8 Noise and Vibration

8.1 INTRODUCTION

8.1.1 This chapter assesses the impact of the Proposed Development on the local noise and vibration environment and assesses the suitability of the existing on-site noise climate for the Proposed Development.

8.1.2 In particular this chapter considers the potential impacts of:

- The existing noise environment and potential impact on the Proposed Development once operational;
- The construction phase of the Proposed Development and it's potential impact on existing local noise and vibration sensitive receptors; and
- The noise and vibration impacts that may arise on existing local sensitive receptors as a result of the operation of the Proposed Development.

8.1.3 This chapter (and its associated figures and appendices) is not intended to be read as a stand alone assessment and reference should be made to the Front End of this ES (**Chapters 1 – 5**), as well as **Chapter 15 - Cumulative Effects**.

8.1.4 This chapter is necessarily technical in nature so to assist the reader, a glossary of terminology relating to noise and vibration is provided within **Appendix 8.1**.

8.2 LEGISLATION, POLICY AND GUIDANCE

Legislative Framework

8.2.1 For a development of this nature, there is no specific all-encompassing legislation relating to the standards associated with noise emission/noise impact. Noise legislation, where it does exist, tends to be either EC-derived and focussed on specific items of noise-emitting plant or on more general nuisance, such as that addressed by the provisions of the Environmental Protection Act 1990 (Ref 8.1).

8.2.2 In lieu of any specific legislation, assessing the effect of such a development during the site preparation, earthworks and construction and operational phases must draw on information from a variety of sources. Accordingly, this assessment makes reference to a number of British Standards, official planning guidance notes and national guidance on noise.

Planning Policy

8.2.3 Planning policy at the national, regional and local level is discussed in **Chapter 5 - Planning Policy Context** and corresponding **Appendix 5.1**. Additional aspects relating to those policies relevant to Noise and Vibration are discussed briefly below.

National Planning Policy

Planning Policy Guidance Note 24: 1994: Planning and Noise

8.2.4 PPG 24: *Planning and noise* (Ref 8.2) was published in September 1994 and sets out the Government's policies on noise related planning issues. It gives guidance to Local Authorities in England on the use of their planning powers to minimise the adverse impact of noise. Specifically, it:

- Outlines the considerations to be taken into account when determining planning applications for both noise-sensitive developments and for those activities which will generate noise;
- Sets out Noise Exposure Categories for residential development, encourages their use and recommends appropriate levels for exposure to different sources of noise; and
- Advises on the use of planning conditions to minimise the impact of noise.

8.2.5 The four Noise Exposure Category (NEC) bands set out in PPG 24 are designed to assist Local Planning Authorities in evaluating applications for residential development in noisy areas. **Table 8.1**

summarises the planning guidance for each NEC band. **Table 8.2** sets out the noise levels relating to each NEC band for road traffic noise, as is relevant in this case.

8.2.6 PPG 24 allows a degree of Local Authority discretion in the application of the above criteria, up to 3 dB(A) either way, but for the purpose of this assessment, the NECs have been adopted as published.

Table 8.1: Planning Advice for Each Noise Exposure Category

NEC	Planning Advice
A	Noise need not be considered as a determining factor in granting planning permission, although noise at the high end of the category should not be regarded as a desirable level.
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 quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise.
D	Planning permission should normally be refused.

Table 8.2: Road Traffic Noise Levels Corresponding to the NECs for New Dwellings, $L_{Aeq,T}$ dB(A)

NEC	Road Traffic Noise	
	Day 07:00-23:00, LAeq,16hour	Night 23:00-07:00, LAeq,8hour
A	<55	<45
B	55-63	45-57
C	63-72	57-66
D	>72	>66

8.2.7 In addition to the above, PPG 24 also states that during the night, (23:00-07:00 hours):

> "*Sites where individual noise events regularly exceed 82 dB $L_{Amax\ (slow)}$ several times in any hour should be treated as being in NEC C, regardless of the $L_{Aeq\ (8\ hour)}$ (except where the $L_{Aeq\ (8\ hour)}$ already puts the site into NEC D).*"

8.2.8 Where the advice within PPG 24 is that conditions should be imposed to ensure a commensurate level of protection against noise, reference is made to other standards that establish suitable internal noise levels, such as BS 8233: 1987: *Sound insulation and noise reduction for buildings - Code of practice* (updated in 1999) (Ref 8.3) and BS 4142: 1990: *Method for rating industrial noise affecting mixed residential and industrial areas* (updated in 1997) (Ref 8.4).

8.2.9 The requirements of BS 8233: 1999 and BS 4142: 1997 are summarised in the **Guidance Section** below, along with other relevant guidance and standards.

Regional Planning Policy

8.2.10 *The North West of England Plan Regional Spatial Strategy to 2021* (RSS) (Ref 8.5) was adopted in September 2008. There are no policies within the RSS that are specific to noise alone, but those which are most pertinent to noise and this development are DP 7 'Promote environmental quality' and W2 'Locations for regionally significant economic development'.

8.2.11 An overview of policy W2 is provided in **Appendix 5.1** and Policy DP 7 states that:

> *"Environmental quality (including air, costal and inland waters), should be protected and enhanced"*

Guidance

BS 4142 1997: Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas

8.2.12 BS 4142 is intended to be used to assess whether noise from proposed factories, industrial premises or fixed installations and sources of an industrial nature are likely to give rise to complaints from people residing in nearby dwellings.

8.2.13 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, the 'specific noise' level, immediately outside the dwelling with the 'background noise' level. 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 noise' level ($L_{A,r}$).

8.2.14 The likelihood of noise provoking 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."*

8.2.15 For the daytime, this assessment is carried out over a one hour period, and over a five minute period at night. Day or night are not defined in the Standard but it states that night should cover the times when the general adult population are preparing for sleep or are actually sleeping. For the purposes of this assessment it is assumed that the day and night periods reflect those stated in PPG 24, i.e. day is 07:00 to 23:00 hours and night 23:00 to 07:00 hours.

BS 8233: 1999: Sound Insulation and Noise Reduction for Buildings - Code of Practice

8.2.16 This standard provides recommendations for the control of noise in and around buildings. It suggests appropriate criteria and limits for different situations, which are primarily intended to guide the design of new buildings, or refurbished buildings undergoing a change of use, rather than to assess the effect of changes in the external noise climate.

8.2.17 The standard suggests suitable internal noise levels within different types of buildings, including residential dwellings. It suggests that an internal noise level of 30 dB $L_{Aeq,T}$ within bedrooms is a 'good' standard, whilst 35 dB $L_{Aeq,T}$ is a 'reasonable' standard. For living areas in the daytime, the standard recommends 30 dB $L_{Aeq,T}$ as a 'good' standard and 40 dB $L_{Aeq,T}$ as being a 'reasonable' standard. BS 8233 also states that individual noise events should '*not normally*' exceed 45 dB L_{AFmax} in bedrooms at night.

8.2.18 With regards to external noise levels, BS 8233 states:

> *"it is desirable that the steady state noise level does not exceed 50 dB $L_{Aeq,T}$ and 55 dB $L_{Aeq,T}$ should be regarded as the upper limit."*

World Health Organisation (WHO): 1999: Guidelines for Community Noise (Ref 8.6)

8.2.19 This is a wide ranging document describing the effects of community noise. It provides information about the effects of noise that may occur at certain levels of exposure. For dwellings, the critical effects of noise are taken to be sleep disturbance, annoyance and speech interference.

8.2.20 Indoor guideline values are provided for bedrooms with the aim of protecting against sleep disturbance, a guideline value of 30 dB L_{Aeq} for continuous noise and 45 dB L_{Amax} for single sound events is recommended. To enable casual conversation during the daytime an internal guideline noise level of 35 dB L_{Aeq} is provided.

8.2.21 With respect to external noise levels it is stated that:

> *"To protect the majority of people from being seriously annoyed during the daytime, it is recommended that the sound pressure level on balconies, terraces, and outdoor living areas should not exceed 55 dB L_{Aeq} for a steady continuous noise. To protect the majority of people from being moderately annoyed during the daytime, the outdoor noise level should not exceed 50 dB L_{Aeq}."*

8.2.22 The 'good' and 'reasonable' internal noise level criteria stated in BS 8233 are concordant with the WHO guidelines, as is the L_{AFmax} night-time noise criterion. Therefore, the recommendation for night-time L_{AFmax} noise levels presented in the WHO guidelines has been adopted for this assessment.

8.2.23 With respect to the night-time L_{AFmax} noise levels, the WHO guidelines quote the findings from research conducted by Vallet & Vernet, 1991 which states:

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

8.2.24 On this basis, for the purpose of assessing night-time L_{AFmax} noise events, this assessment has considered the 10th highest L_{AFmax} noise event occurring in a typical night-time (23:00 – 07:00) period.

Building Bulletin (BB)93: Acoustic Design of School (Ref 8.7)

8.2.25 BB 93 provides acoustic guidance on the design of schools that seeks to facilitate clear communication of speech between teacher and student (and between students) and that seeks to ensure noise environments that do not interfere with study activities.

8.2.26 This document presents a series of maximum noise level design criteria for both internal and external teaching and learning spaces. These design criteria are specified in terms of the $L_{Aeq,30minute}$ and $L_{A1,30minute}$ noise indices. The stipulated noise criteria are applicable within the teaching/learning spaces without contribution from pupils, teachers, equipment and playgrounds. A selection of the stipulated noise level criteria are presented in **Table 8.3** below:

Table 8.3: BB93 Noise Level Criteria for Teaching and Learning Spaces, dB(A)

Teaching Space	**Upper Limit for Ambient noise level $L_{Aeq,30minute}$**
Large lecture rooms, classrooms for hearing impaired pupils, drama studios, performance rooms, recital rooms, ensemble rooms, recording studios	30 dBA
Nursery School: playrooms and quiet rooms Primary School: classrooms, class bases, general teaching areas, small group rooms Secondary School: classrooms, general teaching areas, seminar rooms, tutorial rooms and language laboratories, quiet library study areas	35 dBA
Open plan teaching areas and resource areas, design and technology areas, art rooms, indoor sports halls, dance studios, gymnasiums,	40 dBA
Outdoor teaching areas	Noise levels in unoccupied playgrounds, playing fields and other outdoor areas should not exceed 55 dB $L_{Aeq,30minute}$ and there should be at least one area suitable for outdoor teaching activities where noise levels are below 50 dB $L_{Aeq,30minute}$.

The Design Manual for Roads and Bridges (DMRB): Volume 11: Environmental Assessment (Ref 8.8)

8.2.27 Published by the Department of Transport in 1993 (amended August 2008), this document sets out procedures for undertaking the environmental assessment of new road schemes, including the assessment of noise impacts from road traffic. In particular, it describes a method for assessing the severity of a noise impact, in terms of the number of people who will be bothered from any noise increase due to a new road scheme. In undertaking a DMRB assessment, the calculation of traffic noise levels uses the methodology contained within the *Calculation of Road Traffic Noise* (CRTN) Memorandum as described below.

8.2.28 Although the DMRB more readily applies to new road schemes, the principles of the approach contained within the document can also be applied to the assessment of noise from road traffic in general. The Proposed Development has the potential to affect road traffic noise levels along existing roads, hence the need for this assessment.

8.2.29 The DMRB assessment suggests that the magnitude of noise changes from a project should be classified into levels of impact. An example classification of impact magnitudes for traffic noise level changes is provided within the document and has been replicated within **Table 8.4**.

Table 8.4: Classification of Magnitude of Noise Impacts

Noise Change, $L_{A10,18hour}$	Magnitude of Impact
0	No Change
0.1 – 0.9	Negligible
1 – 2.9	Minor
3 – 4.9	Moderate
5+	Major

8.2.30 The DMRB goes on to state that the scale provided in **Table 8.4** may not be applicable to all situations or projects, in that other factors such as time of day, and the spectral content of the noise can also influence the magnitude of effect.

8.2.31 It is considered that the descriptions specified in the above table provide a good indication of the likely significance of changes in noise levels in this case. Therefore, these have been used to supplement the assessment of potential effects.

Calculation of Road Traffic Noise Memorandum: 1988 (Ref 8.9)

8.2.32 Published by the then Department of Transport and the Welsh Office in 1988, this document sets out standard procedures for calculating noise levels from road traffic. The calculation methods use a number of input variables, including traffic flow volume, average vehicle speed, percentage of heavy goods vehicles, type of road surface, site geometry and the presence of noise barriers or acoustically absorbent ground. CRTN predicts the $L_{A10,18hour}$ or $L_{A10,1hour}$ noise level for any receptor point at a given distance from the road.

BS 5228: Noise and Vibration Control on Construction and Open Sites - Part 1: Noise: 2009 (Ref 8.10)

8.2.33 This Standard sets out techniques to predict and assess the likely noise effects from construction works, based on detailed information on the type and number of plant being used, their location, and the length of time they are in operation.

8.2.34 The noise prediction method is used to establish likely noise levels in terms of the $L_{Aeq,T}$ over the core working day.

8.2.35 This Standard also documents a database of information, comprising previously measured sound power levels for a variety of different construction plant undertaking various common activities.

8.2.36 Example criteria are presented for the assessment of the significance of noise effects. Such criteria maybe concerned with fixed noise limits and/or ambient noise level changes. With respect to fixed noise limits BS 5228 discusses those included within Advisory Leaflet 72: 1976: *Noise control on building sites*. These limits are presented according to the nature of the surrounding environment, for a 12-hour working day. The presented limits are:

- 70.0 dBA in rural, suburban and urban areas away from main road traffic and industrial noise; and
- 75.0 dBA in urban areas near main roads and heavy industrial areas.

