DRAGONFLY

CONSULTING

PRIMETALENT Ltd

Hutton Bank, Ripon

Noise Impact Assessment

DC3010-R1v3

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Report Version Issue Log

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Limitations to this Report

This report entails a physical investigation of the site with a sufficient number of sample measurements to provide quantitative information concerning the type and degree of noise affecting the site. The objectives of the investigation have been limited to establishing sources of noise material to carrying out an appropriate assessment.

The number and duration of noise measurements have been chosen to give reasonably representative information on the environment within the agreed time, and the locations of measurements have been restricted to the areas unoccupied by building(s) that are easily accessible without undue risk to our staff.

As with any sampling, the number of sampling points and the methods of sampling and testing cannot preclude the existence of “hotspots” where noise levels may be significantly higher than those actually measured due to previously unknown or unrecognised noise emitters. Furthermore, noise sources may be intermittent or fluctuate in intensity and consequently may not be present or may not be present in full intensity for some or all of the survey duration.

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1.0 INTRODUCTION

Addison Planning Consultants, on behalf of PRIMETALENT Ltd, has appointed Dragonfly Consulting to carry out a Noise Impact Assessment in support of a planning application for a proposed residential development on Hutton Bank.

The noise assessment has been conducted in accordance with the National Planning Policy Framework.

This report therefore describes a noise survey of the site and the subsequent analysis to determine the noise environment of the proposed development. It then compares the results with the adopted criteria. Recommendations are also made with respect to the design of the development.

Measurement of external noise levels have been completed for the proposed development to allow demonstration by calculation that suitable internal noise levels will be achieved within the most noise exposed rooms.

Whilst reasonable effort has been made to ensure that this report is easy to understand, it is technical in nature; to assist the reader, a glossary of terminology is included in Appendix A.

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2.0 SITE DESCRIPTION

2.1 Existing Site Conditions

The site is currently a large brownfield area with a warehouse located towards the North of the site, a car wash to the East and a disused area of grassland on the South-west tip. The 'Ripon Land Rover' car dealership is situated to the East of the site, with residential housing to the North & West and a major road (A61) to the southeast.

2.2 Proposed Site Conditions

The site is to be renovated from its current state to residential housing. An outline site plan, provided by Addison Planning Consultants, is shown in Figure 2.1 below:

Figure 2.1
Proposed Site Plan

3.0 GUIDANCE

3.1 Consultation with Local Authority

The consultation response from Mark Lee of Harrogate Borough Council (HBC), dated 9th November 2018), states the following:

"2. Amenity Loss and sustainable development – noise, odour, fumes, light.

The information provided has not adequately considered the impact this proposal will have upon Ripon Land Rover or the effect Ripon Land Rover activities will have upon the occupants of the proposed residential premises and as a result of this lack of consideration I do not currently accept that the proposal provides a sustainable development that should be approved.

The proposal introduces residential premises, whose occupants are sensitive to noise, odours, fumes and external light pollution, next to an existing use that is likely to give rise to noise, odours, fumes and external light pollution and so I am concerned that if approved it will result in unacceptable harm to the occupants of the proposed sensitive residential premises and to the adjacent commercial use both in terms of placing unacceptable restrictions or financial constraints on Ripon Land Rovers current operating practices and / or severely harm Ripon Land Rover's ability to grow and develop in the future.

A number of pre-existing residential premises in the area are protected from activities at Ripon Land Rover due to distance and the shielding provided by the existing large buildings on the proposed currently underutilised site (partly underutilised because of the inability for certain types of business to operate without causing neighbourhood nuisance complaints). This proposal will remove the shielding provided and place a number of homes and gardens adjacent to Ripon Land Rover. It is also noted that the main potential noise, odour, and fume generating activities at Ripon Land Rover will be from the vehicle preparation, repair and service workshop and valeting areas and these are located to the rear and side of their main building adjacent to the proposed noise sensitive premises.

I note that conditions such as operating hours, approval of details and noise rating levels where applied to the planning permission given for the Ripon Land Rover site based upon minimising nuisance but any such condition or approval of details were made taking into account the site and its locality at the time and so will not necessarily be appropriate or enforceable for the currently proposed sensitive residential use.

Informative:-

Should nuisance impact assessments be carried out that identify the development would be suitable for residential use but with mitigation, then I would expect all mitigation options available are identified and fully appraised not just on the ability to address the problem but also to assess the sustainability of the actual mitigation measures proposed based upon a good sustainable design process such as that identified for noise in the Professional Practice Guidance on Planning and Noise, 'ProPg:Planning and Noise'"

3.2 Noise Policy Statement for England

The document 'Noise Policy Statement for England' sets out the following vision for ongoing noise policy:

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

This vision should be achieved through the following 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."*

To achieve this vision, the Noise Policy Statement sets 3 noise levels to be defined by the assessor:

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.

SOAEL – Significant Observed Adverse Effect Level

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

The Noise Policy Statement considers that noise levels above the SOAEL would be seen to have, by definition, significant adverse effects and would be considered unacceptable. Where the assessed noise levels fall between the LOAEL and the SOAEL noise levels, the Policy Statement 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."

Where noise levels are below the LOAEL, it is considered there will be no adverse effect. Once noise levels are below the NOEL, there will be no observable change.

Summaries of the relevant standards are given below.

3.3 BS7445-1:2003

The assessment of noise impact for this development has been undertaken by measuring external noise levels in accordance with the guidance detailed in BS7445-1:2003 *Description and Measurement of Environmental Noise – Part 1: Guide to Quantities and Procedures*.

This document defines the basic quantities to be used for the description of noise in community environments and describes basic procedures for the determination of these quantities.

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The methods and procedures described in this British Standard are intended to be applicable to sounds from all sources, individually and in combination, which contribute to the total noise at a site. This British Standard does not specify limits for environmental noise.

3.4 British Standard 4142

British Standard 4142:2014 – *Methods for rating and assessing industrial and commercial sound*. This new edition of BS4142 clarifies the application of the standard and introduces the consideration of uncertainty as part of the assessment methodology. The standard provides a method for rating and assessing sound of an industrial or commercial nature, including:

- Sound from industrial and manufacturing process;
- Sound from fixed installations which comprise mechanical and electrical plant and equipment;
- Sound from the loading and unloading of goods and materials at industrial and/or commercial premises;
- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as from FLTs or that from train or ship movements on or around an industrial/commercial site.

The standard is intended for use for both the assessment of complaints and the assessment of the impact of commercial and industrial noise on both new and existing residential developments.

The method described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes at which the sound is incident. The standard specifically excludes itself for the use of determination of nuisance.

The procedure contained in BS4142 for assessing the likelihood of complaint requires the calculation of the noise level from the source to be assessed at a location immediately outside the relevant dwelling; this is described as the 'specific sound level'. Where the specific noise source already exists, its noise level can be derived by measuring the total noise present, or 'ambient noise', and subtracting from it the noise from sources that are not under consideration. Noises not under consideration are called the 'residual noise'.

A 'rating level' is then calculated from the specific sound level. The rating level is then compared with the measured background noise level at that measurement location. If the specific noise source does not yet exist but the details of the intended plant are known, the specific sound level can be derived from first principles using manufacturers' and other data.

The specific, ambient and residual noise levels are measured in terms of $L_{Aeq,T}$ values and the background noise level is measured in terms of an L_{A90} value.

BS4142 considers that certain acoustic features can increase impact of a new noise source over that expected from a simple comparison between the specific noise level and the background noise level. These features can be assessed in one of three ways:

- Objective method - comparing adjoining third octave band noise levels (if available) for the sound source;

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- The reference method by analysing measured plant noise levels using the Joint Nordic method;
- Using the prescribed subjective methodology.

These features and the penalties applied to calculate a rating level when assessing subjectively as defined by BS4142 are as follows:

- Tonality – For sound ranging from not tonal to prominently tonal, the Joint Nordic Method gives a correction of between 0 and +6dB for tonality.
    - 2dB for a tone which is just perceptible;
    - 4dB where it is clearly perceptible;
    - 6dB where it is highly perceptible.
- Impulsivity – A correction of up to 9dB can be applied for sound that is highly impulsive, considering both the rapidity of change in sound level and the overall change in sound level.
    - 3dB just perceptible impulsivity;
    - 6dB clearly perceptible impulsivity;
    - 9db highly perceptible impulsivity.
- Intermittency – Where the specific sound has identifiable on/off conditions, the specific sound level ought to be representative of the time period of length equal to the reference time period that contain the greatest amount of 'on' time. This can necessitate measuring the specific sound over a number of shorter periods that are in combination less that the reference time interval in total.
    - If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3dB can be applied.
- Where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive from the residual acoustic environment, a 3dB penalty can be applied.

In order to assess the significance of the impact, the background noise level is subtracted from the rating level. The standard considers that the greater the difference, the greater the significance.

- 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.

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The standard goes on to highlight that these values are not absolute. There are a number of factors that should be taken in to account when assessing the impact and significance of the noise including:

- The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low;
- Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night;
- Where residual sound levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts. The margin by which the rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse;
- The character and level of the residual sound compared to the character and level of the specific sound;
- The sensitivity of the receptor and if the receptor already includes acoustic design features to mitigate noise.

3.5 British Standard 8233

The scope of British Standard 8233:2014: Sound insulation and noise reduction for buildings is the provision of guidance for the control of noise in and around buildings. It suggests appropriate criteria and limits for different situations; the primary intention of these is to guide the design of new buildings or refurbished buildings undergoing a change of use rather than to assess the effect of changes in the external noise climate. The standard suggests suitable internal noise levels within different types of buildings, including residential dwellings, as shown in Table 3.1.

Table 3.1
Indoor Ambient Noise Levels in Spaces When They Are Unoccupied

Activity	Typical Situations	Design Range $L_{Aeq,\,T}$ dB	
		0700h to 2300h	2300h to 0700h
Resting	Living rooms	35	--
Dining	Dining Room / Area	40	--
Sleeping	Bedrooms	35	30

BS8233 states in Note 4 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 LAMax,f depending on the character and number of events per night. Sporadic noise events could require separate values."

As such, it has been considered appropriate to define a limit for regular maximum noise levels of 45dB(A) with sporadic events not exceeding 50dB(A).

BS8233 also suggests noise limits for external areas or a property such as gardens or balconies. It states that:

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"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 LAeq,T, with an upper guideline value of 55 dB LAeq,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."

3.6 ProPG: Planning and Noise

The document 'ProPG: Planning & Noise - Professional Practice Guidance on Planning & Noise' provides advice for Local Planning Authorities, developers and their respective advisors and compliments government planning, noise policy and guidance. The document seeks to:

- Advocate full consideration of the acoustic environment from the earliest possible stage of the development control process;
- Encourage the process of good acoustic design in around new residential developments;
- Outline what should be taken into account in deciding planning applications for new noise sensitive developments;
- Improve understanding of how to determine the extent of potential noise impact and effect;
- Assist in the delivery of sustainable development.

Following the guidance in paragraph 17 of the NPPF, planning should always seek to secure high quality design and a good standard of amenity for all existing and future occupants of land and buildings. ProPG describes an acoustic design process which seeks to deliver the best acoustic outcome for the site.

