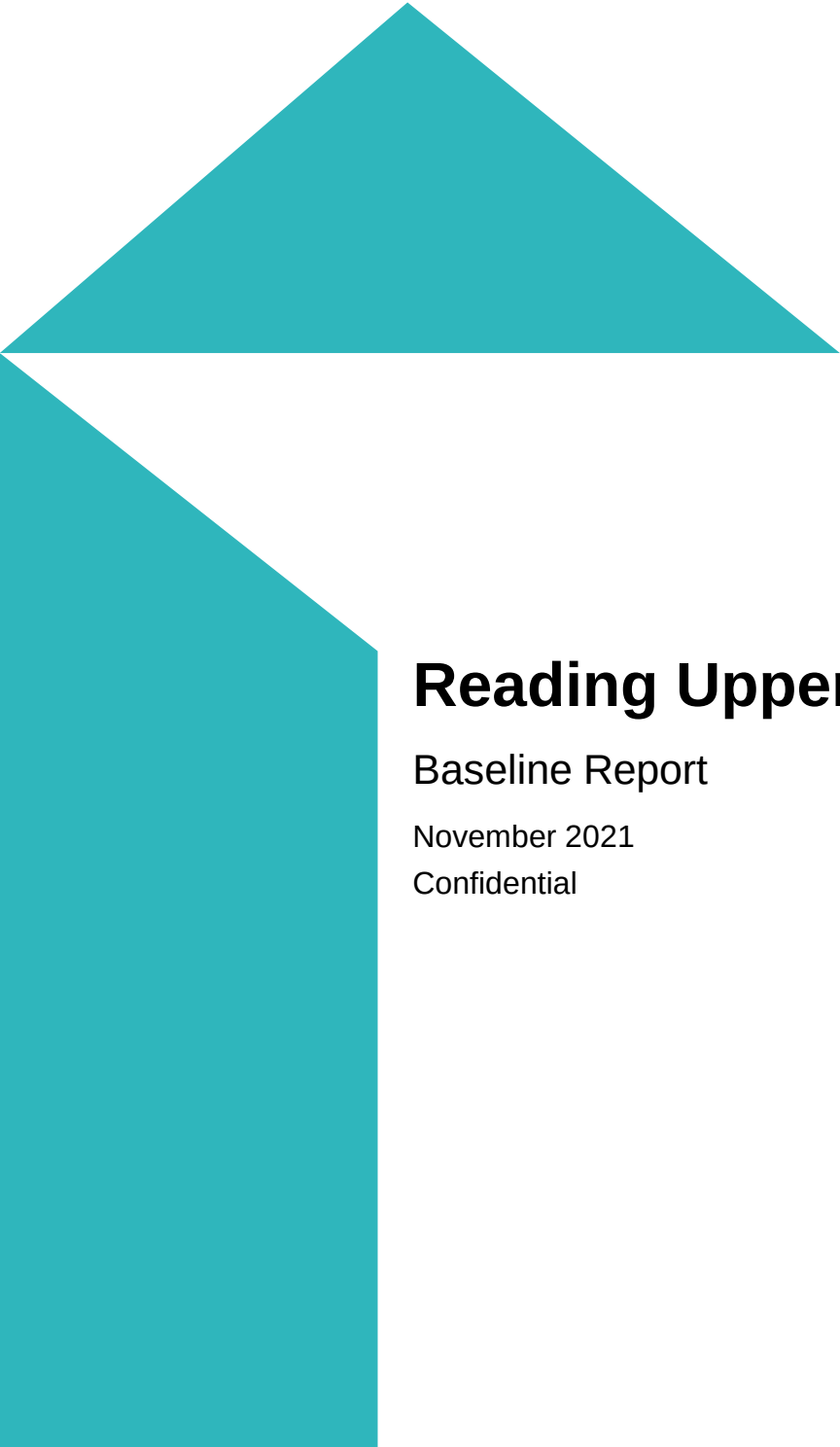




Reading Upper Triangle Depot

Baseline Report

November 2021

Confidential

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Noise Assessment Report

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Executive summary

Network Rail has commissioned Mott MacDonald Limited to conduct a noise assessment of a proposed depot at the Reading Upper Triangle Depot off Cow Lane in Reading. This document presents the results.

The assessment considered noise levels from fixed mechanical plant items associated with the proposed buildings and rail related noise sources. Rail related noise sources have been assessed in two ways. The first assessment method considers change in overall noise level according to IEMA Guidelines for Environmental Noise Assessment [IEMA, 2014] for environmental impact type assessments. The second assessment method considers the low frequency content of the noise emitted by idling locomotives according to the 'Procedure for the assessment of low frequency noise complaints' 2005 Defra NANR45'.

Based on a noise criterion of 40dB L_{Aeq} at the residential receptors, indicative limits for the Sound Power Levels (SWL) for fixed mechanical plant items have been derived. These SWL limits should be considered when selecting plant items and decisions as to whether additional attenuation will be required. Once final selections have been made further calculations of predicted noise level at residential receptors should be made to ensure compliance with criteria.

Rail related operations have been assessed in two ways. One is by considering the existing level of rail related noise at the nearest affected residences, predicting the level of new rail related noise and assessing the change in noise level in relation to a standard environmental impact type methodology as given in the IEMA Guidelines for Environmental Noise Assessment [IEMA, 2014].

The second methodology is to consider absolute levels of noise from the proposed new rail related operations and to compare them against absolute noise criteria particularly with respect to low frequency noise. Diesel locomotives can generate significant levels of low frequency noise, especially when idling, which can present specific issues. Attenuating structures such as noise barriers, double glazing etc have significantly lower attenuation performance at low frequency than at high frequencies. Low frequency noise can be particularly annoying to some people and can sometimes be mistaken for vibration.

In summary the impacts are considered Minor or Negligible except when a loco is idling at Location A which is just outside the Running Shed when the impact would be **Moderate**.

The assessment of low frequency noise shows that the low frequency spectrum curve is exceeded in most 1/3 Octave bands for four locos idling simultaneously and for single locos at all four source locations, A, B, C and D. However, the 'Procedure for the assessment of low frequency noise complaints' 2005 Defra NAN R45' states that:

"The procedure is intended to assist in the evaluation of existing problems. It is not intended as a means of predicting when disturbance might occur, for example in a planning situation, and would not be reliable to use as such. This is because disturbance by LFN depends on a number of factors, such as the character of the sound, whose effects are neither well understood, nor readily predictable."

1 Introduction

1.1 Introduction

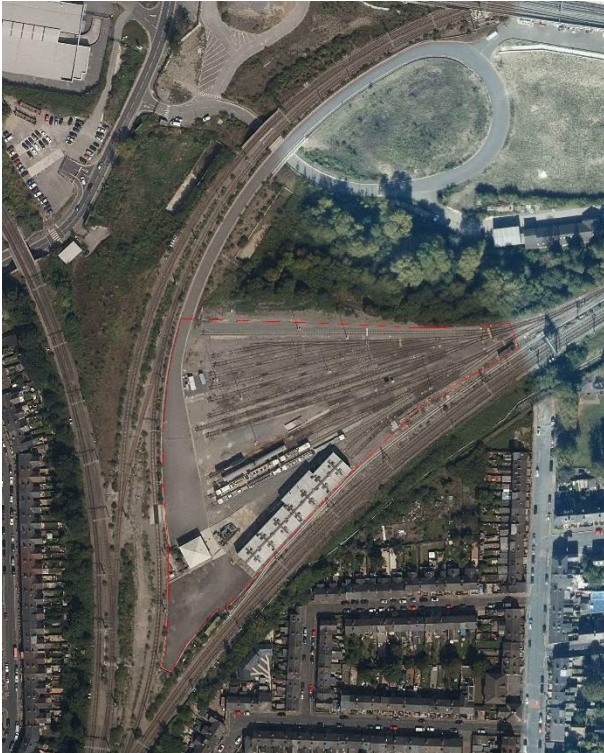
This report comprises a noise assessment and baseline noise survey report in support of a site known as Network Rail Reading Triangle Depot (RUT). The RUT site is proposed to be upgraded to serve as a regional depot for stabling and light maintenance of the supply chain operations (SCO) fleet. The upgraded depot will provide improved working conditions and facilities, to contemporary welfare standards, for the fleet maintenance staff. The facility will be used to securely stable, inspect, maintain, refuel, replenish and operate the maintenance fleet, and to create and maintain stock in stores.

The existing site comprises approximately 14 sidings and a former GWR refuelling shed over an area of approximately 2 hectares. The site has been used as a depot since the 1960s and was most recently refurbished in the 1980s. The site has been underutilised since refuelling activities ceased around 2007. Since then, the site has been used intermittently by the SCO fleet for stabling, but not for dedicated exam maintenance activities.

1.2 Site description

The site is located in Reading, at easting 470422 and northing 173703. The site is part of the Reading Upper Triangle Site and is located approximately 1km west of Reading station. A site location plan is shown in Figure 1.1.

Figure 1.1: Location of RUT



Source: Crown Copyright and database right 2020 Ordnance Survey 0100040692

2 Proposed Operation of the Site

2.1 Operating Hours

The operating hours of the site will be from 8am to 6pm generally Monday to Friday as the trains which are stored and maintained on the site work on the wider network during night-time. During the daytime works will usually last for 4 to 5 hours per day.

2.2 Noise Generating Activities and plant

The main noise generating activities which would occur on the proposed site are discussed below.