8.2.37 The standard goes on to provide methods for determining the significance of construction noise levels considering the change in the ambient noise level with the construction noise. Two example

assessment methods are presented; these are the ABC method as summarised within **Table 8.5** and the 5 dBA change method.

Table 8.5: Example Threshold of Significant Effect at Dwellings – ABC Method

Assessment Category and Threshold Value Period	Threshold value, in decibels (dB)		
	Category (A)	Category (B)	Category (C)
Night-time (23:00 – 07:00)	45	50	55
Evenings and weekends[D)]	55	60	65
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75
NOTE 1: A significant effect has been deemed to occur if the total L_{Aeq} noise level, including construction, exceeds the threshold level for the Category appropriate to the ambient noise level. NOTE 2: If the ambient noise level exceeds the threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a significant effect is deemed to occur if the total L_{Aeq} noise level for the period increases by more than 3 dB due to construction activity NOTE 3: Applied to residential receptors only			
A) Category A: threshold values to use when ambient levels (when rounded to the nearest 5 dB) are less than these values. B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as Category A values. C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than Category A values. D) 19.00-23.00 weekdays, 13.00-23.00 Saturdays and 07.00-23.00 Sundays			

8.2.38 With respect to the 5 dB(A) change method, the guidance states:

> *"Noise levels generated by construction activities are deemed to be significant if the total noise (pre-construction ambient plus construction noise) exceeds the pre-construction ambient noise by 5 dB or more, subject to lower cut-off values of 65 dB, 55 dB and 45 dB L_{Aeq}, Period, from construction noise alone, for the daytime, evening and night-time periods, respectively; and a duration of one month or more, unless works of a shorter duration are likely to result in significant impact."*

BS 5228: Noise and Vibration Control on Construction and Open Sites - Part 2: Vibration: 2009 (Ref 8.10)

8.2.39 This standard provides recommendations for basic methods of vibration control relating to construction and open sites. The legislative background to vibration control is described and guidance is provided concerning methods of measuring vibration and assessing its effects on the environment.

8.2.40 Guidance criteria are suggested for the assessment of the significance of vibration effects, such criteria are provided in terms of Peak Particle Velocities (PPV) and are concerned with both human and structural responses to vibration. Those applicable to human perception and disturbance are presented within **Table 8.6** below.

Table 8.6: Guidance on Effects of Vibration Levels based on Human Perception

Vibration Level	Effect
0.14 mm s^{-1}	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mm s^{-1}	Vibration might be just perceptible in residential environments.
1.0 mm s^{-1}	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10 mm s^{-1}	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

8.2.41 The standard goes on to present guidance criteria applicable to the vibration response limits of buildings in terms of the component PPV, these are presented within **Table 8.7** below.

Table 8.7: Transient Vibration Guide Values for Cosmetic Damage

Type of building	Peak Component Particle Velocity in Frequency Range of Predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	50 mm/s at 4Hz and above
Unreinforced or light framed structures Residential or light commercial buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
NOTE 1: Values referred to are at the base of the building. NOTE 2: At frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) is not to be exceeded.		

8.2.42 It should be noted that the values presented within **Table 8.7** are applicable to cosmetic damage only. It is stated within BS 5228-2 that minor damage is possible at vibration magnitudes which are greater than twice those given in the table. It can be seen that the guide values for building damage are an order of magnitude higher than for human disturbance.

8.3 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

Scope of the Assessment

8.3.1 A formal Environmental Scoping Letter was issued to WMBC (October 2009) (**Appendix 2.2**). This document identified the key sources of noise that are anticipated to be prevalent across the Site.

8.3.2 The Scope of this assessment has been prepared with due consideration to these potential noise sources. This chapter will consider the noise and vibration effects that will occur during the site preparation, earthworks and construction and operational phases of the Proposed Development, as summarised below:

Site Preparation, Earthworks and Construction Phase

- Increase in noise to existing local noise-sensitive receptors; and
- Groundborne vibration levels to existing local sensitive receptors.

Operational Phase

- Existing road traffic noise and industrial / commercial noise (where prevalent) on proposed residential development;
- Existing road traffic noise and industrial / commercial noise (where prevalent) on proposed educational facilities;
- Noise from shipping movements within the East Float Dock and Bascule Bridge operation on proposed sensitive development e.g. residential and educational facilities;
- Changes in road traffic noise levels associated with the Proposed Development on existing local noise-sensitive receptors;
- Noise from industrial / commercial / plant arising from the Proposed Development on existing and proposed sensitive receptors; and
- Existing groundborne vibration on the Proposed Development as a result of the western and eastern Bascule Bridges (which are close to the perimeter of the Site).

8.3.3 The last of the above assessments is an additional assessment when comparing against those specified within **Appendix 2.2**. This additional assessment has been included following perceptible levels of groundbourne vibration being observed during baseline noise monitoring.

Extent of the Study Area

8.3.4 When considering the suitability of the Site for the proposed noise-sensitive aspects of the development, consideration has been given to the noise environment within the Site boundary.

8.3.5 For construction phase impacts and the potential impact of noise which may be generated from within the Site (industrial / commercial / plant noise), the study area has been selected to include a sample of local noise-sensitive receptors outside the Site boundary, as detailed in **Section 8.4, '**Baseline Conditions'.

8.3.6 When considering the changes in local road traffic noise that could arise as a result of the operation of the Proposed Development, consideration has been given to local road traffic routes within the study area adopted for the Transportation Assessment (TA). It is anticipated, that the greatest impacts will arise on the routes in close proximity to the Site, before the development generated traffic is dispersed across the wider network.

Consultation

8.3.7 At the outset of this project, consultation was undertaken with Environmental Health Department of WMBC to ensure that the proposed assessment methodology was in accordance with their requirements. During consultation, it was agreed that this assessment should be based upon the guidance contained within PPG 24, as outlined above.

8.3.8 We were also advised that 12 Quays Dock is used by passenger and vehicle ferries for departures and arrivals to and from Dublin and Belfast, and that increases in local road traffic movements, including increases in HGVs could arise around the docking times. Accordingly it was requested that baseline noise measurements should be timed to ensure that associated traffic noise increases were captured.

Method of Baseline Data Collation

Desk Study

8.3.9 At the outset of the project a desk study was undertaken to establish likely key noise sources on, and in the vicinity of the Site as well as potential existing noise and vibration sensitive receptors in the vicinity of the Site.

8.3.10 The presence or otherwise of these sources and receptors was confirmed during the baseline noise surveys as detailed below.

Baseline Noise Surveys

8.3.11 In order to determine the baseline noise levels present at existing receptors and at the location of proposed noise-sensitive receptors, a series of environmental noise surveys were undertaken on, and in the vicinity of the Site. Noise monitoring locations were selected such that the dominant noise sources at existing and proposed noise-sensitive receptors could be determined.

8.3.12 The baseline noise surveys were undertaken between the following periods:

- 18:00 hours on the 11 August 2009 and 15:00 hours on the 13 August 2009;
- 11:10 hours on the 9 September 2009 and 16:00 hours on the 11 September 2009; and
- 21:40 hours and 22:45 hours on the 9 November 2009.

8.3.13 The noise surveys comprised a combination of short term fully attended rotational spot measurements, undertaken during key times of the daytime and night-time, and continuous daytime and night-time measurements subject to occasional attendance such that the noise environment could be observed and noted.

8.3.14 Details of the Type 1 sound level monitoring equipment employed during the surveys are presented within **Table 8.8**. All sound level meters had been calibrated to traceable standards within the preceding two years, and the calibrators within the preceding 12 months.

Table 8.8: Noise Measurement Equipment

Equipment	Make and Model	Serial Number
Sound level meter	01dB SIP 95	001417
Preamplifier	01dB PRE 12 N	991523
Microphone	Microtech Gefell MK250	5487
Sound level meter	01dB SIP 95	10566
Preamplifier	01dB PRE 12 N	991313
Microphone	Microtech Gefell MK250	3738
Sound level meter	01dB SIP 95	10565
Preamplifier	01dB PRE 12 N	002557
Microphone	Microtech Gefell MK250	42589
Sound level meter	01dB Solo Master	10330
Preamplifier	01dB PRE 21 S	10423
Microphone	Microtech Gefell MCE212	33494
Sound level meter	01dB Solo Master	10717
Preamplifier	01dB PRE 21 S	11139
Microphone	Microtech Gefell MCE212	42448
Sound level meter	01dB Solo Master	11750
Preamplifier	01dB PRE 21 S	12309
Microphone	Microtech Gefell MCE212	61802
Acoustic Calibrator	01dB Cal 01	11332
Acoustic Calibrator	01dB Cal 21	51031263
Acoustic Calibrator	01dB Cal 21	01120240

8.3.15 Weather conditions present throughout each of the survey periods were conducive to obtaining accurate and reliable measurements.

8.3.16 The measurement locations used during the noise survey are presented within **Figure 8.1** and are described below:

- Measurement Location 1, positioned 2.5m above ground and 10m from Duke Street, free-field conditions;
- Measurement Location 2, positioned 2.5m above ground and 10m from Dock Road, free-field conditions;
- Measurement Location 3, positioned 2.5m above ground and 5m from the East Float Dock edge, in the vicinity of the converted grain warehouses, free-field conditions;
- Measurement Location 4, positioned 1.5m above ground and 10m from Tower Road, free-field conditions;
- Measurement Location 5, positioned 2.5m above ground and 12m from Corporation Road, free-field conditions;
- Measurement Location 6, positioned 1.5m above ground and 10m from Oakdale Road to the rear of adjacent dwellings, free-field conditions;

- Measurement Location 6A, positioned 1.5m above ground and 10m from Oakdale Road to the front of adjacent dwellings, free-field conditions;
- Measurement Location 7, positioned 1.5m above ground and 1m from the road side at the front of adjacent dwellings on Birkenhead Road, free-field conditions;
- Measurement Location 8, positioned 1.5m above ground 3m from the front of residential dwellings on Cathcart Street, adjacent to this road traffic route, free-field conditions;
- Measurement Location 9, positioned 1.5m above ground and 3m from the front the residential dwellings on Old Bidston Road, adjacent to this road traffic route, free-field conditions;
- Measurement Location 10, positioned 1.5m above ground, at the waters edge on the southern harbour front of East Float Dock, free-field conditions; and
- Measurement Location 11, positioned 1.5m above ground and 15m from the side of the western Bascule Bridge (Duke Street Bridge), free-field conditions.

8.3.17 **Table 8.9** below summarises the reasons for the adoption of each measurement location and the measurements that were undertaken.

Table 8.9: Summary of Completed Noise Measurements

Measurement Location	Measurement Summary
1	This location was subject to continuous measurement of daytime and night-time road traffic emanating from Duke Street. Measurements included two complete 8 hour night-time periods and two daytime periods, one of 16 hours in duration and one of 13 hours in duration. This measurement location was also used to determine background noise levels representative of the Proposed Development fronting both sides of Duke Street. The lowest measured daytime and night-time $L_{A90,1hour}$ background noise levels have been adopted to represent a worst case situation.
2	This location was used to undertake a 3 hour daytime road traffic noise measurement (in accordance with the Shortened Measurement Procedure defined within CRTN) and a continuous night-time 8 hour road traffic noise measurement adjacent to Dock Street. This night-time measurement included a period of increased road traffic following the arrival of a ferry to 12 Quays Dock. This measurement location was also used to determine background noise levels during the night-time period. A background noise measurement was also undertaken during the evening, between 18:00 and 23:00 hours. Measured background noise levels were considered representative of the noise environment that will be experienced by proposed noise-sensitive development fronting Dock Road. The lowest measured daytime and night-time $L_{A90,1hour}$ background noise levels have been adopted to represent a worst case situation.
3	This location was subject to a continuous 19 hour background noise measurement encompassing the quietest parts of the daytime and night-time (late evening and the middle of the night-time), and is considered representative of the background noise environment at the adjacent converted grain warehouses residential development. The lowest measured daytime and night-time $L_{A90,1hour}$ background noise levels have been adopted to represent a worst case situation.
4	This location was subject to a 3 hour daytime road traffic noise measurement undertaken in accordance with the Shortened Measurement Procedure defined in CRTN. This location was not secure for a continuous night-time 8 hour road traffic noise measurement so a 25 minute measurement was undertaken at the beginning of the night-time to identify a noise level representative of a worst case $L_{Aeq,8hour}$ night-time road traffic noise level. This measurement location was also subject to 30 and 15 minute measurements during

Measurement Location	Measurement Summary
	the late evening and middle of the night-time, to determine worst case background noise levels representative of proposed noise-sensitive development fronting Tower Road.
5	This location was subject to a continuous 24 hour road traffic noise measurement to determine the levels generated from Corporation Road during both the daytime and night-time. This measurement location was also used to determine background noise levels representative of existing and proposed noise-sensitive receptors facing this route. The lowest measured daytime and night-time $L_{A90,1hour}$ background noise levels have been adopted to represent a worst case situation.
6 and 6A	These measurement locations were subject to 15 and 17 minute measurements during the late evening and middle of the night-time, to determine worst case background noise levels representative of existing nearby residential dwellings, including those fronting Oakdale Avenue.
7	This measurement location was subject to 16 minute measurements during the late evening and middle of the night-time, to determine worst case background noise levels representative of existing nearby residential dwellings, including those fronting Birkenhead Road.
8	This measurement location was subject to 15 and 16 minute measurements during the late evening and middle of the night-time, to determine worst case background noise levels representative of existing nearby residential dwellings, including those fronting Cathcart Street.
9	This measurement location was subject to 16 and 17 minute measurements during the late evening and middle of the night-time, to determine worst case background noise levels representative of existing nearby residential dwellings, including those fronting Old Bidston Road.
10	This measurement location was used to measure the noise levels generated by a typical container ship movement through East Float Dock.
11	This measurement location was used to measure the noise levels generated by the opening and closing of the western Bascule Bridge and the passage of a container ship.

