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Barry Waterfront

Environmental Statement
Chapter J

Noise & Vibration

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1.0 Introduction

1.1 This chapter considers the noise and vibration effects of the proposed development; specifically the effects of existing conditions on the suitability of the site for the proposed development and the effects of noise and vibration generated by the proposed development at sensitive locations, during both construction and operation/occupation of the proposed development.

1.2 In the context of this study, noise is defined as unwanted or undesirable sound derived from sources such as road traffic, air traffic or construction works that interfere with normal activities, including conversation, sleep or recreation. Vibration is defined as the transmission of energy through the medium of ground or air resulting in small movements of the transmitting medium, such as a building, which can cause discomfort or even damage to structures if the movements are large enough.

1.3 In summary, the chapter addresses:

- the potential constraints from existing sources of noise and vibration on the internal and external noise environments within the proposed development and where necessary the types of measures that might be adopted to overcome these constraints;
- the impact of noise and vibration on existing sensitive receptors during the demolition and construction works;
- the impact of noise from changes in road traffic resulting from the operation of the proposed development; and
- the impact of noise from the operation of any building services plant that may be associated with the development.

1.4 The methodology and criteria adopted in the assessment is presented in Section 3 and has been developed and agreed during consultation with the Environmental Health Department (EHD) of the Vale of Glamorgan Council (VoGC).

1.5 The assessment is based on the results of environmental noise and vibration measurements undertaken by RSK Ltd for the existing situation; both on the site and at noise-sensitive receptor locations in the vicinity, in addition to predicted future noise conditions once the development has been completed and occupied. The assessment identifies the potential for noise and vibration impacts, the availability of options for the mitigation of these impacts, and assesses the significance of residual impacts remaining after mitigation has been implemented.

1.6 Further technical details relating to the assessment, including an introduction to acoustics and a glossary of terms, are provided in Technical Appendix J1 which should be read in conjunction with this chapter.

2.0 Planning Policy Context

National Policy

Planning Guidance (Wales), Technical Advice Note (Wales) 11, Noise – October 1997

2.1 This note provides advice on how the planning system within Wales can be used to minimise the adverse impact of noise, without placing unreasonable restrictions on development or adding unduly to the costs and administrative burdens of business.

2.2 It outlines some of the main considerations which local planning authorities should take into account in drawing-up development plan policies and when determining planning applications for development, which will either generate noise or be exposed to existing noise sources.

Local Policy

Vale of Glamorgan (VoG): Unitary Development Plan (UDP): 1996 - 2011

2.3 The following policies relevant to potential noise and vibration impacts are contained within the VoG UDP.

Policy ENV 6 – The proposal would not cause unacceptable environmental effects by way of visual or noise intrusion.

Policy ENV 29 – Development will not be permitted if it would be liable to have an unacceptable effect on either people's health and safety or the environment from smoke, fumes, gases, dust, smell, noise, vibration, light or other polluting emissions.

Policy HOUS 8 – Subject to the provisions of Policy HOUS 2, development will be permitted which is within or closely related to the defined settlement boundaries provided that the proposal has no unacceptable effect on the amenity and character of existing or neighbouring environments of noise, traffic congestion, exacerbation of parking problems or visual intrusion.

Policy EMP 2 – Proposals for new business and industrial development including agricultural service industries and the extension, conversion and replacement of existing premises for such purposes, will be permitted if the proposal does not have an unacceptable effect on residential amenity by virtue of noise.

Policy TRAN 11 – In order to reduce the unacceptable environmental effects of heavy goods vehicles developments which generate HGV movements which would unacceptably affect the amenity and character of the existing or neighbouring environments by virtue of noise will not be permitted.

Policy SHOP 2 – New and improved retailing facilities within and adjoining established town / district shopping centres, and in the area of comprehensive redevelopment at Barry waterfront, will be permitted if the proposal has no unacceptable effect on the amenity and character of existing or neighbouring environments by virtue of noise.

3.0 Assessment Methodology & Significance Criteria

Consultation with Local Authority

3.1 An Environmental Health Officer (EHO), Rebecca Athay, within the EHD of the VoGC was consulted, to determine any specific requirements or policies in respect of noise and vibration.

3.2 Accordingly, the noise and vibration assessment chapter has been based on the methodologies and criteria agreed during this consultation. A summary of the discussions is presented below, with the subsequent confirmation email exchange presented in Appendix J2.

Suitability of site for residential elements of the proposed development

3.3 The assessment of the suitability of the site for residential development is required to be carried out in accordance with the guidance presented in Technical Advice Note (Wales) 11: 1997: *Noise*.

3.4 Where the advice contained within TAN 11 identifies that mitigation measures may be necessary to provide a commensurate level of protection against noise, then the guidance presented in BS 8233: 1999: *Sound insulation and noise reduction for buildings - Code of Practice* and the World Health Organisation (WHO): 1999: *Guidelines for community noise* should be referenced and used to derive appropriate criteria.

3.5 The EHO raised no concerns in relation to the potential impact of vibration arising from rail traffic on the local and main line railway, running to the north of the proposed development. Notwithstanding this, for completeness the following assessment also considers the potential impact of vibration on the suitability of the site for residential development, based on measurements carried out in accordance with the guidance presented in BS 6472: 2008: *Guide to evaluation of human exposure to vibration in buildings*, Part 1, *Vibration sources other than blasting.*

Construction Noise and Vibration Impacts

3.6 The impact of noise and vibration during construction of the proposed development requires prediction and assessment in accordance with the guidance presented in BS 5228: 2009: *Code of practice for noise and vibration control on construction and open sites.*

3.7 The EHO stated that for a development of this size, nature and construction duration, that agreement on the proposed working methods, working hours and noise control strategy would be required, once detailed information on the

proposed phasing and precise methodologies is available, prior to the commencement of significant works.

Changes in Road Traffic Noise

3.8 The impact of changes in noise level resulting from new roads associated with the scheme and changes in traffic flow and composition on existing roads as a result of the proposed development, requires assessment in accordance with the guidance presented in the Design Manual for Roads and Bridges (DMRB): 2008: Volume 11 *Environmental Assessment*: Section 3 *Environmental Assessment Techniques.*

3.9 Given the nature of the proposed development, the EHO stated that every effort should be made to control the impact of road traffic noise, with further mitigation or robust justification being required, should predicted noise levels at existing noise-sensitive receptor locations increase by more than 3 dB(A).

Building Services Plant

3.10 The impact of noise from any building services associated with the proposed development requires assessment in accordance with British Standard 4142: 1997: *Method for rating industrial noise affecting mixed residential and industrial areas* required, either to assess the impact of, or propose limits for such equipment.

3.11 The EHO stated that the $L_{Ar,Tr}$ rating noise level from such equipment (including as appropriate an 'acoustic correction') should ideally not exceed the existing $L_{A90,T}$ background noise level at noise-sensitive receptor locations.

3.12 The measurement, prediction and assessment of noise and vibration levels associated with the proposed development and the significance of their potential impacts have been assessed in accordance with national guidance and recognised codes of practice, as requested by the EHD of VoGC. These are discussed below and have been specifically applied to the following conceptual significance impact matrix as appropriate.

Site Preparation and Construction Phase

Construction Noise

3.13 Noise levels generated by construction activities have the potential to impact upon nearby noise-sensitive receptors. However, the significance of the potential impact will depend upon a number of variables, such as:

- the noise generated by plant or equipment used on-site;
- the period of time construction plant is operational;
- the distance between the noise source and the receptor; and
- the level of attenuation likely due to ground absorption and barrier effects.

3.14 TAN 11 references BS 5228 as presenting an appropriate methodology to predict and assess noise emission levels from a construction site.

3.15 BS 5228 sets out a methodology for predicting, assessing and controlling noise levels arising from a wide variety of construction and related activities. As such, it can be used to predict noise levels arising from the operations at proposed construction sites. BS 5228 also sets out tables of sound power levels generated by a wide variety of construction plant to facilitate such predictions.

3.16 Noise levels generated by the proposed site operations and experienced at local receptors will depend upon a number of variables, the most significant of which are:

- the amount of noise generated by plant and equipment being used at the development site, generally expressed as a sound power level;
- the periods of operation of the plant at the development site, known as the "on-time";
- the distance between the noise source and the receptor, known as the "stand-off";
- the attenuation due to ground absorption or barrier screening effects; and
- the reflection of noise due to the presence of hard vertical faces such as walls.

3.17 BS 5228 gives several examples of acceptable limits for construction or demolition noise. The most simplistic being based upon the exceedance of fixed noise limits and states in paragraph E.2:

"Noise from construction and demolition sites should not exceed the level at which conversation in the nearest building would be difficult with the windows shut."

3.18 Paragraph E.2 goes on to state:

"Noise levels, between say 07.00 and 19.00 hours, outside the nearest window of the occupied room closest to the site boundary should not exceed: 70 decibels (dBA) in rural, suburban areas away from main road traffic and industrial noise or 75 decibels (dBA) in urban areas near main roads in heavy industrial areas. These limits are for daytime working outside living rooms and offices."

3.19 Notwithstanding the urban nature of the area surrounding the site and indeed the previously industrial nature of the proposed development site itself, the existing noise climate at the location of the existing noise-sensitive receptors in the vicinity of the site is considered more comparable to that of a suburban area away from road traffic and industrial noise.

3.20 Accordingly, and to represent a worst case, 70 dB $L_{Aeq,T}$ has been selected as the target criteria to control the impact of construction noise, with the criteria for assessing the magnitude of noise impacts according to the margin by which this target criteria is achieved or exceeded presented in Table J1 below.

Noise Level, $L_{Aeq,T}$ dB	Significance of Impact
>75	Major Adverse
70 - 75	Moderate Adverse
55 - 70	Minor Adverse
<55	Negligible

Table J1: Criteria for assessing the magnitude of construction noise impacts

3.21 It is worth noting that the purpose of the target construction noise criteria is to control the impact of construction noise insofar as is reasonably practicable, whilst recognising that it is unrealistic for developments of this nature to be constructed without causing some degree of disturbance in the locality. Hence, even if the criteria adopted for this assessment is achieved, noise from construction activities is likely to be readily noticeable and as such, in broad assessment terms may be approaching in adverse impact level of moderate significance.

Construction Vibration

3.22 Vibration may be impulsive, such as that due to hammer-driven piling; transient, such as that due to vehicle movements along a railway; or continuous, such as that due to vibratory driven piling. The primary cause of community concern generally relates to building damage from both construction and operational sources of vibration, although, the human body can perceive vibration at levels which are substantially lower than those required to cause building damage.

3.23 Damage to buildings associated solely with ground-borne vibration is not common and although vibration may be noticeable, there is little evidence to suggest that they produce cosmetic damage such as a crack in plaster unless the magnitude of the vibration is excessively high. The most likely impact, where elevated levels of vibration do occur during the demolition and construction phases, is associated with perceptibility.

3.24 BS 5228 indicates that the threshold of human perception to vibration is around 0.15mm/s, although it is generally accepted that for the majority of people vibration levels in excess of between 0.15 and 0.3 mm/s peak particle velocity (ppv) are just perceptible.

3.25 There are currently no British Standards that provide a methodology to predict levels of vibration from construction activities, other than that contained within

BS 5228 which relates to percussive or vibratory piling only. Therefore, it is not possible to accurately predict levels of vibration during the site preparation and construction phases of the development. As such, to control the impact of vibration during the site preparation and construction of the proposed development, limits relating to the perceptibility of vibration have been set.

