

8 AIR QUALITY & CLIMATE / NOISE & VIBRATION

This section, prepared by AWN Consulting, assesses both the air quality & climate and the likely noise & vibration impact of the proposed works, in the context of current relevant standards and guidance, and identifies any requirements or possibilities for mitigation.

The proposed works will not have any air quality or noise and vibration impact during its operational phase. As a result, it is only considered necessary to assess the potential noise and vibration impact on the surroundings during the construction phase.

The construction phase will be short term in nature and will generally comprise of the following works:

- Dredging;
- Concrete wall reinforcement;
- Construction of earthen embankment walls;
- HGV movements, and;
- Piling works.

8.1 AIR QUALITY & CLIMATE - EXISTING ENVIRONMENT

Meteorological Data

A key factor in assessing temporal and spatial variations in air quality is the prevailing meteorological conditions. Depending on wind speed and direction, individual receptors may experience very significant variations in pollutant levels under the same source strength (i.e. traffic levels)⁽¹²⁾. Wind is of key importance in dispersing air pollutants and for ground level sources, such as traffic emissions, pollutant concentrations are generally inversely related to wind speed. Thus, concentrations of pollutants derived from traffic sources will generally be greatest under very calm conditions and low wind speeds when the movement of air is restricted. In relation to PM₁₀, the situation is more complex due to the range of sources of this pollutant. Smaller particles (less than PM_{2.5}) from traffic sources will be dispersed more rapidly at higher wind speeds. However, fugitive emissions of coarse particles (PM_{2.5} – PM₁₀) will actually increase at higher wind speeds. Thus, measured levels of PM₁₀ will be a non-linear function of wind speed.

The nearest representative weather station collating detailed weather records is Cork Airport, which is located approximately 20 km northeast of the site. Cork Airport met data has been examined to identify the prevailing wind direction and average wind speeds over a five-year period (see Figure 8.1 in Appendix 8A). For data collated during five representative years (2003-2007), the predominant wind direction is south to westerly in direction. The average wind speed over the period 1968 – 1996 is approximately 5.7 m/s.

Available Background Data

Air quality monitoring programs have been undertaken in recent years by the EPA and Local Authorities. The most recent annual report on air quality “*Air Quality Monitoring Report 2010*”⁽¹⁰⁾, details the range and scope of monitoring undertaken throughout Ireland. In terms of air monitoring, Bandon is categorised as Zone D (see Appendix 8A)⁽¹⁰⁾.

Long-term NO₂ monitoring is carried out at the two rural Zone D locations, Glashaboy and Kilkitt. The NO₂ annual average in 2010 for both sites was 10 and 3 µg/m³ respectively⁽¹⁰⁾. The results of NO₂ monitoring carried out at the urban Zone D location in Castlebar in 2010 indicated an average NO₂ concentration of 10 µg/m³ while the Zone C locations of Newbridge and Celbridge had average NO₂ concentrations of 17 and 12 µg/m³ respectively with no exceedences of the 1-hour limit value⁽¹⁰⁾. Hence long-term average concentrations

measured at these locations were significantly lower than the annual average limit value of $40 \mu\text{g}/\text{m}^3$. Based on the above information and baseline monitoring data, a conservative estimate of the 2012 background NO_2 concentration for the region of the Proposed Scheme is $15 \mu\text{g}/\text{m}^3$.

Long-term PM_{10} monitoring was carried out at the urban Zone D locations of Castlebar and Longford in 2010. The PM_{10} annual averages for both locations in 2010 were 15 and $21 \mu\text{g}/\text{m}^3$ respectively⁽¹⁰⁾. The PM_{10} annual average in 2010 for the rural Zone D location of Kilkitt was $10 \mu\text{g}/\text{m}^3$ ⁽¹⁰⁾. In addition, data from the Phoenix Park provides a good indication of urban background levels, with an annual average in 2010 of $11 \mu\text{g}/\text{m}^3$ ⁽¹⁰⁾. Based on the above information, a conservative estimate of the background PM_{10} concentration for Bandon of $18 \mu\text{g}/\text{m}^3$ has been used.

A study by the UK ODP⁽¹³⁾ gives estimates of likely dust deposition levels in specific types of environments. In open country a level of $39 \text{ mg}/(\text{m}^2 \cdot \text{day})$ is typical, rising to $59 \text{ mg}/(\text{m}^2 \cdot \text{day})$ on the outskirts of town and peaking at $127 \text{ mg}/(\text{m}^2 \cdot \text{day})$ for a purely industrial area. As a worst-case, a level of $127 \text{ mg}/(\text{m}^2 \cdot \text{day})$ can be estimated as the existing dust deposition level for the current location.

With regard to benzene, continuous monitoring was carried out at Emo Court (Zone D) and Old Station Road (Zone B) in 2010, with long-term averages of $0.4 \mu\text{g}/\text{m}^3$ and $1.1 \mu\text{g}/\text{m}^3$ respectively⁽¹⁰⁾. Based on the above information a conservative estimate of the background benzene concentration for the region of the proposed development in 2012 is $1.1 \mu\text{g}/\text{m}^3$.

In terms of CO, results for the Zone C locations of Newbridge and Celbridge are low, peaking at 5% of the maximum 8-hour limit value which is set at $10 \text{ mg}/\text{m}^3$ ⁽¹⁰⁾ in 2010. Based on the above information a conservative estimate of the background CO concentration for the region of the proposed development in 2012 is $0.5 \text{ mg}/\text{m}^3$.

In summary, existing baseline levels of NO_2 , PM_{10} , $\text{PM}_{2.5}$, CO and benzene based on extensive long-term data from the EPA are below ambient air quality limit values in the vicinity of the proposed development.

8.2 NOISE & VIBRATION - EXISTING ENVIRONMENT

Environmental noise surveys were conducted in order to quantify the existing noise environment. The survey was conducted in general accordance with ISO 1996: 2007: *Acoustics – Description, measurement and assessment of environmental noise*.

Choice of Measurement Locations

Six measurement locations were selected; each is described in turn below and shown in Figures 8.1 & 8.2.