8.3.18 A summary of the measured noise levels gathered for this assessment can be found in **Tables 8.10 to 8.13** below.

8.3.19 **Table 8.10** presents a summary of the measured road traffic noise levels used to assess the noise climate across the Site in accordance with PPG 24, including the determination of the applicable Noise Exposure Categories. **Table 8.11** presents a summary of the measured road traffic noise levels in terms of the highest measured $L_{Aeq,30minute}$ for measurement periods during a typical school daytime; 08:30 to 17:00 (including after school activities). These measurement data have been used in the assessment of Site suitability for proposed educational facilities, as required for assessment with BB93 internal noise criteria.

8.3.20 **Table 8.12** presents a summary of the measured background noise levels measured on, and in the vicinity of the Site, considered representative of existing and proposed noise-sensitive development. **Table 8.13** presents the source noise levels determined for a typical shipping movement through the dock and operation of the western Bascule Bridge.

Table 8.10: Summary of Measured Road Traffic Noise Levels (Daytime and Night-time) – Free-field, dB(A)

Measurement Location	Period	Start – Finish Time	Time Period	$L_{Aeq,T}$	$L_{A10,T}$[1]	Typical $L_{ASmax,T}$	Typical $L_{AFmax,T}$
1	Day	Daytime periods between 18:00 11/08/2009 and 15:00 13/08/2009	16 hours	65.9[2]	-	-	-

Measurement Location	Period	Start – Finish Time	Time Period	$L_{Aeq,T}$	$L_{A10,T}$[1]	Typical $L_{ASmax,T}$	Typical $L_{AFmax,T}$
	Night	Night-time periods between 23:00 11/08/2009 and 07:00 13/08/2009	8 hours	58.4[3]	-	74.6	75.8
2	Day	11:10 09/09/2009 to 14:10 09/09/2009	3 hours	-	66.6		
	Night	23:00 11/08/2009 to 07:00 12/08/2009	8 hours	61.4	-	77.7	77.7
4	Day	10:00 12/08/2009 to 13:00 12/08/2009	3 hours	-	68.5		
	Night	23:00 12/08/2009 to 23:25 12/08/2009	8 hours	60.8[4]	-	71.3[5]	73.8[5]
5	Day	Daytime periods bewteen12:00 10/09/2009 and 12:00 11/09/2009	16 hours	61.2	-		
	Night	23:00 10/09/2009 to 07:00 11/09/2009	8 hours	54.8	-	74.2	74.6

Typical L_{ASmax} noise level taken as the 3rd loudest event in any one hour in accordance with PPG 24
Typical L_{AFmax} noise level taken as the 10th loudest event during the night-time measurement period in general accordance with WHO.
[1] Arithmetic average of 3 consecutive $L_{A10,1hour}$ noise measurements
[2] Arithmetic average of one 16 hour and one 13 hour measurement
[3] Arithmetic average of two 8 hour measurements
[4] 25 minute measurement at start of night-time considered of represent a worst case 8 hour night-time noise level
[5] Highest L_{AFmax} and L_{ASmax} in measurement period.

Table 8.11: Summary of Measured Road Traffic Noise Levels, Highest Measured $L_{Aeq,30minute}$ During School Daytime (08:30 to 17:00), – Free-field, dB(A)

Measurement Location	Period	Start – Finish Time	Highest Measured $L_{Aeq,30minute}$
1	Day	School daytime periods between 18:00 11/08/2009 and 15:00 13/08/2009	68.5
2	Day	School daytime periods between 11:10 09/09/2009 and 14:10 09/09/2009	64.9
4	Day	School daytime periods between 10:00 12/08/2009 and 13:00 12/08/2009	66.5
5	Day	School daytime periods between 12:00 10/09/2009 and 12:00 11/09/2009	63.9

Table 8.12: Summary of Measured Background Noise Levels – Free-field, dB(A)

Measurement Location	Period	Start – Finish Time	Time Period	$L_{A90,T}$
1	Day	Daytime periods between 18:00 11/08/2009 and 15:00 13/08/2009	Lowest measured 1 hour period	54.0
	Night	Night-time periods between 23:00 11/08/2009 and 07:00 13/08/2009	Lowest measured 1 hour period	45.0
2	Day	Daytime periods between18:00 11/08/2009 and 13:00 11/08/2009	Lowest measured 1 hour period	42.5
	Night	23:00 11/08/2009 to 07:00 12/08/2009	Lowest measured 1 hour period	38.0
3	Day	Daytime periods between 14:00 09/09/2009 and 09:00 to 10/09/2009	Lowest measured 1 hour period	48.7
	Night	23:00 09/09/2009 to 07:00 to 10/09/2009	Lowest measured 1 hour period	43.2
4	Day	22:30 12/08/2009 to 23:00 12/08/2009	Quiet Daytime period (late evening)	49.6
	Night	02:11 10/09/2009 to 092:26 10/09/2009	Quiet Night-time period (middle of night-time)	41.7
5	Day	Daytime periods between 12:00 10/09/2009 and 12:00 11/09/2009	Lowest measured 1 hour period	40.1
	Night	23:00 10/09/2009 to 07:00 11/09/2009	Lowest measured 1 hour period	34.8
6A	Day	21:27 09/11/2009 to 21:42 09/11/2009	Quiet Daytime period (late evening)	42.6
6	Night	03:18 13/08/2009 to 03:35 13/08/2009	Quiet Night-time period (middle of night-time)	37.9
7	Day	21:48 09/11/2009 to 22:04 09/11/2009	Quiet Daytime period (late evening)	47.9
	Night	02:57 13/08/2009 to 03:13 13/08/2009	Quiet Night-time period (middle of night-time)	36.1
8	Day	22:09 09/11/2009 to 22:24 09/11/2009	Quiet Daytime period (late evening)	45.6
	Night	02:36 13/08/2009 to 02:52 13/08/2009	Quiet Night-time period (middle of night-time)	37.8
9	Day	22:28 09/11/2009 to 22:44 09/11/2009	Quiet Daytime period (late evening)	47.0
	Night	02:13 13/08/2009 to 02:30 13/08/2009	Quiet Night-time period (middle of night-time)	36.8

Table 8.13: Summary of Measured Noise Levels for Shipping Movements and Bascule Bridge Operation, Free-field, dB(A)

Measurement Location 11	Description	Time Period (mm:ss)	$L_{Aeq,T}$	L_{AFmax}
Dock Side	Passage of Ship	05:49	58.0	71.1
15m from western Bascule Bridge	Bridge Raising	01:00	75.4	86.3
	Bridge Lowering	00:43	77.1	89.9
	Full Event - Bridge Raising, ship pass-by and Bridge Closing	**07:02**	**71.9**	**89.9**

Assessment Methodology and Modelling

Construction Noise

8.3.21 Given the strategic nature of the outline application, consideration will be given to construction noise in general terms, drawing upon the good practice guidance for the control of construction noise and vibration presented with BS 5228-1:2009. Following the fixed noise level limits presented within BS 5228 for urban areas, and regions close to main road traffic, where it is anticipated that construction noise levels could exceed the 75 dB $L_{Aeq,T}$ (façade) applicable to the core working day, it is considered that a noise impact of moderate to major magnitude could arise. Noise levels below this criterion are considered to give rise to an impact of low magnitude.

8.3.22 Consideration has been given to the noise mitigation guidance contained within BS 5228: Part 1, and the control measures available to Local Authorities under the provision of the Control of Pollution Act 1974 (Ref 8.12).

Construction Vibration

8.3.23 The assessment of groundborne vibration associated with typical on-site demolition/construction activities has been undertaken drawing upon the guidance presented within BS 5228-2:2009. Consideration has been given to the historic groundborne vibration levels presented within this document, as well as the groundborne prediction methodologies. These data have been used to determine the magnitude of potential groundborne vibration during the during the construction phase for a sample of construction operations.

8.3.24 The magnitude of vibration effects has been assessed drawing upon the guidance criteria presented within BS 5228-2:2009, for human perception. In this regard the following criteria have been adopted:

Table 8.14: Magnitude of Effect Applicable to Construction Vibration based on Human Perception

Vibration Level	Effect	Magnitude of Effect
<0.3 mm s^{-1}	Unlikely to be perceptible in residential environments	Negligible
0.3>1.0 mm s^{-1}	Onset of perceptibility in residential environments.	Low
1.0>10.0 mm s^{-1}	Onset of complaints in residential environments	Medium
>10.0 mm s^{-1}	Vibration is likely to be intolerable for any more than a very brief exposure to this level.	High

Road Traffic Noise Impact on Proposed Development

8.3.25 During attendance on-site it was noted that road traffic noise dominated noise levels present on the Site throughout the daytime and night-time periods. Occasional local industrial / commercial noises emanating from the opposite side of Corporation Road to the Site were noted, but the level of these sources was well below the prevailing road traffic noise levels.

8.3.26 When considering the effect of the existing noise climate upon proposed residential accommodation, the suitability of the Site has been assessed in accordance with PPG 24 by determination of the applicable Noise Exposure Categories, and by comparing the results of the completed baseline noise surveys with the absolute noise level criteria presented in BS 8233 for residential occupation. This approach allows development design considerations to be included as part of the assessment such that wherever possible, any negative effects can be designed out of the Proposed Development.

8.3.27 When considering the effect of existing noise climate upon proposed educational facilities, the suitability of the Site has been assessed by comparing the results of the completed baseline noise surveys with the absolute noise level criteria presented in BB93 for typical teaching and learning environments. Again, this approach allows development design considerations to be included as part of the assessment such that wherever possible, any negative effects can be designed out of the Proposed Development.

Shipping and Bascule Bridge Operation Noise Impact on Proposed Development

8.3.28 When considering the noise impact of these sources on proposed residential accommodation the assessment has compared the measured noise levels against the absolute noise level criteria presented in BS 8233 for residential occupation. This approach allows for the necessary noise mitigation measures to be incorporated into the developing scheme design such that any negative effects can be designed out of the Proposed Development.

Noise from Proposed Plant/Equipment

8.3.29 The Proposed Development includes a number of different noise-sensitive uses including residential and educational. In addition there are development aspects (e.g. employment uses and fixed plant items that may be installed), that have the potential to generate noise. However, at this strategic stage of the Proposed Development, the precise details of the proposed type, number and location of any such aspects are not available.

8.3.30 Therefore, suitable noise control limits to which any such plant and activities should conform have been determined. These limits include any corrections for possible acoustic characteristics where applicable.

8.3.31 BS 4142 states that a rating noise level of +5 dB above background is of marginal significance when assessing the likelihood of complaints. However, if such a criterion was applied to individual items of plant it is likely that a gradual increase in background noise levels (a 'creeping background') may result due to the cumulative noise levels generated by all plant items.

8.3.32 In order to reduce the possibility of a creeping background, the cumulative effect of all external plant to be incorporated in to the proposals has been accounted for in the determined noise limits. Noise limits have been specified based on achieving an overall rating over background level of -5 dB at the closest noise-sensitive receptors (existing and future) during both daytime and night-time periods. Where this criterion is exceeded, impacts of moderate to major magnitude are registered. Where this criterion is met, adverse impacts of minor magnitude are registered.

Development Generated Road Traffic Noise on Existing Receptors

8.3.33 The Proposed Development has the potential to give rise to changes in traffic flows on the surrounding network, and therefore changes to the noise levels generated across the local road network.

8.3.34 Based on the scheme traffic flow data and the results of road traffic noise level calculations undertaken in accordance with the prediction methodology presented within the CRTN memorandum, the noise level changes predicted to arise adjacent to a sample of road traffic routes in the vicinity of the Site have been determined. The impact magnitude associated with the predicted noise level changes has been assessed based on the classification of effects presented within the DMRB, as duplicated in **Table 8.15**

below. It should be noted that the descriptor terms have been altered to ensure consistency with the terms used throughout this ES.

Table 8.15: Impact Scale for Comparison of Future Noise against Existing Noise

Change in Noise Level dB(A)	Magnitude of Effect
0	None
0 – 0.9	Negligible
1 – 2.9	Low
3 – 4.9	Medium
5+	High

Significance Criteria

8.3.35 The significance level attributed to predicted noise and vibration impacts has been assessed based on the magnitude of effect and the sensitivity of the receptor. Impact magnitude and receptor sensitivity are both assessed on a scale of high, medium, low and negligible (as shown in **Table 2.1** in **Chapter 2 – Approach to EIA**).

8.4 BASELINE CONDITIONS

Existing Sensitive Receptors

8.4.1 Existing noise and vibration sensitive receptors in the vicinity of the site have been identified by means of the desk review and baseline noise survey. Identified local noise vibration sensitive receptors include:

- Residential dwellings forming part of the converted grain warehouses;
- Residential dwellings forming part of the proposed North Bank East Development;
- Residential dwellings to the north of the Site, including those on Oakdale Avenue and beyond;
- Residential dwellings to the north-west of the Site, including those on Birkenhead Road and beyond;
- Residential dwellings to the south of the Site, including those on and in the vicinity of Cathcart Street;
- Residential dwellings to the south-east of the Site including those on and in the vicinity of Old Bidston Road;
- A Childrens Nursery on the south side of Corporation Road; and
- Quay side walls, locks, the hydraulic engine house and tower and the grain warehouses (vibration only).

