



**Proposed Residential Development,
Phase 2, Thurnscoe Bridge Lane, Rotherham**

Noise and Vibration Assessment Report

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On behalf of
Jaguar Estates / Wortley Construction JV

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1.0 INTRODUCTION

- 1.1 Blue Tree Acoustics has been appointed by Jaguar Estates / Wortley Construction JV to carry out an assessment of existing noise and vibration levels for a proposed residential development on land at Thurnscoe Bridge Lane, Rotherham.
- 1.2 The development site situated to the south of Thurnscoe town centre. It is bounded by Thurnscoe Bridge Lane to the west, with open fields beyond, and bounded by a wooded area to the south. Existing dwellings bound the site to the north, and the Wakefield Line railway runs north/south past the eastern boundary of the site.
- 1.3 The surrounding area has a mix of residential, commercial, and leisure use. To the east of the railway line is Fields End Business Park, which comprises various offices and commercial/light industrial units. Further beyond this is Phoenix Park community park and woodland area. Immediately to the north of the site boundary is Jaguar Estates / Wortley Construction JV's recent Phase 1 housing development for which Blue Tree Acoustics previously undertook a noise and vibration assessment – report ref. 1545.24/1 (BTA internal document ref. 01545-240100) dated 20/09/2012. There is a wider area of established housing beyond this, and also to the northeast of the development site.
- 1.4 The noise impact assessment has included:
- i) Inspection of the site and surroundings.
 - ii) Review of outline architectural plans for the proposed development provided by the Client.
 - iii) Noise and vibration monitoring surveys undertaken at locations on the site during daytime and nighttime.
 - iv) Evaluation of the site in accordance with relevant planning policy guidance.
 - v) Consideration of noise control measures required to maintain acceptable noise levels within the proposed bedrooms and living rooms in accordance with *British Standard 8233: 2014, 'Guidance on sound insulation and noise reduction for buildings'* (BS8233:2014) and relevant Local Authority guidance.
 - vi) Evaluation of the site in accordance with *BS6472:2008 'Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)'* (BS6472).
- 1.5 All findings, comments, recommendations, etc., in this report are for acoustic purposes only; any and all other considerations and requirements, e.g. structural, airflow, thermal, fire safety,

determination of whether materials are dangerous, hazardous, deleterious, etc. (non-exhaustively), are the responsibility of other such suitably qualified specialists to check and advise on.

2.0 EXISTING NOISE SOURCES

Road

- 2.1 Road traffic movements on Thurnscoe Bridge Lane were moderate, with occasional passing vehicles. Distant road traffic was also audible at times at the development site.

Railway Line

- 2.2 Trains passing on the nearby railway line are the primary source of noise as experienced on the development site. The line is relatively busy, with both passenger and freight train movements passing the site, and multiple train movements can occur within an hourly period. Passing trains are less frequent during nighttime hours.

Commercial/Industrial Premises

- 2.3 Fields End Business Park is to the southeast of the development site. Some noise from that direction was observed during the surveys, but this did not have a significant effect on the surrounding noise climate, and is not considered to be a significant noise source in terms of impact on the development site.

3.0 NOISE AND VIBRATION SURVEYS

Noise Survey

- 3.1 Noise monitoring was undertaken by Blue Tree Acoustics to determine the existing ambient noise climate at the site during representative daytime and nighttime periods.
- 3.2 Noise surveys were undertaken at the site during daytime and nighttime periods on Monday 08/06/2020 and Tuesday 09/06/2020.
- 3.3 Attended logging noise measurements were taken on the development site at Location 1 and Location 2, indicated in Figure 1.
- 3.4 The instrumentation used for the noise monitoring was 2no Rion NA-28 sound level meters. Each of these meters is a Type 1/Class 1 Integrating Sound Level Meter. Each meter was within a valid period of laboratory calibration. A proprietary environmental windshield was fitted to the microphone in each case, and measurements were made with each microphone mounted on a tripod at approximately 1.5m from local ground level. Calibration checks were carried out both before and after the measurements, with no variance observed.
- 3.5 Weather conditions throughout the survey periods were dry and relatively calm. Archival data from a nearby weather station is presented in Appendix IV.
- 3.6 The noise measurement results are detailed in Appendix II. The survey results show that noise levels were greatest at Location 1 near the railway line, having an average daytime noise level of 61dB L_{Aeq} , and an average nighttime noise level of 50dB L_{Aeq} . Average noise levels at Location 2 near Thurnscoe Bridge Lane were 57dB L_{Aeq} during daytime, and 51dB L_{Aeq} during nighttime.
- 3.7 The Location 1 measurement data shows 22no passing trains during the daytime survey periods, and 4no passing trains during nighttime survey period. These are visible as distinct spikes in the measurement data plotted on the charts in Appendix II.

Vibration Survey

- 3.8 Vibration monitoring was undertaken by Blue Tree Acoustics to assess the existing vibration levels from passing trains. The monitoring was undertaken at the site during daytime and

nighttime periods on Monday 08/06/2020 and Tuesday 09/06/2020, simultaneously to the above noise surveys.

- 3.9 Attended vibration measurements were taken on the development site at Location 1, indicated in Figure 1.
- 3.10 The instrumentation used for the vibration monitoring was 1no Svan 958A Type 1/Class 1 4-channel vibration meter. The meter was fitted with its corresponding proprietary tri-axial transducer, which was positioned directly on the ground surface. The transducer was positioned with the X axis perpendicular to the railway line and the Y axis parallel to the railway line, with Z being the vertical axis. The meter was within a valid period of laboratory calibration.
- 3.11 Continuous logging measurements over contiguous 1-minute periods were taken of vibration levels, including vibration dose value (VDV). Internal frequency weightings were set to W_d weighting for horizontal vibration, and to W_b weighting for vertical vibration.
- 3.12 The vibration measurement results are detailed in Appendix III. The passing trains can clearly be seen as discrete events in the Location 1 charts, and these align with corresponding spikes in the noise measurement data.
- 3.13 The highest measured individual 1-minute VDV values were recorded on Monday 08/06/2020, being $0.028 \text{ ms}^{-1.75} \text{ VDV}_z$ for a passing freight train, and $0.025 \text{ ms}^{-1.75} \text{ VDV}_z$ for a passing passenger train.

Environmental Noise Climate during UK's COVID-19 2020 Partial Lockdown

- 3.14 As this monitoring was being undertaken during the COVID-19 partial lockdown, the potential for environmental noise and vibration levels to be lower than usual has been considered. Although the Phase 1 measurements were taken in 2012, it is useful to compare the Phase 2 measurements taken in 2020 with the 2012 data measured at similar locations on the Phase 1 development site land (detailed in Blue Tree Acoustics' above-referenced Phase 1 report). Average measured sound levels from the 2020 and 2012 surveys are presented in the tables below for comparison.