- | | |
|-------------------|--|
| Location 1 | is located in the vicinity of the southern façade of the Mill Street Apartment Block. |
| Location 2 | is located in the vicinity of the southern façade of The Riverbank apartment complex. |
| Location 3 | is located in the vicinity of the southern façade of a row of terraced houses along Watergate St. |
| Location 4 | is located in the vicinity of the west end of a row of terraced houses located at the end of Casement Rd |
| Location 5 | is located in the vicinity of a number of detached dwellings along New Rd just northeast of the Topaz service station. |
| Location 6 | is located in the vicinity of a number of mobile homes located along Mill Rd. |

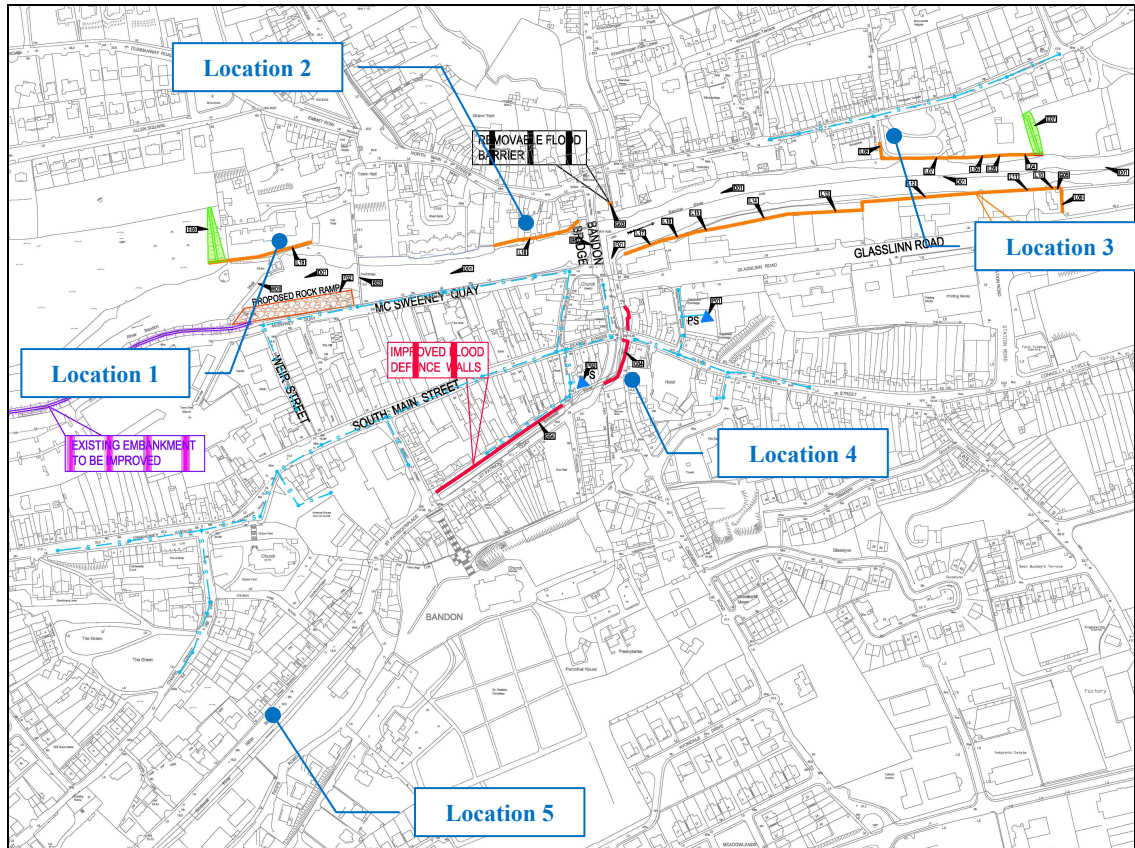


Figure 8.1 Site Layout Showing Approximate Positions of Measurement Locations 1 – 5

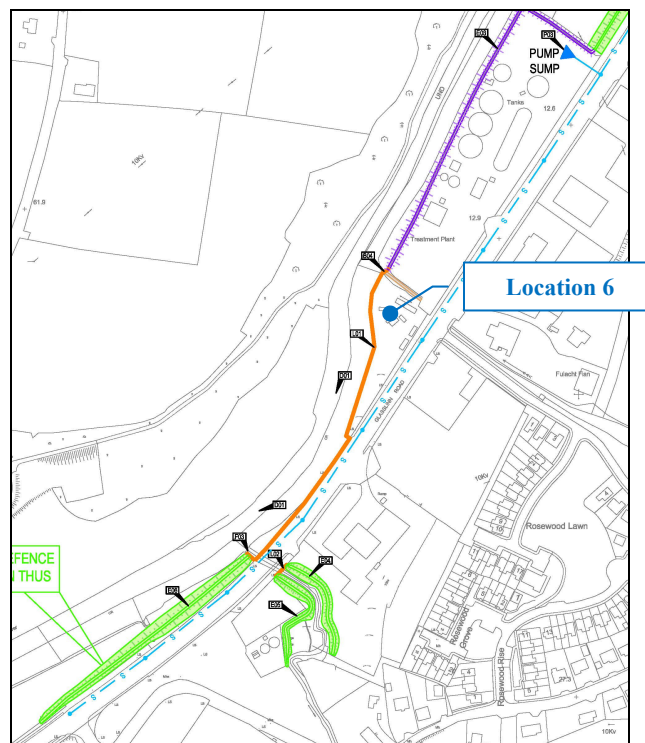


Figure 8.2 Site Layout Showing Approximate Positions of Measurement Location 6

8.2.1 Survey Methodology

Survey Periods

All works associated with the surveys were carried out during the daytime period. Noise measurements were conducted over the course of the survey period as follows:

- Daytime 09:25 to 15:25hrs 15 February 2012

The daytime measurements cover a period that was selected in order to provide a typical snapshot of the existing noise climate, with the primary purpose being to ensure that the proposed noise criteria associated with the development are commensurate with the prevailing environment.

The weather during the survey period was generally dry and calm.

Personnel and Instrumentation

Brian S. Johnson (AWN) conducted the measurements. The noise measurements were conducted using a Brüel & Kjær Type 2260 Sound Level Meter. The measurement apparatus was checked and calibrated both before and after the measurement survey using a Brüel & Kjær Type 4231 Sound Level Calibrator.

Procedure

Measurements were conducted at Locations 1 to 6 on a cyclical basis. Sample periods for the noise measurements were 15 minutes. The results were noted onto a Survey Record Sheet immediately following each sample, and were also saved to the instrument memory for later analysis where appropriate. Survey personnel noted all primary noise sources contributing to noise build-up.

Measurement Parameters

The noise survey results are presented in terms of the following five parameters:

- L_{Aeq}** is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period.
- L_{Amax}** is the instantaneous maximum sound level measured during the sample period.
- L_{Amin}** is the instantaneous minimum sound level measured during the sample period.
- L_{A10}** is the sound level that is exceeded for 10% of the sample period. It is typically used as a descriptor for traffic noise.
- L_{A90}** is the sound level that is exceeded for 90% of the sample period. It is typically used as a descriptor for background noise.

The “A” suffix denotes the fact that the sound levels have been “A-weighted” in order to account for the non-linear nature of human hearing.

All sound levels in this report are expressed in terms of decibels (dB) relative to 2×10^{-5} Pa.

8.2.2 Results & Discussion

Location 1

The survey results for Location 1 are summarised in Table 8.1 below.

Time		Measured Noise Levels (dB re. 2×10^{-5} Pa)				
		L _{Aeq}	L _{Amax}	L _{Amin}	L _{A10}	L _{A90}
Daytime	09:25 – 09:40	56	69	54	56	55
	10:30 – 10:45	54	72	52	54	53
	11:25 – 11:40	55	74	52	54	53

Table 8.1 Summary of Measured Noise Levels at Location 1

The sources of noise noted in the area were the river, traffic on nearby roads, seagulls / general birdsong and occasional car park events. Noise levels were in the range 54 to 56dB L_{Aeq} and 53 to 55dB L_{A90}.