8.4.2 It is considered that all of the above receptors have a high sensitivity with respect to potential noise and vibration impacts.

Proposed Sensitive Receptors

8.4.3 As well as existing noise-sensitive dwellings, it is also appropriate to consider proposed noise-sensitive receptors. Noise-sensitive receptors are proposed as part of this development, and may also arise as a result of Proposed Developments to the east of Tower Road and to the west of Duke Street.

8.4.4 It is considered that all of the above receptors have a high sensitivity with respect to potential noise and vibration impacts.

8.5 ASSESSMENT OF IMPACTS, MITIGATION AND RESIDUAL EFFECTS

Site Preparation, Earthworks and Construction Phase

Increase in noise to existing local noise-sensitive receptors

8.5.1 It is inevitable with any major development that there will be some disturbance caused to those nearby during the Site clearance and construction phases of the Proposed Development, however, disruption due to such activities is generally localised and is temporary in nature.

8.5.2 From the proposed construction programme outlined in **Chapter 4 – Consideration of Alternatives and Description of Proposed Development**, noise from earthworks and construction activities can be generated from a variety of sources including excavation, use of pumps, generators, delivery vehicles together with activities such as hammering, drilling and cutting etc.

8.5.3 Although there are techniques available to predict the likely effect of noise from demolition/construction works, such as those contained within BS 5228, Part 1: 2009, they are necessarily based on detailed information of the type and number of plant being used, their location and the length of time they are in operation. Given the strategic nature of this application, sufficient detailed information on construction techniques and equipment is not yet available. Consequently at this stage, it is not possible to calculate accurately the level of noise from site clearance and construction activities. It is therefore more appropriate at this stage to consider the potential effects in a qualitative manner drawing upon the measures which are available to control construction noise, including the powers available to the Local Authority through the *Control of Pollution Act 1974* (more detail is provided in the mitigation section below).

8.5.4 The DMRB states that "*one study has shown that at least half of the people living within 50m either side of the Site boundary were seriously bothered by construction nuisance of one from or another, but that beyond 100m less than 20% of the people were seriously bothered (see TRRL Supplementary Report SR 562*"). In the case of this development, the vast majority of local receptors are positioned more than 100m from the site boundary. It is anticipated that for these receptors, construction noise levels could easily be controlled to within the 75 dB $L_{Aeq,T}$ façade criterion over the course of the working day. The sensitivity of these receptors is considered to be high and the magnitude of impact is considered to be low. Therefore, there is likely to be a direct, temporary, medium term effect on those receptors beyond 100m of **minor to moderate negative** significance prior to the implementation of mitigation measures.

8.5.5 Receptors within 100m of the Site include the converted grain warehouses and the children's nursery on the south side of Corporation Road. These receptors are located at distances of approximately 27 and 44m from the closest proposed building structures. At these distances, it is anticipated that construction noise levels could be controlled to ensure achieving the adopted 75dB $L_{Aeq,T}$ façade criterion over the core working day for most of the time, but that occasional exceedances may arise. The sensitivity of the receptors is considered to be high and the magnitude of impact is considered to be low for the majority of the time, but occasionally medium. Therefore, there is likely to be a direct, temporary medium term effect on the converted grain warehouses and the children's nursery of **minor to moderate negative** significance occasionally rising to **moderate to major negative** significance for short durations, prior to the implementation of mitigation measures.

Mitigation

8.5.6 Several safeguards exist to minimise the effects of construction noise, these include:

- The various EC Directives and UK Statutory Instruments that limit noise emissions of a variety of construction plant;
- Guidance set out in BS 5228: Part 1: 2009, which covers noise control on construction sites; and
- The powers that exist for local authorities under Sections 60 and 61 of the *Control of Pollution Act 1974* to control noise from construction sites.

8.5.7 The adoption of Best Practicable Means, as defined in Section 72 of the *Control of Pollution Act 1974* is usually the most effective means of controlling noise from construction sites. Such measures where appropriate may include the following:

- Any compressors brought onto the Site to be silenced or sound reduced models fitted with acoustic enclosures;
- All pneumatic tools to be fitted with silencers or mufflers;
- Care to be taken when erecting or striking scaffolds to avoid impact noise from banging steel. All operatives undertaking such activities to be instructed on the importance of handling the scaffolds to reduce noise to a minimum;
- The majority of deliveries to be programmed to arrive during normal working hours only. Care to be taken when unloading vehicles to minimise noise. Delivery vehicles to be routed so as to minimise disturbance to local residents. Delivery vehicles to be prohibited from waiting within or in the vicinity of the Site with their engines running;
- All plant items to be properly maintained and operated according to manufacturers' recommendations in such a manner as to avoid causing excessive noise;
- All plant to be sited so that the effect of noise at nearby noise-sensitive properties is minimised;
- Local hoarding, screens or barriers to be erected as necessary to shield particularly noisy activities; and
- Problems concerning noise from construction works can often be avoided by taking a considerate and neighbourly approach to relations with the local residents. Works should only take place during given periods (e.g. during normal construction hours) and not at night.

8.5.8 It is recommended that the above measures be included in any Construction Environmental Management Plan (CEMP) that may be issued to and agreed with the contractor(s) conducting the works. The CEMP should include detailed noise level predictions which should be completed once the precise construction methods and phasing can be confirmed. The requirements of construction phase monitoring to demonstrate compliance with appropriate construction noise limits should also be included if necessary.

8.5.9 Notwithstanding the above, it should be noted that through the provisions of the Section 60 and 61 of the *Control of Pollution Ac 1974*, the Local Authority have means of controlling construction noise where they consider than an unacceptable noise nuisance is being generated by the works.

8.5.10 It is proposed that detailed construction noise impact assessments be undertaken when the necessary level of detail is available.

Residual Effects

8.5.11 The implementation of the above mitigation measures will serve to minimise any disturbance caused to nearby receptors during this phase. For the majority of this phase, where activities take place at locations towards the centre of the Site (away from existing noise-sensitive receptors), and for receptors at distance from the Site, it is expected that noise levels associated construction phase will have a low magnitude. Where activities take place close to the converted grain warehouses and the children's nursery (i.e closest to noise-sensitive receptors), it is possible that isolated effects of medium to high magnitude may be experienced for limited periods. However these will be short term and temporary in nature limiting the duration and significance of any resulting residual effects.

8.5.12 The sensitivity of the closest noise-sensitive receptors to the Site is considered to be high and the magnitude of impact (when construction operations are undertaken for the majority of the time at locations away from existing receptors), following mitigation is expected to be low. Therefore, there is likely to be a direct temporary medium term effect on the closest noise sensitive receptors of **minor to moderate negative** significance following the implementation of mitigation measures. Where, for limited durations, activities are conducted near the site boundaries adjacent to noise-sensitive receptors, there is likely to be a direct temporary short-term effect of **moderate to major negative significance**.

Groundborne vibration levels to existing local sensitive receptors

8.5.13 Groundborne vibration calculations have been performed for typical construction activities/machinery based on the empirical prediction procedures and historical measurement data

presented within *BS 5228-2:2009* and the Transport and Road Research Laboratory Research Report 246: *Traffic induced vibrations in buildings* (TRL RR 246): 1990 (applicable to HGV induced vibration).

8.5.14 These predictions have been performed in order to determine the possible distances at which the adopted magnitude of effect criteria may be registered based on a specified confidence limit (where applicable). In this regard, the following groundborne vibration levels and associated distances have been identified for a sample of typical construction vibration sources. It is noted that there may be a variety of different potential vibration generating activities employed during the construction phase of the Proposed Development, other than those presented below. The predicted levels given within **Table 8.16** have been provided for indicative purposes such that the possibility of groundborne vibration effects arising and their magnitude of effect can be considered.

Table 8.16: Predicted Groundborne Vibration Levels Applicable to Typical Vibration Generating Construction Activities

Operation	Confidence limit	Distance (m)	PPV (mm/s)
Vibratory Rollers – start & end	95	60	0.3
	95	23	1.0
Vibratory Rollers – steady state[1]	95	3.3	10
Piling – Driven cast in place	95	215	0.3
	95	85	1.0
	95	15	10
Rotary Bored Piling - Augering	N/A	20	≤0.3
	N/A	6	≤1.0
	N/A	0.6	≤10
Rotary Bored Piling – Auger hitting base	N/A	45	≤0.3
	N/A	14	≤1.0
	N/A	1.4	≤10
Rotary Bored Piling – Driving casing	N/A	75	≤0.3
	N/A	23	≤1.0
	N/A	2.3	≤10
HGV's[2]	N/A	50	≤0.3[3]
	N/A	17	≤1.0[3]
	N/A	2.5	≤10[3]

[1]. Assumes 2 drums, 0.4mm amplitude, drum width of 1.3m, e.g. heavy duty ride on roller
[2]. Assumes max height / depth of surface defect of 50 mm, max speed of 30 km/h, and that surface defect occurs at both wheels.
[3]. Where alluvium soils are present, higher vibration levels can be expected.

8.5.15 The data presented within **Table 8.16** are general in nature and not specific to any one site, however the vibration levels and associated distances can be used to determine the typical distances at which specific effects may be registered. The data upon which the above table has been prepared is taken from BS 5228 and covers a variety of different ground conditions.

8.5.16 Based on the East Float Neighbourhood Parameter Plans and Principles, the closest existing residential properties and the children's nursery, are located at distances of 27 and 44m from the closest proposed building structures respectively. Although some activities may arise at closer distances, e.g. those associated with road building, it is generally operations associated with ground consolidation and foundation works that generate the highest levels of groundborne vibration.

8.5.17 Accordingly, **Table 8.17** presents the predicted magnitude of effects at these properties. It should be noted that the significance ratings presented within the table, in some cases, have been generated based on a 95 percent confidence limit. Therefore, in reality, it is likely that lower impact magnitudes will prevail for the majority of activities.

Table 8.17: Predicted Magnitude of Effects from Sample Construction Activities for Groundborne Vibration Based on Human Perception at 27m

Activity	Magnitude of effect at 27m
Vibratory Rollers	Low
Piling – Driven cast in place	Medium
Rotary Bored Piling – Augering	Negligible
Rotary Bored Piling – driving casing	Low
HGV's	Low

8.5.18 From **Table 8.17** it is evident that effects of medium magnitude may occur in the event that piling activities (similar to driven cast in place piling) are conducted within 27m of existing local residential receptors (and the children's nursery). The sensitivity of the closest existing local residential receptors (and the children's nursery) are high and the magnitude of impact, prior to mitigation is medium. Therefore, there is likely to be a direct, temporary, short term effect on these receptors of **moderate to major negative significance** prior to the implementation of mitigation measures.

8.5.19 It should be noted that this is very much a worse case assessment based on the minimum possible distances at which construction activities could reasonably take place from existing vibration sensitive receptors. In reality, for the majority of the construction phase, it is expected that activities will take place at greater distances from such properties thus leading to effects of lesser significance. Furthermore it should be noted that the vibration predictions have utilised a large dataset covering a range of measured levels applicable to each operation. It is evident from this dataset that, for the majority of operations (approximately 95 % in most cases), predicted levels will be lower than those adopted for this assessment.

8.5.20 It should also be noted that the above assessment has been undertaken based on vibration levels associated with a small range of groundborne vibration generative construction activities. It is possible that activities other than those presented may take place; similarly some of those presented may not be applicable to the construction activities specific to the Proposed Development site. The conclusions drawn from this assessment should therefore be used for indicative purposes only.

8.5.21 In addition to habited receptors, consideration also needs to be given to the potential for structural damage which could arise at sensitive structures such as quay side walls and locks, the hydraulic engine house and tower, and the grain warehouses etc. Generally, the levels of vibration that are required to give rise to structural damage are significantly greater than those which are perceptible to humans, but at this stage, the precise nature of the construction techniques to be adopted and their location(s) with respect to sensitive structures are not known. Accordingly, it is recommended that a detailed construction vibration assessment be undertaken once these details are confirmed such that the acceptability of the proposed construction techniques can be determined.

Mitigation

8.5.22 It is possible to employ a number of physical and operational measures in order to reduce the potential effects resulting from construction generated vibration, such measures may include;

- Adoption of low vibration working methods. Consideration should be given to use of the most suitable plant;
- Where processes could potentially give rise to significant levels of vibration, on-site vibration levels should be monitored regularly by a suitably qualified person;
- Where piling is to take place, any obstructions should first be removed;

- The provision of cut-off trenches in order to interrupt the direct transmission path of vibrations;
- Reduction of energy input per blow (applicable to piling); and
- Application of piling techniques aimed at reducing resistance to penetration e.g. pre-boring for driven piles and adding water to the hole for impact bored piles.

8.5.23 In light of the predicted significance of effects and the presence of vibration sensitive structures such as quay walls and locks, the hydraulic engine house and tower, and the grain warehouses etc, it is recommended that the need for a detailed groundborne vibration assessment be screened for each Quarter of the development. These assessments should include due consideration to mitigation measures such as those presented above. The results of these assessments can be used to ensure the appropriate set back distances are used, and that acceptable construction techniques are adopted.