Table 1: Comparison of average measured free-field external noise levels near railway line

Period	Year	dB L _{Aeq}	dB L _{A10}	dB L _{A90}	Comment
Day	2012	61	58	51	10-minute measurements 1100-1300 hours
	2020	61	51	45	1-minute logging 1400-1700 hours and 2130-2300 hours
Night	2012	57	49	36	10-minute measurements 2300-0100 hours
	2020	50	43	37	1-minute logging 2300-0100 hours

Table 2: Comparison of average measured free-field external noise levels near road

Period	Year	dB L _{Aeq}	dB L _{A10}	dB L _{A90}	Comment
Day	2012	56	58	50	10-minute measurements 1100-1400 hours
	2020	59	63	49	15-minute measurements 1400-1700 hours
Night	2012	48	49	36	10-minute measurements 2300-0100 hours
	2020	51	50	37	1-minute logging 2300-0100 hours

- 3.15 Some caution is needed in comparing these values as they were taken at different locations and over different measurement periods. However, some indicators can be used to draw broad conclusions.
- 3.16 The L_{A90} parameter is an indicator of the background sound level, and the results indicate lower daytime levels in 2020 than in 2012, which accords with the lesser general daytime activity in the wider area during the partial lockdown. Nighttime L_{A90} levels are similar in all periods, which can be expected since typically there is little street activity in the area at those times in any case.
- 3.17 The average L_{Aeq} value is a logarithmic quantity, and therefore tends toward the higher measured values and provides an indicator of the magnitude of passing cars and trains. For measurement locations near Thurnscoe Bridge Lane road traffic, the 2020 measured sound levels show an increase during daytime and nighttime. For measurement locations near the railway line, the average measured daytime sound level is the same, whilst the 2020 nighttime level is 7dB(A) lower than the 2012 nighttime level. At the railway line measurement locations, the L_{A10} parameter is consistently less than the L_{Aeq} value, which is an indicator that the noise climate is dominated by intermittent short-term noise events, i.e. passing trains.
- 3.18 The above accords with publicly available government statistical data for changes in transport use during the COVID-19 partial lockdown (<https://www.gov.uk/government/statistics/transport-use-during-the-coronavirus-covid-19-pandemic>), which indicates that by Monday 08/06/2020 road traffic flows had increased significantly from the initial lockdown period, whilst rail traffic was still on a reduced timetable.

- 3.19 Considering the above, it is concluded that the 2020 measured sound levels are suitably representative for the purpose of this assessment, although the potential for nighttime sound levels at Location 1 near the railway line to be higher by around 7dB(A), has been noted.
- 3.20 Vibration monitoring in 2012 was found to be comparable to the 2020 measurements, with the highest measured individual VDV value in 2012 being $0.027 \text{ ms}^{-1.75} \text{ VDV}_z$ for a passing freight train. As this compares maximum measured values, there is no reason to expect 2020 vibration levels to be any greater than those measured onsite in 2012.

4.0 NOISE ASSESSMENT CRITERIA

- 4.1 First published in March 2012, and most recently updated in June 2019, the National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these are expected to be applied. Reference to noise is made at Paragraph 170 of NPPF Section 15 'Conserving and enhancing the natural environment', stating that:

"170. Planning policies and decisions should contribute to and enhance the natural and local environment by:

[...]

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

- 4.2 Noise is also referenced within the Ground conditions and pollution subsection within Section 15 of the NPPF at Paragraph 180, which states:

"180. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

- (a) Mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life ⁶⁰,*
- (b) Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason."*

⁶⁰ See Explanatory Note to the Noise Policy Statement for England (Department for the Environment, Food and Rural Affairs, 2010).

- 4.3 Department for Environment, Food and Rural Affairs, Noise Policy Statement for England (NPSE), 2010 states:

Noise Policy Vision

Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.

Noise Policy Aims

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

- **avoid significant adverse impacts on health and quality of life;**
- **mitigate and minimise adverse impacts on health and quality of life; and**
- **where possible, contribute to the improvement of health and quality of life.**

Guiding principles of sustainable development

Ensuring a Strong Healthy and Just Society – Meeting the diverse needs of all people in existing and future communities, promoting personal wellbeing, social cohesion and inclusion, and creating equal opportunity for all.

Using Sound Science Responsibly – Ensuring policy is developed and implemented on the basis of strong scientific evidence, whilst taking into account scientific uncertainty (through the precautionary principle) as well as public attitudes and values.

Living Within Environmental Limits – Respecting the limits of the planet's environment, resources and biodiversity – to improve our environment and ensure that the natural resources needed for life are unimpaired and remain so for future generations.

Achieving a Sustainable Economy – Building a strong, stable and sustainable economy which provides prosperity and opportunities for all, and in which environmental and social costs fall on those who impose them (polluter pays), and efficient resource use is incentivised.

Promoting Good Governance – Actively promoting effective, participative systems of governance in all levels of society – engaging people's creativity, energy and diversity.

Source: Securing the future – delivering UK sustainable development strategy, HM Government, March 2005.

4.4 The Noise Policy Statement for England Explanatory note states that:

Noise is an inevitable consequence of a mature and vibrant society. For some the noise of city life provides a desirable sense of excitement and exhilaration, but for others noise is an unwanted intrusion that adversely impacts on their quality of life, affecting their health and well being.

The management of noise has developed over many years as the types and character of noise sources have altered and as people's attitude to noise has changed. The Noise Abatement Act came into law in 1960 and the Report from the Committee on the Problem of Noise was published in 1963 (the Wilson report). Since then, examples of noise management can be found in many areas including reducing noise at source; the use of the land use and transport planning systems, compensation measures, the statutory nuisance and licensing regimes and other related legislation.

Furthermore, the broad aim of noise management has been to separate noise sources from sensitive noise receivers and to 'minimise' noise. Of course, taken in isolation and to a literal extreme, noise minimisation would mean no noise at all. In reality, although it has not always been stated, the aim has tended to be to minimise noise as far as reasonably practical. This concept can be found in the Environmental Protection Act 1990, where, in some circumstances, there is a defence of 'best practicable means' in summary statutory nuisance proceedings.

By describing clear policy vision and aims the NPSE provides the necessary clarity and direction to enable decisions to be made regarding what is an acceptable noise burden to place on society.

The intention is that the NPSE should apply to all types of noise apart from noise in the workplace (occupational noise). For the purposes of the NPSE, "noise" includes:

- *"environmental noise" which includes noise from transportation sources;*
- *"neighbour noise" which includes noise from inside and outside people's homes;*
- and*
- *"neighbourhood noise" which includes noise arising from within the community such as industrial and entertainment premises, trade and business premises, construction sites and noise in the street.*

The application of the NPSE should mean that noise is properly taken into account at the appropriate time. In the past, the opportunity for the cost effective management of noise has often been missed because the noise implications of a particular policy, development or other activity have not been considered at an early enough stage.

In addition, the application of the NPSE should enable noise to be considered alongside other relevant issues and not to be considered in isolation. In the past, the wider benefits of a particular policy, development or other activity may not have been given adequate weight when assessing the noise implications.

In the longer term, the Government hopes that existing policies could be reviewed (on a prioritised basis), and revised if necessary, so that the policies and any noise management measures being adopted accord with the vision, aims and principles of the NPSE.

Noise management is a complex issue and at times requires complex solutions. Unlike air quality, there are currently no European or national noise limits which have to be met, although there can be specific local limits for specific developments. Furthermore, sound only becomes noise (often defined as 'unwanted sound') when it exists in the wrong place or at the wrong time such that it causes or contributes to some harmful or otherwise unwanted effect, like annoyance or sleep disturbance. Unlike many other pollutants, noise pollution depends not just on the physical aspects of the sound itself, but also the human reaction to it. Consequently, the NPSE provides a clear description of desired outcome from the noise management of a particular situation.

The guiding principles of Government policy on sustainable development should be used to assist in its implementation. The development of further principles specifically to underpin implementation of noise management policy will be kept under review as experience is gained from the application of the NPSE.

There are several key phrases within the NPSE vision and these are discussed below.

Health and quality of life

The World Health Organisation defines health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity, and recognises the enjoyment of the highest attainable standard of health as one of the fundamental rights of every human being.

It can be argued that quality of life contributes to our standard of health. However, in the NPSE it has been decided to make a distinction between 'quality of life' which is a subjective measure that refers to people's emotional, social and physical well being and 'health' which refers to physical and mental well being.

It is recognised that noise exposure can cause annoyance and sleep disturbance both of which impact on quality of life. It is also agreed by many experts that annoyance and sleep disturbance can give rise to adverse health effects. The distinction that has been made between 'quality of life' effects and 'health' effects recognises that there is emerging evidence that long term exposure to some types of transport noise can additionally cause an increased risk of direct health effects. The Government intends to keep research on the health effects of long term exposure to noise under review in accordance with the principles of the NPSE.

Promote good health and good quality of life

This statement expresses the long term desired policy outcome, but in the use of 'promote' and 'good' recognises that it is not possible to have a single objective noise-based measure that is mandatory and applicable to all sources of noise in all situations.

