9.0 EFFECT ON THE ENVIRONMENT: Air Quality (and Dust)

9.1 Introduction.

9.1.1 This chapter has been prepared by Malone O'Regan and AWN Consulting and discusses the existing air quality on the Poolbeg Peninsula, the potential impacts of the Draft Planning Scheme on air quality, the potential impacts on future occupiers of the Scheme and the abatement or mitigation measures that can be employed to reduce/ eliminate potential impacts where necessary or possible.

9.2 Assessment Methodology.

9.2.1 Ambient Air Quality Standards.

9.2.1.1 Assessment of the significance of a particular level of pollution is usually made with reference to Air Quality Standards (AQSs). AQSs are usually based on the effects of pollutants on human health, although other factors such as effect on ecosystems and vegetation are sometimes taken into account.

9.2.1.2 European and national statutory bodies have set limit values in ambient air for a range of air pollutants in order to reduce the risk to health from poor air quality. These limit values or AQSs 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.

9.2.1.3 The *Air Quality Standards Regulations, 2002 (S.I. No. 271 of 2002*) which came into effect on the 17th of June, 2002, deal with sulphur dioxide, nitrogen dioxide, particulate matter, lead, carbon monoxide and benzene. These regulations are based on *EU Directives 1999/30/EC, 2000/69/EC* and *96/62/EC,* and are summarised in Table 9.2.1.1 below with regard to key pollutants. *EU Directive 2008/50/EC* was published last year and as yet has not been transposed into Irish law. Annex XI of the new directive sets out the limit values for the protection of human health. Comments are provided in Table 9.2.1.1 where relevant in the summary table.

Table 9.2.1.1 Air Quality Standards Regulations 2002 (SI 271 of 2002)

Parameter	**Limit/Guideline**	**Concentration (µg/m³)**
Nitrogen Dioxide (NO_2)	99.8th percentile of 1-hour averages	200
Nitrogen Dioxide (NO_2)	Annual average	40
Nitrogen Dioxide (NO_2)	Annual average for the protection of vegetation	30
Sulphur Dioxide (SO_2)	99.7th percentile of 1-hour averages	350
Sulphur Dioxide (SO_2)	99.2th percentile of 24-hour averages	125
Sulphur Dioxide (SO_2)	Annual Average	20
Particulate Matter less than 10 micrometers in size (PM_{10})	90th percentile of 24 – hour averages	50
Particulate Matter less than 10 micrometers in size) (PM_{10})	Annual average	40 (1)
Particulate Matter less than 2.5 micrometers in size) ($PM_{2.5}$)	Annual Average	25 (1)
Total Organic Compounds (TOC)	Running Annual Average	5.0(2)
Lead (Pb)	Annual Average	0.5

(1) EU Directive 2008/50/EC annual average limit value for PM2.5 of 25 µg / m³ to be attained by 2015 and annual limit for PM10 until 2020 of 40 µg /m³ thereafter.

(2) Limit value is for benzene as a worst case.

9.2.1.4 The current trends in air quality in Ireland are reported in the EPA publication 'Air Quality in Ireland (Key Indicators of Ambient Air Quality) – Annual Report 2007' which is currently the most up to date analysis of air quality data for Ireland. Four national air quality zones have been designated in Ireland. The Draft Planning Scheme Area is within Zone A (Dublin). The designated zones have been defined to meet the criteria for air quality monitoring, assessment and management as defined in the Framework Directive (CEC, 1996) and Daughter Air Quality Directives (CEC, 1999 and EP and CEU, 2000). The ozone in Ambient Air Regulations 2004 (DEHLG, 2004) transposed the third Daughter Directive (EP and CEU, 2002) dealing with ozone into Irish law.

9.2.1.5 The Irish Regulations specify the dates by which the limit or target values for each of the pollutants must be achieved and also the reference methods for sampling, analysis and measurement. Specific requirements are also set in relation to providing the public with information on ambient air quality.

9.2.2 Baseline Monitoring.

9.2.2.1 Baseline monitoring is carried out in the Dublin area by DCC Air Quality Monitoring Unit. The Peninsula and surrounding areas have also been subject to air quality monitoring for the period 2003 – 2007 as part of the baseline data gathering exercise for the Waste to Energy EIS. The most recent data was presented at the oral hearing for the waste license application in April 2008. No further ambient air monitoring has been carried out as part of this assessment of the receiving environment as the baseline survey is considered sufficient for the purposes of this assessment. To substantiate this, Dr. Brian Broderick's report for An Bord Pleanala regarding the Dublin Waste to Energy Air Quality and Climate section of the EIS stated:

"A detailed baseline survey of air quality in the vicinity of the proposed WtE facility was carried out between July 2003 and December 2005. The methods used and results obtained are reported in the EIS. Additional air quality monitoring took place between August 2005 and February 2007, the results of which were made available by Dr Porter (AWN Consulting) in his brief of evidence to the oral hearing.

The sampling and analysis methods used in the baseline survey are appropriate. The extent of sampling was sufficient to assess the temporal and spatial variation in ground level concentrations in the vicinity of the plant, and to compare existing air quality with limit values."