8.5.24 It is also recommended that vibration monitoring surveys should be considered and screened for each Quarter in accordance with the recommendations outlined in BS 5228 Part 2 and BS 7385 1990: *Evaluation and measurement for vibration in buildings, Part 1: Guide for measurement of vibrations and evaluation of their effects on buildings* (Ref 8.13). The results of these surveys could be used to confirm the vibration levels generated during the actual construction works and check compliance with the results of the detailed vibration assessment for each Quarter (where appropriate).

Residual Effects

8.5.25 The sensitivity of the closest existing local residential receptors (and the children's nursery) are high and the magnitude of impact, assuming operational and physical mitigation measures are adopted is medium. Therefore, there is likely to be a direct, temporary, short term effect on these receptors of **minor or moderate** significance following the implementation of mitigation measures**.** However, where mitigation measures cannot control vibration, a direct, temporary, short term effect on these receptors of **moderate to major negative significance** is anticipated following the implementation of mitigation measures.

8.5.26 Following confirmation of the precise construction programme it is recommended that a further assessment are considered and screened for each development Quarter, to inform the selection of appropriate construction techniques.

Operational Phase

Existing road traffic noise and industrial / commercial noise (where prevalent) on proposed residential development

8.5.27 During attendance on-site it was noted that local road traffic noise from Dock Road, Tower Road, Corporation Road and Duke Street were the dominant sources across the Site.

8.5.28 It order to establish the suitability of the Site for residential development it is appropriate to assesses the measured road traffic noise levels by comparison with the Noise Exposure Categories presented within Planning Policy Guidance Note 24.

8.5.29 **Table 8.19** below compares the measured daytime and night-time noise levels for Locations 1, 2, 4 and 5 against the PPG 24 NECs.

8.5.30 The PPG 24 NECs are based on the $L_{Aeq,T}$ noise levels over 16 hour daytime and 8 hour night-time periods. For locations 2 and 4, it has therefore been necessary to correct the measured daytime $L_{A10,3hour}$ noise levels to the $L_{Aeq,16hour}$ noise index. The CRTN memorandum states that an $L_{A10,3hour}$ noise level can be corrected to an $L_{A10,18hour}$ noise level by subtracting 1 dB, and PPG 24 states that an $L_{A10,18hour}$ noise level can be corrected to an $L_{Aeq,16hour}$ noise level by subtracting 2 dB. These corrections have been applied in the determination of the noise levels presented in **Table 8.18** below.

Table 8.18: PPG 24 Noise Exposure Categories at Measurement Locations1, 2, 4 and 5, Free-field, dB(A)

Measurement Location (Figure 8.1)	Period	Time Period	$L_{Aeq,T}$	L_{ASmax}	PPG 24 NEC
Location 1 - 10m from Duke Street	Daytime (07:00 to 23:00)	16 hours	65.9	-	C
	Night-time (23:00 to 07:00)	8 hours	58.4	76.3[3]	C
Location 2 - 10m from Dock Road	Daytime (07:00 to 23:00)	16 hours	63.6[1]	-	B/C
	Night-time (23:00 to 07:00)	8 hours	61.4	77.7[3]	C
Location 4 - 10m from Tower Road	Daytime (07:00 to 23:00)	16 hours	65.5[1]	-	C
	Night-time (23:00 to 07:00)	8 hours	60.8[2]	71.3[4]	C
Location 5 - 12m from Corporation Road	Daytime (07:00 to 23:00)	16 hours	61.2	-	B
	Night-time (23:00 to 07:00)	8 hours	54.8	74.2[3]	B

[1] $L_{Aeq,16hour}$ noise level derived from 3 hour road traffic noise measurement
[2] Worst case $L_{Aeq,8hour}$ noise level, actual noise level measured over 30 minute period between 23:00 and 23:30.
[3] L_{ASmax} noise levels taken as the 3rd loudest maximum level arising during any night-time 1 hour period.
[4] L_{ASmax} noise level taken as the single loudest L_{ASmax} level during the night-time 30 minute measurement.

8.5.31 The above NEC classifications apply at the measurement locations. It is therefore appropriate to determine the NECs that would arise at the closest proposed build line to each existing road traffic route. Based on the East Float Neighbourhood Parameter Plans and Principles, the closest proposed building lines at ground level to each road traffic route are approximately as follows:

- Dock Road – 17m;
- Tower Road – 4m;
- Corporation Road – 30m; and
- Duke Street – 11m.

8.5.32 The noise levels at these distances have been calculated based on standard acoustic distance corrections of a 3 dB loss per doubling of distance from a line source ($L_{Aeq,T}$ noise levels) and a 6 dB loss per doubling of distance for a point source (L_{ASmax} noise levels). It is assumed that the source line is 3.5m into the road from the curb edge (in accordance with CRTN).

Table 8.19: PPG 24 Noise Exposure Categories at Closest Proposed Development to Duke Street, Dock Road, Tower Road and Corporation Road, Free-field, dB(A)

Measurement Location	Period	Time Period	$L_{Aeq,T}$	L_{ASmax}	PPG 24 NEC
Closest ground floor development to Duke Street (11m)	Daytime (07:00 to 23:00)	16 hours	65.6	-	C
	Night-time (23:00 to 07:00)	8 hours	58.1	75.7[3]	C
Closest ground floor	Daytime	16 hours	61.8[1]	-	B

Measurement Location	Period	Time Period	$L_{Aeq,T}$	L_{ASmax}	PPG 24 NEC
development to Dock Road (17m)	(07:00 to 23:00)				
	Night-time (23:00 to 07:00)	8 hours	59.6	74.1[3]	C
Closest ground floor development to Tower Road (4m)	Daytime (07:00 to 23:00)	16 hours	68.1[1]	-	C
	Night-time (23:00 to 07:00)	8 hours	63.4[2]	76.4[4]	C
Closest Ground floor development to Corporation Road (30m)	Daytime (07:00 to 23:00)	16 hours	57.9	-	B
	Night-time (23:00 to 07:00)	8 hours	51.5	67.5[3]	B

[1] $L_{Aeq,16hour}$ noise level derived from 3 hour road traffic noise measurement.
[2] Worst case $L_{Aeq,8hour}$ noise level, actual noise level measured over 30 minute period between 23:00 and 23:30.
[3] L_{ASmax} noise levels taken as the 3rd loudest maximum level arising during any night-time 1 hour period.
[4] L_{ASmax} noise level taken as the single loudest L_{ASmax} level during the night-time 30 minute measurement.

8.5.33 Given that NEC C has been identified at some regions of the Site, consideration has been given to the distances at which NEC B applies. These set back distances are presented in **Table 8.20** below

Table 8.20: Distances from Duke Street, Dock Road, Tower Road and Corporation Road at Which PPG 24 Noise Exposure Category B Applies

Source	Period	Distance from road edge to NEC B (m)	Overall (m)
Duke Street	Daytime	20	20
	Night-time	18	
Dock Road	Daytime	11	30
	Night-time	30	
Tower Road	Daytime	18	26
	Night-time	26	
Corporation Road	Daytime	13	23
	Night-time	23	

8.5.34 The guidance to the local planning authority in PPG 24 for site regions falling within NEC C is:

"*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 commensurate level of protection against noise.*"

8.5.35 The guidance to the local planning authority in PPG 24 for site regions falling within NEC B is:

"*Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise.*"

8.5.36 As NECs B and C have been identified, in accordance with PPG 24, mitigation measures are required to provide a commensurate level of protection against noise for future occupants. These are considered further in the mitigation section below.

Mitigation

8.5.37 Consideration has been given to appropriate acoustic attenuation measures, to provide a commensurate level of protection against noise for future occupants of the development (assuming residential development at the closest proposed ground floor distances to local road traffic routes).

8.5.38 In its explanation of the noise limits that define the boundary between NEC B and NEC C, PPG 24 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.*"

8.5.39 It is therefore appropriate in the first instance to explore the protection that could be afforded by the sound insulation performance of the glazing elements / building fabric.

8.5.40 **Table 8.21** below presents the external free-field noise levels predicted at the closest proposed ground floor façades to each road traffic route. Also presented are the internal noise level criteria applicable to residential occupation (taken from BS 8233 and WHO guidance), and the calculated sound reduction performance required to achieve these criteria.

Table 8.21: Required Sound Insulation Performance for Residential Dwellings at Worst Case Development Distances, dB(A)

Location	Period	Ambient Noise Level, dB(A)	Internal Target Noise Levels	Required Sound Insulation Performance ($R_{,TRA}$)
Closest proposed ground floor development to Duke Street (11m)	Day ($L_{Aeq,16hour}$)	65.6	30 - 40	25.6 - 35.6
	Night ($L_{Aeq,8hour}$)	58.1	30 - 35	23.1 – 28.1
	Night (L_{AFmax})	75.2	45	30.2
Closest proposed ground floor development to Dock Road (17m)	Day ($L_{Aeq,16hour}$)	61.8	30 - 40	21.8 – 31.8
	Night ($L_{Aeq,8hour}$)	59.6	30 - 35	24.6 – 29.6
	Night (L_{AFmax})	74.1	45	29.1
Closest proposed ground floor development to Tower Road (4m)	Day ($L_{Aeq,16hour}$)	68.1	30 - 40	28.1 – 38.1
	Night ($L_{Aeq,8hour}$)	63.4[2]	30 - 35	28.4 – 33.4
	Night (L_{AFmax})	78.9	45	33.9
Closest proposed ground floor development to Corporation Road (30m)	Day ($L_{Aeq,16hour}$)	57.9	30 - 40	17.9 – 27.9
	Night ($L_{Aeq,8hour}$)	51.5	30 - 35	16.5 – 21.5
	Night (L_{AFmax})	67.9	45	22.9

8.5.41 It is assumed that the proposed buildings will be of a masonry construction and as such, the glazing will be the acoustic weak link in the sound reduction performance of the façade. PPG 24 sets out generic data relating to the typical noise reduction performance of three glazing types, namely single, thermal double and secondary mounted in a brick/block façade. The performance values for a typical road traffic noise spectrum are set out in the **Table 8.22** below.

Table 8.22: Sound Insulation Performances of Different Glazing Types for Road Traffic Noise, As Set Out In PPG 24, dB.

Noise Source	Difference between dB(A) levels outside and inside		
	Single Glazing	Thermal Double Glazing	Secondary Glazing
Road Traffic	28	33	34

8.5.42 Comparing the required performances for the closest development to Duke Street (**Table 8.21**), with the glazing performances set out in **Table 8.22**, it can be seen that use of glazing with a similar acoustic performance to the example of *well sealed thermal double glazing* given in PPG 24 would be sufficient to meet the "good" $L_{Aeq,T}$ criterion during the night and ensure a daytime condition much better than the "reasonable" $L_{Aeq,T}$ criterion. Similar glazing would also be sufficient to achieve the adopted L_{AFmax} criterion which is applicable during the night-time.

8.5.43 Comparing the required performances for the closest development to Dock Road and Corporation Road (**Table 8.21**), with the glazing performances set out in **Table 8.22**, it can be seen that use of glazing with a similar acoustic performance to the example of *well sealed thermal double glazing* given in PPG 24 would be sufficient to meet the "good" $L_{Aeq,T}$ criterion during both the daytime and night-time periods whilst also being sufficient to achieve the L_{AFmax} criterion which is applicable during the night-time period.

8.5.44 Drawing similar comparisons for the closest development to Tower Road, it can be seen that use of glazing with a similar acoustic performance to the example of *well sealed thermal double glazing* given in PPG 24 would be sufficient to ensure daytime and night-time conditions better than the "Reasonable" $L_{Aeq,T}$ criteria. Such glazing would fall within 1 dB of achieving the night-time L_{AFmax} criterion applicable during the night-time. However, it should be noted that there are many different glazing configurations on the market which have acoustic performances superior to that of 'typical' thermal double glazing, and this criterion could also therefore be achieved by selection of an appropriately enhanced glazing specification.

8.5.45 The above glazing calculations are intended to be for planning purposes only. More detailed calculations will be required for the procurement of the glazing units, once the site layout and housing floor plans/elevations have been progressed.

8.5.46 The above assessment has been undertaken for the closest Proposed Development at ground floor level to local road traffic routes. Based on the East Float Neighbourhood Parameter Plans and Principles, it can be seen that in some instances, development at upper floors may be marginally closer to local noise sources than at ground floor level. However, it is anticipated that any associated small increases in noise levels at upper floors could be addressed by means of appropriate façade design considerations (e.g. glazing and ventilation specifications).

8.5.47 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.*"

8.5.48 Where appropriate, the preferred choice of ventilation is through the use of natural acoustically attenuated 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. The future occupants would then have the option of keeping windows closed for most of the time and opening windows for rapid ventilation and summer cooling.

8.5.49 The Building Research Establishment (BRE) has published an Information Paper on the acoustic performance of such passive ventilation systems. IP4/99: 1999: *Ventilators: Ventilation and Acoustic Effectiveness* (Ref 8.14) details 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 as follows:

Table 8.23: Range of Measured Sound Reduction Performance of Passive Ventilators, with Vents Open, dB(A)

Window Mounted Trickle Vents (open)	Passive Through-Wall Ventilators (open)
From 14 to 40 (depending on model)	From 30 to 46 (depending on model)
Figures corrected for effective area of ventilator	

8.5.50 It can be seen from the above figures that 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.

8.5.51 With regards to external daytime noise levels it is evident that a significant proportion of the Site will experience noise levels in excess of the WHO 55 dB(A) criterion adopted for this assessment.