No significant source of vibration was noted during the survey periods.

Location 2

The survey results for Location 2 are summarised in Table 8.2 below.

Time		Measured Noise Levels (dB re. 2×10^{-5} Pa)				
		L _{Aeq}	L _{Amax}	L _{Amin}	L _{A10}	L _{A90}
Daytime	09:45 – 10:00	57	75	52	59	55
	10:45 – 11:00	57	78	52	59	54
	11:45 – 12:00	58	72	53	59	55

Table 8.2 Summary of Measured Noise Levels at Location 2

The sources of noise noted in the area were the river, traffic on nearby roads, seagulls / general birdsong and occasional pedestrian events. Noise levels were in the range 57 to 58dB L_{Aeq} and 54 to 55dB L_{A90}.

No significant source of vibration was noted during the survey periods.

Location 3

The survey results for Location 3 are summarised in Table 8.3 below.

Time		Measured Noise Levels (dB re. 2×10^{-5} Pa)				
		L _{Aeq}	L _{Amax}	L _{Amin}	L _{A10}	L _{A90}
Daytime	10:10 – 10:25	53	79	37	52	41
	11:05 – 11:20	50	68	37	52	40
	12:00 – 12:15	52	69	37	55	42

Table 8.3 Summary of Measured Noise Levels at Location 3

The sources of noise noted in the area were the river, traffic on nearby roads, seagulls / general birdsong and occasional dog barking and car parking events. Noise levels were in the range 50 to 53dB L_{Aeq} and 41 to 42dB L_{A90}.

No significant source of vibration was noted during the survey periods.

Location 4

The survey results for Location 4 are summarised in Table 8.4 below.

Time		Measured Noise Levels (dB re. 2×10^{-5} Pa)				
		L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}
Daytime	12:20 – 12:35	58	77	55	59	56
	13:25 – 13:40	58	72	55	60	56
	14:30 – 14:45	59	74	55	61	56

Table 8.4 Summary of Measured Noise Levels at Location 4

The sources of noise noted in the area were the river, traffic on nearby roads, pedestrian events and occasional car park events. Noise levels were in the range 58 to 59dB L_{Aeq} and of the order of 56dB L_{A90} .

No significant source of vibration was noted during the survey periods.

Location 5

The survey results for Location 5 are summarised in Table 8.5 below.

Time		Measured Noise Levels (dB re. 2×10^{-5} Pa)				
		L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}
Daytime	12:40 – 12:55	74	89	49	78	59
	13:45 – 14:00	74	89	47	78	55
	14:50 – 15:05	74	93	50	78	58

Table 8.5 Summary of Measured Noise Levels at Location 5

The predominant source of noise noted in the area was traffic along New Road. Other contributing sources were the adjacent stream and occasional dog barking. Noise levels were of the order of 74dB L_{Aeq} and 55 to 59dB L_{A90} .

No significant source of vibration was noted during the survey periods.

Location 6

The survey results for Location 6 are summarised in Table 8.6 below.

Time		Measured Noise Levels (dB re. 2×10^{-5} Pa)				
		L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}
Daytime	13:05 – 13:20	76	88	53	79	58
	14:10 – 14:25	75	90	51	79	57
	15:10 – 15:25	76	93	53	79	57

Table 8.6 Summary of Measured Noise Levels at Location 6

The sources of noise noted in the area were the river, traffic on nearby roads, seagulls / general birdsong and occasional dog barking and car parking events. Noise levels were in the range 50 to 53dB L_{Aeq} and 41 to 42dB L_{A90} .

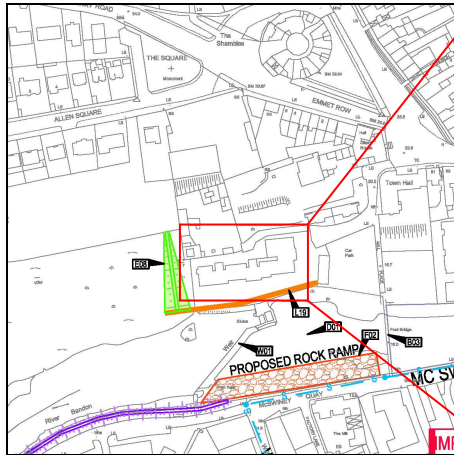
No significant source of vibration was noted during the survey periods.

8.2.3 Noise Sensitive Receptors

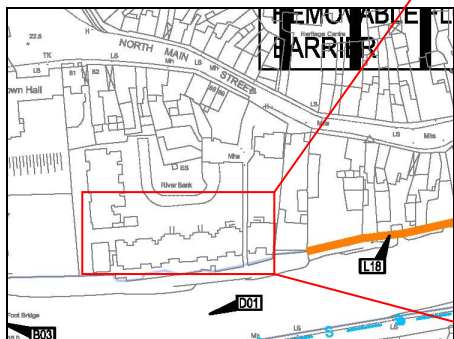
A survey of the noise sensitive locations that are currently adjacent to each of the proposed works areas was conducted. The following diagrams / photos detail each of the adjacent noise sensitive receptors that were identified as being in close proximity to the various proposed work areas.

Environmental Impact Statement

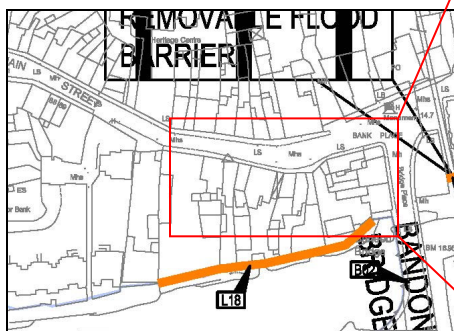
NSL 1: Mill Street Apartment Block



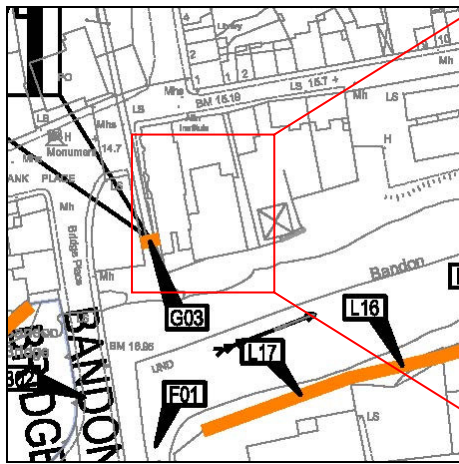
NSL 2: Riverbank Apartment Block



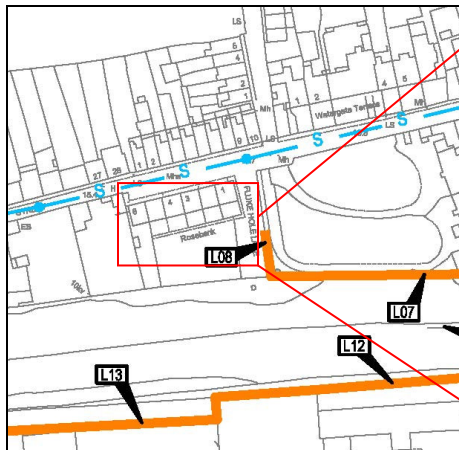
NSL 3: North Main Street Terraced Dwellings