Effective management of noise

This concept confirms that the policy applies to all types of 'noise' (environmental, neighbour and neighbourhood) and that the solution could be more than simply minimising the noise.

Within the context of Government policy on sustainable development

Sustainable development is a core principle underpinning all government policy. For the UK Government the goal of sustainable development is being pursued in an integrated way through a sustainable, innovative and productive economy that delivers high levels of employment and a just society that promotes social inclusion, sustainable communities and personal wellbeing. The goal is pursued in ways that protect and enhance the physical and natural environment, and that use resources and energy as efficiently as possible.

There is a need to integrate consideration of the economic and social benefit of the activity or policy under examination with proper consideration of the adverse environmental effects, including the impact of noise on health and quality of life. This should avoid noise being treated in isolation in any particular situation, i.e. not focussing solely on the noise impact without taking into account other related factors.

There are several key phrases within the NPSE aims and these are discussed below.

“Significant adverse” and “adverse”

There are two established concepts from toxicology that are currently being applied to noise impacts, for example, by the World Health Organisation. They are:

NOEL . No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

LOAEL . Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected.

Extending these concepts for the purpose of this NPSE leads to the concept of a significant observed adverse effect level.

SOAEL . Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur.

It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not

having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available.

The first aim of the Noise Policy Statement for England

Avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

The first aim of the NPSE states that significant adverse effects on health and quality of life should be avoided while also taking into account the guiding principles of sustainable development.

The second aim of the Noise Policy Statement for England

Mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

The second aim of the NPSE refers to the situation where the impact lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development. This does not mean that such adverse effects cannot occur.

The third aim of the Noise Policy Statement for England

Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

This aim seeks, where possible, positively to improve health and quality of life through the proactive management of noise while also taking into account the guiding principles of sustainable development, recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society. The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim.

- 4.5 Unfortunately, the above guidance gives no objective, tangible standards or criteria that enable planning decisions to be made. In the absence of such guidance, quantification of noise impact in terms of guidance such as BS8233:2014, which present noise limits and criteria based on World Health Organisation recommendations, can be considered as appropriately assessing the potential noise impact with regard to toxicology concepts and hence in line with the principles of the NPPF and NPSE. Therefore, if a site meets the recommendations of BS8233:2014 and any associated Local Authority noise requirements, it can be considered as being below the level where there is no detectable adverse effect on health and quality of life due to noise, and this meets the NOEL (No Observed Effect Level) set out in the NPSE.

- 4.6 *British Standard 8233: 2014, 'Guidance on sound insulation and noise reduction for buildings'* (BS8233:2014) provides information on the design of internal acoustics in buildings. It deals with control of noise from outside the building, noise from plant and services within it, and room acoustics for non-critical situations.
- 4.7 BS8233:2014 provides guidance regarding indoor ambient noise criteria for residential accommodation, as presented below.

Table 3: BS8233:2014 Guidance criteria for indoor ambient noise levels

Activity	Location	0700-2300 hours	2300-0700 hours
Resting	Living rooms	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} (8 hour),

- 4.8 BS8233:2014 does not stipulate any criteria for maximum noise levels within rooms in terms of dB L_{Amax} , but does state that:

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.

- 4.9 It is noted that BS8233:2014 also states that, where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5dB and reasonable internal conditions still achieved.
- 4.10 In addition, the BS8233:2014 guidance relating to gardens makes reference to external noise levels in gardens and balconies, etc., as follows:

For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of

land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.

Other locations, such as balconies, roof gardens and terraces, are also important in residential buildings where normal external amenity space might be limited or not available, i.e. in flats, apartment blocks, etc. In these locations, specification of noise limits is not necessarily appropriate. Small balconies may be included for uses such as drying washing or growing pot plants, and noise limits should not be necessary for these uses. However, the general guidance on noise in amenity space is still appropriate for larger balconies, roof gardens and terraces, which might be intended to be used for relaxation. In high-noise areas, consideration should be given to protecting these areas by screening or building design to achieve the lowest practicable levels. Achieving levels of 55 dB $L_{Aeq,T}$ or less might not be possible at the outer edge of these areas, but should be achievable in some areas of the space.

- 4.11 The following general noise mitigation advice is based on achieving the BS8233:2014 indoor noise level criteria to ensure a suitable level of protection for the future occupants of the development. Noise ingress calculations have been carried out in accordance with BS8233:2014. Calculations have been undertaken to limit noise ingress to 45dB L_{Amax} within bedrooms at nighttime, as this is typically applied for control of train noise. Calculations are based on the typical noise events occurring at the site as presented herein; however, it must be acknowledged that there will always remain potential for atypical events, such as emergency sirens, police/ambulance helicopter, temporary works, etc., that could result in L_{Amax} noise levels exceeding 45dB within bedrooms. It is therefore not possible to determine with 100% accuracy which external noise levels will occur on any given day, nor is it possible to predict the maximum noise levels that may occur outside the dwellings in the future, and thus it is impossible to design and install a building envelope to ensure that an absolute maximum noise level criterion in a bedroom is never exceeded. The building envelope calculations are based on the typical noise events understood to occur at the site, and therefore provide a reasonable basis for appropriate acoustic design.
- 4.12 Published guidance on implementing limiting L_{Amax} criteria in bedrooms (e.g. *ProPG: Planning and Noise* and *WHO Community Noise Guidelines*) commonly advises that individual noise events should not normally exceed 45dB L_{Amax} more than 10no times per night, as this represents a threshold below which the effects of individual noise events on sleep can be regarded as negligible. Such an approach is commonly accepted by Local Authorities.

5.0 NOISE MITIGATION MEASURES

- 5.1 There are a variety of proportionate and reasonable techniques that could be introduced to mitigate the effects of noise, such as:
- a) **Engineering:** reduction of noise at source (e.g. use of quiet machinery and working methods), containment of generated noise, and protection of noise-sensitive buildings (e.g. by sound insulation and/or screening them by purpose-built barriers);
 - b) **LAYOUT:** adequate distance between source and noise-sensitive building; screening by natural barriers, other buildings or non-critical rooms in a building;
 - c) **Administrative:** limiting operating time of source, restricting activities onsite, specifying an acceptable noise limit.
- 5.2 The daytime L_{Aeq} noise level at this development site exceeds the BS8233:2014 55dB L_{Aeq} upper limit for garden areas, and therefore measures should be implemented to reduce noise impact from road traffic and rail traffic in private gardens. This will require the provision of acoustic barrier fencing to gardens positioned along the eastern and western site boundaries, i.e. Plot 11, Plot 12, Plot 13, Plot 21, Plot 22, Plot 23, Plot 24, Plot 25, and Plot 26 shown in Figure 2.
- 5.3 Acoustic fencing should be minimum 2m high and constructed of solid, weather-treated timber (or ply) of minimum 18mm thickness. All joints should be tight-buttet with timber cover strips or tongue and groove boards to ensure that there are no airgaps in the structure or between the base of the fence and the ground beneath. Alternatively, acoustic barriers can be created from almost any solid material that can be made impermeable to air; for example, the barrier could be constructed from masonry, concrete, plastic, timber panels, etc., if desired. Proprietary acoustic fencing products are available from various suppliers, such as Jacksons Jakoustic® acoustic fencing. The manufacturer's guidance and installation instructions must be followed for all proprietary systems. The above is based on the assumption that the ground level at the new dwellings is no lower than the level of the railway; if the ground level is lower, the barrier height should be increased accordingly.
- 5.4 Plot 1, Plot 2, Plot 3, Plot 4, Plot 5, and Plot 6 face Thurnscoe Bridge Lane, but have gardens to the rear of the building, and so these will be suitably shielded from the road traffic. These, and all remaining gardens, should be provided with minimum 1.8m high close-boarded timber fencing.

