adrian james acoustics limited

TECHNICAL REPORT

GRUNDON SERVICES, BANBURY

Acoustic Assessment

Adrian James Acoustics Document Control Sheet

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QA Control

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A	16 May 2019	Michael Cheong MIOA	Andy Thompson MIOA	Andy Thompson MIOA
B	2 September 2019	Michael Cheong MIOA	Mat Tuora MIOA	Adrian James FIOA

Revision History

Rev	Details
A	Update location of waste transfer station
B	Typographic and formatting errors corrected

Disclaimer

1 INTRODUCTION

1.1 Background

We have been appointed by Grundon Waste Management Ltd to undertake a noise assessment for a proposed residential development at Higham Way, Banbury. The site is predominantly brownfield with an LGV depot located on the western third of the site.

The significant noise sources affecting the site are:

- Diesel locomotives on the rail line on the site's southern boundary;
- Activities taking place at Chiltern Railway's Light Maintenance Depot close to the site's south-eastern boundary;
- Road traffic on the M40 approximately 950m east of the site;
- Noise from the industrial estate approximately 300m north-east of the site.

1.2 Structure of this report

The structure of this report is as follows:

- Section 2 describes the criteria used in this assessment;
- Section 3 describes the existing site and proposed development;
- Section 4 sets out our methodology and summarises the results of our survey;
- Section 5 presents our assessment of the impact of noise from the Light Maintenance Depot upon the occupants of the proposed dwellings;
- Section 6 presents our assessment of the impact of noise from the waste transfer station upon the occupants of the proposed dwellings;
- Section 7 sets out the results of our noise model and details of the proposed noise barrier;
- Section 8 describes noise control measures to meet the internal ambient noise criteria;
- Section 9 presents a summary of our conclusions;
- Technical terms and units used in this report are described in Appendix A;
- Details of the measurement equipment used, and calibration are set out in Appendix B.

1.3 Sources of information, assumptions and limitations

This assessment is based on the following information provided to us by JSA Planning:

Drawing No.	Revision	Title
PL-111	F	Proposed Site plan
PL-110	A	Indicative Movement Parameter Plan
PL-111	A	Indicative Trees and Landscaping areas
PL-114	A	Indicative Land Use Plan
PL-115	A	Proposed Levels
1581- Figure 4B	B	Proposed site layout (Waste management facility)

2 NOISE CRITERIA

2.1 National Planning Policy Framework

The National Planning Policy Framework (NPPF) came into force in March 2012 and was revised in July 2018. The NPPF replaced a series of Planning Policy Guidance (PPG) and Planning Policy Statement (PPS) documents. These included Planning Policy Guidance 24 “Planning and Noise” (PPG24), which outlined considerations in determining planning applications for noise-sensitive developments and for activities that generate noise. The NPPF does not set out numerical criteria for noise affecting proposed development sites, but states that planning policies and decisions should aim to:

- 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;
- identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

2.2 BS 8233:2014 Guidance on sound insulation and noise reduction for buildings

Section 7.7.2 of British Standard BS 8233 suggests the following indoor ambient noise levels for dwellings:

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

Table 1- BS8233:2014 indoor ambient noise levels

Note 4 of this section states:

“Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values.”

For external amenity areas BS8233: 2014 (Section 7.7.3.2) states:

“For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50dB $L_{Aeq,T}$, with an upper guideline value of 55dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognised that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces but should not be prohibited.”

2.3 ProPG: Planning and Noise

The Professional Practice Guidance on Planning and Noise (ProPG) was published in May 2017 and produced jointly by the Association of Noise Consultants, the Institute of Acoustics and the Chartered Institute of Environmental Health. The guidance adopts a 2-stage approach to assessing potential residential developments that will be exposed predominately to airborne noise from transport sources.

Stage 1 is an initial noise risk assessment of the proposed development site. This should indicate whether the site poses a negligible, low, medium or high noise risk. An indication that there may be more than 10 noise events at night (23:00hrs – 07:00hrs) with $L_{AF\ Max}$ > 60dB means the site should not be regarded as negligible risk.

Stage 2 is a full assessment of 4 key elements to be undertaken in parallel. These are:

1. Good acoustic design.
2. Internal noise level guidelines.
3. External amenity area noise assessment.
4. Assessment of other relevant issues.

The target noise levels are shown in Table 2 and are based upon the levels contained in BS 8233:2014 and WHO Guidelines.

Activity	Location	07:00 to 23:00hrs	23:00 to 07:00hrs
Resting	Living room	35dB $L_{Aeq,16hr}$	-
Dining	Dining room/area	45dB $L_{Aeq,16hr}$	-
Sleeping (daytime resting)	Bedroom LAeq,16hr	35dB $L_{Aeq,16hr}$	30dB $L_{Aeq,8hr}$ 45dB $L_{AF,\ Max}$
Where development is considered necessary or desirable, the internal $L_{Aeq,T}$ target levels can be relaxed by up to 5dB and reasonable internal conditions still achieved.			
For external amenity areas that are an intrinsic part of the overall design, noise levels should ideally not be above the range of 50 – 55dB $L_{Aeq,16hr}$.			

Table 2 – Target noise levels

2.4 British Standard BS 4142:2014

British Standard BS 4142:2014 “Method for rating and assessing industrial and commercial sound” is a tool widely used by local authorities to determine whether a new industrial sound source is likely to give rise to complaint from people living in the vicinity.

The standard is complicated, but basically it sets out a method of assessing the impact of measured or calculated sound, based on the difference between the “rating level” of the sound and the “background sound level” (L_{A90}) that would otherwise exist in the absence of the sound. The “rating level” is derived by adding any correction that is necessary, due to certain characteristics of the sound to the “specific sound level”.

The “specific sound level” is the equivalent continuous A-weighted sound pressure level (L_{Aeq}) of the sound, at the assessment position, over a time period specified in the standard. The assessment position must be outside the dwelling or other noise sensitive building affected by the sound and the measurements must be representative of the specific sound and the background sound level.

Where the sound has a tonal element e.g. whine, hiss, screech, hum etc., or contains distinct impulses such as bangs, clicks, clatters, or thumps etc, the standard recommends that, an adjustment of between 2 to 9dB is added to the “specific sound level” to give a “rating level”.

The standard provides an assessment by subtracting the background sound level from the rating level:

- A rating level 10dB or more above background is likely to be an indication of a significant adverse impact.
- A rating level 5dB above background is likely to be an indication of an adverse impact.

2.5 Criteria set by the council

We have had discussions with Trevor Dixon at Cherwell District Council. Mr Dixon has agreed that noise levels within dwellings and in external amenity areas should not exceed the levels set out in BS 8233:2014. Mr Dixon also asked us to consider noise generated from the nearby Light Maintenance Depot and any other industrial noise sources that may become apparent during the noise survey.

3 SITE DESCRIPTION

3.1 Existing site

The site is shown in Figure 1 delineated with a red line. The Light Maintenance Depot (LMD) is to the south-east of the site, separated by the rail line and shown in Figure 1 delineated with a yellow line. Approximately 150m north-east of the site is a Waste Transfer Station, operated by Grundon Services, this site operates from 07:00hrs Monday to Saturday. The M40 motorway is approximately 950m east of the site, running north / south.

The topography of the site is relatively flat with less than two metres variation between the highest and lowest point of the site. The rail line runs adjacent to the south-west boundary of the site and is slightly roughly level with the north-west end of the site and approximately 1.5m higher than the south-east end of the site.

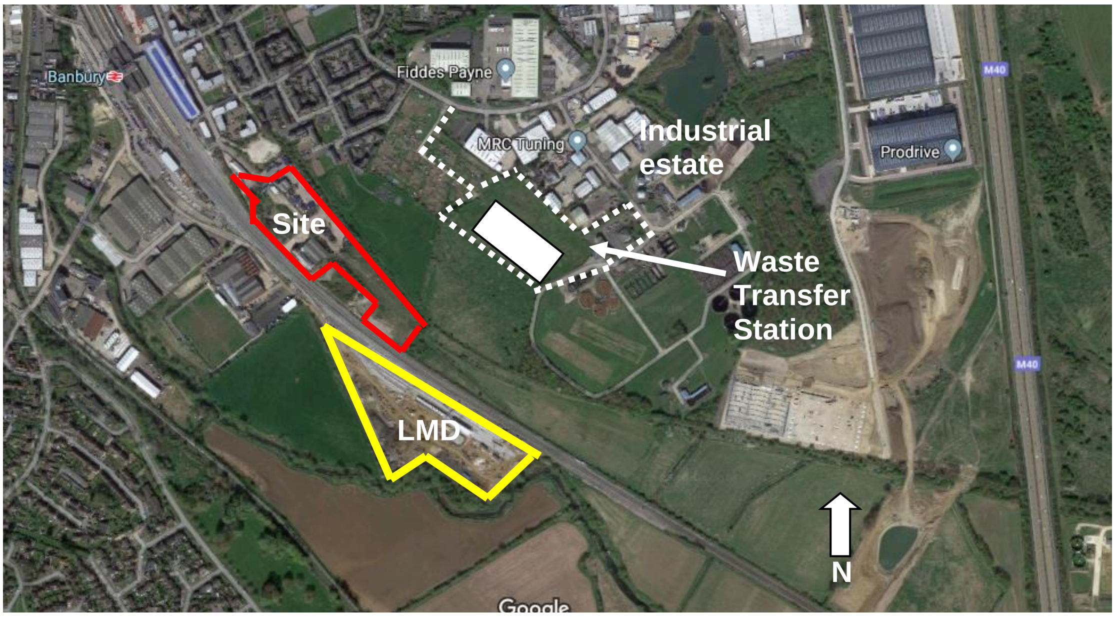


Figure 1 – Site location (image from Google Earth©)

3.2 Proposed development

We understand that the proposed development would comprise eleven blocks, ranging from three to six storeys in height, accommodating up to 200 dwellings.