9.2.2.2 The baseline survey is further discussed under Section 9.3 – The Receiving Environment.

9.2.3 Assessment Methodology – Impact on Future and Existing Occupiers

9.2.3.1 The Draft Planning Scheme for Poolbeg envisages developing the available land-bank for mixed uses, side by side with existing utilities such as the Waste Water Treatment Plant, ESB Poolbeg and Synergen generating stations and the proposed Waste to Energy Plant. The Waste to Energy plant has been granted planning permission by An Bord Pleanala and a waste license by the EPA. Accordingly, the impact on future occupiers of the Draft Scheme has been assessed in terms of the impact on air quality at groundlevel and at height from existing and proposed point sources with reference to the AQSs using the CALPUFF model prepared by AWN Consulting for the Waste to Energy plant. . Appendix 9.1 contains a copy of the assessment report prepared by AWN Consulting Ltd. All worst case scenarios in terms of operation and emissions from the Waste to Energy plant and meteorological conditions were considered e.g. conditions where shoreline fumigation could occur. The corrected background concentrations used for all parameters are the same as those used for the Waste to Energy plant assessments (including any revisions presented to the EPA in April 2008) at the oral hearing to objections on the Proposed Decision for the waste license. The recently issued Inspector's report to the Board of the Agency on the objections to the Proposed Decision, did state that the use of the NETCEN emission factor tool to correct background concentrations has not been justified in the circumstances (given the general lower rate of reduction in PM_{10} concentrations observed in Ireland compared to the UK) and consequently the predicted future PM_{10} levels are not regarded, by the Inspector, as robust. As a consequence the Inspector considered that a condition be inserted into the license effectively requiring further baseline monitoring, comparison of actual measurements with predictions for air quality post 2012 and updating of the impact assessment prior to the commencement of incineration. However, the Board issued the license without a condition addressing this requirement. Furthermore, it should be noted that there are no published tools in Ireland with regard to carrying out background corrections and it is also noted that NETCEN is listed in Appendix C of the H1 Environmental Risk Assessment Part 2 Assessment of Point Source Releases and Cost Benefit Analysis published by DEFRA as a source when determining background concentrations. The NRA refer to it in their "Guidelines for the Treatment of Air Quality During the

Planning and Construction of National Road Schemes." Further comment on the DDDA's position with regard to further investigation of the PM_{10} results to date and/or baseline monitoring to validate (or otherwise) the background corrections used is presented elsewhere in this chapter.

9.2.3.2 The Inspector also considered it inappropriate to predict a reduced NO_2 level for 2012 given that there is no requirement for the combustion plants in the vicinity to reduce their emissions prior to 2012 and that no downward trend is noted from national monitoring as reported by the EPA. The Inspector also considered that the use of the 99.8th %ile 1-hour value as background would represent the worst case scenario even though there would be spatial or temporal differences in the occurrence of the 99.8th %ile value for background and process contribution. However no recommendations arose from these considerations and, subsequently no conditions were inserted in the license.

9.2.3.3 The traffic emission predictions have been combined with the output from CALPUFF to determine the cumulative impact of both the point sources and the traffic emissions on future and existing receptors.

9.3 The Receiving Environment.

9.3.1 General Available Data for Zone A – Dublin.

9.3.1.1 Monitoring carried out throughout the country is reported by the EPA. Dublin is in Zone A.

9.3.1.2 In 2007 carbon monoxide, sulphur dioxide, oxides of nitrogen, benzene, PM_{10} and $PM_{2.5}$ and lead monitoring was carried out at a number of locations in Dublin. Table 9.3.1.1 summaries the type of monitoring undertaken at each location.

Table 9.3.1.1 Monitoring Locations in Dublin

Parameter	Winetavern St	Coleraine St	Rathmines	Ballyfermot	Marino	Phoenix Park	Ringsend
Sulphur Dioxide (SO_2)	√	√	√	√	-	-	-
Nitrogen Dioxide (NO_2) and Oxides of Nitrogen (NOx)	√	√	√	√	-	-	-
Particulate Matter (PM_{10} & $PM_{2.5}$)	√	√	√	√	√	√	-
Black Smoke	-	-	-	-	-	-	√
Lead (Pb)	√	√	√	-	-	-	-
Benzene (C_6H_6)	-	-	√	-	-	-	-
Carbon Monoxide (CO)	√	-	-	-	-	-	-
Ozone (O_3)	-	-	√	-	-	-	-

9.3.1.3 The summary results prepared for 2007 by the EPA are described below:

Sulphur Dioxide –The annual mean at the Dublin sites was 3 $\mu g/m^3$, 3 $\mu g/m^3$, 3 $\mu g/m^3$ and 1 $\mu g/m^3$ respectively, to be compared with the annual limit for the protection of ecosystems which is 20 $\mu g/m^3$. The daily limit value for the protection of human health set at 125 $\mu g/m^3$ (not to be exceeded more than three times per year) was not exceeded at any of the above monitoring stations.

