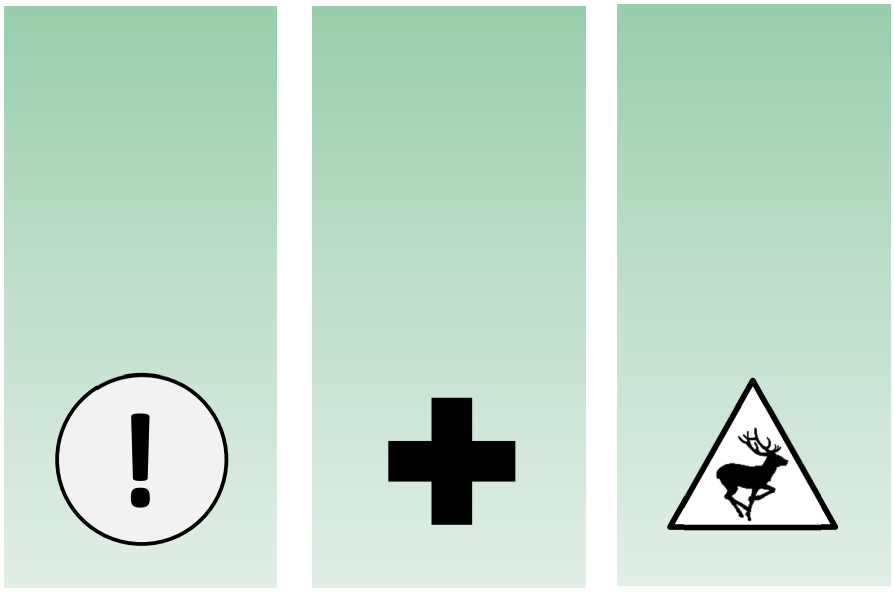
NOISE AND VIBRATION IMPACT ASSESSMENT

LAND EAST OF DOWNEND ROAD, PORTCHESTER

REC REFERENCE: AC108766-1R0

REPORT PREPARED FOR: MILLER HOMES LTD

24TH AUGUST 2020



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EXECUTIVE SUMMARY

Noise and Vibration Surveys

A series of Noise and Vibration Surveys have been completed in order to quantify the impact of road traffic noise, train noise and vibration, and commercial sound upon the proposed residential development.

Due to the continuing influence of the COVID-19 epidemic on general activity and consequent ambient noise levels for many sources, noise survey data obtained during November 2016 are used. In normal times source noise levels are considered acceptable for around 3 years, and so this represents only a minor extension of this approach.

Noise and Vibration Impact Assessment

The Noise and Vibration Impact Assessment has identified that the key noise sources impacting upon the development are the M27 motorway to the north, the railway line to the south and the Veolia site to the north-west. Accordingly appropriate mitigation has been specified in order to reduce these impacts for internal habitable areas.

The key source of vibration is train pass-bys on the railway line to the south.

Accordingly, appropriate consideration has been given towards the mitigation measures required to ensure a commensurate level of protection against noise for future residents.

Recommended Noise Mitigation Measures

This assessment has recommended the following mitigation measures in order to ensure an adequate level of protection from noise:

- Alternative ventilation should be fitted to habitable rooms as specified in the figures as an alternative to opening windows.

The Noise Impact Assessment has determined that with mitigation measures in place, the NOAEL can be achieved with noise being noticeable and not intrusive and with the following advice:

"Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life."

The assessment is based upon robust and worst-case assumptions and demonstrates that, subject to the incorporation of the identified mitigation measures, the proposed layout will lead to no adverse impacts at the proposed dwellings as a result of existing noise.

Subject to the incorporation of the identified mitigation measures, it is considered that in principle, the Site is suitable for the promotion of residential development.

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1. INTRODUCTION

1.1 Background

Ensafe have been commissioned by Miller Homes to undertake a Noise and Vibration Impact Assessment for a proposed residential development on land located at Land East of Downend Rd, Portchester, to be referred to hereafter as '*the Site'*.

This assessment has been undertaken to identify key noise and vibration sources in the vicinity of the Site which may have the potential to impact upon the proposed noise and vibration-sensitive residential development.

All acronyms used within this report are defined in the Glossary presented in Appendix II.

1.2 Site Location & Proposed Development

The Site comprises a parcel of agricultural land. To the north lies agricultural land beyond which the M27 passes through a deep cutting. To the south lies the Southampton-Portsmouth railway line. To the east is Portchester crematorium, memorial gardens a further farmland, while to the west there are horse paddocks. Not adjoining the site but bordering approximately 120m from the nearest proposed dwelling is a Veolia operated site, understood to be involved in waste and recycling.

The key noise sources impacting upon the Site are road traffic using the M27 to the north, train pass-bys to the south with occasional commercial sound from the Veolia site to the north-west. The key sources of vibration are train pass-bys.

Proposals include for the construction of residential dwellings together with amended means of access, landscaping and ancillary works.

This assessment has been undertaken with due regard to the provisional master planning layout shown on the following drawing:

- Illustrative master plan (drawing number 2495-01 /RS-SK-004, Rev B) dated 10/07/2020 and produced by Terence O'Rourke.

The Planning Layout is shown in Figure 1 of Appendix III.

1.3 Limitations

The limitations of this report are presented in Appendix I.

1.4 Confidentiality

Ensafe has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from Ensafe; a charge may be levied against such approval.

2. ASSESSMENT CRITERIA

2.1 National Planning Practice Guidance

Noise needs to be considered when new developments may create additional noise and when new developments would be sensitive to the prevailing acoustic environment. When preparing local or neighbourhood plans, or taking decisions about new development, there may also be opportunities to consider improvements to the acoustic environment.

