7.0 AIR AND CLIMATE

This Chapter of the Environmental Impact Statement assesses the impacts of the proposed gas storage facility in terms of Climate, Noise and Vibration. The impact on Air Quality is also considered.

7.1 Climate

7.1.1 Existing Climate

The nearest meteorological observation station to Islandmagee is the Met Office station at Aldergrove, approximately 21 miles from the site and at an elevation of 62m, similar to that of the proposed facility. The 30-year temperature and rainfall averages (1971-2000) from the Aldergrove station, published by the Met Office are presented in Figure 7.1 and Figure 7.2. A shorter dataset 2007-2010 is also available from a weather station in Larne.

The climate at Islandmagee is influenced mainly by its (relatively) low elevation and coastal situation. Northern Ireland's climate in general is defined as a "temperate oceanic climate" and it experiences a lack of temperature extremes compared to similar latitudes within mainland Europe areas. Summers are generally warm and winters are very mild. There is a small amount of regional variation, with inland areas being cooler in winter and warmer in summer than their coastal counterparts.

7.1.1.1 Rainfall

Rainfall in Northern Ireland varies widely, with the wettest places being in the Sperrin, Antrim and Mourne Mountains. The highest areas have average annual totals of about 1,600 mm, which is about half that of the English Lake District or the western Highlands of Scotland. In addition to topographic effects, greater exposure to rain-bearing winds off the Atlantic results in higher averages in the more western counties of Fermanagh, Londonderry and Tyrone. The wettest places are in the upland area around Killeter Forest in the extreme west of County Tyrone, where the annual average reaches about 1,950 mm. The driest places are further east - around Strangford Lough and close to the east coast, and near to the southern and eastern shores of Lough Neagh - where the annual totals are just under 800 mm (Met Office, 2009).

The seasonal variation of rainfall in Northern Ireland is less marked in the drier southern and eastern areas than in the wetter areas, but in all areas the wettest months are between October and January. This is partly a reflection of the high frequency of winter Atlantic depressions and the relatively low frequency of summer thunderstorms in Northern Ireland. For example, at Armagh, thunder occurs on an average of less than 4 days a year, compared with 15 to 20 days at many places in England. Only in a few locations, mainly away from the coast, does the frequency of thunder exceed 5 days a year.

The course of mean monthly rainfall for 1971-2000 for the Aldergrove station is shown below. When compared with other principal stations in Northern Ireland, at Coleraine (Co.

Londonderry), Corgary (Co. Fermanagh) and Spelga Dam (Co Down) the pattern of rainfall is similar at each, with the months of October to January showing as the wettest and the late spring and early summer months being driest.

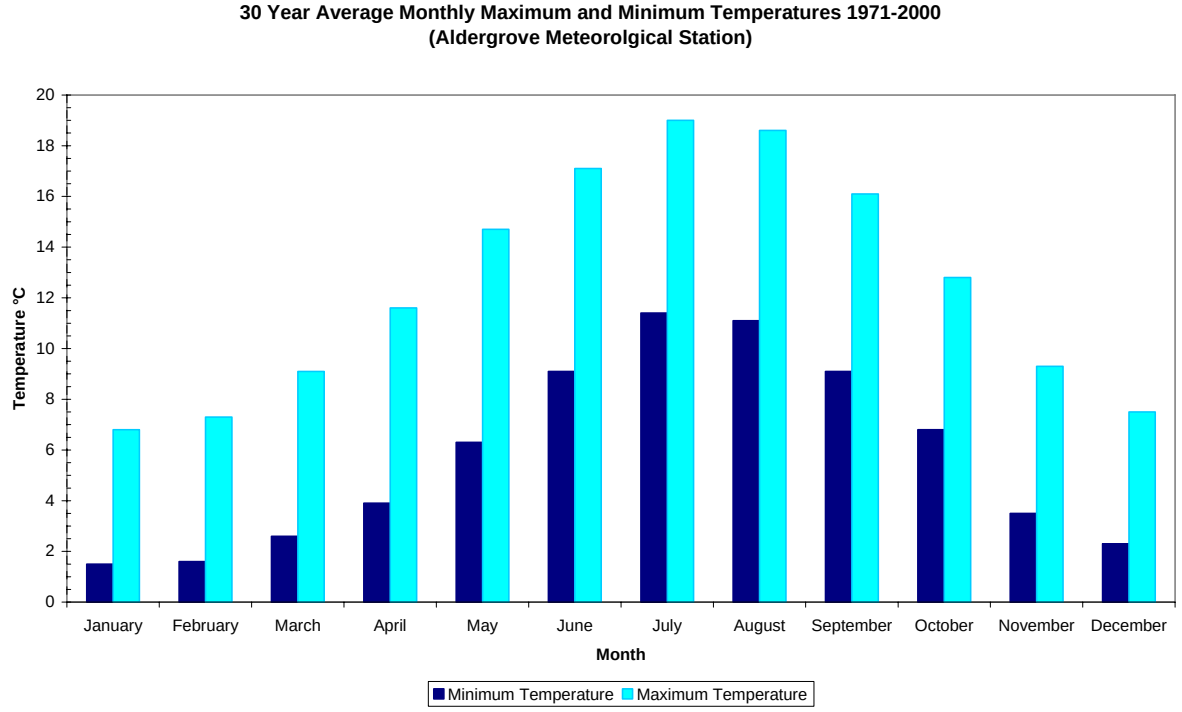

Figure 7.1 30 Year Average 1971-2000 Maximum and Minimum Monthly Temperatures

(Source: Met Office 2009)