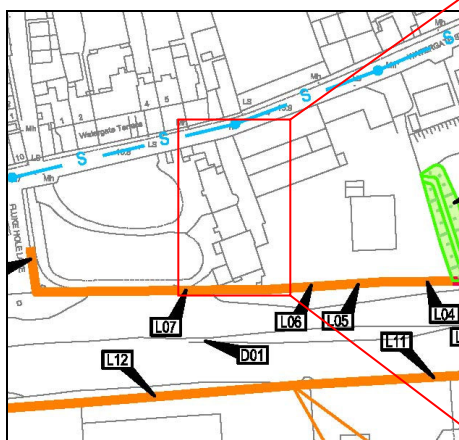
NSL 4: Riverside Hall Apartment Complex



NSL 5: Watergate Street Terraced Dwellings



NSL 6: Watergate Street Private Dwellings



NSL 7: Temporary Dwellings (Mobile Homes)



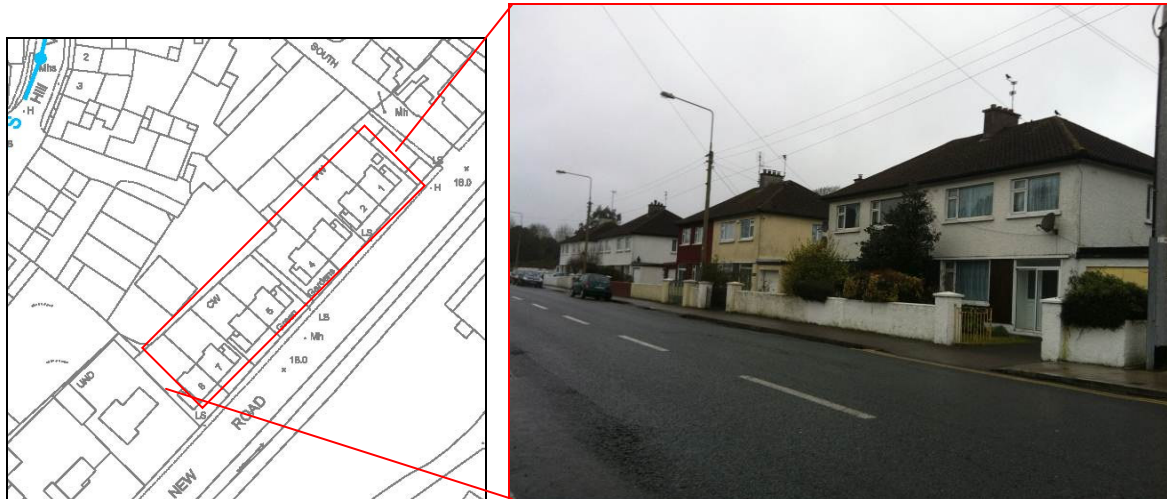
NSL 8: Cherrywood Road Private Dwellings



NSL 9: Casement Road Semi-Detached Dwellings



NSL 10: New Road Private Dwellings



NSL 11: New Road Private Dwellings



8.3 ASSESSMENT OF THE PROPOSED WORKS

8.3.1 Air Quality & Climate

Ambient Air Quality Standards

In order to reduce the risk to health from poor air quality, national and European statutory bodies have set limit values in ambient air for a range of air pollutants. These limit values or “Air Quality Standards” are health or environmental-based levels for which additional factors may be considered. For example, natural background levels, environmental conditions and socio-economic factors may all play a part in the limit value which is set (see Tables 8.1 – 8.4 in Appendix 8A).

Air quality significance criteria are assessed on the basis of compliance with the appropriate standards or limit values. The applicable standards in Ireland include the Air Quality Standards Regulations 2011, which incorporate EU Directive 2008/50/EC which combines the previous air quality framework and subsequent daughter directives (see Table 8.1 in Appendix 8A). Although the EU Air Quality Limit Values are the basis of

legislation, other thresholds outlined by the EU Directives are used which are triggers for particular actions (see Appendix 8A).

There are no statutory guidelines regarding the maximum dust deposition levels that may be generated during the construction phase of a development in Ireland. Furthermore, no specific criteria have been set in respect of this development. However, guidelines from the Department of the Environment, Heritage and Local Government currently exist for dust emissions from quarrying and ancillary activities⁽¹⁾. These can be implemented with regard to dust emissions from the proposed construction sites.

With regard to dust deposition, the German TA-Luft standard for dust deposition (non-hazardous dust)⁽²⁾ sets a maximum permissible immission level for dust deposition of 350 mg/(m²*day) averaged over a one year period at any receptors outside the site boundary. Recommendations outlined by the Department of the Environment, Health & Local Government⁽¹⁾, apply the Bergerhoff limit of 350 mg/(m²*day) to the site boundary of quarries.

The concern from a health perspective is focused on particles of dust which are less than 10 microns. EU ambient air quality standards (Council Directive 2008/50/EC transposed into Irish law as S.I. 180 of 2011) centres on PM₁₀ (particles less than 10 microns) as it is these particles which have the potential to be inhaled into the lungs and cause some adverse health impact. The Directive also sets an ambient standard for PM_{2.5} (particles less than 2.5 microns) which will come into force in 2015 (see Table 8.1 in Appendix 8A).

Climate Agreements

Ireland ratified the United Nations Framework Convention on Climate Change (UNFCCC) in April 1994 and the Kyoto Protocol in principle in 1997 and formally in May 2002^(3, 4). For the purposes of the EU burden sharing agreement under Article 4 of the Kyoto Protocol, in June 1998, Ireland agreed to limit the net growth of the six GHGs under the Kyoto Protocol to 13% above the 1990 level over the period 2007 to 2012^(5,6). The UNFCCC is continuing detailed negotiations in relation to GHGs reductions and in relation to technical issues such as Emission Trading and burden sharing. The most recent Conference of the Parties (COP17) to the agreement was convened in Durban, South Africa in December 2011.

Research Methodology

The assessment of air quality has been carried out using a phased approach as recommended by the UK DEFRA^(7, 8). The phased approach recommends that the complexity of an air quality assessment be consistent with the risk of failing to achieve the air quality standards. In the current assessment, an initial scoping of possible key pollutants was carried out and the likely location of air pollution “hot-spots” identified. An examination of recent EPA data⁽⁹⁻¹¹⁾ has indicated that SO₂, smoke and CO are unlikely to be exceeded at locations such as the current one and thus these pollutants do not require detailed monitoring or assessment to be carried out. Nevertheless, CO was included in the impact assessment. The initial scoping of pollutants did, however, indicate potential problems in regards to nitrogen dioxide (NO₂) and PM₁₀ at busy junctions in urban centres⁽⁹⁻¹¹⁾. Benzene, although previously reported at quite high levels in urban centres⁽⁹⁾, has recently been measured at several city centre locations to be well below the EU limit value⁽¹⁰⁻¹¹⁾.