3.26 Accordingly 1 mm/s ppv has been selected as the target criteria to control the impact of construction vibration, with the criteria for assessing the magnitude of vibration impacts according to the margin by which this target criterion is achieved or exceeded presented in Table J2 below. This target criterion is based on the guidance contained within BS 5228, experience from previous sites and accepted vibration policy criteria across a range of enforcing authorities elsewhere in the UK. The limits are presented in terms of peak particle velocity (PPV) as it is the simplest indicator for both perceptibility and building damage.

Vibration Level, mm/s ppv	**Significance of Impact**
>1.0	Major Adverse
0.30 - 1.0	Moderate Adverse
0.15 - 0.30	Minor Adverse
<0.15	Negligible

Table J2: Criteria for assessing the magnitude of construction vibration impacts

3.27 It is worth noting that the purpose of the target construction vibration criteria is to control the impact of construction vibration insofar as is reasonably practicable and is entirely based on the likelihood of the vibration being perceptible, rather than causing damage to property. Hence, although vibration levels in excess of 1 mm/s ppv would be considered a major adverse impact in respect of the likelihood of perceptibility, they would not be considered significant in terms of the potential for building damage, which would require levels of at least 15 mm/s ppv to result in minor cosmetic damage in light / unreinforced buildings.

Operational Phase

Suitability of Site for Residential Development - Noise

3.28 The aim of noise policy within Wales is to protect individuals from excessive noise levels both in the workplace and within their homes. It has been recognised that severe annoyance to individuals due to noise can lead to sleep disturbance and adverse health effects.

3.29 Technical Advice Notes set out the Government's policies on different aspects of planning. TAN 11 outlines the considerations for planning authorities in assessing planning applications with respect to noise sensitive and noise-generating developments.

3.30 TAN 11 introduces the concept of noise exposure categories (NECs), intended to assist local planning authorities in assessing the suitability of new residential developments alongside existing transport related noise sources. The NECs A to D categorise noise level ranges for different transportation noise sources which are defined in terms of $L_{Aeq,T}$ during the daytime period (07:00 to 23:00 hours) and the night-time period (23:00 to 07:00 hours).

3.31 In order to assess the NEC within which all or part of a site falls, existing noise levels are compared with the corresponding values for each NEC as set out in Table J3 below. The 'road traffic' category has been used for comparative purposes in this instance as it is taken to best reflect the sources of noise in the vicinity of the site.

Noise Source		Noise Exposure Category			
		A	B	C	D
Road Traffic	07.00-23.00	<55	55-63	63-72	>72
	23.00-07.00	<45	45-57	57-66	>66

Table J3: Noise Levels Corresponding to NEC's for new dwellings, $L_{Aeq,T}$ dB, free-field

3.32 The advice given in TAN 11 to local authorities when considering new development applications with respect to each NEC, is summarised in Table J4 below.

NEC	Advice to Planning Authority
A	Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as desirable.
B	Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise.
C	Planning permission should not normally be granted. Where it is considered that permission should be given, for example because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise.
D	Planning permission should generally be refused.

Table J4: Planning advice corresponding to NEC's for new dwellings

3.33 Where development land falls in NEC B, C and D, reference is made to other standards, such as BS 8233 or WHO guidelines, to guide the design of noise mitigation measures and determine whether the proposed development is capable of providing a commensurate level of protection against noise.

3.34 BS 8233, for example, makes recommendations for the control of noise in and around buildings. It suggests appropriate criteria for different situations and is primarily intended to guide the design of new or refurbished buildings undergoing a change of use rather than to assess the effect of changes in the external noise climate. It recommends 'good' and 'reasonable' internal noise levels, but does not define under what conditions these different standards might apply. The noise levels recommended in BS 8233 are almost identical to those presented in WHO guidelines.

3.35 The recommendations and guidance presented in TAN 11, BS 8233 and the WHO guidelines and summarised above has been used to derive criteria for assessing the impact of noise on the suitability of the site for residential development based on noise exposure levels at the site, and for assessing the impact of noise within the proposed residential dwellings once constructed, which will include any specific noise mitigation proposed in accordance with TAN 11 guidance for areas of the site classified as NEC B, C or D.

Daytime Noise Level	Night-time Noise Level	Significance of Impact
Noise Exposure Levels at Site		
>66 dB $L_{Aeq,T}$	>72 dB $L_{Aeq,T}$	Major Adverse
57 - 66 dB $L_{Aeq,T}$	63 - 72 dB $L_{Aeq,T}$	Moderate Adverse
45 - 57 dB $L_{Aeq,T}$	55 - 63 dB $L_{Aeq,T}$	Minor Adverse
<45 dB $L_{Aeq,T}$	<55 dB $L_{Aeq,T}$	Negligible
Internal Noise Levels		
> 40 dB $L_{Aeq,T}$	> 35 dB $L_{Aeq,T}$	Major Adverse
35 - 40 dB $L_{Aeq,T}$	33 - 35 dB $L_{Aeq,T}$	Moderate Adverse
30 - 35 dB $L_{Aeq,T}$	30 - 33 dB $L_{Aeq,T}$	Minor Adverse
<30 dB $L_{Aeq,T}$	<30 dB $L_{Aeq,T}$	Negligible

Table J5: Criteria for assessing the suitability of the site for residential development in respect of noise

Suitability of Site for Residential Development - Vibration

3.36 The assessment of potential vibration impacts has been carried out in accordance with BS 6472: 2008 *Guide to evaluation of human exposure to vibration in buildings*, Part 1, *Vibration sources other than blasting,* which provides guidance over the frequency range 0.5 Hz to 80 Hz

3.37 BS 6472 describes how to determine the vibration dose value, VDV, from frequency-weighted vibration measurements. The vibration dose value is used to estimate the probability of adverse comment, which might be expected from human beings experiencing vibration in buildings. Consideration is given to the time of day and use made of occupied space in buildings, whether residential,

office or workshop. BS 6472 states that in homes, adverse comment about building vibrations is likely when the vibration levels to which occupants are exposed are only slightly above thresholds of perception.

3.38 BS 6472 contains a methodology for assessing the human response to vibration in terms of either the vibration dose value, or in terms of the acceleration or the peak velocity of the vibration, which is also referred to as peak particle velocity. The advice contained in BS 6472 states that when the vibration is intermittent, as is the case at this site, with the only significant potential source of vibration being the railway to the north, the vibration dose value, or VDV, may be used to assess the potential for impacts.

3.39 Appropriately-weighted vibration measurements can be aggregated to derive the vibration dose values. The vibration dose value is a single figure descriptor that represents the cumulative dose of transient vibrations, taking into account the frequency spectrum and duration of each event. The vibration dose value is determined over a 16 hour daytime period or 8 hour night-time period.

3.40 The recommendations and guidance presented in BS 6472 has been used to derive criteria for assessing the impact of vibration on the suitability of the site for residential development, as set out in Table J6 below.

Daytime Vibration Level, VDV	Night-time Vibration Level, VDV	Significance of Impact
>1.6	>0.51	Major Adverse
0.80 - 1.6	0.26 - 0.51	Moderate Adverse
0.20 - 0.80	0.13 - 0.26	Minor Adverse
<0.20	<0.13	Negligible

Table J6: Criteria for assessing the potential impact of vibration

Road Traffic Noise Impacts

3.41 The impact of any changes in road traffic noise levels has been assessed in accordance with the principles and guidance presented within the Design Manual for Roads and Bridges (DMRB).

3.42 The DMRB states that *"The impact of a project at any location can be reported in terms of changes in absolute noise level. In the UK the standard index used for traffic noise is the $L_{A10,18hour}$ level, which is quoted in decibels".*

3.43 In order to determine whether changes in traffic noise levels are likely to occur as a result of the proposed development, noise levels have been predicted in accordance with the methodology contained within the Calculation of Road Traffic Noise (CRTN), based on traffic flow data for the local road network with and without the development.

3.44 The DMRB also presents an impact significance matrix for assessing the magnitude of changes in noise level, which has been used as criteria for assessing the impact of any changes in road traffic noise levels and is summarised in Table J7 below.

Change in Noise Level, dB(A)	Significance of Impact
>5.0	Major Adverse
3.0 - 4.9	Moderate Adverse
1.0 - 2.9	Minor Adverse
0.0 - 0.9	Negligible

Table J7: Criteria for assessing the impact of changes in road traffic noise levels

Building Services Plant

3.45 Given the outline nature of the proposed development application, the precise nature, extent and location of building services / fixed plant items to be installed are not yet known. Accordingly, limits have been set for building services plant, which if adopted, will ensure that noise from such sources does not give rise to complaints from sensitive receptors.

3.46 The limits have been set in accordance with the principles of BS 4142, which sets out a method to assess whether noise from factories, industrial premises or fixed installations is likely to give rise to complaints from noise-sensitive receptors in the vicinity. The procedure contained in BS 4142 for assessing the likelihood of complaint is to compare the measured or predicted noise level from the source in question, outside the dwelling - the $L_{Aeq,T}$ 'specific' noise level, with the measured $L_{A90,T}$ 'background' noise level.

3.47 Where the noise contains a 'distinguishable discrete continuous note (whine, hiss, screech, hum etc.) or if there are distinct impulses in the noise (bangs, clicks, clatters or thumps), or if the noise is irregular enough to attract attention' then a correction of +5 dB is added to the specific noise level to obtain the 'rating' $L_{Ar,Tr}$ noise level.

3.48 The likelihood of the noise giving rise to complaints is assessed by subtracting the background noise level from the rating noise level. BS 4142 states 'A difference of around 10 dB or higher indicates that complaints are likely. A difference of around 5 dB is of marginal significance. A difference of –10 dB is a positive indication that complaints are unlikely.'

3.49 The daytime assessment is carried out over a 1-hour period and the night-time assessment is carried out over a 5-minute period. The periods associated with day and night are not defined within BS 4142, but the standard states that night should cover the times when the general adult population are preparing for sleep or are actually sleeping. For the purpose of this study the periods presented in TAN 11 have been used for the daytime (07:00 to 23:00) and night-time (23:00 to 07:00) periods.

3.50 It is considered that with new developments, the opportunity exists to minimise potential noise impacts with an acoustically sympathetic design approach. As such, and in accordance with the requirements of the EHD of the VoGC, the target rating noise level criteria for building services plant is for it not to exceed the numerical value of existing background noise level at noise-sensitive receptor in the vicinity.

3.51 The guidance presented in BS 4142 and the target criteria agreed with the VoGC has been used to derive criteria for assessing the impact of building services plant noise, as presented in Table J8 below.

Excess of $L_{Ar,Tr}$ Rating Noise Level above Existing $L_{A90,T}$ Background Noise Level	**Significance of Impact**
10 dB or more	Major Adverse
5 - 10 dB	Moderate Adverse
0 - 5 dB	Minor Adverse
0 dB or less	Negligible

Table J8: Criteria for assessing the impact of building services plant

4.0 Baseline Conditions

4.1 The baseline conditions across the site have been determined by a combination of environmental noise and vibration measurements and computerised noise modelling techniques. This combined approach has been employed due to the extent of the site, the complex topography adjacent to the southern boundary and the necessity for the subsequent noise assessment to consider sources of noise such as proposed roads, that do not currently exist.

4.2 The existing noise conditions at the site and at noise-sensitive receptors in the vicinity have been determined by detailed environmental noise and vibration measurements, which commenced on Monday 22nd June 2009. With the exception of one noise measurement and one vibration measurement position that was largely unattended for a continuous 24-hour period, the measurements were fully attended, with most carried out during both daytime and night-time periods.

4.3 The primary purpose of the noise survey was to gather sufficient acoustic information on noise levels at the site and at existing noise-sensitive receptor locations in the vicinity of the site during daytime and night-time periods, to validate the predictive noise modelling carried out in the following assessment and to allow appropriate noise limits to be set for any proposed building services plant.