Local planning authorities' plan-making and decision taking should take account of the acoustic environment and in doing so consider:

- Whether or not a significant adverse effect is occurring or likely to occur;
- Whether or not an adverse effect is occurring or likely to occur; and
- Whether or not a good standard of amenity can be achieved.

In line with the Explanatory Note of the Noise Policy Statement for England, this would include identifying whether the overall effect of the noise exposure (including the impact during the construction phase wherever applicable) is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level for the given situation.

The Observed Effect Levels are as follows:

- Significant observed adverse effect level: This is the level of noise exposure above which significant adverse effects on health and quality of life occur.
- Lowest observed adverse effect level: this is the level of noise exposure above which adverse effects on health and quality of life can be detected.
- No observed effect level: this is the level of noise exposure below which no effect at all on health or quality of life can be detected.

Table 1 summarises the noise exposure hierarchy, based on the likely average response.

Table 1 Noise Exposure Hierarchy

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not Noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
		Lowest Observed Adverse Effect Level	
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the	Observed Adverse Effect	Mitigate and reduce to a minimum

	acoustic character of the area such that there is a perceived change in the quality of life.		
		Significant Observed Adverse Effect Level	
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

The subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation.

These factors include:

- The source and absolute level of the noise together with the time of day it occurs. Some types and level of noise will cause a greater adverse effect at night than if they occurred during the day – this is because people tend to be more sensitive to noise at night as they are trying to sleep. The adverse effect can also be greater simply because there is less background noise at night;
- For non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise;
- the spectral content of the noise and the general character of the noise. The local topology and topography should also be taken into account along with the existing and, where appropriate, the planned character of the area.

More specific factors to consider when relevant:

- Where applicable, the cumulative impacts of more than one source should be taken into account along with the extent to which the source of noise is intermittent and of limited duration.
- Consideration should also be given to whether adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the proposed mitigation relies on windows being kept closed most of the time. In both cases a suitable alternative means of ventilation is likely to be necessary. Further information on ventilation can be found in the Building Regulations.
- If external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed as intended.

2.2 Local Authority Guidance and Criteria – Fareham and Gosport Borough Councils' Environmental Health Department

Ensafe (formerly REC Ltd) has contacted Mark Homeyard of Fareham and Gosport Borough Councils (FGBC) on the 8th and 30th November 2016 in order to agree the methodology for the noise survey and the appropriate noise criteria for this assessment. The following were agreed:

- Ensafe will look to achieve a maximum permissible average noise level in garden areas of 55dB $L_{Aeq,16hr}$ where applicable, in accordance with BS8233: 2014;
- The maximum permissible average noise level in living rooms shall not exceed 35dB $L_{Aeq,16hr}$;
- The maximum permissible average noise level in bedrooms shall not exceed 30dB $L_{Aeq,8hr}$; and,
- The maximum permissible instantaneous noise level in bedrooms shall not exceed 45dB $L_{Amax,fast}$ criteria.

Replies included a suggestion that weekend train noise surveys be undertaken, which was done, as described in Section 3.

With regard to the BS4142:2014 assessment:

- Ensafe suggested that the Rating Level of any commercial sound, $L_{A,r}$, shall not exceed the existing typical Background Sound Level, L_{A90} ($L_{A,r} = L_{A90}$); however
- FGBC requested that a criterion of $L_{A,r} = L_{A90}$ - 5dBA be used instead, lower than suggested by the guidance.

Prior to the 2020 full revision of the assessment, further contact was sought by email. It was proposed that the 2016 survey data was used and appropriate correction made for the elapsed time. It was noted that the 3.5 year elapsed period is not significantly longer than the 3 years generally accepted for survey validity.

No reply was received; however the assessment methodology is considered robust.

2.3 Calculation of Road Traffic Noise 1988

The Calculation of Road Traffic Noise (CRTN) memorandum, produced by the Department of Transport for the Welsh Office, describes the procedures for calculating noise from road traffic. Section III of this memorandum details the shortened measurement procedure whereby measurements of the L_{10} parameter are made over any three consecutive hours between 10:00 and 17:00. From the arithmetic average of the three 1-hour values, the $L_{10,18hr}$ noise levels is derived before derivation of the $L_{Aeq,16hr}$ value.

2.4 Transport Research Laboratory – Converting the UK Traffic Noise Index $L_{A10,18hr}$ to EU Noise Indices for Noise Mapping

This document provides a method for converting the $L_{A10,18hr}$ level to the L_{night} level using the following formula, applicable to non-motorway roads;

$$L_{night} = 0.90 \times L_{A10,18hr} - 3.77dB$$

2.5 British Standard BS8233: 2014: Guidance on Sound Insulation and Noise Reduction for

Buildings

The scope of this standard is the provision of recommendations for the control of noise in and around buildings. It suggests appropriate criteria and limits for different situations, which are primarily intended 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 dwellings, as shown in Table 2:

Table 2: BS8233 Recommended Internal Noise Levels

Criterion	Typical Situation	Design $L_{Aeq,T}$ (dB)
Suitable resting / sleeping conditions	Living Room	35
	Bedroom	30
For a reasonable standard in bedrooms at night, individual noise events (measured with fast time weighting) should not normally exceed 45dB L_{Amax}		

BS8233 goes on to recommend noise levels for gardens, thus:

> *"It is desirable that the external noise level does not exceed 50dB $L_{Aeq,T}$, with an upper guideline value of 55dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognised that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors might be warranted".*
>
> *"In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited".*

2.6 World Health Organisation's (WHO) 'Guidelines for Community Noise'

The WHO 'Guidelines for Community Noise' offers advice with regard to setting noise criteria applicable to sleep disturbance. Section 4.2.3 specifies:

> *'If the noise is not continuous, L_{Amax} or SEL are used to indicate the probability of noise-induced awakenings. Effects have been observed at individual L_{Amax} exposures of 45 dB or less. Consequently, it is important to limit the number of noise events with a L_{Amax} exceeding 45 dB.'*

The guidelines go on to state:

> *'At night, sound pressure levels at the outside façades of the living spaces should not exceed 45 dB L_{Aeq} and 60 dB L_{Amax}, so that people may sleep with bedroom windows open. These values have been obtained by assuming that the noise reduction from outside to inside with the window partly open is 15 dB.'*

The sound insulation performance value of 15dB for a façade containing a partially open window accords with the guidance offered in BS8233:2014.