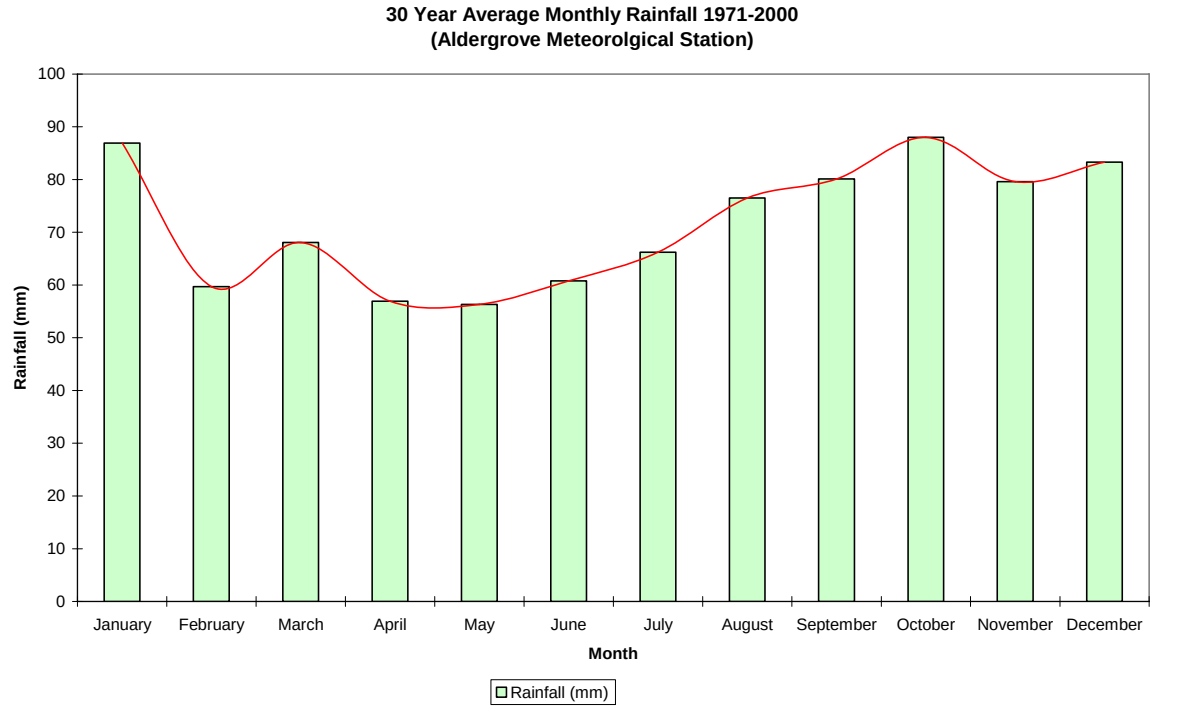

Figure 7.2 30 Year Average 1971-2000 Monthly Rainfall

(Source: Met Office 2009)

Over much of Northern Ireland, the number of days with a rainfall total of 1mm or more ('wet days') tends to follow a pattern similar to the monthly rainfall totals. In the higher parts, over 55 days is the norm in winter (December to February) and over 45 days in summer (June to August). In the driest areas around Lough Neagh and eastwards to Strangford Lough, less than 45 days in winter and about 35 days in summer are typical.

The combination of close proximity to active weather systems arriving from the Atlantic and the extensive areas of upland can lead to notable daily and monthly falls.

7.1.1.2 Wind

Northern Ireland is one of the windier parts of the UK, with the windiest areas being over the highest ground and along the coasts of Counties Antrim and Down.

The strongest winds are associated with the passage of deep areas of low pressure close to or across the UK. The frequency and strength of these depressions is greatest in the winter half of the year, especially from November to January, and this is when mean speeds and gusts (short duration peak values) are strongest.

The variation in monthly mean speeds (average of a continuous record) and highest gusts ('instantaneous' speed averaged over about 3 seconds) at Aldergrove is shown in Figure 7.3)