Key Noise Sources

4.4 The site is currently disused and best described as derelict. As such, no significant sources of noise are currently present on the proposed development site, other than natural sources such as seagulls.

4.5 The most significant sources of noise at the site and in the surrounding area were noted to be from road traffic on the surrounding local network, noise from natural sources such as seagulls, noise from occasional passenger train movements between Barry and Barry Island, as well as occasional freight and passenger trains on the main line located over 100 metres to the north of the site.

Measurement Survey

4.6 The environmental noise measurements were carried out between Monday 22nd and Tuesday 23rd June 2009, to determine the prevailing noise levels during daytime and night-time periods.

4.7 The weather conditions during the survey were conducive to noise, with warm dry conditions, with wind speeds ranging from 1 to 4 m/s, with the wind direction varying between NW to SW on the 22nd, to NNE to SE on the 23rd.

4.8 All noise measurements were undertaken between 1.2 and 1.5 metres above local ground level and under free-field conditions. The microphones were fitted with protective windshields for the measurements. The vibration measurements were carried out with the transducers placed on open earth and weighed down with sand bags to ensure a good connection with the surrounding area.

4.9 All acoustic measurement equipment used during the noise surveys conformed to Type 1 specification of British Standard 61672. A full inventory of this equipment is presented in Table J9 below.

Item	Make & Model	Serial Number
A - Sound Level Meter	01dB-Metravib Solo	61280
A - Preamplifier	01dB-Metravib PRE 21 S	14175
A - Microphone	GRAS MCE 212	96399
B - Sound Level Meter	Rion NA-28	00370297
B – Preamplifier	Rion NH-23	60306
B – Microphone	Rion UC-59	00386
Calibrator	Larson Davis Cal 200	3724
Vibration Meter	Vibrock V901	747

Table J9: Inventory of Acoustic Measurement Equipment

4.10 All noise measurements were undertaken by a consultant certified as competent in environmental noise monitoring, and, in accordance with the principles of BS 7445: 2003: *Electroacoustics. Sound level meters,* Part 1 *Specifications* and following the guidance given in BS 4142. The noise parameters of $L_{Aeq,T}$, $L_{A90,T}$, $L_{A10,T}$, and $L_{AFmax,T}$ were recorded at each position.

4.11 All vibration measurements were undertaken by a consultant competent in vibration monitoring in accordance with the principles of BS 6472. The vibration meter was a self-calibrating meter and had been laboratory calibrated within the 12 months preceding the survey.

4.12 The measurements were recorded at nine positions which are described in more detail below and identified in Figure J1.

- Position 1 – Daytime and night-time receptor noise measurement;
- Position 2 – Daytime and night-time receptor noise measurement;
- Position 3 – Daytime shortened CRTN validation noise measurement;
- Position 4 – Daytime and night-time receptor noise measurement;
- Position 5 – Continuous 24 hr validation noise measurement
- Position 6 – Daytime and night-time receptor noise measurement;
- Position 7 – Daytime and night-time receptor noise measurement;
- Position 8 – Daytime shortened CRTN validation noise measurement; and
- Position 9 – Continuous 24 hr railway vibration measurement.

4.13 The 'daytime and night-time receptor measurements' carried out at Position's 1, 2, 4, 6 and 7, were primarily carried out for the purpose of setting limits for building services plant at the closest existing noise sensitive receptor locations to the site, in addition to general baseline noise model validation. Accordingly, the measurements were focussed on periods of typical noise level during the day when receptors are less sensitive to noise and the absolute quietest period of the night (0200-0400) when receptors are most sensitive to noise. This approach then allows a range of limiting noise levels for building services plant to be derived, depending on the intended hours of operation.

4.14 A summary of recorded noise measurement results for Positions 1 - 8 during the daytime and night-time periods is presented in Table J10 and J12 respectively below. Full tabulated results are provided in Technical Appendix J3.

Position	Start Time	Duration	Noise Level, dB			
			$L_{Aeq,T}$	L_{AFmax}	$L_{A90,T}$	$L_{A10,T}$
1	23/06/2009 10:09	30 mins	48.5	72.3	43.5	49.1
2	23/06/2009 09:30	30 mins	61.3	79.3	44.7	65.4
3	22/06/2009 10:49	3-hours	64.8	94.9	57.5	67.2
4	23/06/2009 08:37	40 mins	50.6	71.2	52.1	47.1
5	22/06/2009 10:13	16-hours	54.8	84.0	44.0	54.1
6	23/06/2009 11:20	30 mins	52.9	74.2	43.9	52.9
7	23/06/2009 10:44	30 mins	53.2	73.6	39.3	48.8
8	22/06/2009 13:58	3-hours	67.1	95.0	49.9	70.2

Table J10: Daytime Noise Measurement Results

Position	Start Time	Duration	Noise Level, dB			
			$L_{Aeq,T}$	L_{AFmax}	$L_{A90,T}$	$L_{A10,T}$
1	23/06/2009 02:54	15-mins	35.9	49.9	32.0	35.2
2	23/06/2009 02:28	15-mins	44.7	69.2	37.1	31.6
4	23/06/2009 02:08	15-mins	38.0	61.7	33.3	38.1
5	22/06/2009 10:13	8-hours	47.1	76.2	41.1	45.3
6	23/06/2009 03:40	15-mins	48.0	66.4	42.8	50.4
7	23/06/2009 03:16	15-mins	39.1	59.3	33.1	38.0

Table J11: Daytime Noise Measurement Results

4.15 A summary of recorded vibration measurement results for Position 9 during the daytime and night-time periods is presented in Table J12 below

Position	Start	Duration	Vibration Level, VDV		
			X Axis	Y Axis	Z Axis
9	22/06/2009 10:00	13-hours	0.022	0.020	0.029
	22/06/2009 23:00	8-hours	0.018	0.018	0.026
	23/06/2009 0700	6-hours	0.021	0.021	0.030

Table J12: Vibration Measurement Results

Baseline Noise Modelling

4.16 Given the geographical extent of the proposed development site, the dominance of noise from road traffic on the noise climate at the site and the ready availability of existing traffic flow data on the surrounding road network, a noise modelling exercise has been undertaken to provide a clear representation of noise levels across the proposed development site.

4.17 The propagation of noise from road traffic on the surrounding network has been predicted using the Cadna/A suite of noise modelling software. The Cadna/A

noise model utilises standard acoustic principles in conjunction with approved prediction methodologies and is a tried and tested method for accurately predicting noise from a variety of sources. In this case, the model was set up to undertake predictions in accordance with the Calculation of Road Traffic Noise (CRTN) prediction methodology.

4.18 The model is based on 18-hour Annual Average Weekday Traffic (AAWT) flows and vehicle composition information provided by Arup for the 2008 existing situation, for the key roads that surround the site, as detailed in Transportation Chapter D of this ES.

4.19 To allow prediction of both daytime and night-time noise levels from the 18-hour traffic flow data provided above, the DEFRA/TRL $L_{A10,18hour}$ 'End Correction' *Method for converting the UK road traffic noise index LA10,18h to the EU noise indices for road noise mapping* has been utilised.

4.20 To comply with the requirements of the Environmental Noise Directive, which require member states to produce noise exposure maps in terms of L_{den} and L_{night} indices, TRL Limited were commissioned by DEFRA to develop an interim computation method for use in the UK, to determine $L_{Aeq,12hour}$ (daytime 0700-1900), $L_{Aeq,4hour}$ (evening 1900-2300) and $L_{Aeq,8hour}$ (night-time 2300-0700) noise levels, from the $L_{A10,18hour}$ values predicted in accordance with the UK national road traffic noise prediction methodology CRTN. The 'End Correction' was subsequently derived and has been utilised in this instance to allow consideration of both $L_{Aeq,16hour}$ daytime (0700-2300) and $L_{Aeq,8hour}$ night-time (2300-0700) noise levels, from the $L_{A10,18hour}$ daytime (0600-0000) noise levels predicted in accordance with the CRTN prediction methodology.

4.21 The site and surrounding area has been assumed as acoustically reflecting 'hard ground'. The model considers the presence of all existing buildings that surround the site, which were assumed as acoustically reflecting. The model was set to consider one order of reflection and to assume light down wind propagation in all directions. This is considered to represent a typical worst case in terms of noise propagation from the roads in the area across the proposed development site.

4.22 The predicted $L_{Aeq,16hour}$ daytime and $L_{Aeq,8hour}$ night-time noise levels across the site for the 2008 baseline 'open site' situation are presented in Figures J2 and J3.

5.0 Potential Impacts

Site Preparation and Construction Phase

Construction Noise

5.1 The operation of equipment associated with site preparation and construction of the proposed development has the potential to result in noise impacts at existing noise sensitive receptors in the vicinity. Furthermore, construction activities associated with the later phases of the development have the potential to impact upon the occupants of the early phases of the development

5.2 In order to predict and assess the impact of noise during construction of the proposed development, noise predictions have been undertaken using the noise modelling suite Cadna/A, which implements the full range of UK calculation methods, including BS 5228.

5.3 The prediction procedure essentially involves taking the source noise level of each item of plant and correcting it for (i) distance effects between source and receiver (ii) percentage operating time of the plant; (iii) barrier attenuation effects; (iv) ground absorption; and (v) facade corrections. The latter correction involves a 3 dB noise increase due to the reflection effects for a receiving point location 1m in front of a building facade. All predictions presented in this section include the façade correction and in addition, assume that the ground between the source and receiver is acoustically hard, to represent worst case.

5.4 Details of the plant and assumptions made in the construction noise predictions are provided in Technical Appendix J4. The predictions are based on source noise data for the various items of plant, as presented in BS 5228.

5.5 The construction works associated with the proposals have been divided into four discrete sub-phases: enabling works (including demolition and site preparation); sub-structure (including digging out of basement and forming the foundations); super-structure (building erection); and roads (minor road improvement works, paving and landscaping), and plant complements typical of each phase have been assumed.

5.6 Notwithstanding that four discrete construction phases have been identified for the purpose of predicting noise emission levels and potential impacts, the proposed phasing of the development, as described in Chapter C is such that some overlap between phases is likely to occur when consider the geographical extent of the site.

5.7 In respect of the sub-structure phase of construction, the assumptions presented in Technical Appendix J4 identify that for the sub-structure phase, consideration has been given to the use of conventional bore piling rigs for the formation of foundations, which represents a robust worst case when compared

to the augured techniques that are more likely to occur in practise. However, it is understood that the ground conditions in certain areas of the site, may at times necessitate the use of potentially noisier driven piling techniques.

5.8 Accordingly, consideration has also been given to the potential impact, should driven piling be undertaken. It is understood that if driven piling is required, it is most likely to involve driving pre-cast concrete piles with a hydraulic drop hammer. The noise emission for such driven piling is dependant on the ground conditions and the type of dolly utilised, with the noise levels predicted below being based on the logarithmic average of sound emission levels for piling in similar ground conditions with a variety of dollies.

5.9 With regard to barrier attenuation effects, consideration has been given to the acoustic screening that will be provided by permanent structures on the intervening land between the proposed construction areas and receptor, in addition to the topography of the area. However, the construction noise predictions assume no attenuation from site hoardings at receptor locations.

5.10 Construction noise levels have been predicted at the closest existing residential receptor locations to the proposed development parcels, which are identified in Figure J4.

5.11 The predicted noise levels are ‘worst case’, assuming the shortest distance between the source of construction noise and the receptor. The noise levels predicted at the closest façade of each construction assessment position during each phase and sub-phase of the works are shown in Table J13.