The guidelines reference a study by Vallet & Vernet, 1991, which concluded that:

> *'For a good sleep, it is believed than indoor sound pressure levels should not exceed approximately 45 dB $L_{AF,max}$ more than 10-15 times per night.'*

Accordingly this assessment has utilised the 10th highest measured maximum noise level from the night-time period and allows for a an assessment of a typical maximum noise level in determining façade sound insulation performance.

2.7 BS4142: 2014 'Methods for rating and assessing industrial and commercial sound'

This standard describes methods for rating and assessing sound of an industrial or commercial nature which includes:

- Sound from industrial and manufacturing processes;
- 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; and,
- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from processes or premises, such as that from forklift trucks, or that from train or ship movements on or around an industrial or commercial Site.

The procedure detailed in the standard compares the measured or predicted noise level 'the specific noise level' from any of the above detailed noise sources with the background sound level at a residential dwelling. The measured background sound level at a receptor should be reliable and should not necessarily ascertain a lowest measured background sound level, but rather to quantify what is typical.'

The specific noise level also acknowledges the following reference time intervals depending upon whether the noise source operates during daytime or night-time periods:

- Daytime (07:00 – 23:00): 1 hr; and,
- Night-time (23:00 – 07:00): 15 minutes.

There are a number of 'penalties' which can be attributed to the specific sound level depending upon the 'acoustic features' of the sound level under investigation as follows. These penalties vary in their weighting depending upon the severity of the acoustic feature, as follows:

Tonality

- +2dB: where the tonality is just perceptible;
- +4dB: where the tonality is clearly perceptible; and,
- +6dB: where the tonality is highly perceptible.

Impulsivity

- +3dB: where the impulsivity is just perceptible;
- +6dB: where the impulsivity is clearly perceptible; and,
- +9dB: where the impulsivity is highly perceptible.

Intermittency

- +3dB: where the intermittency is readily distinctive against the acoustic environment.

In addition to the above acoustic features, there is a penalty for 'other sound characteristics' of +3dB where a sound exhibits characteristics that are neither tonal nor impulsive, though are readily distinctive against the acoustic environment.

BS4142 goes on to state that the rating level is equal to the specific sound level if there are no such features present or expected to be present.

Assessment of the rating level relative to the background noise level can yield the following commentary:

- Typically the greater this difference (between the rating level and the background sound level), the greater the magnitude of impact;
- A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context; and,
- 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. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact.

With the above in mind, it is common that a Local Planning Authority will specify their own criteria for the rating level relative to the background sound level and, where this is the case, this criteria usually takes precedence over a simple comparison of the rating level against the background sound level.

2.8 British Standard BS6472: 2008: Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)

With respect to human exposure to building vibration, BS6472 provides guideline values of the Vibration Dose Value (VDV) above which various degrees of adverse comment may be expected from the occupants of residential buildings. The VDV is defined mathematically as the fourth root of the time integral of the fourth power of the vibration acceleration, after it has been frequency weighted. The guideline values recommended by BS6472 are shown in Table 3 below.

Table 3: BS6472 Guideline Values

Place	Low Probability of Adverse Comment	Adverse Comment Possible	Adverse Comment Probable
	VDV (m/s)		
Residential Buildings (16 Hour Day)	0.2 – 0.4	0.4 – 0.8	0.8 – 1.6
Residential Buildings (8 Hour Night)	0.1 – 0.2	0.2 – 0.4	0.4 – 0.8

Where the vibration is intermittent rather than continuous in nature, BS6472 defines procedures for

calculating the estimated Vibration Dose Value (eVDV), based on the number and duration of vibration events and the recorded value of the root mean square frequency weighted vibration acceleration. The frequency weighting takes into account the response of the human body to vibrations of different frequency and whether the person is lying down or standing. The eVDV can then be taken as the VDV for use in the assessment of human exposure to vibration in buildings.

The above guidance relates to vibration measured at the point of entry into the human body, which is usually taken to mean the ground surface or at a point mid-span of an upper storey floor, rather than the point of entry into the building (a foundation element).

3. SURVEYS

Noise and vibration measurement positions are shown on Figure 2 of Appendix III. NMP numbering has been preserved from previous documents.

3.1 Road Traffic Noise Survey – M27

Ensafe has conducted a Road Traffic Noise Survey in order to measure the level of noise generated by vehicles using the M27 to the north of the site. The survey was carried out over the following period:

- 23:00 Wednesday 9th to 23:00 Thursday 10th November 2016.

The following noise measurement position was chosen for the Road Traffic Noise Survey:

- Noise Measurement Position 2 (NMP2): Located on an agricultural field between the northern Site boundary and the M27, at 99m from the road centre. The microphone was located 1.5m above ground level and in free-field conditions. Noise at this location consisted predominately of vehicle noise from the M27.

A summary of the measured sound pressure levels from the Road Traffic Noise Survey is presented in Table 4.