Rail Vehicle Movements - In most instances a maximum of 4 trains will enter the site per day. Six trains would be a typical worst case and 9 trains would be an absolute worst case. The site would have a maximum capacity for 12 trains. Most works will be conducted within the maintenance shed and running shed with washdown, refuelling and rewatering occurring on sidings to the north of the sheds

Besides the movement of trains, the noisiest activities would be, engine running and impact noises such as hammering to remove pins etc (though these would occur inside the sheds) but much of the time activities would be relatively quiet such as dipstick checks and basic repairs. There is a preference for the maintenance and running shed doors to be shut during works to rail vehicles inside but activities may occur with doors open.

There will be an audible alarm with flashing lights before the train is allowed to move.

Running Shed and Maintenance Shed

The proposal comprises two main sheds which will accommodate rail vehicles. These vehicles will be maintained within these sheds which would use a pillar crane (5m 5 tonnes) for lifting heavy components. There may be additional handling equipment, up to two welders, grinders, compressor and similar items. It is likely that the sheds will sometimes operate with the main doors open.

Between the two sheds are proposed to be welfare facilities, offices and workshops where components will be worked upon.

Other noise generated by the site include:

- The **Washdown** is located north of the running shed. The washdown will comprise four fixed lances used for underframe washing, side steps etc. Washdown activities will occur for approximately 1 hour per day, on average 5 times per week.
- **Refuelling** – Up to 6 trains per day will be refuelled
- **Water Refilling** Up to 6 trains per day will be refilled from a 15000 litre tank refilled every two weeks.

2.3 Fixed Plant

Detailed design of the fixed mechanical plant has yet to be conducted. The mechanical design is however expected to provide the noise producing provisions described below.

Cooling and heating to the new Server / Comms room and meeting room will be via DX units. The server / comms room is to house Un-interruptible Power Supply (UPS) equipment which will require ventilation to prevent the build-up of heat. It is assumed that the mechanical extract ventilation will be provided via an in-line extract air fan ducted to outside via a louvred opening with thermostatic control to initiate fan operation.

Space heating to the new welfare facility, stores and workshop building will be via an Air Source Heat Pump (ASHP) and Electric back up boiler. There will be the provision of mechanical ventilation in the new welfare facility, stores and workshop building via local heat recovery units. Mechanical supply and extract fresh air ventilation for the offices and occupied areas in the building will be provided via an above ceiling mounted heat recovery ventilation unit which will provide a fresh air supply from outside via an external wall mounted intake air louvres and exhaust stale air via roof exhaust weather terminal.

There will be the provision of radiant heating to the new Maintenance Shed via HL radiant panels and ASHP. There will be provision of radiant heating to the existing refurbished Running Shed via high level radiant panels and ASHP.

There will be Diesel Exhaust ventilation in the Maintenance and Running sheds. The ventilation system shall consist of a high level extract ductwork mounted above the crane and lighting levels but as low as possible to avoid any clashes with other systems. The extract will be ducted to external exhaust fans placed on the ground and discharge at least 1m above roof level.

This will include external fans, two of which will be on the south eastern exterior façade of the running shed and therefore close to residential areas, and two external fans that will be located on the north facade of the maintenance shed. These will require inline attenuators and casing noise attenuation in order to reduce noise below the environmental noise criteria set out below.

A Natural Smoke Ventilation System is required in Maintenance and Running Sheds. Each Shed will have roof mounted smoke ventilators with wall mounted inlet air ventilators. Each shed will be a single smoke zone.

There will be the provision of compressed air supply in the Maintenance and Running sheds and Workshop area. The compressed air system will supply compressors in each shed. Maintenance Shed will have two compressors installed internally; each compressor will serve one pit. The same arrangement will follow in Running Shed, with two compressors also internal to the shed.

The core WCs / Showers and changing areas will be provided with roof mounted small extremal Air Handling Unit (AHU) / Matrix Heat Recovery Unit (MHRU).

A back-up generator will be of a trailer mounted type but will be procured on an as-and- when-required basis by Network Rail.

Servicing Roads

The servicing roads will be used for water and fuel replenishment. There will be 2 forklifts onsite which may at times be loading on to road vehicles on the servicing roads.

There will generally be 3 Light Commercial Vehicle (LCV) and 0.5 Heavy Good Vehicle (HGV) movements per day on the site.

2 Guidance and Standards

2.1 Local Authority Policy and Guidance

2.2 Reading Local Plan

Although the development is not subject to a formal planning approval, due consideration has been given to The Reading Borough Local Plan, Adopted November 2019¹. Section CC8: 'Safeguarding Amenity' states:

Development will not cause a detrimental impact on the living environment of existing residential properties or unacceptable living conditions for new residential properties, in terms of:

- *Noise and disturbance;*
- *Vibration;*

Section 4.2.90 the Reading Borough Local Plan states:

"Exposure to high levels of noise can have a significant effect on human health. This policy deals with noise issues in general, whilst policy EN17 deals particularly with noise-generating equipment. It is worth noting that there is a Professional Practice Guide on Planning and Noise available which provides guidance on design of residential developments to take account of noise, and taking account of this from the early design stage will help to reduce noise effects on future residents."

Policy7 EN17 states:

"Noise Generating Equipment

Where noise generating equipment is proposed, the noise source specific level (plant noise level) should be at least 10dBA below the existing background level as measured at the nearest noise sensitive receptor."

In order to set limits on plant noise emissions it is necessary to conduct a background Noise Survey. The background noise survey is detailed in Section 3.0.

Reading Local Plan further states in relation to noise:

4.2.92 The Local Plan proposals will see a high level of development within Reading. Reading is a densely populated town with many new planning developments taking place. Residents live in close proximity to commercial activities, therefore it is important to minimise background creep in order to protect the noise environment and maintain quality of life for people living and working in the town. The negative impact of environmental noise on health is becoming better understood (for example WHO 1999, 2009 and 2011).

4.2.93 Planning Practice Guidance on noise states that no specific measures are required to manage the acoustic environment in situations where noise can be heard as a result of a development and there is a slight effect on the acoustic character of the

¹ https://images.reading.gov.uk/2019/12/Local_Plan_Adopted_November_2019.pdf

area but there is no effect on the behaviour and attitude of people exposed to the noise. However, the guidance also states that:

- The cumulative impacts of more than one source of noise should be considered; and
- In cases where existing noise sensitive locations already experience high noise levels, a development that is expected to cause even a small increase in the overall noise level may result in a significant adverse effect occurring.

4.2.94 The Council considers that the above two factors apply due to the town being densely populated and there being a high likelihood of subsequent noise generating plant being installed in a particular location. It is therefore necessary for each planning application for noisy plant to protect the acoustic environment and as far as possible prevent the increase in background noise levels because the cumulative impact of installation of noisy plant which causes an increase in background noise level is likely to lead to an adverse effect.

4.2.95 The Planning Practice Guidance on noise also states that local planning authorities may decide to develop specific standards to apply to various forms of proposed development in their area. It cautions against the implementation of fixed thresholds because specific circumstances may justify some variation being allowed. Because this policy sets a noise target in relation to the background noise level, this allows variation of the threshold with the local circumstances because it does not set an absolute noise level that the plant must achieve, it relates it to the local noise level.

4.2.96 Where the plant noise rating level does not meet this standard, the background noise will increase. When subsequent new plant is added it will be assessed against this higher background level which results in an increasing benchmark against which subsequent new plant is introduced. This leads to an incremental increase in the noise in an area each time new plant is introduced ('background creep'). This policy standard has been applied by Reading Borough Council for a number of years and experience has demonstrated it to be achievable in most cases. In addition, noise control technology is improving, therefore further increasing the achievable

2.3 Institute of Environmental Management and Assessment (IEMA) Guidelines for Environmental Noise Impact Assessment

The IEMA Guidelines for Environmental Noise Assessment [IEMA, 2014]² provide guidance on noise assessment in the EIA context. The guidelines define key methodologies used within the noise impact assessment process and provide advice on their limitations. They are relevant to all scales of project. In the context of this assessment the IEMA Guidelines have been used to inform the relation between magnitude of impact and significance of effect of noise changes upon noise sensitive receptors.

These criteria are based on the example classification of impact from change in noise levels given in Table 1-14 of the IEMA Guidelines which are based upon methodology from the Phase 1 Environmental Statement for the High Speed Two (HS2) project.

² IEMA Guidelines for Environmental Noise Assessment [IEMA, 2014]

Table 2.1: Criteria for the assessment of airborne noise from railway operations

Criteria	Impact
Façade noise levels below 50 dB $L_{Aeq,06:00 \text{ to } 24:00}$ Or 45 dB $L_{Aeq,00:00 \text{ to } 06:00}$ in all before and after scenarios	No impact
Noise change relative to baseline less than 3 dB	Negligible
Noise change relative to baseline 3 to 4.9 dB	Minor
Noise change relative to baseline 5 to 9.9 dB	Moderate
Noise change relative to baseline 10 dB or more	Major

2.4 ‘Procedure for the assessment of low frequency noise complaints’ 2005 Defra NAN R45

Idling locomotives produce significant levels of low frequency noise. Low frequency noise present specific challenges which are not sufficiently addressed by considering simple changes in noise level.

A study entitled A Review of Published Research on Low Frequency Noise and its Effects, Report for Defra by Dr Geoff Leventhall of Salford University³ concludes:

“There is no doubt that some humans exposed to infrasound experience abnormal ear, CNS (central nervous system), and resonance induced symptoms that are real and stressful. If this is not recognised by investigators or their treating physicians, and properly addressed with understanding and sympathy, a psychological reaction will follow and the patient’s problems will be compounded. Most subjects may be reassured that there will be no serious consequences to their health from infrasound exposure and if further exposure is avoided, they may expect to become symptom free.”