Nitrogen Oxides –Monitoring of nitrogen dioxide levels was carried out at Winetavern Street, Coleraine Street, Rathmines and Ballyfermot with the annual mean values of 34 $\mu g/m^3$, 39 $\mu g/m^3$, 23 $\mu g/m^3$ and 19 $\mu g/m^3$, respectively. All results were within the annual limit value for health protection of 40 $\mu g/m^3$. All stations were also compliant with the more stringent hourly limit value, i.e. no more than 18 values to exceed 200 $\mu g/m^3$.

Particulate Matter PM_{10} –Monitoring of particulate matter (PM_{10}) levels was carried out at Winetavern Street, Coleraine Street, Marino, Rathmines, Phoenix Park and Ballyfermot. The annual mean at each of the sites was 18 $\mu g/m^3$, 18 $\mu g/m^3$, 13 $\mu g/m^3$, 17 $\mu g/m^3$, 12 $\mu g/m^3$ and 15 $\mu g/m^3$, respectively. Results were similar to 2006 and 2005. All stations were compliant with the 2005 limit value which permits no more than 35 exceedances greater than 50 ug/m^3.

9.3.1.4 Black smoke which consists of fine solid particles suspended in air mainly arises from the incomplete burning of fossil fuels such as coal, oil and peat. Open fires in dwelling houses would be a major source of particulate matter emitted as smoke. Monitoring results for Black Smoke for the period April 2006 –March 2007 show that smoke concentrations were low during the reporting period and were in full compliance with the revoked standards (see below). Black smoke concentrations were typically one tenth of the 98-percentile standard of 250 $\mu g/m^3$. At the monitoring station of Ringsend, an annual mean value of 2 $\mu g/m^3$ and a 98-percentile value of 13 $\mu g/m^3$ were measured.

9.3.1.5 Directive 80/779/EEC, (CEC, 1980) was revoked with effect from 1 January 2005 whereupon black smoke no longer has to be measured. PM_{10} is the parameter now used to measure particulates and includes the black smoke particulates. Black smoke has been measured in Ireland for over twenty years now and is a valuable parameter for observing trends in air quality especially in towns and cities.

Lead – Lead monitoring was carried out at Winetavern Street, Coleraine Street, Rathmines and Kilbarrack for Zone A. The concentrations were well below the limit value for the protection of human health of 0.5 $\mu g/m^3$, applicable from 2005. The annual mean concentrations measured were less than one tenth of the limit value with recorded values of 0.01 $\mu g/m^3$ for all four stations listed.

Carbon Monoxide - Monitoring was carried out at Winetavern Street and Coleraine Street for Zone A, with annual mean values of 0.2 mg/m^3 and 0.5 mg/m^3, respectively. The highest maximum daily 8-hour CO level of 3.4mg/m^3 was recorded at Wintavern Street. The CO maximum daily 8-hour mean limit value for the protection of human health is 10 mg/m^3.

Benzene – Benzene levels monitored in Zone A were measured at the Rathmines monitoring station and results show an annual mean value of 2.8μg/m^3 indicating that benzene levels would be well within the annual mean limit value of 5 μg/m^3, the annual mean limit value for the protection of human health, which comes into force in 2010. The highest annual mean across all zones was also recorded at Rathmines. In general, benzene levels in petrol have reduced in recent years.

Ground Level Ozone (O3) – Ozone levels, which according to the EPA, in Ireland are highly influenced by transboundary sources, are low in comparison with mainland Europe. Average levels in Ireland are generally well below the thresholds for effects on human health and vegetation set down in the 2002 Directive on ozone. Directive 2002/3/EC (EP and CEU, 2002) set out a target value for the protection of human health in respect of ozone concentrations, stipulating that maximum 8-hour mean concentrations of ozone should not exceed 120 μg/m^3 on more than 25 days averaged over 3 years. The Directive also contains a long term objective that maximum 8-hour mean concentrations should never exceed 120 μg/m^3. Ozone levels recorded in 2007 were lower than those recorded in 2006, most likely due to meteorological factors.

9.3.1.6 Monitoring in Zone A was carried out at the Rathmines station with a maximum 8-hour mean value of 110 μg/m^3 recorded in 2007.

9.3.2 Recent Baseline Studies – Ambient Air Monitoring.

9.3.2.1 A recent study of existing ambient air quality has been carried out over a four year period by AWN Consulting Ltd as part of the air quality assessment process for the Dublin Waste to Energy facility proposed at Poolbeg. A fixed monitoring station was set up at the Irish Glassbottle site, approximately 12m from Sean Moore Road. A further six spatial monitoring locations also formed part of the study particularly with regard to NO_x monitoring.

9.3.2.2 The monitoring locations are shown on a figure taken from Chapter 8 of the Waste to Energy EIS and contained within Appendix 9.3. A summary of the results for each pollutant is extracted from the EPA oral hearing brief of evidence presented by AWN Consulting Ltd. for the waste license application and is presented below in italics. Further additional comments arising from a review of the data with regard to key air quality parameters NO_2/NO_x and PM_{10} is also presented below:

Nitrogen Dioxide and Nitrogen Oxides.