8.5.52 The location with the highest daytime noise level is development adjacent to Tower Road, with a daytime $L_{Aeq,T}$ noise level of 68.1 dB. In order to achieve the adopted 55 dB(A) criterion at this location, a reduction of approximately 13 dB(A) is required.

8.5.53 A reduction of this order can be achieved by incorporation of careful layout design considerations within the parameters set, e.g. locating balconies/gardens/outdoor amenity areas on the facades facing away from, and with no direct line of sight to, local road traffic sources. This approach would afford significant acoustic attenuation due to the screening afforded by the proposed buildings themselves and would also ensure further attenuation due to increased distance. It can therefore be seen that with due consideration to layout design techniques, the external living space criterion could also be met across the Proposed Development.

Residual Effects

8.5.54 It has been identified that the Site generally falls within PPG 24 NEC's B and C. For each of these categories, accounting for a worst case scenario of residential development at the closest proposed distance to local road traffic routes, it has been identified that with due consideration to appropriate mitigation measures, a commensurate level of protection can be afforded to future residents.

8.5.55 For outdoor areas it has been identified that, with the incorporation of appropriate site layout design (within the parameters set) acceptable outdoor noise levels can also be achieved. This is likely to be through considerations that primary outdoor amenity areas are located at sufficient distances from road traffic routes and / or amenity areas are well screened from nearby road traffic routes.

8.5.56 The sensitivity of the proposed residential dwellings within the Site is considered to be high, however, it is anticipated that with the implementation of appropriate design techniques, the magnitude of impact is negligible. Therefore, there is likely to be a **negligible** effect to such receptors, following the implementation of mitigation measures.

Existing road traffic noise and industrial / commercial noise (where prevalent) on proposed educational facilities

8.5.57 The Noise Exposure Categories presented in PPG 24 are only applicable to residential development and are not applicable to educational facilities. Accordingly, this assessment has been based on determining the sound reduction that will be required to ensure a sample of internal noise criteria adopted from BB93 is achieved.

8.5.58 Paragraph 8.5.31 above identifies the distances of the closest Proposed Development blocks to Dock Road, Tower Road, Corporation Road and Duke Street. Based on these distances, the highest measured $L_{Aeq,30minute}$ noise levels presented in **Table 8.11** have been corrected to give worst case external

noise levels for the proposed educational facilities. The standard acoustic distance correction of a 3 dB loss per doubling of distance from a line source has been applied. The calculated noise levels are presented in **Table 8.24** below. Also presented in this table are the sample internal noise criteria adopted from BB93, and the required sound reduction performances required to achieve these internal criteria.

Table 8.24: Required Sound Insulation Performance for Educational Facilities at Worst Case Development Distances, dB

Location	Period	Ambient Noise Level, dB(A)	Internal Target Level	Required Sound Insulation Performance Requirement ($R_{,TRA}$)
Closest proposed ground floor development to Duke Street (11m)	Day ($L_{Aeq,30minute}$)	68.2	30 – 35 - 40	28.2 - 33.2 - 38.2
Closest proposed ground floor development to Dock Road (17m)	Day ($L_{Aeq,30minute}$)	63.1	30 – 35 - 40	23.1 – 28.1 – 33.1
Closest proposed ground floor development to Tower Road (4m)	Day ($L_{Aeq,30minute}$)	69.0	30 – 35 - 40	29.0 – 34.0 – 39.0
Closest proposed ground floor development to Corporation Road (30m)	Day ($L_{Aeq,30minute}$)	60.6	30 – 35 - 40	20.6 – 25.6 – 30.6

8.5.59 The above table presents the sound attenuation performances that will be required to ensure a commensurate level of protection against noise for proposed educational facilities at the closest proposed build lines to key local road traffic source in the vicinity of the Site. In accordance with these requirements, consideration has been given to appropriate noise mitigation measures in the following section.

Mitigation

8.5.60 **Table 8.22** above presents the typical noise reduction performance of three glazing types, namely single, thermal double and secondary, as specified in PPG 24. Comparing these typical noise reduction performances with the required performances presented in **Table 8.22**, it can be seen that even at these worst case distances, glazing with a similar acoustic performance to the example of typical thermal double glazing would be sufficient to ensure achieving the 35 dB criterion (primary and secondary school classrooms etc) at the closest Proposed Development blocks to Duke Street, Dock Road, and Corporation Road, whilst falling only 1dB short of the requirement for Tower Road. A similar glazing specification would fall only 1 to 6 dB short of achieving the most stringent 30 dB criterion (applicable to only the most sensitive educational rooms such as recital rooms and recording studios etc).

8.5.61 However, it should be noted that there are many different glazing configurations on the market which have acoustic performances superior to that of 'typical' thermal double glazing, so the most stringent 30dB criterion could also be achieved by the selection of appropriate glazing products. Alternatively, the internal noise level criteria could be achieved by appropriate consideration to detailed layout design, e.g. by

locating more sensitive teaching spaces at greater distances from local road traffic routes, or well screened from these routes by Proposed Development blocks.

8.5.62 The above glazing calculations are intended to be for planning purposes only. More detailed calculations will be required for the procurement of the glazing units, once the site layout, floor plans and elevations have been progressed.

8.5.63 The location with the highest daytime noise level is at 4m from Tower Road where a daytime $L_{Aeq,30minute}$ noise level of 69.0 dB is predicted. In order to achieve the 55 and 50 dB(A) criteria specified in BB93 for external teaching areas, reductions of 14 and 19 dB would therefore be required respectively.

8.5.64 A reduction of this order can be achieved by the consideration of careful layout design within the parameters set, such that these teaching spaces are located on the opposite side of development blocks to local noise sources. Following this approach, external teaching spaces would be subject to noise reduction as a result of both increased distance from the source, and the acoustic screening afforded by the development blocks themselves. It can therefore be seen that with incorporation of appropriate design techniques, the external teaching/learning space criterion could also be met across the Proposed Development.

Residual Effects

8.5.65 It has been identified that with due consideration to façade design within the parameters set, including selection of appropriate glazing and ventilation systems, a commensurate level of protection can be afforded for proposed educational facilities.

8.5.66 For outdoor teaching areas, it has been identified that, with the incorporation of appropriate design layout consideration, with these spaces being afforded appropriate levels of attenuation due to distance and acoustic screening, the guidance criteria specified in BB93 could be achieved.

8.5.67 The sensitivity of the proposed educational facilities within the Site is considered to be high, however, it is anticipated that with the implementation of appropriate design techniques, the magnitude of impact is negligible. Therefore, there is likely to be a **negligible** effect to such receptors following the implementation of mitigation measures.

Noise from shipping movements within the East Float Dock and Bascule Bridge operation on proposed sensitive development (e.g. residential and educational facilities)

8.5.68 In accordance with PPG 24 is appropriate to assess noise from these facilities based on likely compliance with the internal noise level criteria presented within BS 8233 for residential accommodation.

8.5.69 Comparing the full event $L_{Aeq,T}$ noise level for the Bridge Raising, Ship Pass-by and Bridge Closing (71.9 dB(A) at 15m), with the 'good' internal noise level criteria for bedrooms taken from BS 8233 it can be seen that a noise reduction of 41.9 dB is required. Similarly, comparing the L_{AFmax} noise level of 89.9 dBA taken from **Table 8.13** with the 45 dB criterion presented within BS 8233, a noise level reduction of 44.9 dB is required.

8.5.70 However, it should be noted that these noise level reductions are only applicable at the measurement distance of 15m from the Bascule Bridge. Accordingly, the mitigation section below considers the noise reduction that would be afforded by the combined affect of both distance attenuation and building fabric.

Mitigation

8.5.71 Adopting the standard distance correction of a 6 dB loss per doubling of distance from a point source, it is calculated that at a distance of 60m from the Bascule Bridges the full event $L_{Aeq,T}$ and L_{AFmax} noise levels would be 59.9 and 77.9 dB(A) respectively. Considering the typical sound reduction performances presented in **Table 8.22** above, it is calculated that with the installation of glazing with a similar acoustic performance to the example of typical thermal double glazing given in PPG 24, both the 45 dB L_{AFmax} and 30 dB $L_{Aeq,T}$ criterion adopted for this assessment could be achieved.

8.5.72 Alternatively, glazing units with an enhanced acoustic specification could be used, where shorter setback distances are required. The precise set back distances that would be applicable would depend on the precise acoustic performance specifications for the proposed glazing units and the proposed scheme layout and elevation drawings. However this assessment demonstrates how appropriate internal noise level criteria could be achieved.

8.5.73 For external living spaces at this distance (60m) from the Bascule Bridges, a noise level reduction of 4.9 dB would be required to achieve the external 55 dB(A) criterion for living spaces and reductions of 4.8 and 9.8 dB(A) would be required to achieve the 50 and 55 dB criteria for external teaching spaces.

8.5.74 These reductions could be achieved by the incorporation of careful layout design techniques (within the parameters set), such as locating these spaces at increased distance from the source, or locating these spaces on the opposite side of the Proposed Development blocks. It can therefore be seen that with incorporation of appropriate layout design techniques, the external living space and teaching/learning criteria could also be met. If external teaching / learning areas were located within 60m of Bascule bridges, these would warrant further assessment accounting for the detailed scheme layout.

Residual Effects

8.5.75 It has been identified that with due consideration to façade design and scheme layout techniques (within the parameters set), a commensurate level of protection can be afforded for proposed residential and educational facilities in the vicinity of the Bascule Bridges.

8.5.76 For outdoor teaching areas and external living spaces, it has been identified that with the incorporation of appropriate design layout considerations, these spaces could be afforded appropriate levels of noise attenuation to ensure achieving the guidance criteria specified in BS 8233 and BB93.

8.5.77 The sensitivity of the residential and educational facilities within the Site is considered to be high, however, it is anticipated that with the implementation of mitigation, the magnitude of impact is negligible. Therefore, there is likely to be a **negligible** effect to such receptors following the implementation of mitigation measures.

Changes in road traffic noise levels associated with the Proposed on existing local noise sensitive receptors

8.5.78 Upon completion of the Proposed Development, it is possible that local road traffic noise levels may change as a result of development generated traffic. Therefore, it is appropriate to consider the magnitude of any associated changes that might arise.

8.5.79 The results of the TA (which was prepared by Savell Bird & Axon), and more specifically the road traffic flow data, have been used as the basis for determining the change in road traffic noise levels that will result from development generated traffic. This assessment focuses on the roads that will be used to access the Site, before the site-related traffic is dispersed across the wider network.

8.5.80 Road traffic noise calculations have been carried out in accordance with CRTN, being undertaken for a notional receptor location 10m from the edge of the carriageway of each road considered, and 1.5m above ground level. A notional receptor has been used because the change in traffic noise level adjacent to any given road will be the same at all distances where noise from that route is dominant. Traffic noise calculations have been undertaken to establish the change in the daytime $L_{A10,18hour}$ noise level.

8.5.81 Predictions have been undertaken for the following scenarios:

- 2008 Baseline flows (no development and no committed development);
- 2015 With scheme flows (baseline flows + committed development flows +scheme flows); and
- 2030 With scheme flows (baseline flows + committed development + scheme flows).

8.5.82 For this scheme, the committed developments are the consented North Bank East development, and the Hydraulic Tower development. To ensure that a worst case scenario is considered, noise level changes have been determined against the 2008 Base Flows. In practice, lower noise level changes would arise as a result of the Proposed Development itself, as the determined noise level changes include a contribution from the North Bank East Development which is not part of the scheme.

8.5.83 The predicted changes in road traffic noise are shown in **Table 8.25** for each considered link. This table shows the noise level changes for the following comparisons:

- 2015 With scheme - 2008 Baseline; and
- 2030 With scheme - 2008 Baseline.