Table 4: Summary of Measured Noise Levels for NMP2

Measurement Position	Period	Measured Sound Pressure Level, free-field (dB)	
		$L_{Aeq,T}$	$L_{Amax,fast}$[1]
NMP2	Daytime (0700-2300)	62.5	-
	Night-time (2300 – 0700)	55.0	65.0
[1] 10th highest $L_{Amax,fast}$ from overnight period			

The following equipment was used for the Noise Surveys.

Table 5: Noise Measurement Equipment

Measurement Position	Equipment Description	Manufacturer & Type No.	Serial No.	Calibration Due Date
All	Sound Level Meter	01dB-Metravib Black Solo	65882	10th Feb 2018
	Pre-amplifier	01dB-Metravib PRE 21 S	16614	
	Microphone	01dB Metravib MCE212	175374	
	Calibrator	01dB-Metravib CAL-21	35134328	10th February 2017
Calibration Level at Start of Survey	93.9dB	Calibration Level at End of Survey	93.9dB	Drift: 0dB

DfT data has been used to look at the change in road traffic between the 2016 survey date and 2020. The change in traffic flow is less than 2.3%, corresponding to a change of 0.1 dB in noise level, and so can be disregarded.

The sound level meter was field-calibrated on Site prior to and after noise measurements were taken. No significant drift was witnessed. Calibration certificates are available upon request.

3.2 Train Pass-by Noise Survey

Ensafe has conducted attended sound measurements of train pass-bys during a typical weekday period. The survey was carried out over the following period:

- Saturday 12th November 2016 at 07:00 and Tuesday 15th at 07:00.

The following noise measurement position was chosen for the Train Pass-by Noise Survey:

- Noise Measurement Position 3 (NMP3): Located 11m from the southern Site boundary of the Site with the railway line, approximately 20m from the centre of the tracks. The microphone was located 1.5m above ground level and in free-field conditions. Noise sources at this location consisted predominately of train-pass-bys.

The resultant time history was retrospectively coded in the dBTrait software to extract the train pass-bys and reject contribution from background sources between train pass-bys. A summary of the measured sound pressure levels from the Train Pass-by Noise Survey is presented in Table 6.

Table 6: Summary of Measured Noise Levels for NMP3; partial levels due to train pass-bys.

Measurement Position	Measurement Period	Measured Sound Pressure Level, free-field (dB)	
		$L_{Aeq,T}$	$L_{Amax,fast}$
NMP3	Saturday daytime (0700 – 2300)	54.1	-
	Monday daytime (0700-2300)	54.7	-
	Monday night-time (2300-0700)	50.6	75.9

Equipment used was as per Table 5 above.

3.3 Commercial Sound Survey - Veolia

Ensafe has conducted an attended commercial sound survey in order to quantify the impact, if any, of commercial sound from the Veolia site to the north-west of the site. The survey was carried out over the following period:

- Wednesday 23rd November 2016 between 14:38 and 16:39.

The following noise measurement position was chosen for the Commercial Sound Survey:

- Noise Measurement Position 1 (NMP1): Located on the north-western Site boundary where attended measurements were undertaken of any commercial sound. The coding feature of the sound level meter was used in order to isolate the commercial sound from the existing ambient sound level. The microphone was located 1.5m above ground level and in free-field conditions. Only occasional brief commercial sounds were audible, primarily vehicle movements and other sounds including impacts. Noise sources at this location consisted predominately of distant traffic, birdcalls and other sources.

A summary of the measured sound pressure levels is presented in Table 7. The distance quoted is to the centre of the site.

Table 7: Summary of Measured Noise Levels for NMP1

Location	Measured Commercial Sound Pressure Level, free-field L_{Aeq} (dBA)	Residual sound level L_{Aeq} (dBA)	Background (residual) subtracted commercial level (dBA)	Measured On-Time (mm:ss)	On-time corrected commercial sound level (dBA)	Distance to Source (m)
NMP1	57.7	57.4	45.9	01:40	30.4	175

Equipment used was as per Table 5 above.

3.4 Background Sound Survey

Ensafe has conducted a full 24 hour weekday Background Sound Survey in order to establish the existing background sound levels in the absence of any commercial sound. The survey was carried out over the following period:

- 07:00 Sunday 20th November 2016 to 07:00 Tuesday 22nd November 2016.

The following noise measurement position was chosen for the Background Sound Survey:

- Noise Measurement Position 4 (NMP4): Located on the northern boundary of the Site. The NMP and the closest part of the proposed development to the commercial site lie at the same distance from the railway line, and also from the M27, and so experience the same background sound level. The microphone of the sound level meter was located at a height of 1.5m above ground level and in free-field conditions. Sound sources at this location consisted of distant road traffic, distant train pass-bys, occasional birdcalls and aircraft.

A summary of the range of measured sound pressure levels from the Background Sound Survey is presented in Table 8. A full hourly breakdown of the measurements is presented in Table A1 in Appendix IV.

Table 8: Summary of Measured Background Sound Levels, 0700 - 1700

Period	Median Measured Sound Pressure Level, free-field (dB)	
	L_{A90}	$L_{Aeq,T}$
Sunday 20th November, daytime	49.6	52.1
Monday 21st November, daytime	52.9	55.7

Table 9 details the recorded meteorological conditions at the start and end of the background sound survey.

Table 9: Record of Meteorological Conditions at Start and End of Survey

Measured Wind Speed (m/s)	Wind Direction	Precipitation Occurred?	Fog or Mist Evident?	Was the Ground Wet, Frozen or Snow Covered?	Temperature (°C)	Cloud Cover (%)
2	NE	No	No	No	6	60
4	SSW	No	No	No	4	100

Equipment used was as per Table 5 above.