"Nitrogen Dioxide (NO_2) – on-site measurements averaged 25 mg/m^3 over the March 2007 to February 2008 survey period whilst diffusion tube measurements in the surrounding environment averaged between 15 – 23 mg/m^3 over the same period. These levels should be compared with the air quality annual limit value for nitrogen dioxide of 40 mg/m^3. Thus, ambient levels of this compound are currently between 38 - 63% of the ambient limit value. Since monitoring commenced in 2003, a clear downward trend in the data has been evident."

9.3.2.3 The raw data was reviewed as part of this EIS and it is noted that full continuous sets of data were achieved for some of the years between 2003 and 2007 with regard to monitoring of NO_2 and NO_X. The dataset is sufficiently comprehensive in our opinion. Only 2 of the hourly readings exceeded the 200 ug/m^3 limit value in the 4 years. The results correlate well with those recorded at Winetavern and Coleraine St.

9.3.2.4 The fixed station data with regard to assessing compliance with the NOx limit for vegetation is not suitable under the requirements of EU legislation. NOx was not monitored at other stations however based on the application of the NO_2/NO_X ratio (derived from the fixed location monitoring and presented in Chapter 8 and Appendix 8 of the WtE EIS) to NO_2 results for monitoring locations such as the Nature Reserve and Sean Moore Park it would appear that the annual limit value for total NOx for vegetation has been marginally exceeded at these locations, although they are not listed as protected sites. Further data was presented at the WtE waste license oral hearing in this regard where modelling was carried out where the concentration was averaged out over the whole Bay showing that there would not be an exceedance for the whole pNHA. The EPA Inspector's report noted that the South Dublin Bay SAC is an extensive sand and mudflat habitat and that the North Dublin Bay SAC includes the dune system of North Bull Island. The Inspector further noted that it "*it is appropriate that the grasses of the dune system are provided protection from nitrogen oxides. The current average annual NOx level measured at Bull Island is 20.6 µg/m^3.*"

Particulate Matter (as PM_{10}).

Particular Matter (as PM_{10}) – on-site measurements averaged 32 mg/m^3 over the 2007 survey period. This should be compared with the air quality annual limit value for PM10 of 40 mg/m^3. Since 2005, the data indicates that levels are gradually falling in the area and are currently around 30 mg/m^3 as an annual average.

9.3.2.5 The full raw data for the monitoring carried out at the fixed monitoring stations shows an exceedance of the limit value for the 24 hour average. Some 35 exceedances in a calendar year constitute an exceedance of the limit value for the 24 hour average. The dataset is non-continuous and therefore the results may be statistically skewed with more relatively high values. However the 24 hour limit value is still exceeded taking the 90.4 percentile dataset instead. In contrast, the 24 hour limit value has not been exceeded at Winetavern or Coleraine Street in recent years although individual daily exceedances can occur. Furthermore, the annual mean PM_{10} values recorded at these locations in 2007 were much lower than levels recorded at the Poolbeg site.

9.3.2.7 The EPA and DCC Air Quality Units are aware of the unusually high PM_{10} exceedances relative to other monitoring sites in Dublin. The DCC Air Quality Unit is responsible for the air quality monitoring network in Dublin. The EPA instructs DCC in the making of Air Quality Management Plans (AQMPs) if required. The matter of the high PM_{10} levels will be reviewed by DCC and the EPA in due course and further monitoring will be undertaken by the responsible bodies i.e. the EPA and DCC. If further investigation or monitoring continues to show high PM_{10} levels then an AQMP may be required for the area; - however this is a matter for the EPA to consider.The DDDA will liase with the EPA and DCC on this matter.

Sulphur Dioxide.

"Sulphur Dioxide (SO_2) - diffusion tube surveys in the surrounding environment averaged between 6 – 12 mg/m^3 based on 2006 data. This should be compared with a limit of 20 mg/m^3 for the protection of ecosystems. Thus, ambient levels of this compound are currently low."

Volatile Organic Compounds.

"Volatile Organic Compounds (VOC) – Benzene diffusion tube surveys in the surrounding environment in 2006 averaged 1.6 mg/m^3. This should be compared with a limit value of 5 mg/m^3 for the protection of human health.

HCl and HF.

HCl & HF – on-site measurements averaged 0.47 mg/m3 and 0.05 mg/m^3 over the 2007 survey period which is insignificant.

Dioxins and Furans.

Dioxins and Furans – on-site measurements averaged 20 - 21 fg/m^3 over the 2007 survey period. The range of values reflects two approaches in dealing with measurements below the limit of detection. The first approach considers non-detects to be zero whilst the second approach considers non-detects to be at the limit of detection. This range is similar to previously ambient measurements in Ireland and generally lower than urban areas of the UK and Europe.

Metals.

Metals – Average concentrations of antimony (Sb), arsenic (As), cadmium (Cd), cobalt (Co), chromium (Cr), copper (Cu), mercury (Hg), manganese (Mn), nickel (Ni), lead (Pb), thallium (Tl) and vanadium (V) measured were also significantly below their respective annual limit values."