In order to identify the presence of low frequency noise issues, The ‘Procedure for the assessment of low frequency noise complaints’ 2005 Defra NANR45⁴ for the assessment of low frequency noise complaints was developed. This document states:

“The objective of this document is to assist Environmental Health practitioners to handle complaints of low frequency noise as efficiently and correctly as possible. In particular, it aims to assist them to distinguish cases where an environmental sound that could account for the disturbance is present, in which case some remedial action may be possible within their remit, from those where no such action is feasible. Thus, this guidance provides a procedure to determine whether low frequency sound that might be expected to cause disturbance is present in a complainant’s premises.”

“The procedure is intended to assist in the evaluation of existing problems. It is not intended as a means of predicting when disturbance might occur, for example in a planning situation, and would not be reliable to use as such. This is because disturbance by LFN depends on a number of factors, such as the character of the sound, whose effects are neither well understood, nor readily predictable.”

The procedure for the assessment of low frequency noise complaints, provides criteria curves for day and night time which apply to noise levels within the building in which the potentially sensitive receptor resides. These are discussed in more detail in Section 4.2.2.

³ https://www.livingstoncounty-il.org/wordpress/wp-content/uploads/2014/11/PR-Ex.-75-Leventhall_A-Review-of-Published-Research-on-LFN.pdf

⁴ Procedure for the assessment of low frequency noise complaints’ 2005 Defra NAN R45

2.5 British Standard BS4142:2014+A1:2019

As noted above Reading Borough Council's local plan states:

Where noise generating equipment is proposed, the noise source specific level (plant noise level) should be at least 10dBA below the existing background level as measured at the nearest noise sensitive receptor."

This criterion is based on an accepted methodology provided by British Standard BS4142. British Standard BS 4142:2014+A1:2019⁵, titled '*Methods for rating and assessing industrial and commercial sound*', provides a method for assessing the impact of industrial noise sources on residential receivers as a process to assess sound from sources of an industrial nature.

The level of sound from proposed new plant, the 'rating level', is predicted in terms of the A-weighted equivalent continuous sound level dB L_{Aeq} , and compared to the existing 'background sound level', in terms of L_{A90} . The L_{A90} is to be representative of the period being assessed. If the new sound source is impulsive, intermittent, or tonal in nature, then a penalty is added to the 'rating level' to account for the character of the noise.

The outcome of the assessment is defined in BS4142:2014+A1:2019 with the following points that relate to the difference between the background sound level and the rating level:

- Typically, the greater this difference, the greater the magnitude of the impact.
- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.

The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

2.6 British Standard BS8233:2014

British Standard BS 8233:2014⁶ titled '*Guidance on sound insulation and noise reduction for buildings*', provides guidance for the control of noise in and around new or refurbished buildings. Within the guidance, values for the internal ambient noise levels for different building uses are recommended. It states that it is 'desirable' that internal noise levels in dwellings do not exceed 35 dB $L_{Aeq,16hr}$ in living rooms and bedrooms during the day, 40 dB $L_{Aeq,16hr}$ in dining rooms during the day and 30 dB $L_{Aeq,8hr}$ in bedrooms at night.

2.7 World Health Organisation Guidance

WHO Guidelines for Community Noise⁷ and Night Noise Guidelines⁸ provides guidance on maximum noise levels within residential dwellings during night-time periods which can cause sleep disturbance. Guidance advises that internal noise levels should not exceed 45 dB $L_{Amax,f}$ due to regular individual events (not to be exceeded 10-15 times a night).

⁵ BSI, BS 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound', 2019

⁶ British Standard 8233:2014 '*Guidance on sound insulation and noise reduction for buildings*', 2014

⁷ WHO Environmental Guidelines for Community Noise, 1999

⁸ WHO Night Noise Guidelines for Europe, 2009

The WHO Environmental Noise Guidelines for the European Region⁹ provides evidence-based recommendations on the health effects of noise. The guidelines complement the expert-based recommendations of the WHO 'Night Noise Guidelines' (2009) (NNG). Guidelines provide source specific recommendations road traffic, railway, aircraft and wind turbine noise, and indoor as well as outdoor exposure levels for leisure noise.

⁹ WHO Environmental Noise Guidelines for the European Region, 2018

3 Baseline noise survey and results

3.1 Procedure and equipment

The noise survey comprised unattended and attended baseline measurements within and near to the site boundaries. Unattended long-term measurements were obtained at the southern part of the site (LT1-RUT) and a secured location below the embankment adjacent to the eastern boundary (LT2- end of George Street). Attended short-term measurements were conducted outside the residential properties near to the eastern boundary (ST1-cross section of Little Street and Cambridge Street) and near to the western boundary (ST2-Salisbury). Figure 3.1 shows the survey locations.

Figure 3.1: Long-term and short-term baseline noise survey locations.



Source: Crown Copyright and database right 2020 Ordnance Survey 0100040692

Both attended and unattended noise measurements were made using an environmental sound level meter (SLM) with a windshield fitted to the microphone. They were set up at heights of approximately 1.5m above local ground level. Measurements recorded the ambient noise level over contiguous 15 minute sample periods. Measurement parameters included overall L_{Aeq} , L_{Amax} , L_{A10} and L_{A90} sound pressure levels. Photographs of survey positions are shown Appendix A.

The unattended measurements were carried out between 9 and 22 September 2020, during a COVID-19 affected period with lower railway activity and lower traffic numbers than normal.

The attended noise measurements were made on 9 and 22 September 2020. All the positions of the noise measurements were more than 3.5m away from vertical reflecting surfaces - i.e. each of the measurements were taken under free-field conditions. Weather conditions during the attended survey were dry with temperatures in the range of 20°C - 26°C. Wind speeds were less than 1.5m/s. Road surfaces were dry throughout the measurement period. Clear to full

cloud cover during the measurement periods was observed. These conditions were considered to be suitable for environmental noise measurements.

All measurements were undertaken by consultants competent in environmental noise monitoring and completed in accordance with the principles of BS 7445¹⁰. Acoustic measurement equipment used during the noise survey was designed to be in conformance with BS EN 61672-1¹¹ to the requirements of Class 1 standard. Table 3.1: Noise monitoring equipment shows noise survey equipment used for the baseline noise survey.

The calibration of the meter was checked using a Larson Davis CAL200 calibrator and no significant drift of calibration was noted before or after the survey period.

Table 3.1: Noise monitoring equipment

Location	Item	Make & model	Serial number	Laboratory calibration due
LT1	SLM	RION NL52	01143538	5/2/2022
LT2	SLM	RION	01265461	25/4/2021
ST1 & ST2	SLM	RION	743137	18/12/2020
All	Calibrator	Larson Davis CAL200	5132	7/8/2021

Source: Mott MacDonald

3.1.1 General Observations

During the noise survey, there were frequent passenger trains and occasional freight trains using all tracks of the adjacent GWR Mainline. The train noise was audible throughout the site and at the off-site receptors. Tools and mechanical noise from the existing RUT site, and birdsong were also audible.

RUT (LT1) was located in an area currently used as a depot. Therefore, operational noise on the site reflected the level of activity. Audible noise sources included plant noise (e.g. train diesel engine running idle, mechanical plant noise, hand tools), frequent vehicle movements on the GWR Mainline, workers footsteps and conversation. Other noise sources included aircraft movements at high altitude and birdsong. Road traffic from Cow Lane was audible.

Noise levels at LT2 were dominated by the frequent train movements on the GWR Mainline, the construction noise adjacent to the SLM location as well as children playing in the playground at the end of George Street

Noise levels at ST1 comprised mainly the busy train movements on the GWR Mainline, occasional car passing on Little Street, Cambridge Street and Mason Street and birdsongs.

Noise levels at ST2 comprised the busy train movements on the GWR Mainline, road traffic noise from Cow Lane and occasion vehicle movements on Salisbury Road (Cul de sac), distant but audible operational noise from the RUT Depot and birdsongs.

3.2 Baseline noise survey results

A summary of the results for the unattended and attended noise measurements between 9 and 22 September 2020 is presented in Table 3.2.

¹⁰ BSI, 2003, BS 7445-1:2003 Description and measurement of environmental noise. Guide to quantities and procedures

¹¹ BSI, 2013, BS EN 61672-1:2013 Electroacoustics. Sound level meters. Specifications

Table 3.2: Summary of measured baseline noise levels

Location	Daytime dB (07.00-23.00)						Night-time dB (07.00-23.00)					
	L _{Aeq} , 1hrs		L _{A90} , 1hr		L _{Amax} , 1hr		L _{Aeq} , 15mins		L _{A90} , 15mins		L _{Amax} , 15mins	
	W/D	W/E	W/D	W/E	W/D	W/E	W/D	W/E	W/D	W/E	W/D	W/E
LT1	62	59	44	43	98	96	57	56	39	37	93	92
LT2	53	51	41	36	87	85	55	49	32	31	85	83
ST1	51	-	38	-	72	-	-	-	-	-	-	-
ST2	49	-	41	-	71	-	-	-	-	-	-	-

Source: Mott MacDonald

During the week, the measured ambient noise levels on site were averaged at 62dB L_{Aeq}, 1hr during the day and 57dB L_{Aeq}, 15min at night. At the weekend, it was measured on average at 59dB L_{Aeq}, 1hr during the day and 53dB L_{Aeq}, 15min at night.

The representative background noise levels were measured at 44dB L_{A90}, 1hr during the day and 39dB L_{A90}, 15min at night during the week. At the weekend, it was measured at 43dB L_{A90}, 1hr during the day and 37dB L_{A90}, 15min at night.