Table 8.25: Predicted Changes in Road Traffic Noise Levels Resulting from Operation of the Redevelopment, Free-field, dB(A)

Road section	Predicted Noise Level $L_{A10,18hour}$			Change in Noise Levels (B-A) - (C-A)
	2008 Baseline (A)	2015 With scheme (B)	2030 With scheme (C)	
Mill Lane, north of Poulton Rd / Breck Rd Jct.	65.0	65.0	65.0	0 - 0
Mill Lane, south of Poulton Rd / Breck Rd Jct.	66.8	66.8	66.8	0 - 0
Breck Rd, west of Mill Lane Jct.	62.9	62.9	62.9	0 - 0
Poulton Rd	63.2	63.2	63.2	0 - 0
Docks Link	73.5	73.7	75.3	0.2 - 0.8
Dock Rd, between Poulton Bridge Rd and Duke St	67.1	68.6	70.5	1.5 - 3.4
Poulton Bridge Rd, between Dock Rd and Corporation Rd	65.9	66.1	66.9	0.2 - 1.0
Corporation Rd, west of Poulton Bridge Rd	35.0	35.0	35.0	0 - 0
Corporation Rd, between Poulton Bridge Rd and Duke St	62.7	63.1	64.5	0.4 - 1.8
Poulton Bridge Rd, south of Corporation Rd Jct	64.0	64.0	64.0	0 - 0
Duke Street, south of Corporation Rd Jct	64.6	64.9	65.6	0.3 - 1.0
Duke St, north of Corporation Rd Jct	66.0	66.3	66.9	0.3 - 0.9
Duke Street, north of Sky City Link Rd	66.6	66.7	70.3	0.1 - 3.7
Duke St, north of Dock Rd Jct	66.9	68.0	70.2	1.1 - 3.3
Dock Rd, east of Duke St	67.4	68.8	70.0	1.4 - 2.6
Dock Rd, between NBW Link Rd and NBE Link Rd	68.7	69.5	70.4	0.8 - 1.7
Kelvin Park Link Rd	44.6	44.6	44.6	0 - 0
Dock Rd, east of NBE Link Rd	66.3	67.7	68.6	1.4 - 2.3
Birkenhead Rd, north of roundabout, south of Kelvin Rd	66.7	67.0	67.4	0.3 - 0.7
Birkenhead Rd, north of Kelvin Rd Jct	63.9	64.4	65.0	0.5 - 1.1
Kelvin Rd, west of Birkenhead Rd Jct	63.0	63.0	63.0	0 - 0
Four Bridges Rd, between Pump Rd and Dock Rd	68.1	68.8	69.5	0.7 - 1.4
Pump Rd	61.8	61.8	61.8	0 - 0
Four Bridges Rd, south of Pump Rd roundabout	67.1	67.8	68.5	0.7 -1.4
Tower Rd, south of Tower Wharf	66.9	67.6	68.2	0.7 - 1.3
Tower Wharf Link Rd	55.1	55.1	55.1	0 - 0
Tower Rd, Canning St	66.1	66.5	66.9	0.4 - 0.8

Road section	Predicted Noise Level $L_{A10,18hour}$			Change in Noise Levels (B-A) - (C-A)
	2008 Baseline (A)	2015 With scheme (B)	2030 With scheme (C)	
Rendell St, north of Freeman St	65.5	66.2	67.2	0.7 - 1.7
Freeman St	57.2	57.2	57.2	0 - 0
Rendell St, south of Freeman St	65.1	65.9	66.9	0.8 - 1.8
Rendell St, south of Corporation Rd	63.6	64.7	66.1	1.1 - 2.5
Corporation Rd, west of Rendell St	61.6	62.7	65.5	1.1 - 3.9
Corporation Rd, between MV Link and Vittoria Studios Link	62.0	63.2	66.2	1.2 - 4.2
Corporation Rd, west of Vittoria Studios West Link	62.4	63.1	65.1	0.7 - 2.7
Gorsey Lane	65.8	65.9	66.2	0.1 - 0.4
Kingsway Tunnel	67.7	68.2	69.0	0.5 - 1.3

8.5.84 It can be seen form the table above that for the scenario comparisons considered, the vast majority of links will be subject to a noise level change of less than 3 dB. Only when considering the noise level change to the year 2030 are noise level increases greater than 3dB predicted to arise. Noise level changes of greater than 3dB are predicted for sections of Dock Rd, Duke Street and Corporation Road, However, the affected sections of these routes are fronted by industrial / commercial development, not sensitive receptors such as residential dwellings.

8.5.85 It should be noted that the predicted noise level changes are likely to occur gradually over time, rather than there being a sudden step change in the noise environment. The guidance within the DMRB confirms that people are less '*bothered*' by gradual noise level changes. Accordingly, when the determined noise level change dictates an impact magnitude that spans two terms, e.g. 'minor to moderate'; the lower of the two ratings has been adopted.

8.5.86 For noise level changes of less than 3dB, the impact magnitude is determined to be low. For noise level changes of between 3 and 4.9 dB, the impact magnitude is determined to be medium. The sensitivity of residential dwellings is high whilst the sensitivity of industrial and commercial facilities is considered to be low. Therefore, where noise level changes of less than 3 dB(A) are predicted to arise at residential properties and where changes of between 3 and 4.9 dB(A) are predicted to arise at industrial / commercial receptors, a direct, permanent long term effect on such receptors of **minor negative** significance.

Mitigation.

8.5.87 Given that at worst, only minor negative noise impacts are predicted, consideration to detailed noise mitigation measures is unwarranted.

Residual Effects

8.5.88 As detailed above, the sensitivity of the existing local noise sensitive receptors is high whilst the sensitivity of industrial and commercial facilities is considered to be low. Therefore, where noise level changes of less than 3 dB(A) are predicted to arise at residential properties and where changes of between 3 and 4.9 dB(A) are predicted to arise at industrial / commercial receptors, a direct, permanent long term effect on such receptors of **minor negative** significance.

Noise from industrial / commercial / plant arising from the Proposed Development on existing and proposed sensitive receptors

8.5.89 The Proposed Development includes a number of different uses to be incorporated into the overall scheme. It is expected that some of these uses, and associated proposed plant items have the potential to generate noise once operational.

8.5.90 At this stage of the Proposed Development, precise details relating to the proposed type, number and location of any such plant or facilities are not known. In the absence of detailed information it is therefore appropriate to specify suitable noise control limits to which any plant/operations should conform. These limits should include any corrections for acoustic characteristics.

8.5.91 BS 4142 states that a rating noise level ($L_{A,r}$) of +5 dB above background is of marginal significance when assessing the likelihood of complaints. However, if such a criterion was applied to individual items of plant it is likely that background 'creep' would result. Consequently, it is appropriate that the cumulative effect of all external plant to be incorporated in the proposals and operating at worst case duty, should be specified to meet an excess of rating over background level of -5 dB at the closest noise-sensitive receptors during both the daytime and night-time periods.

8.5.92 BS 4142 also states that this assessment method is not valid where background noise levels are below 30 dB(A) and rating noise levels are below 35 dB ($L_{A,r}$), and that rating noise levels below 35 dB ($L_{A,r}$) are considered to be "*very low*". Accordingly, a rating noise level of 35 dB has been applied where the background noise would dictate a limit lower than 35 dB.

8.5.93 **Table 8.26** below presents the lowest measured daytime and night-time background noise levels at a sample of locations taken from **Table 8.12**. These background noise levels are considered representative of a sample of existing and proposed local noise-sensitive receptors. Also presented are the calculated Plant noise limits, based on achieved a rating noise level 5 dB below background, or 30 dB $L_{A,r}$, as described above.

Table 8.26: Receptor Noise Limits for Proposed Plant and Commercial/industrial noise, Free-field $L_{A,r}$ (dB)

Measurement Location (Figure 8.1)	Sensitive Receptors	Period	Lowest Measured Background Noise Level ($L_{A90,T}$)	Proposed Rating Noise Level Limit based on BS 4142 ($L_{A,r}$)
1	Proposed and existing noise-sensitive development fronting Duke Street	Daytime	54.0	49.0
		Night-time	45.0	40.0
2	Proposed noise-sensitive development fronting Dock Road	Daytime	42.5	37.5
		Night-time	38.0	35.0
3	The existing converted grain warehouses	Daytime	48.7	43.7
		Night-time	43.2	38.2
4	Proposed noise-sensitive development fronting the east and west sides of Tower Road	Daytime	49.6	44.6
		Night-time	41.7	36.7
5	Proposed and existing noise-sensitive development fronting Corporation Road	Daytime	40.1	35.1
		Night-time	34.8	35.0
6A 6	Existing residential development in the vicinity of Oakdale Road	Daytime	42.6	37.6
		Night-time	37.9	35.0
7	Existing residential development in the vicinity of Birkenhead Road	Daytime	47.9	42.9
		Night-time	36.1	35.0
8	Existing residential development in the vicinity of Cathcart Street	Daytime	45.6	40.6
		Night-time	37.8	35.0
9	Existing residential	Daytime	47.0	42.0

Measurement Location (Figure 8.1)	Sensitive Receptors	Period	Lowest Measured Background Noise Level ($L_{A90,T}$)	Proposed Rating Noise Level Limit based on BS 4142 ($L_{A,r}$)
	development in the vicinity of Old Bidston Road	Night-time	36.8	35.0

8.5.94 The above rating noise level limits apply at 3.5m from the façade of any residential property (free-field) or at the closest point of any open area proposed for noise-sensitive development.

8.5.95 In accordance with BS 4142, assessments of plant noise emissions should include +5 dB rating correction for tonal and irregular or intermittent plant (where applicable), before comparison with the above limits.

8.5.96 The sensitivity of the existing and proposed noise-sensitive receptors is high and provided that the derived plant noise limits are achieved, the magnitude of change is negligible. Therefore, there is likely to be an effect on such receptors of **negligible** significance provided that the derived plant noise limits are achieved.

Mitigation

8.5.97 The assessment of noise from proposed plant and commercial and industrial operations has been limited given the absence of detailed development uses, equipment specifications and precise locations. Therefore, this assessment has proposed noise limits in accordance with BS 4142:1997.

8.5.98 It is anticipated that at this stage of the Proposed Development, the specification and location of any plant and the scheme design and layout is sufficiently flexible to ensure suitably quiet plant can be procured and appropriate site layout considerations (within the parameters set) can be incorporated into the scheme design to ensure compliance with the proposed noise limits.

8.5.99 It is anticipated that the proposed noise limits could be incorporated into the planning conditions with respect to fixed plant items and commercial / industrial operations associated with the Proposed Development.

8.5.100 Once the detailed nature of such future uses are confirmed, noise from any related operations can be reconsidered and an appropriate noise mitigation scheme devised and incorporated into the layout of the Proposed Development to ensure that the above limits are achieved. It is anticipated that this may require consideration to detailed site layout, appropriate positioning of noise generating activities, and the selection of appropriate plant.

8.5.101 It should be noted that the noise emission limits specified within **Table 8.25** are applicable to the total noise from the simultaneous operation of all external plant / industrial / commercial operations incorporated into the scheme. As such, noise emissions from individual items of plant may need to be lower than the given limit. The exact limit for each individual item of plant will depend upon its type, noise characteristics and location etc. This issue is best addressed during the detailed design stage.

Residual Effects

8.5.102 The proposed noise limits are based on the situation being better than that described in BS 4142 as of '*marginal significance*', or a rating noise level described as '*very low*'. It is considered that the sensitivity of both existing and proposed noise-sensitive receptors is high and providing that the derived plant noise limits are achieved, the magnitude of change is negligible. Therefore, there is likely to be an effect on such receptors of **negligible** significance provided that the derived plant noise limits are achieved.

Existing groundbourne vibration on the Proposed Development as a result of the western and eastern Bascule Bridges (which are close to the perimeter of the Site)

8.5.103 During the noise measurements undertaken at 15m from the western Bascule Bridge, perceptible levels of groundborne vibration were generated. Whilst detailed vibration measurements have not been undertaken to date, it is was considered that these observed levels of vibration could give rise to a potential

impact on proposed sensitive development, subject to precise location and incorporated mitigation measures.

Mitigation

8.5.104 It is recommended that a detailed vibration assessment is undertaken, including detailed groundborne vibration measurements at a series of different distances from both Bascule Bridges. This assessment should be undertaken in accordance with the assessment methodology presented within BS 6472 :2008: *Guide to evaluation of human exposure to vibration in buildings. Part 1: Vibration sources other than blasting* (Ref 8.11). This assessment should include the determination of appropriate vibration mitigation measures and set back distances for proposed vibration sensitive development. Mitigation measures and set back distances should be determined to ensure compliance with the condition described in BS 6472 as a '*Low probability of adverse comment*' within the Proposed Development.

Residual Effects

8.5.105 The sensitivity of the proposed residential and educational facilities is considered to be high; however, provided that the determined mitigation measures and setback distances are complied with, the magnitude of impact is negligible. Therefore, there is likely to be an effect to such receptors of **negligible** significance provided that the determined mitigation measures and setback distances are complied with.

Monitoring and Follow Up

Site Preparation, Earthworks and Construction Phase

8.5.106 It is recommended that when the construction techniques and phasing have been confirmed, detailed construction noise level predictions should be undertaken which could form part of the scheme Construction and Environmental Management Plan (CEMP) for agreement with the appointed contractor. The CEMP should also include the requirements for construction phase noise monitoring to determine compliance with appropriate construction noise limits.

8.5.107 The need for a detailed groundborne construction vibration assessment should be screened for each Quarter of the Proposed Development. This assessment should be used to ensure appropriate set back distances are incorporated into the developing scheme design, and that acceptable construction techniques are adopted. The assessment should include consideration to both human perception and the potential for structural damage (including consideration to dock walls and locks etc). Construction phase vibration surveys should also be undertaken for each Quarter in accordance with the recommendations outlined in BS 5228 Part 2 and BS 7385 1990: *Evaluation and measurement for vibration in buildings, Part 1: Guide for measurement of vibrations and evaluation of their effects on buildings* (Ref 8.13). The results of these surveys will confirm the vibration levels generated during the actual construction works and can be used to check compliance with the results of the detailed vibration assessment for each Quarter (if required).

Operational Phase

8.5.108 With respect to mitigation measures required to protect the amenity of the proposed new residential and educational aspects of the Proposed Development it is recommended that a further assessment is undertaken at the detailed design stage such that appropriate site layouts can be developed, and that façade constructions, glazing units and ventilation systems can be specified. Façade constructions and ventilation systems would need to be specified once the details of elevations, orientations and internal layouts are known.

8.5.109 It is recommended that the need for detailed vibration assessments are screened for each appropriate Quarter to establish the impact of the operation of the Bascule Bridges on proposed sensitive aspects of the development. This assessment should include groundborne vibration measurements at a series of different distances from both Bascule Bridges. This assessment should be undertaken in accordance with the assessment methodology presented within BS 6472: 2008: *Guide to evaluation of human exposure to vibration in buildings. Part 1: Vibration sources other than blasting*. This assessment should include the determination of appropriate vibration mitigation measures and set back distances for proposed vibration sensitive development. Mitigation measures and set back distances should be

determined to ensure compliance with the condition described in BS 6472 as a '*Low probability of adverse comment*' within the Proposed Development.