3.5 Train Pass-by Vibration Survey

Ensafe has conducted attended measurements of train pass-bys during a typical weekday period. The survey was carried out over the following time period:

- Wednesday 23rd November 2016 between 11:20 and 13:27.

The following vibration measurement position was chosen for the Train Pass-by Vibration Survey:

- Vibration Measurement Position 1 (NMP1): Located on the southern Site boundary with the railway line, approximately 16m from the centre of the tracks. The geophone of the meter was secured into the ground using the supplied spikes.

A summary of the measured vibration levels is presented in Table 10.

Table 10: Summary of Measured Vibration Levels

Measurement Start Time	Direction of travel	Operator	Transverse Peak (mm/s)	Vertical Peak (mm/s)	Longitudinal Peak (mm/s)
11:22	E	SW	0.587	0.302	0.524
11:31	E	GW	0.921	0.714	0.952
11:51	E	SW	0.079	0.079	0.079
12:03	E	SN	0.54	0.175	0.365

12:24	W	SW	0.603	0.254	0.413
12:26	E	SW	0.063	0.063	0.063
12:29	W	ZZ	0.27	0.175	0.317
12:32	E	GW	0.603	0.254	0.429
12:43	W	GW	0.81	0.413	0.794
12:56	E	SN	0.635	0.238	0.651
13:05	W	SN	0.889	0.73	1.159

The following equipment was used for the vibration survey.

Table 11: Vibration Measurement Equipment

Measurement Position	Equipment Description	Manufacturer & Type No.	Serial No.	Calibration Due Date
VMP1	Vibration Meter	Instantel Blastmate III	BA18274	12th April 2017
	Tri-axial Geophone	Instantel Geophone	BG17363	

4. NOISE IMPACT ASSESSMENT

4.1 BS4142 Assessment – Veolia site

This assessment has used the measured noise levels from operations at the Veolia waste processing site to the north-west of the Site to predict the noise level impact at the closest proposed residential dwellings. BS4142:2014 has been used to determine the likelihood of adverse impact within garden areas and within internal habitable rooms.

The measured noise levels have been taken as representative of the closest receptors.

With regard to assumptions for the assessment, the following has been considered:

- Only the daytime period has been assessed, as the site is not active during the 2300-0700 night-time period.

Table 12 below shows the calculation of the specific level due to commercial sound at the closest point on the site boundary to inform a worst-case scenario. These levels are background-subtracted using the overall residual noise level and finally corrected using the measured on-time during the survey period.

As the sound is highly intermittent this level is considered representative of any daytime period including the 1-hour daytime assessment period.

Table 12: Calculation of Specific Noise Level at Receptor

Measured Sound Level, $L_{Aeq,t}$ (dBA)	Background (Residual) Corrected Sound Level, $L_{Aeq,t}$ (dBA)	Measured On-Time (mm:ss)	BS4142:2014 Reference Period (seconds)	On-time corrected sound level (dBA)	Calculated Specific 1-hour Noise Level at Boundary $L_{Aeq,1hr}$ (dB)
57.7	45.9	01:40	3600	30.4	30.4

Table 13 indicates penalties applied using the subjective methodology described in BS4142:2014.

Table 13: Identification of Applicable Penalties

Noise Source	Penalty	Applicable?	Attributable Penalty	Comment
Veolia site	Tonality	No	-	No tonality audible, i.e. reversing alarms
	Impulsivity	Yes	6dB	Impulsivity 'clearly perceptible' at the receptor
	Intermittency	Yes	3dB	Intermittent sound/activity noted
	Other Sound	No	-	Other penalties applied

Table 14 calculates the Rating Level at the nearest proposed residential dwelling for the daytime period. The median background sound level during the daytime period has been used. It is understood

that the site is not active at the weekend; nonetheless a weekend assessment has been included for completeness as the data was available.

The EBC criterion that sound rating level should not exceed the background minus 5dBA has been used.

Table 14: Calculation of Rating Level at Boundary for Daytime Period

Period	Calculated Specific Noise Level at Boundary (dBA)	Total Penalty (dB)	Calculated Rating Level $L_{A,r}$ (dB)	Measured Median Background Sound Level $L_{A90,t}$ (dB)	Criterion (dBA)	Difference + / - (dB)
Weekday (Monday)	30.4	9	39.4	49.6	44.6	-5.2
Weekend (Sunday)	30.4	9	39.4	52.9	47.9	-8.5

Table 14 indicates that the criterion is comfortably satisfied and therefore no mitigation measures are required.

4.2 Rail Vibration Assessment

The total VDV values for the daytime and night-time periods for trains have been calculated in accordance with the methodology presented in BS6472: 2008 using the appropriate weightings.

The total number of trains has been obtained from train timetables published on the internet.

The table below summarises the results of the vibration assessment.

Table 15: Summary of Predicted Vibration Levels

Train Type	Timetabled Train Movements		Predicted Vibration Dose Value ($m/s^{1.75}$)	
	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Freight	2	1	0.008	0.007
Passenger	171	35	0.085	0.057
Total:			0.085	0.057

Table 16 determines the appropriate comment in accordance with BS6472:2008.

Table 16: Determination of Applicable Comment

Place	Calculated Vibration Dose Value (m/s $^{1.75}$)	Applicable Comment
Residential Buildings (16 Hour Day)	0.085	Less than 'low probability of adverse comment'
Residential Buildings (8 Hour Night)	0.057	Less than 'low probability of adverse comment'

As both assessment periods give findings of levels lower than those corresponding to the category 'Low probability of adverse comment', no mitigation is required.