Off site at LT2 (George Road), during the week, the measured ambient noise levels were averaged at 53dB L_{Aeq}, 1hr during the day and 55dB L_{Aeq}, 15min at night. At the weekend, it was measured on average at 51dB L_{Aeq}, 1hr during the day and 49dB L_{Aeq}, 15min at night.

The representative background noise levels at LT2 were measured at 41dB L_{A90}, 1hr during the day and 32dB L_{A90}, 15min at night during the week. At the weekend, it was measured at 36dB L_{A90}, 1hr during the day and 31dB L_{A90}, 15min at night.

It is noted that construction noise due to demolition was occurring adjacent to this monitoring location (approximately 5m away from the construction compound boundary) during the time of the survey. The exact details such as the time and dates of the demolition details is unknown. The construction noise is likely to have some influences on the measured noise levels at this location during the day throughout the weekdays period.

The representative daytime ambient noise levels at ST1 (Little/Cambridge Street) was measured at 62dB L_{Aeq}, 15mins and background noise levels was 38dB L_{A90}, 15min.

At ST2 (Salisbury Street), the representative daytime ambient noise levels were measured at 49dB L_{Aeq}, 15mins and background noise levels was 41dB L_{A90}, 15min.

Full details of the long-term unattended noise measurements can be found in Appendix A.

4 Assessment Criteria

4.1 Noise Criteria for Assessment of Fixed Mechanical Plant

In accordance with Reading Local Plan the rating noise level limits for mechanical plant would be:

LT 1 34dB $L_{Aeq, 1hr}$ during the day and 29dB $L_{Aeq, 15min}$ at night during the week.

33dB $L_{Aeq, 1hr}$ during the day and 27dB $L_{Aeq, 15min}$ at night at the weekend.

LT2 31dB $L_{Aeq, 1hr}$ during the day and 32dB $L_{Aeq, 15min}$ at night during the week.

26dB $L_{Aeq, 1hr}$ during the day and 21dB $L_{Aeq, 15min}$ at night at the weekend.

These levels are very low and considered unduly onerous as discussed below.

It should be noted that the survey was conducted in a period when both rail and road traffic patterns were disrupted by COVID 19 restrictions. It is very likely that the measured noise levels measured are lower than would be measured during normal times.

In relation to the Reading Borough Council's policy of setting a noise 'target noise level from new uses of 10 dB(A) below the background noise level' it can be seen above that this results in an **external** noise criterion in the low 30s or 20s dBA during day and at night for both these locations. These levels are close to or below the **internal** noise level criterion of 30 dB $L_{Aeq, 8hour}$ for bedrooms provide in BS8233, which are based on the WHO Night Noise Guidelines.

BS 4142:2014+A1:2019 states: *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.*

Based on the above we believe that a rating noise level criterion of 10dBA below background L_{A90} levels for noise from mechanical plant for this scheme is not reasonable.

Given the **internal** noise level criterion of 30 dB $L_{Aeq, 8hour}$ for bedrooms provided by BS8233, and that it is widely accepted that a partially open window provides around 15dBA attenuation to external noise levels an external night-time rating noise level criterion of 45dBA would result in compliance with 30 dB $L_{Aeq, 8hour}$ for bedrooms for fixed mechanical plant.

Whilst Reading Borough Council's desire to achieve levels 10dB below background during daytime is recognized and considered reasonable for higher background noise levels it is proposed that noise levels from fixed plant should be limited to:

40dB L_{AeqT} , during the day and night during the week and Weekends.

This would mean that when this level is added to the existing background noise level externally the overall background noise level would remain below 45dBA and, the internal noise criterion of 30 dB $L_{Aeq, 8hour}$ for residential bedrooms being met internally at all times, day and night.

4.2 Noise Criteria for Rail Related Operations

Rail related operations have been assessed in two ways. One is by considering the existing level of rail related noise at the nearest affected residences, predicting the level of new rail

related noise and assessing the change in noise level in relation to a standard environmental impact type methodology as given in the IEMA Guidelines for Environmental Noise Assessment [IEMA, 2014].

The second methodology is to consider absolute levels of noise from the proposed new rail related operations and to compare them against absolute noise criteria particularly with respect to low frequency noise. Diesel locomotives can generate significant levels of low frequency noise, especially when idling, which can present specific issues. Attenuating structures such as noise barriers, double glazing etc have significantly lower attenuation performance at low frequency than at high frequencies. Low frequency noise can be particularly annoying to some people and can sometimes be mistaken for vibration.

The two sets of criteria are discussed below:

4.2.1 Criteria for Rail Noise Level Change

Table 4.3 below presents the criteria used to determine the scale of long-term permanent impacts due to changes in noise level due to rail related operations at Reading Upper Triangle based on existing levels of rail related noise. Existing levels of noise have been modelled and calibrated to the Defra noise contours.

Table 4.3 Criteria for the assessment of airborne noise from railway operations

Criteria	Impact
Façade noise levels below 50 dB $L_{Aeq,06:00 \text{ to } 24:00}$ or 45 dB $L_{Aeq,00:00 \text{ to } 06:00}$ in all before and after scenarios	No impact
Noise change relative to baseline less than 3 dB	Negligible
Noise change relative to baseline 3 to 4.9 dB	Minor
Noise change relative to baseline 5 to 9.9 dB	Moderate
Noise change relative to baseline 10 dB or more	Major

4.2.2 Criteria for Absolute Noise Level from Rail Noise

The Procedure for the assessment of low frequency noise complaints' 2005 Defra NANR45 provides the following criteria curve which applies to noise levels within the building in which the potentially sensitive receptor resides during daytime.

Table 3.2 Proposed reference curve from 'Procedure for the assessment of low frequency noise complaints – Day Time'

Hz	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
dB, Leq	97	92	88	79	69	61	54	48	47	45	43	41	39

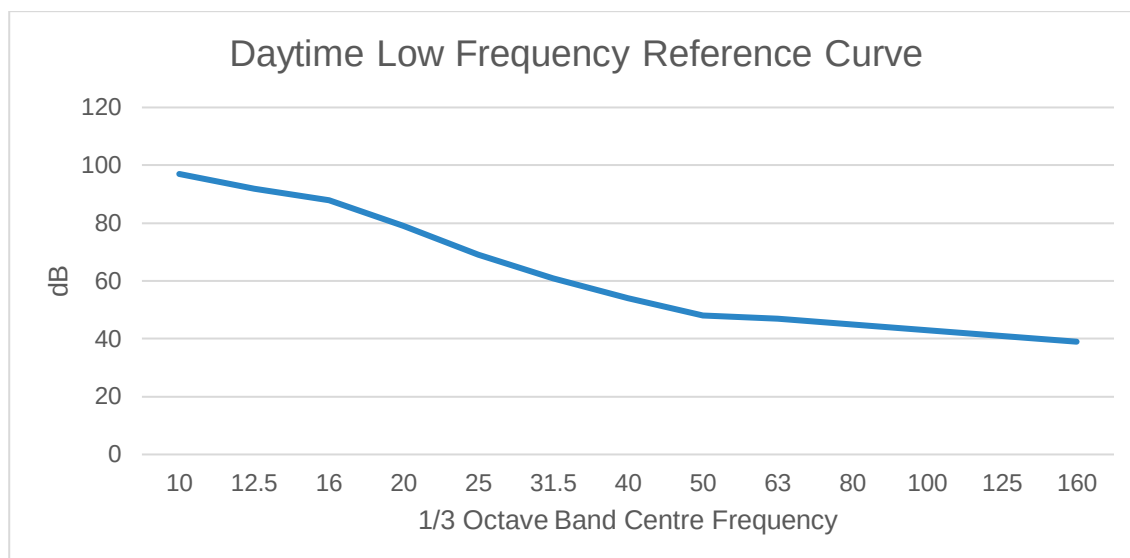


Figure 3.1 Proposed Reference Curve From ‘Procedure for the Assessment of Low Frequency Noise Complaints’ - Daytime

If the measured $L_{Aeq, T}$ noise level exceeds this curve at any point for extended periods of the day/night then a low frequency noise issue is deemed to be present.

The procedure states:

“This document is intended to provide a procedure to help determine whether a low frequency environmental noise exists that could be the cause of complaints. It is not intended to provide a prescriptive indicator of nuisance since there are other factors that may need to be considered in reaching this decision. However, the results may be used by Local Authorities to support their decisions.”

“In forming a decision it should be borne in mind that low frequency noise only slightly above threshold of audibility can cause considerable disturbance and appears to be more difficult to shut out or get used to than other types of noise. This may be counter intuitive when compared with the annoyance caused in other (not low frequency) situations where the level needs to be significantly higher than threshold before the noise could be considered a nuisance.”

5 Prediction Methodology

The operational noise levels from rail related noise sources has been calculated using acoustic modelling software CadnaA [DataKustik GmbH, 2014].

5.1 Base Model:

The Topographical base model for the site has been taken from topographical data provided by Network Rail.

Outside of the site boundary OS MasterMap background has been extracted and has been used for mapping out rail lines and selecting receptors etc. Buildings outside the site have been extracted from OS MasterMap. The proposed buildings on site have been modelled based on the architectural drawings. An acoustic model of the site and surrounding area has been constructed using the above data. The base map for the noise model is shown in Figure 5.1.

Figure 5.1 The base map for the Noise Model



Using this noise model, a number of scenarios have been run. These are described below.

Baseline:

The existing mainlines have been modelled using lines sources and adjusted against $L_{Aeq,16hr}$ Defra Noise Map values at selected receptors. Coarse grids have been run to generate noise contours to check alignment against Defra contours. This scenario has been run with the existing topography.