3.6.1 Good Acoustic Design Objectives

With reference to the guidance set out within the ProPG, the following design objectives are considered to represent good acoustic design and are recommended for this site:

- Full consideration of the acoustic environment from the earliest possible stage of the development process;
- An integrated approach should be taken to achieve optimal acoustic conditions, both internally (inside noise sensitive parts of the building) and externally (in spaces to be used for amenity purposes);
- The basis of good acoustic design should avoid 'unreasonable' acoustic conditions and prevent 'unacceptable' acoustic conditions as defined by the ProPG. Necessary design compromises should ideally not adversely affect living conditions and the quality of life of inhabitants;
- Using fixed unopenable glazing for sound insulation purposes is generally unsatisfactory and should be avoided;

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- Solely relying on sound insulation of the building envelope to achieve acceptable acoustic conditions in new residential development, when other methods could reduce the need for this approach, is not regarded as good acoustic design;

- Evidence should be provided that good acoustic design processes have been followed.

The ProPG empowers the assessing acoustician to assess the acceptability of any noise impact and to establish the need for acoustic mitigation measures by considering the guidance detailed in BS8233:2014 (see Section 3.4) whilst also giving consideration to the context of the site, along with other non-acoustic factors that may affect the need to bring forward a site that is not acoustically ideal.

However, in determining what acoustic conditions would be 'unreasonable' and 'unacceptable', the ProPG also sets out the following guidance:

"The more often internal LAeq levels start to exceed the internal LAeq target levels by more than 5dB, the more that most people are likely to regard them as "unreasonable". Where such exceedances are predicted, applicants should be required to show how the relevant number of rooms affected has been kept to a minimum. Once internal LAeq levels exceed the target levels by more than 10 dB, they are highly likely to be regarded as "unacceptable" by most people, particularly if such levels occur more than occasionally. Every effort should be made to avoid relevant rooms experiencing "unacceptable" noise levels at all and where such levels are likely to occur frequently, the development should be prevented in its proposed form".

Additionally, ProPG makes an addendum to Note 4 of the internal noise level guidelines as stated in BS8233:2014 (Figure 2 in the ProPG document), referring to the acceptability of internal night time LAFMax noise levels:

"…In most circumstances in noise-sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events to not normally exceed 45dB LAmax,F more than 10 times a night…"

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4.0 ENVIRONMENTAL NOISE SURVEY

Daytime and night time measurements were undertaken from 30th to 31st January 2019. The noise measurements established typical external ambient and background noise levels at the site.

4.1 Survey Methodology

The equipment used during the survey is detailed in Appendix B. The sound level meters were calibrated before and after the measurements and no significant calibration drifts were found to have occurred (>0.2dB). All of the noise monitoring equipment had been calibrated to a traceable standard within the twelve months preceding the survey. Calibration certificates are available on request.

Three measurement locations were surveyed in order to establish the typical ambient and background noise levels at the proposed development site. The measurement locations are hereby referred to in this report as follows:

- 'Location 1' – sound level meter positioned approximately 1.5m from the ground at the North-Western end of the site by adjacent residential garden fencing.
- 'Location 2' – sound level meter positioned approximately 1.5m from the ground, located off of the development site within the confines of the Ripon Land Rover dealership.
- 'Location 3' – sound level meter positioned approximately 1.5m from the ground at the southern end of the site, where there is an area of grassland overlooking the Hutton Bank/Ure Bank mini-roundabout.

The measurement locations are shown in Appendix C.

Further, attended measurements at a fourth location were undertaken to assess the direct impact of noise from operations at Lloyd Land Rover Ripon upon proposed dwellings toward the eastern end of the site:

- 'Location 4' – sound level meter positioned approximately 1.5m from the ground at the developable area towards the North-Eastern end of the site, between the existing railway shed and the eastern site boundary.

4.2 Survey Results

The weather during the unattended survey was suitable for the noise measurements, it being dry with low wind speeds.

Summaries of the measured noise levels are given in Tables 4.1 and 4.2 and are displayed in full in Appendix D.

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Table 4.1
Summary of Measured Noise Levels – 30/01/2019 to 31/01/2019 – free field, dB

Location	Date	Period	Time (h)	$L_{Aeq, T}$	L_{A10}	L_{A90}	L_{AFMax}
1	30/01/2019	Daytime	1700-2300	47.4	48.5	40.3	73.7
	30/01/2019-31/01/2019	Night Time	2300-0700	43.1	41.8	32.0	63.2
	31/01/2019	Daytime	0700-0925	52.2	54.3	47.3	67.3
2	30/01/2019	Daytime	1720-2300	56.5	57.9	46.4	83.4
	30/01/2019-31/01/2019	Night Time	2300-0700	51.1	49.4	35.4	81.7
	31/01/2019	Daytime	0700-0915	60.5	62.3	55.0	79.3
3	30/01/2019	Daytime	1745-2300	54.7	56.1	48.9	77.5
	30/01/2019-31/01/2019	Night Time	2300-0700	49.3	49.9	40.5	64.7
	31/01/2019	Daytime	0700-0940	58.1	59.5	55.6	70.7

Table 4.2
Summary of Measured Noise Levels – 20/05/2019 – free field, dB

Location	Date	Period	Time (h)	$L_{Aeq, T}$	L_{A10}	L_{A90}	L_{AFMax}
4	20/05/2019	Daytime	1135-1440	49.5	50.3	40.8	69.5

4.3 Observations and Comments

During the attended portions of the survey, the acoustic environment at Location 1 consisted of indirect noise from the surrounding area:

- Hutton Bank/Ure Bank mini-roundabout;
- A61;
- A61/A6108/Sharow Lane roundabout (southeast of the Hutton Bank/Ure Bank mini-roundabout).

At Location 2, the acoustic environment consisted of road noise from the A61 and some non-dominant operational noise from both the car wash (jet washers etc.) and the Ripon Land Rover dealership (engines, alarms, vehicle transporters etc.).

At Location 3, the acoustic environment consisted of road noise from the A61, North Road, Ure Bank and Station Drive, the Hutton Bank/Ure Bank mini-roundabout and the A61/A6108/Sharow Lane roundabout.

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5.0 ASSESSMENT

5.1 Site Noise Risk Assessment

Further to the guidance detailed in the ProPG, the site has initially been assessed to establish the risk of noise adversely affecting the site. This assessment assists in quantifying whether further consideration of noise impact is required which may lead to the introduction of specific noise mitigation measures to ensure that the principles of good acoustic design are met.

Based on the noise risk assessment matrix detailed in Figure 1 of the ProPG, taking account of the measured noise levels and the context of the site, it is considered that this site is subject to noise which generates a medium risk of an adverse effect.

A medium risk suggests that detailed consideration should be given to how noise affects the site and any future development. Development should take account of that noise risk and reflect good acoustic design principles in the layout of dwellings and the use of space.

It is not expected that noise should be a barrier to the development of a site considered as medium risk.

5.2 Assessment of Noise from Ripon Land Rover

With specific reference to Locations 1, 2 & 4 in close proximity to the Ripon Land Rover dealership, the values of the NOEL, LOAEL and SOAEL are drawn from the criteria and values detailed in BS4142:2014. The standard sets very clear values and these are interpreted as follows:

NOEL – No Observed Effect Level – Rating Noise Level is below the measured background noise level. The Standard considers that *"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"*.

LOAEL – Lowest Observed Adverse Effect Level – This has been set as a Rating Noise Level of 5dB above the background noise level. The standard considers *"A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context"*.

SOAEL – Significant Observed Adverse Effect Level – Rating Noise Level is 10dB above background noise level. The standard considers *"A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context"*.

An assessment has been carried out in accordance with the requirements of BS4142:2014 to quantify the level and significance of any noise impacts on residents of the proposed properties due to the noise generated by the existing fixed plant unit.

It is understood that the business operates during the following hours:

- From 0830h to 1800h, Monday to Friday;
- From 0830h to 1700h each Saturday;
- From 1100h to 1600h each Sunday.

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For Location 1 and Location 2, the specific noise level has been determined by performing a logarithmic subtraction of the ambient level, $L_{Aeq,1h}$, across adjacent 1-hour periods when the site was operational and non-operational.

The following values have, therefore, been used within this assessment:

- Location 1:
    - Ambient Level (operational), $L_{Aeq,55min}$* (1705h-1800h) – 48.7dB(A);
    - Residual Level (non-operational), $L_{Aeq,1h}$ (1800h-1900h) – 47.9dB(A);
    - Calculated Specific Level, $L_{Aeq,1h}$ (1700h-1800h) – 41.0dB(A);
    - Background Level (non-operational), $L_{A90,1h}$ (1800h-1900h) – 44.8dB(A).

*It should be noted that BS4142:2014 typically requires a reference time period of 1 hour for daytime assessments. The measurement period at Location 1 began at 1700h but included an atypical noise event at the start of the measurement, caused by the on-site engineer during set-up. Therefore, in the interests of producing a more reliable result, the first 5 minutes of the measurement period and therefore the operational ambient level consists of data from 1705h to the closing time of 1800h.

- Location 2:
    - Ambient Level (operational), $L_{Aeq,1h}$ (1700h-1800h) – 59.9dB(A);
    - Residual Level (non-operational), $L_{Aeq,1h}$ (1800h-1900h) – 59.7dB(A);
    - Calculated Specific Level, $L_{Aeq,1h}$ (1700h-1800h) – 46.4dB(A);
    - Background Level (non-operational), $L_{A90,1h}$ (1800h-1900h) – 53.0dB(A).

Due to the intervening railway shed currently shielding noise from the A61 at Location 4 and following discussions with the Local Authority, it is considered appropriate to utilise the measured data, $L_{Aeq,1h}$, at Location 4 as the Specific Level and measured data at Location 1, $L_{A90,1h}$, as a proxy location Background Level when assessing the noise impact due to commercial operations at Location 4.

- Location 4:
    - Measured Specific Level, $L_{Aeq,1h}$ (1340h-1440h) – 51.8dB(A);
    - Background Level (non-operational), $L_{A90,1h}$ (1800h-1900h) – 44.8dB(A).

When calculating the rating level, there are four correction types that can be considered. They are:

- Tonality;
- Impulsivity;
- Intermittency;
- Specific noise readily distinctive from the residual environment.

Due to the nature of the activities observed from Lloyd Land Rover Ripon during the survey, it is considered appropriate to apply a +3dB correction for intermittency at Location 4; it is not considered

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appropriate to apply any character corrections to the specific level for the assessment at Locations 1 and 2 as the predominant noise source at these locations was considered to be from road traffic and not the operations at Lloyd Land Rover Ripon.

The results of the assessment are shown in Table 5.1:

Table 5.1
Assessment of Commercial Noise Impact at Example Dwellings, dB

Measurement Location	Rating Noise Level at NSR	Measured Background Level, $L_{A90, 1hr}$	Difference, dB(A)
Location 1	41.0	44.8	-3.8
Location 2	46.4	53.0	-13.3
Location 4	51.8	44.8	+10.0

When considering the assessment, it should be noted that BS4142 states:

"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."

For Location 1 and Location 2, given the context of the assessment, it is considered that the noise levels are below the NOEL for the assessment period.

For Location 4, given the context of the assessment, it is considered that the noise levels are above the LOAEL for the assessment period.

Impacts below the Lowest Observable Adverse Effect Level (LOAEL) are considered to be acceptable when assessed against the requirements of the NPPF. On this basis, the assessment demonstrates that the operations of Ripon Land Rover may cause an unacceptable adverse impact at Location 4.

5.3 Predicted Internal Noise Levels within Dwellings

5.3.1 Site Layout and Design

Based on site observations, it is considered that the main sources of noise impacting upon the development site are road traffic from the A61 and the roundabouts to the South, with some operational noise from the Ripon Land Rover dealership to the East.

It is therefore considered good practice to design the site such that, where practicable, any non-residential areas are focused toward the southern and eastern ends of the site.

