, No. 1	7	65	55	55	65	64[5]	62	62	59	53
10/06/2021	13:12	P3, Set 2, No. 2		64	55							
03/06/2021	14:34	P4, Set 1, No. 1	4	69	59	59	68	67	63	66	63	57
03/06/2021	15:39	P4, Set 1, No. 2		66	57							
03/06/2021	16:40	P4, Set 1, No. 3		70	60							
10/06/2021	12:23	P4, Set 2, No. 1	4	69	59	58	68	67	63	65	62	57
10/06/2021	13:31	P4, Set 2, No. 2		68	58							

[5] Estimated dB $L_{A10,18hr}$ based on two shortened CRTN measurements rather than three. Result to be treated with caution.

Date	Start time	Location	Distance from road edge (m)	dB L_{A10}	dB L_{A90}	Mean dB LA_{90}	CRTN shortened measurement procedure			Predictions to TRL Method 3 (at measurement location)		
							Mean dB L_{A10}	Estimated dB $L_{A10,18hr}$	dB $L_{A10,18hr}$ corrected to 10m	dB L_{day}	dB L_{eve}	dB L_{night}
10/06/2021	14:37	P4, Set 2, No. 3		68	57							
03/06/2021	14:11	P5, Set 1, No. 1	4	70	59	57	70	69	65	67	64	58
03/06/2021	15:21	P5, Set 1, No. 2		70	57							
03/06/2021	16:22	P5, Set 1, No. 3		70	56							
10/06/2021	12:03	P5, Set 2, No. 1	4	69	56							
03/06/2021	13:50	P6, Set 1, No. 1	4	65	56	54	65	64	60	62	59	53
03/06/2021	15:00	P6, Set 1, No. 2		65	54							
03/06/2021	16:02[4]	P6, Set 1, No. 3		64	53							
03/06/2021	15:58	P7, Set 1	-	40	34	-	-	-	-	-	-	-
03/06/2021	16:35	P8, Set 1	-	69	49	-	-	-	-	-	-	-
10/06/2021	11:43	P8, Set 2, No. 1	-	67	50	-	-	-	-	-	-	-
10/06/2021	14:13	P8, Set 2, No. 2	-	68	48	-	-	-	-	-	-	-

Date	Start time	Location	Distance from road edge (m)	dB L_{A10}	dB L_{A90}	Mean dB LA_{90}	CRTN shortened measurement procedure			Predictions to TRL Method 3 (at measurement location)		
							Mean dB L_{A10}	Estimated dB $L_{A10,18hr}$	dB $L_{A10,18hr}$ corrected to 10m	dB L_{day}	dB L_{eve}	dB L_{night}
10/06/2021	19:07	P9, No. 1	-	63	50	48	-	-	-	-	-	-
10/06/2021	20:28	P9, No. 2	-	60	47		-	-	-	-	-	-
10/06/2021	22:08	P9, No. 3	-	61	48		-	-	-	-	-	-
10/06/2021	19:25	P10, No. 1	-	51	43	43	-	-	-	-	-	-
10/06/2021	20:47	P10, No. 2	-	52	43		-	-	-	-	-	-
10/06/2021	22:27	P10, No. 3	-	52	42		-	-	-	-	-	-
10/06/2021	19:50	P11, No. 1	-	53	41	41	-	-	-	-	-	-
10/06/2021	21:08	P11, No. 2	-	55	43		-	-	-	-	-	-
10/06/2021	22:50	P11, No. 3	-	50	40		-	-	-	-	-	-
10/06/2021	20:10	P12, No. 1	-	61	45	45	-	-	-	-	-	-
10/06/2021	21:30	P12, No. 2	-	60	44		-	-	-	-	-	-

Figure 3.2 - ML01 noise levels

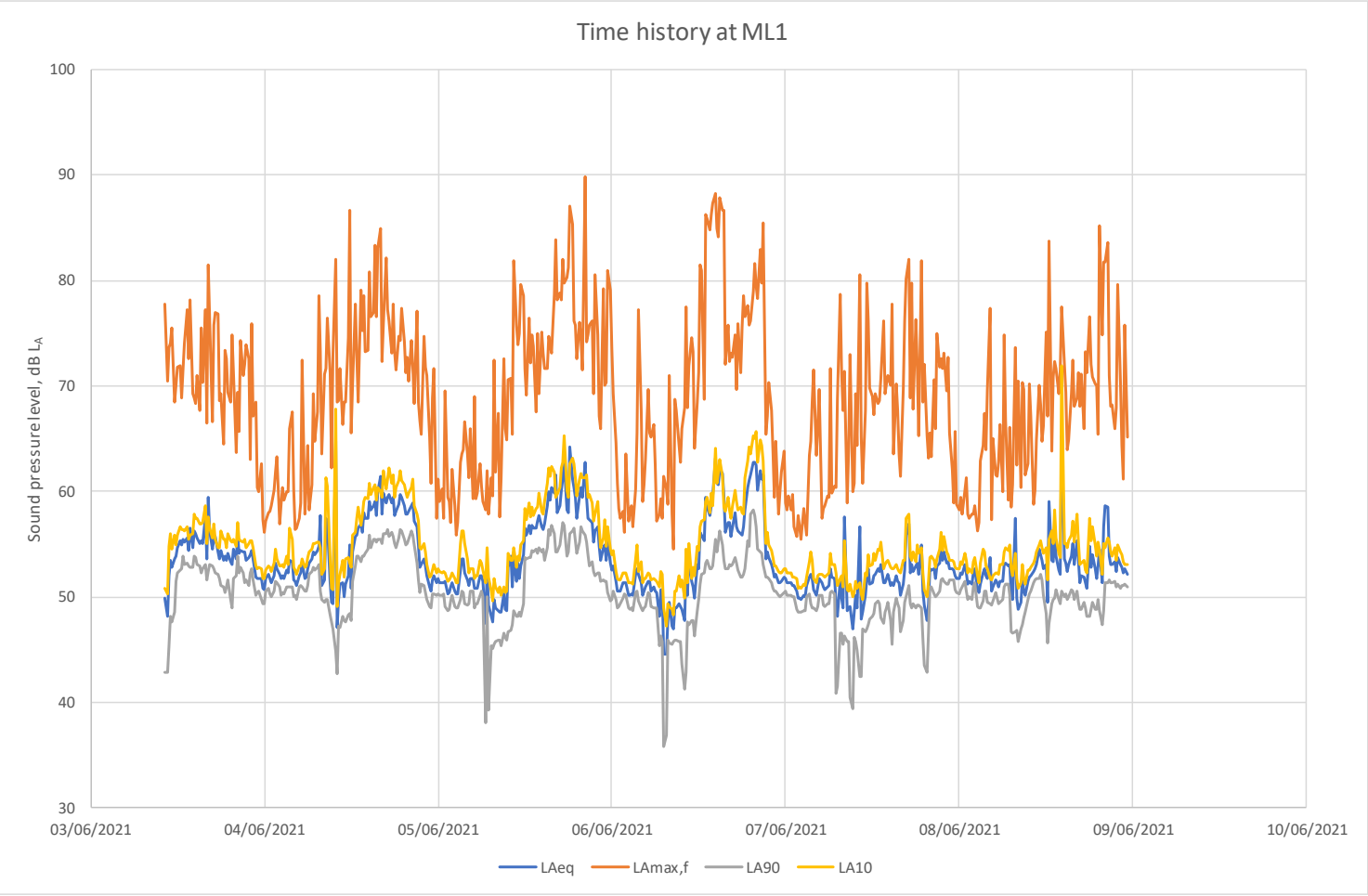
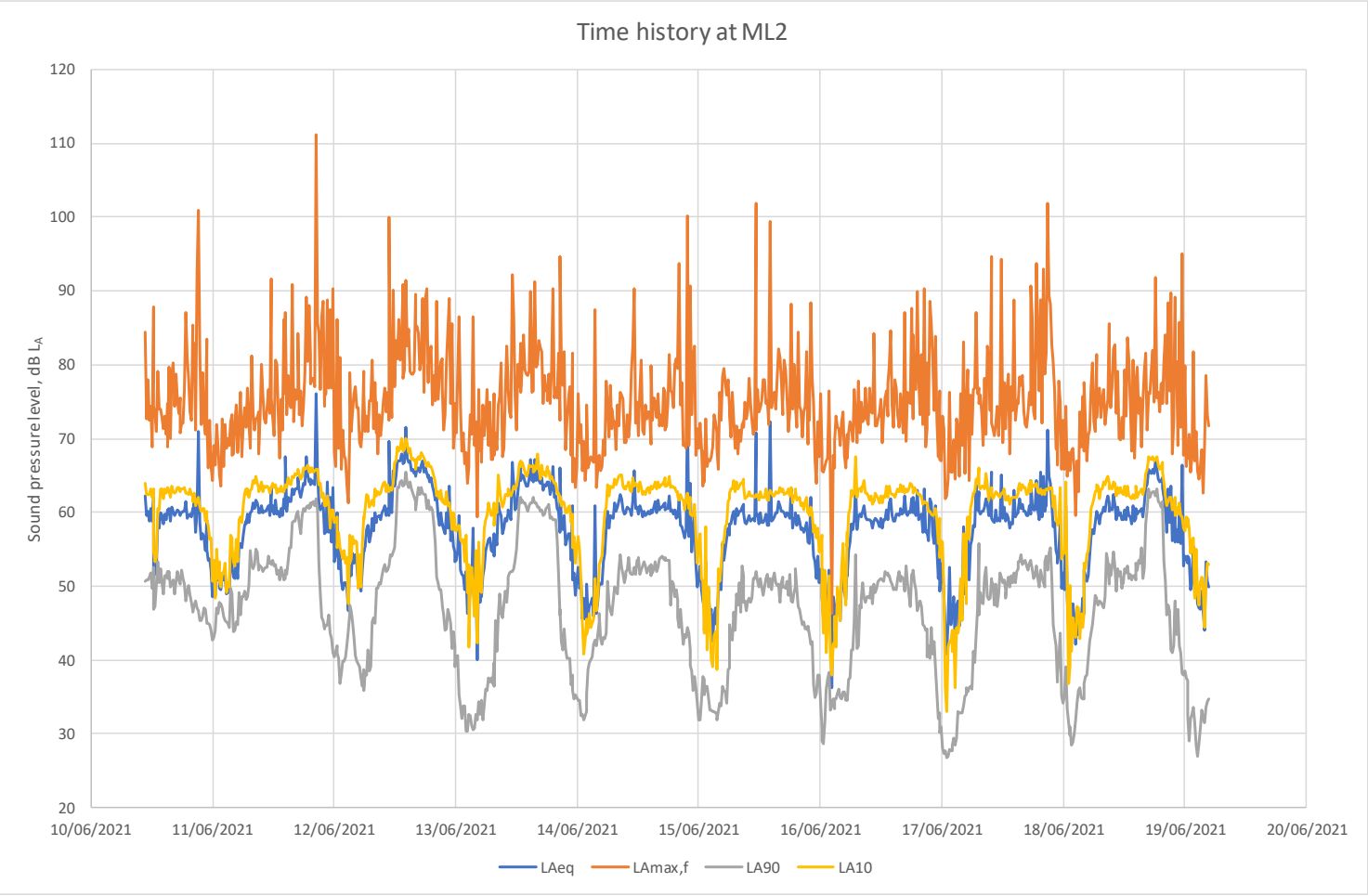


Figure 3.3 - ML02 noise levels



BACKGROUND SOUND LEVEL DATA ANALYSIS

The measured noise levels have been analysed to determine the day and night-time background sound level for weekday and weekend periods. The methodology used follows the statistical approach presented in BS 4142.

The measured levels in conjunction with the spread of noise levels, are used to determine the representative background sound level.

Where noise from the funfair on the site of the Proposed Location is considered to have affected the L_{A90}, this has been discounted from the analysis.

Table 3-7 - ML01 background sound levels, dB(A)

Noise Index/Indicator	Daytime (07:00-19:00)	Evening (19:00-23:00)	Night-time (23:00-07:00)
Arithmetic average $L_{A90,15min}$	50	51	50
Mode $L_{A90,15min}$	52	52	50
Maximum $L_{A0,15min}$	56	55	53
Minimum $L_{A90,15min}$	36	43	38
Selected Representative Value	**52**	**52**	**50**

Table 3-8 - ML02 background sound levels, dB(A)

Noise Index / Indicator	Daytime (07:00-19:00)	Evening (19:00-23:00)	Night-time (23:00-07:00)
Arithmetic average $L_{A90,15min}$	51	46	38
Mode $L_{A90,15min}$	52	47	35
Maximum $L_{A0,15min}$	59	61	51
Minimum $L_{A90,15min}$	37	37	27
Selected Representative Value	**52**	**47**	**35**

Histogram charts showing the spread of the background noise levels over the measurement period are shown in Figure 3.4 to Figure 3.9.