Proposed Operations:

The new site layout plans and new building elements have been built into the topographic model. New sources comprising locomotives within the depot/sidings – assumed to be stationary at 4 reasonable worst case locations (Position A to Positions D).

Due to the size of the rail vehicles, they have been modelled as area sources. In the absence of specific noise levels and spectral data for the C1203 and other vehicles two different approximations to the spectrum of the C1203 have been modelled. These both use the upper limit of noise emissions allowed by the Technical Specification for Interoperability (TSI)s for this type train when stationary thus representing a worst case noise level, this being L_{Aeq} 78dB at 7.5m.

These Spectra are shown in Appendix B.

As the level of disturbance which may result from these noise levels are quite dependent on the low frequency content of the spectrum, two frequency spectra have been used. These have been taken from previous measurements conducted by Mott MacDonald of Class 66 and Class 68 engine data. These are believed to represent a best case and reasonable worst case (Option A = Class 66 and Option B = Class 68) in relation to low frequency noise content.

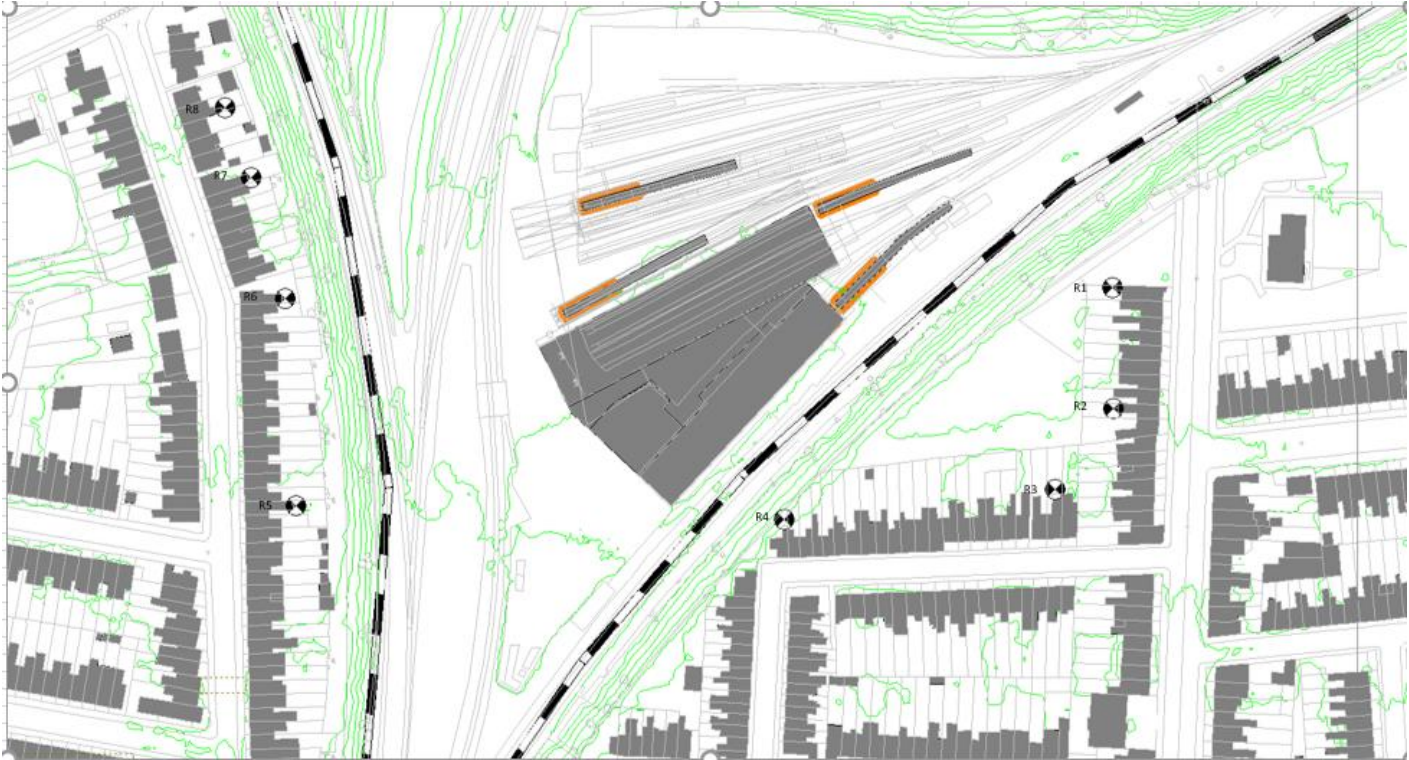
The open door and the roofs of the running and Maintenance sheds have been modelled as area sources based on calculated reverberant internal noise levels assuming the use of an angle grinder and compressor within the sheds. The spectra used for these area sources are shown in Appendix B.

Outputs:

The output results include overall A-weighted and 1/3 octave band low frequency values (40Hz – 125 Hz) for the following scenario including 4 locos:

- Four Class 68 locomotives, roof noise sources and door noise sources on running shed and maintenance shed, wash noise source
- Four Class 66 locomotive, roof noise sources and door noise sources on running shed and maintenance shed, wash noise source

The model was then run for the following scenarios including single locos. The assessed receptor locations are shown in Figure 5.2.

Figure 5.2 Assessed Receptor Locations**Table 5.1 Model Scenarios for Single Locos**

Scenario	Rail Sources		Loco Location	Shed Sources		
	class 68 source	class 66 source		Roof source	Door source	Wash source
1_Variant 1	on		A	on	on	on
2_Variant 2		on	A	on	on	on
3_Variant 3	on		B	on	on	on
4_Variant 4		on	B	on	on	on
5_Variant 5	on		C	on	on	on
6_Variant 6		on	C	on	on	on
7_Variant 7	on		D	on	on	on
8_Variant 8		on	D	on	on	on

6 Assessment

6.1 Fixed Mechanical Plant

Based on a noise criterion of 40dB L_{Aeq} at the residential receptors indicative limits for the Sound Power Levels (SWL) for fixed mechanical plant items have been derived. These SWL limits should be borne in mind when selecting plant items and decisions as to whether additional attenuation will be required. Once final selections have been made further calculations of predicted noise level at residential receptors should be made to ensure compliance with criteria.

In the table below the limit for extract fans has been set at 37dB L_{Aeq} for casing breakout at 37dB L_{Aeq} for the duct outlet such that when both sources are combined the overall noise level will be 40dB L_{Aeq} .

Table 6.1 Derived Indicative Plant Noise Criteria

Plant Item	Noise Level Limit at Residence dBA	Approx Distance to Residence m	Distance Attenuation dB	SPL Limit at 1m	SWL Limit dBA	Source	Limiting Receptor Location
Smoke Extract on SE side of Running Shed	37	30	30	67	72*	Casing Breakout	Cambridge Street
	37	30	30	67	78	at outlet of duct	Cambridge Street
Smoke Extract on NE end of Maintenance Shed	37	111	41	78	83	Casing Breakout	George Street
	37	111	41	78	89	at outlet of duct	George Street
Smoke Extract on NE end of Maintenance Shed	37	120	42	79	84	Casing Breakout	Salisbury Road
	37	120	42	79	90	at outlet of duct	Salisbury Road
Plant above Office Block and any other exterior noise sources at the office facades.	40	112	41	81	86	All Noise Sources	Salisbury Road

*This fan is located at the base of the running shed wall and subject to reflection from wall and ground.

6.2 Rail Related Noise Sources

The Defra website shows noise contours which show the various residential areas around the site to be subject to the following noise levels:

Gower Street/Mason Street $L_{Aeq,16Hr}$ 55dB to 59.9dB (upper end of range)

Little Street/Cambridge Street	L _{Aeq,16Hr} 55dB to 59.9dB (upper end of range)
George Street	L _{Aeq,16Hr} 55dB to 59.9dB (upper end of range)
Salisbury Road	L _{Aeq,16Hr} 55dB to 59.9dB (mid range)

Measured noise levels recorded during the baseline survey were generally lower than those predicted by Defra as might be expected due to rail movements being disrupted by Covid 19 restrictions. For example, at LT2 at the end of George Street a typical L_{Aeq,1 hr} of 53dB was measured compared to a predicted L_{Aeq,16hr} of 55dB to 59.9dB. The following Tables show calculated existing L_{Aeq,16hr} values at each of the potentially affected streets in Column 2 as calibrated against the Defra noise contours.

The predicted future L_{Aeq,16hr} values with the depot in operation are shown in Columns 3 onwards using spectral data for both Class 68 and Class 66 locos adjusted to the upper limit of the TSIs to represent the C2103 Track Grinding Train. This has been done for a total of four loco located at source Locations A, B, C, and D as shown on Figure 5.1 and then repeated for single locos at each of the same locations. All models include a contribution from break out from the running and maintenance sheds, the main doors being assumed to be open.

The models have also been run with shed doors closed and it was found that the difference in overall dBA levels was between 0.4 and 0.6dB for receptor locations R1 to R3, which are all to the east. Closing the doors had negligible effect at receptors to the west R4 to R8.

Results

6.1.1 Noise Level Change

The results of the noise modelling for four locos idling are shown in Table 6.2 below:

All predictions assume work within both the running shed and maintenance sheds and the shed doors are open. The shaded cells show a 'moderate' impact.