5.3.2 In-Façade Noise Mitigation

For this assessment, the values of the NOEL, LOAEL and SOAEL are drawn from the criteria and values detailed in BS8233:2014. These criteria are set as internal noise levels and are based on the criteria detailed in the above table.

NOEL – No Observed Effect Level – Internal noise levels within rooms achieve the BS8233:2014 standard calculated with windows open and assuming a 15dB(A) noise reduction for an open window.

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LOAEL – Lowest Observed Adverse Effect Level – Internal noise levels achieve the requirements of the BS8233:2014 standard assuming windows are closed and an additional source of ventilation is provided.

SOAEL – Significant Observed Adverse Effect Level – Internal noise levels fail to achieve the BS8233:2014 standard calculated assuming windows are closed and an additional source of ventilation is provided.

With reference to the guidance in Section 3, the predicted internal levels have been assessed against the following criteria:

- $L_{Aeq,16h}$ (Daytime) – internal levels must not exceed 35dB(A)* within living rooms and lounges;
- $L_{Aeq,8h}$ (Night Time) – internal levels must not exceed 30dB(A) within bedrooms;
- L_{AFMax} (Highest) – internal levels must not exceed 50dB(A) within bedrooms;
- L_{AFMax} (Typical) – internal levels must not exceed 45dB(A) within bedrooms.

*With specific reference to Location 4, which is considered to be exposed to distinctive changes in noise level due to the operational periods of Lloyd Land Rover Ripon, it is recommended that this limit be altered to 30dB(A) to reduce the likelihood of complaints arising from residents of dwellings along the eastern boundary.

The ProPG addendum to Note 4 of the internal noise level guidelines within BS8233:2014 (Figure 2 in the ProPG document), states:

"…In most circumstances in noise-sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events to not normally exceed 45dB $L_{Amax,F}$ more than 10 times a night…"

As such, it has been deemed appropriate to consider the 'Typical L_{AFMax}' as the 10th highest L_{AFMax} value measured throughout the survey period.

Calculations of internal noise levels have been completed for the proposed development to demonstrate that suitable internal noise levels can be achieved within the most noise exposed rooms.

As the site is currently in the outline stages of the development, detailed floor plans or layouts have not yet been provided. Therefore, the internal noise levels have been calculated for three example dwellings at the most exposed façades of the site.

- Example Dwelling A – considered to be representative of 'Location 1';
- Example Dwelling B – considered to be representative of 'Location 2';
- Example Dwelling C – considered to be representative of 'Location 3';
- Example Dwelling D – considered to be representative of 'Location 1' and with specific reference to 'Location 4' during periods when Lloyd Land Rover Ripon is in operation.

For these dwellings, it has been assumed that the Daytime and Night Time data obtained at the measurement locations will be representative of the acoustic environments.

The following noise levels were considered as being incident on the façades:

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Table 5.2
Noise Levels Incident on Façade – free-field, dB

Example Dwelling	Noise Period/Type	Frequency in Hz				
		125	250	500	1000	2000
A	Daytime - L_{eq}	48.1	46.4	45.8	46.7	38.4
	Night Time - L_{eq}	52.3	41.0	38.5	39.9	30.7
	Night Time – Highest L_{fMax}	72.4	61.1	58.6	60.0	50.8
	Night Time – Typical L_{fMax}	63.6	52.3	49.8	51.2	42.0
B	Daytime - L_{eq}	64.0	56.8	54.6	57.6	52.2
	Night Time - L_{eq}	53.6	47.2	45.2	48.0	43.0
	Night Time – Highest L_{fMax}	84.2	77.8	75.8	78.6	73.6
	Night Time – Typical L_{fMax}	70.3	63.9	61.9	64.7	59.7
C	Daytime - L_{eq}	56.4	50.1	51.2	56.3	49.5
	Night Time - L_{eq}	48.6	41.4	43.4	47.3	40.3
	Night Time – Highest L_{fMax}	64.0	56.8	58.8	62.7	55.7
	Night Time – Typical L_{fMax}	59.9	52.7	54.7	58.6	51.6
D	Daytime - L_{eq}	51.7	48.0	45.1	42.1	41.7
	Night Time - L_{eq}	52.3	41.0	38.5	39.9	30.7
	Night Time – Highest L_{fMax}	72.4	61.1	58.6	60.0	50.8
	Night Time – Typical L_{fMax}	63.6	52.3	49.8	51.2	42.0

Predicted Internal Levels – Partially Open Window

Given a nominal sound reduction of -15dB for a partially open window, the internal noise levels would be as follows:

Table 5.3
Internal Levels in Rooms in dB(A) – Windows Partially Open

Example Dwelling	Room	Period	Level	BS8233 Classification
A	Lounge	Daytime	34.1	Below Limit
	Bedroom	Night Time	28.1	Below Limit
		Night Time – Highest Maxima	48.2	Below Limit
		Night Time – Typical Maxima	39.4	Below Limit
B	Lounge	Daytime	45.3	Above Limit
	Bedroom	Night Time	35.7	Above Limit
		Night Time – Highest Maxima	66.3	Above Limit
		Night Time – Typical Maxima	52.4	Above Limit
C	Lounge	Daytime	43.0	Above Limit
	Bedroom	Night Time	34.1	Above Limit
		Night Time – Highest Maxima	49.5	Below Limit
		Night Time – Typical Maxima	45.4	Above Limit
D	Lounge	Daytime	33.0	Above Adopted Limit
	Bedroom	Night Time	28.1	Below Limit
		Night Time – Highest Maxima	48.2	Below Limit
		Night Time – Typical Maxima	39.4	Below Limit

Table 5.2 shows that, when assessing for a partially open window, the $L_{Aeq, 16h}$ (Daytime) internal noise levels exceed the criteria for BS8233:2014 for Example Dwelling B, Example Dwelling C and Example Dwelling D. Table 5.2 also shows that, when assessing for a partially open window, the $L_{Aeq, 8h}$ (Night

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Time) internal noise levels exceed the criteria for BS8233:2014 for Example Dwelling B and Example Dwelling C. Furthermore, the L_{AFMax} internal noise levels exceed the standard proposed by Dragonfly Consulting for Night Time maximum noise levels for Example Dwelling B and Example Dwelling C. It is considered that, in order to mitigate the noise incident on these dwellings to acceptable internal levels, a suitable glazing and ventilation specification will be required.

Predicted Internal Levels – Closed Window

Given a typical modern wall construction comprising an internal leaf of concrete block, lined externally with brick and a cavity between of at least 75mm, the following performance would be expected from the external façade construction:

Table 5.4
SRI of Façade, dB (R_W)

Frequency in Hz	125	250	500	1000	2000
SRI of Façade	41	45	45	54	58

The area of external façade that is glazed and unglazed has been calculated using the following assumptions:

- Living Room dimensions of 5m (length) x 4m (width) x 2.3m (height);
- Bedroom dimensions of 3m (length) x 4m (width) x 2.3m (height);
- Double glazed window dimensions of 1m (width) x 1.8m (height);
- Total passive ventilation area of 8000mm^2.

These assumptions have been made based upon typical room sizes of modern family houses. It has been assumed that the most exposed façade would be 4m x 2.3m (9.2m^2), unglazed, and 7.4m^2 with the aforementioned glazing, for both the Living Room and Bedroom.

Acceptable internal noise levels within dwellings are taken from the guidance provided within BS8233:2014, detailed in Section 3.

To achieve acceptable internal noise levels for each of the example dwellings, it is recommended that the Living Rooms and Bedrooms should be installed with sealed double-glazing units and provided with a suitable ventilator.

The glazing and ventilation to be used should provide the following minimum noise attenuation:

Table 5.5
SRI of Glazing, dB (R_W)

System Reference	Frequency in Hz	125	250	500	1000	2000
G1	SRI of Glazing Unit	24	20	25	34	37
G2	SRI of Glazing Unit	26	27	34	40	38

It is considered that a typical '4/12/4' double glazing unit and a typical '10/12/6' double glazing unit would produce SRI values similar to those recommended as Systems G1 and G2 in Table 5.4

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respectively. However, care should be taken to ensure this is the case when choosing a glazing specification for the development.

Table 5.6
$D_{n,e}$ of Ventilator, dB

Ventilator type	Frequency in Hz	125	250	500	1000	2000
V1	Minimum $D_{n,e}$ of Ventilator Unit	34	27	37	35	34
V2	Minimum $D_{n,e}$ of Ventilator Unit	38	42	49	51	53

It is considered that a typical 'Hit and Miss' trickle vent and a 'Titon TV SM 2900 EA' acoustic ventilator would produce $D_{n,e}$ values similar to those recommended as Systems V1 and V2 in Table 5.5, respectively. However, care should be taken to ensure this is the case when choosing a ventilation specification for the development.

Table 5.7
Summary of Glazing and Ventilation Specifications

Example Dwelling	Room Type	Glazing	Ventilation
B	Living Room	G1	V1
	Bedrooms	G2	V2
C	Living Room	G1	V1
	Bedrooms	G1	V1
D	Living Room	G1	V1
	Bedrooms	G1	V1

It has been calculated that, given the above façade constructions with the stated specifications of double glazing and ventilation, the internal noise levels would be as follows:

Table 5.8
Internal Levels in Rooms in dB(A) – Windows Closed

Example Dwelling	Room	Period	Level	BS8233 Classification
B	Lounge	Daytime	30.6	Below Limit
	Bedroom	Night Time	15.0	Below Limit
		Night Time – Highest Maxima	45.6	Within Adopted Criteria
		Night Time – Typical Maxima	31.7	Within Adopted Criteria
C	Lounge	Daytime	26.8	Below Limit
	Bedroom	Night Time	20.3	Below Limit
		Night Time – Highest Maxima	35.7	Within Adopted Criteria
		Night Time – Typical Maxima	31.6	Within Adopted Criteria
D	Lounge	Daytime	20.0	Below Adopted Limit
	Bedroom	Night Time	17.0	Below Limit
		Night Time – Highest Maxima	37.1	Within Adopted Criteria
		Night Time – Typical Maxima	28.3	Within Adopted Criteria

Table 5.7 shows that, when assessed against BS8233:2014, the $L_{Aeq,\ 16h}$ (Daytime) internal noise levels are within the suggested design range for all example dwellings. Table 5.7 also shows that, when assessed against BS8233:2014, the $L_{Aeq,\ 8h}$ (Night Time) internal noise levels are within the suggested

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design range for all example dwellings. Furthermore, the L_{AFMax} internal noise levels meet the standard proposed by Dragonfly Consulting for Night Time maximum noise levels for all example dwellings.

Predicted Internal Levels – Summary

It is therefore considered that the calculated internal noise levels for Example Dwelling A are below the NOEL and the calculated internal noise levels for Example Dwelling B, Example Dwelling C and Example Dwelling D are below the LOAEL set for this project. The LOAEL is defined as:

LOAEL – Lowest Observed Adverse Effect Level – Internal noise levels achieve the requirements of the BS8233:2014 standard assuming windows are closed and an additional source of ventilation is provided.

These levels are below the LOAEL level set for this assessment and, as such, these levels are considered to be acceptable and meet the requirements of the NPPF and the Noise Policy Statement for England.

5.4 External Noise Levels

BS8233 suggests noise limits for external areas or a property such as gardens or balconies. It states that:

"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 LAeq,T, with an upper guideline value of 55 dB LAeq,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."

The measured levels at Locations 2 and 3 exceed 55dB(A) at various points during the measurement period.