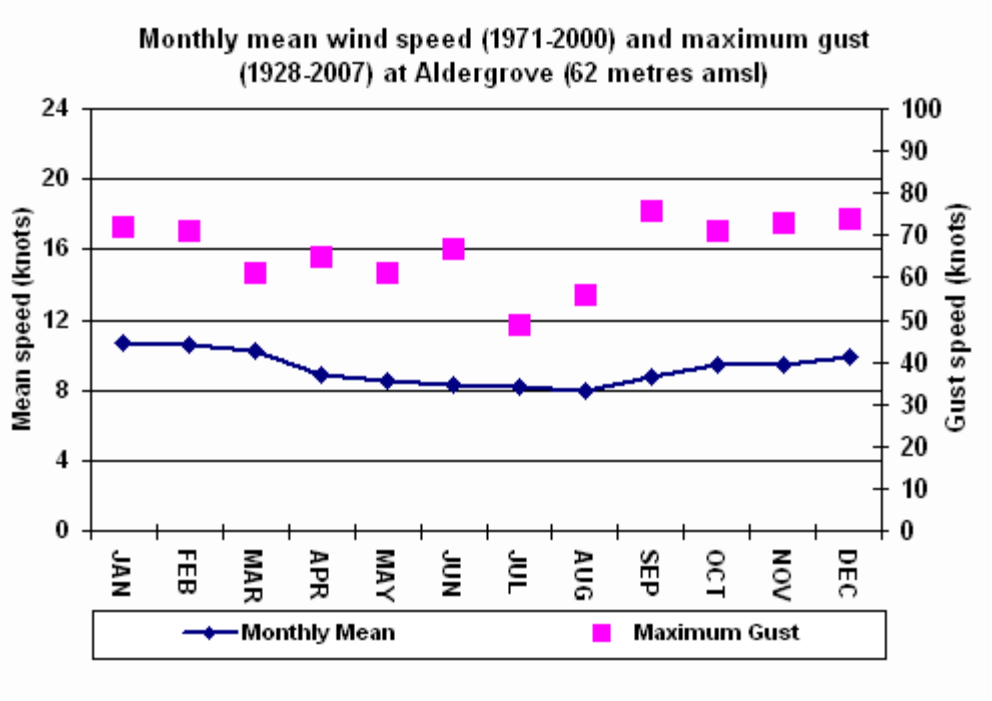

Figure 7.3 Monthly Mean Wind Speed, 1971-2000

Another measure of wind exposure is the number of days when gale force is reached. If the wind reaches a mean speed of 34 knots or more over any 10 consecutive minutes, then that day is classed as having a gale. At low altitudes in Northern Ireland, gales occur most frequently on the coasts of Antrim and Down with about 15 days of gale each year on average. The number of days decreases inland to 5 days or fewer around and west of Lough

Neagh. Wind speed is sensitive to local topographic effects and land use - places sheltered by hills or in urban areas will have lower wind speeds and fewer days of gale.

Wind direction is defined as the direction from which the wind is blowing. As Atlantic depressions pass the UK the wind typically starts to blow from the south or south west, but later comes from the west or north-west as the depression moves away. The range of directions between south and north-west accounts for the majority of occasions and the strongest winds nearly always blow from these directions.

The annual wind rose for Aldergrove is typical of low lying, inland locations in Northern Ireland, with a prevailing south-westerly wind direction through the year. However, there is a high frequency of north, north-east and easterly winds in Spring.

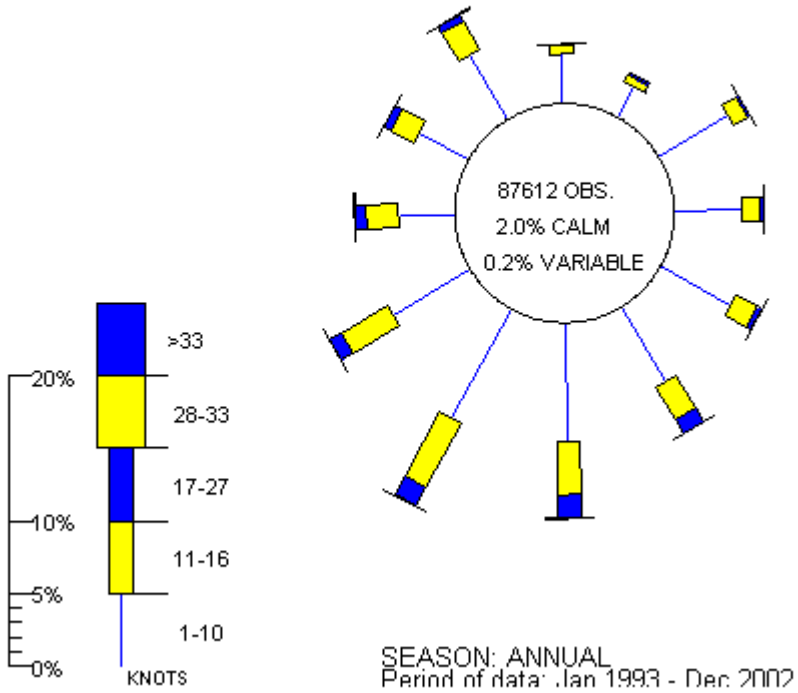

Figure 7.4 10 Year Annual Average Wind Rose for Aldergrove Station 1993-2002

(Source: Met Office 2009)

Although the station at Aldergrove is located inland, the weather conditions at Ballylumford do not vary significantly from the general observations at Aldergrove. Shorter-term data from the weather station in Larne (Figure 7.5) confirm that the prevailing winds are south-westerly to south south-westerly and strong north easterlies are also recorded in spring time.