The current assessment thus focused firstly on identifying the existing baseline levels of NO₂, PM₁₀ and benzene in the region of the proposed development by an assessment of EPA monitoring data. Thereafter, the impact of the development during the construction phase of the project on air quality at the neighbouring sensitive receptors was determined by an assessment of the dust generating construction activities associated with the proposed development.

8.3.2 Noise

As stated previously in this document, the potential noise and vibration impact of the proposed works on the surroundings will all occur during the construction phase. Unfortunately there is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. Local authorities normally control construction activities by imposing limits on the hours of operation and consider noise limits at their discretion.

In the absence of specific noise limits, appropriate criteria relating to permissible construction noise levels for a development of this type may be found in the National Roads Authority (NRA) publication Guidelines for the Treatment of Noise and Vibration in National Road Schemes which indicates the following criteria and hours of operation. The majority of the construction activity is expected to occur during normal working hours.

Table 8.7 indicates the maximum permissible noise levels at the facade of dwellings during the construction period as recommended by the NRA.

Days and Times	Noise Levels (dB re. 2×10^{-5} Pa)	
	$L_{Aeq}(1hr)$	L_{Amax}
Monday to Friday 07:00 to 19:00hrs	70	80
Monday to Friday 19:00 to 22:00hrs	60*	65*
Saturdays 08:00 to 16:30hrs	65	75
Sundays & Bank Holidays 08:00 to 16:30hrs	60*	65*

Table 8.7 Maximum permissible noise levels at the facade of dwellings during construction

*Note: Construction activity at these times, other than that required for emergency works, will normally require the explicit permission of the relevant local authority.

8.3.3 Vibration

Vibration standards come in two varieties: those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. In both instances, it is appropriate to consider the magnitude of vibration in terms of Peak Particle Velocity (PPV).

It is acknowledged that humans are particularly sensitive to vibration stimuli and that any perception of vibration may lead to concern. In the case of road traffic, vibration is perceptible at around 0.5mm/s and may become disturbing or annoying at higher magnitudes. However, higher levels of vibration are typically tolerated for single events or events of short duration. For example, blasting and piling, two of the primary sources of vibration during construction, are typically tolerated at vibration levels up to 12mm/s and 5mm/s respectively. Note that this guidance is applicable to the daytime only; it is unreasonable to expect people to be tolerant of such activities during the night.

Guidance relevant to acceptable vibration within buildings is contained in the following documents:

- British Standard BS 7385 (1993): *Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration*, and;
- British Standard BS 5228 – 2 (2009): *Code of Practice for Noise and Vibration Control on Construction and Open Sites: Vibration*.

BS 7385 states that there should typically be no cosmetic damage if transient vibration does not exceed 15mm/s at low frequencies rising to 20mm/s at 15Hz and 50mm/s at 40Hz and above. These guidelines relate to relatively modern buildings and should be reduced to 50% or less for more critical buildings.

BS 5228 recommends that, for soundly constructed residential property and similar structures that are generally in good repair, a threshold for minor or cosmetic (i.e. non-structural) damage should be taken as a peak particle velocity of 15mm/s for transient vibration at frequencies below 15Hz and 20mm/s at frequencies above than 15Hz. Below these vibration magnitudes minor damage is unlikely, although where there is existing damage these limits may be reduced by up to 50%. In addition, where continuous vibration is such that resonances are excited within structures the limits discussed above may need to be reduced by 50%.

The NRA document Guidelines for the Treatment of Noise and Vibration in National Road Schemes also contains information on the permissible construction vibration levels during the construction phase. These are listed in Table 8.8.

Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of		
Less than 10Hz	10 to 50Hz	50 to 100Hz (and above)
8 mm/s	12.5 mm/s	20 mm/s

Table 8.8 Allowable Vibration During Construction Phase

8.4 POTENTIAL IMPACTS

8.4.1 Air Quality & Climate

8.4.1.1 Air Quality – Dust Generation Rates

Temporary Negligible Impact

Material handling activities on site may typically emit dust. Dust is characterised as encompassing particulate matter with a particle size of between 1 and 75 microns (1-75 μm). Deposition typically occurs in close proximity to each site and potential impacts generally occur within 500 metres of the dust generating activity as dust particles fall out of suspension in the air. Larger particles deposit closer to the generating source and deposition rates will decrease with distance from the source. Sensitivity to dust depends on the duration of the dust deposition, the dust generating activity, and the nature of the deposit. Therefore, a higher tolerance of dust deposition is likely to be shown if only short periods of dust deposition are expected and the dust generating activity is either expected to stop or move on.

The potential for dust to be emitted will depend on the type of activity being carried out in conjunction with environmental factors including levels of rainfall, wind speed and wind direction.

As indicated, dust generation rates depend on the site activity, particle size (in particular the silt content, defined as particles smaller than 75 microns in size), the moisture content of the material and weather conditions. Dust emissions are dramatically reduced where rainfall has occurred due to the cohesion created between dust particles and water and the removal of suspended dust from the air. It is typical to assume no dust is generated under “wet day” conditions where rainfall greater than 0.2 mm has fallen. Information collected from Cork Airport Meteorological Station (1962-1991) identified that typically 204 days per annum are “wet”. Thus for greater than 55% of the time no significant dust generation will be likely due to meteorological conditions.

Large particle sizes (greater than 75 microns) fall rapidly out of atmospheric suspension and are subsequently deposited in close proximity to the source. Particle sizes of less than 75 microns are of interest as they can remain airborne for greater distances and give rise to the potential dust nuisance at the sensitive receptors. This size range would broadly be described as silt. Emission rates are normally predicted on a site-specific particle size distribution for each dust emission source.

Whilst construction activities are likely to produce some level of dust during earth moving and excavating phases of the project, these activities will mainly be confined to particles of dust greater than 10 microns. Particles of dust greater than 10 microns are considered a nuisance but do not have the potential to cause significant health impacts. For instance, bulldozing and compacting operations release 84% of particles which are greater than PM₁₀ with only 16% of particles being less than 10 microns⁽¹⁴⁾.

It is envisaged that the construction of the development will occur in distinct phases. As such, the potential for dust nuisance and significant levels of PM₁₀ & PM_{2.5} concentrations will vary both temporally and spatially as the construction develops.

Worst-case truck movements during the peak construction period would be about 5 inward and 5 outward / hour. Construction traffic of this level will lead to dust emissions of the order of 3 g/m² each hour along the haul roads based on no mitigation being implemented⁽¹⁴⁾. However, provided vehicle speeds are restricted to less than 40 km/hr, this level of construction traffic will lead to dust emissions of the order of 2 g/m² each hour along the haul roads⁽¹⁴⁾. Thus, it is unlikely that the emissions of this magnitude will lead to dust deposition levels at the site boundary which exceed the TA Luft limit value for dust nuisance of 350 mg/(m²*day).

With effective implementation of a dust minimisation plan, the proposed development is expected to have a negligible impact on air quality during the construction phase. Due to the size, nature and location of the development, which will lead to no increase in road traffic emissions, the proposed development is expected to have an imperceptible impact on air quality once it is operational.