Figure 3.4 - ML01 Daytime (07:00-19:00) $L_{A90,15min}$ histogram

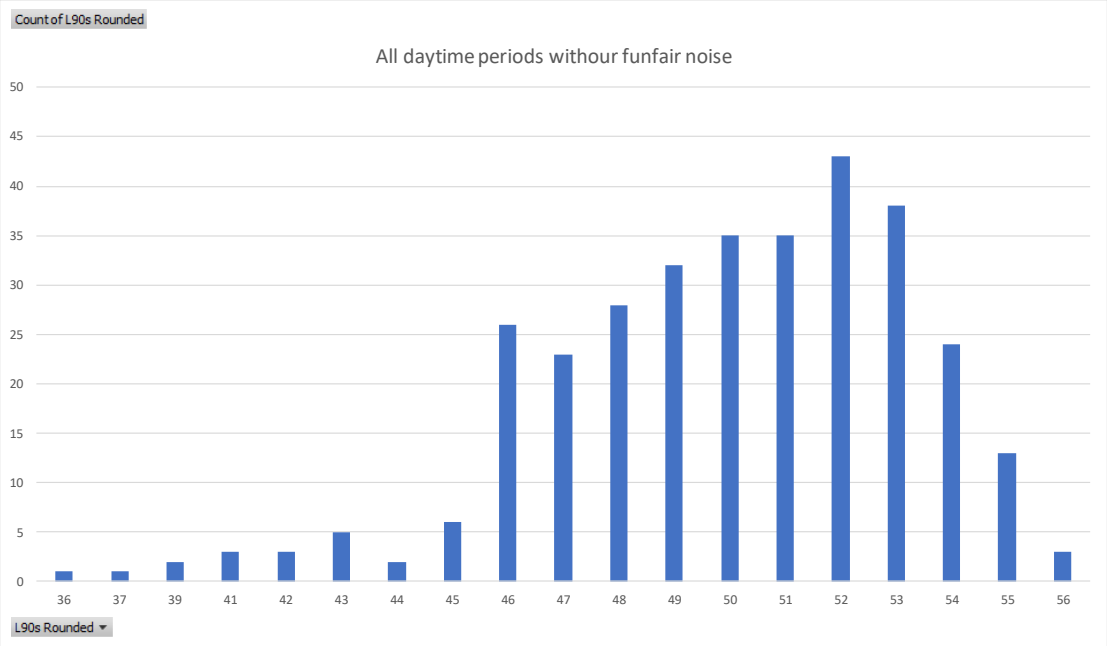


Figure 3.5 - ML01 Evening (19:00-07:00) $L_{A90,15min}$ histogram

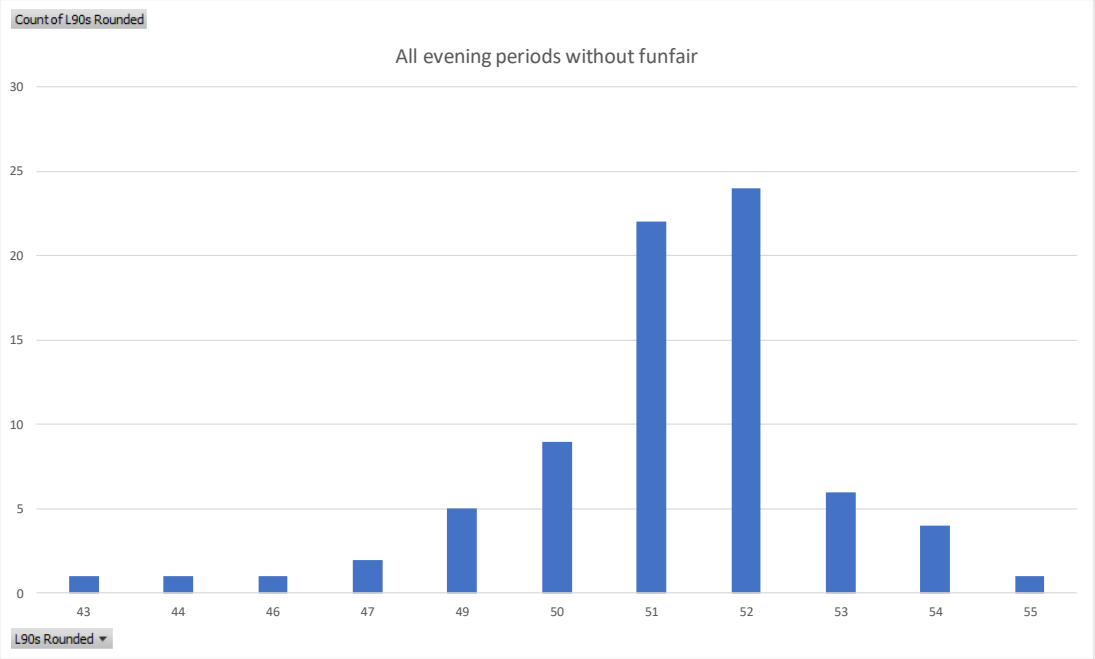


Figure 3.6 - ML01 Night-time (23:00-07:00) $L_{A90,15min}$ histogram

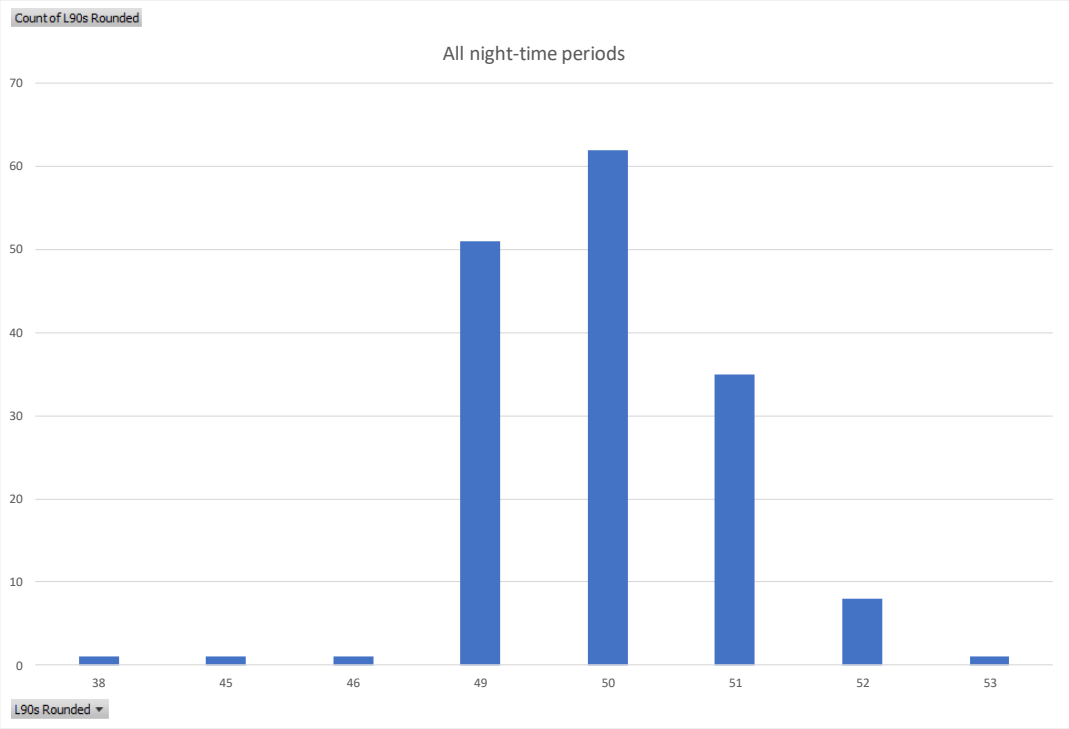


Figure 3.7 - ML02 Daytime (07:00-19:00) $L_{A90,15min}$ histogram

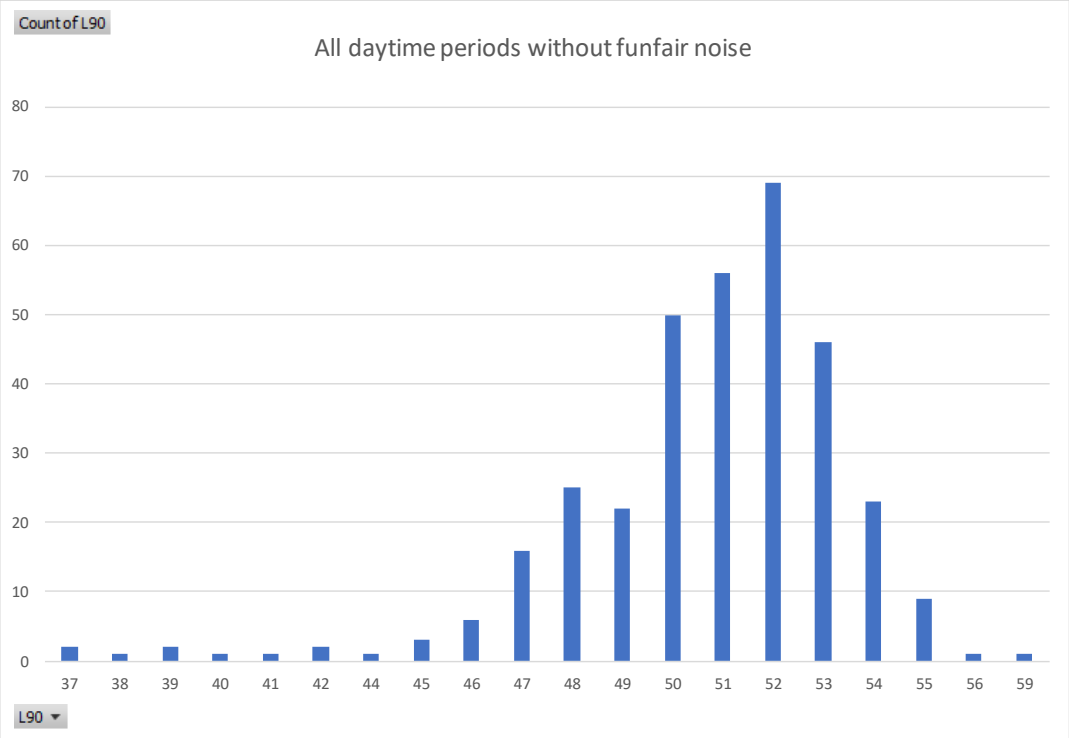


Figure 3.8 - ML02 Evening (19:00 – 9:00) $L_{A90,15min}$ histogram

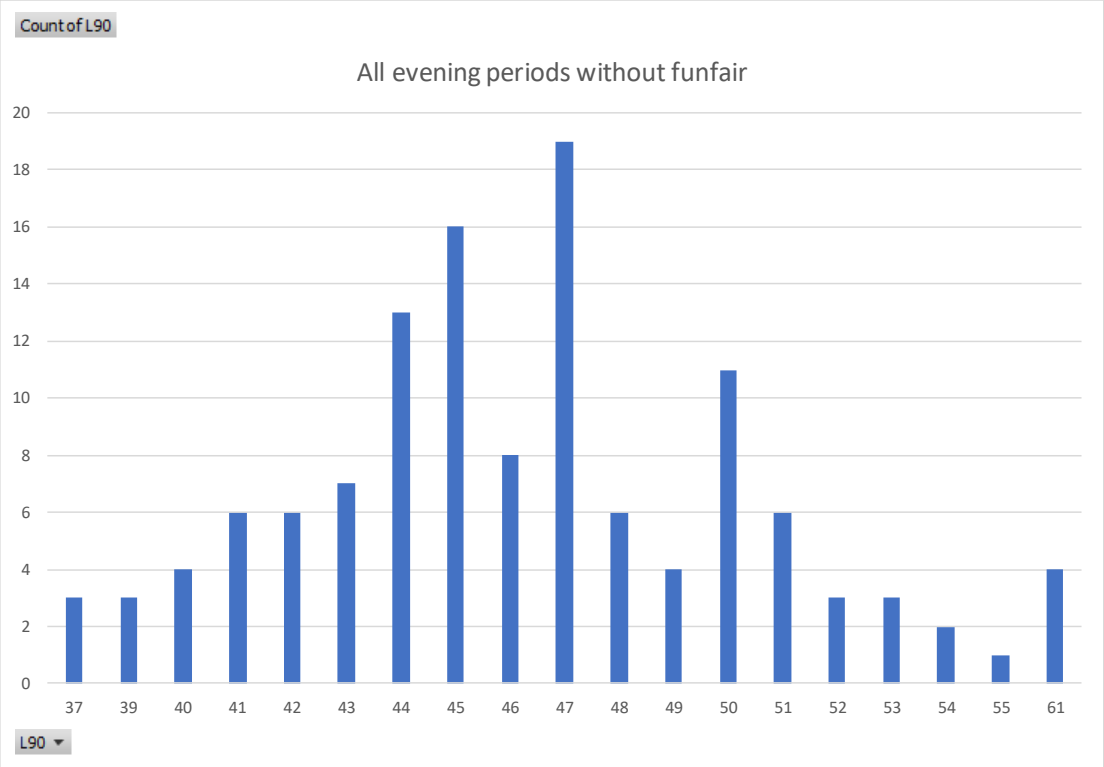
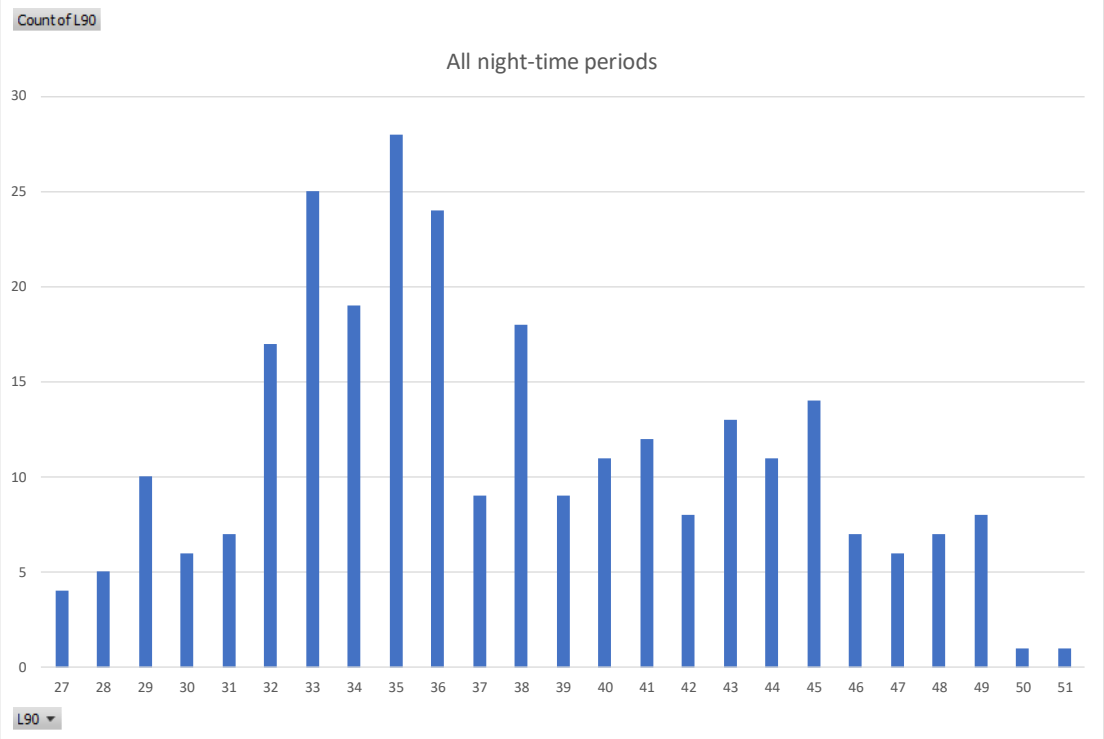


Figure 3.9 - ML02 Night-time (23:00-07:00) $L_{A90,15min}$ histogram



Comparison of attended measurements

Two sets of short duration attended measurements were made at locations P1 to P6: the first during a school holiday (3 June) and the second during term time (10 June). The intention of these measurements was to identify possible differences in road traffic noise levels during periods which could coincide with peak and interpeak operational hours at the Proposed Development. It was also hoped that some comparisons could be made to 2019 baseline traffic flows to see if any Covid related effect on road traffic could be identified and thus whether the measured baseline could be deemed to be representative of 'typical' conditions.

Unfortunately, during the second survey on 10 June 2021, a road traffic accident along Marine Road Central shortly after the survey commenced resulted in disruption to the survey due firstly to emergency vehicles passing the measurement position and subsequently to diverted traffic and standing traffic on Marine Road Central. Only one of the three intended measurements could be made at locations P1, P2 and P3. This also impacted P5 and P6 due to diverted traffic along Central Drive.

Nevertheless, comparisons were made of the calculated basic noise level (BNL), corrected for traffic speed and %HGV, against measured road traffic noise levels ($L_{A10,18hr}$ as derived using the CRTN shortened measurement procedure) at the nearest measurement location to the road link for which data is available, corrected to a reference distance of 10m.

The results of this analysis are provided below:

Table 3-9 – Comparison of predicted BNL against measured BNL

	Marine Road Central (Broadway to Central Drive) dB $L_{A10,18hr}$	B5321 Euston Road (Euston Rd to Central Drive railway station) dB $L_{A10,18hr}$	B5321 Central Drive (railway station to Promenade) dB $L_{A10,18hr}$
Predicted BNL from 2019 baseline data			
Peak 2019 baseline BNL	58.2	63.7	59.8
Inter-peak 2019 Baseline BNL	59.9	65.0	61.4
Measured BNL			
Nearest measurement location	P1	P4	P6
Half term (Peak) - as measured	65.0	67.5	63.5
Normalized to 10m	64.0	63.5	59.5
Predicted minus measured	-5.8	0.2	0.3

	Marine Road Central (Broadway to Central Drive) dB $L_{A10,18hr}$	B5321 Euston Road (Euston Rd to Central Drive railway station) dB $L_{A10,18hr}$	B5321 Central Drive (railway station to Promenade) dB $L_{A10,18hr}$
Term time (Interpeak) - as measured	64.9	67.4	N/aA
Normalized to 10m	63.9	63.4	N/A
Predicted minus measured	-4.0	1.6	N/A

The following observations were made:

- The measured levels during half-term (Peak) and term time (Interpeak) did not vary significantly (around 0.1dB), unlike the predicted levels where there was a difference of around 1.5dB.
- There is close correlation (within 0.3 dB) between half-term measurements (i.e. during Peak operational period) and 2019 baseline road traffic predictions for Euston Road and Central Drive.
- At Euston Road, the measured Interpeak level was lower (by 1.6dB) than predicted.
- At Marine Road Central, the half-term (Peak) measured level was almost 6dB higher than predicted. The Interpeak measured level was 4dB higher.

In summary, there was very good correlation between measured and predicted Peak period BNLs along Euston Road and Central Drive, although Interpeak did not correlate so well as measured levels did not drop significantly during the second set of measurements on 10 June 2021. However, it should be noted that a comprehensive set of reliable measurements was not possible on this date due to the road traffic accident on Marine Road Central. Correlation between measured and predicted BNLs along Marine Road Central was, however, relatively poor with measured levels being higher than predicted levels based on 2019 traffic data, the reasons for which are unclear, but may be due to higher visitor numbers during the periods surveyed, compared with 2019 levels.

This assessment has utilised the 2021 measurement data as the baseline noise level.

4

NOISE MODEL PARAMETERS

4. NOISE MODEL PARAMETERS

An acoustic model of the Site and Proposed Development was created in DataKusttik GmbH CadnaA 2021 MR2 (64-bit). The following approach was adopted in generating the noise model:

- For operational noise, the model was set to apply the following standards/guidance: Industrial sources: ISO 9613-2:1996: Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation (ISO 9613-2);
- Open source LIDAR Composite DTM (Digital Terrain Model) raster elevation data at 2m spatial resolution topographic data is incorporated into the model for the existing application site and surrounding area, extending to encompass the nearest receptors;
- Topographical data taken from landscape general arrangement drawing ref. EDNN-TEP-ZZ-ZZ-DR-L-001, Rev P01 supplied by the applicant has replaced the above DTM data within the Proposed Development redline boundary for the purposes of assessing the operational impact;
- Building facades are set to be acoustically reflective and the model includes second order reflections from solid structures;
- Existing buildings were incorporated based on Ordnance Survey (OS) mapping and aerial photography.
- Globally, ground absorption was set to G=0 (acoustically reflective ground) with areas of existing foliage, vegetation or grassland included separately with ground absorption set to G=1.0 (acoustically absorptive ground);

Noise from Outdoor Events

- For outdoor event noise, a generic public address (PA) loudspeaker arrangement (with main speakers to the left and right of the stage plus sub-woofer at the centre of the stage) has been modelled using typical directivity patterns (as provided by the PA supplier for the Liverpool International Music Festival) and the ISO 9613-2 propagation model;

Noise from Car Parks and Park and Ride

- Car park and Park and Ride noise modelled using the LfU PAN module within CadnaA based on input parameters stated in Section 7 of this report;

Construction Noise

- Construction noise modelled using BS5228-1 module within CadnaA (in terms of the $L_{Aeq,12hr}$ metric at the nearest sensitive receptors);
- Construction noise source data from BS 5228-1 database unless otherwise stated;
- Noise from each construction phase modelled as single point source with all activities combined logarithmically, at likely closest location to noise sensitive receptors, with height of 1.0m above ground.

Construction Noise Model for Ecological Receptors

- Natural England requested noise contour plots for both L_{Aeq} and L_{Amax} construction noise levels and for baseline noise levels for the purposes of comparative assessment. As the BS5228-1 database does not generally include L_{max} source data for individual noise events, it was assumed that the typical L_{Amax} from general construction activities approximated to $L_{Aeq,T}$ +10 dB. This is based on WSP's own measurement library and is considered a reasonable estimate for general site activities (including non-percussion piling techniques).

- The baseline L_{Aeq} noise contour plot for the ecological receptors was generated based on long-term measurement data for weekday daytime ambient noise levels measured at ML2 and verified against short duration daytime measurements made at locations P1, P2, P3 and P7. This was modelled within CadnaA as road sources using the CRTN module.
- The typical L_{Amax} contour was determined by calculating the 95th percentile $L_{Amax,15min}$ for weekday daytime noise levels measured at ML2 and applied as a line source centred on Marine Road Central. This is considered reasonable as road traffic is the dominant noise source determining baseline ambient daytime noise levels in the vicinity of ecological receptors. This was modelled within CadnaA as a moving point source with height 0.5m.

5

CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

PUBLIC

5. CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

CONSTRUCTION NOISE

The assessment of construction noise has been undertaken in accordance with BS 5228-1 and with reference to the results of the baseline noise survey.

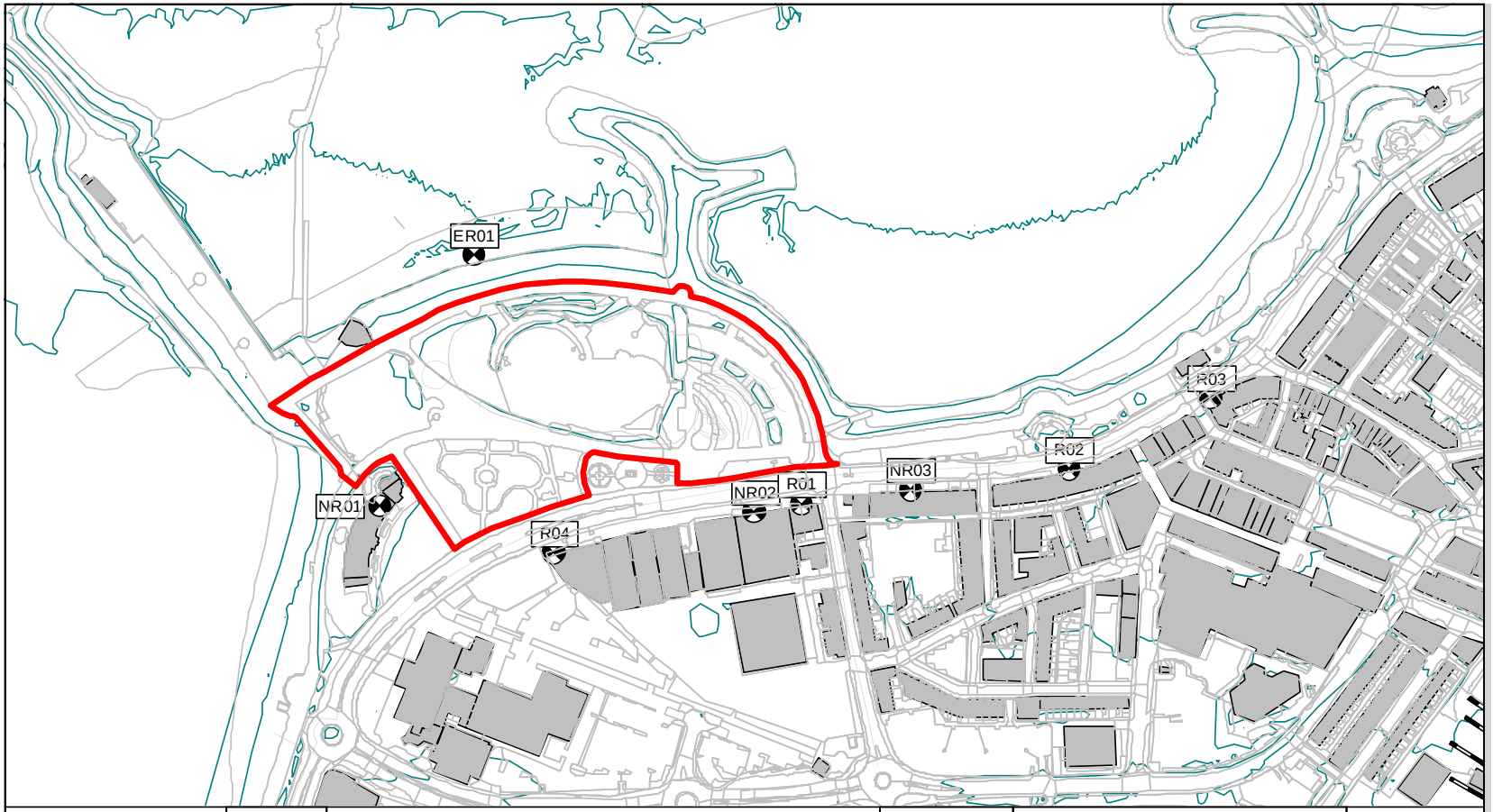
Construction noise level predictions and assessments have been completed at a selection of noise sensitive receptors within 300m of the Proposed Scheme, as described below:

- Residential receptor R01 – Flat at second floor above Costa Coffee on Marine Road Central, adjacent to the Winter Gardens;
- Residential receptor R02 – Flat above shops opposite Eric Morecambe statue, Marine Road Central;
- Residential receptor R03 – Flat at second floor on corner of Marine Road Central and Pedder Street ;
- Residential receptor R04 – Flat at first floor above Rita's Café, adjacent to the Goods Yard car park on Marine Road Central;
- Non-residential receptor NR01 – Third floor rooms of Midland Hotel, Marine Road Central;
- Non-residential receptor NR02 – Second floor balcony of the Winter Gardens, Marine Road Central ;
- Non-residential receptor NR03 – Second floor rooms of Lakeland Rooms Hotel, Marine Road Central; and
- Ecological receptor ER01 – Free-field location 30m north of site boundary, on beach approx. 100m east of RNLI station.

The assessment of potential noise impacts has been provided in the Ecology chapter but the predicted construction noise levels provided to the Ecologist are presented here.

The locations of the above receptors are shown in Figure 5-1 with coordinates provided in Table 5-1.