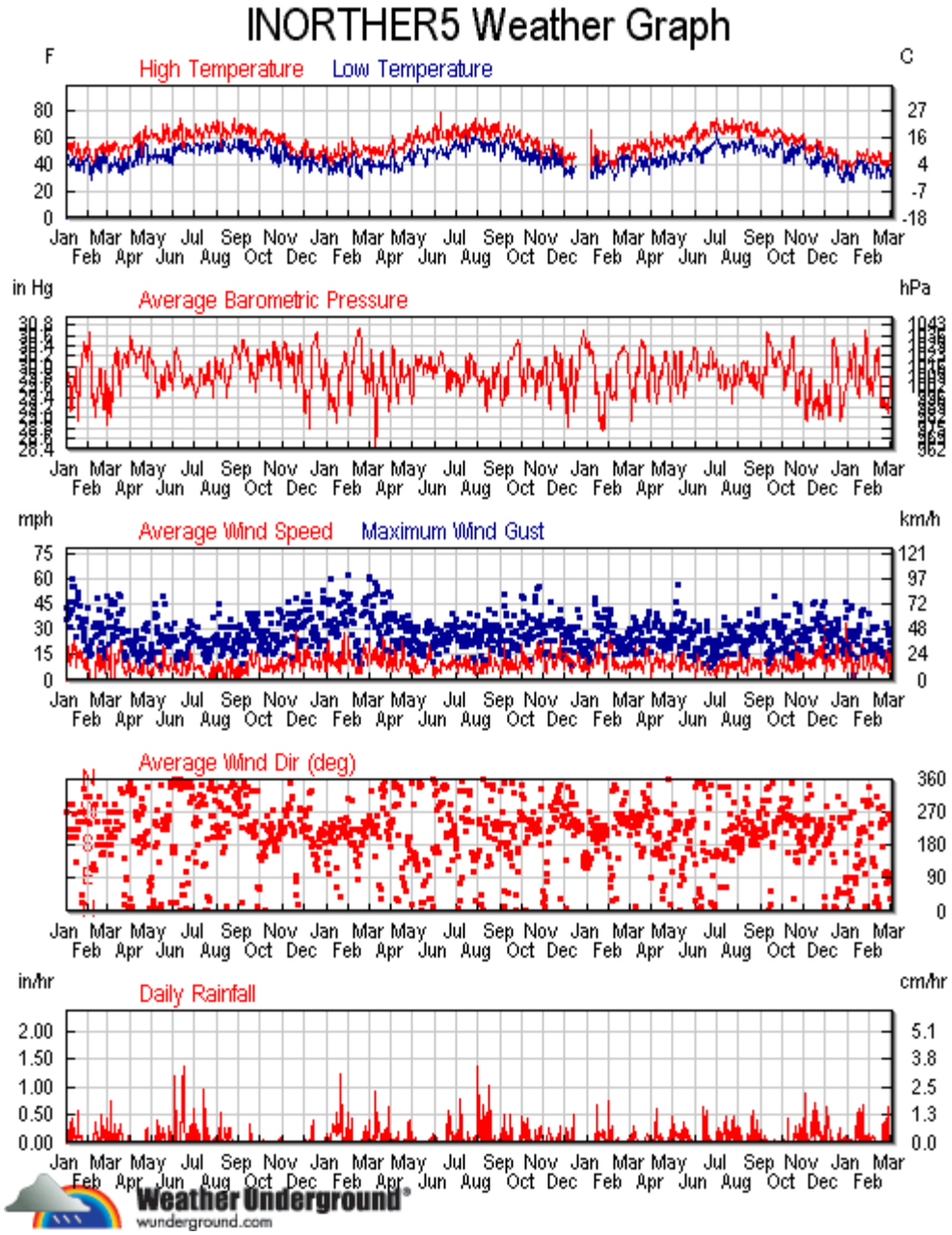

Figure 7.5 January 2007- March 2010 Weather Data from Larne Weather Station

Data sourced from Weather Underground www.wunderground.com

7.1.2 Climate Impact

The gas storage facility will operate as a completely closed system, therefore during normal operation there will be no releases of gas to the atmosphere. However, there may be minimal emissions of gas from the operation of gas hydraulic operated valves, safety relief valves and venting down of filters, etc. for maintenance. The release of natural gas, which is a greenhouse gas, during commissioning and testing has been minimised, as described above, and will have no significant effect on climate.

The proposed gas storage facility will derive the power necessary to drive the pumping equipment during the leaching phase and the compression and heating/dehydration equipment during the operational phase from the National Grid. The proposed development is therefore is not anticipated to directly produce any emissions which may impact on climate locally. Whilst the majority of power generation (currently 93%) in Northern Ireland is achieved through the burning of fossil fuels, DETI has set a target of achieving 12% renewable electricity by 2012 and hopes to surpass the E.U. target of 20% by 2020 by increasing the amount of electricity generated from renewable sources to 40% by 2020 (DETI, 2009). This is likely to be primarily achieved through wind-powered generation.

A shift to renewable energy sources is likely to result in an increasing reliance on gas-fired power stations to support the fluctuations in supply from the intermittent nature of renewable power generation. Other forms of power generation such as nuclear or coal/oil are not able to respond as quickly to rapid changes in demand. The Islandmagee Storage project will allow gas-fired power stations to respond to the rapidly fluctuating gas supply demands for electricity generation, in effect also acting as “electricity storage” in a low carbon economy. It can therefore be considered that the Islandmagee storage project may have a positive impact in that it will permit a reduction in greenhouse gas emissions by enhancing the feasibility of using renewable energy for a greater proportion of power generation.

7.2 Noise

7.2.1 Existing Noise Levels

7.2.1.1 Survey Details

In order to adequately assess the impact, background noise levels were recorded at locations close to the most proximate properties to the proposed works during daytime on 30th November 2009 and during night time on 9th December 2009. Conditions and circumstances were coincident with the expected times of construction.

All measurements were taken with a Cirrus Type 1 Sound Level Meter and under conditions appropriate to criteria in BS4142. Weather conditions were excellent with no rain and little measurable wind speed. The measurements were recorded at a height of between 1.2 and 1.5m from ground level. The measurements were recorded by Mr. P. McEvoy B.Sc. A.M.I.O.A.

7.2.1.2 Survey Results and Discussion

Details of recorded background noise levels are presented in Table 7.1 & Table 7.2. The locations of measurement points are presented in Figure 7.6.

This allows for the assessment of the daytime impact of the noise associated with the ongoing construction works.