Hence the impact on air quality of the proposed development will be insignificant.

8.4.1.2 Climate

Temporary Negligible Impact

Construction traffic would be expected to be the dominant source of greenhouse gas emissions as a result of the development. Vehicles will give rise to CO₂ and N₂O emissions during construction of the proposed development.

8.4.2 Noise Impact

There are a total of five different work activities associated with the proposed works. These generally comprise of the following:

- Dredging;
- Concrete wall reinforcement;
- Construction of earthen embankment walls;
- HGV movements; and
- Piling works

A variety of items of plant will be in use for each of these work activities, such as excavators, lifting equipment, dumper trucks, compressors and generators. Sheet piling and rock breaking are expected to be the noisiest activities and the flow of vehicular traffic to, from and along the easement routes is also a potential source of noise and vibration.

Due to the fact that the construction programme has been established in outline form only, it is not possible to calculate the actual magnitude of noise emissions to the local environment. However, the following sections present calculations of indicative noise levels for typical noise sources associated with each of the identified

activity types. In each instance, source information was obtained from BS 5228: 2009: *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise* which sets out typical noise levels for items of construction plant.

8.4.2.1 Dredging

Temporary Negligible Impact

Dredging is expected to be the most extensive works activity associated with the scheme. It is expected that dredging will be carried out with conventional excavating equipment using excavator buckets with rock teeth, rock ripping and local use of rock breakers where required. Although most of these works will be carried out underwater and will therefore be significantly attenuated, the dredged material will be loaded on to dump trucks which will be used to remove it from the individual works sites.

The understood proposed extent of the dredging works will be from a point beginning in the river in front of the Mill Street Apartment Block (NSL 1) and extending for a distance of approximately 3.6km downstream (reference WYG drawing C008065-10-C-105). The identified nearest noise sensitive locations to these works are NSL 1, 2, 3, 4, 5, 6 & 7.

Table 8.9 lists the expected noise sources associated with the dredging activities, their assumed noise levels and the predicted noise emission levels at each of the nearest noise sensitive locations.

Item Of Plant (BS5228 Ref.)	Noise Level At 10m	Predicted Noise Level at NSL Locations (dB L _{Aeq,1hr})						
		1	2	3	4	5	6	7
Ship Chain Bucket (D.12.1)*	96	58	61	59	54	59	61	60
Tracked Excavator & Water Pump* (D12.2)	85	47	50	48	43	48	50	49
Generator For Submersible Pump (C.8.23)	62	54	57	55	50	55	57	56
Rock Breaker (D.8.13)*	82	44	47	45	40	45	47	46
75kW Wheeled Loader (C.4.13)	84	59	62	60	55	60	62	61
Cumulative	n/a	62	65	63	58	64	65	64

Table 8.9 Predicted Dredging Activity Noise Emission To Nearest Noise Sensitive Locations

** Note: Predicted levels at NSL's assume a nominal 30dB reduction due to propagation through water and air / water acoustic impedance reduction.*

There are no plant items which are expected to result in an exceedance of the minimum adopted daytime noise criterion of 70dB L_{Aeq}. It should also be noted that the calculated levels listed above are commensurate with a worst case condition that would only occur during the short span of time that the listed plant items are at the closest point to each of the noise sensitive locations. For the majority of the time, they will be located at a greater distance away and therefore noise level emissions will be much lower for the majority of the time.

Furthermore, it is possible that the appointed contractor may decide to dry out half the bed at a time allowing an excavator with a ripper to rip the rock rather than using a breaker which is a quieter process entirely.

In summary, the likely short term impact of dredging activities on the local environment would not be significant.

8.4.2.2 Construction of Reinforced Concrete Walls

Temporary Negligible Impact

The construction of the reinforced concrete walls is expected to be carried out in a traditional manner. This will include excavation for foundations, blinding of formation, fixing of the reinforcement and placing of the formwork and concrete. Sheet piling may additionally be required in some areas to provide a cut-off measure where there is a possibility of flood water passing underneath the foundation. However, given that piling may only be required in a few areas and that the relative contribution is unknown at this stage, the impact of piling noise emission is dealt with under a separate section.

The understood proposed extent of the concrete wall reinforcement works will be along the majority of the quays area in central Bandon town, an approximate 250m stretch in the vicinity of NSL 7 and a small 5m stretch in the vicinity of NSL 8. Some additional improvement works will also be conducted on the existing

walls adjacent to New Road. The identified nearest noise sensitive locations to these works are therefore NSL 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, & 11.

Table 8.10 lists the expected noise sources associated with the concrete wall reinforcement activities, their assumed noise levels and the predicted noise emission levels at each of the nearest noise sensitive locations. We have also assumed that a 2.4m high hoarding wall will be provided between the various construction works areas and the nearest noise sensitive locations.

Item Of Plant (BS5228 Ref.)	Noise Level At 10m	Predicted Noise Level at NSL Locations (dB L _{Aeq,1hr})										
		1	2	3	4	5	6	7	8	9	10	11
Excavation Phase												
170kW Tracked Excavator (C.2.16)	75	60	60	58	55	58	60	60	54	n/a	58	58
170kW Wheeled Loader (C.2.28)	76	61	61	59	56	59	61	61	55	n/a	59	59
Dumper (C.2.32)	74	59	59	57	54	57	59	59	53	61	57	57
Cumulative	n/a	65	65	63	60	63	65	65	59	61	63	63
Construction Phase												
Large Concrete Mixer (C.4.22)	76	62	62	60	57	60	62	62	56	n/a	60	60
Truck Mounted Concrete Pump + Boom Arm (C.4.30)	79	65	65	63	60	63	65	65	59	n/a	63	63
Poker Vibrator (C.4.33)	78	64	64	62	59	62	64	64	58	n/a	62	62
4kVA Generator (D.7.49)	76	64	64	62	59	62	64	64	58	n/a	62	62
Cumulative	n/a	70	70	68	65	68	70	70	64	n/a	68	68

Table 8.10 Predicted Reinforcement Concrete Wall Activity Noise Emission To Nearest NSLs

During the excavation phase of the concrete wall construction works, all of the noise emission levels are expected to meet the minimum adopted daytime noise criterion of 70dB L_{Aeq}.

During the regular construction phase of the walls, noise levels will be consistent with or less than the daytime noise criterion of 70dB L_{Aeq}.

As before, it should be noted that the calculated levels listed above are commensurate with a worst case condition that would only occur during the short span of time that the listed plant items are at the closest point to each of the noise sensitive locations.

In summary, the likely impact of concrete wall reinforcement on the local environment is expected to be not significant.

8.4.2.3 Construction Of Earthen Embankments

Temporary Negligible Impact

The construction of the earthen embankments is expected to be carried out by firstly excavating areas for formation and secondly by placing and compaction of suitable clay material. Sheet piling may additionally be required in some areas to provide a cut-off measure where there is a possibility of flood water passing

underneath the embankment. As detailed in the reinforced concrete wall section, the impact of piling noise emission is dealt with under a separate section.