The layout of the proposed development is shown in Figure 2.

Figure 2 – Proposed site layout

4 SITE SURVEY

4.1 Methodology

We undertook an unattended noise survey between Monday 15 April 2019 and Wednesday 26 April 2019 at location 'Kit 1' as shown in Figure 3. Measurements included 0.1 second logging and continuous audio recording facilities which enabled us to identify and isolate individual noise events.

We also installed a weather station close to the sound level meter to record wind speed/direction and precipitation. Any noise measurement data recorded when wind speeds exceeded 5 m/s or during periods of precipitation were excluded from our assessment.

We also took short attended measurements on Wednesday 24 April 2019 between 05:30hrs and 08:15hrs at locations 'Kit 2' and 'Kit 3'. Kit 2 was used to measure noise from the Waste Transfer Station and Kit 3 was used to measure noise from an idling train on the tracks opposite the measurement point.

All measurements were taken under free- field conditions at a microphone height of 1.5m. Details of the equipment used, calibration and personnel are shown in Appendix B.

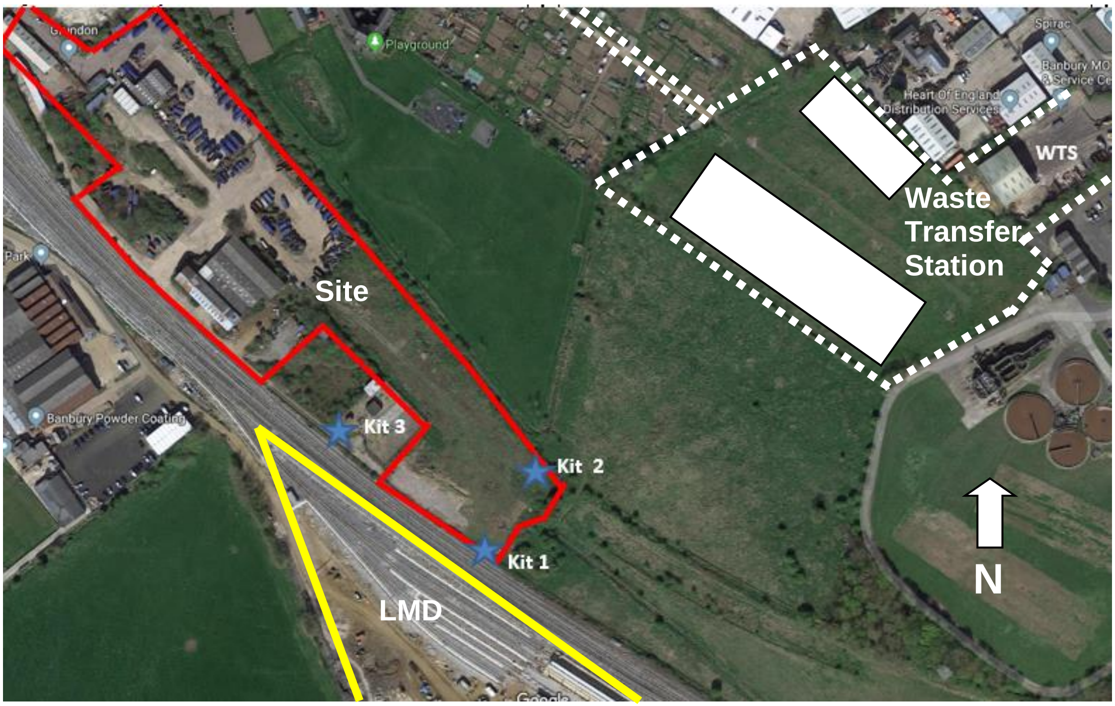


Figure 3 - Measurement locations (Image from Google Earth)

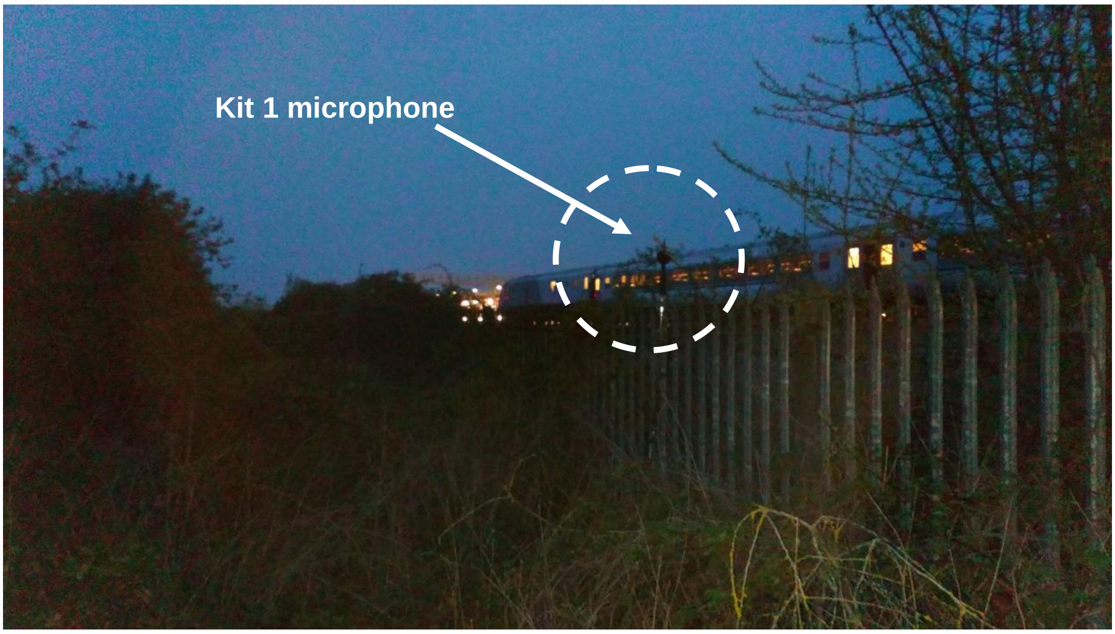


Figure 4 – View of Kit 1 looking towards the Light Maintenance Depot

Figure 5 – Kit 2 looking towards the Waste Transfer Station

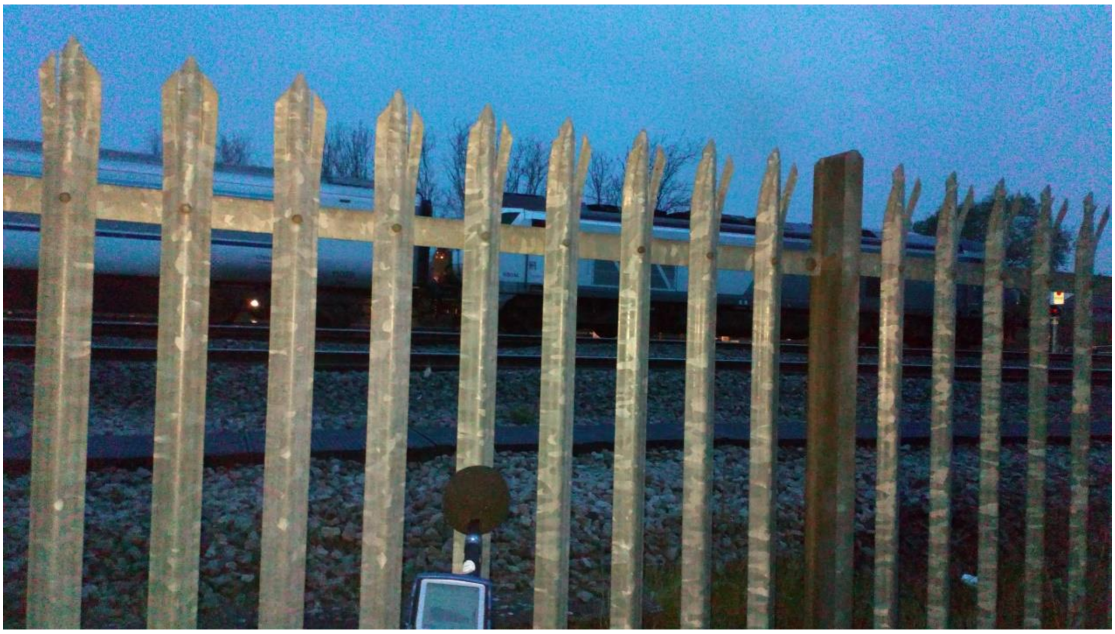


Figure 6 – Kit 3 looking towards the rail line

Figure 7 – Light Maintenance Depot in operation (24 April 2019 06:03hrs)

4.2 Noise sources

Analysis of the audio log for the unattended survey, site visits and attended surveys has identified the following noise sources:

Ref.	Noise source
1	Trains passing along the rail line, including diesel-powered passenger and freight
2	Diesel locomotives idling in the Light Maintenance Depot. This occurred mainly at night, but started as early as 18:30hrs and tended to go on until 06:30hrs
3	Occasional compressed air releases from the braking systems of idling trains at the Light Maintenance Depot.
4	Distant road traffic noise from the M40, audible as an ever-present drone
5	Occasional noise from the Waste Transfer Station. The noise of loading shovel buckets hitting the ground and reversing alarms was just audible during lulls in the ambient noise levels. This only occurred after 07:00hrs.

Although road traffic noise from the M40 was audible throughout the survey, the train line and Light Maintenance Depot were the dominant sources of noise, and hence it was difficult to separate out the motorway noise. To assess the noise contribution from the M40 we have used the most recently-available traffic count data (2016) available from the Department for Transport website in our computer model of the site. The day and night levels were adjusted in accordance with the Transport Research Laboratory's '*Method for Converting the UK Road Traffic Noise Index* $L_{A10,18h}$ *to the EU Noise Indices for Road Noise Mapping'.*

The Department for Transport data only states the percentage of heavy goods vehicles over a 24-hour period and does not state separate figures for day and night-time. We have therefore used a distribution percentage of 25% HGVs during the day and 45% HGVs at night. The assumed daytime HGV percentage is significantly higher than that shown in the M40 24-hour traffic count data and is therefore likely to represent a worst case. For the purposes of our noise break-in calculations we have assumed a typical traffic noise spectrum as set out in BS EN 1793 Part 3.