Figure 5-1 - Receptors used in Construction Noise Assessment



	Author: S. Faircloth	**Eden Project North**	Project No.	70083611
			Project Title	Eden Project North Noise and Vibration Assessment
	Checked: S. Whydle	Assessment receptors	Drawing No.	
	Scale: 1:4000		Date	01.09.21

Standard construction working hours are assumed to be 07:00 to 18:00 hours. Whilst extended working hours would not be the norm, it is possible that some working may be required on Saturdays between 08:00 and 16:00. No working is envisaged on Sundays or Bank Holidays.

In order to determine the ambient noise level applicable at the assessment locations, the CadnaA model was calibrated against long-term daytime sound levels measured at location ML2. The values of L_{day}, derived from the short term attended measurement data at locations P1 to P3 and reported in Table 3-6, were used as additional model verification points. This approach is considered reasonable as road traffic noise is dominant for receptors located along Marine Road Central. In the case of assessment location NR01, long term daytime ambient noise levels measured at location ML01 were used in preference to the predicted levels due to the greater distance from Marine Road Central and the subsequent influence of other noise sources, e.g. nearby building services plant that contributes to the acoustic climate at this location.

Daytime construction noise thresholds have subsequently been determined for each receptor in association with the BS 5228-1 'ABC method', as shown in Table 5-1. Note that hotels have been assumed to have the same construction noise threshold as dwellings.

Table 5-1 - Construction noise thresholds

Receptor	X Coordinate	Y Coordinate	Ambient sound level ($L_{Aeq,T}$) in dB(A)	Construction noise threshold ($L_{Aeq,T}$) in dB(A)
R01	343131	464406	62[6]	65 (Category A)
R02	343324	464431	63[6]	65 (Category A)
R03	343426	464483	64[6]	65 (Category A)
R04	342952	464370	61[6]	65 (Category A)
NR01	342826	464404	54[7]	65 (Category A)[8]
NR02	343097	464400	61[7]	N/A (not noise sensitive)[9]

[6] Baseline ambient sound level derived from CadnaA model prediction

[7] Baseline ambient sound level derived directly from long-term measurement data

[8] Hotels have same construction noise threshold as dwellings

[9] The Winter Gardens is primarily a performance arts venue hosting live music and therefore not sensitive to daytime construction noise. Construction thresholds are not applicable although construction noise levels have been predicted as the receptor was identified by the Local Authority as being of interest.

Receptor	X Coordinate	Y Coordinate	Ambient sound level ($L_{Aeq,T}$) in dB(A)	Construction noise threshold ($L_{Aeq,T}$) in dB(A)
NR03	343210	464416	62[6]	65 (Category A)
ER01	342894	464586	40[6]	N/A (not assessed to BS 5228-1)

At this stage, the type and number of construction plant items, the programme and working methodologies to be applied are not known; these would be dependent upon the Contractor, who would be appointed after planning approval. To inform this assessment, it has been necessary to make assumptions regarding the plant likely to be used, their number and 'on-time' (i.e. the percentage of time in operation). These assumptions are based on professional experience of similar developments.

The key construction stages are:

- Site Setup;
- Demolition;
- Earthworks;
- Piling and concrete works;
- Building construction; and
- Roadworks.

Construction phases are assumed to be undertaken separately. It is appreciated that some of the construction phases may overlap, however, the approach adopted is representative of predicting likely significant effects given that in the case of any such overlapping operations, it will be the closest operations to the receptor that will generally dictate the resulting noise levels.

In practice, the plant items identified for each phase will move around the site, operating at different times, for different durations and at different locations on any one day. Consequently, noise levels at any receptor may vary considerably day-on-day. It is necessary to rationalise the geographic and temporal spread of activities to obtain a meaningful prediction (and subsequent assessment).

The assumed type and number of plant items associated with key construction working stages are presented in Table 5-2. The table details the source information and sound pressure level attributed to each plant item.

Table 5-2 - Construction working stages and plant items

Plant Item	BS 5228-1 Ref.	SPL @ 10m (dBA)	No. of Items Operating in Parallel	On-Time (% of working day)
Site Setup				
Hiab	C2.27	80	1	50
Excavator	C2.5	76	1	50

Plant Item	BS 5228-1 Ref.	SPL @ 10m (dBA)	No. of Items Operating in Parallel	On-Time (% of working day)
2T Dumper	C4.9	77	1	50
Fork Lift	WSP Library	72	1	25
Sweeper	C4.90	76	1	20
Generator	C4.84	74	1	100
Wheelwash	WSP Library	65	2	10
Demolition				
Telehandler	C4_54	79	1	30
Tipper Lorry	C8.20	80	1	25
Hiab Delivery	C2.27	80	1	30
Demolition, Breaking and spreading rubble, Tracked excavator	C1_12	82	1	60
Breaking up concrete	C1_5	72	1	25
Wheelwash	WSP Library	65	2	10
Earthworks				
Tipper Lorry	C8.20	80	2	50
Excavator	C2.3	78	3	60
Dozer	C2_10	80	2	60
Vibratory roller	C2.40	67	2	10
Generator	C4.84	74	1	100
Wheelwash	WSP Library	65	2	10
Piling and concrete works[10]				

[10] Buro Happold has confirmed that percussive piling techniques are unlikely to be required during construction of the Proposed Development and that continuous flight auger (CFA) piling is the anticipated method

Plant Item	BS 5228-1 Ref.	SPL @ 10m (dBA)	No. of Items Operating in Parallel	On-Time (% of working day)
CFA piling; crawler mounted rig	C3.22	80	1	50
CFA piling; tracked excavator	C3.23	68	2	50
CFA piling; tracked excavator (inserting metal cage)	C3.24	74	1	30
CFA piling; concrete pump	C3.25	78	1	20
Compressor & poker vibrator	C4.33	79	3	10
Wheelwash	WSP Library	65	2	10
Building construction				
Tower Crane	C4.48	77	1	20
Goods Hoists	C4.61	68	2	95
Passenger Hoists	C4.62	66	2	55
Mobile Elevated Working Platform (MEWP)	C4.57	67	4	50
4 Tool Compressor	C3.19	75	2	20
Generator	C4.84	74	1	100
Wheelwash	WSP Library	65	2	10
Roadworks				
Road breaker (handheld pneumatic)	C5.3	82	1	10
Ashphalt Paver	C5.30	76	2	33
Vibratory roller	C5.20	75	2	33
Wheeled loader	C2.27	80	1	33
Generator	C4.84	74	1	100
Wheelwash	WSP Library	65	2	10

In practice, activities would take place at different times and durations, and would move around the Site; consequently, construction noise at any receptor is likely to vary. It is necessary to rationalise the geographic and temporal spread of activities to obtain a meaningful prediction and subsequent appraisal. The most important assumptions relate to the type and number of plant items, operational on-time and location of equipment.

Calculations have been undertaken based on all plant items positioned at a single location for each phase of work and at a point considered the likely closest location to each receptor. For example: piling and building construction is assumed at the nearest building footprint to the receptor; earthworks is assumed at the nearest excavated area. If the location of the proposed construction phase of work is unclear, a notional location 30m inside the Site boundary is assumed. This approach is considered to represent a realistic worst-case scenario because due to the size and orientation of the site, the majority of the construction works will occur further away.

Construction noise at sensitive receptors is calculated using the BS 5228-1 method, using the following assumptions:

- Ground assumed to be acoustically reflective (G=0);
- Assumed imperforate site hoarding 2.4m high around perimeter of site;
- Source height 1.0m above ground;
- Receiver height at maximum floor height of receptor (generally 6.5m above ground for 2nd floor dwellings but higher where relevant, e.g. Midland Hotel);
- Predicted levels are assessed 1m from the façade at receptors R01 to R03 and include façade reflections; and
- The predicted level at ER01 (ecological receptor) is free-field at a notional height of 1.5m above ground.

Table 5-3 sets out the resulting construction noise levels calculated for each receptor.

Table 5-3 - Predicted construction façade noise levels, $L_{Aeq,\ 12hr}$ dB

Receptor	Predicted construction noise levels at working stage, dB $L_{Aeq,12hr}$					
	Site Setup	Demolition	Earthworks	Piling and concrete works	Building construction	Roadworks
R01	61	63	66	61	59	62
R02	50	52	55	49	48	50
R03	49	48	51	47	46	50
R04	62	62	67	59	58	61
NR01	63	62	67	61	60	64
NR02	65	66	68	63	62	67
NR03	55	58	61	55	54	55
ER01	52	53	57	50	49	51

The predicted construction noise levels have been compared against threshold criteria for each receptor. The results are given in Table 5-4. A negative value represents compliance, a positive value represents an exceedance.

Table 5-4 - Construction noise compliance, dB

Receptor	Exceedance in construction noise threshold levels at working stage, dB					
	Site Setup	Demolition	Earthworks	Piling and concrete works	Building construction	Roadworks
R01	-4	-2	+1	-4	-6	-3
R02	-15	-13	-10	-16	-17	-15
R03	-16	-17	-14	-18	-19	-15
R04	-3	-3	+2	-6	-7	-4
NR01	-2	-3	+2	-4	-5	-1
NR02	-	-	-	-	-	-
NR03	-10	-7	-4	-10	-11	-10
ER01	-	-	-	-	-	-

It can be seen from Table 5-4 that for all working stages and receptors, the construction noise assessment criteria are met, with the exception of earthworks at receptors R01, where an exceedance of +1dB is identified, and R04 and NR01, where an exceedance of +2dB is identified at each. It is to be noted that two temporary spoil storage areas have been identified in the Logistics report close to the location of receptor NR01 (Midland Hotel). Depending on their height, these spoil areas are likely to provide additional screening to the hotel from much of the proposed Site. Whilst it is acknowledged that the height and location of such spoil areas will vary depending on the stage of construction works, the presence of such spoil areas may nevertheless result in lower construction noise levels at this receptor than predicted above.

Where the predicted noise levels do not exceed the assessment thresholds, there will be a direct, temporary, local adverse **negligible** impact**.** This effect is **not significant**. In addition, the NPSE classification is NOEL.

For receptors R01, R04 and NR01, during earthworks (within 30m of the Site boundary), an exceedance of +1dB, +2dB and +2dB above the threshold respectively is predicted. The magnitude of impact is **minor** and the NPSE Classification is LOAEL. The effect would be short-term, direct and temporary. It is assumed that the duration of exceedance would be short, i.e. not in excess of a period of 10 or more days in 15 consecutive days or for a total number of days exceeding 40 in a six month period. The effect is therefore **not significant.**

It is recognised that occasionally, higher construction noise level could arise, for example, if works are required within 30m of the Site boundary at the closest point to sensitive receptors. However, such works would be occasional, of short duration and therefore not significant.

It is also recognised that the noise levels would be dependent upon the final masterplan and construction schedule that is brought forward. For example, higher noise levels could arise if extended weekend or night-time working is required, which would be of short duration and subject to agreement with the Local Authority.

ECOLOGICAL RECEPTOR

Assessment of the potential impact from construction noise at ecological receptors is addressed within the Ecology chapter.

The following noise contour plots were generated from the CadnaA model and formed the basis of the ecological assessment:

Figure 5-2 - Baseline noise levels for ecological impact assessment, dB $L_{Aeq,12hr}$

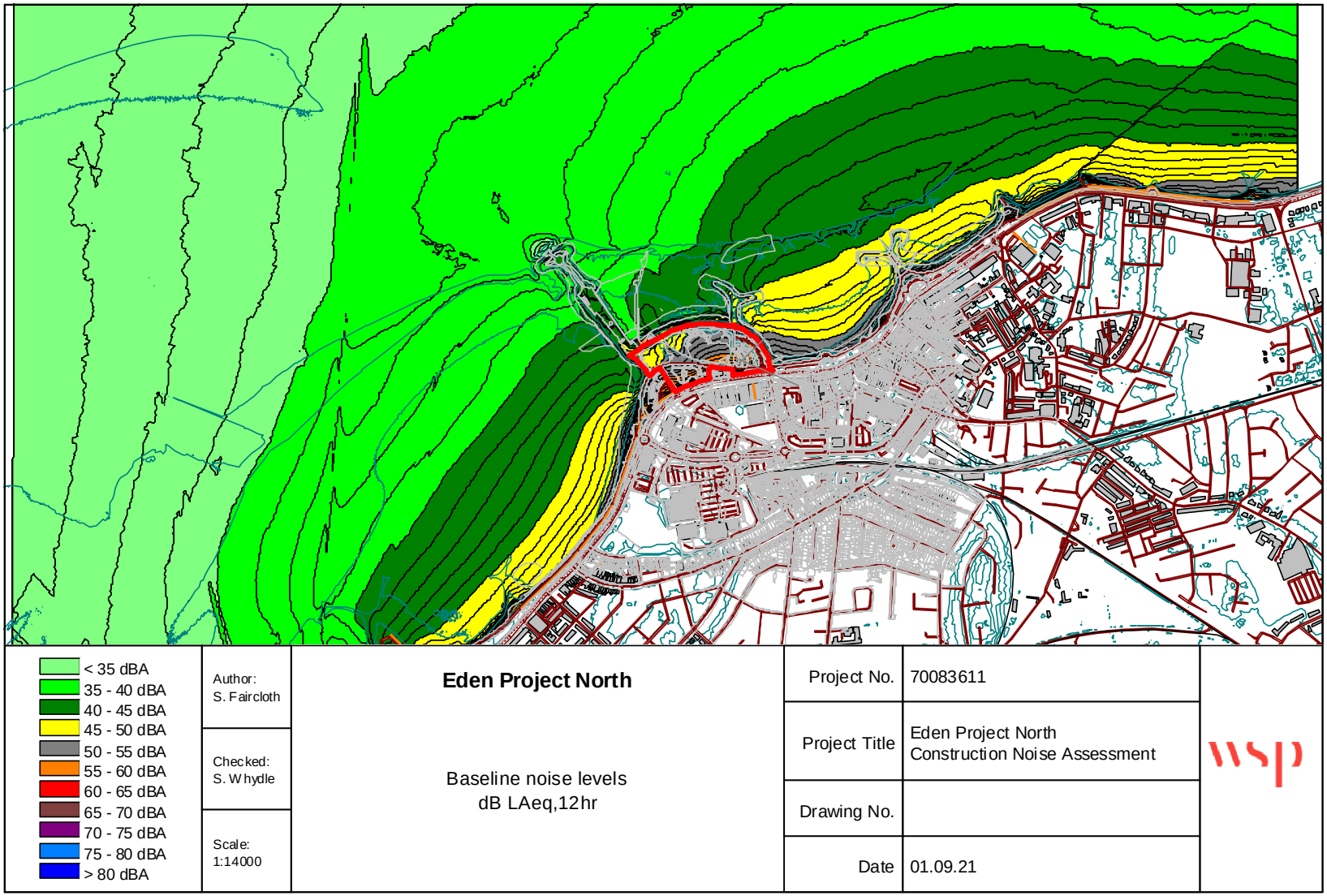


Figure 5-3 - Baseline noise levels for ecological impact assessment, dB $L_{Af,max}$

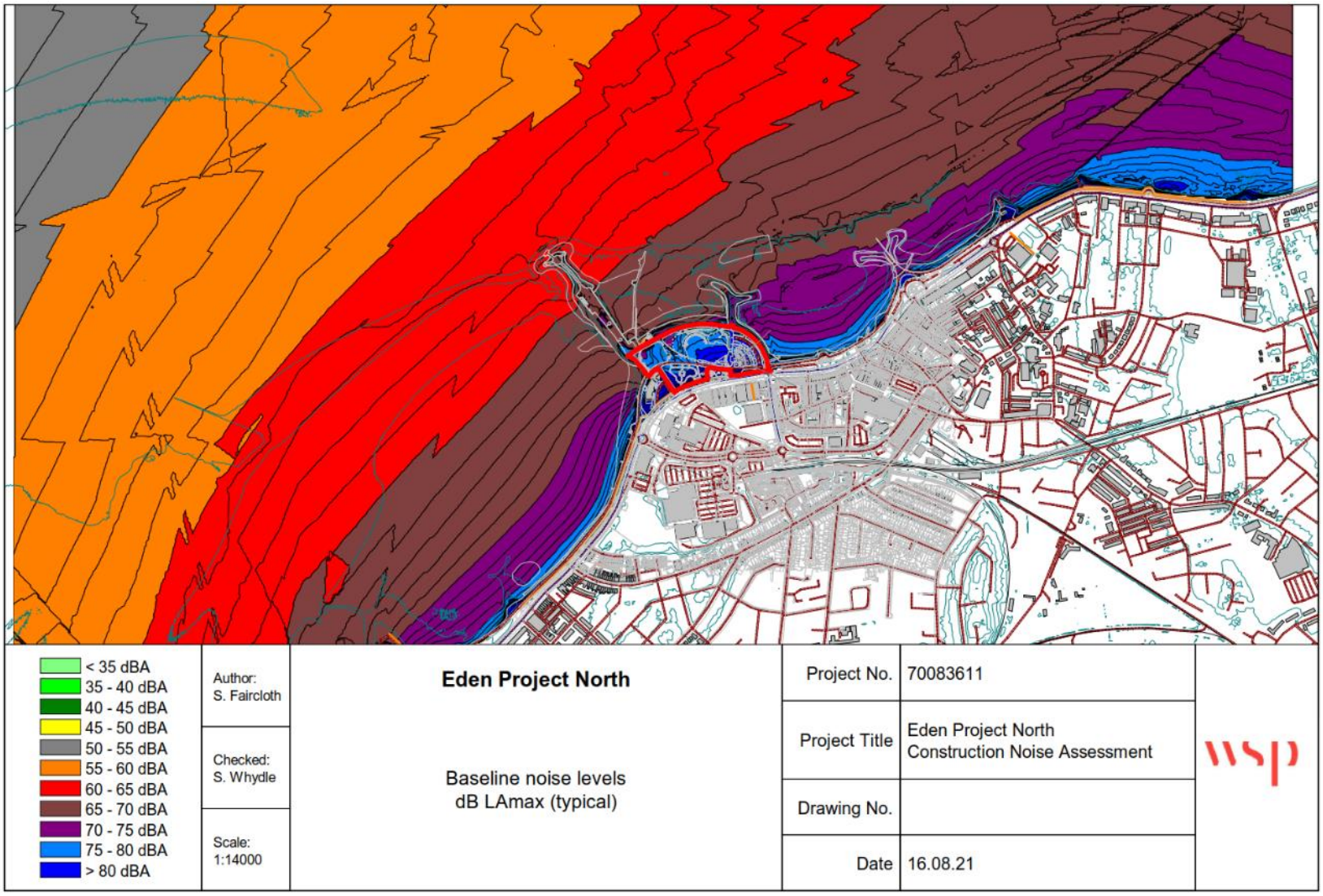


Figure 5-4 - Construction noise levels (Earthworks phase) for ecological impact assessment, dB $L_{Aeq,12hr}$