The understood proposed extent of the earthen embankment works will be in the following locations:

- Along the western property line of the Mill Street Apartment Block;
- Along the Cork road between the roundabout and the petrol station;
- In the vicinity of the water treatment plant adjacent to the Cork Road temporary dwellings (new + improvement works);

The identified nearest noise sensitive locations to these works are NSL 1 & 7.

Table 8.11 lists the expected noise sources associated with the concrete wall reinforcement activities, their assumed noise levels and the predicted noise emission levels at each of the nearest noise sensitive locations. We have also assumed that a 2.4m high hoarding wall will be provided between the various construction works areas and the nearest noise sensitive locations.

Item Of Plant (BS5228 Ref.)	Noise Level At 10m	Predicted Noise Level at NSL Locations (dB L _{Aeq,1hr})	
		1	2
Excavation Phase			
170kW Tracked Excavator (C.2.16)	75	60	n/a*
170kW Wheeled Loader (C.2.28)	76	61	n/a*
Dumper (C.2.32)	74	59	n/a*
Cumulative	n/a	65	
Construction Phase			
Dumper (C.2.32)	78	64	62
82kW Dozer (C.2.13)	78	64	62
Hydraulic Vibratory Compactor (C.2.42)	78	64	62
Cumulative	n/a	69	67

Table 8.11 Predicted Earthen Wall Reinforcement Activity Noise Emission To Nearest NSLs

As can be seen from the table, noise emission levels are expected to meet the minimum adopted daytime noise criterion of 70dB L_{Aeq} during both the excavation and construction phases.

As before, it should again be noted that the calculated levels listed above are commensurate with a worst case condition that would only occur during the short span of time that the listed plant items are at the closest point to each of the noise sensitive locations.

In summary, the likely impact of earthen embankment construction on the local environment is expected to not be significant.

8.4.2.4 HGV Movements

Temporary Negligible Impact

In addition to the construction activities discussed above, the noise impact of additional traffic on the adjacent noise sensitive locations should also be addressed. Access to the development site for construction traffic will be along existing roads adjacent to the works areas as well as on easements that run along both sides of the river. The relative impact on the noise sensitive locations associated with construction traffic is assessed in the following paragraphs.

The noise level associated with an event of short duration, such as a passing vehicle movement, may be expressed in terms of its Sound Exposure Level (L_{AX}). The Sound Exposure Level can be used to calculate the contribution of an event or series of events to the overall noise level in a given period.

The appropriate formula is given below:

$$L_{Aeq,T} = L_{AX} + 10\log_{10}(N) - 10\log_{10}(T) + 10\log_{10}(r_1/r_2)\text{dB}$$

where:

- $L_{Aeq,T}$ is the equivalent continuous sound level over the time period T (in seconds);
- L_{AX} is the “A-weighted” Sound Exposure Level of the event considered(dB);
- N is the number of events over the course of time period T;
- r_1 is the distance at which L_{AX} is expressed;
- r_2 is the distance to the assessment location.

The mean value of Sound Exposure Level for truck moving at low to moderate speeds (i.e. 15 to 45km/hr) is in the order of 82dB L_{AX} at a distance of 5 metres from the vehicle. This figure is based on a series of measurements conducted under controlled conditions.

Worst-case construction traffic volumes have been estimated at 14,500 total round trip movements for excavated material over the two year construction period and an additional 2,250 for delivery of materials. Given these figures, it would be appropriate to consider a maximum of 5 truck movements per hour at each works location as an adequate estimation of a worst case scenario. Using the equation detailed above and taking into account the attenuation due to distance, the predicted noise levels at each of the nearest residential dwellings are listed in Table 8.12.

Location	Distance From Roadway / Easement	Predicted Noise Level (dB, $L_{Aeq,1hr}$)
NSL 1	20m	47
NSL 2	10m	50
NSL 3	2m	56
NSL 4	10m	50
NSL 5	2m	56
NSL 6	5m	53
NSL 7	5m	53
NSL 8	50m	43
NSL 9	5m	53
NSL 10	2m	56
NSL 11	15m	48

Table 8.12 Predicted Construction Traffic Noise Emission At Nearest NSLs

The predicted noise emission levels range between 43 and 56dB $L_{Aeq,30min}$ with 56dB $L_{Aeq,30min}$ being the expected maximum at the remaining noise sensitive locations along construction traffic routes that are located immediately adjacent to the road (i.e. 2m away). These noise levels would all be within the minimum design criterion of 70dB L_{Aeq} .

In summary, the likely impact of construction traffic on the local environment would not be significant.

8.4.2.5 Sheet Piling

Temporary Significant Negative Impact

As mentioned in the concrete reinforcement wall section, there is a possibility that sheet piling may be required either as part of the foundation works or to provide cut-off beneath the flood defences. Unfortunately it cannot be determined whether or not sheet piling will be required until a more detailed site investigation is conducted (which will not occur until after this document is lodged). Given this situation, it would be appropriate in this instance to consider piling at all concrete wall and embankment locations.

Table 8.13 summaries the predicted noise levels due to piling activities at the nearest noise sensitive locations.

Noise Sensitive Location	Piling Activity (BS 5228 Ref.)	Piling Noise Level at 10m Distance (dB L _{Aeq})	Estimated Distance to NSL	Combined Predicted Noise Level at Receiver Locations (dB L _{Aeq,1hr})
NSL 1	Vibratory Piling Rig (C.3.3)	88	15m	85
NSL 2			15m	85
NSL 3			25m	82
NSL 4			15m	85
NSL 5			25m	82
NSL 6			15m	85
NSL 7			15m	85
NSL 8			65m	75
NSL 9			10m	No piling here
NSL 10			25m	82
NSL 11			35m	79

Table 8.13 Typical Piling Noise Levels At Nearest Noise Sensitive Locations

Given the relative close proximities to the nearest noise sensitive locations, piling noise emission would result in significant exceedances of the established design criteria. Although some allowance could likely be made given the relatively short durations that will be required for piling works and that they very likely won't be required at all of these locations, we would recommend that an alternative piling process such as the Giken Seisakusho 'Silent Piler' be employed where possible.

The Giken piling rig employs a 'press-in' method of piling in lieu of the more typical vibratory or impact type of piling. This method allows pre-formed piles to be installed with minimal noise and vibration generation.

Noise level data for the Giken 'Silent Piler'¹ indicates a measured sound pressure level of 75dB(A) at a distance of 1m. Assuming the piling rig operates continuously for one hour, this would result in a noise level of 65dB L_{Aeq, 1hr} at a distance of 10m, which would be a closer distance than the piling works would be to any noise sensitive location. This level would be within the established criteria at each location and, hence, would allow piling activities to occur at any of the proposed works locations without a significant risk of noise emission exceeding the criteria.

In summary, assuming an alternative 'press-in' piling method is employed, the likely impact of piling noise on the local environment would not be significant. If normal piling is employed, there is likely to be a moderate amount of noise impact although it would be likely to occur over relatively short durations.

8.4.3 Vibration Impacts

Temporary Negligible to Significant Negative Impact

The majority of construction activities are not expected to generate perceptible vibrations at the nearby noise sensitive locations. The exception to this will be sheet piling activity.