4.3 Measured ambient and background sound levels

The measured ambient ($L_{Aeq,T}$) and background ($L_{AF90,T}$) sound levels at the unattended measurement position (Kit 1) are shown in Figure 8 and Figure 9. Both the day and night ambient sound levels showed very little variation with most periods recording levels between 64 and 66 dB $L_{Aeq,T}$ with the exception of the night of the 20th April (Easter Monday).

The representative ambient sound level for the day-time period (shown by the red line in Figure 8) is 65 dB $L_{Aeq,\ 16\ hours}$. The representative background sound level for the daytime period is 45 dB $L_{AF90\ 16\ hours}$.

The representative ambient sound level for the night-time period (shown by the red line in Figure 9) is 65 dB $L_{Aeq,\ 8\ hours}$. The representative background sound level for the night-time period is 51 dB $L_{AF90\ 8\ hours}$.

Figure 8 – Measured daytime ambient and background sound levels at Kit 1

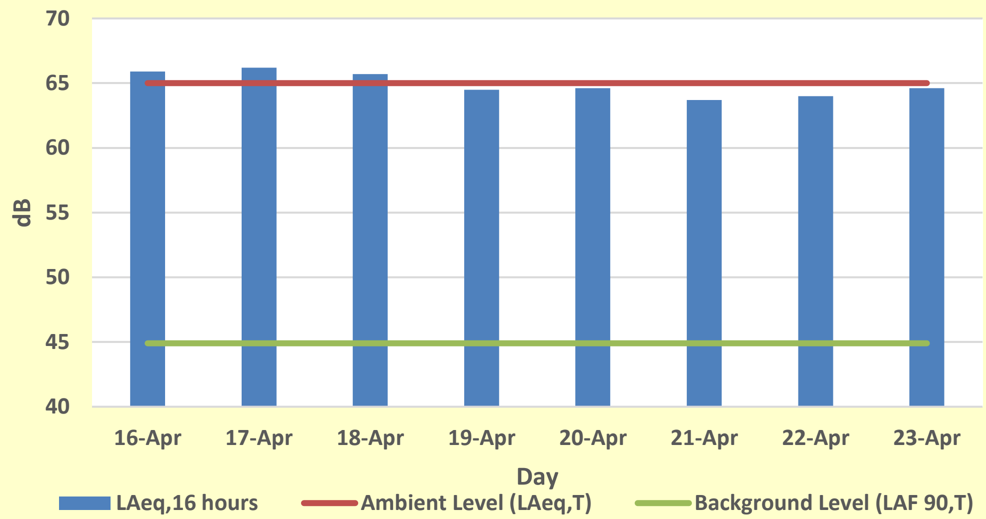
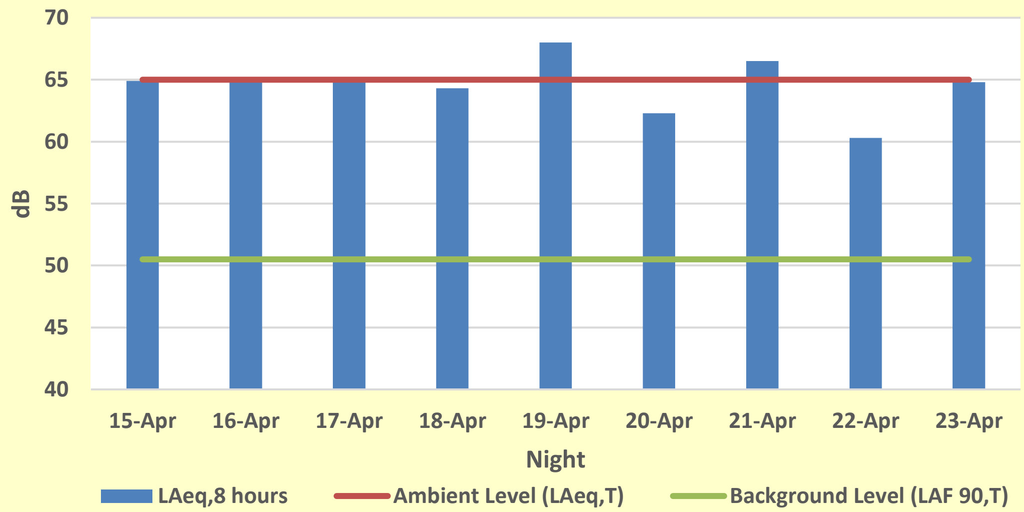


Figure 9– Measured night-time ambient and background sound levels at Kit 1



As discussed in Section 4.2 of this report the Light Maintenance Depot close to the south-east boundary operates mainly at night, but started as early as 18:30hrs and tended to go on until 06:30hrs. The noise sources from this operation consisted of diesel engines idling continuously and occasional compressed air releases from the braking systems.

We have used the data and audio logging capabilities of our unattended monitoring equipment and proprietary post-processing software to identify and isolate individual noise events including idling trains and compressed air releases. The software allows us to exclude events and calculate noise levels in the absence of those events attributable to the Light Maintenance Depot. Figure 10 and Figure 11 show the ambient and background sound levels in the absence of noise from the depot. The results show that the daytime ambient sound levels showed very little variation across the 8-day period with the overall ambient sound level remaining at 65 dB $L_{Aeq,T}$ and the background sound level also remaining at 45 dB $L_{AF90,T}$.

As the depot tends to operate for most of the night-time period ambient sound levels in the absence of noise from the depot were up to 6 dB lower. Note that there is no data for the night of 18 April as the depot operated continuously over the whole period. Individual day and night periods will also show some variance as excluding periods of time when the LMD was operating reduces the period used for the measurement. The overall ambient sound level was 2 dB lower at 63 dB $L_{Aeq,T}$ and the background sound level in the absence of noise from the depot was also reduced by 2 dB to 49 dB $L_{AF90,T}$.

Figure 10 – Daytime ambient and background sound levels with LMD noise excluded

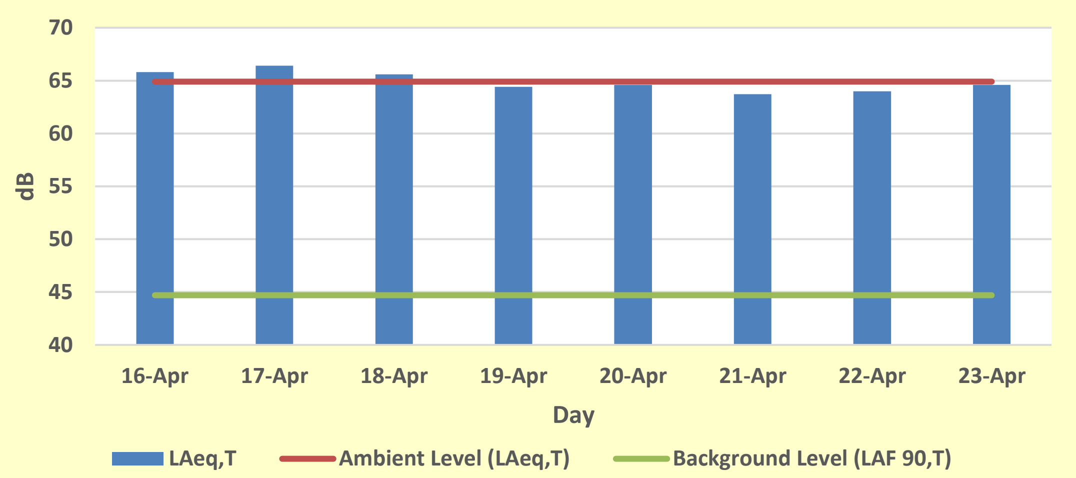
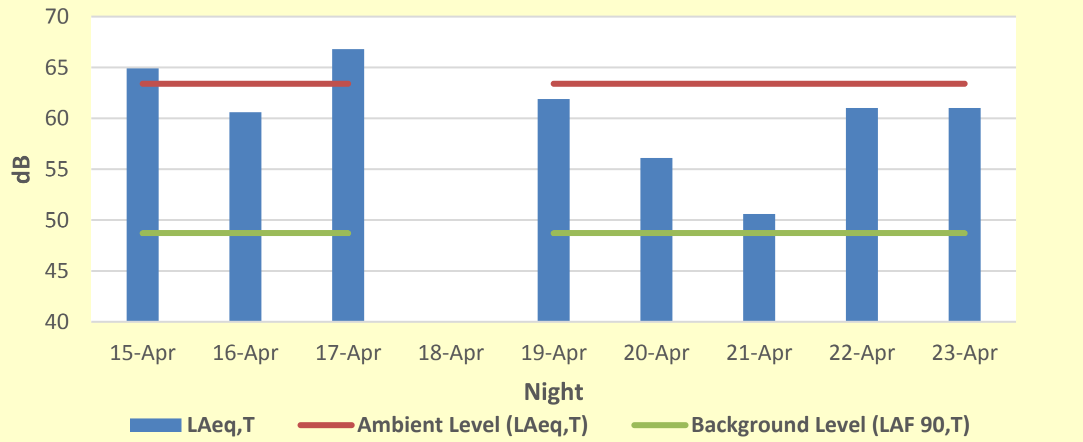


Figure 11– Night-time ambient and background sound levels with LMD noise excluded



The night-time background sound levels are higher than the daytime levels regardless of whether the Light Maintenance Depot noise is excluded or not. However, the site is affected by a number of noise sources including road traffic on the M40 which was audible as an ever-present drone. Using the post processing software to exclude all noise sources attributable to the rail line and Light Maintenance Depot produced background sound levels of 45 and 49 dB $L_{AF90,T}$ and residual sound levels of 53 and 55 dB $L_{Aeq,T}$, for day and night respectively indicating that road traffic noise appears to be the principle contributor to the noise environment in the absence of rail noise.