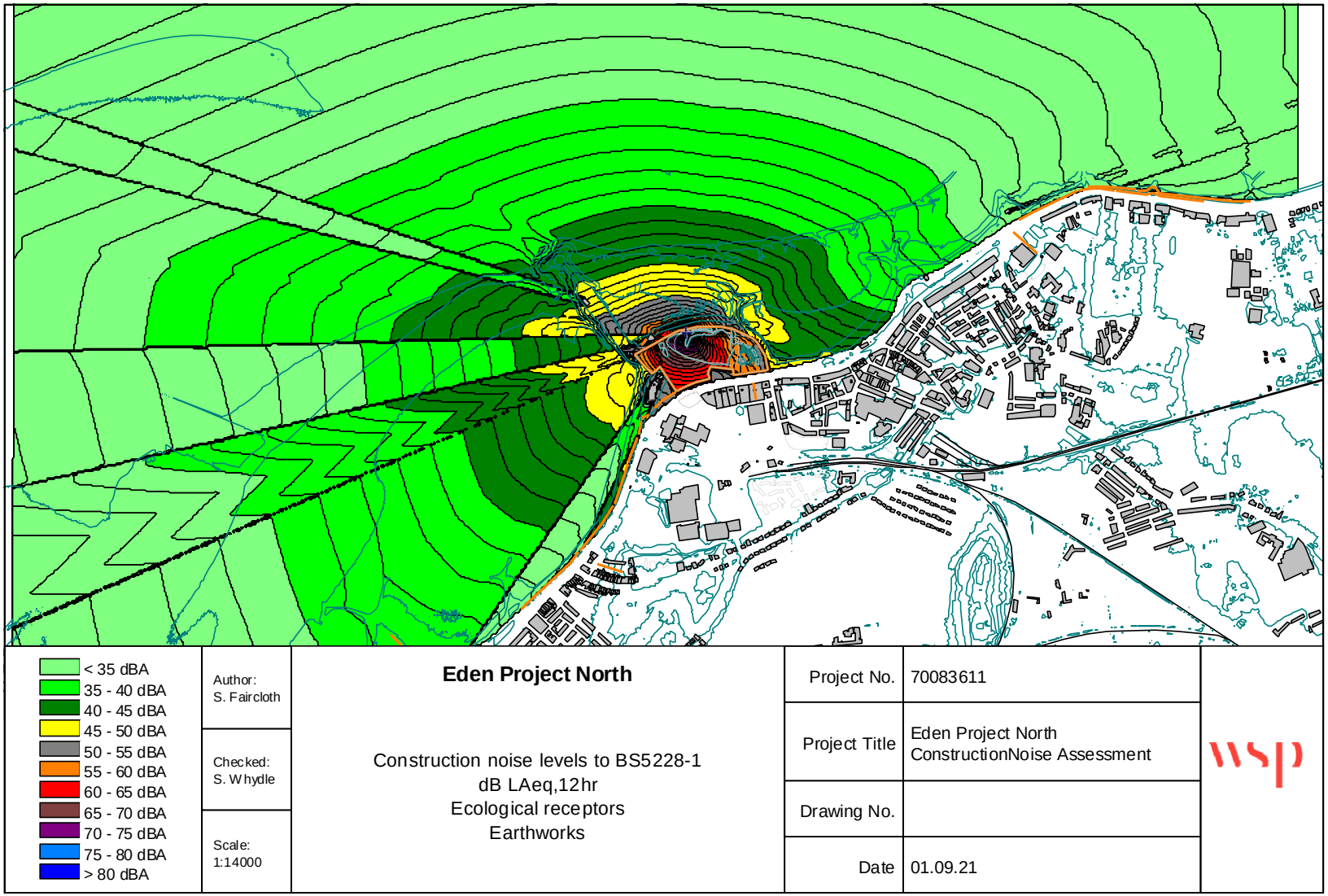
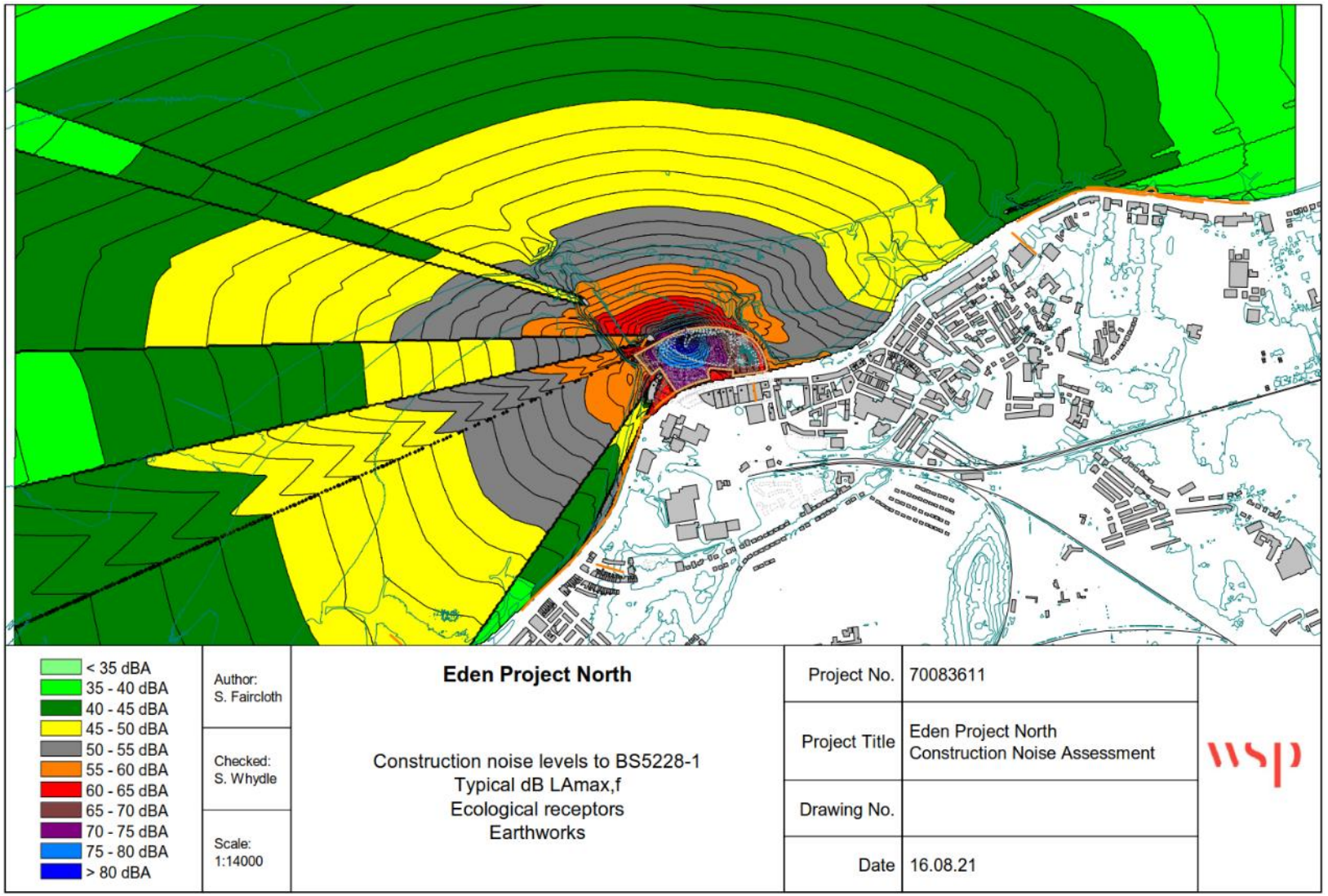


Figure 5-5 - Construction noise levels (Earthworks phase) for ecological impact assessment, dB $L_{Af,max}$



WEEKEND WORKS

It is understood that Lancaster City Council (LCC) do not normally permit weekend working. However, the results of the assessment show it is likely that construction noise thresholds could be met without stringent mitigation measures.

For works required to be completed outside normal hours the appointed Contractor may apply for prior consent under Section 61 of the Control of Pollution Act 1974. Applications would include details of the works, locations, timings, plant and mitigation measures.

MITIGATION

Significant adverse effects are not predicted, however, consideration has been given to mitigation measures to reduce impact of construction noise and which would allow greater margins of compliance.

The adoption of Best Practicable Means (BPM), as defined in Section 72 of the *Control of Pollution Act 1974*, is usually the most effective means of controlling noise from construction sites. Such measures would be included within a Construction Environmental Management Plan (CEMP), to which the appointed contractor will be required to comply. Appropriate measures include:

- The contractor and their sub-contractors will at all times apply the principle of BPM as defined in Section 72 of the Control of pollution act 1974 and carry out all work in such a manner as to avoid or reduce any disturbance from noise (and vibration) as far as is practicable.
- Guidance given in BS 5228-1 (Section 8: *Control of noise and Annex B: Noise sources, remedies and their effectiveness*) will be followed as far as is practicable and advice and training on noise minimisation given to staff during Site induction procedures.
- All plant brought on to Site will comply with the relevant EC/UK noise limits applicable to that equipment or should be no noisier than would be expected based on the noise levels quoted in BS 5228-1. Each plant item will be well maintained and operated in accordance with manufacturers' recommendations and in such a manner as to minimise noise emissions.
- Electrically powered plant will be preferred, where practicable, to mechanically powered alternatives.
- The use of sound reduced plant fitted with suitable silencers, or operated within enclosures will be preferred.
- Pneumatic tools will be fitted with silencers or mufflers.
- Deliveries to Site will be programmed and routed to minimise disturbance to local residents.
- Items of plant operating intermittently will be shut down in the periods between use.
- Where feasible, all stationary plant will be located so that the noise effect at receptors is minimised and, if practicable, every item of static plant, when in operation, will be noise attenuated using methods based on the guidance and advice given in BS 5228-1.
- Careful selection of construction methods and plant will be implemented and utilised, for example, breaking-out of concrete structures using, where possible, low noise methods such as munching or similar, rather than percussion breaking.
- Temporary acoustic barriers and other noise containment measures such as screens, sheeting and acoustic hoarding at the Site boundary (and where required around individual plant) will be erected where appropriate to minimise noise breakout and reduce noise levels at potentially affected receptors.
- There will be a considerate and neighbourly approach to relations with local residents.

- The site manager, or other appointed site representative, will be responsible for logging all received environmental noise and vibration comments/complaints, as well as the action that is taken in response to each point raised, and whether this was successful. Where not successful, supplementary actions will be carried out and resulting effects logged. The contact details for the site representative will be openly advertised so that local residents have a point of contact in case of any issues arising. The site representative will be responsible for keeping an open line of contact with local residents and advising the timing and programming of potentially noisy works.

All of the above measures would be implemented through the Construction Environment Management Plan (CEMP) which would be prepared and submitted to LCC for approval. If necessary, this could also include a requirement for the undertaking of a revised construction noise assessment once the construction contractor has been appointed and the final confirmed construction working methods and programme are known. The results of this re-assessment would be used to identify any areas where construction noise has the potential to give rise to significant effects as defined within this Appendix.

RESIDUAL

The impacts arising as a result of construction noise have been identified to be **negligible** or **minor** with mitigation in the form of a 2.4m high acoustic screen around the boundary, which has been assumed within the calculations. The application of BPM will increase the margin it is predicted that noise levels at the receptors will be reduced further.

At all receptors, once mitigation measures are considered, there is likely to be a direct, temporary, local, adverse **negligible to minor** impact. This effect is considered **not significant**.

It is recognised that occasionally, higher construction noise levels could arise, for example, if particularly intensive works are required at the Site boundary closest to receptors, but that such works would not give rise to significant effects due to being occasional and of short duration.

With regards to NPSE, the worst-case construction noise impacts are predicted to be LOAEL.

CONSTRUCTION VIBRATION

The assessment of construction vibration has been undertaken in accordance with BS 5228-2. The construction vibration criteria, which are independent of time are presented in Table 5-5.

Table 5-5 - Construction vibration criteria

Construction Vibration (x) in PPV, mm/s	Magnitude of Impact	NPSE Classification
x < 0.3	Negligible to Minor	NOEL
0.3 < x < 1.0	Minor to Moderate	LOAEL to SOAEL
1.0 < x	Moderate to Major	Above SOAEL

The criteria are based on BS 5228-2 guidance on the effects of vibration levels:

- 0.3mm/s - vibration might be just perceptible in residential environments;
- 1.0mm/s – It is likely that vibration of this level in residential environments will cause complaints, but can be tolerated if prior warning and explanation has been given to residents; and
- 10 mm/s - vibration is likely to be intolerable for any more than a very brief exposure to this level in most building environments.

At this stage, the type and number of vibration generating construction plant items, the programme and working methodologies to be applied are not known; these would be based on the final design, the ground conditions, and selected by the Contractor, who would be appointed after planning approval. Percussive piling techniques can generate relatively high levels of groundborne vibration. It is understood, however, that non-percussive techniques such as continuous flight auger (CFA) will be employed during construction of the Proposed Development. As such, vibration from piling will not be considered further.

Groundborne vibration calculations have been performed for construction activities typically required for similar developments. The calculations are based on the empirical prediction procedures presented within BS 5228-2. Table 5-6 presents the distances at which vibration levels are predicted to meet the criteria thresholds, based on a specified confidence limit (where applicable).

Table 5-6 - Predicted groundborne vibration levels

Vibration generating activity	Confidence Limit	PPV (mm/s)	Minimum distance between receptor and works (m) before PPV (mm/s) exceeded.
Vibratory Rollers - start & end(1)	95	0.3	80
	95	1.0	30
	95	10	4
Vibratory Rollers - Steady State(1)	95	0.3	60
	95	1.0	25
	95	10	5
HGV Movement(2)	N/A	0.3	7
	N/A	1.0	2
	N/A	10	N/A
Excavation	N/A	0.3	9
	N/A	1.0	3
	N/A	10	N/A

(1) Assumes 2 rollers, 0.5mm amplitude, drum width of 1.3m, e.g. heavy-duty ride on roller.

(2) Assumes PPV of 1 mm/s at 2m, referenced within TRL Report 53.

The data presented in Table 5-6 is general in nature and is not site specific. In addition, different vibration generating activities may be employed other than those listed.

The following sensitive receptors are those closest to the Site boundary and have the greatest potential to be subject to significant effects:

- R01 – Accommodation above Costa Coffee, approximate distance to site boundary 28m;
- R04 – First floor flat above Rita's Café, approximate distance to site boundary 34m;
- NR01 – Midland Hotel, approximate distance from hotel rooms to site boundary 26m (approximate distance from Rotunda Bar to site boundary 4m);
- NR02 – The Winter Gardens, approximate distance to site boundary 30m; and
- NR03 – Lakeland Rooms Hotel, approximate distance to site boundary 65 m.

As with the construction noise assessment, hotel rooms have been considered to be equivalent to residential dwellings and therefore the same criteria are applicable.

Table 5-7 below presents the predicted magnitude of impact and NPSE classification at Receptor NR01, the closest sensitive receptor to the site boundary, for the vibration generating activities.

Table 5-7 - Predicted impact magnitude and NPSE classification

Vibration generating activity	Magnitude of impact	NPSE classification
Receptor NR01 – Midland Hotel (hotel bedrooms, approximately 26m from site boundary)		
Vibratory Rollers – start up	Moderate	SOAEL
Vibratory Rollers – steady state	Minor to Moderate	LOAEL to SOAEL
HGV Movements	Negligible	NOEL
Excavation	Negligible	NOEL

The results of the assessment show that for vibration to be just perceptible within sensitive rooms (PPV <0.3mm/s), vibration generating works would need to take place at distances greater than 80m from the Midland Hotel. Given that the main part of the building is located 26m from the site boundary it is likely that this will be feasible for the majority of activities, assuming similar setback distances (30m inside the Site boundary) given within the noise assessment. This would also apply to the nearest residential dwellings along Marine Road Central.

For all vibration generating activities which occur at more than 80m from sensitive receptors, vibration levels are predicted to not be perceptible (i.e. <0.3mm/s). A direct, temporary, local, adverse **negligible** impact is predicted. The effect is not significant and the NPSE classification is NOEL.

For the majority of vibration generating activities which take place within 80m of the nearest sensitive receptor, a direct, temporary, local, adverse **minor** impact is predicted. It is assumed that the duration of exceedance would be short, i.e. not in excess of a period of 10 or more days in 15 consecutive days or for a total number of days exceeding 40 in a six month period. The effect is therefore **not significant**. In addition, the NPSE classification is LOAEL.

When vibratory rollers are used within 30m of the nearest sensitive receptor, a direct, temporary, local, adverse **moderate** impact is predicted during startup and rundown and therefore has the potential to give rise to a significant effect. As this impact would only occur for a few seconds as the machine is started up and turned off at the end of the activity, the duration of exceedance would be short and would not be in excess of a period of 10 or more days in 15 consecutive days or for a total number of days exceeding 40 in a six month period. On balance, therefore, the effect is **not significant** and the NPSE classification is LOAEL.

The Rotunda Bar

The Rotunda bar is a single storey circular extension at the north-eastern façade of the main Midland Hotel building and is located within 4m of the Proposed Development's redline boundary. It is to be noted that a bar would not normally be considered to be a vibration sensitive receptor. Nevertheless, it is feasible that vibration generating activities that occur close to the eastern Site boundary may result in vibration levels up to, but not exceeding, 10mm/s PPV.

Whilst vibration levels of this magnitude would not be sufficient to cause any cosmetic damage to the building[11] it is possible that complaints may be received from patrons using the bar. It would be necessary, therefore, to ensure that the hotel management is kept fully informed in advance of any potential vibration generating activities that may take place close to the eastern Site boundary.

MITIGATION

In addition to adopting BPM and the relevant measures detailed in the construction noise mitigation section above, the following specific mitigation measures are recommended.

For vibration generating works which take place within 80m of a sensitive receptor, residents are to be notified in advance and given details of the works, including the timing and duration. Works will be programmed to ensure that the following durations are not exceeded, a period of 10 or more days in 15 consecutive days or for a total number of days exceeding 40 in a six month period.

For vibration generating works which take place within approximately 35m of sensitive receptors and resulting in predicted groundborne vibration levels in excess of 0.8mm/s PPV, residents of affected receptors will be notified in advance. In addition, works will be programmed to ensure that the following durations are not exceeded:

- A period of 10 or more days in 15 consecutive days; or
- A total number of days exceeding 40 in a six month period.

The above measures would ensure that where vibration generative working operations with the potential to give rise to a significant effect are required, these would be undertaken following a neighbourly approach and in accordance with the principles of BPM.

[11] Table B.2 of BS5228-2 advises that for a reinforced or framed structure, cosmetic damage would only be expected with a PPV of at least 50mm/s at frequencies of 4Hz and above

The above measures could be implemented through the CEMP which would be prepared and submitted to LCC for approval.

RESIDUAL

With the application of mitigation measures, the worst-case construction vibration impacts are likely to be direct, temporary, local, adverse **minor**. The effect is **not significant**.

During the startup and rundown of vibratory rollers close to the site boundary, which have the potential to give rise to a significant effect, the application of the mitigation measures will control impacts to be no worse than direct, temporary, local, adverse **minor**. The effect is **not significant.**

It is recognised that occasionally, higher construction vibration levels could arise, for example, during startup and rundown of vibratory rollers within 30m of sensitive receptors but that such works will be monitored and would not give rise to significant effects due to being short in duration.

With regards to NPSE, the worst-case construction vibration impacts are predicted to be LOAEL.

6

DEVELOPMENT GENERATED TRAFFIC NOISE ASSESSMENT

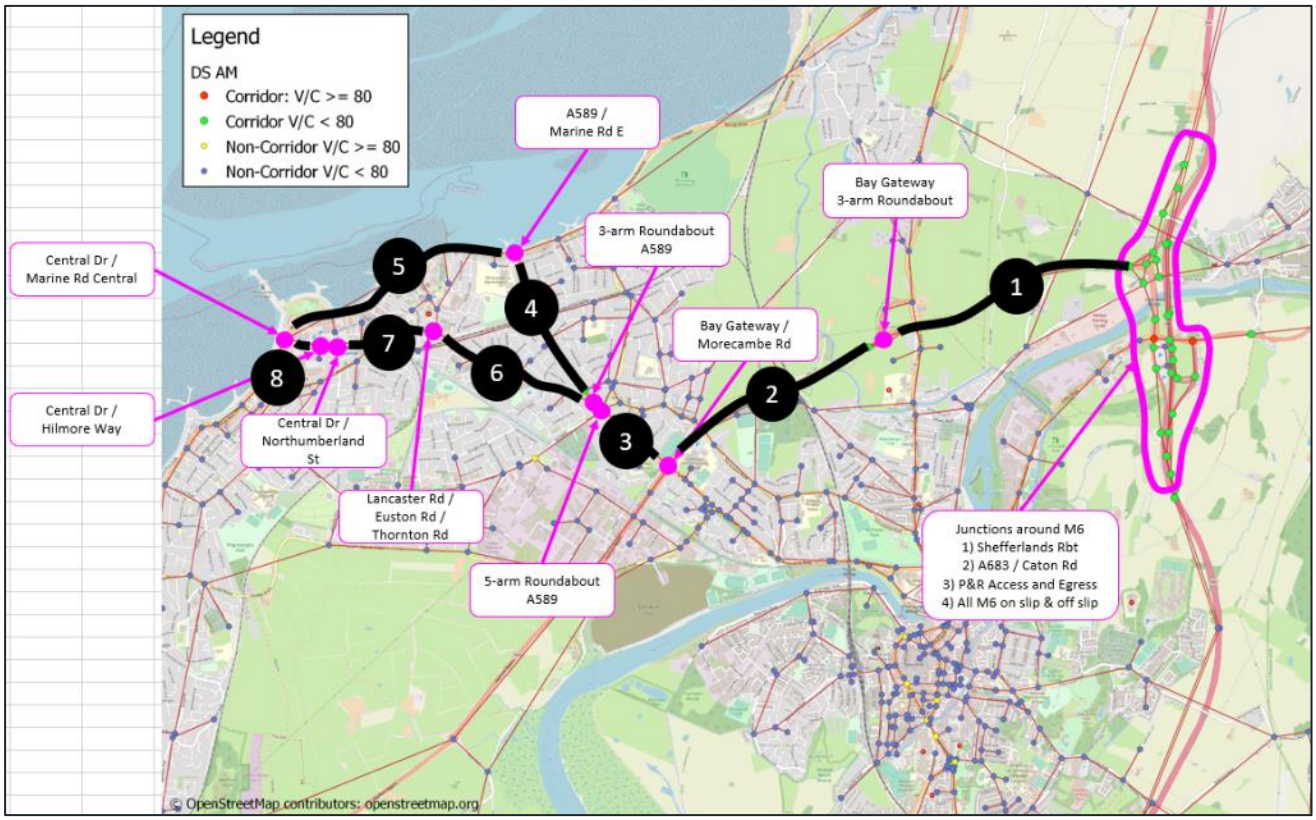
PUBLIC

6. DEVELOPMENT GENERATED TRAFFIC NOISE ASSESSMENT

The results of the **Transport Assessment** have been used as the basis for determining the change in noise levels that would arise on the local road network as a result of development generated road traffic noise.