Table 7.1 Daytime Noise Measurement Results

Location	Address	L_{Aeq}	L_{Amax}	L_{A10}	L_{A90}
1	Residential properties at Coastguard Road, Larne	67.6	76.7	71.3	50.5
2	Bank Road, Larne	66.8	78.9	71.8	46.1
3	Shore Road, Glynn	65.7	88.2	68.9	44.0
4	Ballylumford Road	55.5	73.1	52.1	45.9
5	Ballylumford Road 2	44.2	61.7	45.8	41.4
6	Brown's Bay Road	38.9	58.3	41.0	34.2

Table 7.2 Night time Noise Measurement Results

Location	Address	L_{Aeq}	L_{Amax}	L_{A10}	L_{A90}
1	Residential properties at Coastguard Road, Larne	45.7	64.3	46.7	40.8
2	Bank Road, Larne	54.3	71.9	54.5	36.6
3	Shore Road, Glynn	46.4	59.7	49.6	38.0
4	Ballylumford Road	45.8	60.9	46.8	43.2
5	Ballylumford Road 2	52.7	59.7	55.5	48.7
6	Brown's Bay Road	39.4	60.1	41.8	34.1

Figure 7.6 Measurement Location Plan

7.2.1.3 Noise Sensitive Receptors.

Noise sensitive receptors (residential properties, churches, schools, etc.) have been identified on both sides of Larne Lough. The noise sensitive locations have been identified on the basis that they will be the most proximate or exposed to the construction activities. These have been categorised into a number of noise sensitive locations which are presented in Figure 7.7 and Figure 7.8. Each location has been assigned an identification number which will be used for further reference.

Figure 7.7 Noise sensitive locations, (Not to scale, for illustrative purposes only)

Figure 7.8 Noise sensitive locations, (Not to scale, for illustrative purposes only)

7.2.2 Construction Noise Assessment.

7.2.2.1 Construction Noise Limits

The current noise limits for construction noise within Northern Ireland are based on a guideline document produced by Belfast City Council in September 2002 entitled *'Advice Note for Construction And Demolition Sites'.* This guideline document has been adopted by all of the local councils within Northern Ireland. The limits are as follows:

Monday to Friday	**Maximum at Measurement Points**
07:00 - 19:00	75 dB $L_{Aeq,12h}$
19:00 - 22:00	65 dB $L_{Aeq,1h}$
22:00 - 07:00	No noise audible

Saturday	**Maximum at Measurement Points**
08:00 - 13:00	75 dB $L_{Aeq,12h}$
13:00 - 22:00	65 dB $L_{Aeq,1h}$
22:00 - 07:00	No noise audible

Sunday and Bank Holidays
No Operations*

Vibration Guideline levels
Maximum continuous PPV 2.5 mm/s

*It should be noted that during drilling operations, which will last approximately seven weeks during the drilling of the initial truthing well and a further 9 months when the final six caverns are drilled, will be on a 24 hour, 7 day a week basis. All other construction activities will observe standard daylight construction working hours.

The leaching plant will also be in operation on a 24hr basis during the leaching phase. Although this is a temporary, construction-related noise impact, the duration of leaching activities (4 years) will mean that the leaching plant, which will be housed within a sound-proofed building, must conform to the strict target noise levels for operation phase plant as outlined in 7.2.3 below.

7.2.2.2 Noise Model Input

A computer based noise model was completed for the site. The Datakustik Cadna/A computer based noise modelling software system was used. The Cadna/A software system is compatible with ISO 9613 incl. VBUI and meteorology according to CONCAWE (International, EC-Interim), VDI 2714, VDI 2720 (Germany), DIN 18005 (Germany), ÖAL Richtlinie Nr. 28 (Austria), BS 5228 (United Kingdom), General Prediction Method (Scandinavia) and the P2P calculation model, preliminary version (International) standards and guideline documents relating to industrial noise and noise prediction.

The digital 3D models of the scheme were produced using the digital drawings provided by RPS Consulting Engineers. All models were based on the most up to date designs. Any screening where present was incorporated as per the finalised design. Each property was modelled as a 3D element within the design and assigned properties such as height and reflective attributes.

In each case a 'worst case' scenario was considered. This considered the activities occurring at the periphery of the proposed site. Each item of plant was introduced within the model as a point source and attributes such as height and directionality were applied to each source. In this instance each source was considered to have an even hemispherical propagation pattern. All items of plant were considered to be running continuously.

The sound power levels used for each point source are presented in Table 7.3. As plant noise levels were not available from the contractor, with the exception of the drilling rig, the levels provided in Table 7.3 are based on the source noise levels contained within BS5228. No correction has been made for the presence of and condition of the plant and silencers. All items are considered to be in good working condition and therefore in-line with the submitted noise levels. Information on the operational hours of use of a number of items of plant and

indeed how many are required is not known at this stage therefore in each case a worst case scenario is assumed.

Table 7.3 Plant Sound Power Levels (construction phase works, Source levels taken from BS5228)

Item	Noise level SWL (A) dB
Dozer (Dozing)	120
Dump truck 50t	110
Vibrating roller 50Kw	106
Batching Plant 360 m3	108
Water Pump	107
Tracked Crane 25t	110
Large Excavator	111
Wheeled Digger	110
Stone Lorry 20t	112
Drilling Rig	110
HGV	112
Telehandler	122
Tractor and Trailer	113
Welder	108
Concrete Pump	109
Horizontal Directional Drill	122
Piler (CFA)	108
Screener	112
Sheet Piler	118

The exact method of works has not been determined at this stage. The plant that will be used is based on the units expected to be required.

In each circumstance for each receptor location and height the noise sources have been positioned to provide an approximation of a worst case scenario. Four different noise models were produced to incorporate the worst case scenario for each receptor. The location of each item of plant is located at the perimeter of the works. This has ensured that the results are worst case and assume that all plant is operating simultaneously. In reality the different items of plant will be located for the majority of the time further from the most proximate residential properties and it is unlikely that all plant will operate simultaneously; therefore, the impact at the existing noise sensitive properties will be lower than assessed.

7.2.2.3 Prediction of Construction Noise Levels

The predicted noise levels at each of the receptor locations are presented in Table 7.4 below. Locations are as shown in Figure 7.7 and Figure 7.8. A worst case scenario has been considered in each circumstance.