It is considered that a barrier of suitable height and structure, placed along the boundaries of the proposed site, would provide attenuation to reduce noise levels across the site to meet the criteria within BS8233:2014. The barrier height will be dependent on exact topography and relative distances to the noise sources and houses and, due to the outline nature of the application, may be subject to change as the development progresses. However, the following assumptions have been made, based on site observations and current drawings, for the purposes of this assessment:

- The receiver point is based on a receptor 1.8m tall;
- The source point is based on an average height of 1m above ground, considered to be consistent with typical engine height of cars;
- The topography is relatively flat, with ground level being the same between the sources (A61, Lloyd Land Rover Ripon) and the receptors.

In order to achieve the expected levels of attenuation, the perimeter fence must be of suitable construction i.e. made of material with suitable mass per unit area, have no holes or gaps and must be flush fitting to the ground so as to minimise noise transfer through or under the structure. If the barrier was to be constructed as per the above criteria, it is anticipated that a barrier of 1.8m height would provide suitable mitigation such that the noise impacting on the external amenity areas at the proposed development would not exceed 50dB(A).

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It should be noted that the eastern boundary of the site already benefits from a significant bund (approximately 4m in height) and it is recommended that this be retained as the development progresses.

The measured levels at Location 4 did not exceed 55dB(A) at during the measurement period and is therefore considered to be in accordance with the guidance stated within BS8233:2014. However, a 1.8m barrier fence situated on top of the existing bund is expected to provide a sufficient level of additional attenuation to mitigate against a potentially adverse finding against the assessment criteria in BS4142:2014 from activities at Lloyd Land Rover Ripon, such that the noise levels would be below the LOAEL as previously highlighted in Section 5.2.

Impacts below the Lowest Observable Adverse Effect Level (LOAEL) are considered to be acceptable when assessed against the requirements of the NPPF. On this basis, the proposed mitigation demonstrates that the operations of Ripon Land Rover are unlikely to cause an unacceptable adverse impact at Location 4.

It is also worthy of note that BS8233 does provide an exception for noise levels in external areas as follows:

"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."

The standard does recognise that:

"…these guideline values are not achievable in all circumstances where development might be desirable."

The standard further makes clear that, where development is desirable but is in proximity to the strategic road network, the lowest practicable noise levels should be achieved in external amenity spaces, but development should not be prohibited.

5.5 Uncertainty of the Assessment

Following current good practice, an appraisal of the uncertainty within both the on-site noise survey and the prediction calculations has been completed.

The following negative factors have been noted in considering the uncertainty of the on-site noise survey:

- Sound level meter located at head height level for NSRs;
- Monitoring period of less than 24 hours.

The following positive factors have been noted in considering the uncertainty of the on-site noise survey:

- Low winds and no precipitation.

As such, it is considered that the uncertainty for the on-site noise survey element of the work is ±2dB.

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It is considered that the uncertainty for the prediction elements of the work should be considered in line with the normal use of ISO 9613-2 based point source propagation calculations. However, no distance correction has been utilised within this assessment, so no uncertainty correction has been applied.

Using the root sum of squares method, this gives a combined uncertainty for this assessment of ±2dB. At this level, the uncertainty will have no impact on the conclusions of the assessment.

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5.6 Assertion of Competence

This assessment has been completed by Daniel Vallis, Senior Acoustic Consultant with responsibility for completing acoustic reports on behalf of Dragonfly Consulting. I hold a Bachelor of Science in Music Technology, with Honours, from the University of York and the Institute of Acoustics Diploma in Acoustics and Noise Control. I am a Corporate Member of the Institute of Acoustics.

I have completed several assessments under BS8233:2014 and BS4142:2014 and I assert that I am competent to undertake this assessment under the requirements of the aforementioned British Standards.

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6.0 CONCLUSIONS

Addison Planning Consultants, on behalf of PRIMETALENT Ltd, has appointed Dragonfly Consulting to carry out a Noise Impact Assessment in support of a planning application for a proposed residential development on Hutton Bank.

The noise assessment has been conducted in accordance with the National Planning Policy Framework.

This report therefore describes a noise survey of the site and the subsequent analysis to determine the noise environment of the proposed development. It then compares the results with the adopted criteria. Recommendations are also made with respect to the design of the development.

Measurement of external noise levels have been completed for the proposed development to allow demonstration by calculation that suitable internal noise levels will be achieved within the most noise exposed rooms.

6.1 Site Noise Risk Assessment

Based on the noise risk assessment matrix detailed in Figure 1 of the ProPG, taking account of the measured noise levels and the context of the site, it is considered that this site is subject to noise which generates a medium risk of an adverse effect.

A medium risk suggests that detailed consideration should be given to how noise affects the site and any future development. Development should take account of that noise risk and reflect good acoustic design principles in the layout of dwellings and the use of space.

It is not expected that noise should be a barrier to the development of a site considered as medium risk.

6.2 Assessment of Noise from Ripon Land Rover

When considering the assessment, it should be noted that BS4142 states:

"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."

For Location 1 and Location 2, given the context of the assessment, it is considered that the noise levels are below the NOEL for the assessment period.

For Location 4, given the context of the assessment, it is considered that the noise levels are above the LOAEL for the assessment period.

Impacts below the Lowest Observable Adverse Effect Level (LOAEL) are considered to be acceptable when assessed against the requirements of the NPPF. On this basis, the assessment demonstrates that the operations of Ripon Land Rover may cause an unacceptable adverse impact at Location 4.

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6.3 Predicted Internal Noise Levels

The assessment shows that, when assessing for a partially open window, the $L_{Aeq, 16h}$ (Daytime) internal noise levels are within the criteria for BS8233:2014 for Example Dwelling A. The assessment also shows that, when assessing for a partially open window, the $L_{Aeq, 8h}$ (Night Time) internal noise levels are within the criteria for BS8233:2014 for Example Dwelling A. Furthermore, the L_{AFMax} internal noise levels are within the standard proposed by Dragonfly Consulting for Night Time maximum noise levels for Example Dwelling A.

The assessment shows that, when assessed against BS8233:2014, the $L_{Aeq, 16hr}$ (Daytime) internal noise levels are within the suggested design range for Example Dwellings B, C and D. The assessment also demonstrates that, when assessed against BS8233:2014, the $L_{Aeq, 8hr}$ (Night Time) internal noise levels are within the suggested design range and meet the standard proposed by Dragonfly Consulting for Night Time maximum noise levels at Example Dwellings B, C and D.

It is therefore considered that the calculated internal noise levels are below the LOAEL set for this project. The LOAEL is defined as:

LOAEL – Lowest Observed Adverse Effect Level – Internal noise levels achieve the requirements of the BS8233:2014 standard assuming windows are closed and an additional source of ventilation is provided.

These noise levels are below the LOAEL level set for this assessment and as such these noise levels are considered to be acceptable and meet the requirements of the NPPF and the Noise Policy Statement for England.

6.4 External Noise Levels

BS8233 suggests noise limits for external areas or a property such as gardens or balconies. It states that:

"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 LAeq,T, with an upper guideline value of 55 dB LAeq,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."

The measured levels at Locations 2 and 3 exceed 55dB(A) at various points during the measurement period.

It is considered that a barrier of suitable height and structure, placed along the boundaries of the proposed site, would provide attenuation to reduce noise levels across the site to meet the criteria within BS8233:2014. The barrier height will be dependent on exact topography and relative distances to the noise sources and houses and, due to the outline nature of the application, may be subject to change as the development progresses. However, the following assumptions have been made, based on site observations and current drawings, for the purposes of this assessment:

- The receiver point is based on a receptor 1.8m tall;
- The source point is based on an average height of 1m above ground, considered to be consistent with typical engine height of cars;

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- The topography is relatively flat, with ground level being the same between the sources (A61, Lloyd Land Rover Ripon) and the receptors.

In order to achieve the expected levels of attenuation, the perimeter fence must be of suitable construction i.e. made of material with suitable mass per unit area, have no holes or gaps and must be flush fitting to the ground so as to minimise noise transfer through or under the structure. If the barrier was to be constructed as per the above criteria, it is anticipated that a barrier of 1.8m height would provide suitable mitigation such that the noise impacting on the external amenity areas at the proposed development would not exceed 50dB(A).

It should be noted that the eastern boundary of the site already benefits from a significant bund (approximately 4m in height) and it is recommended that this be retained as the development progresses.

The measured levels at Location 4 did not exceed 55dB(A) at during the measurement period and is therefore considered to be in accordance with the guidance stated within BS8233:2014. However, a 1.8m barrier fence situated on top of the existing bund is expected to provide a sufficient level of additional attenuation to mitigate against a potentially adverse finding against the assessment criteria in BS4142:2014 from activities at Lloyd Land Rover Ripon, such that the noise levels would be below the LOAEL as previously highlighted in Section 5.2.

Impacts below the Lowest Observable Adverse Effect Level (LOAEL) are considered to be acceptable when assessed against the requirements of the NPPF. On this basis, the proposed mitigation demonstrates that the operations of Ripon Land Rover are unlikely to cause an unacceptable adverse impact at Location 4.

It is also worthy of note that BS8233 does provide an exception for noise levels in external areas as follows:

"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."

The standard does recognise that:

"…these guideline values are not achievable in all circumstances where development might be desirable."

The standard further makes clear that, where development is desirable but is in proximity to the strategic road network, the lowest practicable noise levels should be achieved in external amenity spaces, but development should not be prohibited.

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Appendix A – Glossary of Terminology

In order to assist the understanding of acoustic terminology and the relative change in noise, the following background information is provided.

The human ear can detect a very wide range of pressure fluctuations, which are perceived as sound. In order to express these fluctuations in a manageable way, a logarithmic scale called the decibel, or dB scale is used. The decibel scale typically ranges from 0dB (the threshold of hearing) to over 120dB. An indication of the range of sound levels commonly found in the environment is given in the following table.

Table A-1
Sound Levels Commonly Found in the Environment

Sound Level	Location
0dB(A)	Threshold of hearing
20 to 30dB(A)	Quiet bedroom at night
30 to 40dB(A)	Living room during the day
40 to 50dB(A)	Typical office
50 to 60dB(A)	Inside a car
60 to 70dB(A)	Typical high street
70 to 90dB(A)	Inside factory
100 to 110dB(A)	Burglar alarm at 1m away
110 to 130dB(A)	Jet aircraft on take off
140dB(A)	Threshold of Pain

Acoustic Terminology

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

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

L_{Aeq} This is defined as the notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the A-weighted fluctuating sound measured over that period.

L_{10} & L_{90} If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The Ln indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L_{10} is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L_{90} is the 'average minimum level' and is often used to describe the background level. It is common practice to use the L_{10} index to describe traffic noise.

L_{AMax} is the maximum A-weighted sound pressure level recorded over the period stated. L_{AMax} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment.