9.3.2.8 It is worth pointing out that Part 3.10.2 of Condition 3.10 of the recent EPA license for the Waste to Energy Plant requires that the operators of the plant implement a fugitive dust management plan.

9.4 Relevant Characteristics of the Planning Scheme.

9.4.1 Construction Phase.

9.4.1.1 The stripping of topsoil and subsoil on the site and activities related to the construction phase, could lead to potential dust emissions across the site which could transfer to nearby sensitive receptors. Furthermore, the soils are contaminated on site (refer to Chapter 7.0 for further detail) and the construction phase could therefore give rise to emissions of volatile organic compounds (VOCs) e.g. where soil is contaminated with, for example, fuel oil.

9.4.1.2 Emissions of combustion gases will be limited to that arising from earth moving and construction equipment, and construction traffic at the site proper. Exhaust gases from such sources would not typically constitute a significant source of emissions and are expected to be dispersed rapidly by prevailing wind.

9.4.1.3 Both dust and mud generation and migration during excavation processes, general construction phases and during loading and unloading of materials will require careful attention and supervision throughout the excavation phase, particularly given the nature of the soils and subsoils present.

9.4.2 Operational Phase.

9.4.2.1 The Draft Planning Scheme will result in 26,100 people moving into the Poolbeg peninsula to live and work. High rise buildings have been proposed as part of the Draft Scheme. Accordingly, the likely impact on occupiers (at height and ground level) arising from point and diffuse (traffic) sources has been modelled and is discussed below.

9.4.2.2 With regard to existing receptors, the Draft Planning Scheme will result in additional traffic on the existing road network and potential traffic emissions. Chapter 16.0 Material Assets - Traffic, Transportation & Parking contains the details of the expected flows on the surrounding road network in 2020 when the Draft Planning Scheme is expected to be complete. The cumulative impact with existing and future point sources (modelled using CALPUFF) has been assessed by applying 2020 flows to 2012 (as part of the scheme may be built at this stage) and is further discussed below.

9.5 Likely Impact from the Planning Scheme.

9.5.1 Construction Phase.

9.5.1.1 The likely impact of the construction phase on existing receptors is expected to be minor given the proposed mitigation measures listed below.

9.5.2 Operational Phase.

9.5.2.1 Appendix 9.1 contains the report prepared by AWN Consulting Ltd. where modelling using CALPUFF software has been carried out to determine the maximum heights for buildings allowable within the Draft Planning Scheme in order to ensure that the most stringent ambient AQSs and guidelines are not exceeded for NO_2, NOx, SO_2, carbon monoxide (CO), PM_{10}, $PM_{2.5}$, total organic carbon (TOC), hydrogen chloride (HCl), hydrogen fluoride (HF), Dioxins and Furans (PCDD/PCDFs), poly aromatic hydrocarbons (PAHs), mercury (Hg), cadmium (Cd) and thallium (TI) and the sum of As arsenic (As), tin (Sb), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), nickel (Ni), manganese (Mn) and vanadium (V).

9.5.2.2 Appendix 9.2 contains the results of modelling of traffic emissions arising as a result of the proposed scheme. The traffic flows with and without the Draft Scheme in 2020 have been modelled for 2012. The cumulative impact taking account of background levels and emissions from point sources has been predicted. There are no anticipated exceedances of the AQSs at existing or future receptors.

'Do Nothing' Scenario

9.5.2.3 Although exceedances of AQSs are not predicted into the future with or without the Draft Planning Scheme in place, it should be noted that the proposed scheme provides a further imperative to ensure that the AQSs are not exceeded into the future. The 'Do Nothing' scenario may not provide the same impetus.

9.6 Mitigation.

9.6.1 Suitable mitigation measures which will be put in place during both the construction and operational phase are outlined below.

9.6.1.1 Construction Phase.

Construction Management Plans will be required. As a result the following will apply:

- The construction phase will be temporary and dust is expected to settle out before it reaches the nearest sensitive receptors. Wheel washing and road sweeping will be used on site where required to reduce the potential for wind blown dust generation. Care will be taken to ensure that access roads are maintained in a tidy and mud free condition. It is therefore not anticipated that the dust nuisance limit will be approached or exceeded as a result of the proposed development.
- Any topsoil and subsoil storage will be temporary and will be stored in low mounds where possible. The development area will be cleared on a site by site basis, thereby minimising the potential for dust generation.
- All landscaped areas will be grassed as soon as possible after the completion of the re-spreading of any topsoil, thereby further reducing dust emissions.
- Trucks carrying construction materials which could lead to dust emissions will be covered when accessing/ leaving the sites within the development boundary.
- Ready-mix cement will be delivered to the construction site. Accordingly, as cement is not expected to be stored on site, no dust emissions from cement use are envisaged.
- A dust minimisation plan will be formulated for the construction phase of each site within the overall development.
- Construction equipment in general will comply with relevant vehicle emission standards (Directive 96/1/EC which deals with measures to be taken against the emission of gaseous and particulate pollutants from diesel engines).
- As the soils are contaminated, there is a potential for the generation of volatile organic compounds (VOCs) during construction. Therefore, daily random sampling will be undertaken to determine VOC concentrations at boundary and stockpile locations throughout the piling phase of the operations using for example a hand-held photo-ionisation detector (PID). This instrument detects

volatile organic compounds and will give indicative quantitative values for VOCs. The PID will be used as a primary screening mechanism to determine the impact of the works relative to the Air Quality Standards (AQS) for benzene (Air Quality Standards Regulations, 2002 (SI 271 of 2002)) and is more relevant for the health and safety of workers in the area as opposed to existing sensitive receptors.