Table 7.4 Predicted noise levels at receptor locations for Phase 1

	Noise Sensitive Property No.	Height	Predicted Level dB L_{Aeq} 12hr	Compliance with N.I EHD Guidelines	Notes
Phase 1 (Construction of wellpad, seawater intake pumping station, leaching plant, pipe laying and wellpad drilling)	1	4m	56.3	Yes	*Construction activity at wellpad and drilling activity*
	2	4m	59.7	Yes	*Construction activity at wellpad and drilling activity*
	3	4m	69.8	Yes	*Construction activity at leaching plant facility, gas plant facility and pipe laying in close proximity*
	4	4m	67.0	Yes	*Activity at hardstanding storage area, including vehicle movement and batching plant*
	5	4m	74.0	Yes	*Pipe laying activity*
	6	4m	66.1	Yes	*Pipe laying activity, drilling, sheet piling and sea water pumping facility construction*

Table 7.5 Predicted noise levels at receptor locations for Phase 2

	Noise Sensitive Property No.	Height	Predicted Level dB L_{Aeq} 12hr	Compliance with N.I EHD Guidelines	Notes
Phase 2 (Drilling activity at wellpad, construction of Gas Plant facility, leaching facility plant noise and sea water pumping facility plant noise)	1	4m	55.6	Yes	*Drilling activity at wellpad*
	2	4m	59.0	Yes	*Construction activity at gas plant facility and drilling activity at wellpad*
	3	4m	56.4	Yes	*Plant noise at leaching plant facility and construction of gas plant facility*
	4	4m	66.8	Yes	*Activity at hard standing storage area, including vehicle movement and batching plant*
	5	4m	31.1	Yes	-
	6	4m	35.1	Yes	*Plant noise from sea water pumping facility*

Table 7.6 Predicted noise levels at receptor locations for during night time

	Noise Sensitive Property No.	Height	Predicted Level dB L_{Aeq} 1hr	Compliance with N.I EHD Guidelines	Notes
'Worst case' night time noise impact	1	4m	42.0	Yes	*Construction activity at wellpad and drilling activity*
	2	4m	44.5	Yes	*Construction activity at wellpad and drilling activity*
	3	4m	44.8	Yes	*Construction activity at leaching plant facility, gas plant facility and pipe laying in close proximity*
	4	4m	42.2	Yes	*Activity at hardstanding storage area, including vehicle movement and batching plant*
	5	4m	29.7	Yes	*Pipe laying activity*
	6	4m	27.1	Yes	*Pipe laying activity, drilling, sheet piling and sea water pumping facility construction*

Based on the predicted impact levels, it is anticipated that construction noise levels will not exceed the existing ambient noise level at any properties close to the site. The noise prediction model has shown that the Environmental Health noise limits will not be exceeded. However, at *Location 5* the predicted noise levels are close to the recommended noise limit during pipe laying activity. This assumes pipe laying at the closest possible distance from the residential property, where in practice, activity will occur over a very short period of time. At all other times pipe laying operations will be at a greater distance from the residential property at Location 5.

It is noted that there is a caravan situated in close proximity to the proposed location of the wellpad. While it is noted that this caravan is not permanently occupied there is potential for noise disturbance to any occupants. The 'worst case' predicted noise levels for daytime at this caravan are 68 dB L_{Aeq} 12hr, which is within Environmental Health Department target levels for daytime activity. The 'worst case' predicted noise levels for night time at the caravan are 52 dB L_{Aeq} 1hr. This would be above Environmental Health target levels for night time. It would therefore be advisable to liaise with the owner regarding the temporary noise impact.

7.2.2.4 Road Traffic Noise

An assessment was undertaken of the change in noise levels expected as a result of the additional vehicular movements during the construction phase of the works. The impact relates to noise sensitive premises which are located along the local roads and is based minimum distances and HGV movement figures provided by the lead consultant.

Access to all locations is via main roads, with existing traffic. Vehicular activity associated with the works will be limited to deliveries and contractors employees.

Using the *Haul Road Method* in BS5228 and assuming a minimum of 5m from access roads to nearest premises, and typically 5 HGV movements per hour (Q=10) impacts of 43dB $L_{Aeq,1hr}$ may occur during maximum vehicle movement in the daytime.

HGV Movement	=	Average SWL	-	33	+	10 log Q	-	10 log V	-	10 log d
Noise Impact	=	98	-	33	+	10 log 10	-	10 log 30	-	10 log 5
	=	98	-	33	+	10	-	15	-	7
	=	dB $_{LAeq,1h}$								

It is noted that this level is lower than the existing ambient levels at the majority of the noise sensitive properties along the route. This level is a worst case condition and is below typical limits for acceptable traffic noise and given the temporary nature of works at any one location, impact will be minimal.

7.2.3 Operational Noise and Above Ground Installations

Once constructed and commissioned the buried pipeline will operate in silence, any friction noise generated by the flowing medium is deadened by the cover and soil.

The only remaining noise source associated with the pipelines will be the gas plant facility, which will run during both daytime and night time. The compressing units and pumps will both be housed in acoustic buildings specially designed with reference to the BS4142 (1997), "Method of Rating Industrial Noise Affecting Mixed Residential and Industrial Areas", and, the existing background levels at the noise sensitive properties near to the proposed locations.

With regard to BS4142, target exposure levels (L_{Aeq}) at residential/noise sensitive properties are chosen which are equivalent to the lowest recorded background (L_{A90}) value in the vicinity of the gas plant facility. BS4142 indicates in Paragraph 9 that "complaints are unlikely" with this criteria. This target is such that if any noise is tonal or possessing some other recognisable 'character', the corrected level is still of marginal significance as a worst case, again with regard to BS4142. Therefore, it is proposed to incorporate the minimum target level for application of BS4142. The inclusion of this criteria will typically represent a less than marginal condition with respect to complaint.