Receptor	Phase				
	Enabling Works	Sub-structure	Super-Structure	Roads	Driven Piling
1	63	65	61	56	68
2	65	65	63	62	78
3	66	68	64	59	71
4	67	69	65	60	72
5	57	59	55	50	62
6	61	63	59	54	66
7	60	62	58	53	65
8	66	69	64	59	71
9	69	72	68	63	74
10	66	69	64	59	71

Table J13: Predicted Façade Construction Noise Levels (Worst-Case), $L_{Aeq,T}$ dB

5.12 Comparison of the results presented in Table J13 above with the target noise criterion of 70 dB $L_{Aeq,10hour}$ identifiies that facade noise levels are predicted to meet the target criteria for worst case operations at all receptors, for all phases of work, with the exception of any sub-structure works carried out in close proximity to receptor location 9 and driven piling activities at the site boundary closest to Receptors 2. 3. 4. 8, 9 and 10.

5.13 Comparison of these results with the significance criteria presented in Table J1 identifies that for the majority of phases, at the majority of receptors, construction noise impacts would be classified as ‘minor adverse’, with the exceedance at receptor location 9 being classified as a ‘moderate adverse’ impact. For driven piling, the impact at receptor locations 3, 4, 8, 9 and 10 would be 'moderate adverse', within impacts at receptor 2 being classed as 'major adverse' as they exceed 75 dB.

5.14 Accordingly mitigation measures have been considered in the following Section, to reduce impacts and to ensure that the target noise level is achieved at all receptors.

5.15 Predictions have also been carried out to determine the distances at which the combination of activities associated with each construction phase are likely to exceed the target facade construction noise criterion level of 70 dB(A). These distances are presented in Table J14, below and are again, worst case, assuming hard ground conditions and a clear line of sight from the source to the receiver.

Phase	Distance at which 70 dB $L_{Aeq,10hour}$ would be exceeded at façade
Enabling Works	67 metres
Sub-structure	80 metres
Super-structure	54 metres
Roads	29 metres
Driven Piling	121 metres

Table J14: Distances at which Noise from Construction Works is Likely to Exceed 70 dB $L_{Aeq,T}$ at Facade

5.16 The likely exceedance distances presented in Table 14 will be of assistance in determining the eventual timing of any of the proposed construction activities that are due to occur after the occupation of the early completed residential phases of the Proposed Development, or indeed where discrete phases of work are likely to overlap The distances presented in Table 14 can be utilised within the Construction Environmental Management Plan (CEMP), as critical distances from occupied dwellings in which the above activities should ideally not take place, without further detailed predictions, assessment and where necessary targeted and specific mitigation measures.

Construction Traffic

5.17 The greatest increase in road traffic on the local network as a result of vehicles accessing the site is predicted to occur in 2010, for a period of several months as a result of significant material imports.. During this period, traffic flows on the key roads used to access the application site are predicted to increase by up to 240 HGV and 100 car movements per day.

5.18 In general, significant increases in road traffic noise for receptors in the vicinity of existing roads only occur if traffic flows of dramatically increased The calculation methodology set out in CRTN identifies that a doubling of traffic flow equates to a noise increase of 3 dB, assuming that conditions such as speed and road surface remain unchanged and that the hourly distribution of the additional construction vehicles is similar to that of existing site traffic.

5.19 Given the nature of the vehicles that require access to the site, all of the proposed construction traffic access routes utilised routes that already carry significant flows of traffic. Accordingly, the greatest potential increase in traffic noise levels will be on the final approach to the site, along Ffordd y Mileniw where existing traffic flows are lowest.

5.20 The biggest increase in traffic noise levels predicted in accordance with CRTN along this stretch of road is 0.6 dB. When compared with the assessment criteria adopted for this assessment, this change in noise would be described as an imperceptible increases in noise of at most, negligible significance.

5.21 As such, no further mitigation measures will be required to control the impact of construction traffic at any residential receptor locations.

Construction Vibration

5.22 Damage to buildings associated solely with ground-borne vibration is not common and although vibration may be noticeable, there is little evidence to suggest that they produce cosmetic damage such as cracks in plaster unless the magnitude of the vibration is excessively high. The most likely impact, where elevated levels of vibration do occur during the construction works, will be associated with perceptibility.

5.23 Table J15 below details the distances at which certain construction activities could give rise to a just perceptible level of vibration. These figures are based on historical field measurements.

Construction Activity	Distance from activity when vibration may just be perceptible
Excavation	10 - 15 metres
Heavy Vehicles (e.g. dump trucks)	5 - 10 metres
Hydraulic Breakers	15 - 20 metres
Large Rotary Bored Piling Rig	20 - 30 metres
Driven Piling Rig	50 - 100 metres

Table J15: Distances at which vibration may just be perceptible

5.24 On the basis of the figures presented in Table J15 regarding the distances at which vibration from various construction activities is likely to be perceptible, it is considered unlikely that vibration would be discerned at any existing sensitive receptor locations beyond the site boundary for the main phases of construction, as all receptors are located at least 30 metres from the site site.

5.25 However, receptor locations 2, 8, 9 and 10, are located within 100 metres of proposed development blocks that could potentially require driven piling, and as such, may be subjected to levels of vibration above the threshold of perception. Accordingly, mitigation measures to control the impact of construction vibration are presented in the following section.

5.26 In respect of the occupants of the proposed development itself, the distances presented above will be of assistance in determining the eventual phasing of any of the proposed construction activities that are due to occur after the occupation of the early residential phases of the proposed development.

Operational Phase

Suitability of Site for Residential Development - Noise

5.27 The suitability of the site for residential development has been determined by predicting TAN 11 NECs across the site within the noise modelling suite Cadna/A.

5.28 The noise modelling approach has been adopted to allow the primary access routes and traffic that is predicted to be generated by the proposed development to be taken into consideration, as this is likely to significantly affect noise levels and NECs across the site.

5.29 To represent a worst case, the site suitability assessment has been based on traffic flow data provided by Arup for the 2020 design year, with the proposed development, which represents the period with the highest predicted traffic flows on the surrounding network and consequently, higher noise levels at the location of the proposed residential dwellings. The model includes the proposed primary routes associated with the proposed development, in addition to the likely built form of the development.

5.30 The predicted daytime and night-time TAN 11 NECs across the site are presented in Figures J5 and J6 respectively for daytime and night-time periods.

5.31 Detailed analysis of the NEC's presented in Figures J5 and J6 noise levels across the site range from NEC C for the proposed residential units fronting the primary new roads associated with the proposed development, Ffordd y Mileniwm opposite the Morrisons Superstore and Cory Way, with noise levels across the remaining and majority of site ranging from NEC B to NEC A.

5.32 With reference to the guidance presented in TAN 11, mitigation measures will therefore be required for residential dwellings proposed in areas classified as NEC C and NEC B, to ensure that a commensurate level of protection against noise is provided. Accordingly mitigation measures have been considered in the following Section, to reduce impacts and to ensure that the target internal noise levels are achievable for proposed residential dwellings.

Suitability of Site for Residential Development - Vibration

5.33 The below-ground structure of a building or hard surface will affect the levels of vibration present due to a remote source. Different types of foundation will affect the amount of vibration that is transferred from the ground to either the building or the hard surface.

5.34 The below-ground structure of the surface upon which the vibration measurements were taken is not known. Similarly, the foundations of the proposed residential dwellings to be located closest to the railway lines are not known.

5.35 In order to assess the potential impact of vibration at the proposed residential dwellings, it is necessary to use a transfer function that would represent the likely effect that a foundation would have on the transfer of vibration from the ground into the proposed dwellings. It is understood that piled foundations are likely in this case, with a transfer function of 0.4 being appropriate.

5.36 The vibration is likely to be amplified as it propagates up a structure such as a house and amplified again as it propagates across a suspended floor, as might be found in the upper storeys of residential properties. To extrapolate the measured vibration levels up the building to a suspended upper storey, an amplification factor of 2.8 has been used.

5.37 The other factor that may affect the final vibration level within the proposed properties, relative to the amount of vibration that has been measured on-site, is the separation distance between the proposed building and the railway line. In this instance, the measurements were taken at a location that is significantly closer to the railway lines than the proposed dwellings. Accordingly, the vibration levels at the proposed properties should be significantly lower than those that were measured

5.38 Table J16 below shows the likely vibration level within a bedroom located on the uppermost floor of the proposed dwellings. The figures presented below equate to the highest measured values amplified by a transfer function of 1.12 (0.4 x 2.8).

Period	Maximum Measured VDV	Transfer Function	Resulting eVDV	Probability of adverse comments on vibration
Day	0.030	1.12	0.0336	Less than a low probability of adverse comment
Night	0.026	1.12	0.0291	

Table J16: Estimated Vibration Dose Values (eVDV) at Upper Storey of Closest Proposed Dwellings to Railway.

5.39 It can be seen that even at the vibration measurement position much closer to the railway than the closest proposed dwellings, the above values indicate a less than low probability of adverse comment during the day when compared to the guidance contained in BS 6472. No mitigation measures are therefore deemed to be necessary to control the impact of vibration. Comparison of the assessment results presented in Table J16 with the criteria adopted for this assessment identifies that the impact of vibration from the nearby railway on the suitability of the site for residential development is at most, of negligible significance.

Road Traffic Noise Impacts

5.40 It is inevitable with a proposed development of this size and nature that increases in road traffic noise to occur on any routes that will experience a significant increase in traffic flows.

5.41 The traffic flow data provided by Arup has been used as the basis for the road traffic noise assessment. As described above, 18-hour AAWT flows were provided for the local road network surrounding the proposed development for the 2008 existing situation and in addition, the situation in the 2020 design year, both with and without the proposed development. The traffic data provided included details of HGV percentages. To represent worst case and consider the

potential cumulative impact of traffic associated with the proposed 'Mole' development, the 2020 design year with development traffic flows also consider traffic that will be generated by these potential proposals.

5.42 The traffic flow data provided by Arup has been used as the basis for the road traffic noise assessment. As described above, 18-hour AAWT flows were provided for the local road network surrounding the proposed development for the 2008 existing situation and in addition, the situation in the 2020 design year, both with and without the proposed development. The traffic data provided included details of HGV percentages.

5.43 Traffic noise predictions have been made using the Cadna/A noise modelling suite, as described in the Baseline Noise Modelling sub-section of this chapter, in accordance with the CRTN prediction methodology. The model has been used to predict the magnitude of any change in noise level resulting from the development proposals at existing noise-sensitive properties close to the roads that will be used to access the development.

5.44 The noise model considers the effects of all road traffic sources at each location, thus accurately predicting the change in noise level for noise-sensitive receptors where they are affected by more than one road.

5.45 The predicted changes in road traffic noise levels as a direct result of the development proposals have been predicted and assessed by comparing noise levels for the 2020 design year, both with and without the proposed development. In addition to the traffic generated by the proposed development, the ‘with development’ scenario also includes the proposed primary new routes that will be used to access the proposed development.

5.46 The predicted in changes in noise level, identified with respect to the road traffic noise impact assessment criteria, are presented in Figure J7.

5.47 Figure J7 identifies that the majority of the existing noise-sensitive receptors are likely to experience increases in noise level of either less than 1 dB, or between 1 and 3 dB. Given that a change of 3 dB(A) is generally considered to be the smallest change in noise level of a similar type that is noticeable and with reference to the criteria adopted for this assessment, such changes in noise level would be classified at most, as 'minor' adverse impacts.