The study area for the development generated road traffic noise assessment includes the traffic links shown in Figure 6-1, below.

Figure 6-1 – Road traffic links included in noise assessment



The links for which data were provided are summarised below:

- 1 EB - A683 Bay Gateway EB (3-arm Rdbt to M6 J34)
- 1 WB - A683 Bay Gateway WB (M6 J34 to 3-arm Rdbt)
- 2 EB - A683 Bay Gateway EB (Morecambe Rd TO3-arm Rdbt)
- 2 WB - A683 Bay Gateway WB (3-arm Rdbt to Morecambe Rd)
- 3 - A589 Morecambe Rd (Bay Gateway to Gyratory)
- 4 - A589 Broadway (Gyratory to Promenade)
- 5 - Marine Rd Central (Broadway to Central Dr)
- 6 - B5321 Lancaster Rd (Gyratory to Euston Rd)
- 7 - B5321 Euston Rd (Euston Rd to Central Dr railway station)
- 8 - B5321 Central Drive (railway station to Promenade)

The Transport Assessment has generated 18hr AAWT traffic data for the years 2019 (baseline year), 2024 (opening year - OY) and 2039 (future assessment year - FY).

The transport specialist has applied a growth factor, to enable 2039 flows to be generated. Data have been provided to include committed developments and housing infrastructure funding (HIF) developments that may contribute to traffic flows so that a cumulative impact may be assessed. The committed developments and HIF schemes included within the cumulative impact assessment are detailed in the Traffic Forecast and Economic Appraisal Report from 2019[12].

Peak, Interpeak and Off-Peak Periods

The Proposed Development is predicted to generate peak visitor number mostly during summer school holiday periods, with interpeak numbers during other school holidays and spring/summer months. Off-peak periods make up mostly winter months.

The predicted visitor calendar is presented in Figure 6-2.

Figure 6-2 - Proposed Development Typical Seasonal Calendar

January						
Mon	Tue	Wed	Thu	Fri	Sat	Sun
	1*	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

Feburary						
Mon	Tue	Wed	Thu	Fri	Sat	Sun
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28			

March						
Mon	Tue	Wed	Thu	Fri	Sat	Sun
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

April						
Mon	Tue	Wed	Thu	Fri	Sat	Sun
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19*	20	21
22*	23	24	25	26	27	28
29	30					

May						
Mon	Tue	Wed	Thu	Fri	Sat	Sun
		1	2	3	4	5
6*	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27*	28	29	30	31		

June						
Mon	Tue	Wed	Thu	Fri	Sat	Sun
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

July						
Mon	Tue	Wed	Thu	Fri	Sat	Sun
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

August						
Mon	Tue	Wed	Thu	Fri	Sat	Sun
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26*	27	28	29	30	31	

September						
Mon	Tue	Wed	Thu	Fri	Sat	Sun
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						/ 1

October						
Mon	Tue	Wed	Thu	Fri	Sat	Sun
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

November						
Mon	Tue	Wed	Thu	Fri	Sat	Sun
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

December						
Mon	Tue	Wed	Thu	Fri	Sat	Sun
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25*	26*	27	28	29
30	31					/ 1

[12] *Traffic Forecast and Economic Appraisal Report Version 1.0* dated, Atkins, July 2019.

Key:		25	PEAK DAY
25*	BANK HOLIDAY	25	INTER PEAK DAY
25	SCHOOL HOLIDAYS	25	OFF PEAK DAY

As AAWT traffic data by definition is averaged over a calendar year and excludes weekend traffic, this could potentially give rise to predictions that could under (or over) estimate the impact from development traffic. The transport specialist subsequently generated traffic data for both peak and interpeak periods to enable comparisons to be made against both operational scenarios. Off-peak periods were scoped out of the assessment as changes in road traffic noise level above 1dB were not anticipated.

Visitors using private vehicles to travel to the Proposed Development will use a combination of existing capacity at car parks within Morecambe town centre and existing capacity at the Caton Road park and ride scheme located at M6 Junction 34. No new parking infrastructure will be provided.

The assessment has considered the following scenarios:

- 2024 Do minimum[13] opening year[14] (DMOY);
- 2024 Do something[15] opening year (DSOY); and
- 2039 Do something future year (DSFY).

Data for road traffic flows generated by the Proposed Development have been provided for OY. Whilst our understanding is that the visitor traffic would be expected to fall from OY onwards as alternative modes of sustainable transport are promoted, the noise assessment has assumed FY and OY flows are the same, thereby providing a robust and likely worst case assessment.

Basic Noise Level (BNL) calculations have been undertaken for each road link at a reference point 10m from the nearside road edge using traffic flow, speed and HDV percentage, as detailed in the *Calculation of road traffic noise memorandum* 1988 (CRTN) for each local road traffic link, and each of the above scenarios. The change in noise levels arising as a result of the Proposed Development in isolation (short-term), and in combination with natural traffic growth (long-term), have then been determined by making the following comparisons:

- Short-term = DSOY - DMOY; and
- Long-term = DSFY - DMOY.

[13] 'Do minimum' means a scenario without the Proposed Development.

[14] First year of operation.

[15] 'Do something' means a scenario with the Proposed Development.

Comparisons were made for both interpeak and peak periods, with and without committed development traffic.

The results of the short term impact assessments are given in Table 6-1 and Table 6-2 with the long term impact assessments in Table 6-3 and Table 6-4.

Table 6-1 – Predicted Change in Road Traffic Noise Level in the Opening Year – Interpeak Visitor Periods

ID	Road	Without Committed Developments				With Committed Developments		
		Interpeak Noise level $L_{A10,18hr}$, dB		Noise Level Change, dB	Magnitude of Change in the Short Term	Inter peak Noise level $L_{A10,18hr}$, dB	Noise Level Change , dB	Magnitude of Change (Cumulative Effect) in the Short Term
		DMOY [A]	DSOY [B]	Short-term [B-A]		DSOY (with CD) [B_{CD}]	Short-term [B_{CD}-A]	
1 EB	A683 Bay Gateway EB (3-arm Rdbt to M6 J34)	68.4	68.6	0.2	Negligible	68.7	0.3	Negligible
1 WB	A683 Bay Gateway WB (M6 J34 to 3-arm Rdbt)	67.1	67.4	0.3	Negligible	67.9	0.8	Negligible
2 EB	A683 Bay Gateway EB (Morecambe Rd TO3-arm Rdbt)	67.8	68	0.2	Negligible	68.5	0.7	Negligible
2 WB	A683 Bay Gateway WB (3-arm Rdbt to Morecambe Rd)	67.9	68.1	0.2	Negligible	68.4	0.5	Negligible
3	A589 Morecambe Rd (Bay Gateway to Gyratory)	69.1	69.1	0	Negligible	69.3	0.2	Negligible
4	A589 Broadway (Gyratory to Promenade)	61.7	61.8	0.1	Negligible	60.0	-1.7	Minor beneficial
5	Marine Rd Central (Broadway to Central Dr)	59.7	59.8	0.1	Negligible	60.4	0.7	Negligible
6	B5321 Lancaster Rd (Gyratory to Euston Rd)	67.1	67.3	0.2	Negligible	67.4	0.3	Negligible
7	B5321 Euston Rd (Euston Rd to Central Dr railway station)	64.9	65.1	0.2	Negligible	65.1	0.2	Negligible
8	B5321 Central Drive (railway station to Promenade)	61.2	61.2	0	Negligible	61.2	0.0	Negligible

Table 6-2 - Predicted Change in Road Traffic Noise Level in the Opening Year – Peak Visitor Periods

ID	Road	Without Committed Developments				With Committed Developments		
		Peak Noise Level $L_{A10,18hr}$, dB		Noise Level Change, dB	Magnitude of Change in the Short Term	Peak Noise Level $L_{A10,18hr}$, dB	Noise Level Change, dB	Magnitude of Change (Cumulative Effect) in the Short Term
		DMOY [A]	DSOY [B]	Short-term [B-A]		DSOY (with CD) [B_{CD}]	Short-term [B_{CD}-A]	
1 EB	A683 Bay Gateway EB (3-arm Rdbt to M6 J34)	67.1	67.4	0.3	Negligible	67.6	0.5	Negligible
1 WB	A683 Bay Gateway WB (M6 J34 to 3-arm Rdbt)	65.9	66.2	0.3	Negligible	66.7	0.8	Negligible
2 EB	A683 Bay Gateway EB (Morecambe Rd TO3-arm Rdbt)	66.5	66.8	0.3	Negligible	67.2	0.7	Negligible
2 WB	A683 Bay Gateway WB (3-arm Rdbt to Morecambe Rd)	66.6	66.9	0.1	Negligible	67.2	0.6	Negligible
3	A589 Morecambe Rd (Bay Gateway to Gyratory)	67.8	67.9	0	Negligible	68.0	0.2	Negligible
4	A589 Broadway (Gyratory to Promenade)	60.3	60.3	0.1	Negligible	58.3	-2.0	Minor beneficial
5	Marine Rd Central (Broadway to Central Dr)	58.0	58.1	0.3	Negligible	58.8	0.8	Negligible
6	B5321 Lancaster Rd (Gyratory to Euston Rd)	65.8	66.1	0.3	Negligible	66.2	0.4	Negligible
7	B5321 Euston Rd (Euston Rd to Central Dr railway station)	63.6	63.9	0	Negligible	64.0	0.4	Negligible
8	B5321 Central Drive (railway station to Promenade)	59.7	59.7	0.3	Negligible	59.7	0	Negligible

Table 6-3 - Predicted Change in Road Traffic Noise Level in the Future Year – Interpeak Visitor Periods

ID	Road	Without Committed Developments				With Committed Developments		
		Interpeak Noise level $L_{A10,18hr}$, dB		Noise Level Change, dB	Magnitude of Change in the Long Term	Inter peak Noise level $L_{A10,18hr}$, dB	Noise Level Change, dB	Magnitude of Change (Cumulative Effect) in the Long Term
		DMOY [A]	DSFY [C]	Long-term [C-A]		DSFY (with CD) [C_{CD}]	Long-term [C_{CD}-A]	
1 EB	A683 Bay Gateway EB (3-arm Rdbt to M6 J34)	68.4	68.9	0.5	Negligible	69.1	0.7	Negligible
1 WB	A683 Bay Gateway WB (M6 J34 to 3-arm Rdbt)	67.1	67.7	0.6	Negligible	68.1	1.0	Negligible
2 EB	A683 Bay Gateway EB (Morecambe Rd TO3-arm Rdbt)	67.8	68.3	0.5	Negligible	68.8	1.0	Negligible
2 WB	A683 Bay Gateway WB (3-arm Rdbt to Morecambe Rd)	67.9	68.5	0.6	Negligible	68.7	0.8	Negligible
3	A589 Morecambe Rd (Bay Gateway to Gyratory)	69.1	69.5	0.4	Negligible	69.6	0.5	Negligible
4	A589 Broadway (Gyratory to Promenade)	61.7	62.4	0.7	Negligible	60.4	-1.3	Negligible
5	Marine Rd Central (Broadway to Central Dr)	59.7	60.7	1.0	Negligible	60.8	1.1	Negligible
6	B5321 Lancaster Rd (Gyratory to Euston Rd)	67.1	67.6	0.5	Negligible	67.8	0.7	Negligible
7	B5321 Euston Rd (Euston Rd to Central Dr railway station)	64.9	65.4	0.5	Negligible	65.4	0.5	Negligible
8	B5321 Central Drive (railway station to Promenade)	61.2	62.0	0.8	Negligible	61.6	0.4	Negligible

Table 6-4 - Predicted Change in Road Traffic Noise Level in the Future Year – Peak Visitor Periods

ID	Road	Without Committed Developments				With Committed Developments		
		Peak Noise Level $L_{A10,18hr}$, dB		Noise Level Change, dB	Magnitude of Change in the Long Term	Peak Noise Level $L_{A10,18hr}$, dB	Noise Level Change, dB	Magnitude of Change (Cumulative Effect) in the Long Term
		DMOY [A]	DSFY [C]	Long-term [C-A]		DSFY (with CD) [C_{CD}]	Long-term [C_{CD}-A]	
1 EB	A683 Bay Gateway EB (3-arm Rdbt to M6 J34)	67.1	67.8	0.7	Negligible	68.0	0.9	Negligible
1 WB	A683 Bay Gateway WB (M6 J34 to 3-arm Rdbt)	65.9	66.6	0.7	Negligible	67.0	1.1	Negligible
2 EB	A683 Bay Gateway EB (Morecambe Rd TO3-arm Rdbt)	66.5	67.2	0.7	Negligible	67.6	1.1	Negligible
2 WB	A683 Bay Gateway WB (3-arm Rdbt to Morecambe Rd)	66.6	67.3	0.7	Negligible	67.6	1.0	Negligible
3	A589 Morecambe Rd (Bay Gateway to Gyratory)	67.8	68.2	0.4	Negligible	68.4	0.6	Negligible
4	A589 Broadway (Gyratory to Promenade)	60.3	61.3	1.0	Negligible	58.8	-1.5	Negligible
5	Marine Rd Central (Broadway to Central Dr)	58.0	59.6	1.6	Negligible	59.2	1.2	Negligible
6	B5321 Lancaster Rd (Gyratory to Euston Rd)	65.8	66.4	0.6	Negligible	66.6	0.8	Negligible
7	B5321 Euston Rd (Euston Rd to Central Dr railway station)	63.6	64.3	0.7	Negligible	64.3	0.7	Negligible
8	B5321 Central Drive (railway station to Promenade)	59.7	61.0	1.3	Negligible	60.1	0.4	Negligible

Short-term Operational Road Traffic Noise Effects

In the short-term Interpeak period, excluding the effect of committed developments, there are no road links with a change ≥1dB. The magnitude of impact is **negligible** and the NPSE classification is NOEL. The effect would be adverse, not significant, short-term, direct and permanent.

With the inclusion of committed development traffic to the opening year do-something Interpeak period, there is one link - ID 4 (A589 Broadway Gyratory to Promenade) - where there is a reduction in road traffic noise level of 1.7dB. The magnitude of impact is **minor** and the NPSE classification is NOEL. The effect would be beneficial, not significant, short-term, direct and permanent.

During the Peak operational period, excluding the effect of committed developments, there are no road links with a change ≥1dB. At all links, the magnitude of impact is **negligible** and the NPSE classification is NOEL. The effect would be adverse, not significant, short-term, direct and permanent.

With the inclusion of committed development traffic to the opening year do-something Interpeak period, there is a reduction in noise level at link ID4 of 2.0dB. The magnitude of impact is **minor** and the NPSE classification is NOEL. The effect would be beneficial, not significant, short-term, direct and permanent.

At all other links, the magnitude of impact is **negligible** and the NPSE classification is NOEL. The effect would be adverse, not significant, short-term, direct and permanent.

Long-term Operational Road Traffic Noise Effects

In the long-term Interpeak period, excluding the effect of committed developments, there are no road links with a change ≥3dB. The magnitude of impact is **negligible** and the NPSE classification is NOEL. The effect would be adverse, not significant, long-term, direct and permanent.

With the inclusion of committed development traffic to the future year do-something Interpeak period, there are no road links with a change ≥3dB. The magnitude of impact is **negligible** and the NPSE classification is NOEL. The effect would be adverse, not significant, long-term, direct and permanent.

In the long-term Peak period, excluding the effect of committed developments, there are no road links with a change ≥3dB. The magnitude of impact is **negligible** and the NPSE classification is NOEL. The effect would be adverse, not significant, short-term, direct and permanent.

With the inclusion of committed development traffic to the future year do-something Peak period, there are no road links with a change ≥3dB. The magnitude of impact is **negligible** and the NPSE classification is NOEL. The effect would be adverse, not significant, long-term, direct and permanent.

MITIGATION

Impacts associated with the Proposed Development are not significant, further consideration to mitigation is not warranted.

RESIDUAL

The worst-case changes on the existing network during Interpeak operational periods are **negligible** adverse with one link (ID4, A589 Broadway Gyratory to Promenade) experiencing a **minor** beneficial (not significant) change in the short-term. In the long-term, the changes during Interpeak operational periods are **negligible** adverse (not significant) at worse.

The worst-case changes on the existing network during Peak operational periods in the short term are **negligible** adverse with one link (ID4, A589 Broadway Gyratory to Promenade) experiencing a **minor** beneficial (not significant) change. In the long-term, the changes during Peak operational periods are **negligible** adverse (not significant) at worse.

As significant adverse effects are not identified, mitigation is not considered warranted and the identified (not significant) effects would remain.

Road traffic noise level changes do not cause a shift in the NPSE Classification (a function of absolute noise level from one category to another).

7

OPERATIONAL NOISE ASSESSMENT

7. OPERATIONAL NOISE ASSESSMENT

OUTDOOR EVENT NOISE

The Rhythm Gardens along the eastern boundary of the Proposed Development is an outdoor space where concerts are intended to be held. The intention is to re-purpose the existing Bay Arena space which currently hosts occasional outdoor events. The proposal is that up to 8 concerts a year would take place, primarily during summer months (but potentially also late spring/early autumn) with amplified music ceasing at 23:00. During such events, a temporary stage would be erected at the southwest corner of the site facing northeast into the tiered area of the gardens. The capacity of the event space is around 6,000.

The accurate modelling of noise from public address (PA) systems within music arenas (be they outdoors or indoors) requires specialist software and in-depth knowledge of the directivity patterns of specific loudspeakers. The latter determines the geometric divergence of sound from the speaker and is critical in determining how noise 'spreads out' from the speaker. A loudspeaker with a high degree of directivity can be orientated to project sound directly at the audience whilst minimising unwanted lateral spread ('side loading') which in this case could impact receptors along Marine Road Central.

Such specialist concert noise modelling is outside the scope of the noise and vibration chapter of the ES. However, a 3D environmental noise model of the development and surrounding area was assembled using CadnaA in order to estimate the potential noise levels from concerts and identify any receptors where high noise levels may occur.

Whilst not providing the capabilities of specialist PA modelling software, it is considered that a CadnaA model would be appropriate to establish an early prediction of likely worst case noise levels from concerts.

INPUT PARAMETERS

Noise model parameters used for the prediction of concert music noise are provided in Section 4.

A key issue will be the reference music noise level (MNL) most appropriate for the event. This is determined at the 'front of house' (FOH) location – i.e. the sound engineer's mixing desk – which is commonly at a distance of 30 – 50m from the stage at an outdoor live event. Typically a reference level of 95 – 99 dBA FOH would be used with levels adjusted following live measurements at agreed noise monitoring locations outside the venue according to any event specific noise limits specified as part of the event's licensing arrangements. In our experience of measuring noise from outdoor concerts in built-up areas where strict noise limits apply (e.g. Finsbury Park in London), a level of 90 dBA FOH would not be unusual. For the purposes of this assessment, a reference level of 90m dBA has been applied in the noise model, at a reference location 30m from the stage.