Table 6.2 Predicted Noise Level Changes due to proposed scheme for 4 Locomotives Idling Simultaneously

Receptor Name	Baseline Level dBA	Predicted Noise Level dBA		Predicted Change in Noise Level dB	
		Class 68 spectrum	Class 66 Spectrum	Class 68 spectrum	Class 66 Spectrum
R1	56.6	60.5	60.5	3.9	3.9
R2	55.8	61.6	62.3	5.8	6.5
R3	56.4	60.9	61.3	4.5	4.9
R4	60.9	62.1	62	1.2	1.1
R5	58.3	58.9	58.8	0.6	0.5
R6	59.7	60.7	60.5	1	0.8
R7	56	57.8	57.4	1.8	1.4
R8	55.5	57.3	57.3	1.8	1.8

With four locos idling simultaneously the noise impacts at receptors R2, would be considered **'Moderate'**. At R1 and R3 the noise impact would be considered **Minor**. At all other locations the impact would be considered **'negligible'** for both spectra.

The results of the noise modelling for a single Loco idling are shown in Table 6.3 below:

Table 6.3 Noise Level Predictions for Single Idling Locomotive at Locations A to D

Receiver	Broadband L _{Aeq}								
Name	Baseline	1_Class	2_Class	3_Class	4_Class	5_Class	6_Class	7_Class	8_Class
		68 Spectrum	66 Spectrum	68 Spectrum	66 Spectrum	68 Spectrum	66 Spectrum	68 Spectrum	66 Spectrum
Source Location									
		A	A	B	B	C	C	D	D
R1	56.6	59.8	60	59.3	59.3	57.8	57.8	57.9	57.8
R2	55.8	61	61.9	60.3	60.7	58.8	58.8	58.8	58.8
R3	56.4	60.4	60.9	59.8	60.2	58.5	58.5	58.5	58.5
R4	60.9	62	62	61.1	61	61	61	61	61
R5	58.3	58.3	58.3	58.4	58.3	58.7	58.7	58.5	58.5
R6	59.7	59.7	59.7	59.8	59.8	60.4	60.3	60	60
R7	56	56.1	56	56.2	56.1	57.2	57	56.8	56.7
R8	55.5	55.5	55.5	55.7	55.6	56.5	56.7	56.4	56.4

Table 6.4 Predictions of Noise Level Change for Single Idling Locomotive at Locations A to D

Receiver	Broadband LAeq								
Name	Baseline	1_Class 68 Spectrum	2_Class 66 Spectrum	3_Class 68 Spectrum	4_Class 66 Spectrum	5_Class 68 Spectrum	6_Class 66 Spectrum	7_Class 68 Spectrum	8_Class 66 Spectrum
Source Location									
		A	A	B	B	C	C	D	D
R1	56.6	3.2	3.4	2.7	2.7	1.2	1.2	1.3	1.2
R2	55.8	5.2	6.1	4.5	4.9	3	3	3	3
R3	56.4	4	4.5	3.4	3.8	2.1	2.1	2.1	2.1
R4	60.9	1.1	1.1	0.2	0.1	0.1	0.1	0.1	0.1
R5	58.3	0	0	0.1	0	0.4	0.4	0.2	0.2
R6	59.7	0	0	0.1	0.1	0.7	0.6	0.3	0.3
R7	56	0.1	0	0.2	0.1	1.2	1	0.8	0.7
R8	55.5	0	0	0.2	0.1	1	1.2	0.9	0.9

At receptor Location R1 A single loco idling at location A would be a **Minor** impact. A single loco at locations B, C or D would be considered a **negligible** impact.

At receptor Location R2 A single loco idling at location A would be a **Moderate** impact. A single loco at locations B, C or D would be considered a **Minor** impact.

At receptor location R3 a single loco at locations A or B would be considered a **Minor** impact whilst a single loco at locations C and D would be **Negligible**.

At receptor locations R4, R5, R6, R7 and R8 a single loco at any of the four locations would be considered a **negligible** impact.

6.1.2 Low Frequency Assessment

The results of the computer noise model for each scenario have also been presented in terms of 1/3 Octave bands in the Tables below for the range 40Hz to 125Hz. These 1/3 Octave band levels are compared with the Low Frequency noise criterion for each band for daytime. The shaded cells show an exceedance of the low frequency noise criteria curve.

Table 6.5 Noise Level Predictions Four Idling Locomotive at Locations A,B,C and D – Class 68 Spectrum

Class 68 Spectrum							
1/3 Octave Centre Freq		40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz
Criteria Curve		54	48	47	45	43	41
R1		72.8	71.9	73.6	73.6	61.6	60.5
R2		71.5	70.6	72.3	72.8	60.9	61
R3		71.5	70.6	72.5	72.8	60.6	59.7
R4		72.5	71.4	73	72.8	60	58.6
R5		65.3	64.4	66.1	66	53.8	52.6
R6		68.9	68.6	71	70.9	58.7	57.5
R7		69.1	68.5	70.4	70.2	58	56.7
R8		68.1	67.2	68.9	68.6	56.2	54.9

Table 6.5 shows that the low frequency spectrum curve is exceeded in all 1/3 Octave bands at all locations for four locos idling simultaneously using the Class 68 spectrum. The exceedances range between 14 and 28dB.

Table 6.6 Noise Level Predictions Four Idling Locomotive at Locations A,B,C and D – Class 66 Spectrum

Class 66 Spectrum						
1/3 Octave Centre Freq	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz
Criteria Curve	54	48	47	45	43	41
R1	61.6	66.4	61.8	62.1	55.7	46.6
R2	60.3	65.1	60.7	61.5	55.1	47.8
R3	60.3	65.2	60.9	61.5	54.8	46.5
R4	61.4	66.1	61.8	61.9	54.2	45.2
R5	54.1	58.8	54	54.1	47.8	37.7
R6	57.7	63	58.7	58.9	52.7	42.4
R7	57.9	62.9	58.1	58.2	52	41.7
R8	56.9	61.6	56.6	56.6	50.2	39.8

Table 6.6 shows that the low frequency spectrum curve is exceeded in most 1/3 Octave bands at all locations for four locos idling simultaneously using the Class 66 spectrum. The exceedances are up to 17dB. As expected, these exceedances are lower than for the Class 68 spectrum.

Table 6.7 Noise Level Predictions for Single Idling Locomotive at Location A Class 68

Position 1_Class 68						
1/3 Octave Centre Freq	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz
Criteria Curve	54	48	47	45	43	41
R1	70.4	69.6	71.5	71.4	59.5	58.4
R2	69.4	68.6	70.4	71.1	59.3	59.8
R3	69.9	69.1	71.1	71.7	59.6	58.8
R4	71.5	70.6	72.3	72.3	59.5	58.2
R5	50.8	49.4	50	48.9	35.6	33.7
R6	54.3	52.6	53.2	52	38.6	36.5
R7	54.9	53.3	53.9	52.7	39.2	37.1
R8	54.7	53.1	53.8	52.6	39.1	37

Table 6.7 shows that the low frequency spectrum curve is exceeded in most 1/3 Octave bands at all locations for a single loco idling at Location A using the Class 68 spectrum. The exceedances are up to 27dB.

Table 6.8 Noise Level Predictions for Single Idling Locomotive at Location A – Class 66

Position 1_Class 66						
1/3 Octave Centre Freq	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz
Criteria Curve	54	48	47	45	43	41
R1	59.3	64.2	60	60.1	53.7	45.1
R2	58.3	63.3	59.3	60.1	53.5	47
R3	58.7	63.8	59.8	60.6	53.8	46
R4	60.4	65.4	61.4	61.5	53.7	44.9
R5	39.8	45	41.5	40.7	30.4	24.5
R6	43.2	47.7	43.2	42.2	33.1	26
R7	43.8	48.2	43.7	42.7	33.7	26.2
R8	43.6	48	43.3	42.4	33.5	25.9

Table 6.8 shows that the low frequency spectrum curve is exceeded in most 1/3 Octave bands at locations on the east side of the site for a single loco idling at Location A using the Class 66 spectrum. The exceedances are up to 17dB. As expected, these exceedances are lower than for the Class 68 spectrum.

Table 6.9 Noise Level Predictions for Single Idling Locomotive at Locations B Class 68

Position 2_Class 68						
1/3 Octave Centre Freq	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz
Criteria Curve	54	48	47	45	43	41
R1	68.6	67.8	69.6	70.1	58.2	57.3
R2	67.9	67	68.8	69	57.1	56.1
R3	67.1	66.3	68	67.9	55.6	54.6
R4	66.4	65.6	66.7	66	52.4	50.8
R5	53.8	52.7	53.9	53	38.9	37.1
R6	56.8	56	57.7	57.6	45.3	44
R7	58.1	57.2	58.9	58.8	46.7	45.4
R8	58.2	57.3	59	58.9	46.8	45.6

Table 6.9 shows that the low frequency spectrum curve is exceeded in most 1/3 Octave bands at all locations for a single loco idling at Location B using the Class 68 spectrum. The exceedances are up to 25dB.

Table 6.10 Noise Level Predictions for Single Idling Locomotive at Location B Class 66

Position 2_Class 66						
1/3 Octave Centre Freq	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz
Criteria Curve	54	48	47	45	43	41
R1	57.5	62.5	58.3	59.1	52.5	44.5
R2	56.7	61.7	57.9	58.3	51.5	45.4
R3	56	61.2	57.6	57.9	50.2	44.4
R4	55.5	61.1	58.1	57.8	47.3	41.8
R5	42.7	47.7	43.6	42.9	33.3	25.6
R6	45.7	50.7	46.3	46.3	39.4	30
R7	46.9	51.9	47.4	47.4	40.8	31.3
R8	47	51.9	47.4	47.4	40.9	31.3

Table 6.10 shows that the low frequency spectrum curve is exceeded in most 1/3 Octave bands most locations for a single locos idling at Location B using the Class 66 spectrum. The exceedances are up to 15dB.