The background sound level is an underlying level of sound over a given time period and does not reflect the occurrence of transient and/or higher sound level events. It is generally governed by continuous or semi-continuous sounds. The background sound can be significantly affected by meteorological conditions, particularly where the main sources of residual sound are remote from the assessment location as is the case with the M40.

However, the relatively high levels of ambient sound for both day and night periods are of more significance to this noise assessment than the background sound levels.

4.4 Measured $L_{AF\ Max,T}$ levels

As discussed in Section 2.2 of this report, BS8233:2014 states that regular individual noise events such as passing trains can cause sleep disturbance and a guideline value may be set in terms of SEL or $L_{AFmax,T}$, depending on the character and number of events per night. Passing trains were the source of frequent short duration, high noise level events affecting the site.

We have used the data and audio logging capabilities of our unattended monitoring equipment and proprietary post processing software to identify and isolate individual noise events including passing trains. Figure 12 shows the statistical distribution of the night-time train pass-bys in terms of $L_{AF\ Max,T}$ over the 8 nights of the survey. Only 10% of recorded events exceeded 85 dB $L_{AF\ Max,T}$. However, to provide a robust assessment, we have selected 85 dB $L_{AF\ Max,T}$ as the representative level for our assessment.

Figure 12 – Statistical distribution of night-time train pass-bys in terms of $L_{AF\ Max,T}$

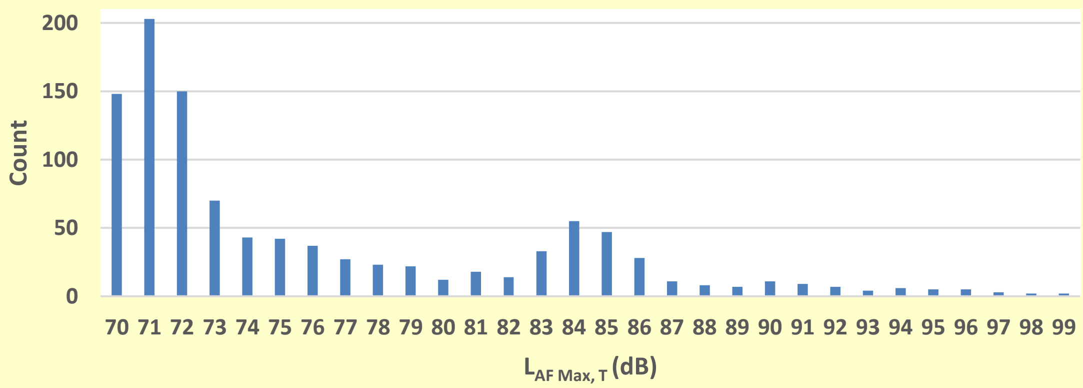
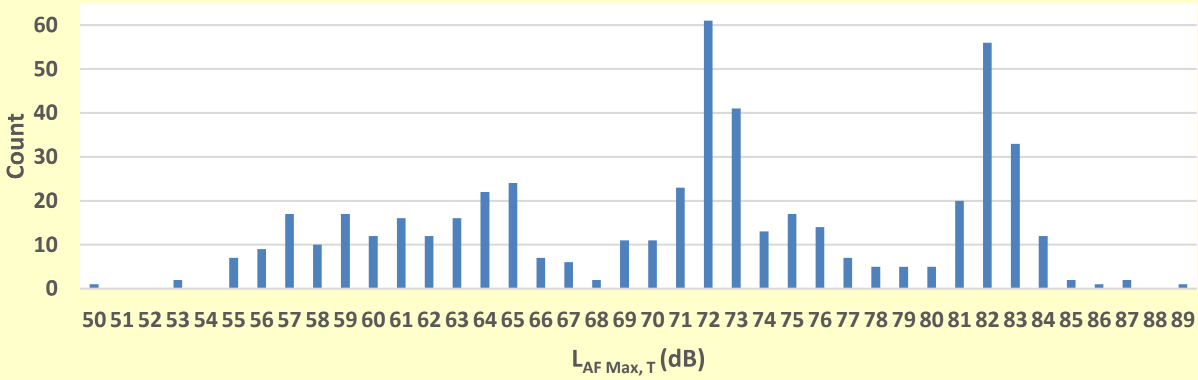


Figure 13 shows the statistical distribution of events attributable to compressed air releases from the braking systems of trains idling at the Light Maintenance Depot. Fewer than 2% of recorded events exceeded 84 dB $L_{AF\ Max,T}$. However, to provide a robust assessment, we have selected 84 dB $L_{AF\ Max,T}$ as the representative level for our assessment.

Figure 13– Statistical distribution of night-time air brake noise in terms of $L_{AF\ Max,T}$



4.5 Summary of results

The measured levels we have used for our noise model and assessment are shown in Table 3.

Time period	Ambient sound level $L_{Aeq,T}$ (dB)	$L_{AF\ Max,T}$ (dB)	Background sound level $L_{AF\ 90,T}$ (dB)
Day (07:00hrs to 23:00hrs)	65	-	45
Night (23:00hrs to 07:00hrs)	65	85	48

Table 3 – Results summary

5 LIGHT RAIL MAINTENANCE DEPOT

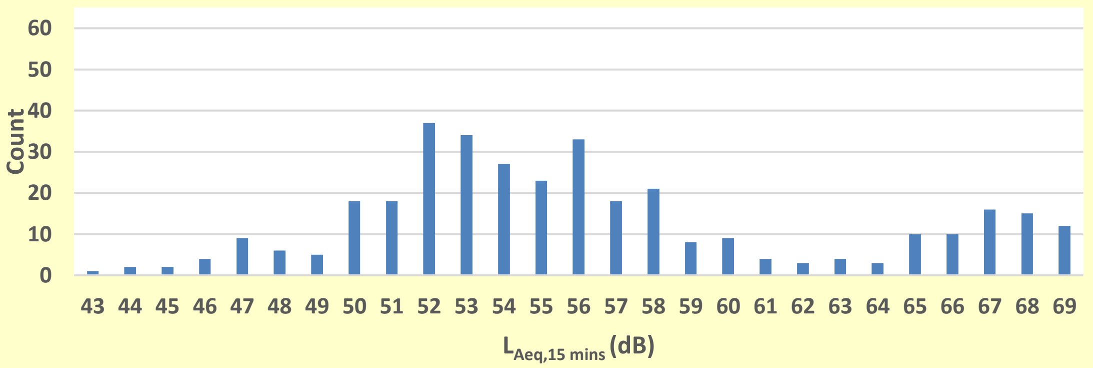
5.1 Description

Following a conversation with Trevor Dixon from Cherwell Council's Environmental Health Department, we understand that noise generated from activities surrounding the train depot is currently attracting complaints from other residential areas close to the depot. As discussed in Section 4.2 of this report, the Light Maintenance Depot close to the south-east boundary operates mainly at night, but started as early as 18:30hrs and tended to go on until 06:30hrs.

5.2 Specific sound levels

The noise sources from this operation consisted of diesel engines idling continuously and occasional compressed air releases from the braking systems. Figure 15 shows the statistical distribution of noise levels measured by Kit 1 when trains were idling at the depot during the night. The noise from idling engines was broadband and continuous with very little fluctuation in level over each 15-minute time period. Levels ranged from 43 to 69 dB $L_{Aeq,15\ mins}$ but these differences in levels were dependent upon the location of the idling train as there are several lines within the depot where the trains can be parked (see Figure 7). The highest levels were measured when the idling train was on the line nearest to the measurement position. We confirmed this by taking a short, attended measurement with Kit 3 directly opposite an idling train on the main line which produced a measurement of 67.1 dB $L_{Aeq,\ 15\ minutes}$.

Figure 15– Statistical distribution of measured idling train noise in terms of $L_{Aeq,15\ mins}$



To provide a robust assessment, we have selected 68 dB $L_{Aeq,\ 15\ minutes}$ as our specific sound level. This includes the contribution of the sound of occasional compressed air releases from the braking systems at 84 dB $L_{AF\ Max,T}$.

5.3 Rating level

Due to the impulsive nature of the compressed air releases, using the BS4142 method we have added a 6dB penalty to the specific sound level to produce a rating level of 74dB L_r.

5.4 Initial assessment

The initial assessment of the Light Maintenance Depot is shown in Table 4.

Rating level Lr (dB)	Background sound level $L_{AF90,\ 15\ mins}$ (dB)	Difference of Rating over Background (dB))	Initial assessment
74	48	+26	Significant Adverse impact

Table 4 – BS 4142:2014 initial impact assessment for the Light Maintenance Depot

Although this initial assessment indicates a significant adverse impact at night, BS 4142 advises that the significance of an industrial sound must be assessed on both the margin by which it exceeds the background level and the context in which the sound occurs, and that the initial estimate of the impact may need to be modified due to the context.

In Section 11 "Assessment of the impacts" BS4142 states:

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

1. *The absolute level of the sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual level is low. Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night……..*

2. *The character and level of the residual sound compared to the character and level of the specific sound. Consider whether it would be beneficial to compare the frequency spectrum and temporal variation of the specific sound with that of the ambient or residual sound, to assess the degree to which the specific sound source is likely to be distinguishable and will represent an incongruous sound by comparison to the acoustic environment that would occur in the absence of the specific sound…..*

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

   i. *Facade insulation treatment;*

   ii. *Ventilation and/or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation; and*

   iii. *Acoustic screening."*

In this case the rating level at night is 26dB above the background sound level, but the residual sound levels are extremely high due to the passing trains on the rail line and road traffic on the M40. The sound of the trains idling at the depot is not incongruous in comparison to the acoustic environment of passing trains on the line.