5.48 Changes in road traffic noise level of 4 dB(A) are predicted at a limited number of existing residential dwellings fronting Ffordd y Mileniwm, on Ffford Sealand and Rhodfa Sweldon, as a result of significant increases in traffic flow on this primary access route to the proposed development site from the north. Subjectively, these increases in noise level are likely to be perceptible and when compared to the criteria adopted for this assessment, would be classified at a 'moderate' adverse impacts.

5.49 Changes in road traffic noise level of approximately 6 dB are predicted for two properties at the junction of Earl Crescent and Clive Road, with increase of approximately 4 dB predicted at 5 other properties, as a result of significant increases in traffic flow on the primary access route to the proposed development site from the south. Subjectively, these increases in noise level are likely to range from perceptible to noticeable and when compared to the criteria adopted for this assessment, would be classified at a 'moderate' to 'major' adverse impacts.

5.50 Mitigation measures to control the identified impacts are considered in the following Section.

Building Services Plant

5.51 New development can often incorporate fixed plant such as air conditioning units that have the potential to generate noise, especially if they operate at night when background noise levels are at their lowest.

5.52 Good practice dictates items of building services plant associated with all new developments should be designed to give a cumulative noise rating level ($L_{Ar,Tr}$) at or below the currently prevailing background level (L_{A90}) at a distance of 1m from the nearest residential facades, including the new residential façades associated with the proposed development itself.

5.53 The results of the baseline environmental noise measurement exercise have been utilised to determine appropriate $L_{Ar,Tr}$ rating noise levels limits at the closest existing residential receptor locations to the proposed development parcels, which are identified in Figure J8 and Table J17 respectively.

Receptor Area	Proposed $L_{Ar,Tr}$ Limiting Noise Level, dB	
	Daytime	Night-time
1	52	33
2	52	33
3	44	37
4	44	37
5	43	32
6	39	31
7	39	31
8	39	31

Table J17: Proposed Limiting Noise Levels to Control the Impact of Building Services Plant Noise Associated with the Proposed Development within Various Receptor Areas

5.54 Providing the above limits are met, this would ensure that the level of noise emitted from any plant is adequately controlled, meets the requirements of the VoGC and that complaints are unlikely. This would remove the necessity for any further specific mitigation measures and ensure that, at most, the impact of noise was of negligible significance.

6.0 Mitigation Measures

Site Preparation and Construction Phase

Construction Noise

6.1 To control the impact of noise during construction of the proposed development, contractors will be contractually bound to ensure that works are carried out in accordance with best practicable means (BPM) as described in BS 5228 comprising the following:

- where possible, 'silenced' plant and equipment will be used;
- where vehicles are standing for a significant period of time, engines will be switched off;
- acoustic enclosures will be fitted where possible to suppress noisy equipment;
- plant will operate at low speeds, where possible, and incorporate automatic low speed idling;
- where possible, electrically driven equipment will be selected in preference to internal combustion powered, hydraulic power in preference to pneumatic and wheeled in lieu of tracked plant;
- all plant will be properly maintained (greased, blown silencers replaced, saws kept sharpened, teeth set and blades flat, worn bearings replaced, etc);
- consideration will be given to temporary screening or enclosures for static noisy plant to reduce noise emissions and plant should be certified to meet any relevant EC Directive standards;
- all contractors will be made familiar with the guidance in BS 5228 (Parts 1 and 2) which will form a pre-requisite of their appointment; and
- early and good public relations with the adjacent tenants and occupants of buildings will also reduce the likelihood of complaints.

6.2 These general measures to control construction noise will be incorporated within the Construction Environmental Management Plan (CEMP) and/or detailed in construction method statements. By adopting the recommended best practicable means, construction noise levels can typically be reduced by 5 to 10 dB(A).

6.3 In respect of driven piling, the mass of the hammer, the height of the drop and the type of dolly utilised can influence source noise levels by over 10 dB. The guidance presented in BS 5228, indicates that use of a 4 tonne rig, with 0.9 metre drop height and timber dolly would result in noise levels some 11 dB quieter than the logarithmic average level assumed in the initial impact predictions. The use of such a system in close proximity to receptor location 2 would be sufficient to prevent exceedance of the stringent criteria adopted for this assessment.

6.4 The CEMP will present procedures to control the potential impact of noise at any proposed residential units that are occupied prior to the completion of the construction activities at the site. Essentially, where construction activities associated with any phase are identified to be within the critical distances identified in Table J14 above, consideration will be given to the use of quieter techniques or targeted and specific noise mitigation measures (such as reduced duration of operation, enclosure of equipment etc.) to ensure compliance with the criterion limit.

Construction Vibration

6.5 Should any activities take place within the critical distances identified in Table J15, then the following mitigation measures could be adopted, although the precise needs and intentions in respect of vibration control cannot be specified until detailed construction planning and phasing programmes are completed. The proposals in respect of vibration mitigation therefore comprise the following:

- for each phase of construction, estimates of likely vibration levels would be made on the basis of detailed Construction Method Statements developed with Contractors. Full construction details would be available by this time. These estimates would be provided to the relevant Authorities, for comparison with the agreed criteria;
- the contractor would control vibration levels using Best Practicable Means to reduce vibration levels at source;
- where necessary, consideration would be given to the implementation of specific mitigation measures to control vibration; and
- where it is not practicable to work to the target criteria (for example, if ground conditions determine particular construction techniques), provisions would be set out in advance and with the agreement of the VoGC to reduce, monitor and control any adverse affects.

6.6 If necessary, a programme of vibration monitoring would be implemented during the early stages of each potentially significant construction activity to ascertain the likely severity of any off-site vibration impacts and to manage/rebut any third party claims made as a result of damage caused by the construction of the proposed development. However, it is considered unlikely that this will be necessary in practice.

Operational Phase

Suitability of Site for Residential Development - Noise

6.7 Consideration has been given to the level of sound attenuation that will need to be provided as part of the construction of the proposed dwellings, in order to provide an adequate level of protection against environmental noise for the future occupants of the residential units.

6.8 In its explanation of the noise limits that define the boundary between NEC B and NEC C, TAN 11 states that: *'Because noise should be taken into account when determining planning applications in NEC B, it has been assumed that the minimum amelioration measure available to an occupant at night will be to close bedroom windows'.*

6.9 Therefore, in order to assess the acoustic performance of the proposed dwellings, it is appropriate in the first instance to explore the level of protection that will be afforded by the performance of the glazing elements.

6.10 Windows do not reduce noise equally across the entire frequency spectrum, so the frequency content of the sound will influence the overall sound reduction performance of a given window and by extension, the resulting noise levels within the receiving room.

6.11 Many glazing manufacturers test their products under laboratory conditions using a typical road traffic noise frequency spectrum source. The resultant measured noise attenuation, in dB, gives a very useful guide to in-situ sound reduction performance of the window for situations where road traffic noise dominates.

6.12 Table 1 in Annex 6 of Planning Policy Guidance Note (PPG) 24: 1994: *Planning and Noise,* upon which TAN 11 is broadly based, provides examples of typical noise reductions for a dwelling façade with windows set in a brick/block wall. The table shows various levels of noise reduction provided by different glazing configurations and for different noise sources. The values shown are the level difference (in dBA) between the outside and the inside of a typical dwelling and to represent worst case, it is assumed that the outside level is a façade measurement.

6.13 For a road traffic noise spectrum (R_{TRA}), PPG 24 states that standard thermal double glazing will provide a façade sound insulation performance of 33 dB(A), which for free-field noise levels, as predicted in this case would be 30 dB(A). An example of a glazing unit that could achieve the above performance, the glazing manufacturer SG states that its 4/12/4 double glazed window unit has an R_{TRA} of 30dB. The 4/12/4 notation refers to a glazing unit comprising a 4mm pane of glass and a 4mm pane of glass, separated by a 12mm air gap.

6.14 On this basis, providing free-field $L_{Aeq,16hour}$ daytime noise levels are less than 70 dB, $L_{Aeq,8hour}$ and night-time noise levels are less than 65 dB at proposed receptors, then the minimum criteria adopted for this assessment, of providing at least 'reasonable' internal noise levels would be achievable with standard thermal double glazing alone.

6.15 To determine whether the installation of standard thermal double glazing would be capable of providing an adequate level of protection against external noise intrusion, $L_{Aeq,16hour}$ daytime and $L_{Aeq,8hour}$ night-time noise levels have been

predicted at those proposed residential façades likely to be most affected by noise. The facades considered in the assessment are identified in Figure J9 .

6.16 The results of this initial assessment are presented in Table J18, with the corresponding internal noise level that would be achieved with the use of standard thermal double glazing with an R_{TRA} performance of 30 dB.

Façade Assessment Location	Noise Level, dB			
	External		Internal	
	$L_{Aeq,16hour}$	$L_{Aeq,8hour}$	$L_{Aeq,16hour}$	$L_{Aeq,8hour}$
1	64.2	53.6	34.2	23.6
2	59.5	51.6	29.5	21.6
3	61.0	52.8	31.0	22.8
4	66.6	58.6	36.6	28.6
5	65.7	57.7	35.7	27.7
6	66.9	58.9	36.9	28.9
7	66.3	58.3	36.3	28.3
8	65.4	57.4	35.4	27.4
9	66.0	58.1	36.0	28.1
10	66.6	58.7	36.6	28.7
11	63.9	56.1	33.9	26.1
12	61.5	53.8	31.5	23.8

Table J18: Predicted Internal Noise Levels with Standard Double Glazing

6.17 Table J18 identifies that the provision of standard thermal double glazing with an R_{TRA} sound insulation performance of 30 dB, will be capable of providing an adequate level of protection against noise, for all of the façade assessment

locations, providing between 'reasonable' and 'good' internal noise levels during the day and 'good' internal noise levels during the night.

6.18 However, in order to strive towards the ‘good’ standard of internal noise levels recommended in BS 8233 during the daytime, it is clear that for the proposed residential development façades fronting the primary new roads associated with the proposed development, Ffordd y Mileniwm, opposite the Morrisons Superstore and Cory Way, that higher performance glazing would be required.

6.19 High performance double glazing configurations are readily available that would be capable of providing the required level of sound insulation, although the precise acoustic performance requirements will depend on a number of factors such as the precise location of the façade, the angle of view to the road, the dimensions of the window and façade in relation to the volume of the room etcetera. It is therefore recommended that a more detailed assessment of the sound insulation performance requirements for the proposed residential dwellings most affected by noise is undertaken at the detailed design stage.

6.20 The above calculations do not make any allowance for the incorporation of permanent ventilation to the dwellings. On ventilation, BS 8233 advises that: *‘The Building Regulations on ventilation recommend that habitable rooms in dwellings have background ventilation. Trickle ventilators can provide this, and sound attenuating types are available. Where sound insulation requirements preclude opening windows for rapid ventilation and cooling, acoustic ventilation units incorporating fans are available for insertion in external walls; these can provide sound reduction comparable with domestic secondary glazing.’*

6.21 Where appropriate, the preferred choice of ventilation is through the use of natural ventilation openings such as trickle vents, air-bricks and passive ventilation devices. Such ventilators can be used to meet the requirements of the Building Regulations Approved Document F for background ventilation.

6.22 The Building Research Establishment (BRE) has published an Information Paper on the acoustic performance of such passive ventilation systems, detailing a study into the sound reduction performance of fourteen different window mounted trickle ventilators and seven different through-wall passive ventilators. The measured sound reduction performance, after taking into account flanking sound paths (i.e. sound paths that do not travel directly through the vent) and the effective area of the ventilator were 14 to 40 dB(A) for ‘window mounted trickle vents’ and 30 to 46 dB(A) for ‘passive through wall ventilators’.