Table 6.11 Noise Level Predictions for Single Idling Locomotive at Locations C Class 68

Position 3_Class 68						
1/3 Octave Centre Freq	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz
Criteria Curve	54	48	47	45	43	41
R1	56.4	56.3	56.8	56.2	43.4	42.6
R2	55.3	55.5	56.3	55.7	43.6	45
R3	55.9	56.2	57	56.4	44.3	43.9
R4	60.5	60.4	60.7	59.7	45.9	44.4
R5	63	62.1	64	63.9	52	50.9
R6	66.6	66.8	69.4	69.4	57.1	55.9
R7	66.3	66.1	68.1	67.8	55.6	54.4
R8	64.7	63.9	65.4	65.1	52.8	51.5

Table 6.11 shows that the low frequency spectrum curve is exceeded in most 1/3 Octave bands at all locations for a single loco idling at Location C using the Class 68 spectrum. The exceedances are up to 24dB.

Table 6.12 Noise Level Predictions for Single Idling Locomotive at Locations C Class 66

Position 3_Class 68							
1/3 Octave Centre Freq		40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz
Criteria Curve		54	48	47	45	43	41
R1		46.3	53.5	52.5	52.6	41.5	40.7
R2		45.4	53	52.9	53	42.3	43.7
R3		45.9	53.8	53.9	54.1	43	42.9
R4		50.2	57.8	56.5	56.1	42.9	40.8
R5		51.8	56.6	51.9	52.1	46	36
R6		55.4	61.2	57.2	57.4	51.1	40.9
R7		55.2	60.5	55.9	55.9	49.6	39.4
R8		53.5	58.3	53.3	53.2	46.9	36.6

Table 6.12 shows that the low frequency spectrum curve is exceeded at R5 to R8 on the western side of the site in the 40Hz and 100Hz 1/3 Octave bands for a single loco idling at Location C using the Class 66 spectrum. The exceedances are up to 13dB.

Table 6.13 Noise Level Predictions for Single Idling Locomotive at Locations D Class 68

Position 3_Class 6o							
1/3 Octave Centre Freq		40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz
Criteria Curve		54	48	47	45	43	41
R1		60	59.5	60.8	60.4	47.1	45.7
R2		58.6	57.9	58.8	58	45.4	46.4
R3		58.2	57.8	58.7	58	45.6	44.8
R4		60	60.1	60.5	59.6	45.9	44.4
R5		60.1	59.3	61.1	60.9	48.5	47.3
R6		63.7	62.9	64.7	64.6	52.6	51.5
R7		64.8	63.9	65.7	65.6	53.5	52.2
R8		64.3	63.4	65.2	65	52.5	51.3

Table 6.13 shows that the low frequency spectrum curve is exceeded in most 1/3 Octave bands at all locations for a single loco idling at Location D using the Class 68 spectrum. The exceedances are up to 21dB.

Table 6.14 Noise Level Predictions for Single Idling Locomotive at Locations C Class 66

Position 3_Class 68						
1/3 Octave Centre Freq	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz
Criteria Curve	54	48	47	45	43	41
R1	49.3	55.5	53.4	53.5	43.3	40.9
R2	48	54.3	53.3	53.4	42.9	43.8
R3	47.8	54.7	54.1	54.2	43.5	42.9
R4	49.7	57.6	56.4	56.1	42.9	40.8
R5	48.9	53.8	49.3	49.3	42.5	32.7
R6	52.5	57.3	52.6	52.8	46.6	36.6
R7	53.6	58.3	53.5	53.7	47.5	37.3
R8	53.1	57.8	53	53.1	46.5	36.3

The low frequency spectrum curve is exceeded in most 1/3 Octave bands at all locations for a single loco idling at Location D using the Class 66 spectrum. The exceedances are up to 11dB.

6.1.3 Discussion

It is clear that the low frequency spectrum curve is exceeded in most 1/3 Octave bands for four locos idling simultaneously and for single locos at all four source locations. It should be noted, in relation to the 'Procedure for the assessment of low frequency noise complaints' 2005 Defra NANR45' that:

"The procedure is intended to assist in the evaluation of existing problems. It is not intended as a means of predicting when disturbance might occur, for example in a planning situation, and would not be reliable to use as such. This is because disturbance by LFN depends on a number of factors, such as the character of the sound, whose effects are neither well understood, nor readily predictable."

7 Conclusions

An assessment of the various noise sources associated with the proposed depot at Reading Upper Triangle has been conducted. This assessment considered noise levels from fixed mechanical plant items associated with the proposed buildings and rail related noise sources. Rail related noise sources have been assessed in two ways. The first assessment method considers change in overall noise level according to IEMA Guidelines for Environmental Noise Assessment [IEMA, 2014] for ES type assessments. The second assessment method considers the low frequency content of the noise emitted by idling locomotives according to the 'Procedure for the assessment of low frequency noise complaints' 2005 Defra NANR45'.

7.1 Fixed Mechanical Plant

Based on a noise criterion of 40dB L_{Aeq} at the residential receptors indicative limits for the Sound Power Levels (SWL) for fixed mechanical plant items have been derived. These SWL limits should be considered when selecting plant items and decisions as to whether additional attenuation will be required. Once final selections have been made further calculations of predicted noise level at residential receptors should be made to ensure compliance with criteria.

7.2 Rail Related Noise Sources

7.2.1 Overall Change in noise level.

Four Locos

With four locos idling simultaneously at source Locations A,B,C and D, the noise impacts at receptor R2, would be considered '**Moderate**'. At R1 and R3 the noise impact would be considered Minor. At all other locations the impact would be considered '**negligible**'.

Single Locos

At receptor Location R1 a single loco idling at location A would be a **Minor** impact. A single loco at locations B, C or D would be considered a **negligible** impact.

At receptor Location R2 a single loco idling at location A would be a **Moderate** impact. A single loco at locations B, C or D would be considered a **Minor** impact.

At receptor location R3 a single loco at locations A or B would be considered a **Minor** impact whilst a single loco at locations C and D would be **Negligible**.

At receptor locations R4, R5, R6, R7 and R8 a single loco at any of the four locations would be considered a **negligible** impact.

In summary the impacts are considered Minor or Negligible except when a loco is idling at Location A which is just outside the Running Shed when the impact would be **Moderate**.

7.2.2 Low Frequency Noise

The assessment of low frequency noise shows that the low frequency spectrum curve is exceeded in most 1/3 Octave bands for four locos idling simultaneously and for single locos at all four source locations, A, B, C and D. However, the 'Procedure for the assessment of low frequency noise complaints' 2005 Defra NANR45' states that:

“The procedure is intended to assist in the evaluation of existing problems. It is not intended as a means of predicting when disturbance might occur, for example in a planning situation, and would not be reliable to use as such. This is because disturbance by LFN depends on a number of factors, such as the character of the sound, whose effects are neither well understood, nor readily predictable.”

Appendices

- A. Results of the unattended 24 hours continuous noise monitoring at RUT Site (LT1) and on George Street (LT2) between 9-22 September 2020 41

A. Results of the unattended 24 hours continuous noise monitoring at RUT Site (LT1) and on George Street (LT2) between 9-22 September 2020