4.3 Transportation Noise Impact

FDBC suggested that a weekend train survey should be undertaken, in addition to weekday. Results are given in Section 3, showing that weekend levels are lower. Therefore the weekday results used in this report serve as a worst-case.

In order to accurately assess road and rail traffic noise across the Site, a 3D Noise Model has been constructed using the modelling software CadnaA. The following assumptions, inputs and considerations have been included in the model:

- Planning Layout as listed in Section 1;
- Site elevations have been taken as existing;
- Topographical data at 2m horizontal and 0.60m vertical resolution have been used;
- Existing buildings that provide shielding from any of the noise sources have been included in the model;
- A reflection order of 2 has been used in all calculations; and
- Noise levels generated using ISO 9613-1 and ISO 9613-2 "*Acoustics – Attenuation of sound during propagation outdoors*" as incorporated into the CadnaA software.

4.3.1 External Amenity Areas

In order to assess noise levels in external amenity areas across the Site, a grid noise map has been calculated in the model at a height of 1.5m above ground level, using the proposed site layout, and is shown in Figure 3 of Appendix III.

In accordance with BS8233:2014 and as proposed to the LPA, the criterion for noise levels in private outdoor amenity areas (private gardens) is 55dB $L_{Aeq,16hr}$ over at a significant section of each garden area, with 50% being desirable.

Without any consideration of any proposed fencing, Figure 3 shows that all proposed gardens meet the criterion of 55dBA.

Without mitigation in place, it is concluded that the NOAEL is achieved which would be noticeable and not intrusive resulting in the following:

"Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life."

4.3.2 Internal Habitable Rooms

The Building Noise Evaluation tool in the CadnaA noise modelling software has been used to calculate free-field levels outside façades, from which internal noise levels can be derived. Therefore, it is possible to place limits on façade levels to meet certain indoor noise criteria.

With regard to internal noise levels, BS8233:2014 suggest that a glazing unit with configuration 6mm glass/12mm air space/6mm glass affords sound insulation performance of the order of 33dBA; however, this is for a pink noise spectrum. The same unit, weighted for road traffic noise using the '+C_{tr}' correction, has a sound insulation performance value of approximately 30dBA, and so this value has been used to calculate internal noise levels. BS8233:2014 also goes on to recommend that a partially open window provides approximately 15dBA attenuation.

Using the above attenuations and the internal L_{Aeq} noise criteria of BS8233:2014, Appendix III Figures 4 and 5 show, for each façade and for both daytime and night-time, where mitigation is required.

Note that night-time criteria apply only to bedrooms, and daytime only for sensitive rooms used for daytime amenity, and not kitchens/bathrooms etc.

Additionally, for the M27 and railway, assessment of point sound sources calibrated to the 10th highest $L_{Amax,fast}$ recorded from the night-time period have been included in the model at representative points on the road and rail line. Required mitigation for the first floor (for bedrooms only) is shown in Figure 6.

Mitigation is discussed in Section 5.

Without mitigation in place, the LOAEL is achieved which would be noticeable and disruptive resulting in the following if windows were opened in order to provide background ventilation and for certain living rooms close to the road:

"Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance".

5. MITIGATION

5.1 Internal Habitable Rooms

Section 4 determined that daytime and night-time internal noise limits are exceeded for some facades where windows are open. These facades are marked up on Figure 4 for daytime amenity, and Figures 5 and 6 for bedrooms.

Accordingly, it is necessary to consider an alternative ventilation scheme which does not require the opening of windows to provide fresh air flow and background ventilation. Windows should remain openable for purge ventilation.

This might take the form of a through-frame window mounted trickle ventilator incorporated into the glazing unit of such habitable rooms so that fresh air can enter the room and provide background ventilation without having to open windows, this would be considered under System 1 of the Approved Document F.

The exact requirement for alternative ventilation ultimately falls to the developer and, from an acoustics perspective, needs to ensure that fresh air flow can be achieved without the need for opening windows. It is necessary to meet the requirements given in BS8233:2014, Section 8.4.5.4, which states that:

"The Building Regulations' supporting documents on ventilation [48, 49, 50] recommend that habitable rooms in dwellings have background ventilation. Where openable windows cannot be relied upon for this ventilation, trickle ventilators can be used and sound attenuating types are available. However, windows may remain openable for rapid or purge ventilation, or at the occupant's choice.

Alternatively, acoustic ventilation units (see 7.7.2) are available for insertion in external walls. These can provide sound reduction comparable with double glazed windows. However, ducted systems with intakes on the quiet side of the building might be required in very noisy situations, or where appearance rules out through-the-wall fans."

Section 7.7.2 states:

"NOTE 5 If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level."

With mitigation in place, it is concluded that the NOAEL is achieved which would be noticeable and not intrusive resulting in the following:

"Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life."

6.0 CONCLUSION

Ensafe have been commissioned by Miller Homes to undertake a Noise and Vibration Impact Assessment for a proposed residential development on agricultural land at Land East of Downend Road, Portchester, Hants.

This assessment has been undertaken to identify key noise and vibration sources in the vicinity of the Site which may have the potential to impact upon the proposed noise-sensitive residential development.

The Noise and Vibration Impact Assessment has identified that the key noise sources impacting upon the development are road traffic using the M27, trains using the adjacent railway line and commercial sound associated with the Veolia site to the north-west.

No adverse impact is found for commercial noise form the Veolia site.

This Noise and Vibration Impact Assessment has recommended alternative ventilation for certain specified bedrooms and daytime amenity spaces as an alternative to opening windows.

Subject to the incorporation of the identified mitigation measures, it is considered that in principle, the Site is suitable for the promotion of residential development.

APPENDIX I LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between Ensafe Limited and the Client as indicated in Section 1.2.

2. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.

3. Ensafe cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by Ensafe is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by Ensafe in this connection without their explicit written agreement there to by Ensafe.

4. Where a noise survey is required to inform the assessment, Ensafe will endeavour to ensure that all noise measurements taken are robust, representative and reliable in order to inform an accurate noise impact assessment. Where limitations or constraints exist which prevent a suitable noise survey being completed, Ensafe will take all reasonable steps to make the client fully aware of any such limitations or constraints with a view to achieving the best possible outcome for the client. Where additional sound surveys are required, over and above those specified in our scope of works, then Ensafe reserves the right to charge additional fees.

5. Where mitigation measures are specified in our report, it should be noted that these measures are relative to a specific sound source, both in terms of the measured sound pressure level and the character of the source. Where either the sound pressure level or the character of the sound varies following completion of the sound survey, Ensafe cannot be held responsible for any subsequent variations in the proposed mitigation performance.

APPENDIX II GLOSSARY OF ACOUSTICAL TERMINOLOGY

Noise

Noise is defined as unwanted sound. Human ears are able to respond to sound in the frequency range 20 Hz (deep bass) to 20,000 Hz (high treble) and over the audible range of 0 dB (the threshold of perception) to 140 dB (the threshold of pain). The ear does not respond equally to different frequencies of the same magnitude, but is more responsive to mid-frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates the response of the human ear, a weighting mechanism is used. This reduces the importance of lower and higher frequencies, in a similar manner to the human ear.

Furthermore, the perception of noise may be determined by a number of other factors, which may not necessarily be acoustic. In general, the impact of noise depends upon its level, the margin by which it exceeds the background level, its character and its variation over a given period of time. In some cases, the time of day and other acoustic features such as tonality or impulsiveness may be important, as may the disposition of the affected individual. Any assessment of noise should give due consideration to all of these factors when assessing the significance of a noise source.

The most widely used weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or L_{Aeq}, L_{A90} etc., according to the parameter being measured.

The decibel scale is logarithmic rather than linear, and hence a 3 dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective, but as a general guide a 10 dB(A) increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3 dB(A) is generally regarded as the minimum difference needed to perceive a change under normal listening conditions.

An indication of the range of sound levels commonly found in the environment is given in the following table.

Table A1: Typical Sound Pressure Levels

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

Acoustic Terminology

Table A2: Terminology

Descriptor	Explanation
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 (2x10-5Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
$L_{Aeq, T}$	L_{Aeq} is defined as the notional steady sound level which, over a stated period of time (T), would contain the same amount of acoustical energy as the A - weighted fluctuating sound measured over that period.
L_{Amax}	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 Leq noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
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 noise. It is common practice to use the L_{10} index to describe traffic noise.
Free-field Level	A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other reflective surfaces. Generally as measured outside and away from buildings.
Fast	A time weighting used in the root mean square section of a sound level meter with a 125millisecond time constant.
Slow	A time weighting used in the root mean square section of a sound level meter with a 1000millisecond time constant.

APPENDIX III FIGURES

Figure 1 - Proposed layout.

Figure 2 – Survey locations.