6.23 Trickle vents or passive through wall ventilators are available that meet the requirements of the Building Regulations Approved Document F for background ventilation and also provide a sound reduction performance that meets or exceeds that required from the glazing elements. As such, it is recommended that the required performance of the ventilation elements is also taken into consideration at the detailed design stage.

Suitability of Site for Residential Development - Vibration

6.24 The impact of vibration on the suitability of the site for residential development is predicted to be of negligible significance. As such, no further mitigation measures are considered to be necessary.

Road Traffic Noise Impacts

6.25 The road traffic noise impact assessment presented above, predicts increases in noise of approximately 4 dB at a limited number of existing residential dwellings fronting Ffordd y Mileniwm, on Ffford Sealand and Rhodfa Sweldon. These moderate adverse impacts are the result of significant increases in traffic on Fford y Mileniwm that will be the primary access to the proposed development site and currently only experiences modest traffic flows.

6.26 Practical options for reducing the impact of traffic noise at these dwellings, without significantly reducing the number of future vehicle movements on this road are limited. One potential option would be a reduction in the speed limit on this section of road to 20 mph, and ensuring broad compliance with this limit through appropriate traffic management. This would be capable of reducing the predicted increase in road traffic noise level by approximately 1.5 dB, with the resulting residual increase in traffic noise being at most 3 dB and as such, a barely perceptible increase in noise of minor adverse significance. The practicality of restricting speeds on this route is at this stage unknown, and as such, is presented as an example of how the impact of this predicted increase can be reduced.

6.27 Changes in road traffic noise level of approximately 6 dB are also predicted for two properties at the junction of Earl Crescent and Clive Road, with increase of approximately 4 dB predicted at 5 other properties, as a result of significant increases in traffic flow on the primary access route to the proposed development site from the south.

6.28 Practical options for reducing the impact of traffic noise at these dwellings, without significantly reducing the number of future vehicle movements are again limited. One option may be the construction of localised acoustic barriers, which would be sufficient to reduce the predicted increase in noise at these locations to acceptable levels, providing it is feasible to find a barrier alignment that interrupts the line of sight between the source and receiver. If such an alignment is deemed impractical at the detailed design stage, then another option may be to consider the provision of additional boundary screening and possibly sound insulation for any properties that are predicted to experience increases in noise of more than 5 dB.

6.29 Notwithstanding the above, it is considered that the significance of the potential impacts above is potentially reduced by the fact that any increases in noise would occur gradually, over a period of more than 10 years, given the phased nature of the proposed development. Accordingly, existing sensitive

receptors are likely to become accustomed to the gradual increase in noise and unlikely to perceive it as an abrupt change.

Building Services Plant

6.30 Limiting noise levels have been set for building services plant that will ensure that the limits stipulated by the VoGC are achieved and will ensure that the impact of noise from such plant is of negligible significance. As such, no further mitigation measures are considered to be necessary.

7.0 Residual Impact Assessment

Site Preparation and Construction Phase

Construction Noise

7.1 With the implementation of the mitigation outlined above, a reduction in general construction noise levels at receptors of between 5 and 10 dB(A) would be expected. On the conservative basis that at least a 5 dB reduction in noise levels will be achieved, residual construction noise levels have been predicted and presented in Table J19 below.

Receptor	Phase				
	Enabling Works	Sub-structure	Super-Structure	Roads	Driven Piling
1	58	60	56	51	57
2	60	60	58	57	67
3	61	63	59	54	60
4	62	64	60	55	61
5	52	54	50	45	51
6	56	58	54	49	55
7	55	57	53	58	54
8	61	64	59	54	60
9	64	67	63	58	63
10	61	64	59	54	60

Table J19: Predicted Residual Façade Construction Noise Levels (Worst-Case), $L_{Aeq,10hour}$ dB

7.2 Comparison of the results presented in Table J19 above with the target noise criterion of 70 dB $L_{Aeq,10hour}$ identified that with appropriate mitigation, facade noise levels are predicted to meet the target criteria for worst case operations at all receptors, for all phases of work.

7.3 Comparison of these results with the significance criteria presented in Table J1 identifies that construction noise impacts would be generally be classified as 'minor', with the target noise level being achieved by a significant margin at all receptors.

7.4 Predictions have also been carried out to determine the residual distances at which the combination of activities associated with each construction phase are likely to exceed the target facade construction noise criterion level of 70 dB(A). These distances are presented in Table J20 below and are again worst case, assuming hard ground conditions and a clear line of sight from the source to the receiver.

Phase	**Residual Distance at which 70 dB $L_{Aeq,10hour}$ would be exceeded at façade**
Enabling Works	38 metres
Sub-structure	45 metres
Super-structure	31 metres
Roads	17 metres
Driven Piling	35 metres

Table J20: Residual Distances at which Noise from Construction Works is Likely to Exceed 70 dB $L_{Aeq,10hour}$ at Facade

7.5 The distances presented in J20 can again be utilised within the CEMP, as critical distances from occupied dwellings in which the above activities should ideally not take place, without further detailed predictions, assessment and where necessary targeted and specific mitigation measures.

Construction Vibration

7.6 The critical distance table for vibration perceptibility and the CEMP will ensure that residual vibration impacts remain negligible.

Operational Phase

Suitability of Site for Residential Development - Noise

7.7 In respect of the proposed residential elements of the development, the above assessment has identified that adequate levels of protection against noise can be provided for the future occupants of the proposed development. Where 'good' internal noise levels are provided this would be classified as a negligible

impact and where better than 'reasonable' internal noise levels are provided this would be classified as a minor adverse impact. Accordingly the proposed development site is considered to be suitable for residential development.

Suitability of Site for Residential Development - Vibration

7.8 No further mitigation measures are considered to be necessary to control the impact of vibration on the suitability of the site for residential development, with the impact of vibration remaining negligible.

Road Traffic Noise Impacts

7.9 Providing the mitigation measures described above are implemented, then any changes in road traffic noise resulting from the proposed development will be adequately controlled.

Building Services Plant

7.10 Limiting noise levels have been set for building services plant that will ensure that the limits stipulated by the VoGC are achieved and ensure that the impact of noise from such plant is of negligible significance.

7.11 Table J21 presents a summary of all initially identified impacts, proposed mitigation measures and residual effects,

Environmental Topic	Description of Impact		Description of Mitigation Measures	Description of Residual Impact	
	Description	Significance		Description	Significance
Noise: Construction Impacts	Construction Noise	Moderate to Major Adverse Direct, Temporary Medium-Term Local	Implementation of Best Practicable Means to control noise emissions	Construction Noise	Minor to Moderate Adverse Direct, Temporary Medium-Term Local
Vibration: Construction Impacts	Construction Vibration	Negligible Direct, Temporary Medium-Term Local	Implementation of Best Practicable Means to control noise emissions	Construction Vibration	Negligible Direct, Temporary Medium-Term Local
Noise: Site Suitability	Affects of noise on	Negligible to Moderate	Appropriate sound insulation	Affects of noise on suitability of	Negligible to Minor Adverse

	suitability of site for residential development	Adverse Direct, Permanent Long-Term Local		site for residential development	Direct, Permanent Long-Term Local
Vibration: Site Suitability	Affects of vibration on suitability of site for residential development	Negligible Direct, Permanent Long-Term Local	None required	Affects of vibration on suitability of site for residential development	Negligible Direct, Permanent Long-Term Local
Noise: Changes in road traffic noise	Affects of changes in road traffic noise at existing receptors	Negligible to Major Adverse Direct, Permanent Long Term Local	Reduction in speed limit, traffic management, acoustic barriers	Affects of changes in road traffic noise at existing receptors	Negligible to Minor Adverse Direct, Permanent Long Term Local
Noise: Building services plant noise	Affects of building services plant noise at existing receptors	Potential Major Adverse Direct, Permanent Long Term Local	Limiting noise criteria	Affects of building services plant noise at existing receptors	Negligible Direct, Permanent Long Term Local

Table J21: Summary Table of Residual Effects of the Proposal Together with Mitigation Measures

8.0 Summary and Conclusions

8.1 This chapter has considered the noise and vibration effects of the proposed development; specifically the effects of existing conditions on the development and the effects of noise and vibration generated by the proposed development on surrounding properties, during construction and during the operation/occupation of the proposed development.

8.2 The assessment has been based on a series of environmental noise measurements undertaken at the site and noise predictions, to identify any noise impacts that are likely as a result of the construction and operation of the proposed development.

8.3 The impact of noise and vibration during construction of the proposed development has been predicted and assessed in accordance with BS 5228. Mitigation measures have been recommended, which when implemented and incorporated within the Construction and Environmental Management Plan for the development, will ensure that the impact of noise and vibration during the construction of the development is adequately monitored and controlled.

8.4 An assessment has been carried it out in accordance with TAN 11, to determine the suitability of the site for the proposed residential elements of the development. This assessment has identified that noise need not constrain the proposed development and that with appropriate construction techniques, determined at the detailed design stage, better than 'reasonable' internal noise levels will be experienced within all proposed dwellings during both the day and the night, with the provision of 'good' internal noise levels also being achievable.

8.5 The impact of potential increases in road traffic noise levels, as a result of new vehicles accessing the site and as a result of the proposed new development access roads has been assessed. For the majority of receptors, it is predicted that at most, road traffic noise levels will be barely perceptible and considered to be ‘negligible’ to ‘minor adverse’ impact significance. Significant increases in road traffic noise of ‘moderate adverse’ impact significance have been predicted within one discrete receptor area next to the site’s primary access to the north on Ffordd y Mileniwm, with mitigation measures to reduce these impacts to at most 'minor adverse' identified accordingly. Significant increases in road traffic noise of ‘moderate to major adverse’ impact significance have been predicted within a very small receptor area next to the site southern primary access at the junction with Clive Road, with a mitigation strategy to reduce the impact in this area presented.

8.6 Limiting noise levels have been set for any fixed plant, such as air conditioning units, that may be associated with the proposed development. Complying with the proposed limits will ensure that complaints are unlikely and that the impact of such plant is of negligible impact significance.

9.0 Abbreviations

EHD - Environmental Health Department
VoGC - Vale of Glamorgan Council
EHO - Environmental Health Officer
TAN - Technical Advice Noise
CoPA - Control of Pollution Act
VoG - Vale of Glamorgan
UDP - Unitary Development Plan
BS - British Standard
WHO - World Health Organisation
DMRB - Design Manual for Roads and Bridges
Cadna/A - Computer Aided Noise Abatement
CRTN - Calculation Road Traffic Noise
dB - Decibel
CEMP -= Construction and Environmental Management Plan
NEC - Noise Exposure Category
DEFRA - Department of Environment and Rural Affairs
BSI - British Standards Institute
TRL - Transport Research Laboratory
BPM - Best Practicable Means

10.0 References

References
Technical Advice Note (Wales) 11: 1997: *Noise*. HMSO
British Standard 8233: 1999: *Sound insulation and noise reduction for buildings - Code of Practice.* BSI
World Health Organisation (WHO): 1999: *Guidelines for community.* ISBN.
British Standard 6472: 2008: *Guide to evaluation of human exposure to vibration in buildings*, Part 1, *Vibration sources other than blasting.* BSI.
British Standard 5228: 2009: *Code of practice for noise and vibration control on construction and open sites.* BSI
Control of Pollution Act (CoPA) 1974. HMSO
Design Manual for Roads and Bridges (DMRB): 2008: Volume 11 *Environmental Assessment*: Section 3 *Environmental Assessment Techniques..* HMSO
British Standard 4142: 1997: *Method for rating industrial noise affecting mixed residential and industrial areas.* BSI
Vale of Glamorgan (VoG): Unitary Development Plan (UDP): 1996 - 2011.
Department of Environment: 1988: Calculation of Road Traffic Noise (CRTN). HMSO
British Standard 61672: *Electroacoustics. Sound level meters*, Part 1 *Specifications* .BSI
British Standard 7445: 2003: Description and measurement of environmental noise. BSI
Transport Research Laboratory. $L_{A10,18hour}$ 'End Correction' *Method for converting the UK road traffic noise index LA10,18h to the EU noise indices for road noise mapping .* HMSO

Appendix J1 Technical Appendix

Introduction to Acoustics

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

10.2 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 0 dB (the threshold of hearing) to over 120 dB.