9.6.1.2 Operational Phase.

9.6.1.3 The proposed building heights within the Planning Scheme will not exceed the heights specified in Appendix 9.1 Figure 1.3 in order to ensure that future occupiers are not potentially exposed to levels of air pollutants exceeding the AQSs. The DDDA will liaise with the EPA and DCC on further PM_{10} investigations/monitoring in Poolbeg. The background corrections used in the assessment will be reviewed as monitoring results become available, however any future exceedances of the 24 hour limit value would be addressed in an AQMP for the area in any case.

9.6.1.4 The Draft Planning Scheme will provide an imperative for improving air quality in the area as more people move into the area.

9.6.1.5 Existing activities such as cement plants may move elsewhere in time; - thus potentially removing an existing source of nuisance dust and also $PM_{10.}$

9.6.1.6 The Draft Planning Scheme will be served by public transport in order to reduce reliance on cars and hence reduce associated emissions to air.

9.6.1.7 Occupiers of the scheme are unlikely to be affected by the management of fly or bottom ash associated with the Waste to Energy Plant. It is understood from Chapter 10 of the Waste to Energy Plant EIS and subsequent oral hearing documentation that the Fly Ash will be kept in enclosed containers and will cause no fugitive dust emissions. The Bottom Ash will be brought from the Waste to Energy facility to an area directly east of the proposed Pigeon House Dock in Open Trucks with Tarpaulin Covering. The trucks will then be emptied using either a crane grab or potentially a covered conveyor belt. However, it is understood that bottom ash is similar in appearance to lumps of coal or stone aggregates of a similar size and it will be maintained in a wet state at all times. Accordingly, it is unlikely that the loading and transport of this will cause any excessive or invasive dust emissions.

9.6.1.8 Condition 3.10 of the waste license granted for the Waste to Energy Plant requires the license to install and provide adequate measures for dust control including fugitive dust emissions. This will ensure that the potential effect of nuisance from the Waste to Energy Plant is minimised.

9.7 References.

Report on Oral Hearing on objections to the proposed determination issued on the waste license application from Dublin City Council for Dublin Waste to Energy Project, Pigeon House Road, Poolbeg Peninsula, Dublin 4, Register of license No. W0232-01, Ms. Marie O' Connor, September 2008.

Air Quality in Ireland 2007, Key Indicators of Ambient Air Quality, EPA, 2008.

Dublin Waste to Energy Project, Dr Brian Broderick, Trinity College Dublin for An Bord Pleanala, Oct 2007.

Dublin Waste to Energy Project, Ringsend, Dublin, Environmental Impact Statement, Chapters 87 10, Appendix8,Elsam, June 2006.

Air Pollution – Nature and Origin of PM_{10} and smaller particulate matter in urban air (2000-LS-6.1-M1) Final Report prepared for the Environmental Protection Agency, by Atmospheric Research Group, Department of Experimental Physics, National University of Ireland, Galway, 2006.

WHO Air Quality Guidelines, Global Update, 2005.

WHO Air Quality Guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide, Global update 2005, Summary of Risk Assessment.

EPA Oral Hearing into Dublin Waste to Energy Facility, Brief of Evidence, Air Quality, Dr. Edward Porter, April 2008

Inspectors Report on a License Application, Office of Climate Change, Licensing & Resource Use, EPA, June 2007

DDDA Poolbeg Planning Scheme, Air Quality Critique, J McCarthy & V Jennings, August 2008.

Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe.

AEA Appraisal for the Air Quality chapter of the EIS of the "Dublin Waste to Energy" Project, June 2008.

Mixed Use Office and Residential and Supporting Retail Facilities Development at South Bank Road, Ringsend, Dublin 24 for Fabrizia Developments, Environmental Impact Statement, Reid Associates, 2004.

Dublin Bay Power Plant, IPCL No. P0486/01, EPA Annual Environmental Report, 2006.

Poolbeg Generating Station, Annual Environmental Report, December 2006.

Dublin Bay Power Plant, EPA Quarterly Emissions Report, Reporting Periods July to September 2006, October to December 2006, January to March 2007, April to June 2007.

ESB Poolbeg Generating Station, Pigeon House Road, Dublin 4, Emissions to Atmosphere Report No.: PO577-02CAR07-01, IPPC No. PO577-02, Euro Environmental Services, February 2007.

9.8 Appendices.

Appendix 9.1 – CALPUFF Modelling of Tall Buildings, AWN Consulting.