Figure A.1: Baseline noise survey photos



LT1: Southern part inside the RUT site



LT2: George Street



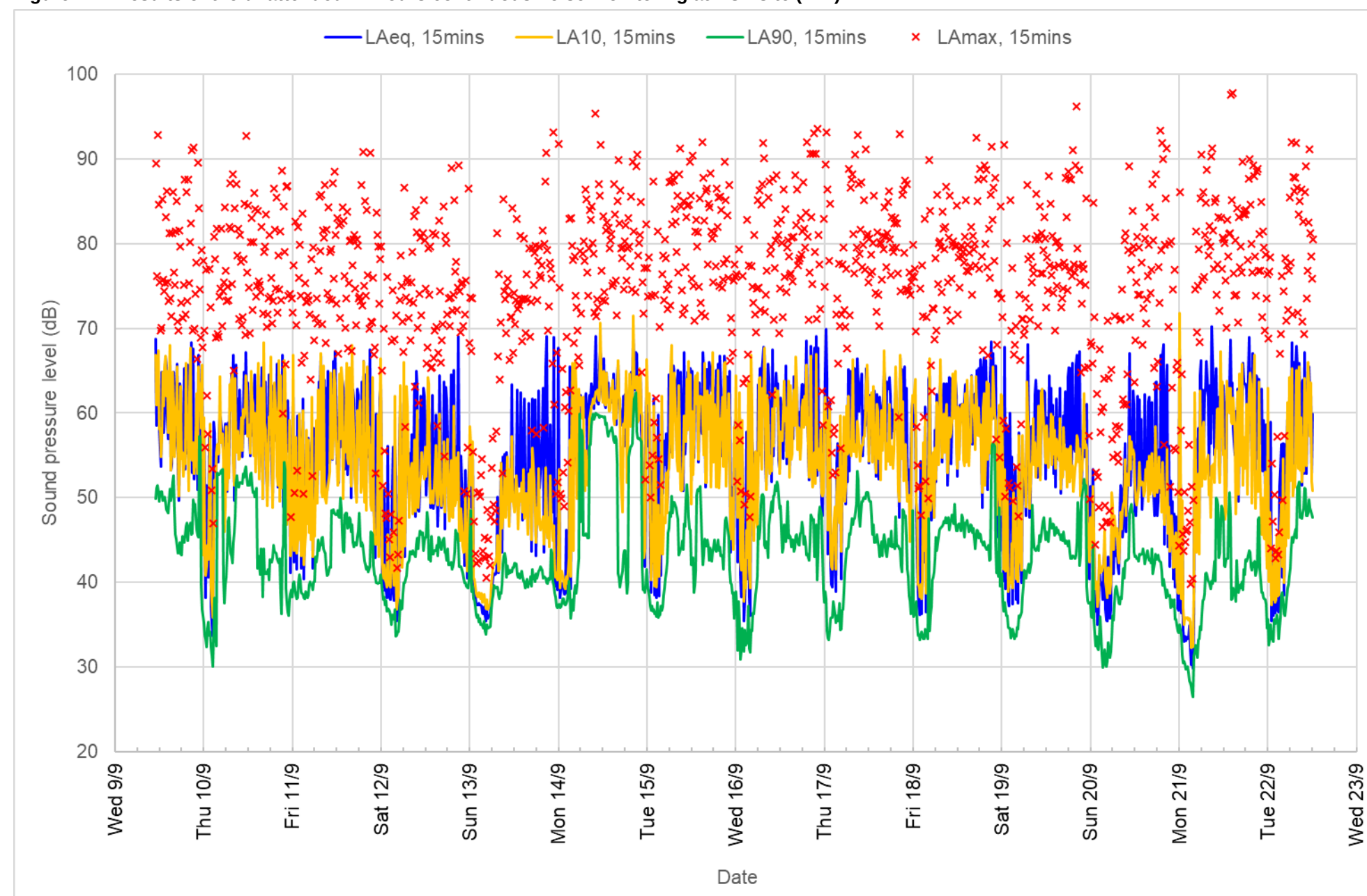
ST1: Little Street/Cambridge Street



ST2: Salisbury Road

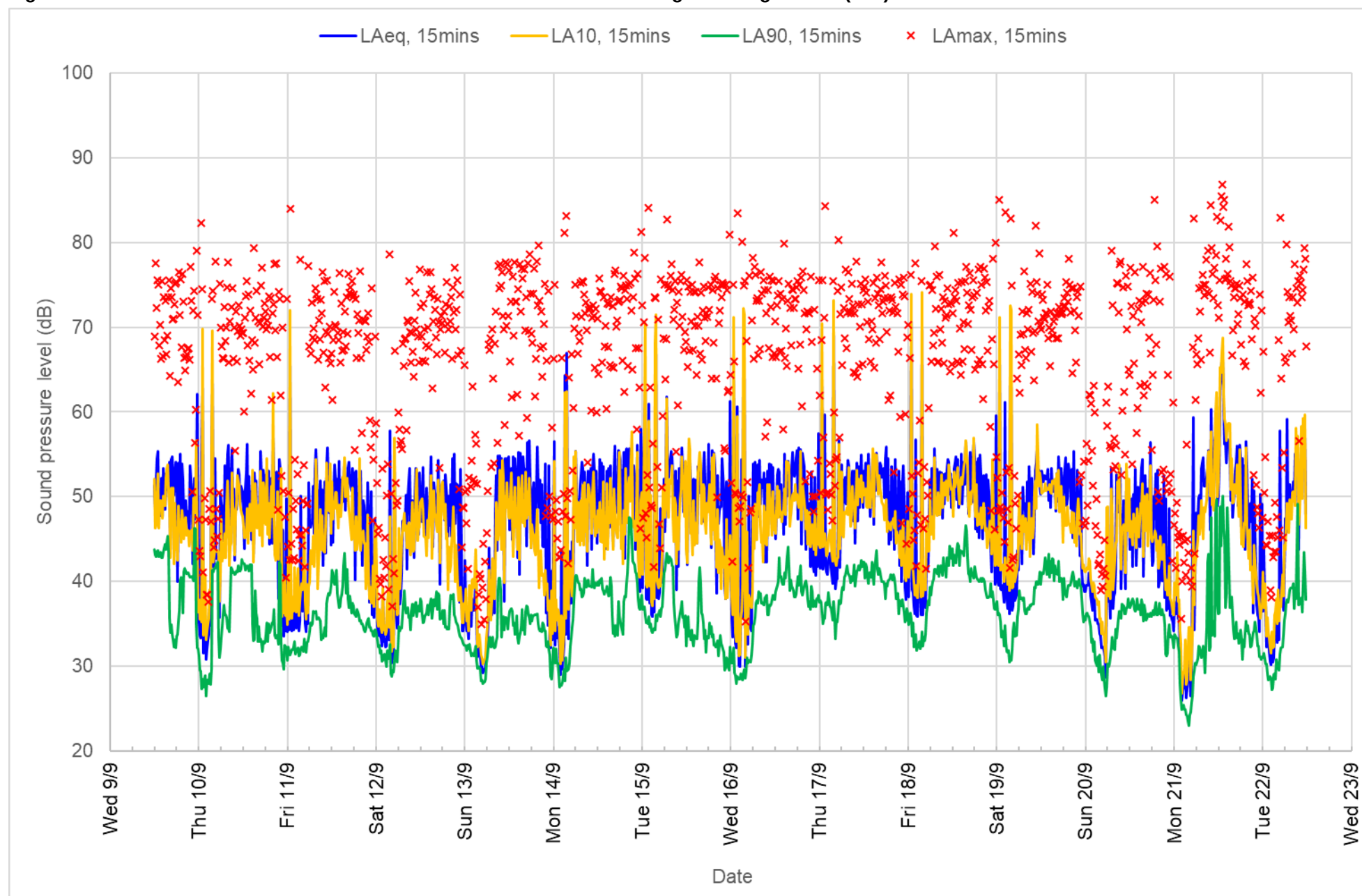
Source: Mott MacDonald

Figure A.1: Results of the unattended 24 hours continuous noise monitoring at RUT site (LT1)



Source: Mott MacDonald

Figure A.2: Results of the unattended 24 hours continuous noise monitoring on George Street (LT2)



Source: Mott MacDonald

B. Appendix B Source Levels used for Locomotives and Shed Sources

The spectrum shape for the Class 68 and Class 66 locomotives are given below. These have been adjusted to provide 78dBA at 7.5m.

	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	6.3 kHz	8 kHz	10 kHz	12.5 kHz	16 kHz	20 kHz
Class 68	59.3	69.6	70.8	70.6	75.2	92.8	92.0	93.9	93.9	82.0	81.0	72.9	72.9	69.8	69.2	69.1	70.0	69.6	68.1	67.8	65.3	61.1	57.8	56.2	51.9	49.1	47.7	43.9	44.4	42.1	35.5	29.1	24.5
Class 66	55.6	64.0	62.3	63.3	73.8	75.5	80.3	75.5	75.8	69.9	59.8	55.8	56.7	57.5	60.4	61.8	64.7	69.0	65.1	62.9	60.8	56.2	56.4	53.9	60.4	54.0	49.6	47.8	43.6	41.8	41.3	41.1	42.2

The Source sound power levels used for the shed sources are shown below.

Octave Band Centre Frequency	63 Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
SWL of total area of Open Door	108	97	88	85	93	99	95	95
SWL of total area of Roof	107	92	82	73	79	85	74	74

Glossary

Terms	Explanations
A-weighting	The human ear has a nonlinear frequency response; it is less sensitive at low and high frequencies and most sensitive in the range 1 kHz to 4 kHz (cycles per second). The A-weighting is applied to measured sound pressure levels so that these levels correspond more closely to the subjective response. A-weighted noise levels are often expressed in dB(A).
Ambient Noise	Ambient noise is the total sound in a given situation at a given time usually composed of sound from many sources, near and far.
Decibel, dB	The unit of measurement of sound pressure levels and noise levels. The decibel scale is logarithmic rather than linear. The threshold of hearing is zero decibels while, at the other extreme, the threshold of pain is about 130 decibels.
Facade Noise Level	The noise level which is measured one metre in front of the most exposed window or door in a facade. Noise is reflected from hard surfaces in a similar manner to light by a mirror and the effect is to produce a slightly higher (about 2.5dB) noise level than would occur if the building was not there. Façade noise levels in this assessment are the levels calculated at one metre from the most exposed façade with a reflection correction added.
Free-Field Noise Level	The noise level which is measured or calculated, in the open, in the absence of any reflections from nearby surfaces.
L _{A10} index	L _{A10} descriptor is the A-weighted sound pressure level in dB that is exceeded for 10% of the measurement period. This is the standard index used within the UK to describe traffic noise.
L _{A90} index	The background noise level is commonly quoted using the L _{A90} index. This is the A-weighted sound pressure level in dB that is exceeded for 90% of the measurement period.
L _{Aeq,T} index	The equivalent continuous level L _{Aeq,T} is the level of a notional steady A-weighted sound, which at a given position and over a defined period of time (T) would have the same A-weighted acoustic energy as the fluctuating noise.
L _{Amax} index	The maximum A-weighted sound pressure level measured during a given time period.
Noise	A sound that can be described as being unwanted.
Screening	An environmental or man-made barrier between noise source and receiver that interrupts the transmission path, reducing the received noise levels.
Sound Level Meter	The instrumentation used to measure noise with a standardised frequency and exponential time weighting. There are many types used to measure various descriptions of sound. The measurement should be capable of accuracy and repeatability.
Sound Pressure Level	A logarithmic measure of the fluctuation in sound pressure relative to a reference sound pressure and is expressed in terms of decibels.
Vibration Dose Value	The Vibration Dose Value (VDV) is a cumulative measurement of the vibration level received at a specific position over the 8-hour night-time period (23:00 to 07:00) or the 16-hour daytime period (07:00 to 23:00). The value is used to evaluate human response.