Dwelling Protection

- 5.5 The design of the building envelope of the new dwellings can incorporate suitable sound insulation to satisfy the internal noise criteria set out above. Noise ingress calculations have been carried out in accordance with BS8233:2014 to determine appropriate sound insulation measures to satisfy the acoustic criteria set out above. The precise requirements will depend on the external noise level experienced at the dwellings. The following sound insulation measures are recommended, assuming the recommendations for acoustic fencing as outlined above are put in place.
- 5.6 A traditional pitched tile/slate roof construction should provide suitable sound insulation. Ceilings in bedrooms immediately below the roofspace should comprise minimum 2no layers solid gypsum-based board (total minimum mass per unit area 20kg/m^2), overlaid with mineral wool insulation of minimum 100mm thickness.
- 5.7 External walls should comprise dense masonry cavity construction (e.g. outer brickwork with inner blockwork leaf of minimum density 1000 kg/m^3). The external wall cavity should be minimum 100mm and insulated with mineral wool to the same thickness as the cavity depth.
- 5.8 Our calculations indicate that an enhanced acoustic specification for glazing and ventilation will be required in order that BS8233:2014 internal noise levels can be met. However, it is clear that the BS8233:2014 criteria can be met, and that the site is suitable for residential development.
- 5.9 The BS8233:2014 nighttime 45dB $L_{A\text{max}}$ criterion in bedrooms is the most onerous performance requirement. Bedrooms in the plots nearest to and most exposed to the road traffic and rail traffic should therefore be provided with double-glazing comprising 10mm glass / 12mm airgap / 6mm glass (minimum 38dB R_w), and an acoustic ventilator of minimum sound insulation performance of 42dB $D_{n,e,w}$ (e.g. Greenwood EAR42W or Rytons AAC635HMCW). This should be applied to the following plots shown in Figure 2:
- a) Bedrooms in Plot 9, Plot 10, Plot 11, Plot 12, Plot 15, and Plot 16
 - b) Bedrooms on east-facing building elevations in Plot 13, Plot 14, Plot 20, and Plot 21
 - c) Bedrooms on west-facing building elevations in Plot 1, Plot 2, Plot 3, Plot 4, Plot 5, Plot 6, Plot 22, Plot 23, Plot 24, Plot 25, and Plot 26
- 5.10 Living rooms and all other bedrooms should be provided with double-glazing comprising 6mm glass / 16mm airgap / 4mm glass (minimum 33dB R_w), and an acoustic ventilator of

minimum sound insulation performance of 35dB $D_{n,e,w}$. Such a performance is achievable by various models of ventilator from manufacturers, such as RW Simon, Titon, or Greenwood.

- 5.11 Glazing and ventilators to non-habitable rooms or spaces do not require special acoustic measures, and these spaces may have standard trickle ventilation. (For the purposes of noise assessment, separate kitchens, bathrooms, WCs, etc., are considered as non-habitable spaces.)
- 5.12 Precise specification of sound insulation measures will be verified once the final site layout is confirmed. Depending on the layout, it may be feasible to reduce specification for properties within the site (i.e. more shielded from noise sources) without compromising the specified acoustic criteria.
- 5.13 The specifications given above are suitable recommendations. Equivalent acoustic performance may be achieved by other materials or products, but acoustic performance data for all proposed systems should be checked by a competent acoustic consultant in order to ensure adequate acoustic performance will be achieved.
- 5.14 It should be acknowledged that careful design and close attention to detail, along with high standards of site supervision and workmanship, are essential in achieving the required acoustic performance, particularly in relation to controlling flanking sound transmission paths, airgaps, and use of suitable materials. Therefore, effective work management plans will be needed to ensure all contractors and tradesmen are aware of the acoustic performance requirements and details to ensure works are implemented to the necessary standard.

6.0 VIBRATION ASSESSMENT

- 6.1 Guidance on predicting human response to vibration in buildings is set out in *British Standard 6472: 2008 'Guide to the evaluation of human exposure to vibration in buildings'* (BS6472). The standard includes a section on intermittent vibrations and requires the vibration exposure to be determined in terms of 'vibration dose value' ('VDV'), which is determined from frequency-weighted vibration acceleration measurements to assess the probability of adverse comment from human beings experiencing vibration in buildings. Consideration is given to time of day and use of the space (e.g. residential, office, or workshop).
- 6.2 VDV takes into account the magnitude of the vibration and the duration of the exposure and is defined as a cumulative measurement of the vibration level received over a given period; it is the integrated fourth power vibration value with units $\text{ms}^{-1.75}$ and has the advantage of sensitivity to vibration peak levels.
- 6.3 The vibration dose summation procedure described in BS6472-1 allows comparison of all types of vibration exposure on a common basis, i.e. the severity of impulsive and/or intermittent vibration is evaluated on a basis applicable equally to continuous vibration.
- 6.4 Unless the direction of vibration having the dominant effect is known, the motion should be recorded in 3no orthogonal axes and evaluated for the single axis in which the magnitude of weighted acceleration is greatest. Vertical vibrations are generally more perceptible than horizontal vibrations.
- 6.5 BS6472-1 sets out the likely human response in terms of probability of adverse comment to VDV levels ($\text{ms}^{-1.75}$) for vertical and horizontal vibration in residential buildings in the table titled 'Vibration dose value ranges which might result in various probabilities of adverse comment within residential buildings', which is reproduced below:

Vibration dose value ranges which might result in various probabilities of adverse comment within residential buildings

Place and time	Low probability of adverse comment $\text{m}\cdot\text{s}^{-1.75}$ 1)	Adverse comment possible $\text{m}\cdot\text{s}^{-1.75}$	Adverse comment probable $\text{m}\cdot\text{s}^{-1.75}$ 2)
Residential buildings 16 h day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 h night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

- 6.6 As presented in Appendix III, measurements of vibration were carried out at Location 1 during the same periods as the noise survey. The survey gathered a series of 1-minute VDV_z in each of the 3 orthogonal directions. From these measurements, the 16-hour VDV or 8-hour VDV may be estimated. The total day VDV or night VDV can be evaluated using the following relationship for (N) number of vibration episodes during the assessment period:

$$\text{VDV} = (\sum_{i=1-N} \text{VDV}_i^4)^{0.25}$$

- 6.7 There was no perceptible vibration experienced underfoot during the passage of trains, but the objective measurement is deemed more critical than the subjective assessment onsite. The greatest single VDV measurement was 0.028 ms^{-1.75} VDV_z for a passing freight train. Assuming this level occurred continuously – i.e. if a similar train passed the site every minute – the 16-hour daytime VDV at Location 1 is calculated to be 0.16 ms^{-1.75}. The 8-hour nighttime VDV at Location 1 is calculated to be 0.13 ms^{-1.75}. This equates to vibration levels around the lower threshold of the “low probability of adverse comment” range defined in BS6472-1. Clearly, this is very much a theoretical worst-case situation that would not occur onsite, as there are fewer passing trains and most generate less vibration, but it shows that vibration levels at the new dwellings are expected to be within acceptable limits, with a low probability of adverse comment.
- 6.8 *British Standard 7385-2:1993 ‘Evaluation and measurement for vibration in Buildings – Part 2: Guide to damage levels from ground-borne vibration’* (BS7385-2) provides vibration criteria relating to building damage, and advice on acceptable levels of vibration in structures. The standard uses the PPV quantity as correlating best with recorded occurrences of vibration-induced damage. The BS6472-1 VDV vibration criteria are more sensitive than the BS7385-2 PPV limits for transient vibrations, and therefore assessment in terms of the more critical BS6472-1 standard is considered appropriate.