As it is the rating level at night that needs to be addressed, the context in which the sound occurs will be within the receptors' bedrooms. Therefore, the facade insulation of the buildings can be considered.

The sound insulation requirements for the building envelope are primarily determined by night-time maximum levels from train movements, which are significantly higher than the operational noise levels reported above.

With the noise mitigation measures set out in Section 7.2 and façade insulation measures set out in Section 8.3 of this report, the contribution of the Light Maintenance Depot to the internal noise levels of the closest rooms on the upper storeys of the proposed developments would be 23dB $L_{Aeq,\ 15\ mins}$ with maximum levels from compressed air releases of 27 dB $L_{AF\ Max,T}$. These levels are significantly below the BS8233:2014 guideline levels.

Noise source	**External free field level**		**Internal reverberant level**	
	$L_{Aeq,15\ mins}$	**$L_{AF,max}$**	**$L_{Aeq,15\ mins}$**	**$L_{AF,max}$**
Engine idling	60dB	-	23dB	-
Compressed air releases	-	67dB	-	27dB

Table 5– External and internal levels from LMD activity

5.5 Full assessment

If the noise mitigation measures set out in Section 7.2 and façade insulation measures set out in Section 8.3 of this report are incorporated into the development, the Light Maintenance Depot should not have a significant adverse impact upon residents of the development.

5.6 Uncertainty

To reduce uncertainty, we have used the highest measured noise levels from the Light Maintenance Depot operation for our assessment. As the calculated internal noise levels are 8 dB(A) below the BS 8233:2014 values discussed in Section 2.2 of this report, the uncertainty inherent in the calculation should not have a significant impact upon the assessment.

6 WASTE TRANSFER STATION

6.1 Description

As discussed in Section 4.2 of this report, during our surveys we noticed occasional noise from the Waste Transfer Station located on the industrial estate approximately 300m north-east of the site. The noise of loading shovel buckets hitting the ground and reversing alarms was just audible during lulls in the ambient noise levels. This only occurred after 07:00hrs during the day.

6.2 Specific sound levels

Figure 16 shows the level versus time history of impact noise caused by loading shovel buckets dropping onto the hardstanding, as measured at position 'Kit 2'. Individual events were of very short duration (between 1 and 4 seconds per event) with a total duration for the 28 events of 44 seconds. The sound level of this noise source is 54.4 dB $L_{Aeq,\ 44\ seconds}$ which when adjusted for the reference level of 1 hour produces a specific sound level of 35.3 dB $L_{Aeq,\ 1\ hour}$.

As the noise is only just audible at the boundary of the site we have added a feature correction of +3 dB. Therefore, the rating level is 38.3 dB L_r.

Figure 16 - Level v Time history of impact noise from Waste Transfer Station

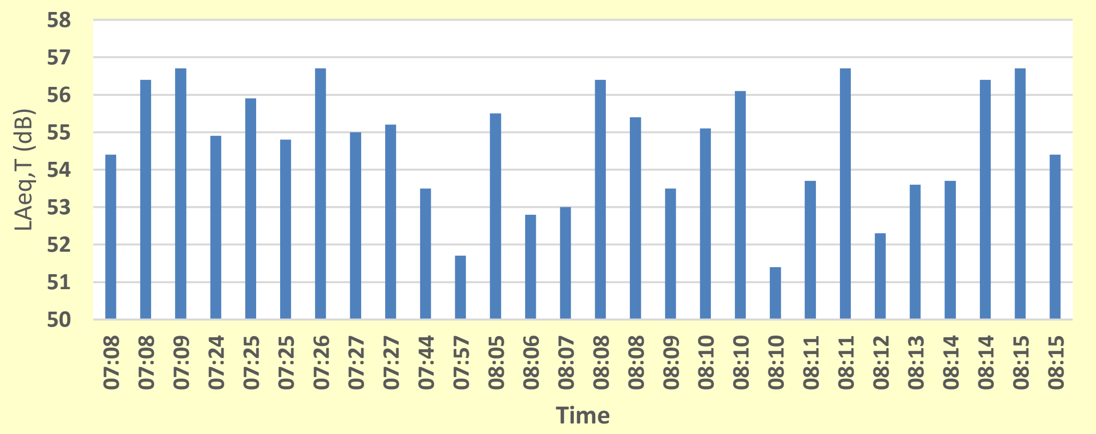


Figure 17 shows a level versus time history of reversing alarms from the Waste Transfer Station. The sound level of this noise source is 52.5 dB $L_{Aeq,\ 90\ seconds}$ which when adjusted for the reference level of 1 hour produces a specific sound level of 36.5 dB $L_{Aeq,\ 1\ hour}$.

As the noise is only just audible at the boundary of the site we have added a feature correction of +3dB. Therefore, the rating level is 39.5 dB L_r.

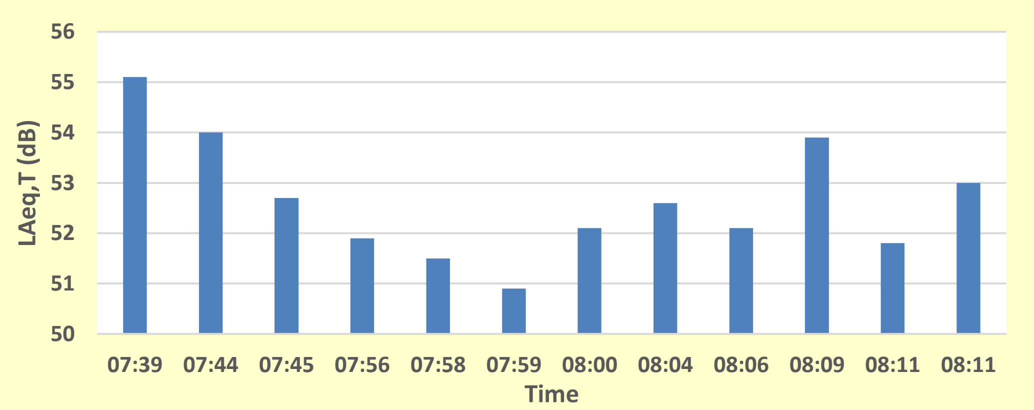


Figure 17 - Level v Time history of reversing alarms from Waste Transfer Station

6.1 Initial assessment

The initial assessment results are shown in Table 6. The assessment indicates that the activities taking place at the Waste Transfer Station will have a low impact upon future occupants of the proposed development. We do not believe that the assessment needs to be modified in this case.

Noise source	Rating level Lr (dB)	Background sound level $L_{AF90,\ 1\ hour}$ (dB)	Difference of Rating over Background (dB))	Initial assessment
Impact sound	38.3	45	-6.7	Low Impact
Reversing horns	39.5	45	-5.5	Low Impact

Table 6 – BS 4142:2014 initial impact assessment for the Waste Transfer Station

6.2 Uncertainty

As the rating level is more than 5 dB below the background sound level, the uncertainty of the measurement should not have a significant impact upon the assessment.

7 NOISE MODEL AND RESULTS

7.1 Methodology

To assess noise levels affecting the development, we created a computer model of the site using proprietary modelling software (CadnaA by DataKustik Gmbh). The software allows us to assess noise propagation across the proposed site and determine noise levels at the facades of the proposed dwellings.

7.1.1 Road traffic noise

As discussed in Section 4.2 of this report, we have calculated road traffic noise levels from the M40 using the CRTN (Calculation for Road Traffic Noise) guidance published by the Department of Transport.

7.1.2 Rail noise

We have used the measured noise levels reported in Section 4.5 of this report. To model noise from the railway line it is necessary to know the effective noise source height of the trains. The Department of Transport's document *Calculation of Railway Noise* states:

"*…….the top surface of the near-side railhead of a particular track defines the source line for noise generated by moving railway vehicles, apart for diesel locomotives operating at full power settings*", and;

"When the source of noise is a diesel locomotive operating on full power the source position is located 4m above the near side rail".

As we know that the locomotives using the line are diesel powered, we have considered the noise source height to be at 4m.

7.2 Proposed mitigation measures

We understand that it is proposed to install a noise barrier around the south-west boundary of the site as shown in Figure 18. We recommend that the proposed barrier should be a total of 6 metres high and can be a combination of earth bund topped with a fence if achieving this height is difficult with either bund or fence alone. Fencing should have no holes or gaps and a minimum surface density of 10 kg/m^2. We have included the proposed screening in the model to assess noise levels at different heights on the building facades.

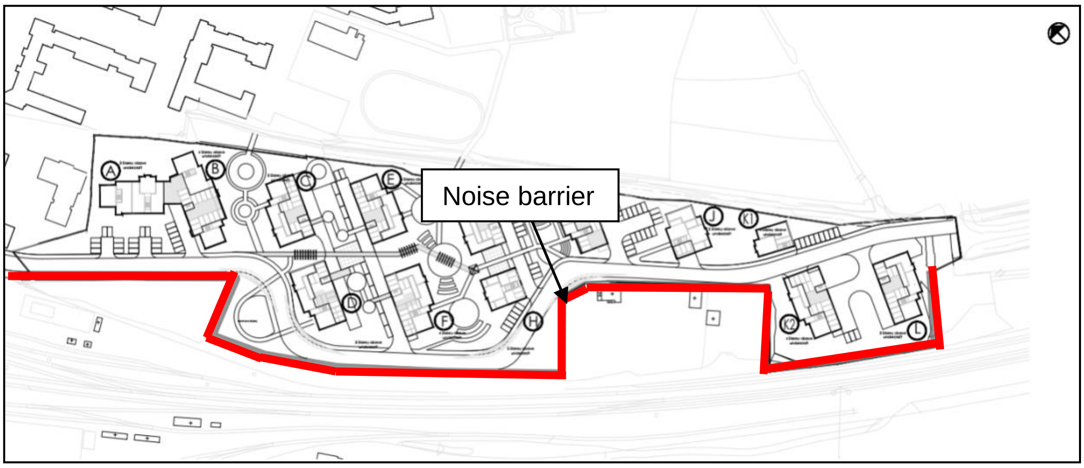


Figure 18 - Location of mitigation measures

7.3 Results

The calculated free field levels from our CadnaA model are provided in Table 7. These levels have been calculated at a height of 7.5m to take into account the flats on the upper storeys.