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Appendix B – Monitoring Equipment

Table B-1
Noise Monitoring Equipment

Equipment	Serial Number
01dB Cube Sound Level Meter	10892
GRAS 40CD Microphone	231555
01dB Cube Sound Level Meter	10889
GRAS 40CD Microphone	233511
01dB Fusion Sound Level Meter	11860
GRAS 40CD Microphone	331802
Castle GA601 Acoustic Calibrator	039063

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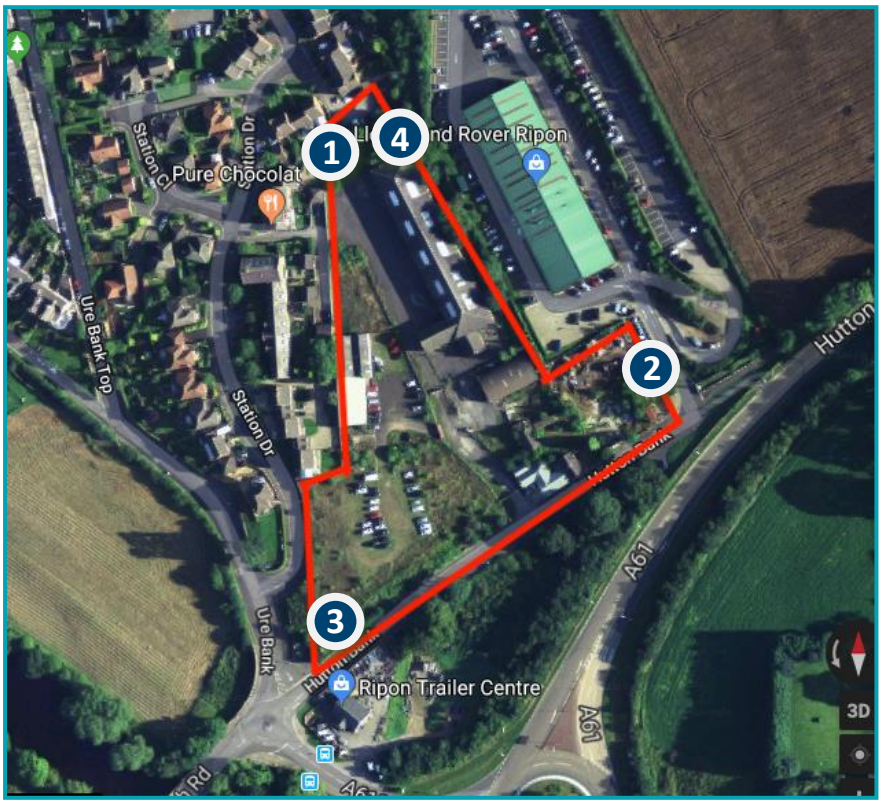
Appendix C – Measurement Locations

Figure C-1
Measurement Location Plan



Measurement Locations

Development Site

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Appendix D – Full Survey Results

It should be noted that records highlighted in red denote values that were considered atypical due to interference from the on-site engineer. As such, they have not been included within the assessment.

Table D-1
Full Survey Data – Location 1 – 30/01/2019 to 31/01/2019 – free-field, dB

Start Time (hh:mm)	Duration	L_{Aeq}	L_{A10}	L_{A90}	L_{AFMax}
17:00	5 Minutes	57.6	58.2	46.8	73.7
17:05	5 Minutes	48.1	50.2	45.7	54.5
17:10	5 Minutes	46.8	47.9	45.2	49.5
17:15	5 Minutes	46.7	48.1	44.7	50.2
17:20	5 Minutes	47.3	48.7	44.8	51.2
17:25	5 Minutes	48.0	50.0	45.5	57.7
17:30	5 Minutes	49.2	50.7	47.4	54.8
17:35	5 Minutes	48.1	49.4	46.3	50.8
17:40	5 Minutes	49.5	52.1	45.6	59.3
17:45	5 Minutes	53.2	56.5	46.1	64.5
17:50	5 Minutes	46.9	48.9	43.9	52.2
17:55	5 Minutes	47.3	48.6	45.5	51.0
18:00	5 Minutes	48.6	49.9	46.7	51.2
18:05	5 Minutes	48.7	49.3	46.2	58.8
18:10	5 Minutes	46.9	48.2	44.9	49.6
18:15	5 Minutes	46.0	47.9	43.2	51.1
18:20	5 Minutes	47.5	49.1	44.7	57.2
18:25	5 Minutes	48.5	50.7	45.0	53.6
18:30	5 Minutes	50.8	53.4	46.5	55.9
18:35	5 Minutes	47.4	49.3	44.8	51.6
18:40	5 Minutes	48.0	50.5	45.2	52.7
18:45	5 Minutes	47.0	48.5	43.7	50.5
18:50	5 Minutes	46.7	48.7	43.6	50.6
18:55	5 Minutes	46.8	48.3	43.5	55.9
19:00	5 Minutes	52.9	57.3	44.2	64.5
19:05	5 Minutes	45.8	48.3	41.0	51.9
19:10	5 Minutes	45.0	47.4	41.8	50.8
19:15	5 Minutes	44.8	47.1	41.2	49.2
19:20	5 Minutes	47.1	50.5	41.9	53.7
19:25	5 Minutes	49.7	52.8	43.9	55.9
19:30	5 Minutes	50.2	53.8	43.5	57.0
19:35	5 Minutes	48.9	51.8	42.6	56.7
19:40	5 Minutes	47.1	49.4	43.2	52.2
19:45	5 Minutes	42.2	44.3	38.6	52.1
19:50	5 Minutes	40.8	42.6	36.6	44.1
19:55	5 Minutes	38.4	40.7	35.5	43.3
20:00	5 Minutes	40.7	42.1	37.4	54.0
20:05	5 Minutes	43.3	45.7	38.8	56.5
20:10	5 Minutes	41.8	44.3	37.7	48.4
20:15	5 Minutes	43.7	46.4	39.3	50.0
20:20	5 Minutes	47.1	50.4	37.1	61.4
20:25	5 Minutes	41.3	44.0	35.6	47.6

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Start Time (hh:mm)	Duration	L_{Aeq}	L_{A10}	L_{A90}	L_{AFMax}
20:30	5 Minutes	42.3	45.1	36.6	48.6
20:35	5 Minutes	45.1	47.9	40.6	52.7
20:40	5 Minutes	45.6	48.6	39.8	53.9
20:45	5 Minutes	45.0	49.2	36.7	52.3
20:50	5 Minutes	44.7	48.0	35.5	53.8
20:55	5 Minutes	46.4	49.7	39.3	53.9
21:00	5 Minutes	45.2	48.4	38.9	53.7
21:05	5 Minutes	46.3	50.0	38.3	54.9
21:10	5 Minutes	44.0	46.1	37.6	55.6
21:15	5 Minutes	44.3	47.4	39.0	51.3
21:20	5 Minutes	44.2	45.5	31.8	62.3
21:25	5 Minutes	47.4	46.8	37.7	63.0
21:30	5 Minutes	45.4	48.5	38.3	52.9
21:35	5 Minutes	46.3	49.4	37.0	59.0
21:40	5 Minutes	48.4	51.1	42.6	54.7
21:45	5 Minutes	46.4	51.2	36.1	57.7
21:50	5 Minutes	45.1	49.2	36.0	52.9
21:55	5 Minutes	46.4	50.1	38.3	58.9
22:00	5 Minutes	46.0	50.1	30.2	57.2
22:05	5 Minutes	46.4	50.3	35.5	56.0
22:10	5 Minutes	44.7	48.6	35.4	55.5
22:15	5 Minutes	45.2	48.3	38.8	52.8
22:20	5 Minutes	45.4	48.4	40.4	53.6
22:25	5 Minutes	42.7	46.0	36.6	49.1
22:30	5 Minutes	41.6	45.6	30.6	51.2
22:35	5 Minutes	42.5	44.8	35.8	51.8
22:40	5 Minutes	38.0	42.0	32.1	44.9
22:45	5 Minutes	40.6	44.3	30.6	52.4
22:50	5 Minutes	42.1	45.5	34.6	51.6
22:55	5 Minutes	39.3	41.8	32.4	49.1
23:00	5 Minutes	41.4	45.4	31.1	47.9
23:05	5 Minutes	37.5	40.8	28.7	47.2
23:10	5 Minutes	41.2	45.7	31.2	51.6
23:15	5 Minutes	46.5	45.2	34.6	60.8
23:20	5 Minutes	39.9	42.6	34.4	47.7
23:25	5 Minutes	56.3	58.4	37.6	63.2
23:30	5 Minutes	46.9	53.9	31.6	60.0
23:35	5 Minutes	35.4	39.3	29.6	45.9
23:40	5 Minutes	34.9	38.3	28.5	45.8
23:45	5 Minutes	41.0	44.7	34.2	48.2
23:50	5 Minutes	38.2	36.8	28.3	60.7
23:55	5 Minutes	36.8	41.6	28.9	45.4
00:00	5 Minutes	36.7	42.4	28.1	48.4
00:05	5 Minutes	35.8	40.5	25.6	45.8
00:10	5 Minutes	38.8	44.0	27.8	46.1
00:15	5 Minutes	29.5	31.6	26.6	36.3
00:20	5 Minutes	38.7	42.5	31.6	54.5
00:25	5 Minutes	41.9	46.7	33.0	53.2
00:30	5 Minutes	32.3	33.3	29.9	40.1
00:35	5 Minutes	35.6	39.5	28.4	46.7

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Start Time (hh:mm)	Duration	L_{Aeq}	L_{A10}	L_{A90}	L_{AFMax}
00:40	5 Minutes	41.6	44.9	31.0	52.5
00:45	5 Minutes	38.9	42.9	30.0	48.6
00:50	5 Minutes	31.6	34.3	28.4	39.3
00:55	5 Minutes	28.9	30.2	27.5	34.3
01:00	5 Minutes	29.4	32.1	27.1	38.4
01:05	5 Minutes	41.9	44.1	27.4	60.3
01:10	5 Minutes	33.4	37.1	28.1	40.6
01:15	5 Minutes	26.3	27.5	25.2	29.6
01:20	5 Minutes	32.8	36.9	25.8	40.9
01:25	5 Minutes	31.3	34.0	25.9	37.4
01:30	5 Minutes	25.8	27.2	24.5	30.0
01:35	5 Minutes	32.3	37.1	24.6	42.9
01:40	5 Minutes	31.5	35.8	24.6	39.4
01:45	5 Minutes	27.7	29.1	25.6	36.6
01:50	5 Minutes	31.4	35.4	25.2	42.5
01:55	5 Minutes	26.7	26.5	24.6	38.8
02:00	5 Minutes	36.6	40.5	25.1	49.4
02:05	5 Minutes	38.5	38.0	25.8	53.1
02:10	5 Minutes	34.8	39.8	26.7	45.9
02:15	5 Minutes	34.1	38.4	27.2	46.1
02:20	5 Minutes	37.6	42.1	27.3	50.5
02:25	5 Minutes	38.6	43.8	24.7	50.3
02:30	5 Minutes	28.2	30.9	25.2	33.6
02:35	5 Minutes	35.9	39.9	30.0	45.8
02:40	5 Minutes	30.3	33.5	24.8	41.7
02:45	5 Minutes	29.1	32.8	24.1	40.4
02:50	5 Minutes	34.6	38.0	26.2	48.7
02:55	5 Minutes	28.4	30.2	26.4	33.0
03:00	5 Minutes	36.8	40.4	27.2	51.8
03:05	5 Minutes	42.0	48.1	28.2	52.8
03:10	5 Minutes	38.2	42.9	28.0	46.6
03:15	5 Minutes	38.9	43.3	30.6	46.8
03:20	5 Minutes	33.7	36.0	28.0	43.2
03:25	5 Minutes	35.3	39.3	27.5	47.3
03:30	5 Minutes	31.6	33.3	27.2	44.0
03:35	5 Minutes	30.9	33.0	26.3	42.0
03:40	5 Minutes	37.0	42.3	27.9	48.4
03:45	5 Minutes	37.5	40.9	32.6	44.8
03:50	5 Minutes	39.2	42.3	31.8	53.9
03:55	5 Minutes	37.9	42.1	30.4	48.5
04:00	5 Minutes	40.1	43.9	32.0	53.4
04:05	5 Minutes	38.5	41.9	31.5	50.1
04:10	5 Minutes	39.3	43.3	32.3	46.6
04:15	5 Minutes	37.7	41.4	32.4	44.9
04:20	5 Minutes	39.7	42.9	30.9	45.6
04:25	5 Minutes	37.0	41.3	29.3	46.9
04:30	5 Minutes	39.9	43.4	33.1	46.7
04:35	5 Minutes	38.6	42.1	33.5	44.0
04:40	5 Minutes	38.4	41.6	33.9	46.1
04:45	5 Minutes	39.8	42.2	35.1	46.3