10.3 The ear is less sensitive to some frequencies than to others. The A-weighting scale is used to approximate the frequency response of the ear. Levels weighted using this scale are commonly identified by the notation dB(A).

10.4 In accordance with logarithmic addition, combining two sources with equal noise levels would result in an increase of 3 dB(A) in the noise level from a single source.

10.5 A change of 3 dB(A) is generally regarded as the smallest change in broadband continuous noise which the human ear can detect (although in certain controlled circumstances a change of 1 dB(A) is just perceptible). Therefore, a 2 dB(A) increase would not be normally be perceptible. A 10 dB(A) increase in noise represents a subjective doubling of loudness.

10.6 A noise impact on a community is deemed to occur when a new noise is introduced that is out of character with the area, or when a significant increase above the pre-existing ambient noise level occurs.

10.7 For levels of noise that vary with time, it is necessary to employ a statistical index that allows for this variation. These statistical indices are expressed as the sound level that is exceeded for a percentage of the time period of interest. In the UK, traffic noise is measured as the L_{A10}, the noise level exceeded for 10% of the measurement period. The L_{A90} is the level exceeded for 90% of the time and has been adopted to represent the background noise level in the absence of discrete events. An alternative way of assessing the time varying noise levels is to use the equivalent continuous sound level, L_{Aeq}.

10.8 This is a notional steady level that would, over a given period of time, deliver the same sound energy as the actual fluctuating sound.

10.9 To put these quantities into context, where a receiver is predominantly affected by continuous flows of road traffic, a doubling or halving of the flows would result in a just perceptible change of 3 dB, while an increase of more than 25%, or a decrease of more than 20%, in traffic flows represent changes of 1 dB in traffic noise levels (assuming no alteration in the mix of traffic or flow speeds).

10.10 Note that the time constant and the period of the noise measurement should be specified. For example, BS 4142 specifies background noise measurement periods of 1 hour during the day and 5 minutes during the night. The noise levels are commonly symbolised as $L_{A90,1hour}$ dB and $L_{A90,5mins}$ dB. The noise measurement should be recorded using a 'FAST' time response equivalent to 0.125 ms.

Glossary of Acoustic Terminology

Term	Definition
Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
Sound Pressure Level (Sound Level)	The sound level is the sound pressure relative to a standard reference pressure of 20μPa (20x10-6 Pascals) on a decibel scale.
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 log10 (s1 / s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20μPa.
A-weighting, dB(A)	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
$L_{eq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level during the period T. L_{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.

$L_{90,T}$	A noise level index. The noise level exceeded for 90% of the time over the period T. L_{90} can be considered to be the "average minimum" noise level and is often used to describe the background noise.
$L_{10,T}$	A noise level index. The noise level exceeded for 10% of the time over the period T. L_{10} can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise.
Free-Field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5m
Facade	At a distance of 1m in front of a large sound reflecting object such as a building façade.
Displacement, Acceleration and Velocity Root Mean Square (r.m.s.) and Peak Values Peak Particle Velocity (PPV)	Vibration is an oscillatory motion. The magnitude of vibration can be defined in terms of displacement (how far from the equilibrium position that something moves), velocity (how fast something moves), or acceleration (the rate of change of velocity). When describing vibration, one must specify whether peak values are used (i.e. the maximum displacement or maximum velocity) or r.m.s. / r.m.q. values (effectively an average value) are used. Standards for the assessment of building damage are usually given in terms of peak velocity (usually referred to as Peak Particle Velocity, or PPV), whilst human response to vibration is often described in terms of r.m.s. or r.m.q. acceleration.
Root Mean Square (r.m.s.)	The r.m.s. value of a set of numbers is the square root of the average of the squares of the numbers. For a sound or vibration waveform, the r.m.s. value over a given time period is the square root of the average value of the square of the waveform over that time period.
Root Mean Quad (r.m.q.)	The r.m.q. value of a set of numbers is the fourth root of the average of the fourth powers of the numbers. For a vibration waveform, the r.m.q. value over a given time period is the fourth root of the average value of the fourth power of the waveform over that time period.

Appendix J2 Consultation Correspondence

From: Athay, Rebecca [mailto:RAthay@valeofglamorgan.gov.uk]
Sent: 31 July 2009 09:35
To: Kev Foster - Innovate Acoustics
Subject: RE: Proposed Development - Barry

Hello Kev,

Another thought, would you mind putting together some considerations if there is the need for piling during the development.

Kind regards,

Rebecca Athay
Environmental Health Officer

Vale of Glamorgan Council
Holton Road
Barry
CF63 4RU

Tel: 01446 709105
Fax: 01446 709449

From: Athay, Rebecca [mailto:RAthay@valeofglamorgan.gov.uk]
Sent: 30 July 2009 08:29
To: Kev Foster - Innovate Acoustics
Subject: RE: Proposed Development - Barry

Hello Kevin,

Thanks for that. Everything discussed appears to be have been noted. I am sure we will have further discussions when the planning applications come in.
If you have any further queries, please do not hesitate to get in contact.

Kind regards,

Rebecca Athay
Environmental Health Officer

Vale of Glamorgan Council
Holton Road
Barry
CF63 4RU

Tel: 01446 709537
Fax: 01446 709449

From: Kev Foster - Innovate Acoustics [mailto:kev.foster@innovateacoustics.co.uk]
Sent: 28 July 2009 14:36
To: Athay, Rebecca
Subject: Proposed Development - Barry

Dear Rebecca,

Many thanks for taking the time to discuss the noise and vibration assessment I am undertaking for the proposed residential development at Barry. Herewith my understanding of our discussion. If I have misinterpreted anything or your requirements differ from the below, then please do not hesitate to make a note of any necessary amendments by return email.

1. The assessment methodologies and criteria agreed during our discussions, along with any other observations made are presented below

2. **Suitability of site for residential elements of the proposed development**

3. The assessment of the suitability of the site for residential development is required to be carried out in accordance with the guidance presented in Technical Advice Note (Wales) 11: 1997: *Noise*.

4. Where the advice contained within TAN 11 identifies that mitigation measures may be necessary to provide a commensurate level of protection against noise, then the guidance presented in BS 8233: 1999: *Sound insulation and noise reduction for buildings - Code of Practice* and the World Health Organisation (WHO): 1999: *Guidelines for community noise* should be referenced and used to derive appropriate criteria.

5. **Construction Noise and Vibration Impacts**

6. The impact of noise and vibration during construction of the proposed development requires predictions and assessment in accordance with the guidance presented in BS 5228: 2009: *Code of practice for noise and vibration control on construction and open sites.*

7. For a development of this size, nature and construction duration, an agreement under Section 60 or Section 61 of the Control of Pollution Act 1974 would normally required, once detailed information on the proposed construction methodologies and phasing is available, prior to the commencement of any significant works. Such an agreement would also seek to limit the hours of operation for construction activities to 0800-1800 hours Monday to Friday, and 0800-1300 on Saturdays, with no work being permitted on Public Holidays or Sundays.

8. **Changes in Road Traffic Noise**

9. The impact of changes in noise level resulting from new roads associated with the scheme and changes in traffic flow and composition on existing roads as a result of the proposed development, requires assessment in accordance with the guidance presented in the Design Manual for Roads and Bridges (DMRB): 2008: Volume 11 *Environmental Assessment*: Section 3 *Environmental Assessment Techniques.*

10. Given the nature of the proposed development, every effort should be made to control the impact of road traffic noise, with further mitigation or robust justification being required should predicted noise levels at existing noise-sensitive receptor locations increase by more than 3 dB(A).

11. **Building Services Plant**

12. The impact of noise from any building services / fixed plant items associated with the proposed development requires assessment in accordance with British Standard 4142: 1997: *Method for rating industrial noise affecting mixed residential and industrial areas* required, either to assess the impact off, or propose limits for such equipment.

13. The rating noise level from such equipment (including as appropriate an 'acoustic correction') should ideally not exceed the existing $L_{A90,T}$ background noise level at noise-sensitive receptor locations.

14. For the record, my contact details are present below. I also understand that your direct dial phone number is 01446 709537.

Kind regards

Kev Foster MIOA
Director - Innovate Acoustics Limited
01392 314546 or 07715 990824

Registered office: 1 Emperor Way, Exeter Business Park, Exeter, EX1 3QS
Registered in England No: 05923228

Appendix J3 - Full-Tabulated Noise Measurements Results

Start Time	Noise Level, dB			
	$L_{Aeq,5min}$	L_{AFmax}	$L_{A90,5min}$	$L_{A10,5min}$
23/06/2009 02:54	33.4	46.8	34.5	31.4
23/06/2009 02:59	32.0	44.8	32.9	30.5
23/06/2009 03:04	34.7	47.0	36.2	31.9
23/06/2009 10:09	46.7	57.8	48.1	44.3
23/06/2009 10:14	46.9	51.4	48.5	44.5
23/06/2009 10:19	49.2	63.5	51.3	44.1
23/06/2009 10:24	51.3	68.3	51.1	42.5
23/06/2009 10:28	46.3	54.8	47.9	43.9
23/06/2009 10:32	49.0	72.3	49.2	42.3
23/06/2009 10:36	46.1	53.8	47.4	43.1

Table AJ3-1: Position 1 - All Noise Measurement Results

Start Time	Noise Level, dB			
	$L_{Aeq,5min}$	L_{AFmax}	$L_{A90,5min}$	$L_{A10,5min}$
23/06/2009 02:29	34.7	61.3	34.4	31.6
23/06/2009 02:34	49.3	69.2	40.7	32.0
23/06/2009 02:38	37.0	52.4	37.6	31.3
23/06/2009 09:30	58.9	72.2	64.3	43.1
23/06/2009 09:35	59.9	70.5	65.2	43.2
23/06/2009 09:40	60.7	72.5	65.4	42.7
23/06/2009 09:45	61.9	73.9	65.8	47.5
23/06/2009 09:50	58.8	70.5	62.8	42.8
23/06/2009 09:55	62.9	75.3	67.3	45.7

Table AJ3-2: Position 2 - All Noise Measurement Results

Start Time	Noise Level, dB			
	$L_{Aeq,5min}$	L_{AFmax}	$L_{A90,5min}$	$L_{A10,5min}$
22/06/2009 10:49	63.6	72.2	66.0	58.1
22/06/2009 10:54	64.4	76.8	67.2	56.5
22/06/2009 10:59	65.7	76.7	68.7	60.6
22/06/2009 11:04	65.2	76.2	67.9	58.7
22/06/2009 11:09	63.9	71.6	67.0	55.2
22/06/2009 11:14	65.1	74.7	67.8	59.0
22/06/2009 11:19	64.1	75.5	67.0	55.9
22/06/2009 11:24	64.3	73.8	67.0	57.5
22/06/2009 11:29	64.5	74.4	67.6	56.4
22/06/2009 11:34	64.3	82.1	66.7	56.5
22/06/2009 11:39	64.6	75.3	67.6	58.1
22/06/2009 11:44	64.6	73.9	67.1	59.2
22/06/2009 11:49	64.9	73.9	67.5	58.5
22/06/2009 11:54	64.6	73.5	67.4	58.5
22/06/2009 11:59	64.8	76.8	67.3	58.1
22/06/2009 12:04	63.4	71.7	66.7	54.4
22/06/2009 12:09	63.3	78.7	66.1	54.5
22/06/2009 12:14	64.6	80.3	67.0	58.2
22/06/2009 12:19	64.6	73.5	67.5	57.3