Location	$L_{Aeq,16hr}$ Daytime	$L_{Aeq,8hr}$ Night-time	$L_{AF,max}$ Night-time
Facades facing the railway line	57dB	57dB	77dB
Facades facing away from the railway line	54dB	50dB	64dB

Table 7 – Free-field levels at facades

7.4 External noise levels

7.4.1 Daytime

BS8233:2014 sets the design criteria for external noise at 50dB $L_{Aeq,16\text{-}hr}$ with an upper value of 55dB $L_{Aeq,16\text{-}hr}$. Figure 19 shows the calculated external daytime noise levels across the proposed site at a height of 1.5 metres. This includes the effects of proposed screening discussed in Section 7.2 of this report.

Areas which comply with the lower design criterion set out BS8233:2014 are shown in green. Most other areas on the site do not exceed the upper noise value of 55dB, which is shown in yellow.

Figure 20 shows the calculated external daytime noise levels across the proposed site at a height of 7.5 metres. We have used the façade levels from this noise model to calculate internal noise levels of the nearest flats on the upper storeys of the proposed development.

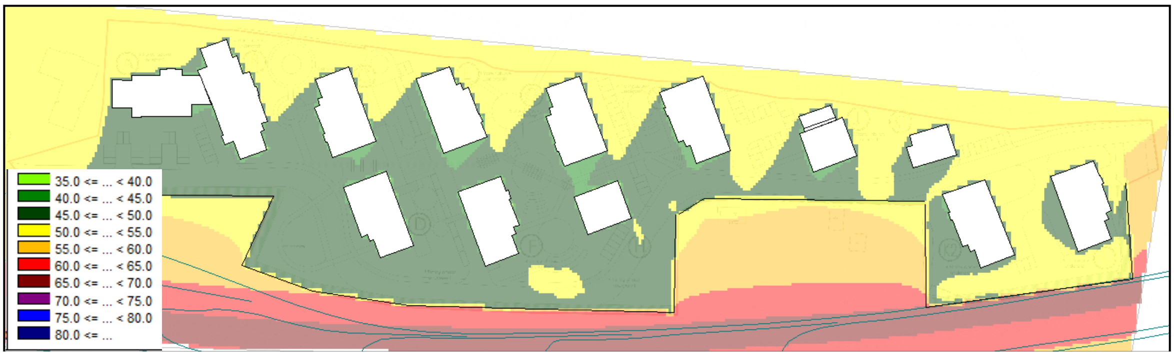


Figure 19 – External daytime levels across the site at 1.5m height ($L_{Aeq,16\ hours}$)

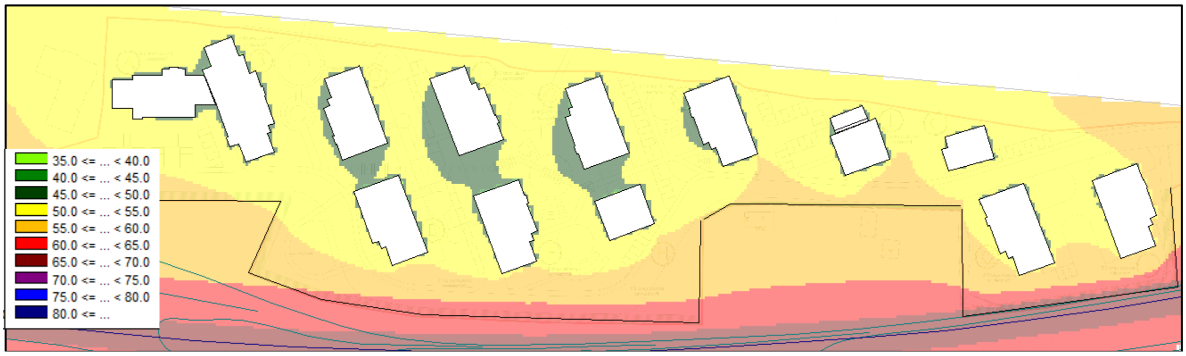


Figure 20– External daytime levels across the site at 7.5m height ($L_{Aeq,16\ hours}$)

7.4.2

7.4.2 Night-time

Figure 21 shows the calculated external night-time noise levels across the proposed site at a height of 1.5 metres. This includes the effects of proposed screening discussed in Section 7.2 of this report. Most of the site, shown in green, is below 50dB $L_{Aeq,\ 8\ hours}$.

External levels at 7.5m height are +8dB(A) higher than at 1.5m due to the reduced attenuating effect of the barrier. This 8dB(A) difference in levels at the upper storeys is also reflected in the $L_{AF\ Max}$ levels for train pass-bys , air brake releases from trains idling at the Light Maintenance Depot and for the $L_{Aeq,\ 15\ minutes}$ level for engine idling noise. The calculated external noise levels at 1.5m and 7.5m for these noise sources are shown in Figure 23 to Figure 28.

Figure 21– External night- levels across the site at 1.5m height ($L_{Aeq,8\ hours}$)

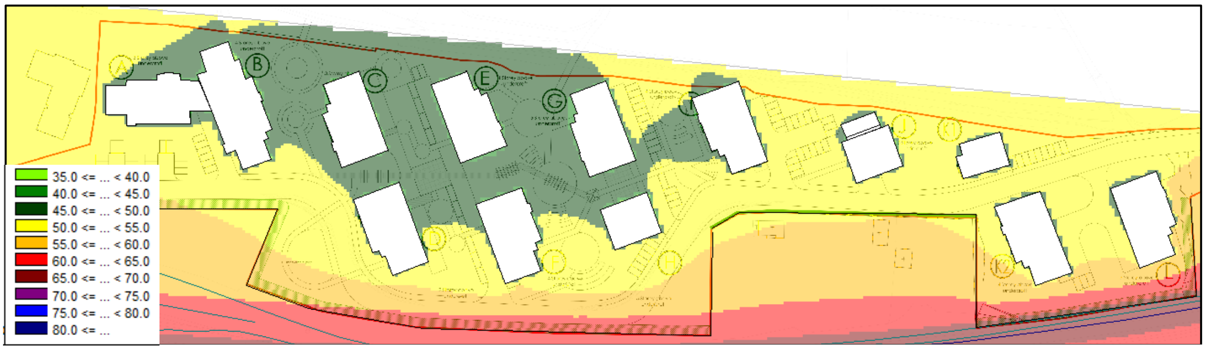


Figure 22– External night- levels across the site at 7.5m height ($L_{Aeq,8\ hours}$)

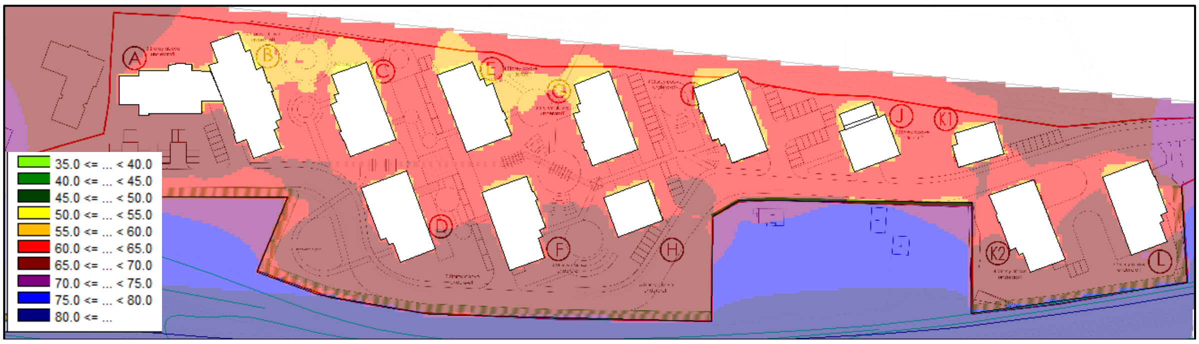


Figure 23– External levels across the site from train pass-bys at 1.5m height ($L_{AF\ Max,T}$)

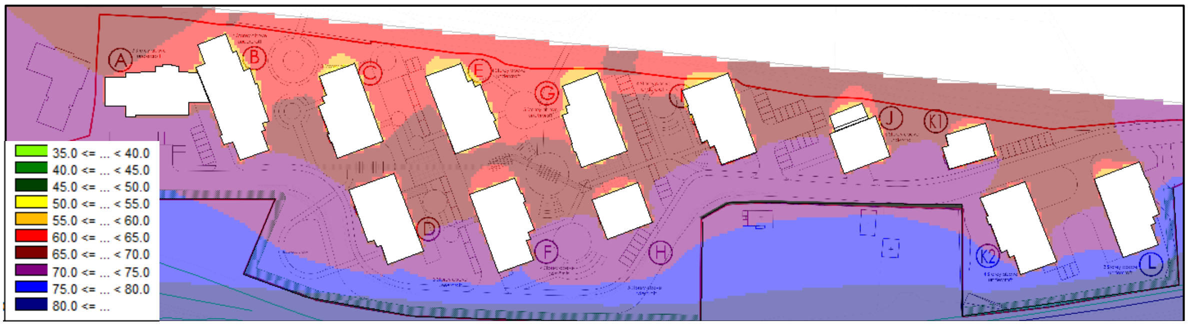


Figure 24– External levels across the site from train pass-bys at 7.5m height ($L_{AF\ Max,T}$)