Limitations and Assumptions

8.5.110 As the Proposed Development is currently at a strategic stage, detailed information on construction techniques and equipment is not available. Consequently it has not been possible to accurately calculate the noise and vibration effects that may arise during the site clearance and construction works. The potential effects associated with the earthworks/construction phase of the Proposed Development have therefore been assessed in a qualitative manner which is considered suitable at this stage.

8.5.111 The assessment of effects of road traffic noise on proposed new sensitive development, (residential dwellings and educational facilities) has been made based on worst case set back distances from local road traffic sources at ground floor level.

8.5.112 Road traffic noise level changes associated with development generated traffic have been determined and assessed based on traffic data provided by the Savell Bird & Axon. These road traffic noise level changes have been determined up to the year 2030 as this is the furthest date in the future for which it is reasonable to forecast to at this present time for **Transport Assessment**. For further information, please refer to **Chapter 6 – Traffic and Transportation**. Therefore, road traffic noise level changes beyond 2030 have not been determined or assessed.

8.5.113 The assessment of road traffic noise effects upon noise sensitive aspects of the Proposed Development has been undertaken assuming an open, undeveloped site (as specified in PPG 24). This assessment has been based on measured noise levels determined on the site, an assessment approach which is specified within PPG24. In reality it is expected that a certain element of acoustic screening will be provided by the development itself, thus resulting in more favourable effects.

Cumulative Impacts

8.5.114 The assessment of development generated traffic noise has included the combined affect of both the Proposed Development (including Hydraulic Tower development), and the consented North Bank East development and compared against a baseline scenario without any of these developments. In light of this it is considered that the assessment of road traffic noise effects on existing noise-sensitive receptors has already accounted for the cumulative effects associated with these committed / existing developments.

8.5.115 For noise and vibration it is appropriate to consider each different impact area separately, based on the assessment guidance and criteria specific to that impact. In each case the adopted criteria is not transferable to other individual impacts, or the assessment of cumulative impacts.

8.5.116 As specified in **Section 8.2**, there is no specific 'all-encompassing' legislation relating to noise emissions from a development such as this, and it is therefore necessary to draw upon a series of different British Standards, official planning guidance notes and other national guidance.

8.6 SUMMARY

8.6.1 The baseline noise environment within the vicinity of the Site predominantly consists of road traffic noise from Duke Street, Dock Road, Tower Road and Corporation Road. There are a number of existing noise sensitive receptors located in the vicinity of the Site, including dwellings forming part of the converted grain warehouses, and those in the vicinity of Oakdale Avenue, Birkenhead Road, Cathcart Street and Old Bidston Road, and a childrens nursery located on the southern side of Corporation Road.

8.6.2 A qualitative assessment of noise associated with the construction phase of the Proposed Development has identified that significant negative effects may occur at the closest sensitive receptors to the Site (the converted grain warehouses and childrens nursery). A number of mitigation measures have been identified with a view to minimising the effects of any construction noise. Such measures generally involve the treatment of noise at source through appropriate selection, maintenance and siting of plant as well as the adoption of operational measures associated with the timing and routing of deliveries and the implementation of local hoarding/screens.

8.6.3 The assessment of potential groundborne vibration levels associated with the site preparation, earthworks and construction phase of the Proposed Development has been undertaken. It has been identified that where mitigation measures are adopted and included within the development of the site construction methodologies, groundborne construction vibration levels can be controlled such that any significant effects would be temporary and for short durations.

8.6.4 An assessment of the current on-site noise environment has identified that with the incorporation of careful site design and layout techniques (within the parameters set) and the use of appropriate façade specifications, noise levels can be appropriately controlled for residential accommodation and educational facilities.

8.6.5 It has been recommended that an assessment of groundborne vibration levels generated by the operation of the Bascule Bridges be undertaken and used to inform the development of the detailed scheme layout and design.

8.6.6 An assessment of noise generated by fixed plant, commercial and industrial facilities proposed, has also been undertaken. Based on measured background noise levels and British Standard guidance, noise limits have been determined that can be used to control the levels of noise generated by these sources. These limits have been specified based on achieving an industrial / commercial / plant noise levels of 5 dB below the current prevailing background noise levels, or at a level which is described by British Standard guidance as "*very low*".

8.6.7 An assessment of development generated road traffic noise has been undertaken. This assessment has determined that noise level changes associated with development generated traffic will be of minor significance. This assessment has considered the noise level changes that will occur between 2008 and 2030.

Table 8.27: Summary of Effects Table for Noise and Vibration

Description of Likely Significant Effects	Significance of Impacts					Summary of Mitigation / Enhancement Measures	Significance of Residual Effects					Relevant Policy	Relevant Legislation
	(Major, Moderate, Minor, Negligible)	Positive / Negative	(P/T)	(D/I)	ST/MT/LT)		(Major, Moderate, Minor, Negligible)	Positive / Negative	(P/T)	(D/I)	ST/MT/LT)		
Site Preparation, Earthworks and Construction													
Increase to noise to existing local noise sensitive receptors	Minor to Moderate, occasionally Moderate to Major	Negative	T	D	MT/ST	■ Adoption of Best Available Techniques ■ CEMP ■ Further construction noise impact assessments	Minor to Moderate, occasionally Moderate to Major	Negative	T	D	MT/ST	PO3	The Control of Pollution Act, BS 5228: Part 1: 2009.
Groundborne vibration levels to existing local sensitive receptors	Moderate to Major	Negative	T	D	ST	■ Detailed Construction vibration assessments undertaken to determine setback distances and mitigation measures (the need will be screened) ■ Construction vibration monitoring programmes	Minor to Major (see main text)	Negative	T	D	ST	N/A	BS 5228: Part 2: 2009 BS 7385: Part 1: 1990
Operational													
Existing road traffic noise and industrial / commercial noise (where prevalent) on proposed residential	N/A	N/A	N/A	N/A	N/A	■ Incorporation of appropriate layout design techniques ■ Use of appropriately specified façade	Negligible	N/A	N/A	N/A	N/A	PO4	BS 8233, WHO and BB93

development						constructions (e.g. wall glazing and ventilation acoustic specifications)							
Existing road traffic noise and industrial / commercial noise (where prevalent) on proposed educational facilities	N/A	N/A	N/A	N/A	N/A		Negligible	N/A	N/A	N/A	N/A	PO4	BS 8233, WHO and BB93
Noise from shipping movements within the East Float Dock and Bascule Bridge operation on proposed sensitive development (e.g. residential and educational facilities)	N/A	N/A	N/A	N/A	N/A	▪ Incorporation of appropriate layout design techniques ▪ Use of appropriately specified façade constructions (e.g. wall glazing and ventilation acoustic specifications)	Negligible	N/A	N/A	N/A	N/A	PO4	BS 8233, WHO and BB93
Changes in road traffic noise levels associated with the Proposed on existing local noise sensitive receptors	Minor	Negative	P	D	LT	▪ None	Minor	Negative	P	D	LT	PO3	CRTN: 1988 DMRB: 2008
Noise from industrial / commercial / plant arising from the Proposed Development on existing and proposed sensitive receptors	Negligible	N/A	N/A	N/A	N/A	▪ Compliance with determined noise limits ▪ Further assessment when plant and commercial / industrial operations are known	Negligible	N/A	N/A	N/A	N/A	PO3 and PO4	
Existing groundbourne vibration on the Proposed Development as a	N/A	N/A	N/A	N/A	N/A	▪ Detailed groundborne vibration assessment to be undertaken as and	Negligible	N/A	N/A	N/A	N/A	PPG 24	BS 6472: 2008

result of the western and eastern Bascule Bridges (which are close to the perimeter of the Site)						where appropriate ■ Incorporation of appropriate mitigation and/or setback distances based on results of above assessment							

Key to table:

P/T = Permanent or Temporary, D/I = Direct or Indirect, ST/MT/LT = Short Term, Medium Term or Long Term

N/A = Not Applicable

8.7 REFERENCES

8.1 The Department of the Environment, Environmental Protection Act 1990

8.2 The Department of the Environment and the Welsh Office, Planning Policy Guidance Noise 24: 1994: Planning and noise.

8.3 The British Standards Institute, BS 8233: 1999: Sound insulation and noise reduction for buildings – Code of practice.

8.4 The British Standards Institute, BS 4142: 1997: Method for rating industrial noise affecting mixed residential and industrial areas.

8.5 London, The Stationary Office, 2008, North West of England Plan Regional Spatial Strategy to 2021

8.6 The World Health Organisation: 1999: Guidelines for community noise.

8.7 London, The Stationary Office, Building Bulletin 93: Acoustic design of schools

8.8 The Department of Transport: 2008: The design manual for roads and bridges: Volume 11 Environmental assessment, Section 7:Noise and vibration.

8.9 The Department of Transport and the Welsh Office: 1988: Calculation of road traffic noise.

8.10 The British Standards Institute, BS 5228: 2008 Noise and vibration control on construction and open sites.

8.11 The British Standards Institute, BS 6472: 1992: Evaluation of human exposure to vibration in buildings.

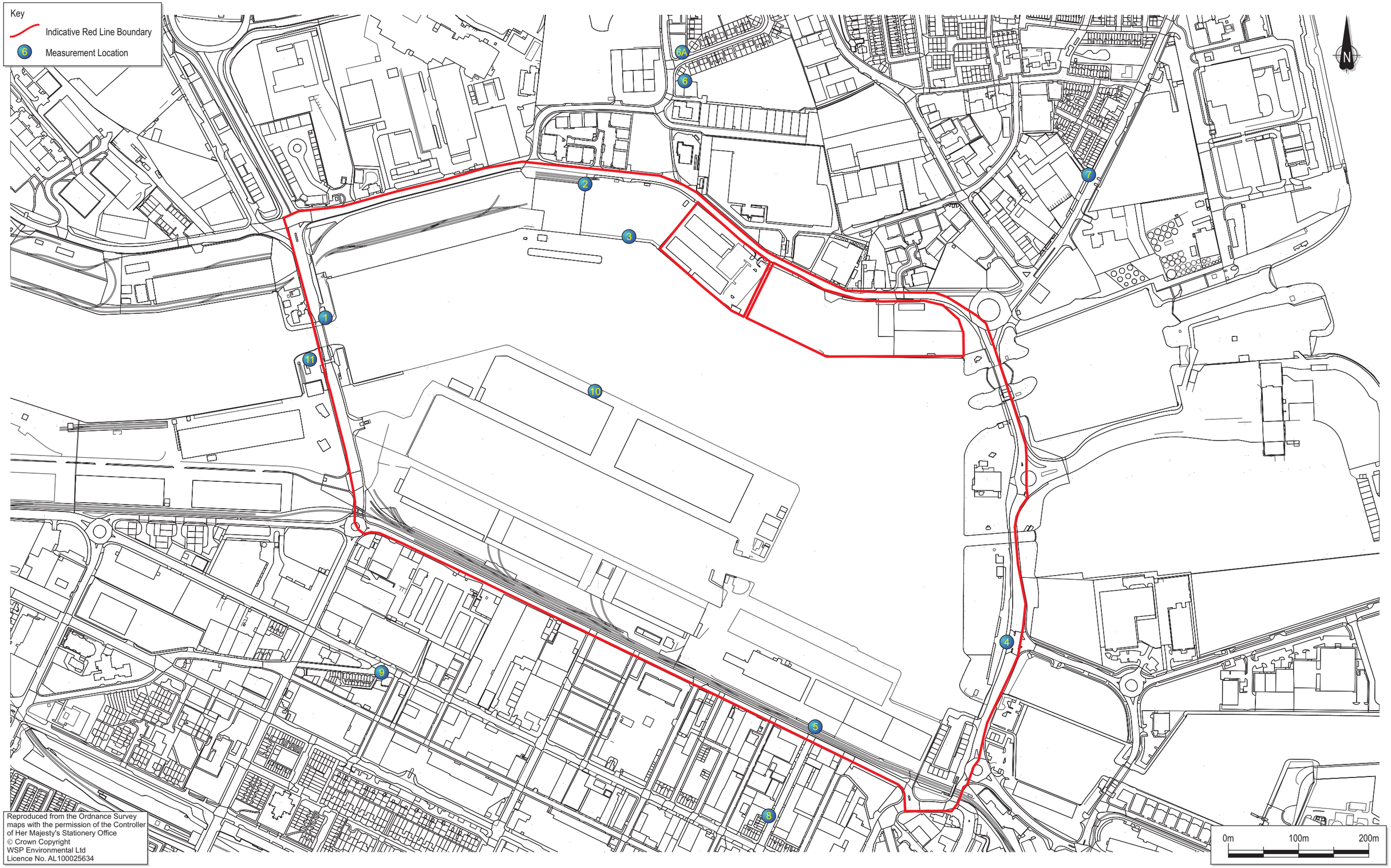
8.12 HMSO, The Control of Pollution Act 1974

8.13 The British Standards Institute, BS 7385: 1990: Evaluation and measurement for vibration in buildings.

8.14 The Building Research Establishment: 1999: Ventilators: Ventilation and acoustic effectiveness.

Noise Measurement Locations

Figure 8.1



PROJECT: East Float, Wirral Waters
PROJECT No: 12261552-001
CLIENT: Peel Land and Property (Ports) Limited

DRAWN: GH
CHECKED: JP
APPROVED: AR
REVISION: A
DATE: December 2009

Wirral Waters

WSP