22/06/2009 12:24	64.6	75.6	67.5	58.4
22/06/2009 12:29	64.0	74.6	67.4	54.5
22/06/2009 12:34	70.9	94.9	69.5	58.7
22/06/2009 12:39	63.9	70.3	66.7	58.7
22/06/2009 12:44	64.6	73.9	67.4	58.7
22/06/2009 12:49	64.3	75.9	66.9	57.4
22/06/2009 12:54	64.0	73.2	66.8	57.8
22/06/2009 12:59	64.0	72.5	66.5	57.4
22/06/2009 13:04	64.6	74	67.3	56.7
22/06/2009 13:09	63.5	70.9	66.1	57.8
22/06/2009 13:14	64.5	74.5	67.3	58.5
22/06/2009 13:19	64.1	74.4	66.6	57.8
22/06/2009 13:24	64.5	83.5	66.2	56.4
22/06/2009 13:29	65.9	89.1	68.0	57.7
22/06/2009 13:34	63.9	76.8	67.1	55.4
22/06/2009 13:39	64.3	76.4	67.0	56.5
22/06/2009 13:44	65.8	78.7	68.3	59.4

Table AJ3-3: Position 3 - All Noise Measurement Results

Start Time	Noise Level, dB			
	$L_{Aeq,5min}$	L_{AFmax}	$L_{A90,5min}$	$L_{A10,5min}$
23/06/2009 02:08	37.4	56.8	38.54	33.9
23/06/2009 02:13	40.8	61.7	41.2	34.82
23/06/2009 02:18	33.6	45.3	35.18	31.44
23/06/2009 08:37	50.2	64.2	52.24	47.12
23/06/2009 08:42	50.5	61.4	52.04	48.02
23/06/2009 08:47	50.8	67.9	52.68	46.18
23/06/2009 08:52	50.1	62.4	51.9	46.72
23/06/2009 08:57	52.5	66.7	54.42	47.94
23/06/2009 09:02	51.9	65.2	53.36	49.56
23/06/2009 09:07	49.0	60.7	50.9	46.28
23/06/2009 09:12	49.2	71.2	50.14	45.14

Table AJ3-4: Position 4 - All Noise Measurement Results

Start Time	Noise Level, dB			
	$L_{Aeq,1hour}$	L_{AFmax}	$L_{A90,1hour}$	$L_{A10,1hour}$
22/06/2009 10:00	53.3	71.6	42.0	55.6
22/06/2009 11:00	53.3	74.2	43.0	55.5
22/06/2009 12:00	53.1	71.9	43.0	54.9
22/06/2009 13:00	54.8	77.1	42.9	56.9
22/06/2009 14:00	56.6	76.1	44.0	59.3
22/06/2009 15:00	55.8	76.2	42.9	57.3
22/06/2009 16:00	57.8	78.6	43.3	60.3
22/06/2009 17:00	54.8	73.6	41.3	57.9
22/06/2009 18:00	52.1	74.6	40.9	53.7
22/06/2009 19:00	49.0	68.1	41.3	49.7
22/06/2009 20:00	47.3	68.7	39.2	47.2
22/06/2009 21:00	50.6	78.9	38.6	47.7
22/06/2009 22:00	43.0	59.1	36.8	45.1
22/06/2009 23:00	42.9	59.7	38.0	45.0
23/06/2009 00:00	42.8	57.6	39.5	44.2
23/06/2009 01:00	41.8	55.4	38.3	43.7
23/06/2009 02:00	41.9	58.9	37.7	43.5
23/06/2009 03:00	49.8	73.1	39.2	50.1
23/06/2009 04:00	45.3	58.9	42.2	47.1

23/06/2009 05:00	45.8	67.2	40.7	46.7
23/06/2009 06:00	52.3	75.6	43.5	52.6
23/06/2009 07:00	58.6	81.1	46.9	59.1
23/06/2009 08:00	56.7	81.5	49.0	58.6
23/06/2009 09:00	56.3	78.1	47.1	58.3
23/06/2009 10:00	56.3	78.8	44.7	58.5

Table AJ3-5: Position 5 - All Noise Measurement Results

Start Time	Noise Level, dB			
	$L_{Aeq,5min}$	L_{AFmax}	$L_{A90,5min}$	$L_{A10,5min}$
23/06/2009 03:40	48.7	66.4	51.3	42.6
23/06/2009 03:45	47.5	62.9	49.6	43.2
23/06/2009 03:50	47.3	62.6	49.8	42.1
23/06/2009 11:20	56.7	74.2	54.5	43.9
23/06/2009 11:25	50.8	66.7	51.9	43.9
23/06/2009 11:30	49.2	64.8	51.4	44.5
23/06/2009 11:35	52.8	72	53.5	44.2
23/06/2009 11:40	56.6	74	56.0	43.7
23/06/2009 11:45	50.2	62.8	52.7	44.4
23/06/2009 11:50	47.3	60.6	49.8	42.8
23/06/2009 11:55	49.7	64.7	53.2	43.4

Table AJ3-6: Position 6 - All Noise Measurement Results

Start Time	Noise Level, dB			
	$L_{Aeq,5min}$	L_{AFmax}	$L_{A90,5min}$	$L_{A10,5min}$
23/06/2009 03:16	38.1	48.2	38.2	32.4
23/06/2009 03:21	43.4	52.6	43.2	37.0
23/06/2009 03:26	33.0	41.9	34.5	31.1
23/06/2009 03:31	34.4	46.9	36.1	32.0
23/06/2009 10:44	51.5	66.6	50.5	39.7
23/06/2009 10:49	41.3	55.6	43.2	38.1
23/06/2009 10:54	43.7	62.1	45.7	38.2
23/06/2009 10:59	47.8	68.6	45.4	37.6
23/06/2009 11:04	59.6	73.6	57.3	41.7
23/06/2009 11:09	49.9	69.6	48.8	37.8

Table AJ3-7: Position 7 - All Noise Measurement Results

Start Time	Noise Level, dB			
	$L_{Aeq,5min}$	L_{AFmax}	$L_{A90,5min}$	$L_{A10,5min}$
22/06/2009 13:58	64.6	75	68.8	44.5
22/06/2009 14:03	69.3	90.7	71.5	51.6
22/06/2009 14:08	66.1	79.2	69.5	48.7
22/06/2009 14:13	68.3	88.4	70.6	48.2
22/06/2009 14:18	65.6	79.5	69.5	47.2
22/06/2009 14:23	65.6	80.2	69.4	45.1
22/06/2009 14:29	66.1	79.2	69.8	49.9
22/06/2009 14:34	68.0	91.3	70.5	50.3
22/06/2009 14:39	65.6	77.1	70.0	49.0
22/06/2009 14:44	68.2	85.8	70.4	50.8
22/06/2009 14:49	66.4	78.6	70.3	49.4
22/06/2009 14:54	67.5	81.6	70.8	51.7
22/06/2009 14:59	67.5	79.5	71.5	51.9
22/06/2009 15:05	66.4	76.9	71.0	47.9
22/06/2009 15:10	66.3	82.5	70.0	50.0
22/06/2009 15:15	66.6	88.7	70.1	51.2
22/06/2009 15:20	67.9	86.8	70.4	49.3
22/06/2009 15:25	68.5	89.2	71.0	51.9
22/06/2009 15:30	68.1	79.9	71.7	53.5

22/06/2009 15:35	65.0	78.6	69.3	48.1
22/06/2009 15:41	65.4	77.8	69.6	46.7
22/06/2009 15:46	67.2	83.6	70.5	52.5
22/06/2009 15:51	65.5	77.9	69.5	47.5
22/06/2009 15:56	65.7	80.9	69.7	48.1
22/06/2009 16:01	66.1	79	70.1	50.1
22/06/2009 16:06	66.5	78.7	70.1	51.2
22/06/2009 16:11	66.3	79.6	69.7	51.1
22/06/2009 16:17	65.9	79.6	69.8	47.9
22/06/2009 16:22	66.3	80.5	69.6	50.5
22/06/2009 16:27	67.4	84.4	70.2	52.6
22/06/2009 16:32	66.8	73.9	70.5	54.3
22/06/2009 16:37	68.1	81.7	70.9	53.5
22/06/2009 16:42	65.5	75.8	69.5	51.3
22/06/2009 16:47	65.5	76.4	69.5	51.4
22/06/2009 16:53	66.7	84.5	70.3	49.2

Table AJ3-8: Position 8 - All Noise Measurement Results

Appendix J4 - Construction Noise Prediction Assumptions

Plant Item	Sound Power	No	% On Time	Data Source
Enabling Works				
Tracked Excavator (excavation)	103	2	40	BS5228, T2, Av 14-25
Dozer (Earthworks)	108	2	20	BS5228, T2, Av 10-13
Wheeled Backhoe Loader	105	1	40	BS5228, T2, 8
Pulversiser on Excavator	105	1	40	BS5228, T1, Av 3-5
Wheeled Loader	107	1	40	BS5228, T2, Av 26 - 28
Dump Truck	102	2	30	BS5228, T2, 32
Hand held Breaker	111	2	10	BS5228, T1, 6
Compressor	93	1	100	BS5228, T5, 5
Concrete Saw	107	1	10	BS5228, T4, 72
Sub-Structure				
Tracked Excavator (excavation)	103	2	40	BS5228, T2, Av 14-25
Dozer (Earthworks)	108	2	20	BS5228, T2, Av 10-13
Dump Truck (Tipping Fill)	107	2	10	BS5228, T2, Ref 30
Dozer (Towing Roller)	109	1	10	BS5228, T2, Ref 36
Vibratory Plate	108	1	10	BS5228, T2, 41
Hydraulic Vibratory Compactor	106	2	20	BS5228, T2, ref 42
Concrete Pump	105	2	25	BS5228, T3, 25-26

Tracked Mobile crane	97	2	60	BS5228, T3, 28-30
Gas Cutter	95	1	5	BS5228, T3, 34 - 35
Generator	101	2	100	BS5228, T3, Ref 32
Concrete Mixer Truck	105	2	40	BS5228, T4, Ref Av 21-22
Bore Piling Rig	107	2	25	BS5228, T3, 21
Super-Structure				
Concrete Mixer Truck	105	1	50	BS5228, T4, Ref Av 21-22
Truck mounted concrete pump	106	1	50	BS5228, T4, 29-31
Poker Vibrator	104	1	60	BS5228, T4, 33-34
Mobile telescopic crain	101	1	50	BS5228, T4, 39,41,43,46
Concrete Cutting (circular saw)	110	1	5	BS5228, T4, Av 72-73
Generator	94	1	100	BS5228, T4, Av 76 - 85
Tower Crane	105	1	50	BS5228, T4, 48
Roads				
Spreading Shipping/Fill (Dozer)	108	1	20	BS5228, T5, Av 12-13
Earth Works (Tracked Excavator)	108	1	10	BS5228, T5, 18
Vibratory Roller	103	1	20	BS5228, T5, Av 20, 25-28
Driven Piling				
Driven Pre-cast Concrete - Average	119	1	60	BS5228 - T12, Av 35-39
Driven Pre-cast Concrete - Best	108	1	60	BS5228 - T12, 36

Table AJ4-1: Construction Noise Prediction Assumptions