7.0 SUMMARY AND CONCLUSIONS

- 7.1 A noise and vibration assessment has been carried out on behalf of Jaguar Estates / Wortley Construction JV for a proposed residential development on land at Thurnscoe Bridge Lane, Rotherham.
- 7.2 The assessment has included measurements of environmental noise levels at the site during representative daytime and nighttime periods. Rail traffic noise was found to be the dominant noise source at the undeveloped site. Measurements of vibration levels near the site's boundary with the railway line were also taken during the noise survey periods.
- 7.3 Calculations indicate that the stated BS8233:2014 noise criteria can be met, as enhanced acoustic specification of ventilation and glazing can provide sufficient sound attenuation.
- 7.4 The assessment has also considered the magnitude of vibration experienced on the site.
- 7.5 Theoretical maximum levels of vibration were found to be at the lower threshold of the "low comment probability of adverse comment" range, and therefore within suitable limits for residential development. More typical vibration exposure is expected to be below the "low comment probability of adverse comment" threshold.
- 7.6 The site may be considered suitable for residential development in planning and noise terms, as acceptable noise levels in accordance with BS8233:2014 can be achieved following the design and implementation of suitable noise mitigation measures.
- 7.7 In addition, the assessment has been undertaken with regard to the *National Planning Policy Framework* (NPPF) and the *Noise Policy Statement for England* (NPSE). Appropriate noise assessment and design targets for internal noise levels have been used to quantify noise impact and determine suitability for residential development with due regard to effects on health and quality of life as set out in the NPSE. On this basis, we consider that the noise assessment methodology and conclusions meet the principles set out in the NPPF and NPSE.

FIGURE 1 – SITE AERIAL VIEW AND APPROXIMATE MEASUREMENT LOCATIONS



FIGURE 2 – INDICATIVE LAYOUT PLAN / SITE RED LINE PLAN



APPENDIX I – TECHNICAL UNITS AND INDICES

a) Sound Pressure Level and the decibel (dB)

A sound wave is a small fluctuation of pressure in air. The human ear responds to these variations in pressure, producing the sensation of hearing. The ear can detect a very wide range of pressure variations. Due to the wide range of pressure variations detectable by the ear, a logarithmic scale is used to convert the values into manageable numbers. The dB (decibel) is the logarithmic unit used to describe sound (or noise) levels. The usual range of sound pressure levels is from 0 dB (threshold of hearing) to 120 dB (threshold of pain).

b) Frequency and Hertz (Hz)

Frequency is a measure of the rate of fluctuation of a sound wave. The unit used is cycles per second, or Hertz (Hz). Sometimes large frequencies are often written as kilohertz (kHz), where 1kHz = 1000Hz.

Young people with normal hearing can hear frequencies in the range 20Hz to 20kHz. However, the upper frequency limit gradually reduces as a person gets older.

As the ear hears some frequencies better than others, the A-weighting scale is used to mimic human hearing. A-weighting applies a correction to the sound level at a given frequency depending on how well the ear hears that frequency.

c) Glossary of Terms

In order to describe noise where the level is continuously varying, a number of other indices, including statistical parameters, are used. The indices used in this report are described below.

L_{Aeq} This is the A-weighted equivalent continuous sound level which is an average of the total sound energy measured over a specified time period. In other words, L_{Aeq} is the level of a continuous noise which has the same total (A-weighted) energy as the real fluctuating noise, measured over the same time period.

L_{Amax} This is the maximum A-weighted sound level that was recorded during the monitoring period.

L_{A90} This is the A-weighted sound level exceeded for 90% of the time period. L_{A90} is used as a measure of background noise.

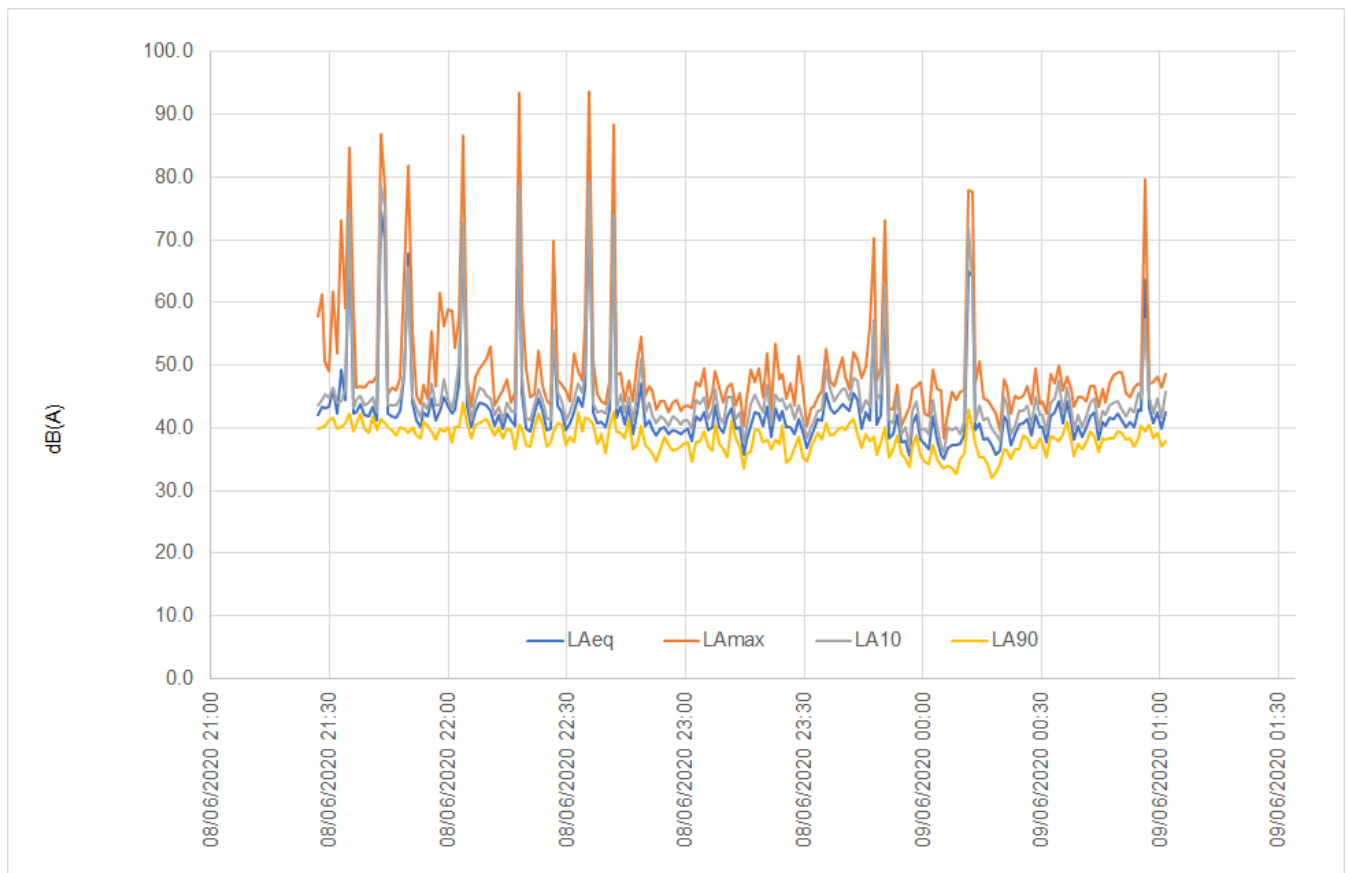
L _{A10}	This is the A-weighted sound level exceeded for 10% of the time period and is often used in the assessment of road traffic noise.
SEL	This is the Single Event Level or Sound Exposure Level. The SEL is the total energy measured over the event, compressed into 1 second. $SEL = L_{Aeq} + 10\log(t)$, where t is time in seconds. Also $L_{Aeq} = SEL - 10\log(t) + 10\log(n)$ where t is time in seconds and n is the number of events in the time period.
NR	Measured noise levels in each octave band are compared to the NR curve reference values. The overall NR value is the lowest NR curve that has not been exceeded.
D _{nT,w}	Weighted standardised level difference, a single figure generated by comparing the D _{nT} with a reference curve. The reference curve is shifted in 1dB steps until the sum of adverse deviation of the test curve, compared to the reference curve, is as large as possible, but no more than 32.0 dB. The value of the shifted reference curve at 500Hz is taken as the D _{nT,w} . N.B. As D _{nT,w} for airborne transmission represents a level difference, an improvement generates a larger figure – used in airborne tests.
R _w	Similar to the D _{nT,w} term, but a measure of the airborne sound insulation performance of a separating element, when tested in laboratory conditions. As such the build is essentially perfect, and has no flanking noise routes. D _{nT,w} values measured onsite will always be of a significantly lower value than the R _w value for a structure.
VDV	Vibration Dose Value: cumulative measurement of the vibration level received over a given period. It is the integrated fourth power vibration value with units ms ^{-1.75} and has the advantage of sensitivity to vibration peak levels.
PPV	Peak Particle Velocity: Instantaneous maximum velocity reached by a vibrating element as it oscillates about its rest position.