The model includes speaker stacks 5m high either side of the assumed stage location with a single subwoofer 1m high at the front-centre of the stage. The directivity pattern of a typical (rather than

specialist) PA loudspeaker[16] has been applied to project sound into the audience to a reasonable degree.

Whilst the podium level of the main Eden site has been included in the model (due to it being a high mass structure and hence offering potential screening effects), the lightweight ETFE biomes have not as the façade material may be considered, at least for this noise source, acoustically 'transparent'.

ASSESSMENT CRITERIA

Noise from concerts has been assessed primarily against criteria provided in the Code of Practice (CoP) on Environmental Noise Control at Concerts.

This national CoP was published by the Noise Council in 1995 and provides guidance on the control of noise from concerts or events where amplified music is a component, in order to reduce the risk of complaints from occupants at nearby noise sensitive premises. The CoP provides measurement, assessment and rating methods specifically relating to outdoor music noise, using the concepts of noise level, duration/frequency of events, comparison with ambient conditions and an upper absolute level.

As shown in Table 2-4, the CoP provides guideline levels for music noise levels based on the type of venue and number of proposed events per year. For up to 3 events per year, the least onerous limits apply, namely 65 dBA / 75 dBA MNL, depending on type of venue (i.e. urban stadia/arenas or other urban and rural areas). Between 4 and 12 events per year, the guidance suggests that the MNL should not exceed the background noise level by 15 dBA over a 15 minute period. There is no tiered increase in applicable limits between 4 and 12 events with the same limits being applicable.

The CoP is currently under review and although it was based on best practice at the time of its original publication, research undertaken since (e.g. by Griffiths and Staunton, Proc IOA, Vol. 28 Part 7, 2006) suggests that the guideline values as reported in Table 2-4 would benefit from further refinements, particularly in relation to the proposed noise levels, number of events and categories. One of the particular issues that has been raised is the step change in guideline values between 3 and 4 events per calendar year. In many cases, this results in a step change in the permitted noise levels of 10 dB or more, depending on the background sound level at the nearest sensitive receptor. It is unlikely that an increase in the number of events by one would necessitate a 10dB change in the permitted noise level to bring about a corresponding change in the observed effect at sensitive receptors.

The experience of outdoor music venues would suggest that higher noise limits could be adopted without resulting in significant complaints from nearby residents. For example, Lancashire County Cricket Ground has limits conditioned within its license of 80 dB $L_{Aeq,15mins}$ at the nearest residential premises and 75 dB $L_{Aeq,15mins}$ for dwellings located farther from the ground. The Etihad Stadium has an off-site limit of 75 dB $L_{Aeq,15mins}$, as does the Coventry Building Society Arena for 5 events per

[16] Directivity patterns of loudspeakers utilised at Liverpool International Music Festival 2018 were applied within the model.

year. There is therefore scope to agree an alternative noise limit to those suggested in the CoP, depending on the number of proposed events per year.

A further complication is that the CoP was published several years prior to the NPSE and as such the classification of impact in terms of NOEL, LOAEL and SOAEL does not readily correlate. It could be suggested that compliance with any of the guideline values in the CoP would be equivalent to achieving LOAEL; above the guideline values would tend towards SOAEL. There is no guidance as to what noise level would equate to NOEL.

The background noise level as defined in Table 2-4 is determined by calculating the arithmetic average of the $L_{A90,15min}$ over the last four hours of the proposed music events. Since the proposal is for music to cease at 23.00, the applicable assessment period would be 19.00 to 23.00.

The noise survey indicates an arithmetic average background sound level of 46 dB $L_{A90,1900-2300}$ measured at ML2, the Winter Gardens balcony overlooking Marine Road Central which has been assumed to be applicable to noise sensitive receptors, i.e. dwellings such as flats, B&Bs and hotels, located along Marine Road Central. Note that the background sound level during the applicable weekend evening period (Friday to Sunday) included contributions from the funfair located on the site of the Proposed Development and thus these periods were excluded from the assessed L_{A90} data.

For events occurring in the range of 4 to 12 per year, it is considered that a tiered target noise level based on an MNL above the background sound level, increasing by 1 dB per event, with an 'absolute' limit value may be more appropriate. An example is shown in Table 7-1.

Table 7-1 – Proposed MNL limits for Outdoor Concerts at Proposed Development

No. of events	Proposed Criteria dB(A) MNL	Target Noise Level dB(A) MNL[17]	Upper Limit dB(A) MNL	Potential NPSE Classification
Any	>75 dB(A) MNL			SOAEL
1 - 3	75 dB(A) MNL			LOAEL to SOAEL
4	Background level +23	69	75	
5	Background level +22	68	75	
6	Background level +21	67	75	
7	Background level +20	66	75	
8	Background level +19	65	75	
9	Background level +18	64	75	
10	Background level +17	63	75	
11	Background level +16	62	75	
12	Background level +15	61	75	
No more than 12	Background level +14 or less	60		< LOAEL

It is considered that a target noise level for 8 events per year equivalent to 65 dB(A) MNL, with an upper limit of 75 dB(A), would be appropriate and achievable at residential receptors (and at sensitive non-residential receptors such as hotels and B&Bs).

RESULTS

A summary of results from the CadnaA noise model at the key noise sensitive receptors in proximity to the Rhythm Gardens is provided in Table 7-2.

Extracts from the noise model are provided in Figure 7-1 and Figure 7-2 and illustrate the predicted MNL noise contours in colour-coded 5dB bands modelled at a height of 6.5m from the ground (to coincide with the height of second floor flats located along Marine Road Central). Figure 7-1 shows

[17] Target noise levels based on arithmetic average $L_{A90,15min,19:00-23:00}$ = 46 dB $L_{A90,15min}$ measured at ML2

the predicted noise contours based on 90 dBA FOH with Figure 7-2 illustrating predicted noise levels at the nearest impacted properties.

Table 7-2 - Predicted Music Noise Levels, $L_{Aeq,15min}$ dB

Receptor	Music Noise Level, dB $L_{Aeq,15min}$	Exceedance of Target MNL (dB)	Exceedance of Upper Limit MNL (dB)
R01	71	+6	-4
R02	69	+4	-6
R03	61	-4	-14
R04	60	-5	-15
NR01	49	-16	-26
NR02	71	N/A[18]	N/A[18]
NR03	73	+8	-2
ER01	46	N/A[19]	N/A[19]

The predicted magnitude of impact would be as follows:

Table 7-3 - Predicted impact magnitude and NPSE classification

Receptor	Magnitude of impact	NPSE classification
R01	Moderate	LOAEL to SOAEL
R02	Moderate	LOAEL to SOAEL
R03	Minor	LOAEL to SOAEL
R04	Minor	LOAEL to SOAEL
NR01	Negligible	LOAEL
NR02	N/A	N/A
NR03	Moderate	LOAEL to SOAEL
ER01	N/A	N/A

[18] Winter Gardens not noise sensitive receptor but results included for reference as receptor is site of interest

[19] Ecological receptor included for reference but no assessment required as primary ecological receptor of concern is wintering birds which will not be present during spring/summer/autumn months when concerts will occur

Figure 7-1 - Predicted noise levels (dBA MNL) at reference level of 90 dBA FOH

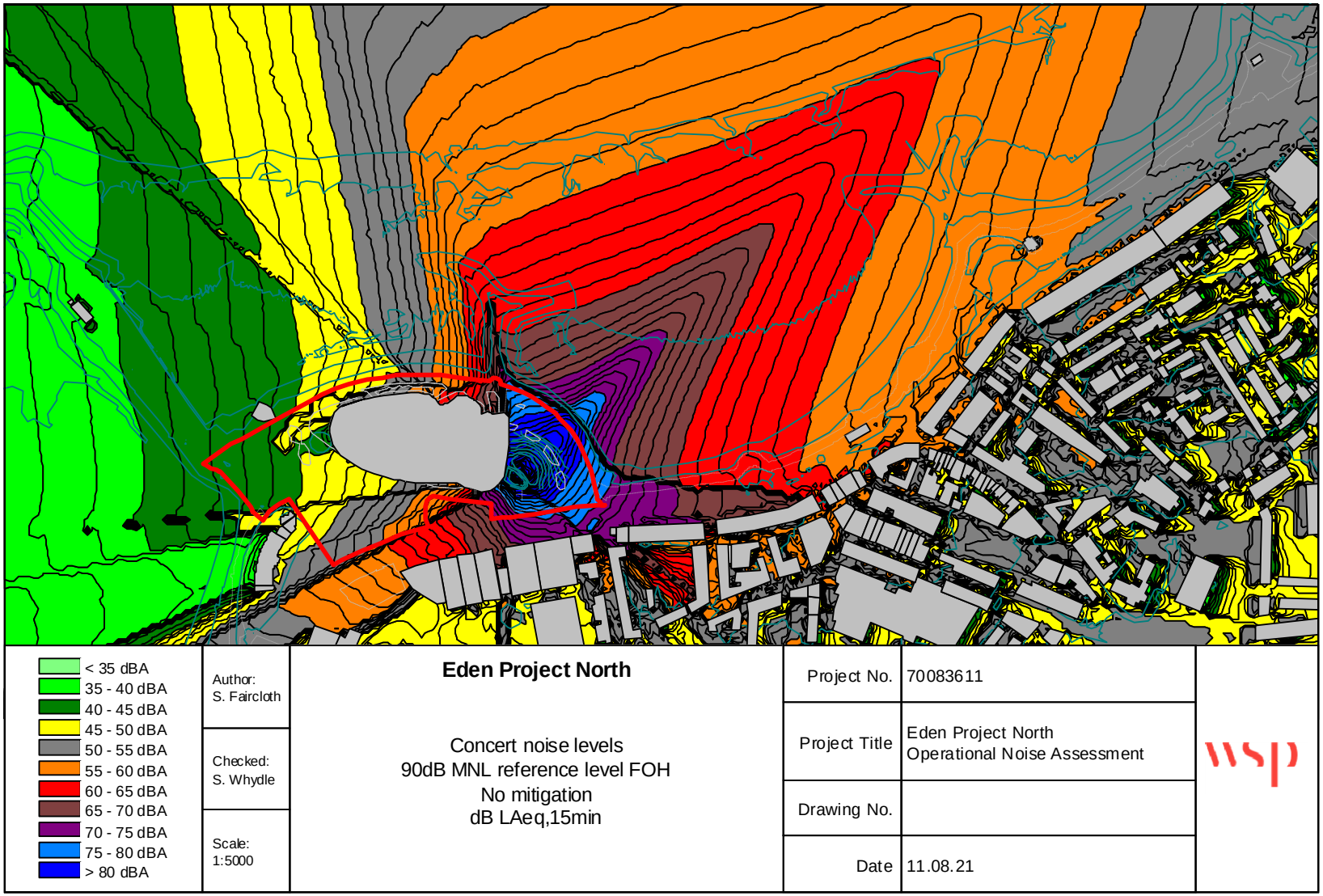
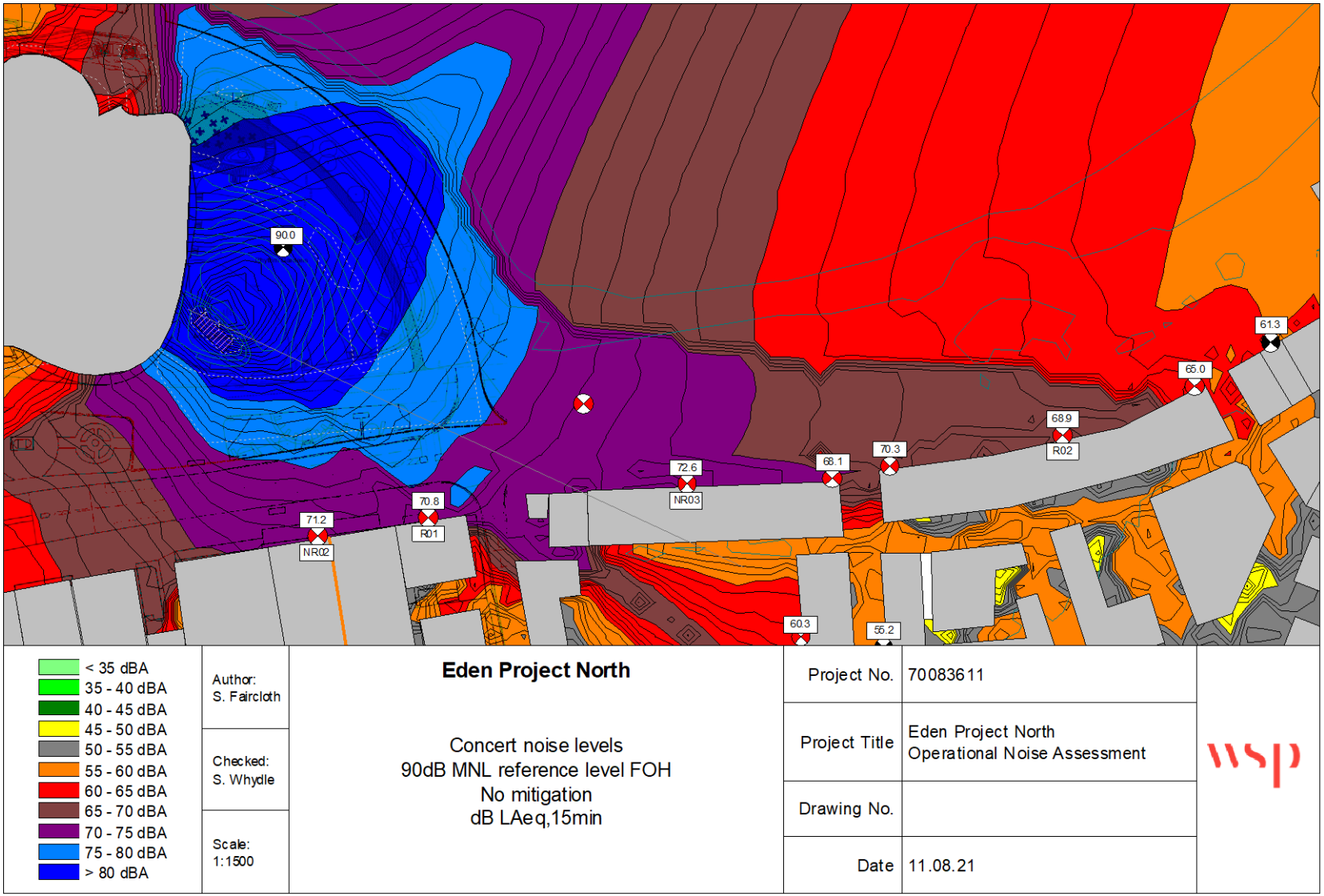


Figure 7-2 - Predicted noise levels (dBA MNL) at receptors on Marine Road Central



The main observations are as follows:

- Noise propagation out into the bay is quite directional, with an 'arrow-head' shape to the noise plot.
- The effect of side loading is still relatively high, with the highest levels of sound impacting buildings located to the immediate south and south east of the stage along Marine Road Central.
- The highest predicted noise level at the nearest non-residential sensitive receptor (Lakeland Rooms Hotel) is 73 dBA, approx. 150m southeast of the stage. It is to be appreciated, however, that hotels and B&Bs are, in many cases, likely to be occupied by visitors attending events taking place at the Rhythm Gardens and as such, residents may not be present whilst events are ongoing. Furthermore, the proprietors of hotels and B&Bs are likely to benefit from the staging of such events which may ameliorate any potential adverse impacts.
- The 61 dBA MNL level (equivalent to LOAEL) is not reached until at a distance of approx. 300m from the stage.
- The first row of buildings located along Marine Road Central provide effective screening of noise to the majority of dwellings located behind. Most receptors deeper into the town and located behind intervening buildings are predicted to experience noise levels in the range of 50 – 55 dBA MNL. The most onerous target noise level of MNL=background+15dB is predicted to be met at these receptors.
- One exception is the corner of Northumberland Street, where gaps between buildings allows sound to radiate into a rear courtyard/car park area, creating a noise 'hot spot' with MNL up to 63 dBA. This would, however, achieve the proposed target noise level of 65dB MNL.
- The Midland Hotel to the southwest of the site is not predicted to be adversely impacted, with a predicted MNL of around 50 – 52 dBA

Based on the results in Table 7-2 and Table 7-5 without any mitigation, the magnitude of impact at the nearest sensitive receptors is **moderate** and the NPSE classification is LOAEL to SOAEL. For sensitive receptors >300m but <600m east of the stage and with line of sight to the stage, the magnitude of impact is **minor** and the NPSE classification is LOAEL to SOAEL. For sensitive receptors >600m east of the stage and with line of sight to the stage, or for those receptors with line of sight interrupted by intervening buildings, the magnitude of impact is **minor** to **negligible** and the NPSE classification is LOAEL.

MITIGATION

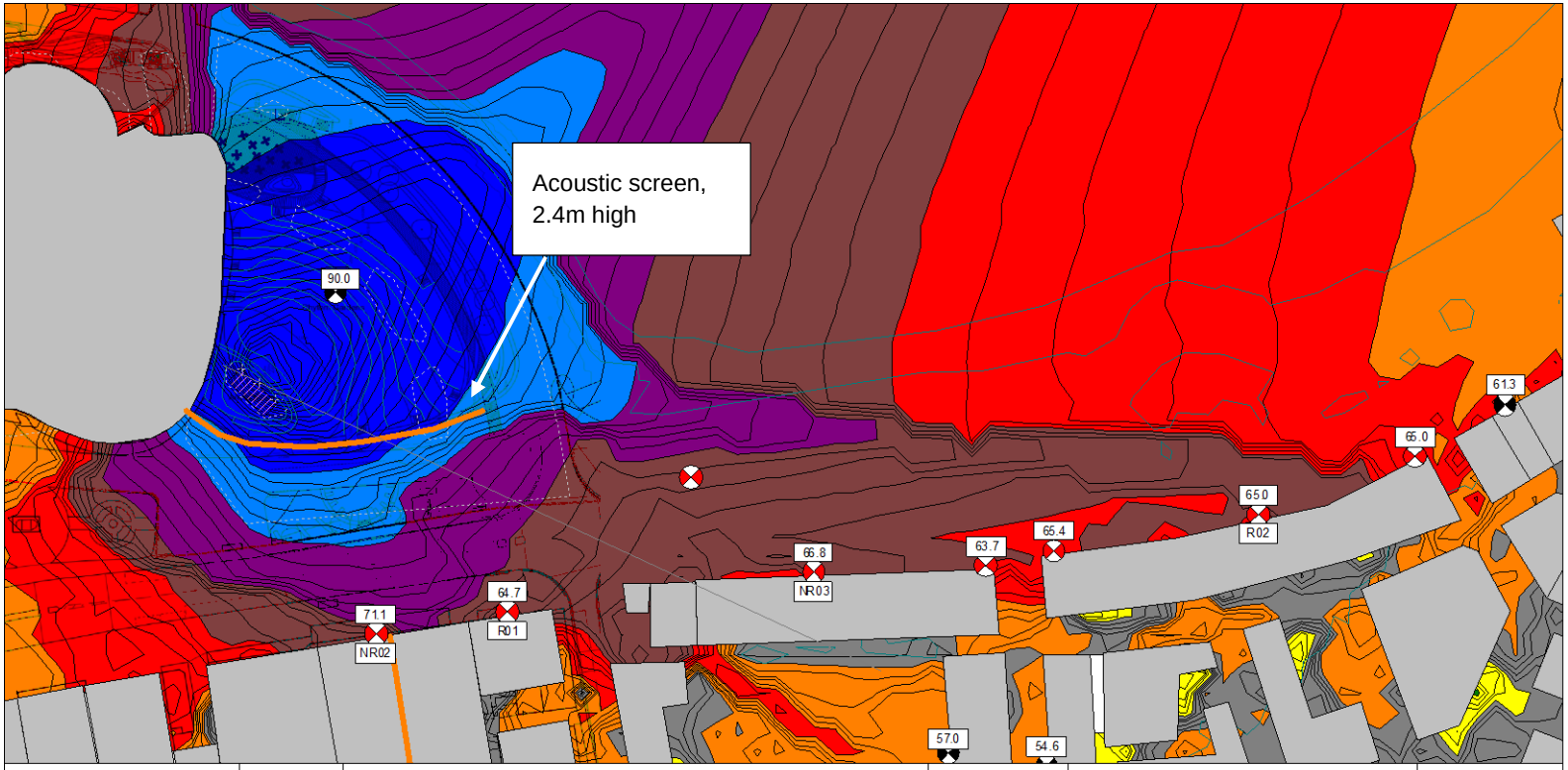
There are a number of potential options available to mitigate noise levels which would need to be investigated further and may be incorporated into a licensing condition for any future concerts. These are discussed below:

Acoustic screening

The effects of localised screens will be limited by the height of speaker stacks (and hence noise sources).