Daytime and Night-time Target Level = 38 dB L_{Aeq}

With reference to the WHO *"Guidelines for Community Noise"* document, this target is within the recommended noise limit for undisturbed sleep, as detailed in Section 4.3.1 of the document.

Therefore, the acoustic housings for the gas plant facility must provide adequate attenuation to ensure that the maximum noise level emanating from the installation does not exceed 38 dB L_{Aeq} at the façade of any near sited residential properties.

7.2.3.1 Permissible levels for fixed plant at Gas Plant Storage Facility

Attenuation by distance = 20 log 250 = 48 dB

Permissible Target Level = 38 + 48 = 86 dB L_{Aeq} (unscreened)

That is, 86 dB L_{Aeq} cumulative limit at 1m from all plant, operating over 24 hours. Plant will be designed or screened so as to meet these daytime and night time external noise targets. This will be verified during the F.E.E.D. (front end engineering design) process.

7.2.4 Mitigation Measures

The noise prediction models considered a worst case scenario; however the extent of the impact, at any property, will vary – depending on the specific plant being used, the distance or range of distances to the property, the "on time" of each activity, and any localised screening.

However, it is recognised that construction activity is typically temporary in nature, with a requirement to use plant with high noise levels at specific locations. The ability to control construction noise levels relates primarily to the duration and time of construction activity in any one day. Therefore, to ensure that no significant ongoing impact occurs at the near sited noise sensitive properties the following mitigation measures are presented for the information of the contractor. This will enable the appropriate measures to be chosen during the construction phase for the appropriate control of construction noise to within the target levels.

As stated previously, the exact plant has not been finalised, but will be the responsibility of the selected contractor. It is therefore not possible to provide more specific details of mitigation measures which need to be provided as the methodology will vary depending on each item of plant in use, the location of each item and the length of time in which each item is in operation.

There are a number of mitigation measures which are considered appropriate and of good working practice for all construction contracts. These measures are detailed in BS5228 (1997), Noise and Vibration Control on Construction and Open Sites, and are summarised below. These guidelines should form the basis of control and limiting of potential impact to noise sensitive locations.

7.2.4.1 Choice of Plant

The contractor should take note of the control measures for relevant plant listed in BS5228 and apply the appropriate measures where practicable. These measures should include:

- positioning of static plant as far as possible from residential properties, and utilising available screening by temporary structures, stock piles, etc.
- use of well maintained plant, and where possible new plant manufactured under more strict EC guidelines for manufacturers.
- substitution of unsuitable plant.
- maintenance of silencers and moving components.

7.2.4.2 Screening

Temporary screening using sandbags, 20mm plywood sheeting or similar dense boarding may be required to reduce impact of static machinery or extensive works close to noise sensitive locations. Such measures can be best assessed during the contract by monitoring. Up to 20 dB attenuation can be provided by the screening of plant depending on the location of the barriers which could reduce the 'worst case' impact to within the proposed target levels.

7.2.4.3 Monitoring

It would be appropriate to conduct noise monitoring of construction during noisy or extensive works at locations close to residential properties. Measurements should be conducted using a Type 2 or better sound level meter to check on the continuing impact of the works. With regard to vibration, it will be necessary to monitor vibration levels at the beginning of the pile driving process to ensure that levels at the most proximate properties do not cause damage.

7.2.4.4 Appointment of a Responsible Person

It is recommended that the contractor should appoint or delegate a 'responsible person' who will be present on site and who will be willing to answer and act upon queries from the local public.

7.2.5 Noise Residual Impacts

Following the appropriate assessment methodology and guidelines provided by Environmental health, the noise associated with the proposed works and the surrounding noise impact have been calculated and predicted. A noise model of each worst case scenario has been completed for each of the identified noise sensitive receptors. The noise impact at each of these receptors has been found to be within the guideline levels with the exception of two locations.

Appropriate mitigation measures have been considered and provided in order to limit the effects of noise on the most proximate receptors to within the proposed Environmental Health Target Noise Levels. As the choice of plant and construction equipment will be the choice of the appointed contractor, and is therefore not known at present, it is not possible to accurately calculate the impact with mitigation measures in place. However, with careful choice of plant, location of equipment and effective screening, reductions of up to 20 dB are possible which can limit the noise impact at the nearby receptors to within the target levels. It is recommended at during critical phases of the works (i.e. close to noise sensitive properties) that on-site noise and vibration monitoring be used to ensure the guideline limits are not exceeded. This will ensure a measure of protection is provided for the most proximate noise sensitive properties around the periphery of the site, and advice can be given to reduce the impact where necessary.

The acoustic housings for the gas plant facility and brine leaching plant will be designed to provide adequate attenuation to ensure that the maximum noise level emanating from the installation does not exceed 38 dB L_{Aeq} at the façade of any near sited residential properties. This will be verified by on-site monitoring.

7.3 Vibration

7.3.1 Existing Environment

Presently there are no significant sources of vibration in close proximity of the near sited residential properties. However, the properties on Ballylumford Road may experience occasional vibration from HGV movement on the road, though this is typically caused by airborne vibration rather than ground borne.

7.3.2 Potential Impacts during Construction Phase

There is potential for ground borne vibration occurring from both drilling and piling activity. This activity will be at a distance in excess of 100m from the properties in close proximity to the sea water pumping station and in excess of 200m to properties at Ballylumford Road. The noise levels associated with piling have been incorporated within the noise level prediction calculation models and therefore have been considered.