Appendix 9.2 – Dispersion Modelling of Road Traffic Emissions in Poolbeg, AWN Consulting.

Appendix 9.3 – Figure 8.1 taken from the Waste to Energy EIS, 2006 depicting approximate locations of air monitoring stations.

Appendix 9.1

CALPUFF Modelling of Tall Buildings, AWN Consulting.

awnconsulting

The Tecpro Building,
Clonshaugh Business & Technology Park,
Dublin 17, Ireland.

T: + 353 1 847 4220
F: + 353 1 847 4257
E: info@awnconsulting.com
W: www.awnconsulting.com

CALPUFF MODELLING OF TALL BUILDINGS IN THE POOLBEG PENINSULA

Technical Report Prepared For

Malone O'Regan
2B Richview Office Park,
Clonskeagh,
Dublin 14

Technical Report Prepared By

Dr. Edward Porter C Chem MRSC

Our Reference

EP/08/4368AR01_1

Date Of Issue

5 December 2008

Cork Office
Unit 5, ATS Building,
Carrigaline Industrial Estate,
Carrigaline, Co. Cork.
T: +353 21 438 7400
F: +353 21 483 4606

AWN Consulting Limited
Registered in Ireland No. 319812
Directors: F Callaghan, C Dilworth,
T Donnelly, E Porter
Associate Director: D Kelly

CALPUFF AIR QUALITY ASSESSMENT

1.0 INTRODUCTION

Dublin Docklands Development Authority has commissioned an extensive and detailed examination of air emissions from the proposed Dublin Waste to Energy facility and existing Power Plants in Dublin 4 using the advanced USEPA approved air dispersion model, CALPUFF. The air model which has already been prepared for the Waste to Energy facility, was used in order to determine the maximum allowable heights of the buildings proposed as part of the Poolbeg Planning Scheme, without causing adverse impacts on human health arising from the emissions from the Dublin WTE facility and the three existing Power Plants (Synergen, Poolbeg and North Wall Power Plants).

The combustion of waste produces a number of emissions, the discharges of which are regulated by the EU Directive on Waste Incineration (2000/76/EC). The emissions to atmosphere which have been regulated are:

- Nitrogen Dioxide (NO_2)
- Sulphur Dioxide (SO_2)
- Total Dust (as PM_{10} and $PM_{2.5}$)
- Carbon Monoxide (CO)
- Total Organic Carbon (TOC)
- Hydrogen Fluoride (HF) and Hydrogen Chloride (HCl)
- Dioxins/Furans (PCDD/PCDFs)
- Cadmium (Cd) & Thallium (Tl)
- Mercury (Hg)
- and the sum of Antimony (Sb), Arsenic (As), Lead (Pb), Chromium (Cr), Cobalt (Co), Copper (Cu), Manganese (Mn), Nickel (Ni) and Vanadium (V).

In addition, Polycyclic Aromatic Hydrocarbons (PAHs) have been assessed as incineration is a potential emission source for this group of compounds.

The scope of the study consists of the following components:

- Review of maximum emission levels from the existing and proposed facilities and other relevant information needed for the modelling study;
- Identification of the significant substances which are released from the Dublin WTE facility and the existing Power Plants;
- Review of baseline ambient air quality in the vicinity of the proposed tall buildings;
- Air dispersion modelling of significant substances released from the Dublin WTE facility and the existing Power Plants using CALPUFF;
- Identification of predicted ambient concentrations of released substances at sensitive receptors in the immediate environment;
- Recommendations on building heights to ensure that the most stringent air quality standards and guidelines are not exceeded.

1.1 EXISTING AIR QUALITY

1.1.1 Baseline Air Quality

Information on the existing (baseline) air quality in the Poolbeg / Ringsend area was obtained from monitoring surveys in the region:

- A detailed baseline survey of air quality was undertaken in the Poolbeg area over a four year period (see Figure 8. 1 of the Dublin WTE EIS)(1).

- Monitoring was undertaken for those substances which have air emission limits under the EU Directive 2000/76/EC.

- Data available from the Dublin City Council and the EPA was also evaluated in deriving appropriate baseline ambient air concentrations.

Results for each of the pollutants is detailed below:

- Nitrogen Dioxide (NO_2) – measurements at the former Irish Glass Bottling plant averaged 25 $\mu g/m^3$ over the March 2007 to February 2008 survey period whilst diffusion tube measurements in the surrounding environment averaged between 15 – 23 $\mu g/m^3$ over the same period. These levels should be compared with the air quality annual limit value for nitrogen dioxide of 40 $\mu g/m^3$. Thus, ambient levels of this compound are currently between 38 - 63% of the ambient limit value. Since monitoring commenced in 2003, a clear downward trend in the data has been evident.

- Sulphur Dioxide (SO_2) - diffusion tube surveys in the surrounding environment averaged between 6 – 12 $\mu g/m^3$ based on 2006 data. This should be compared with a 1-hr and 24-hr limit of 350 and 125 $\mu g/m^3$ respectively for the protection of human health. Thus, ambient levels of this compound are currently low.