That said, there are reasonable gains to be had using a screen along the southern boundary of the Rhythm Gardens up to around 2.8m in height, which may be practicable for a temporary structure. The effect of this screen is shown in Figure 7-3, below:

Figure 7-3 - Predicted noise levels (dBA MNL) at receptors on Marine Road Central with 2.8m high screen along southern boundary of Rhythm Gardens



The revised predicted MNLs with mitigation are provided below:

Table 7-4 - Predicted Music Noise Levels with 2.8m acoustic screen to southern boundary, $L_{Aeq,15min}$ dB

Receptor	Music Noise Level, dB $L_{Aeq,15min}$	Exceedance of Target MNL (dB)	Exceedance of Upper Limit MNL (dB)
R01	65	0	-10
R02	65	0	-10
R03	61	-4	-14
R04	60	-5	-15
NR01	46	-19	-29
NR02	71	N/A[20]	N/A[18]
NR03	67	+2	-8
ER01	46	N/A[21]	N/A[19]

The predicted magnitude of impact would be as follows:

Table 7-5 - Predicted impact magnitude and NPSE classification with mitigation from acoustic screen

Receptor	Magnitude of impact	NPSE classification
R01	Minor to Moderate	LOAEL to SOAEL
R02	Minor to Moderate	LOAEL to SOAEL
R03	Minor	LOAEL to SOAEL
R04	Minor	LOAEL to SOAEL
NR01	Negligible	NOEL
NR02	N/A	N/A

[20] Winter Gardens is not a noise sensitive receptor but the results are included for reference as the receptor is a site of interest

[21] Ecological receptor included for reference but no assessment required as primary ecological receptor of concern is wintering birds which will not be present during spring/summer/autumn months when concerts will occur

Receptor	Magnitude of impact	NPSE classification
NR03	Moderate	LOAEL to SOAEL
ER01	N/A	N/A

It can be seen that the implementation of an acoustic screen results in reasonable reductions in noise levels at sensitive receptors to the south of the Rhythm Gardens but only marginal improvements for receptors to the east.

Specialist PA system

As advised earlier, a specialist PA system supplier would be able to accurately model the noise from the event and optimise the speakers to achieve a more focused sound with much reduced side loading.

Advice was sought from Charcoal Blue, a specialist theatre, acoustics and digital design consultancy, who work with Eden Cornwall on their Eden Sessions live music programmes. They have undertaken some initial feasibility studies into live events at the Rhythm Gardens and whilst their early modelling work did look at potential speaker arrays it did not predict noise levels at external sensitive locations. Nevertheless, they have reviewed the modelling and assumptions detailed above and have indicated that by using 'side fills' (loudspeakers mounted along the sides of the arena and directing sound into the audience) and mounting speakers lower, the spill of noise out of the arena could further reduce noise levels by around 5dB.

With such a system specified, it is considered likely that an appropriate target MNL could be achieved at nearby sensitive receptors, particularly if combined with the temporary acoustic screen described above.

A copy of an email from Charcoal Blue confirming the above is provided at the end of this Section.

Noise management plan

A detailed noise management plan (NMP) would need to be developed prior to each event and would likely form the basis of future licensing conditions to which the events management team would be required to comply. Appropriate measures may include:

- A specialist supplier and installer of PA equipment to be appointed to advise on the most appropriate system for the size of the concert and type of music expected.
- All sound system suppliers to be informed of the requirements of noise control and the type/location/orientation of their systems.
- Computer modelling of noise from the concert, using directivity and sound power data for the proposed sound system, to be undertaken prior to the event.
- Noise limits to be set in consultation with the Local Authority.
- Events management team to set up direct communications with all relevant stakeholders.
- An acoustic consultant to be appointed to monitor noise from the concert in line with Local Authority requirements.
- At least two weeks prior to any event, a letter or newspaper advertisement will be circulated to local residents, informing them of the event taking place, including start and finish times for the event and any soundchecks.

- A dedicated telephone number to be provided for the duration of the event to deal with complaints relating to concert noise.
- A noise monitor to be provided at the mixing desk position and at agreed external location(s). All noise meters to comply with the required standards.
- Real-time noise monitoring to be undertaken during events with noise levels fed back to the sound engineer for adjustment in line with the specified noise limits.
- Event marshalls to be employed during concerts to manage entry and exit of visitors to/from the site.

Existing Music and other Events in Morecambe and Surrounding Areas

It is to be highlighted that Morecambe already hosts an annual music festival, albeit one that takes place predominantly within indoor venues, including the Platform, located on the opposite side of Marine Road Central to the Midland Hotel. The links between the town and live music are well established. Furthermore, it is our understanding that a new nightclub located within the same row of buildings that includes the Winter Gardens has just opened.

The Proposed Development Site already hosts temporary outdoor events within the Bay Arena area and wider site, including the funfair that was present at the time of the baseline measurement surveys. Surrounding receptors are therefore used to experiencing elevated noise levels and amplified music. Indeed, the noise survey results in Section 3 indicate elevated noise levels during afternoon and evening periods (typically Friday to Sunday) that were attributed to the funfair. Noise levels during the evening of up to 60 dB L_{Aeq} and 66 dB L_{Aeq} were measured at ML1 (Midland Hotel) and ML2 (Winter Gardens) respectively. In the case of the Midland Hotel, noise from the funfair is around 10 dB higher than predicted for a live concert. At the Winter Gardens, directly opposite the proposed Rhythm Gardens arena, noise from the funfair is only around 5 dB lower than currently predicted for concerts.

The nearby Lytham festival is a five day annual event and takes place on the promenade of Lytham, with a stage (and hence similar noise sources to Eden) facing inland towards sensitive receptors. Furthermore, the number of visitors to Lytham Festival are in excess of 70,000, significantly higher than those attending the proposed Eden North concerts. If noise issues can be adequately managed at Lytham Festival, we see no reason why similar events at Eden North with a much smaller capacity cannot also be effectively managed.

It is also to be appreciated that there is a high degree of support to the Proposed Development from the local community and particularly from those who operate businesses along then promenade. Many of them are owner occupiers of flats above the commercial premises at ground floor. The potential adverse impact of noise from occasional concerts is likely to be acceptable if there are wider benefits to businesses as a result of the increase in visitors to Morecambe due to the Proposed Development.

RESIDUAL

With the application of mitigation measures, the concert noise impacts are likely to be direct, temporary, local, adverse **minor** or **moderate** at worse. The effect is **not significant**.

Figure 7-4 - Email from Charcoal Blue re live events sound system

Re: Arena Noise Impact Eden North

Reply | Reply All | Forward | ...

AW Alex Wardle <alex.wardle@charcoalblue.com>

To Faircloth, Simon

Cc Tim Narey; ashleyholland; Warrington, James; Pablo Romero; Byron Harrison

Thu 10:53

You forwarded this message on 12/08/2021 16:19.

Hi Simon:

My colleague Pablo (who did our initial modelling) has had a look at this and has the following comments:

Your technical note states what we recommend as general guidelines without going into a detailed modelling - so we're not quite sure what you're asking from us? However, there is some background information worth mentioning:

- We didn't assess noise levels in our preliminary modelling. We only assessed "geometrically" direct sound and reflections spills. We took into account the arena "podium" height, but also we considered some shielding provided by the seating around the stage. Following that preliminary model, the seating area and building elements towards the sensitive receivers have a total height of approx 5m from the arena ground level. We didn't consider acoustic transparency from the domes.
- We considered two options, source height at 6m and at 4m with the second option being the preferable as it enjoys better shielding from seating and other architectural elements around.

Based on the above we can add the following:

- we modelled the sources having in mind that we could have an horizontal dispersion of about 70deg (refer to LAcoustics A and K series). The vertical dispersion is better controlled and it is possible to narrow the coverage exclusively to the seating areas.
- We can also consider some temporary side fills mounted on temporary poles which could help reducing even more the side coverage from the main FOH system. The FOH could be mounted a bit lower covering only the arena ground and the side fills would be at a lower height covering the seating areas.

It is difficult to see from your technical note whether you have already considered the above but if not, we may be able to reduce levels of about 5dB from the predicted levels with the noise screen.

Hope this is helpful.
Best, Alex.
--

Alex Wardle
Charcoalblue LLP

NOISE FROM CAR PARKS

The travel plan for the Proposed Development indicates a predicted peak season maximum of 3,750 visitors per day during school holidays, summer months and bank holidays. This translates into approximately 800 vehicle trips per day.

Since there is no new parking at the Development, approximately 400 of those trips will be to the existing Caton Road Park and Ride (which has a capacity of 650 spaces), with visitors being transported to the Development by 40 – 50 shuttle bus journeys per day. The remaining 400 trips are expected to be to existing car parks within Morecambe, five of which are earmarked for the Proposed Development.

It is our understanding that the car parks are currently operating at approximately 70% total capacity. The remaining capacity would be taken by the Proposed Development.

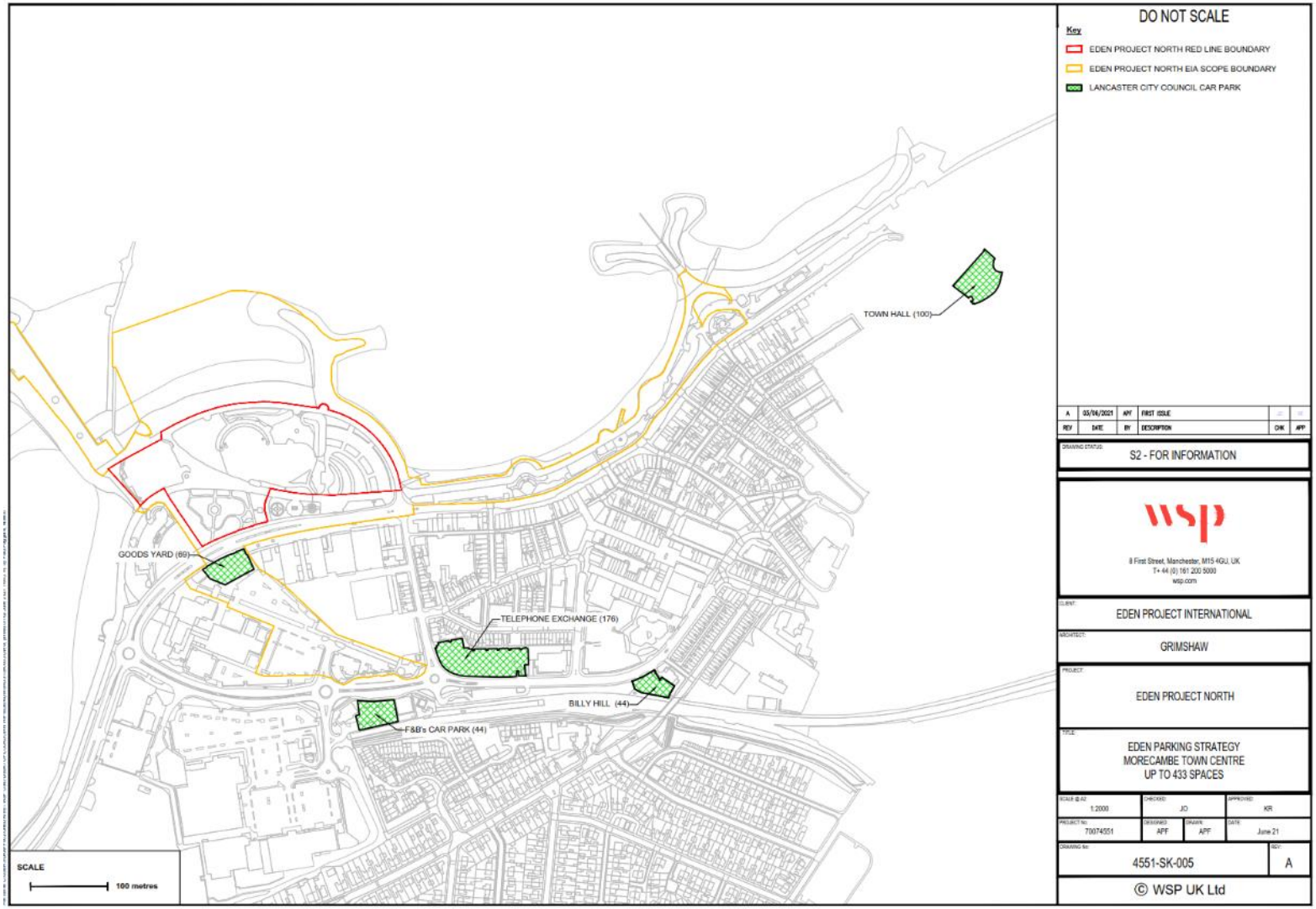
These car parks, and their anticipated spaces available, are shown in Figure 7-5 and summarised in Table 7-6 below together with the Park and Ride.

Table 7-6 – Car park allocation

Car Park Name	Total No. Spaces	Current Use	Spaces Available for Proposed Development
Billy Hill	147	103	44
F&B's	147	103	44
Goods Yard	230	161	69
Telephone Exchange	587	411	176
Town Hall	333	233	100
Total car park spaces	**1443**	**1010**	**433***
Caton Road Park and Ride	650	246	404
Total all spaces	**2093**	**1256**	**837**

*Of this available capacity, 403 would be required by the Proposed Development.

Figure 7-5 - Car parks in Morecambe town centre assigned to the Proposed Development



In order to assess the potential noise impact from the use of car parks by the Proposed Development, noise levels were predicted using the Bavarian State Agency for the Environment (Bayerisches Landesamt Fur Umwelt - LfU) Parking Area Noise (PAN) calculation

The PAN describes a method for calculating sound emission from parking areas and bus stations, as well as multi storey and underground car parks. It adopts a reference value for the movement frequency of each car park space for each type of parking area, the source sound power level for each complete parking process (e.g. arriving, manoeuvring, door slams) and the total number of parking spaces to arrive at an area emission value. Corrections are typically applied for the car park road surface and impulse characteristics.

The PAN calculations were undertaken by utilising a module within CadnaA. The model input parameters are as follows:

Table 7-7 – LfU PAN Calculation Parameters

Calculation Parameter	Parking Type	
	Town Centre Car Parks	Park and Ride
Methodology	LfU Study 2007	
Assumed car park type	Car park, city, chargeable	Park and ride
Average no. of parking events per hour per space over assessment period	0.47	0.30
Assessment period	16 hours (06:00 – 22:00)	16 hours (06:00 – 22:00)
Penalty for parking lot type[22]	+3 (shopping centre) – applicable to 'do minimum' scenario only	0 (park and ride)
Penalty for surface	0 (asphalt)	0 (asphalt)

Note that the 'LfU Study 2007 methodology' calculates the combined noise levels generated by both parking event (entering/leaving parking space, door slams, engine starting etc) and the passage of vehicles through the car park whilst searching for a space.

The number of parking spaces assessed are as shown in Table 7-6. The 'Do Minimum' (DM) scenario has been calculated assuming a 70% space allocation. The 'Do Something' (DS) scenario assumes the remaining spaces have been taken up by the Proposed Development, i.e. 100% space allocation.

[22] A correction is applied to account for impulsive noise sources associated with the type of car park. For example, a 'shopping centre' correction includes an allowance for noise from shopping trolleys etc.

However, as the model input parameters are slightly different for vehicles associated with the Proposed Development compared with DM vehicles, the 70% and 30% allocations have been calculated separately and the results combined to provide the overall DS figure.

Noise levels from car parks have been predicted at the nearest sensitive receptor at a height of 4.0m (1st floor). The results from the calculations are provided below.

Table 7-8 – PAN calculation results

Car Park Name	Do Minimum (Existing Capacity) dB $L_{Aeq,16hr}$	Proposed Development Only dB $L_{Aeq,16hr}$	Do Something (Existing + Proposed Development) dB $L_{Aeq,16hr}$	Noise Level Change dB
Billy Hill	47.6	37.6	48.0	+0.4
F&B's	47.6	37.7	48.0	+0.4
Goods Yard	58.8	48.9	59.2	+0.4
Telephone Exchange	57.4	47.6	57.8	+0.4
Goods Yard	56.0	46.1	56.4	+0.4
Caton Road Park and Ride	35.3	38.0	39.9	+4.6

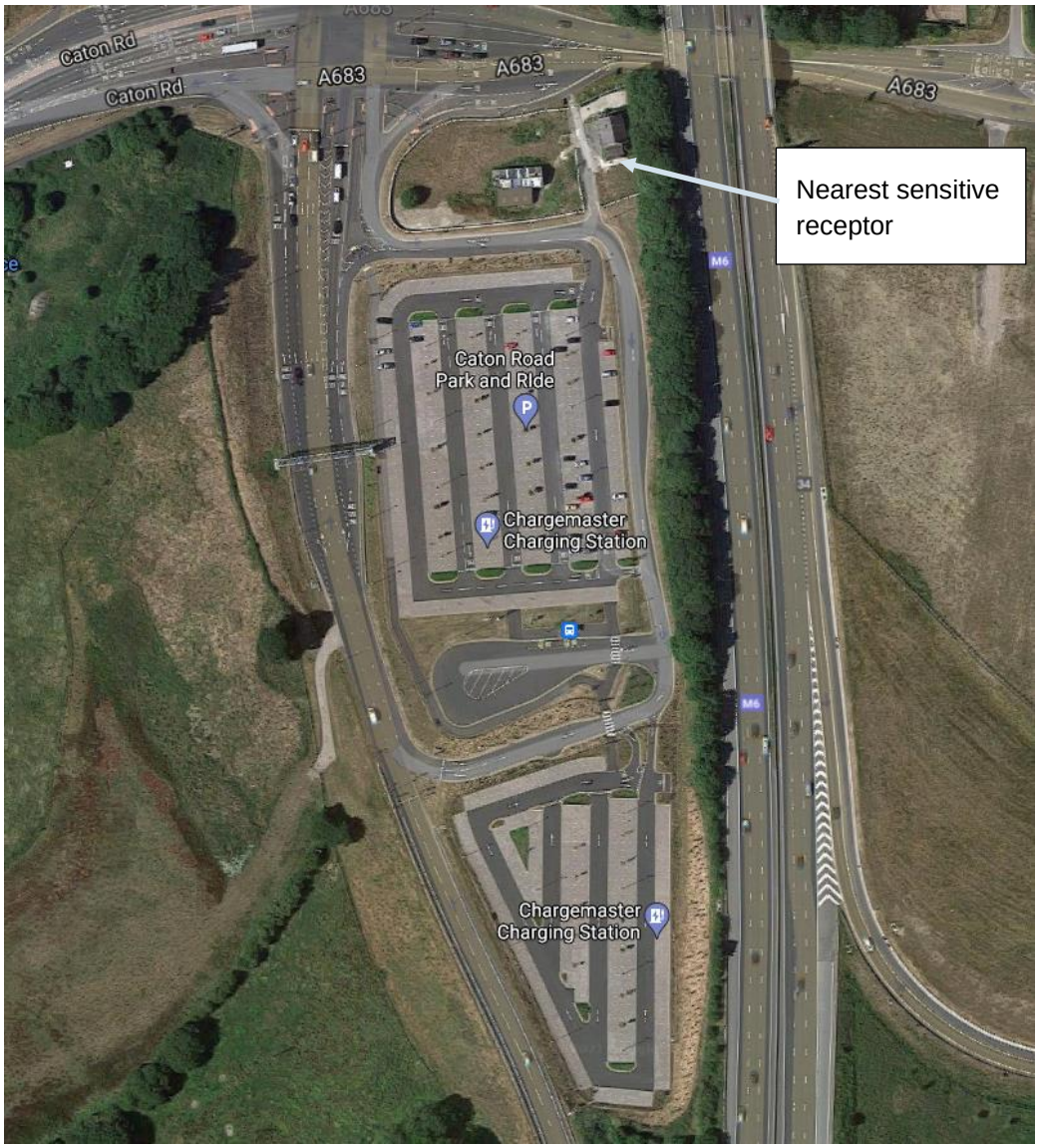
It can be seen that the predicted increase in car park noise level from the Proposed Development is 0.4dB for car parks and 4.6dB for the Park and Ride.