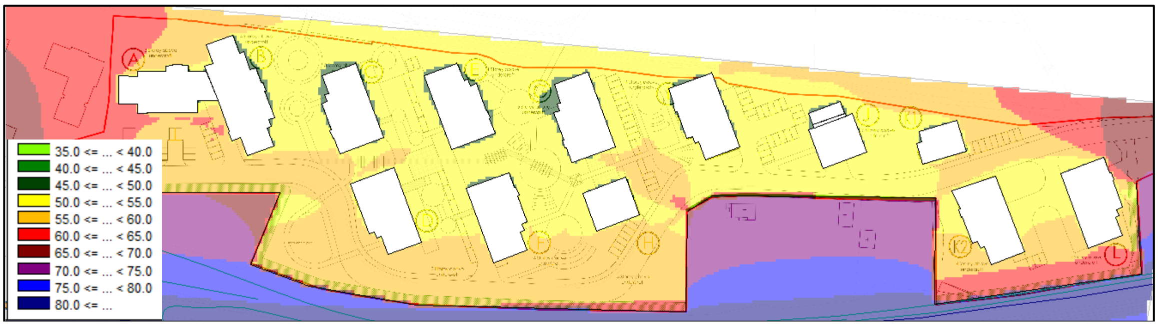


Figure 25– External levels across the site at 1.5m from air brakes at LMD ($L_{AF\ Max,T}$)

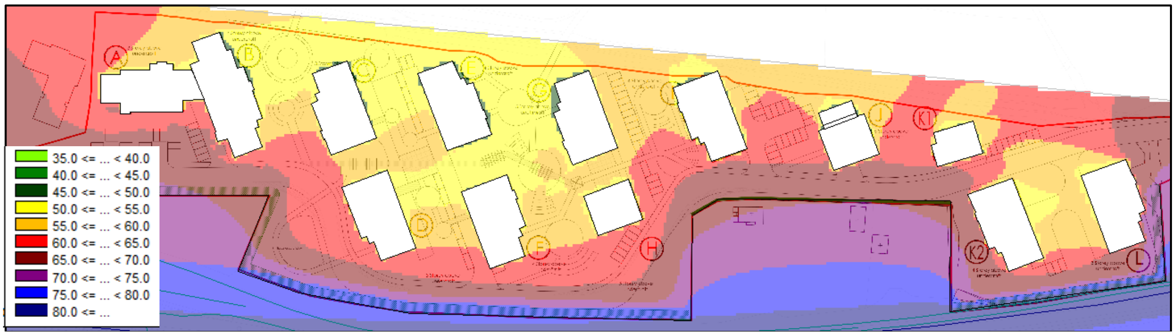


Figure 26– External levels across the site at 7.5m from air brakes at LMD ($L_{AF\ Max,T}$)

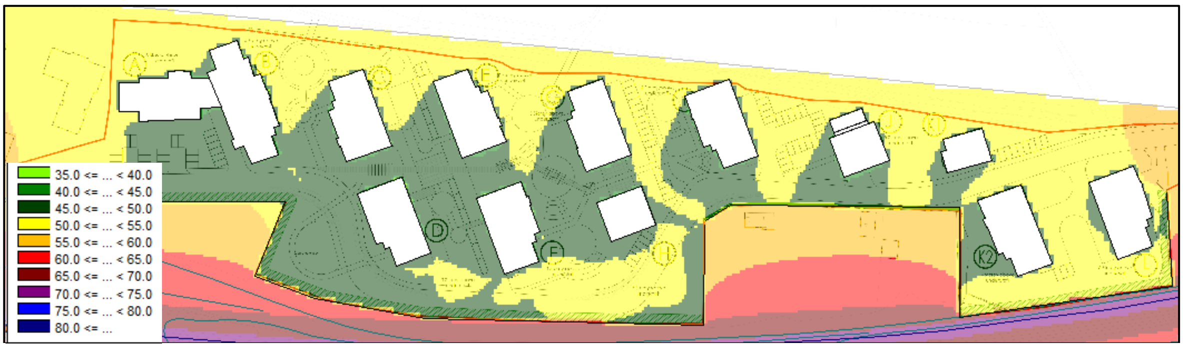


Figure 27– External levels across the site at 1.5m from trains idling at LMD ($L_{Aeq,15\ mins}$)

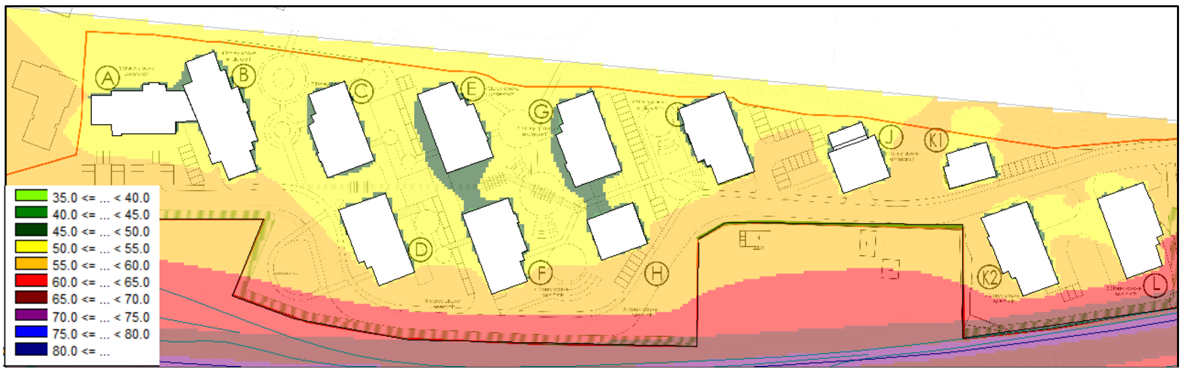


Figure 28 -– External levels across the site at 7.5m from trains idling at LMD ($L_{Aeq,15\ mins}$)

8 INTERNAL NOISE LEVELS AND PRINCIPLES FOR NOISE CONTROL

8.1 Noise criteria

Internal noise levels should meet the A-weighted BS 8233:2014 values discussed in Section 2.2 of this report. These levels are summarised below:

- 35dB $L_{Aeq,16hr}$ daytime
- 30dB $L_{Aeq,8hr}$ night-time (Bedrooms only)
- 45dB $L_{AF,max}$ night-time (Bedrooms only)

8.2 Noise control - general principles

Within conventional facade constructions, windows and unattenuated ventilators are normally the weakest areas of sound insulation of a conventional masonry façade. Opening windows for ventilation purposes will further reduce the effective sound insulation. Regardless of the quality of window or sound insulation of the glazing, the overall insulation of an open window will generally be limited to 10-15dB(A).

We recommend that mechanical ventilation is incorporated into the design. For the purposes of this assessment we have assumed that a natural ventilation strategy will be favoured for background ventilation where possible and our report sets out the minimum element-normalised level difference which will need to be achieved by the ventilation elements. We have also provided maximum noise levels to be achieved by mechanical ventilation systems.

Figure 29 – Plan of noise mitigation measures

We have calculated internal noise levels for a sample of typical residential rooms in the following locations:

- Facades facing the railway (shown orange in Figure 29)
- Facades facing away from the railway (shown blue in Figure 29)

We do not have proposed floor plans for the dwellings so we have assumed room dimensions of 4m x 3m x 2.4m for a typical bedroom, with a reverberation time of 0.5 seconds for a furnished room.

Calculations have been made using noise data as summarised in Section 7.3 of this report.

8.3 Sound insulating constructions

8.3.1 Facades facing the railway (shown in orange)

Our calculations indicate that habitable rooms on facades shown in orange in Figure 29 will require glazing and ventilators with the following minimum acoustic ratings. Recommended specifications for these elements are as follows:

- **Glazing:** Glazed units for dwellings on these facades should have a minimum weighted sound reduction index of 45dB Rw.

  We have used the following sound reduction index data:

	Octave band SRI (dB)						Rw (dB)
Glazing	125	250	500	1k	2k	4k	
10mm / 16mm / 9.1mm Pilkington Optiphon Acoustic Laminate (sealed units)	29	33	44	46	49	57	**45**

  This performance requirement applies to the complete glazing unit as installed including the window frame, up to a total of $4m^2$ of glazing per room. Higher specification units may be required if larger areas of glazing are to be installed.

- **Ventilation:** Background ventilation with windows closed should be via trickle ventilators or airbricks with a weighted element-normalised level difference of at least 43dB $D_{ne,w} + 10\log(n)$ where ‘n’ is the number of units.

  The manufacturer of the chosen ventilator will need to confirm that their product is capable of meeting this criterion with ventilators open. For our calculations we have used data for two Greenwood Airvac AAB4000 Acoustic airbricks.

  Domestic mechanical ventilation and heat recovery (MVHR) units may be used to provide ventilation if required. This is discussed in Section 8.5.

8.3.2 Facades facing away from railway (shown in blue)

Our calculations indicate that habitable rooms on facades shown in blue in Figure 29 will require glazing and ventilators with the following minimum acoustic ratings. Recommended specifications for these elements are as follows:

- **Glazing:** Glazed units with a minimum weighted sound reduction index of 31dB Rw. This should be achievable with standard double-glazed units as follows:

	Octave band SRI (dB)						Rw (dB)
Glazing	125	250	500	1k	2k	4k	
4mm / 12mm / 4mm sealed units	24	20	25	35	38	35	**31**

  This performance requirement applies to the complete glazing unit as installed including the window frame, up to a total of 4m^2 of glazing per room. Higher specification units may be required if larger areas of glazing are to be installed.

- **Ventilation:** Background ventilation with windows closed should be via trickle ventilators or airbricks with a weighted element-normalised level difference of at least 31dB $D_{ne,w} + 10\log(n)$ where 'n' is the number of units.

  The manufacturer of the chosen ventilator will need to confirm that their product is capable of meeting this criterion with ventilators open. For our calculations we have used data for one standard hit and miss trickle vents.

  Again, domestic mechanical ventilation and heat recovery (MVHR) units may be used and are further discussed in Section 8.5.

8.4 Internal levels with proposed treatment

Table 8 shows the free-field external levels and calculated internal levels using the above treatments.