APPENDIX II – NOISE SURVEY MEASUREMENT DATA

Measurement locations were 'free-field', i.e. suitably distant from acoustically reflecting surfaces and structures (other than the ground) to minimise the influence of reflections.

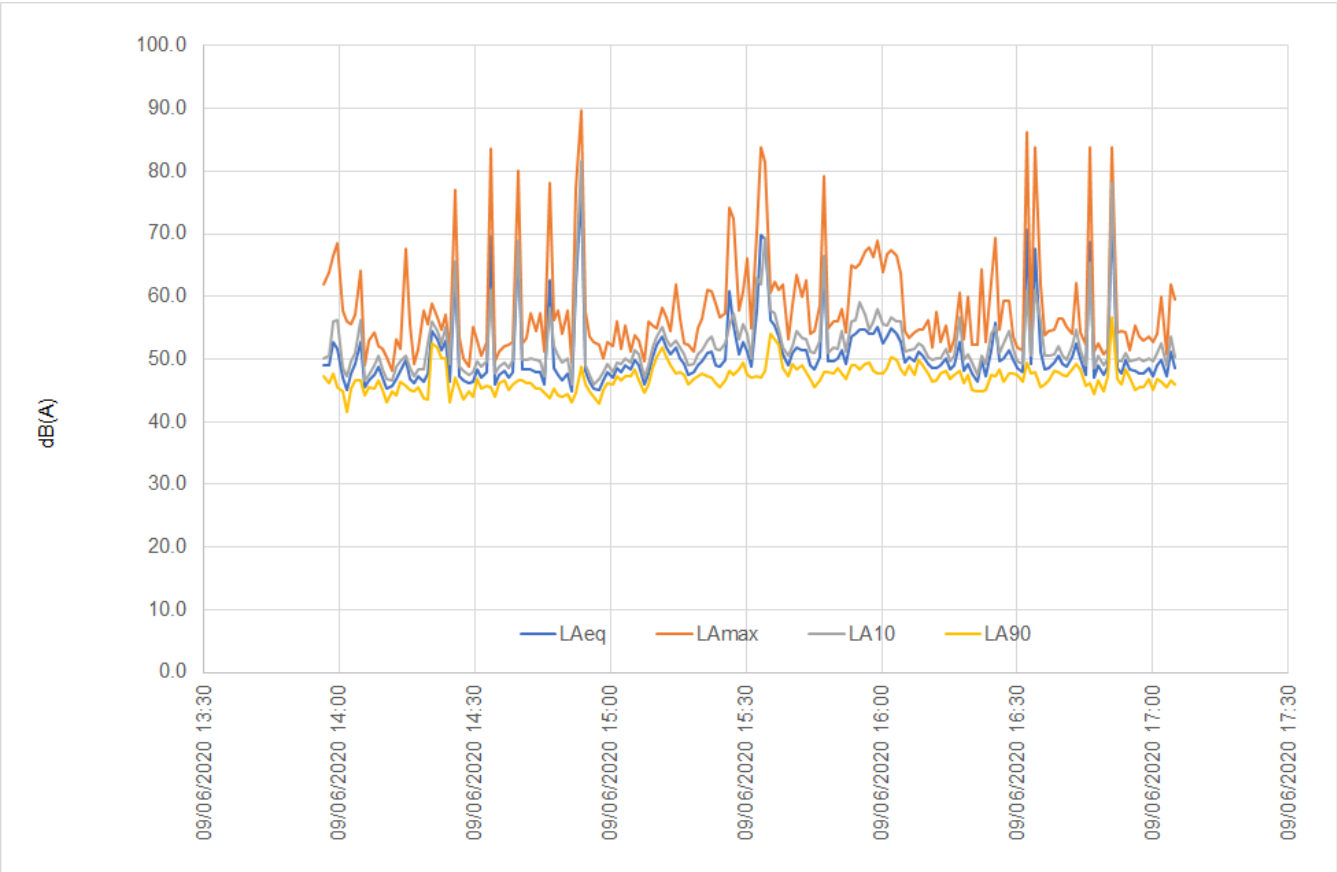
Location 1 – Eastern site boundary near railway line, approximately 16m from nearest track – Evening into nighttime

Rion NA-28 sound level meter, all values dB(A), 1-minute measurement periods.



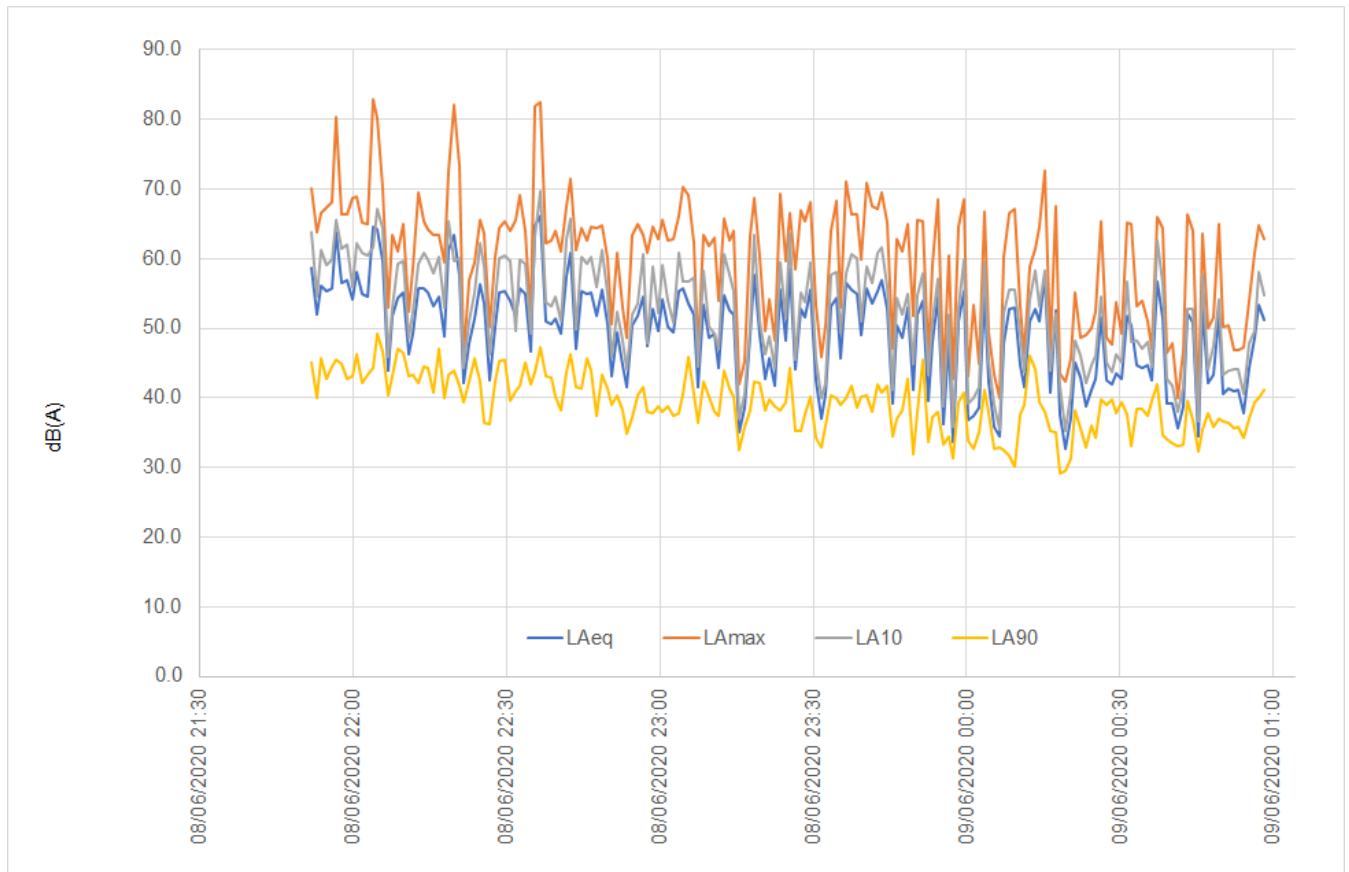
Location 1 – Eastern site boundary near railway line, approximately 16m from nearest track – Daytime

Rion NA-28 sound level meter, all values dB(A), 1-minute measurement periods.