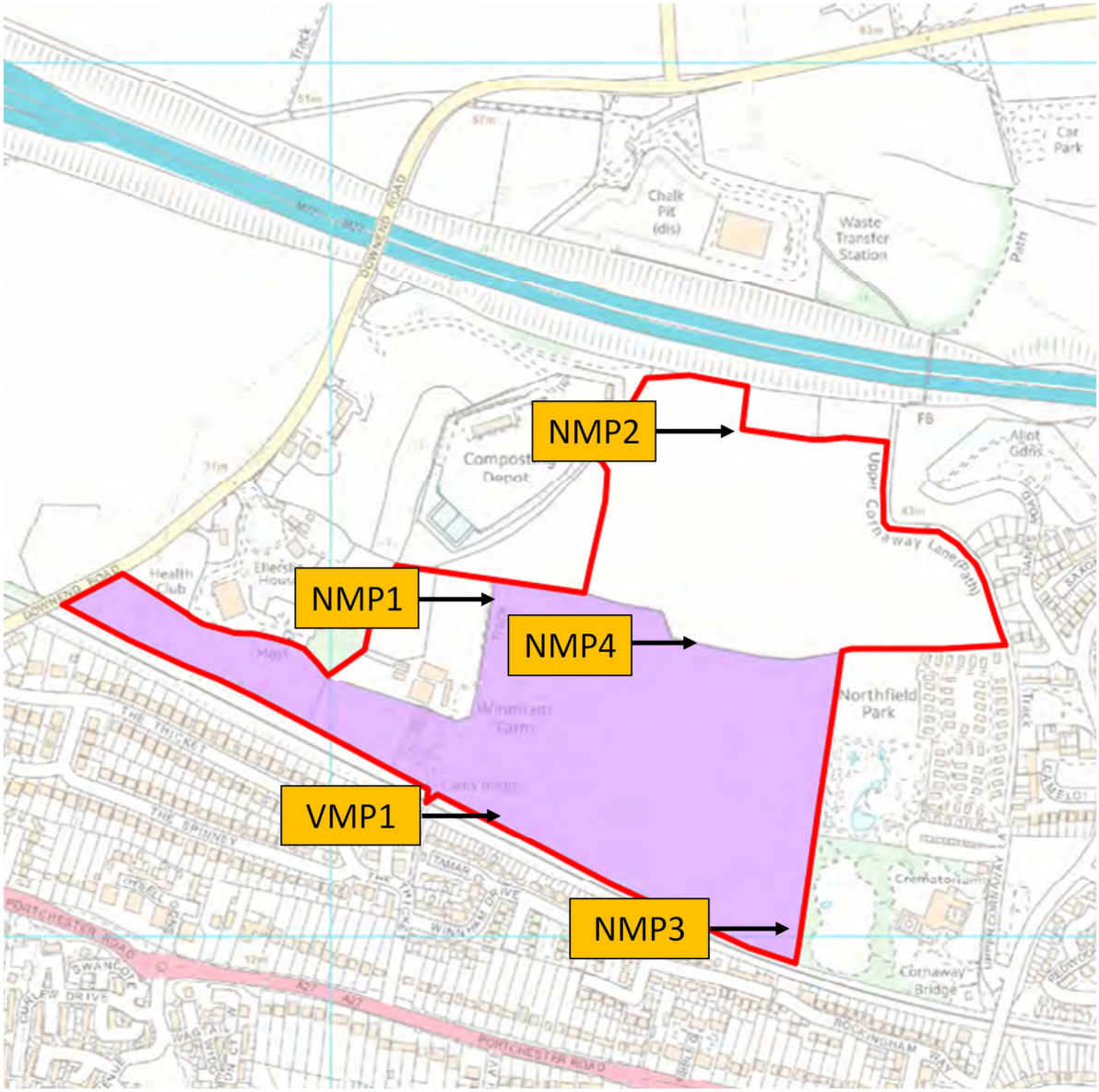

Figure 3 – External amenity

Figure 4 – Mitigation, ground floor daytime

Project:	Daytime external amenity noise level (dBA)	
Land East of Downend Road, Portchester	No mitigation Alt ventilation; 30 dBA glazing sufficient Alt ventilation and 32 dBA glazing Alt ventilation and 34 dBA glazing Alt ventilation and 36 dBA glazing Alt ventilation and 38 dBA glazing Alt ventilation and 40 dBA glazing	
Project-No:		
AC108766		Project Engineer: Dr. Nicholas Haigh

Figure 5 – L_{Aeq} Mitigation, first floor night-time

Project:	Daytime external amenity noise level (dBA)	
Land East of Downend Road, Portchester	No mitigation Alternative ventilation; 30 dBA glazing sufficient Alternative ventilation and 32 dBA glazing Alternative ventilation and 34 dBA glazing Alternative ventilation and 36 dBA glazing Alternative ventilation and 38 dBA glazing Alternative ventilation and 40 dBA glazing	
Project-No:		
AC108766		Project Engineer: Dr. Nicholas Haigh

Figure 6 – L_{AMax} Mitigation, first floor night-time

Project:	Daytime external amenity noise level (dBA)	
Land East of Downend Road, Portchester	No Mitigation required Alt ventilation and 30 dBA glazing Alt ventilation and 32 dBA glazing Alt ventilation and 34 dBA glazing Alt ventilation and 36 dBA glazing Alt ventilation and 38 dBA glazing Alt ventilation and 40 dBA glazing Alt ventilation and 42 dBA glazing Alt ventilation and 44 dBA glazing Alt ventilation and 46 dBA glazing	
Project-No:		
AC108766		Project Engineer: Dr. Nicholas Haigh

APPENDIX IV MEASURED BACKGROUND SOUND LEVELS

Table A3: Summary of Measured Noise Levels for NMP4 – Background survey.

Date and Start Time	Measured Sound Pressure Level, free-field (dB)	
	$L_{Aeq,T}$	L_{A90}
20/11/2016 07:00	49.8	47.1
20/11/2016 08:00	51.5	48.6
20/11/2016 09:00	53.1	50.4
20/11/2016 10:00	53.7	51.6
20/11/2016 11:00	53.1	51.5
20/11/2016 12:00	52.9	51.2
20/11/2016 13:00	52.0	49.7
20/11/2016 14:00	49.2	46.6
20/11/2016 15:00	48.3	46.0
20/11/2016 16:00	52.1	49.5
20/11/2016 17:00	54.7	52.3
20/11/2016 18:00	55.6	51.3
20/11/2016 19:00	57.3	55.4
20/11/2016 20:00	56.9	54.7
20/11/2016 21:00	56.4	54.1
20/11/2016 22:00	56.3	54.2
20/11/2016 23:00	55.0	52.7
21/11/2016 00:00	53.9	49.6
21/11/2016 01:00	55.7	50.2
21/11/2016 02:00	55.2	49.7
21/11/2016 03:00	55.1	48.6
21/11/2016 04:00	52.8	48.5
21/11/2016 05:00	52.8	49.2
21/11/2016 06:00	57.0	53.6
21/11/2016 07:00	57.7	55.9
21/11/2016 08:00	54.8	53.4
21/11/2016 09:00	55.7	53.3

21/11/2016 10:00	57.8	56.2
21/11/2016 11:00	58.1	56.0
21/11/2016 12:00	55.6	52.4
21/11/2016 13:00	57.6	50.9
21/11/2016 14:00	54.8	50.2
21/11/2016 15:00	55.5	50.4
21/11/2016 16:00	54.9	50.4
21/11/2016 17:00	55.2	50.5
21/11/2016 18:00	50.8	48.1
21/11/2016 19:00	49.0	47.5
21/11/2016 20:00	49.2	47.4
21/11/2016 21:00	48.1	45.9
21/11/2016 22:00	50.7	46.1
21/11/2016 23:00	56.8	47.5
22/11/2016 00:00	55.0	46.1
22/11/2016 01:00	52.5	42.4
22/11/2016 02:00	59.2	48.8
22/11/2016 03:00	63.3	51.6
22/11/2016 04:00	47.8	38.2
22/11/2016 05:00	49.3	41.6
22/11/2016 06:00	51.5	46.1