Piling activity is typically one of the most significant sources of vibration on construction sites. However, as discussed in the previous section, if piling operations are conducted through the 'press-in' method, vibration

¹ 'Press-in Piling: Ground vibration and noise during piling installation'; David White Tim Finlay, Malcom Bolton and Grant Bearss; Proceedings of the Deep Foundations Congress; ASCE Special Publication 116.

transmission would be significantly minimised. Although the exact levels will depend on ground composition, measured data provided in the '*Press-in Piling: Ground vibration and noise during piling installation*' published report indicates that vibration levels at a distance of 10m from the piling rig would be of the order of 1mm/s. This level is well below the BS 5228 guidance criteria limits.

If an alternative piling method is conducted to the press-in type, a test pile should be erected at the piling location that is closest to one of the noise sensitive locations. Vibration monitoring should then be conducted to confirm that groundborne vibration will be within the guidance criteria limits listed in Table 8.9 and that no structural damage will therefore occur to adjacent buildings.

In summary, provided the 'press-in' method of piling is employed at all piling locations, the likely impact of vibration from the proposed construction works on the local environment would not be significant.

If normal piling is employed, there is likely to be a moderate amount of vibration impact although it would be likely to occur over relatively short durations.

8.4.4 Comment On Site Investigation and Pipe Laying Works

Temporary Negligible Impact

We note that some additional site investigation and pipe laying works will be carried out. These works may involve some of the activities in the processes assessed in this chapter but are expected to be very low scale in nature and therefore would be considered negligible when compared with the predicted impacts of the assessments contained herein.

8.5 MITIGATION MEASURES

8.5.1 Air Quality & Climate

A dust minimisation plan will be formulated for the construction phase of the project, as construction activities are likely to generate some dust emissions. The potential for dust to be emitted depends on the type of construction activity being carried out in conjunction with environmental factors including levels of rainfall, wind speeds and wind direction. The potential for impact from dust depends on the distance to potentially sensitive locations and whether the wind can carry the dust to these locations. The majority of any dust produced will be deposited close to the potential source and any impacts from dust deposition will typically be within several hundred metres of the construction area⁽¹³⁾.

In order to ensure that no dust nuisance occurs, a series of measures will be implemented. Site roads shall be regularly cleaned and maintained as appropriate. Hard surface roads shall be swept to remove mud and aggregate materials from their surface. Furthermore, any road that has the potential to give rise to fugitive dust must be regularly watered, as appropriate, during dry and/or windy conditions.

Speeds shall be restricted on hard surfaced roads as site management dictates. Vehicles delivering material with dust potential shall be enclosed or covered with tarpaulin at all times to restrict the escape of dust.

Public roads in the vicinity of the site shall be regularly inspected for cleanliness, and cleaned as necessary.

At all times, the dust mitigation measures put in place will be strictly monitored and assessed. In the event of dust nuisance occurring outside the site boundary, movement of materials will be immediately terminated and satisfactory procedures implemented to rectify the problem before the resumption of the operations.

The dust minimisation plan shall be reviewed at regular intervals during the construction phase to ensure the effectiveness of the procedures in place and to maintain the goal of minimisation of dust through the use of best practice and procedures.

8.5.2 Noise & Vibration

In order to sufficiently ameliorate the likely noise and vibration impacts from the proposed works, a schedule of noise control measures has been formulated for the construction phase.

Reference will be made to BS 5228-1: 2009: *Code of Practice for Noise and Vibration Control on Construction and Open Sites: Noise*, which offers detailed guidance on the control of noise & vibration from demolition and construction activities. In particular, it is proposed that various practices be adopted during construction, including:

- limiting the hours during which site activities likely to create high levels of noise or vibration are permitted;
- provision of a 2.4m high hoarding around concrete wall and embankment works areas;
- establishing channels of communication between the contractor/developer, Local Authority and residents;
- appointing a site representative responsible for matters relating to noise and vibration;
- monitoring typical levels of noise and vibration during critical periods and at sensitive locations.

Furthermore, it is envisaged that a variety of practicable noise control measures will be employed. These may include:

- selection of plant with low inherent potential for generation of noise and/ or vibration;
- erection of enclosures as necessary around noisy processes and items such as generators, heavy mechanical plant or high duty compressors;
- placing of noisy / vibratory plant as far away from sensitive properties as permitted by site constraints and the use of vibration isolated support structures where necessary;

We would also recommend that vibration from construction activities be limited to the values set out in Table 8.8. It should be noted that these limits are not absolute, but provide guidance as to magnitudes of vibration that are very unlikely to cause cosmetic damage. Magnitudes of vibration slightly greater than those in the table are normally unlikely to cause cosmetic damage, but construction work creating such magnitudes should proceed with caution. Where there is existing damage, these limits may need to be reduced by up to 50%.

8.6 RESIDUAL IMPACT

8.6.1 Air Quality & Climate

Temporary Negligible Impact

No residual impact is anticipated.

8.6.2 Noise & Vibration

Temporary Negligible Impact

During the construction phase of the project, we would expect that nearby residential properties will be exposed to noise emissions from concrete wall and embankment works given that they are above existing

ambient noise levels. However, given that the construction phase of the development is temporary in nature and calculated levels with mitigation measures in place are within criteria, it is expected that the various noise sources will be relatively negligible. Furthermore, the application of binding noise limits and hours of operation, along with implementation of appropriate noise control measures such as screening and low noise piling methods/durations, will ensure that noise impact is kept to a minimum.

8.7 MONITORING

8.7.1 Air Quality & Climate

The dust mitigation measures put in place will be strictly monitored and assessed throughout the construction phase to ensure their effectiveness. If a dust minimisation plan is effectively implemented there will be no need for dust monitoring during the construction phase.

8.7.2 Noise and Vibration

During the proposed works, noise and vibration monitoring may be conducted during certain activities. It is considered that short term attended noise and vibration measurements would be appropriate to ensure that the project design criteria are being met.

For attended noise monitoring, the following survey methodology should be employed:

- survey engineers should measure LAeq, LAMax, LAMin, LA10 and LA90 over a sample period of 15 minutes;
- detailed notes should be taken in relation to primary noise sources, weather and prevailing winds;
- measurements should be conducted at various locations on a cyclical basis over the course of a typical day.

Noise monitoring should be conducted in accordance with ISO 1996: 2007: *Acoustics – Description, measurement and assessment of environmental noise*.

For attended vibration monitoring or test pile measurements, the following survey methodology should be employed:

- survey engineers should measure the maximum ppv at each location over a sample period of 15 minutes;
- detailed notes should be taken in relation to primary vibration sources; and
- measurements should be conducted at the locations on a cyclical basis over the course of a typical day (attended vibration monitoring only).

Vibration monitoring should be conducted in accordance with either BS 7385-1 (1990) *Evaluation and measurement for vibration in buildings — Part 1: Guide for measurement of vibrations and evaluation of their effects on buildings* or BS 6841 (1987) *Guide to Measurement and Evaluation of Human Exposure to Whole-Body Mechanical Vibration and Repeated Shock* as appropriate.