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Start Time (hh:mm)	Duration	L_{Aeq}	L_{A10}	L_{A90}	L_{AFMax}
04:50	5 Minutes	40.8	44.1	34.5	48.7
04:55	5 Minutes	40.6	42.9	36.1	47.2
05:00	5 Minutes	38.5	41.5	32.4	45.6
05:05	5 Minutes	43.1	46.7	35.3	52.5
05:10	5 Minutes	41.8	45.4	34.5	50.4
05:15	5 Minutes	44.0	47.2	36.4	52.7
05:20	5 Minutes	44.4	48.2	36.5	50.1
05:25	5 Minutes	46.5	48.7	42.7	52.0
05:30	5 Minutes	47.8	50.6	42.3	52.9
05:35	5 Minutes	46.7	49.6	41.9	52.2
05:40	5 Minutes	46.9	49.8	42.9	53.4
05:45	5 Minutes	45.3	48.5	38.8	56.4
05:50	5 Minutes	44.1	46.3	39.9	49.8
05:55	5 Minutes	41.9	43.8	38.1	46.1
06:00	5 Minutes	44.2	47.1	40.1	48.4
06:05	5 Minutes	44.3	46.3	41.3	50.6
06:10	5 Minutes	44.4	46.9	39.8	48.6
06:15	5 Minutes	45.9	48.3	42.6	52.0
06:20	5 Minutes	47.3	49.7	42.9	52.0
06:25	5 Minutes	48.1	50.8	40.0	56.7
06:30	5 Minutes	47.7	50.6	43.6	54.0
06:35	5 Minutes	47.2	49.1	43.5	53.5
06:40	5 Minutes	48.4	50.9	44.1	54.0
06:45	5 Minutes	48.7	50.4	45.6	54.4
06:50	5 Minutes	49.2	51.5	46.1	53.7
06:55	5 Minutes	50.6	52.9	47.0	55.0
07:00	5 Minutes	51.3	53.0	48.5	55.7
07:05	5 Minutes	51.2	52.8	48.7	55.5
07:10	5 Minutes	52.6	55.7	47.1	60.5
07:15	5 Minutes	50.4	51.8	48.2	57.0
07:20	5 Minutes	50.5	52.0	48.5	55.0
07:25	5 Minutes	49.5	50.4	48.3	52.9
07:30	5 Minutes	52.0	54.8	48.5	57.3
07:35	5 Minutes	52.2	54.9	48.4	57.9
07:40	5 Minutes	53.6	56.4	49.1	63.8
07:45	5 Minutes	50.6	52.1	48.5	55.6
07:50	5 Minutes	51.9	54.7	48.6	60.3
07:55	5 Minutes	51.6	53.1	49.3	55.1
08:00	5 Minutes	50.4	51.7	48.7	57.1
08:05	5 Minutes	52.3	54.7	49.3	57.3
08:10	5 Minutes	54.5	56.6	51.6	62.1
08:15	5 Minutes	54.0	55.5	51.8	59.5
08:20	5 Minutes	53.8	56.0	49.0	59.5
08:25	5 Minutes	52.3	54.5	48.7	57.5
08:30	5 Minutes	53.3	57.0	48.4	60.3
08:35	5 Minutes	51.7	55.5	47.4	59.1
08:40	5 Minutes	50.0	51.4	47.6	55.1
08:45	5 Minutes	48.0	50.2	45.6	54.6
08:50	5 Minutes	55.6	60.2	45.3	67.1
08:55	5 Minutes	53.0	57.6	43.8	63.2

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Start Time (hh:mm)	Duration	L_{Aeq}	L_{A10}	L_{A90}	L_{AFMax}
09:00	5 Minutes	46.1	48.6	42.3	54.4
09:05	5 Minutes	46.5	48.7	43.0	59.0
09:10	5 Minutes	53.7	58.0	43.8	66.5
09:15	5 Minutes	54.8	59.7	42.1	67.3
09:20	5 Minutes	53.3	56.9	44.5	64.6
09:25	5 Minutes	50.5	54.3	43.6	59.8
09:30	5 Minutes	57.2	53.6	43.0	74.3

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Appendix D – Full Survey Results

Table D-2
Full Survey Data – Location 2 – 30/01/2019 to 31/01/2019 – free-field, dB

Start Time (hh:mm)	Duration	L_{Aeq}	L_{A10}	L_{A90}	L_{AFMax}
16:40	5 Minutes	60.3	62.8	55.3	67.5
16:45	5 Minutes	61.3	63.5	54.6	68.3
16:50	5 Minutes	60.9	63.6	56.2	66.5
16:55	5 Minutes	59.6	62.3	54.3	66.2
17:00	5 Minutes	62.0	63.7	58.9	67.0
17:05	5 Minutes	61.4	64.0	55.8	69.5
17:15	5 Minutes	59.4	61.3	53.8	68.0
17:20	5 Minutes	60.6	62.2	55.2	75.6
17:25	5 Minutes	58.1	60.6	51.9	64.0
17:30	5 Minutes	60.5	62.8	56.0	71.3
17:35	5 Minutes	59.9	61.8	56.2	69.6
17:40	5 Minutes	59.9	62.4	55.0	70.7
17:45	5 Minutes	60.2	63.5	54.8	69.4
17:50	5 Minutes	60.4	60.8	52.5	79.3
17:55	5 Minutes	59.7	61.9	55.3	70.3
18:00	5 Minutes	60.2	62.9	54.8	69.8
18:05	5 Minutes	59.3	61.4	54.5	68.2
18:10	5 Minutes	58.2	60.2	53.9	69.2
18:15	5 Minutes	58.2	60.8	52.0	66.9
18:20	5 Minutes	57.9	60.2	52.6	66.5
18:25	5 Minutes	59.1	61.6	52.9	71.0
18:30	5 Minutes	66.1	62.2	55.2	83.4
18:35	5 Minutes	57.3	59.7	52.8	63.8
18:40	5 Minutes	56.4	59.2	52.0	62.8
18:45	5 Minutes	56.5	59.0	50.7	62.1
18:50	5 Minutes	56.8	59.8	52.3	63.3
18:55	5 Minutes	56.9	59.8	52.3	63.7
19:00	5 Minutes	58.2	61.1	51.8	65.5
19:05	5 Minutes	56.4	59.4	49.3	63.3
19:10	5 Minutes	56.4	59.3	50.5	62.8
19:15	5 Minutes	54.8	57.8	49.0	62.5
19:20	5 Minutes	55.8	58.3	50.3	61.4
19:25	5 Minutes	56.5	59.0	49.6	62.9
19:30	5 Minutes	57.5	60.1	52.8	65.2
19:35	5 Minutes	55.7	58.7	49.5	63.5
19:40	5 Minutes	56.3	59.0	51.6	61.8
19:45	5 Minutes	59.8	59.8	46.5	80.1
19:50	5 Minutes	53.7	57.3	44.4	63.6
19:55	5 Minutes	51.7	56.0	43.0	59.6
20:00	5 Minutes	52.2	56.5	44.6	60.2
20:05	5 Minutes	53.1	56.9	45.5	61.0
20:10	5 Minutes	53.2	56.9	44.0	62.9
20:15	5 Minutes	53.8	57.4	46.5	62.6
20:20	5 Minutes	51.4	54.7	43.3	59.7
20:25	5 Minutes	53.7	57.7	43.0	65.2

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Start Time (hh:mm)	Duration	L_{Aeq}	L_{A10}	L_{A90}	L_{AFMax}
20:30	5 Minutes	51.5	55.1	44.2	60.1
20:35	5 Minutes	53.7	57.4	47.1	61.3
20:40	5 Minutes	55.0	57.7	45.2	68.5
20:45	5 Minutes	49.7	53.6	41.1	58.1
20:50	5 Minutes	52.7	56.4	42.4	63.3
20:55	5 Minutes	54.1	58.3	46.2	61.3
21:00	5 Minutes	52.9	56.4	45.6	59.1
21:05	5 Minutes	52.4	56.0	44.4	59.3
21:10	5 Minutes	52.1	56.3	42.6	59.9
21:15	5 Minutes	52.1	56.4	43.6	61.0
21:20	5 Minutes	50.8	55.1	34.9	65.6
21:25	5 Minutes	51.0	55.5	40.7	58.8
21:30	5 Minutes	51.0	55.2	41.6	60.5
21:35	5 Minutes	52.2	56.6	41.7	61.5
21:40	5 Minutes	54.4	57.3	48.1	60.3
21:45	5 Minutes	52.3	57.0	39.1	59.4
21:50	5 Minutes	49.9	54.1	38.8	58.5
21:55	5 Minutes	52.7	56.2	41.5	63.0
22:00	5 Minutes	50.5	54.6	33.7	62.7
22:05	5 Minutes	51.9	57.0	35.4	61.5
22:10	5 Minutes	51.6	57.1	38.3	60.8
22:15	5 Minutes	52.2	56.5	43.2	61.7
22:20	5 Minutes	51.5	55.2	44.2	60.6
22:25	5 Minutes	50.8	55.5	39.7	60.4
22:30	5 Minutes	49.7	53.5	34.7	63.0
22:35	5 Minutes	49.1	53.2	39.3	56.7
22:40	5 Minutes	48.6	53.5	37.0	58.2
22:45	5 Minutes	48.4	52.4	34.5	60.8
22:50	5 Minutes	50.4	53.5	38.5	62.9
22:55	5 Minutes	48.3	52.6	37.0	59.3
23:00	5 Minutes	49.0	54.1	29.1	61.5
23:05	5 Minutes	46.6	50.7	32.9	60.4
23:10	5 Minutes	49.0	54.1	32.1	58.1
23:15	5 Minutes	46.1	50.1	35.5	56.0
23:20	5 Minutes	46.7	50.1	35.7	58.6
23:25	5 Minutes	47.1	51.5	34.7	59.1
23:30	5 Minutes	49.0	50.7	32.7	62.5
23:35	5 Minutes	45.1	47.4	29.6	59.3
23:40	5 Minutes	36.7	41.2	29.7	45.0
23:45	5 Minutes	51.7	55.7	37.4	62.4
23:50	5 Minutes	39.5	43.5	29.8	52.1
23:55	5 Minutes	46.7	51.3	33.1	59.1
00:00	5 Minutes	45.3	48.3	27.0	59.8
00:05	5 Minutes	48.1	53.0	25.8	59.9
00:10	5 Minutes	44.7	49.9	28.4	55.5
00:15	5 Minutes	41.3	43.2	27.6	55.8
00:20	5 Minutes	47.5	49.7	31.7	62.6
00:25	5 Minutes	46.2	50.6	32.2	60.8
00:30	5 Minutes	39.4	38.2	30.5	54.6
00:35	5 Minutes	47.2	50.3	28.9	60.5