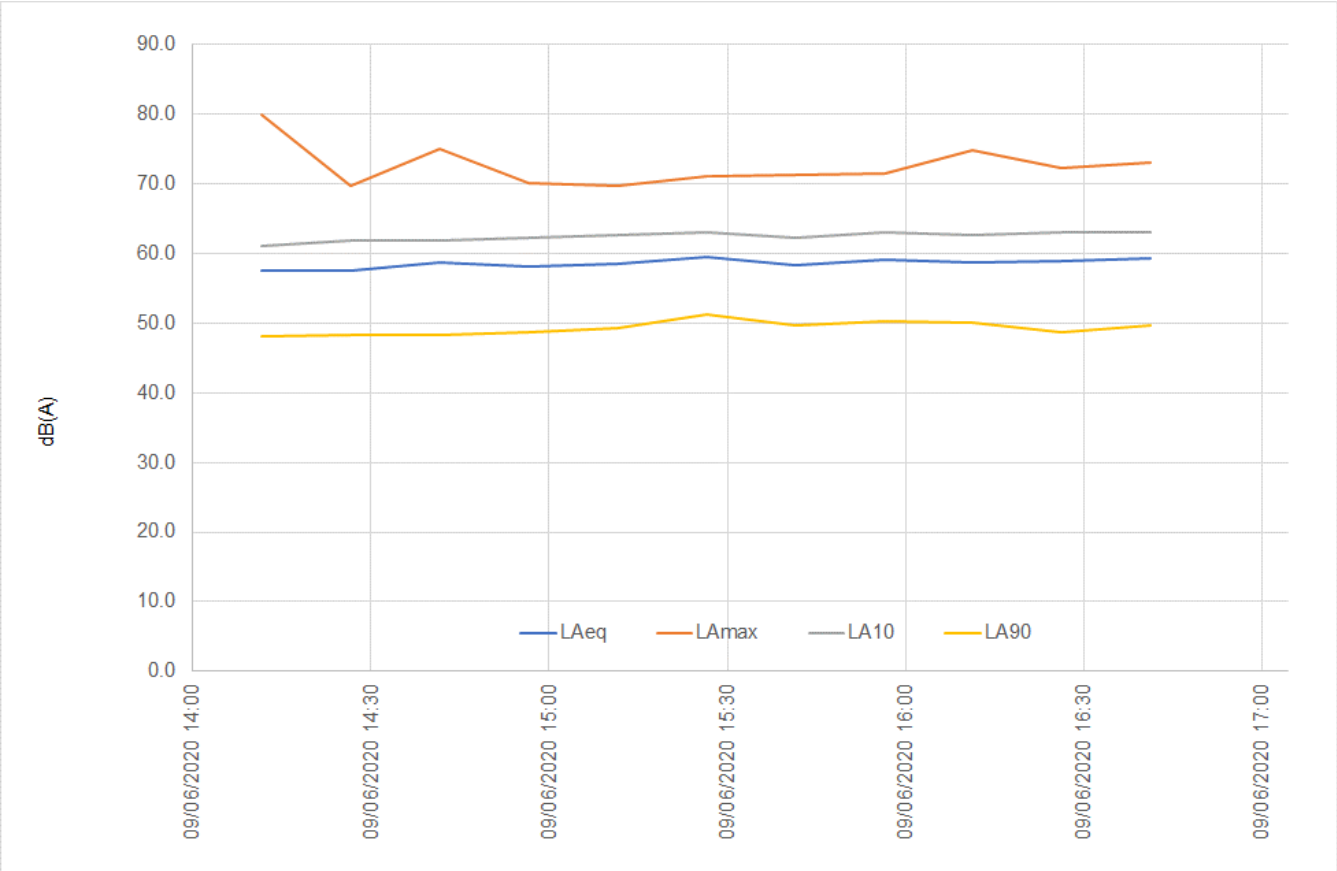
Location 2 – Western site boundary near Thurnscoe Bridge Lane, approximately 10m from nearest kerb – Evening into nighttime

Rion NA-28 sound level meter, all values dB(A), 1-minute measurement periods.



Location 2 – Western site boundary near Thurnscoe Bridge Lane, approximately 10m from nearest kerb – Daytime