7.3.2.1 Vibration Criteria

BS7385, “Evaluation and Measurement for Vibration in Buildings”, was intended to represent the current opinions on the probabilities of damage to structures when exposed to vibration levels with given peak particle velocities. However, the standard is non-specific in many areas due to the limited amount of core data available in the compilation of the document, particularly with regard to vibration damage records.

The guidelines in Table 7.7 have been based on BS7385, previous literature and the experience of this consultancy. “Cosmetic damage” refers to hairline cracking, with possible loosening of some poorly fixed components.

Table 7.7 Guidelines for Likelihood of Damage from Vibration

Peak Particle Velocity (ppv)	Likelihood of Damage
< 2.5 mm/s	Damage unlikely but continuous vibrations should be avoided.
2.5 - 5.0 mm/s	Poor quality or historic structures susceptible to cosmetic damage. Structural damage unlikely. This may cause annoyance to residents.
5.0 - 10.0 mm/s	Slight probability of cosmetic damage to low rise buildings or poorly fixed/secured panelling due to dynamic amplification. Poor quality structures susceptible to minor structural damage.
10.0 - 20.0 mm/s	High probability of cosmetic damage and slight probability of minor structural damage to low rise buildings.
> 20.0 mm/s	Buildings susceptible to structural damage.

Based on extensive monitoring by this consultancy, the main impact of vibration is therefore limited to cosmetic damage to possibly sensitive buildings which are within 10m of any piling

works where impact hammers are to be used. However, there are no properties within 10m of this type of activity.

At 100m damage is unlikely to occur.

The majority of the buildings, both commercial and residential are in a good state of repair. However, it is recommended that the use of tell tales in any suspect building should be used during any piling.

There is also a very limited potential for vibration impact from the other activities on site. Some potential could possibly occur from:-

- Vibration from fixed cyclic or reciprocal plant transmitted to subsoil and perceived at any near sited receptor.
- Vibration from deep excavation (which is transient and short term only) (Likely to be very minimal and below the proposed target level)

7.3.3 Mitigation Measures

It is impossible to accurately predict the potential for vibration impact due to unknown factors such as ground conditions, bedrock seams, and plant choice. However, based on the previous experience of this consultancy, whilst vibration levels may be perceptible in the near sited properties, given the distances involved no significant impact is likely to occur. However, it is recommended that tri-axial vibration monitoring be conducted during the initial piling to establish any potentially excessive impacts above the proposed target criteria. If excessive levels occur low vibration and noise emitting piling systems are available such as augur and giken systems, and indeed may be used by the selected contractor.

It is recommended at during critical phases of the works (i.e. close to noise sensitive properties or adjacent to the Ballylumford PRS) that on-site vibration monitoring is used to ensure the guideline limits are not exceeded. This will ensure a measure of protection is provided for the most proximate properties around the periphery of the site, and advice can be given to reduce the impact where necessary

7.3.3.1 Vibration Residual Impact

With the above mentioned mitigation measures in place, there are not anticipated to be any significant residual impacts relating to vibration.

7.4 Air Quality

This section of the EIS describes the impact to air quality associated with the proposed development of the gas storage facility.

7.4.1 Dust

7.4.2 Construction Phase

Most of machinery used on site will be powered by diesel engines. In order to control the emission of excessive exhaust fumes and smoke, the contractor must ensure that all vehicles and items of plant and equipment are correctly adjusted and maintained.

As with noise control, effective and regular maintenance of the plant will keep these exhaust emissions to acceptable levels.

All plant on site will comply with relevant UK and EC regulations on emissions as discussed in the Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Defra, 2007).

A Dust Minimisation Plan will be formulated for the construction phase of the project. The construction dust minimisation plan should include the following general dust mitigation measures:

- Site roads will be regularly cleaned and maintained as appropriate. Hard surface roads will be swept to remove mud and aggregate materials from their surface while any un-surfaced roads will be restricted to essential site traffic only.

- Any site roads with the potential to give rise to dust will be regularly watered, as appropriate, during dry and/or windy conditions (also applies to vehicles delivering material with dust potential).

- All vehicles exiting the site will make use of a wheel wash facility prior to entering onto public roads, to ensure mud and other wastes are not tracked onto public roads. Wheel washes will be self-contained systems that do not require discharge of the wastewater to water bodies.

- Public roads outside the site will be regularly inspected for cleanliness, and cleaned as necessary.

- Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind and will be located as far from receptors as possible.

- The contractor will be required to ensure that all vehicles are suitably maintained to ensure that emissions of engine generated pollutants is kept to a minimum.

- The transport of soils should be undertaken in tarpaulin-covered vehicles.

In periods of prolonged dry weather, dust emissions may become a problem during the construction works. These additional dust mitigation measures should be employed as appropriate:

- Erection of wind fences to reduce localised windspeeds and allow settlement of particles and prevent erosion on their leeward site;

- Using stockpile orientations and shapes that will minimise the windspeed at their surfaces and hence the erosion and generation of ambient dust;

- Imposing speed restriction on site vehicles.

Precautions will be taken to minimise the deposit of mud and dust on the roads, but this cannot be avoided completely. Any such deposits will be removed regularly using road brushes and vacuum road sweepers.

On-going review of the dust minimisation plan will be necessary throughout the construction phase of the project. Responsibility for dust management should be assigned to a specific member of the project team who will liaise with contractors, suppliers, local residents and the local authority. A complaints procedure will be designed and made available to stakeholders.

7.4.3 Operation Phase

There are not anticipated to be any sources of dust during the operation of the facility.

7.4.4 Dust Residual Impact

Provided the dust minimisation measures outlined above as mitigation are adhered to, there are not anticipated to be any significant residual impacts arising from dust.