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Start Time (hh:mm)	Duration	L_{Aeq}	L_{A10}	L_{A90}	L_{AFMax}
00:40	5 Minutes	53.6	54.4	29.7	69.4
00:45	5 Minutes	42.7	44.5	30.5	58.4
00:50	5 Minutes	39.2	40.5	29.4	55.1
00:55	5 Minutes	30.9	33.1	28.5	38.2
01:00	5 Minutes	39.5	42.7	27.6	53.3
01:05	5 Minutes	45.5	48.8	27.9	62.2
01:10	5 Minutes	44.6	47.7	29.8	57.6
01:15	5 Minutes	27.1	28.0	25.6	36.2
01:20	5 Minutes	45.0	48.7	27.4	57.6
01:25	5 Minutes	45.1	48.6	26.3	59.7
01:30	5 Minutes	26.8	28.1	25.4	32.2
01:35	5 Minutes	43.5	46.0	26.2	57.3
01:40	5 Minutes	41.9	42.7	27.4	58.2
01:45	5 Minutes	28.4	30.4	26.5	37.1
01:50	5 Minutes	41.4	44.3	27.3	56.5
01:55	5 Minutes	29.4	28.0	26.3	43.7
02:00	5 Minutes	42.5	45.2	26.8	54.7
02:05	5 Minutes	59.8	59.1	29.6	81.6
02:10	5 Minutes	61.1	52.9	28.5	81.7
02:15	5 Minutes	38.8	40.2	27.5	52.3
02:20	5 Minutes	44.9	48.9	28.6	57.9
02:25	5 Minutes	53.8	57.1	28.1	69.6
02:30	5 Minutes	41.3	42.1	27.7	57.1
02:35	5 Minutes	45.2	48.5	28.9	58.7
02:40	5 Minutes	33.9	35.3	27.2	47.9
02:45	5 Minutes	40.2	41.0	26.4	54.5
02:50	5 Minutes	39.1	36.2	25.8	54.7
02:55	5 Minutes	38.3	39.4	26.6	55.3
03:00	5 Minutes	44.2	47.8	28.1	58.4
03:05	5 Minutes	48.7	51.9	30.0	61.1
03:10	5 Minutes	44.7	47.4	33.3	58.1
03:15	5 Minutes	45.4	47.8	31.4	58.8
03:20	5 Minutes	41.0	41.8	29.1	54.7
03:25	5 Minutes	44.9	48.1	28.0	60.3
03:30	5 Minutes	43.7	44.2	28.4	59.3
03:35	5 Minutes	42.6	42.6	28.0	58.1
03:40	5 Minutes	37.2	39.8	29.0	48.0
03:45	5 Minutes	47.0	49.2	36.8	58.4
03:50	5 Minutes	46.3	48.7	41.7	57.5
03:55	5 Minutes	44.5	46.5	41.1	58.4
04:00	5 Minutes	57.1	59.9	42.0	73.5
04:05	5 Minutes	50.8	51.1	41.7	67.8
04:10	5 Minutes	47.9	49.2	41.9	61.2
04:15	5 Minutes	47.9	50.4	41.9	60.1
04:20	5 Minutes	49.4	53.3	42.1	60.3
04:25	5 Minutes	45.5	47.4	41.0	57.0
04:30	5 Minutes	49.7	52.8	41.9	63.4
04:35	5 Minutes	48.4	52.7	42.4	59.3
04:40	5 Minutes	49.6	53.3	41.8	61.6
04:45	5 Minutes	50.5	54.6	43.1	61.6

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Start Time (hh:mm)	Duration	L_{Aeq}	L_{A10}	L_{A90}	L_{AFMax}
04:50	5 Minutes	50.1	54.2	42.2	60.5
04:55	5 Minutes	49.0	51.9	42.7	59.6
05:00	5 Minutes	45.4	48.0	41.6	56.5
05:05	5 Minutes	48.4	52.2	41.9	58.3
05:10	5 Minutes	48.9	53.1	41.9	59.4
05:15	5 Minutes	50.5	54.4	43.9	61.3
05:20	5 Minutes	52.0	56.5	43.2	62.2
05:25	5 Minutes	53.4	57.6	46.3	61.4
05:30	5 Minutes	52.5	56.2	45.7	61.2
05:35	5 Minutes	56.0	58.2	47.8	69.6
05:40	5 Minutes	53.0	57.1	45.5	60.8
05:45	5 Minutes	52.5	56.1	45.1	59.9
05:50	5 Minutes	54.7	58.8	46.2	65.4
05:55	5 Minutes	51.6	56.1	44.1	60.5
06:00	5 Minutes	55.7	59.3	45.8	69.5
06:05	5 Minutes	52.4	56.7	43.8	60.9
06:10	5 Minutes	53.8	58.6	45.3	64.1
06:15	5 Minutes	53.5	55.7	47.9	62.1
06:20	5 Minutes	52.3	56.5	45.7	60.9
06:25	5 Minutes	55.8	58.7	47.3	67.8
06:30	5 Minutes	55.4	58.7	47.4	63.3
06:35	5 Minutes	54.5	57.5	47.0	61.4
06:40	5 Minutes	57.5	59.8	50.9	68.5
06:45	5 Minutes	58.3	60.6	53.8	68.9
06:50	5 Minutes	57.0	59.7	51.7	63.7
06:55	5 Minutes	58.2	61.9	51.0	66.0
07:00	5 Minutes	58.2	61.3	51.3	63.7
07:05	5 Minutes	57.5	60.1	52.7	64.9
07:10	5 Minutes	57.5	60.5	51.6	67.9
07:15	5 Minutes	59.4	61.6	52.3	71.3
07:20	5 Minutes	59.6	61.3	55.0	66.7
07:25	5 Minutes	61.5	61.6	54.6	79.3
07:30	5 Minutes	59.6	62.2	53.6	71.1
07:35	5 Minutes	60.2	62.3	54.5	69.5
07:40	5 Minutes	60.7	62.6	55.4	72.6
07:45	5 Minutes	61.0	63.3	53.1	74.5
07:50	5 Minutes	61.2	63.2	56.1	69.7
07:55	5 Minutes	59.6	62.2	54.2	67.8
08:00	5 Minutes	61.1	63.4	54.1	73.3
08:05	5 Minutes	59.7	61.7	56.9	67.1
08:10	5 Minutes	60.2	62.3	56.3	67.3
08:15	5 Minutes	61.1	63.7	52.1	68.2
08:20	5 Minutes	60.2	61.8	55.8	70.5
08:25	5 Minutes	60.9	63.5	55.5	70.1
08:30	5 Minutes	61.3	63.7	56.8	69.6
08:35	5 Minutes	61.7	63.5	59.1	68.1
08:40	5 Minutes	61.8	63.4	59.7	67.7
08:45	5 Minutes	63.3	65.1	59.9	75.7
08:50	5 Minutes	61.7	62.7	56.7	75.1
08:55	5 Minutes	59.8	62.0	55.6	71.1

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Start Time (hh:mm)	Duration	L_{Aeq}	L_{A10}	L_{A90}	L_{AFMax}
09:00	5 Minutes	60.7	62.5	55.2	76.2
09:05	5 Minutes	60.3	60.6	54.9	78.7
09:10	5 Minutes	60.5	61.2	55.2	77.2
09:15	5 Minutes	57.8	60.4	50.6	65.5

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Appendix D – Full Survey Results

Table D-3
Full Survey Data – Location 3 – 30/01/2019 to 31/01/2019 – free-field, dB

Start Time (hh:mm)	Duration	L_{Aeq}	L_{A10}	L_{A90}	L_{AFMax}
17:45	5 Minutes	58.6	61.3	55.1	70.2
17:50	5 Minutes	57.0	59.0	54.3	61.5
17:55	5 Minutes	56.6	58.3	54.6	60.4
18:00	5 Minutes	58.1	59.8	55.3	61.7
18:05	5 Minutes	57.3	59.0	54.8	63.0
18:10	5 Minutes	56.4	58.1	54.1	61.4
18:15	5 Minutes	56.7	58.9	54.0	60.8
18:20	5 Minutes	57.2	59.2	54.0	64.4
18:25	5 Minutes	57.0	58.9	53.5	62.9
18:30	5 Minutes	57.9	59.4	55.2	61.8
18:35	5 Minutes	57.1	58.9	53.6	64.0
18:40	5 Minutes	55.9	58.2	52.9	64.6
18:45	5 Minutes	56.6	58.6	53.3	62.5
18:50	5 Minutes	56.4	58.4	53.5	63.4
18:55	5 Minutes	55.5	57.6	52.3	61.5
19:00	5 Minutes	57.0	60.2	51.8	65.1
19:05	5 Minutes	55.2	57.2	52.0	59.6
19:10	5 Minutes	55.7	57.9	51.7	62.7
19:15	5 Minutes	54.4	57.0	49.8	60.6
19:20	5 Minutes	55.9	57.5	53.3	60.3
19:25	5 Minutes	56.3	58.9	52.2	63.9
19:30	5 Minutes	56.4	58.4	53.4	63.5
19:35	5 Minutes	55.7	57.7	51.6	61.6
19:40	5 Minutes	56.0	58.3	52.8	60.5
19:45	5 Minutes	58.4	56.9	48.9	77.5
19:50	5 Minutes	52.9	55.2	48.5	58.5
19:55	5 Minutes	52.5	55.6	46.6	61.0
20:00	5 Minutes	53.9	54.8	48.1	72.4
20:05	5 Minutes	53.0	55.4	48.1	60.5
20:10	5 Minutes	52.9	55.1	48.5	59.9
20:15	5 Minutes	55.6	57.8	49.2	67.4
20:20	5 Minutes	52.2	55.1	48.0	57.9
20:25	5 Minutes	52.7	55.2	47.5	59.0
20:30	5 Minutes	51.8	54.5	45.9	58.8
20:35	5 Minutes	53.2	55.4	49.6	58.4
20:40	5 Minutes	56.6	56.2	48.7	73.6
20:45	5 Minutes	50.8	53.5	45.8	57.0
20:50	5 Minutes	53.2	55.7	47.9	60.0
20:55	5 Minutes	54.5	55.8	49.6	68.8
21:00	5 Minutes	52.3	54.2	48.1	58.3
21:05	5 Minutes	53.1	55.2	49.9	58.4
21:10	5 Minutes	52.7	54.8	48.1	60.5
21:15	5 Minutes	52.3	55.3	46.8	58.2
21:20	5 Minutes	51.2	54.4	43.1	65.7
21:25	5 Minutes	52.9	54.5	45.3	66.5