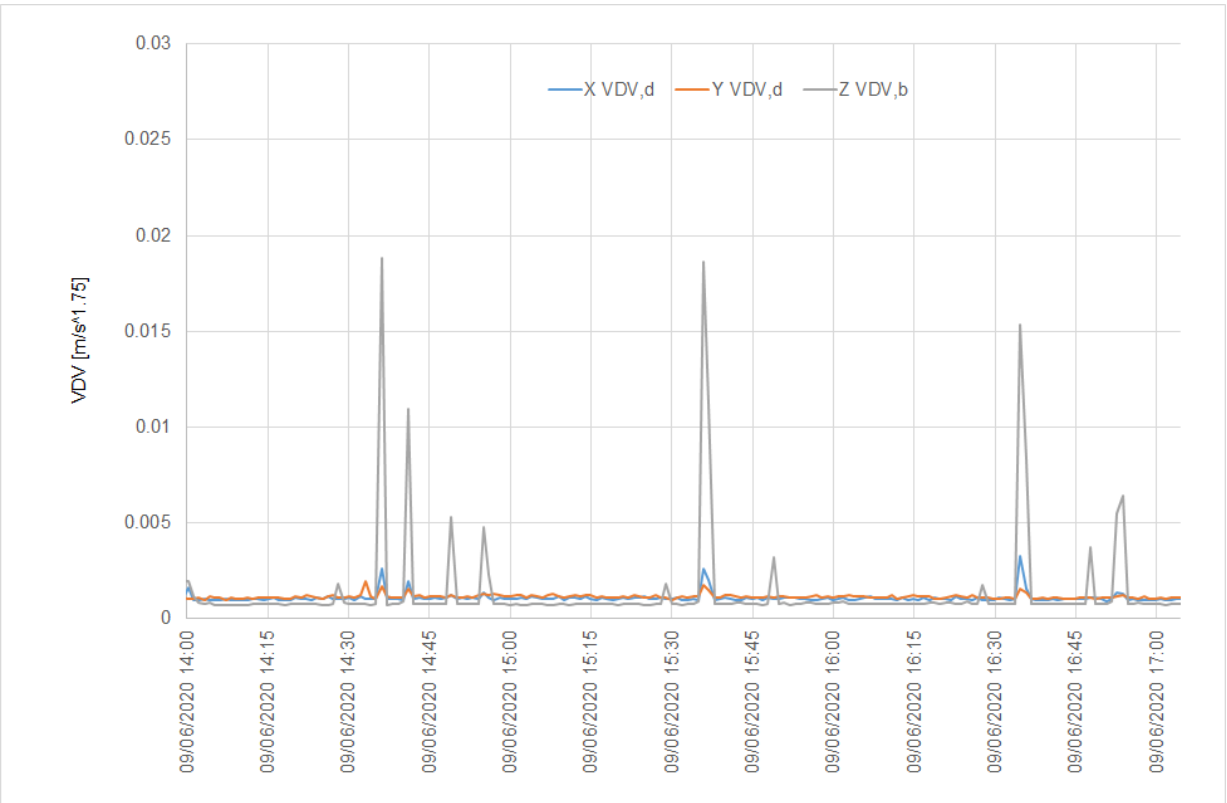
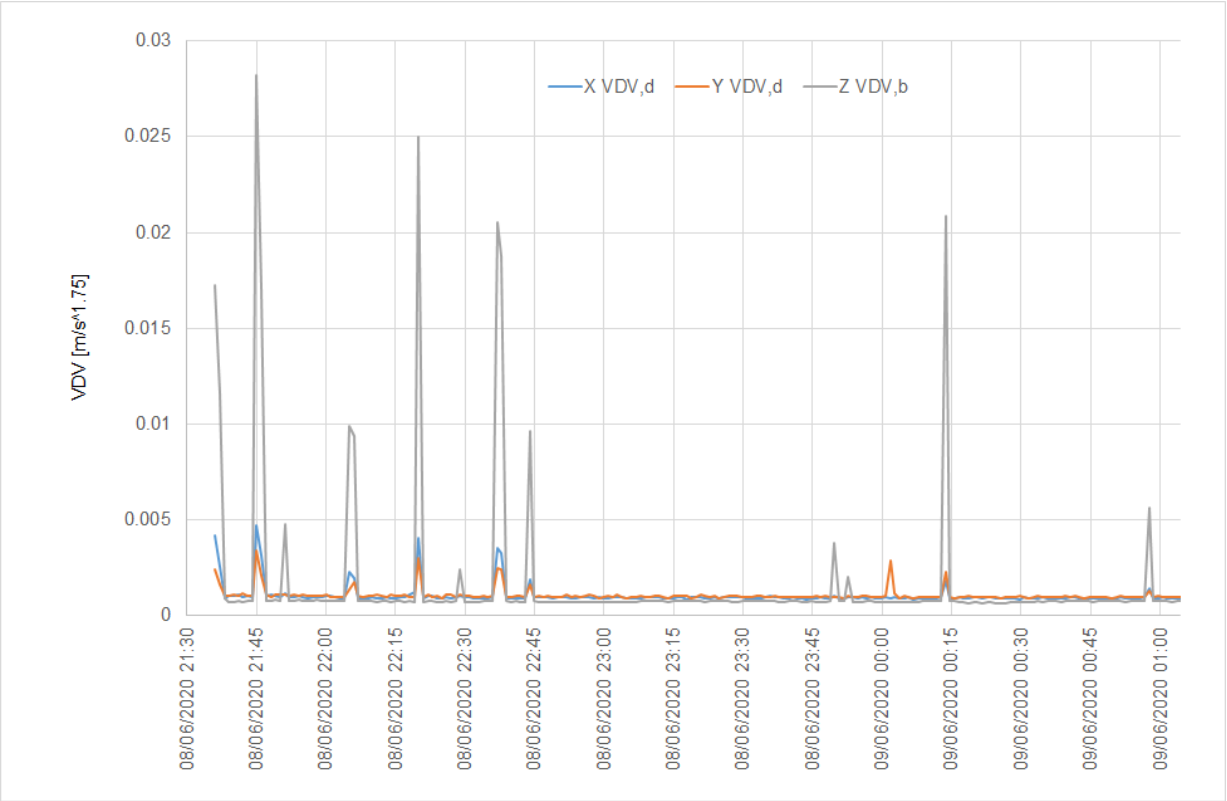
Rion NA-28 sound level meter, all values dB(A), 15-minute measurement periods.



APPENDIX III – VIBRATION SURVEY MEASUREMENT DATA

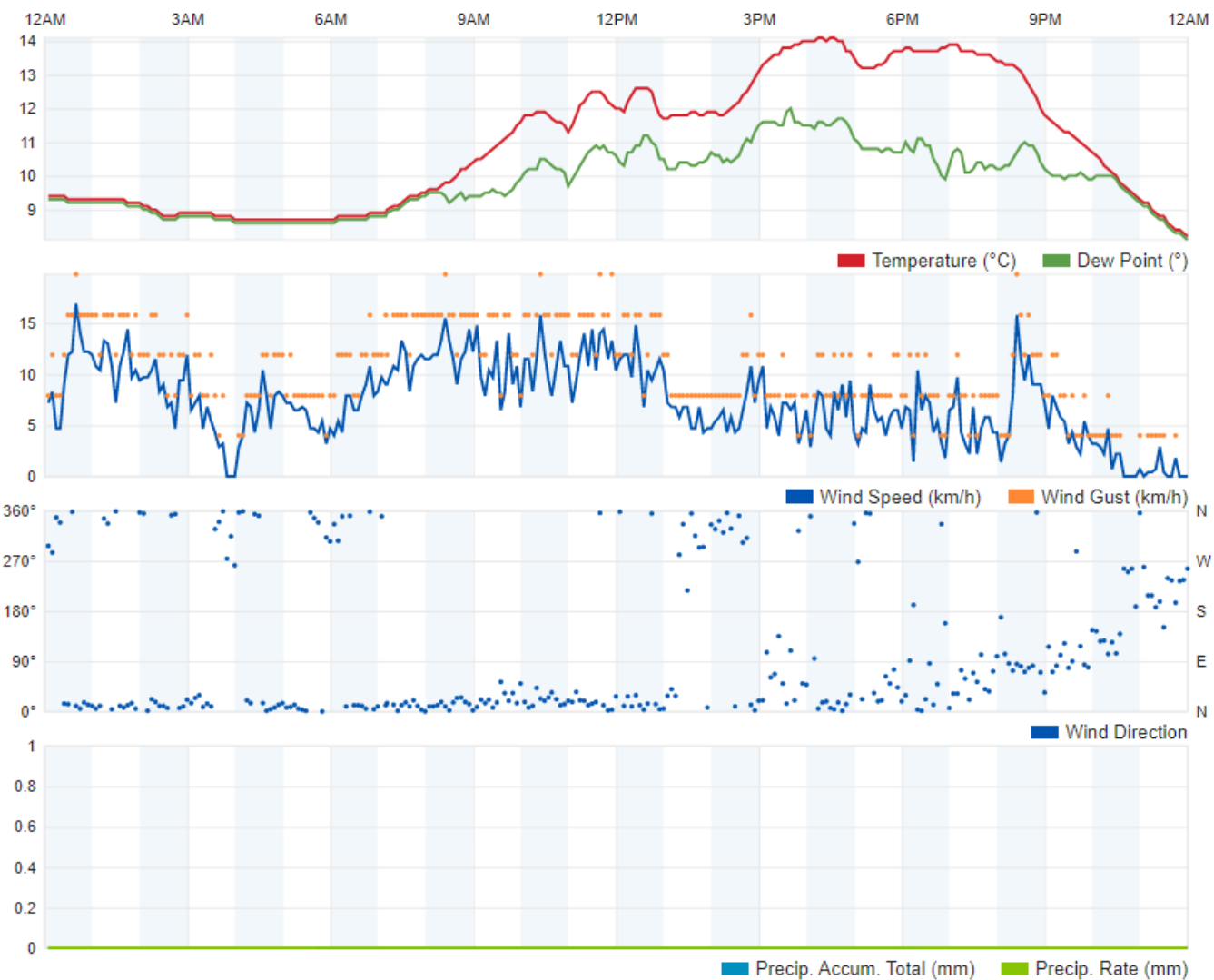
Location 1

Svan 958A vibration meter. All values in $\text{ms}^{-1.75}$, 1-minute measurement periods.



APPENDIX IV – WEATHER DATA

Monday 08/06/2020



Tuesday 09/06/2020