	External free field level			Internal reverberant level		
Location	$L_{Aeq,16hr}$ **Daytime**	$L_{Aeq,8hr}$ **Night-time**	$L_{AF,max}$ **Night-time**	$L_{Aeq,16hr}$ **Daytime**	$L_{Aeq,8hr}$ **Night-time**	$L_{AF,max}$ **Night-time**
Facades facing the railway line	56dB	57dB	77dB	22dB	20dB	40dB
Facades facing away from the railway line	53dB	50dB	63dB	31dB	28dB	41dB

Table 8 – External and internal levels

8.5 Noise from plant and services

Where mechanical ventilation systems are specified to ventilate residential rooms, the M&E engineer or contractor should ensure that fan noise and external noise break in through the ventilation system do not cause the daytime and night-time internal noise criteria set out in Section 8.1 of this report to be exceeded, or restrict the performance of sound insulating constructions. In practice, this will require internal reverberant noise levels from mechanical ventilation systems to be no higher than the following:

Room	Noise limit
Living Rooms	30dB(A) / NR25
Bedrooms	25dB(A) / NR20

Higher levels are acceptable in non-habitable rooms such as kitchens and bathrooms, and rapid extract ventilation does not need to meet these limits.

There are several noise issues to be considered in the design of mechanical ventilation, including:

- Fan noise and other duct-borne noise in noise-sensitive rooms
- Aerodynamic noise, e.g. from high speed airflows at diffusers and in ducts
- Noise from ventilator actuators and dampers – there are special requirements for these and we can assess specific systems against these requirements if required
- Cross-talk through ducts between residential rooms: cross-talk attenuators may be required
- Airborne and structure-borne noise transmission from plant rooms to adjoining residential rooms. Plant may require efficient vibration isolation and possibly inertia blocks.
- Noise emissions to the atmosphere from plant room louvres, intake or discharge terminals.

Noise from services should be steady and broadband in nature with no recognisable tones or characteristics such as ‘hums’, ‘clicks’ or ‘buzzes’. It is the responsibility of the M&E designer or contractor to design plant and services to meet these requirements.

9 SUMMARY OF CONCLUSIONS

- We have assessed noise levels across the proposed site using both attended and unattended surveys.
- Due to the relatively high noise levels across the site the dwellings cannot be ventilated by openable windows and meet the internal noise criteria set out by the council. Noise mitigation measures are discussed in Section 7.2 and 8.3 of this report
- With the proposed mitigation measure and the facade treatments in place, internal noise levels should comply with the noise criteria set out by the Council. The calculated internal noise levels are set out in Section 8.4 of this report.
- External amenity areas across most of the site meet the recommended levels set out in BS8233.
- We have assessed the noise from the Light Maintenance Depot on the site's south-eastern boundary according to BS4142:2014. The proposed dwellings will require noise control measures to avoid significant adverse impacts at night. Our recommended noise control measures are described in Section 7.2 and Section 8.3 of this report.
- We have assessed noise from the waste transfer station to the north of the site according to BS4142:2014. We conclude that noise from the waste transfer station is likely to have a low impact.

APPENDIX A - TECHNICAL TERMS AND UNITS USED IN THIS REPORT

Decibel (dB) - This is the unit used to measure sound level. The range of human hearing from the quietest detectable sound to the threshold of pain is very large. If a normal linear scale of measurement were used, it would have to range from 20 µPa to 200,000,000 µPa. Using such large figures would be unmanageable and for this reason sound pressure levels are expressed on a logarithmic scale, which corresponds to the almost logarithmic response of the ear and which compresses the range to a manageable 0dB to140dB.

Sound Pressure Level (Lp or SPL) - This is a function of the source and its surroundings and is a measure in decibels of the total instantaneous sound pressure at a point in space. The SPL can vary both in time and in frequency. Different measurement parameters are therefore required to describe the time variation and frequency content of a given sound. These are described below.

Frequency - This refers to the number of complete pressure **fluctuations** or cycles that occur in one second. Frequency is measured in Hertz (Hz). The rumble of thunder has a low frequency, while a whistle has a high frequency. The sensitivity of the ear varies over the frequency range and is most sensitive between 1KHz and 5KHz.

Octave and One-Third Octave Bands - The human ear is sensitive to sound over a frequency range of approximately 20 Hz to 20,000 Hz and is more sensitive to medium and high frequencies than to low frequencies. To define the frequency content of a sound, the spectrum is divided into frequency bands, the most common of which are octave bands. Each band is referred to by **its centre frequency**, and the centre frequency of each band is twice that of the band below it. Where it is necessary for a more detailed analysis octave bands may be divided into one-third octave bands.

'**A' Weighting** - The sensitivity of the human ear varies with frequency, some frequencies sound louder than others. The 'A'-weighting curve represents the non-linear frequency response of the human ear and is incorporated in an electronic filter used in sound level meters. Measurements using an 'A'-weighting filter makes the meter more sensitive to the middle range of frequencies, which approximates to the response of the ear and the subjective loudness of the sound. Sound level measurements using 'A'-weighting will include the subscript A, e.g. dB(A).

Statistical Analysis - These figures are normally expressed as LN, where L is the sound pressure level in dB and N is the percentage of the measurement period. The LN figure represents the sound level that is exceeded for that percentage of the measurement period. L90 is commonly used to give an indication of the background level or the lowest level during the measurement period. L10 may be used to measure road traffic noise. See Figure 1.

LAmax - The highest A weighted sound pressure level recorded during the measurement period. The time constant used (Fast or Slow) should be stated. See Figure 1.

Leq,T - The equivalent continuous sound level is used to measure sound that varies with time. The Leq,T is the notional equivalent steady sound level, which contains the same acoustic energy as the actual varying sound level over the period of measurement. Because the averaging process used is logarithmic, the Leq,T level tends to be dominated by the higher sound levels measured. See Figure A1 overleaf:

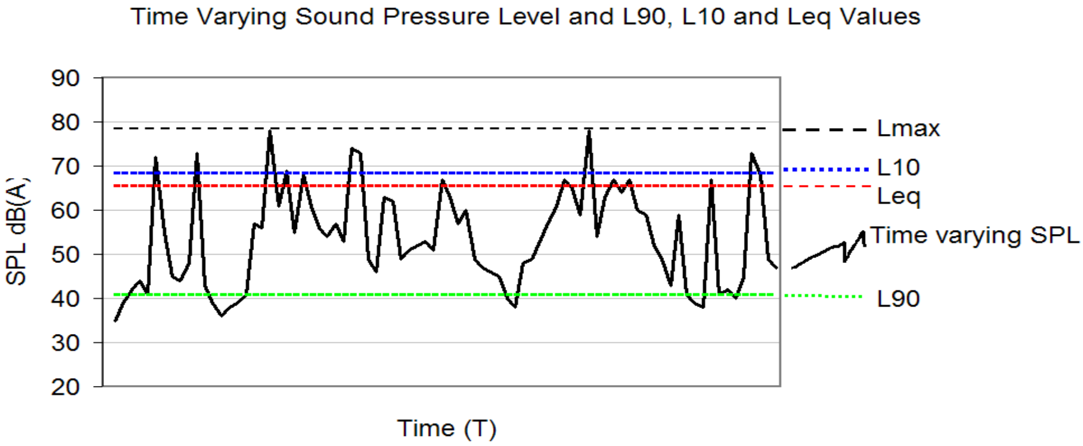


Figure A1 - Time varying sound pressure level

LAE The Single Noise Event level is a measure of the total sound energy contained within an event and is used to calculate the $L_{eq,T}$ over a given period due to a specific event such as train or aircraft passes.

APPENDIX B - MEASURING EQUIPMENT AND CALIBRATION

Job reference and title: 11863 – Grundon Services, Banbury

Measurement location: As per Figure 3

Measurement date(s): Monday 15 April 2019 to Wednesday 26 April 2019

Measuring equipment used:

Equipment description / serial number	Type number	Manufacturer	Date of calibration expiration	Calibration certificate number
Precision sound level meter serial no. A2A-04410-D2	XL2	NTi Audio	16/08/2019	26404
Microphone serial no. 8027	MC230	NTi Audio	16/08/2019	26403
Microphone pre-amplifier serial no. 5309	MA220	Neutrik	16/08/2019	26404
Microphone calibrator serial no. 042951	GA607	Castle Group	16/08/2019	26402
Precision sound level meter serial no. A2A-04410-D2	XL2	NTi Audio	16/08/2019	26404
Calibration level:	**93.7 dB @ 1 kHz**			
Precision sound level meter serial no. A2A-08643-E0	XL2-TA	NTi Audio	08/11/2020	30033
Microphone serial no. 9185	MC230	NTi Audio	08/11/2020	30032
Microphone pre-amplifier serial no. 3489	MA220	Neutrik	08/11/2020	30033
Microphone calibrator serial no. 25993	NOR-1251	Norsonic	08/11/2020	30031
Precision sound level meter serial no. A2A-08643-E0	XL2-TA	NTi Audio	08/11/2020	30033
Calibration level:	**114.0 dB @ 1 kHz**			

Precision sound level meter serial no. A2A-10758-E0	XL2-TA	NTi Audio	20/10/2019	26888
Microphone serial no. 8133	MC230	NTi Audio	20/10/2019	26887
Microphone pre-amplifier serial no. 5308	MA220	Neutrik	20/10/2019	26888
Microphone calibrator serial no. 34541	NOR-1251	Norsonic	20/10/2019	26886
Precision sound level meter serial no. A2A-10758-E0	XL2-TA	NTi Audio	20/10/2019	26888
Calibration level:	**114.0 dB @ 1 kHz**			

Person in charge of measurements: Michael Cheong MIOA

Noise sources: Rail/road traffic, industrial noise

Measurement parameters: Third Octave band $L_{eq,T}$, $L_{AF\ Max,T}$ and $L_{AF90,T}$,