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Start Time (hh:mm)	Duration	L_{Aeq}	L_{A10}	L_{A90}	L_{AFMax}
21:30	5 Minutes	51.8	54.6	46.8	57.3
21:35	5 Minutes	52.2	55.1	46.0	60.5
21:40	5 Minutes	55.0	57.2	51.5	60.6
21:45	5 Minutes	52.0	54.9	45.5	58.7
21:50	5 Minutes	51.2	54.0	46.6	58.0
21:55	5 Minutes	51.5	54.7	45.3	58.3
22:00	5 Minutes	52.6	53.5	38.5	71.7
22:05	5 Minutes	51.4	54.7	42.6	59.4
22:10	5 Minutes	50.2	53.1	44.4	56.9
22:15	5 Minutes	51.4	54.1	46.3	58.2
22:20	5 Minutes	52.4	55.0	48.0	57.2
22:25	5 Minutes	50.2	53.1	45.3	55.8
22:30	5 Minutes	48.7	52.4	39.4	57.8
22:35	5 Minutes	50.5	53.6	45.1	58.8
22:40	5 Minutes	49.0	51.7	43.6	55.7
22:45	5 Minutes	49.4	52.6	41.2	57.5
22:50	5 Minutes	50.1	52.9	43.3	60.7
22:55	5 Minutes	48.5	52.1	42.4	58.7
23:00	5 Minutes	47.3	50.7	37.9	55.4
23:05	5 Minutes	47.2	51.0	38.7	55.9
23:10	5 Minutes	48.2	52.4	38.8	56.5
23:15	5 Minutes	48.4	50.5	39.5	61.8
23:20	5 Minutes	47.5	50.8	39.7	57.1
23:25	5 Minutes	48.1	52.1	40.2	57.3
23:30	5 Minutes	48.6	52.1	40.9	58.9
23:35	5 Minutes	43.9	49.0	35.8	53.2
23:40	5 Minutes	42.2	45.3	35.8	52.8
23:45	5 Minutes	50.4	53.9	43.5	57.2
23:50	5 Minutes	41.7	45.5	36.7	49.5
23:55	5 Minutes	46.4	50.7	39.1	55.1
00:00	5 Minutes	47.4	52.6	37.3	59.9
00:05	5 Minutes	47.9	52.7	36.0	56.3
00:10	5 Minutes	45.8	50.3	37.1	53.3
00:15	5 Minutes	43.6	46.6	36.0	56.6
00:20	5 Minutes	47.8	51.8	37.7	60.4
00:25	5 Minutes	46.2	50.7	37.7	54.2
00:30	5 Minutes	41.4	44.0	37.4	52.4
00:35	5 Minutes	47.3	52.6	37.3	57.7
00:40	5 Minutes	50.0	53.9	37.7	62.0
00:45	5 Minutes	45.6	50.1	37.6	52.7
00:50	5 Minutes	42.8	46.3	37.2	53.4
00:55	5 Minutes	37.8	38.5	37.0	41.5
01:00	5 Minutes	42.3	46.2	36.7	52.4
01:05	5 Minutes	48.2	49.1	36.7	64.7
01:10	5 Minutes	43.6	47.1	36.8	52.4
01:15	5 Minutes	37.2	37.3	36.3	41.8
01:20	5 Minutes	44.2	48.3	36.9	52.8
01:25	5 Minutes	42.3	46.8	35.8	51.4
01:30	5 Minutes	36.8	37.4	36.1	39.1
01:35	5 Minutes	44.8	48.6	36.3	54.0

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Start Time (hh:mm)	Duration	L_{Aeq}	L_{A10}	L_{A90}	L_{AFMax}
01:40	5 Minutes	42.1	46.0	36.5	52.6
01:45	5 Minutes	37.7	39.8	36.4	43.0
01:50	5 Minutes	40.8	44.4	36.5	52.2
01:55	5 Minutes	37.7	37.3	36.4	49.3
02:00	5 Minutes	42.3	46.3	36.6	51.5
02:05	5 Minutes	46.0	49.8	36.9	59.4
02:10	5 Minutes	43.5	47.2	36.9	54.5
02:15	5 Minutes	39.7	43.2	36.8	47.6
02:20	5 Minutes	44.5	47.6	37.4	55.4
02:25	5 Minutes	44.0	48.7	36.8	54.7
02:30	5 Minutes	38.6	41.0	36.5	47.5
02:35	5 Minutes	44.4	49.2	37.1	55.1
02:40	5 Minutes	38.4	40.2	36.0	47.6
02:45	5 Minutes	41.7	46.0	36.0	54.8
02:50	5 Minutes	40.5	43.2	36.4	52.0
02:55	5 Minutes	41.1	44.7	36.3	52.1
03:00	5 Minutes	44.5	48.2	37.2	53.2
03:05	5 Minutes	47.0	51.1	37.7	56.3
03:10	5 Minutes	44.5	48.2	38.4	53.7
03:15	5 Minutes	46.4	50.2	38.4	55.3
03:20	5 Minutes	41.4	44.7	37.1	51.3
03:25	5 Minutes	46.7	51.5	37.1	57.7
03:30	5 Minutes	42.6	46.8	37.1	53.6
03:35	5 Minutes	43.7	49.2	36.8	55.5
03:40	5 Minutes	43.3	47.8	37.4	53.2
03:45	5 Minutes	46.2	49.9	38.9	54.4
03:50	5 Minutes	43.8	46.8	39.1	53.6
03:55	5 Minutes	45.1	48.9	37.0	56.1
04:00	5 Minutes	46.9	50.4	39.0	56.1
04:05	5 Minutes	45.9	50.8	38.2	54.5
04:10	5 Minutes	46.2	49.8	39.9	55.3
04:15	5 Minutes	45.6	48.5	38.3	54.6
04:20	5 Minutes	46.6	49.8	39.6	52.9
04:25	5 Minutes	45.1	49.0	38.5	56.3
04:30	5 Minutes	46.9	49.9	40.1	55.7
04:35	5 Minutes	48.1	51.5	43.2	56.6
04:40	5 Minutes	46.6	49.4	40.4	57.1
04:45	5 Minutes	48.6	51.1	42.6	59.4
04:50	5 Minutes	48.4	52.3	40.3	54.7
04:55	5 Minutes	48.1	52.1	40.2	55.3
05:00	5 Minutes	50.1	53.5	38.5	58.3
05:05	5 Minutes	51.1	52.8	48.6	55.0
05:10	5 Minutes	51.0	52.6	48.8	55.5
05:15	5 Minutes	51.2	53.8	46.9	57.4
05:20	5 Minutes	50.2	53.7	42.0	56.9
05:25	5 Minutes	52.1	54.3	47.1	56.3
05:30	5 Minutes	52.4	54.4	47.5	57.9
05:35	5 Minutes	53.7	56.1	48.8	62.6
05:40	5 Minutes	51.7	54.2	46.8	57.7
05:45	5 Minutes	51.7	54.5	45.8	56.5

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Start Time (hh:mm)	Duration	L_{Aeq}	L_{A10}	L_{A90}	L_{AFMax}
05:50	5 Minutes	55.5	57.3	53.3	61.3
05:55	5 Minutes	53.5	55.3	51.3	56.9
06:00	5 Minutes	53.9	56.1	49.5	61.0
06:05	5 Minutes	52.6	55.8	47.5	58.7
06:10	5 Minutes	51.5	54.0	47.6	57.0
06:15	5 Minutes	54.3	56.6	50.5	58.6
06:20	5 Minutes	52.2	54.9	47.5	57.4
06:25	5 Minutes	54.6	56.9	49.5	60.5
06:30	5 Minutes	53.9	56.0	49.0	57.4
06:35	5 Minutes	53.7	56.0	49.1	58.7
06:40	5 Minutes	55.6	57.9	52.1	60.6
06:45	5 Minutes	56.5	58.6	53.3	61.6
06:50	5 Minutes	56.1	58.2	52.4	61.7
06:55	5 Minutes	57.0	59.1	53.1	61.3
07:00	5 Minutes	57.0	59.0	53.6	60.9
07:05	5 Minutes	56.6	57.9	54.2	61.4
07:10	5 Minutes	56.2	58.2	53.1	60.2
07:15	5 Minutes	57.6	59.5	54.6	61.7
07:20	5 Minutes	58.5	59.7	56.6	61.8
07:25	5 Minutes	58.6	59.5	55.8	70.7
07:30	5 Minutes	58.2	59.6	56.0	62.1
07:35	5 Minutes	58.2	59.8	56.0	63.8
07:40	5 Minutes	59.0	60.4	57.1	63.7
07:45	5 Minutes	59.3	61.1	56.6	64.3
07:50	5 Minutes	59.5	60.8	57.7	67.8
07:55	5 Minutes	58.6	60.4	55.1	66.8
08:00	5 Minutes	58.7	60.5	55.8	62.8
08:05	5 Minutes	58.1	59.3	56.5	60.7
08:10	5 Minutes	58.7	59.9	56.7	61.1
08:15	5 Minutes	59.5	60.7	57.2	63.2
08:20	5 Minutes	58.7	60.1	56.8	61.9
08:25	5 Minutes	59.8	61.3	57.4	63.9
08:30	5 Minutes	60.0	61.5	57.6	70.5
08:35	5 Minutes	59.0	60.7	56.5	62.8
08:40	5 Minutes	58.1	59.7	55.9	63.4
08:45	5 Minutes	58.5	59.7	56.8	62.5
08:50	5 Minutes	59.0	60.4	57.2	62.8
08:55	5 Minutes	57.9	59.6	55.3	62.7
09:00	5 Minutes	57.6	59.6	54.7	61.8
09:05	5 Minutes	56.9	58.3	55.1	60.5
09:10	5 Minutes	57.0	58.4	54.8	63.0
09:15	5 Minutes	56.6	58.3	54.3	61.1
09:20	5 Minutes	56.8	58.2	54.1	61.9
09:25	5 Minutes	57.4	59.0	55.2	61.8
09:30	5 Minutes	56.0	58.0	53.5	59.9
09:35	5 Minutes	55.9	57.8	53.3	59.6
09:40	5 Minutes	56.2	57.7	53.9	59.4

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Appendix D – Full Survey Results

Table D-4
Full Survey Data – Location 4 – 20/05/2019 – free-field, dB

Start Time (hh:mm)	Duration	L_{Aeq}	L_{A10}	L_{A90}	L_{AFMax}
11:35	5 Minutes	47.5	49.8	42.1	60.8
11:40	5 Minutes	44.6	47.0	40.4	49.3
11:45	5 Minutes	45.2	48.2	39.4	51.9
11:50	5 Minutes	46.2	48.4	40.9	60.0
11:55	5 Minutes	44.8	47.9	39.8	53.5
12:00	5 Minutes	43.9	46.4	40.1	50.3
12:05	5 Minutes	45.3	47.6	39.8	53.1
12:10	5 Minutes	53.5	54.0	41.4	68.6
12:15	5 Minutes	48.5	50.5	43.2	57.0
12:20	5 Minutes	45.9	48.9	40.4	54.5
12:25	5 Minutes	46.3	48.4	41.4	57.3
12:30	5 Minutes	53.2	52.4	39.1	68.1
12:35	5 Minutes	45.6	48.5	39.3	57.4
12:40	5 Minutes	45.9	48.8	39.8	55.1
12:45	5 Minutes	46.5	49.2	42.2	52.2
12:50	5 Minutes	48.2	51.4	41.7	61.6
12:55	5 Minutes	46.0	48.0	40.2	58.8
13:00	5 Minutes	43.7	46.5	39.6	50.0
13:05	5 Minutes	50.1	49.7	40.7	65.0
13:10	5 Minutes	44.8	47.2	40.7	51.6
13:15	5 Minutes	46.7	47.7	42.1	63.0
13:20	5 Minutes	50.2	49.1	42.3	66.0
13:25	5 Minutes	48.0	49.9	43.9	56.6
13:30	5 Minutes	45.1	47.4	40.1	55.9
13:35	5 Minutes	43.5	45.7	39.8	50.6
13:40	5 Minutes	53.0	49.7	40.8	66.9
13:45	5 Minutes	53.0	47.7	39.0	69.3
13:50	5 Minutes	55.0	60.1	39.8	66.9
13:55	5 Minutes	52.9	56.7	40.0	65.3
14:00	5 Minutes	46.1	47.8	40.2	59.1
14:05	5 Minutes	47.2	51.4	38.8	58.1
14:10	5 Minutes	50.9	55.8	39.4	58.6
14:15	5 Minutes	50.8	55.4	40.9	59.1
14:20	5 Minutes	51.5	56.5	42.7	59.5
14:25	5 Minutes	49.4	53.8	41.9	59.0
14:30	5 Minutes	54.6	58.7	42.3	69.5
14:35	5 Minutes	46.7	48.8	42.6	54.7

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