When compared against the road traffic noise level change criteria in Table 2-2, the impact would be **negligible** for car parks and **moderate** for the Park and Ride. This does not, however, take into account the absolute noise level generated by the Park and Ride in comparison with the ambient noise level at the receptor from other sources.

Figure 7-6 shows an aerial view of Caton Road Park and Ride with the nearest sensitive receptor indicated. It can be seen that the dwelling highlighted is within 30m of the M6 motorway and within 16m of both the A683 and a busy interchange. The daytime ambient noise level at this location is estimated to be at least 65 dB L_{Aeq}. As such, the noise levels generated by the Park and Ride will likely be inaudible against other road noise sources.

With this context taken into account, the car park impacts are likely to be direct, permanent, local, adverse **negligible**. The effect is **not significant**.

Figure 7-6 - Caton Road Park and Ride



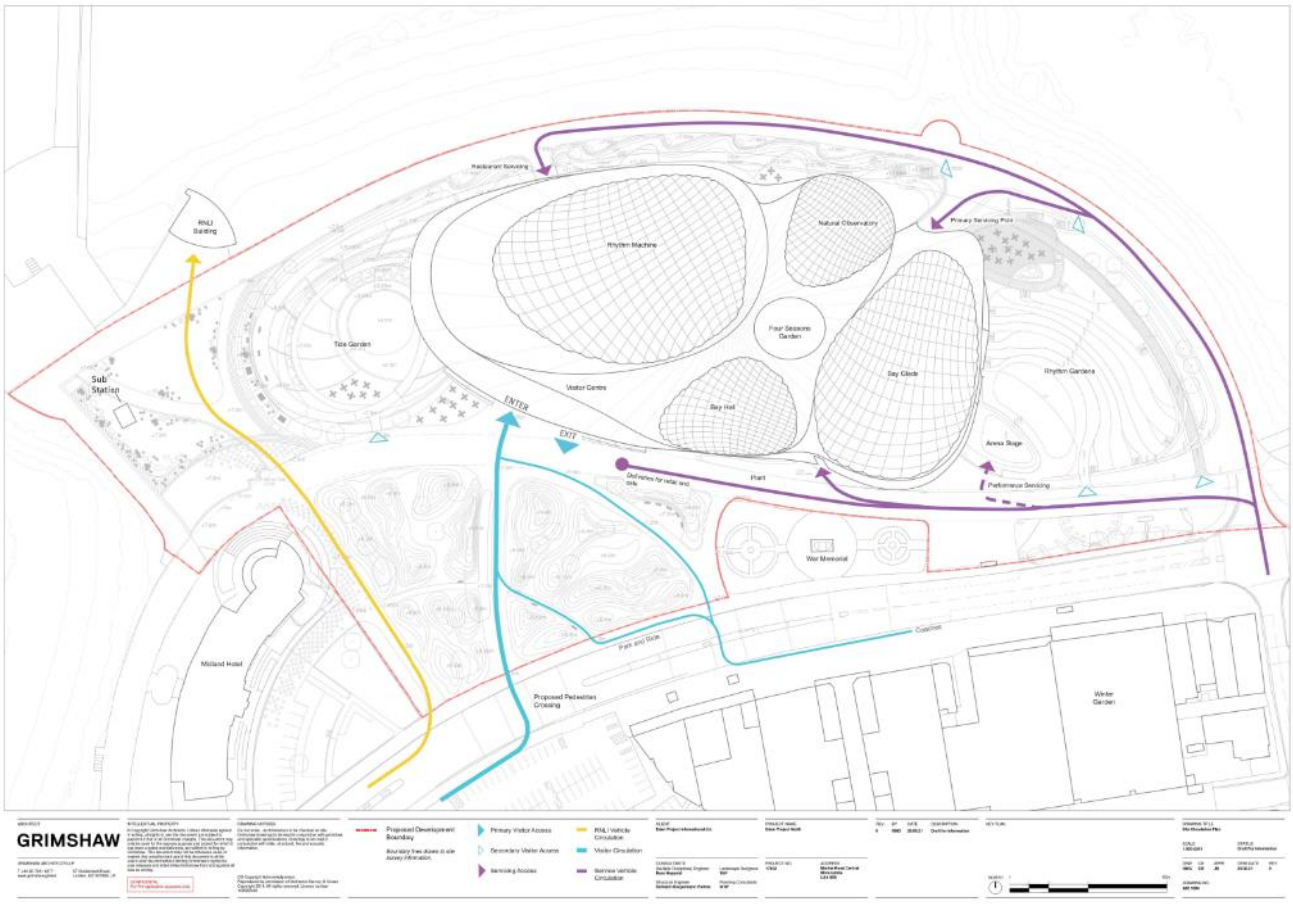
MITIGATION

Impacts from car park use associated with the Proposed Development are not significant and further consideration to mitigation is not warranted.

NOISE FROM DELIVERY/SERVICE VEHICLES

It is our understanding that the Proposed Development will receive between 2 and 5 deliveries per day, either from delivery vehicles or service vehicles (waste collection etc). There are three delivery areas within the Development and the proposed deliveries will be shared between them, depending on need. These delivery areas are shown below:

Figure 7-7 - Proposed Delivery Areas



The three main service and delivery routes (shown in purple in the above drawing) are as follows:

- Primary servicing point to the northeast of Bay Glade;
- Restaurant servicing to the northwest of Rhythm Machine; and
- Deliveries for retail and café to the south of Bay Hall.

There is also a temporary performance servicing area set aside south of the Rhythm Gardens for deliveries to the stage area during open air events.

Of these, the route most likely to cause an impact on nearby sensitive receptors is the area for retail and café deliveries to the south of the Proposed Development and the following assessment therefore concentrates on this route.

For the purposes of this assessment, HGV movements and unloading/loading activities have been assumed based on professional experience and accounting for the size of the service yard areas.

Two alternative scenarios have been modelled:

- Scenario 1 - Ambient Goods Operation; and
- Scenario 2 - Partial Chilled Goods Operation

The latter assumes delivery vehicles have electric powered trailer chillers. The source data used to inform this assessment is presented in Table 7-9 and has been adopted for service/delivery movements in and around the Proposed Development.

This data has been adopted from WSP's library of in-house historic measurement data and manufacturers specifications used in similar facility assessments to that of the Proposed Development.

The noise sources associated with a single delivery include:

- 1 x HGV arrival;
- 1 x HGV manoeuvre;
- 1 x air brakes activated;
- 1 x cab engine idling;
- 30 minutes of unloading/loading; and
- 1 x HGV pulling away.

Table 7-9 - Service yard source noise data, dB

Activity	Sound Pressure Level (dB) in Octave Band Centre Frequency (Hz)								Time (s)	$L_{Aeq,T}$ @ 10m	L_{AFmax} @ 10m
	63	125	250	500	1k	2k	4k	8k			
HGV Arriving & Manoeuvring	71	66	65	66	69	65	58	50	109	72	78
HGV Engine Idling	75	58	66	60	62	59	52	42	37	66	-
HGV Pulling Away	71	65	64	65	63	62	56	46	15	68	-
Electric Powered Chiller	75	71	67	61	58	56	52	45	continuous	65	
Air Brakes	-	-	-	-	-	-	-	-	3	80	81
Unloading Activities	-	-	-	-	-	-	-	-	420	60	77

For HGV movements to and from the service yards, source data has been determined based upon the guidance contained within the Noise Advisory Council guide: *A guide to measurement and prediction of the equivalent continuous sound level* L_{eq} (NAC).

OPERATIONAL NOISE LEVELS AT SENSITIVE RECEPTORS

Calculations have been undertaken to predict operational specific sound levels ($L_{Aeq,T}$) at the following nearby sensitive receptors:

- Residential receptor R01 – Flat at second floor above Costa Coffee on Marine Road Central, adjacent to the Winter Gardens;

- Residential receptor R02 – Flat above shops opposite Eric Morecambe statue, Marine Road Central;
- Residential receptor R04 – Flat at first floor above Rita's Café, adjacent to the Goods Yard car park on Marine Road Central;
- Non-residential receptor NR01 – Third floor rooms of Midland Hotel, Marine Road Central; and
- Non-residential receptor NR03 – Second floor rooms of Lakeland Rooms Hotel, Marine Road Central.

Service/delivery noise emissions from the Proposed Development have been assessed using BS 4142. The significance is determined upon the margin by which the operational noise level exceed the background sound level and the context in which the sound occurs.

Acoustic character corrections are applied based on nature of the operations associated with each assessed scenario. Representative background sound levels are taken from the noise survey results at ML1 and ML2.

The BS 4142 assessment for Receptor R01 is presented in Table 7-10.

Table 7-10 - Receptor R01 BS 4142 assessment

Assessment step	Scenario 1 - Ambient goods operation		Scenario 2 - Chilled goods operation	
Period	Day (1hr assessment period)	Night (15 minute assessment period)	Day (1hr assessment period)	Night (15 minute assessment period)
Modelled Specific Sound Level [A]	33	39	40	42
Tonality [B]	0	0	+2	+2
Impulsivity [C]	0	0	0	0
Intermittency [D]	0	0	0	0
Rating level [E] = [A+B+C+D]	33	39	42	44
Background Sound Level ($L_{A90,T}$) [F]	52	35	52	35
Rating Level vs. Background Sound Level [E-F]	-19	+4	-10	+9
Magnitude of impact	Negligible	Minor	Negligible	Moderate
NPSE classification	NOEL	LOAEL	NOEL	LOAEL - SOAEL

For Scenario 1, the rating level is 19dB below the daytime background sound level and 4dB above the night-time background sound level. The most adverse magnitude of impact occurs during the night-time and is **minor**. The effect would be adverse, direct, long-term and **not significant**.

For Scenario 2, the rating level is 10dB below the daytime background sound level and 9dB above the night-time background sound level. The most adverse magnitude of impact occurs during the night-time and is **moderate**. The effect would be adverse, direct, long-term and on the basis of a precautionary assessment, **significant**.

It is recommended that night-time deliveries of chilled goods are avoided during the night. This is discussed further in the **Mitigation** section below.

The BS 4142 assessment for Receptor R02 is presented in Table 7-11.

Table 7-11 - Receptor R02 BS 4142 assessment

Assessment step	Scenario 1 - Ambient goods operation		Scenario 2 - Chilled goods operation	
Period	Day (1hr assessment period)	Night (15 minute assessment period)	Day (1hr assessment period)	Night (15 minute assessment period)
Modelled Specific Sound Level [A]	28	34	35	37
Tonality [B]	0	0	+2	+2
Impulsivity [C]	0	0	0	0
Intermittency [D]	0	0	0	0
Rating level [E] = [A+B+C+D]	28	34	37	39
Background Sound Level ($L_{A90,T}$)[23] [F]	52	35	52	35
Rating Level vs. Background Sound Level [E-F]	-24	-1	-15	+4
Magnitude of impact	Negligible	Negligible	Negligible	Minor
NPSE classification	NOEL	LOAEL	NOEL	LOAEL - SOAEL

For Scenario 1, the rating level is 24dB below the daytime background sound level and 1dB below the night-time background sound level. For both daytime and night-time operation, the magnitude of impact is **negligible**. The effect would be adverse, direct, long-term and **not significant**.

[23] Typical background sound level assumed to be same as that measured at ML02

For Scenario 2, the rating level is 15dB below the daytime background sound level and 4dB above the night-time background sound level. The most adverse magnitude of impact occurs during the night-time and is **minor**. The effect would be adverse, direct, long-term and **not significant**.

The BS 4142 assessment for Receptor R04 is presented in Table 7-12.

Table 7-12 - Receptor R04 BS 4142 assessment

Assessment step	Scenario 1 - Ambient goods operation		Scenario 2 - Chilled goods operation	
Period	Day (1hr assessment period)	Night (15 minute assessment period)	Day (1hr assessment period)	Night (15 minute assessment period)
Modelled Specific Sound Level [A]	39	45	46	48
Tonality [B]	0	0	+2	+2
Impulsivity [C]	0	0	0	0
Intermittency [D]	0	0	0	0
Rating level [E] = [A+B+C+D]	39	45	48	50
Background Sound Level ($L_{A90,T}$) [F]	52	35	52	35
Rating Level vs. Background Sound Level [E-F]	-13	+10	-4	+15
Magnitude of impact	Negligible	Moderate	Negligible	Major
NPSE classification	NOEL	SOAEL	NOEL	SOAEL

For Scenario 1, the rating level is 13dB below the daytime background sound level and 10dB above the night-time background sound level. The most adverse magnitude of impact occurs during the night-time and is **moderate**. The effect would be adverse, direct, long-term and on the basis of a precautionary assessment, **significant**.

For Scenario 2, the rating level is 4dB below the daytime background sound level and 15dB above the night-time background sound level. The most adverse magnitude of impact occurs during the night-time and is **major**. The effect would be adverse, direct, long-term and on the basis of a precautionary assessment, **significant**.

It is to be noted that the above assessment is based on the representative background sound level measured at a location (the Winter Gardens) to the east of the assessment location and at a location two storeys higher. It is considered that the representative background sound level at NR04 may be higher than assumed due to being closer to the nearby sources of noise, including building services plant associated with the Midland Hotel, 110m to the northwest. Furthermore, it is possible that

existing deliveries to the hotel could also currently occur outside typical daytime periods and as such, would result in noise sources similar to those proposed already encountered at the receptor.

The time history of the measured night-time background sound levels indicated a drop in the L_{A90} between around midnight and 06:00 and it is recommended that both ambient and chilled deliveries to the café/retail delivery area during this period should be avoided. This is discussed further in the **Mitigation** section below.

The BS 4142 assessment for Receptor NR01 is presented in Table 7-13.

Table 7-13 - Receptor NR01 BS 4142 assessment

Assessment step	Scenario 1 - Ambient goods operation		Scenario 2 - Chilled goods operation	
Period	Day (1hr assessment period)	Night (15 minute assessment period)	Day (1hr assessment period)	Night (15 minute assessment period)
Modelled Specific Sound Level [A]	36	42	43	45
Tonality [B]	0	0	+2	+2
Impulsivity [C]	0	0	0	0
Intermittency [D]	0	0	0	0
Rating level [E] = [A+B+C+D]	36	42	45	47
Background Sound Level ($L_{A90,T}$) [F]	52	50	52	50
Rating Level vs. Background Sound Level [E-F]	-16	-8	-7	-3
Magnitude of impact	Negligible	Negligible	Negligible	Negligible
NPSE classification	NOEL	NOEL	NOEL	NOEL

For Scenario 1, the rating level is 16dB below the daytime background sound level and 8dB below the night-time background sound level. For both daytime and night-time operation, the magnitude of impact is **negligible**. The effect would be adverse, direct, long-term and **not significant**.

For Scenario 2, the rating level is 7dB below the daytime background sound level and 3 dB below the night-time background sound level. For both daytime and night-time operation, the magnitude of impact is **negligible**. The effect would be adverse, direct, long-term and **not significant**.

The BS 4142 assessment for Receptor NR03 is presented in Table 7-14.

Table 7-14 - Receptor NR03 BS 4142 assessment

Assessment step	Scenario 1 - Ambient goods operation		Scenario 2 - Chilled goods operation	
Period	Day (1hr assessment period)	Night (15 minute assessment period)	Day (1hr assessment period)	Night (15 minute assessment period)
Modelled Specific Sound Level [A]	30	36	37	39
Tonality [B]	0	0	2	2
Impulsivity [C]	0	0	0	0
Intermittency [D]	0	0	0	0
Rating level [E] = [A+B+C+D]	30	36	39	41
Background Sound Level ($L_{A90,T}$)[24] [F]	52	35	52	35
Rating Level vs. Background Sound Level [E-F]	-22	1	-13	6
Magnitude of impact	Negligible	Minor	Negligible	Moderate
NPSE classification	NOEL	NOEL	NOEL	NOEL

For Scenario 1, the rating level is 22dB below the daytime background sound level and 1dB above the night-time background sound level. The most adverse magnitude of impact occurs during the night-time and is **minor**. The effect would be adverse, direct, long-term and **not significant**.

For Scenario 2, the rating level is 13dB below the daytime background sound level and 6dB above the night-time background sound level. The most adverse magnitude of impact occurs during the night-time and is **moderate**. The effect would be adverse, direct, long-term and on the basis of a precautionary assessment, **significant**.

NOISE FROM FIXED PLANT AND EQUIPMENT

There is the potential for noise to be generated from fixed plant and equipment installed at the Proposed Development. As the detailed requirements for fixed plant and equipment is unknown at

[24] Typical background sound level assumed to be same as that measured at ML02

this stage, noise level limits are specified in Table 7-15. Should the fixed plant be operational 24 hours a day, the night-time rating level takes precedence.

The noise limits are to be achieved at any noise sensitive receptors, including dwellings, hotels and B&Bs. The fixed plant noise level limits are 5 dB below the typical daytime and night-time background sound levels and are sufficiently low that plant noise would not give rise to a change in the ambient noise levels reported in Section 3.

The noise limits are rating levels, as defined in BS4142.

Table 7-15 - Fixed plant and equipment noise limits

Receptor	Rating Level	
	Daytime ($L_{Ar,1h}$ dB)	Night-time ($L_{Ar,15min}$ dB)
Any noise sensitive receptor, including dwellings and hotels	47	30

MITIGATION

Noise from chilled goods deliveries to the café/retail delivery area has the potential to cause a significant adverse effect during the night at the nearest residential receptors. It is recommended that chilled deliveries to the café/retail area are scheduled so as to avoid night-time periods (23:00 – 07:00) and thus prevent a significant effect from occurring.

Furthermore, noise from ambient deliveries to the café/retail delivery area has the potential to cause a significant adverse effect at the nearest residential receptors during the night and it is recommended that these are avoided during the quietest period of the night, namely between 00:00 and 06:00.

It is noted that separate to this planning application, a Traffic Regulation Order will need to be approved and subject to consultation. It is anticipated that noise from deliveries would be assessed in more detail when further information regarding the likely delivery requirements becomes available.

Noise levels generated by fixed plant will be dependent upon the type of plant, the finalised layout and design of plant rooms, and the likely hours of operation. Notwithstanding this, there are a number of mitigation measures that can be employed to reduce and control operational noise emissions from the Site, including:

- The use of localised noise barriers to screen noisy plant or activities;
- Wherever possible, ensure the buildings associated with the Proposed Development screen noise generating plant and activities from sensitive receptors;
- Maximise the distance between noise generating plant and activities and sensitive receptors;
- Limit the areas where specific noise generating activities will be undertaken (e.g. the use of HGV trailer chillers could be contained within parts of the Site that are fully screened from receptors by the Proposed Development buildings themselves);
- Limit the operational working hours or delivery times where practicable;

- Select quiet plant, particularly where that plant is either facing or located close to sensitive receptors;
- Ensure appropriate attenuation is incorporated into any air handling equipment with grilles or louvres facing noise sensitive receptors;
- Specify acoustically attenuated louvres to plant rooms facing sensitive receptors;
- Select plant and equipment that is not tonal; and
- Where possible, specify inverters to variable speed plant items to prevent on/off mechanical switching.

As the detailed building services plant design is progressed, a revised predictive assessment of operational noise emissions may be necessary. If the revised assessment predicts significant effects then appropriate mitigation measures will be developed. A planning condition could be used to ensure that the operational noise emissions from the detailed application are evaluated and reassessed if required.

RESIDUAL

For ambient operation, the most adverse magnitude of impact occurs at Receptor R04 during the night-time and is **minor** (assuming deliveries to the café/retail delivery area can be scheduled to avoid the quietest period of the night). The effect would be adverse, direct, long-term and **not significant**.

For chilled goods operation, the most adverse magnitude of impact occurs at Receptor R04 during the night-time and is **minor** (assuming deliveries to the café/retail delivery area can be scheduled to avoid night-time deliveries). The effect would be adverse, direct, long-term and **not significant**.

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