- Particular Matter (as PM_{10}) – measurements at the former Irish Glass Bottling plant averaged 32 $\mu g/m^3$ over the 2007 survey period. This should be compared with the air quality annual limit value for PM_{10} of 40 $\mu g/m^3$. Since 2005, the data indicates that levels are gradually falling in the area and are currently around 30 $\mu g/m^3$ as an annual average. The 24-hour limit value of 50 $\mu g/m^3$ (as a 90^{th}%ile) was slightly exceeded in 2007 with a value of 53 $\mu g/m^3$ (as a 90^{th}%ile).

- Volatile Organic Compounds (VOC) – Benzene diffusion tube surveys in the surrounding environment in 2006 averaged 1.6 $\mu g/m^3$. This should be compared with a limit value of 5 $\mu g/m^3$ for the protection of human health.

- HCl & HF – measurements averaged 0.47 $\mu g/m^3$ and 0.05 $\mu g/m^3$ over the 2007 survey period which is insignificant.

- Dioxins and Furans – measurements at the former Irish Glass Bottling plant averaged 20 - 21 fg/m^3 over the 2007 survey period. The range of values reflects two approaches in dealing with measurements below the limit of detection. The first approach considers non-detects to be zero whilst the second approach considers non-detects to be at the limit of detection. This range is similar to previously ambient measurements in Ireland and generally lower than urban areas of the UK and Europe.

- Metals – Average concentrations of antimony (Sb), arsenic (As), cadmium (Cd), cobalt (Co), chromium (Cr), copper (Cu), mercury (Hg), manganese (Mn), nickel (Ni), lead

(Pb), thallium (Tl) and vanadium (V) measured were also significantly below their respective annual limit values.

1.2 AIR QUALITY MODELLING

1.2.1 Assessment Approach

Emissions from the proposed Dublin WTE facility have been assessed based on maximum operating conditions. Maximum operations are based on the facility operating at 600,000 tonnes per annum and with emission levels at the limits defined in EU Directive 2000/76/EC. The Dublin Waste To Energy facility has two main process emission points (stacks). The operating details of these major emission points are outlined in Table 1.1 whilst Table 1.2 and Table 1.3 outlines the specific pollutant concentration and emission rate under maximum operation of the Dublin WTE facility. Full details of emission concentrations and mass emissions are given in Annex 8.7 of Appendix 8 of the Dublin WTE EIS(1).

Stack Reference	Stack Height (m)	Exit Diameter (m)	Cross-Sectional Area (m^2)	Temp (K)	Volume Flow (Nm^3/hr)(1)	Exit Velocity (m/sec actual)(2)
Stack 1	100	2.40	4.52	328	275,000 – Maximum	20.3
Stack 2	100	2.40	4.52	328	275,000 – Maximum	20.3

(1) Normalised to 11% O_2, dry, 273K.
(2) Actual - 11%O_2, dry, 373K

Table 1.1 Process Emission Design Details

In order to assess the possible impact from the proposed facility under maximum operations, a conservative approach was adopted that is designed to over-predict ambient concentrations. This cautious approach will ensure that an over-estimation of impacts will occur and that the resultant emission standards adopted are protective of ambient air quality. The approach incorporated several conservative assumptions regarding operating conditions at the proposed facility. This approach incorporated the following features:

- Emissions from all emission points in the assessment (including the cumulative assessment) were assumed to be operating at their maximum emission level, 24 hours/day over the course of a full year. This represents a very conservative approach as typical emission from the proposed facility will be well within the emission limit values set out in the Waste Incineration Directive.

- Worst-case background concentrations were used to assess the baseline levels of substances released from the site.

- Worst-case meteorological conditions over the period 1993 - 2005 have been used in all assessment. Both meteorological data collected on-site in 2004 and 2005 and Met Eireann data from Dublin Airport over the period 1993 - 2005 has been assessed. On-site data from 2004 and 2005 was modelled and compared to modelled results using Dublin Airport data. The worst-case year with regard to the annual average concentrations was selected for modelling (On-site data 2004). Annual average concentrations using on-site year 2004 meteorological data are 18% higher than the average of the fifteen meteorological year files.

As a result of these conservative assumptions, there will be an over-estimation of the emissions from the proposed Dublin WTE facility and existing Power Plants and an over-estimation of the impact of the facilities on human health and the environment.

Modelling Study Methodology

The air dispersion modelling input data consists of detailed information on the physical environment (including building dimensions and terrain features), design details from all emission points for each facility and a full year of worst-case meteorological data. Using this input data, the model predicts ambient concentrations beyond the site boundaries for each hour of the modelled meteorological year. The model post-processes the data to identify the location and maximum value of the worst-case ambient concentration in the applicable format for comparison with the relevant limit values. This worst-case concentration is then added to the existing background concentration to give the worst-case predicted ambient concentration. The worst-case ambient concentration is then compared with the relevant ambient air quality standard for the protection of human health to assess the significance of the releases from the site.

In the absence of detailed guidance from the EPA, the selection of appropriate modelling methodology for the proposed Dublin WTE facility and the existing Power Plants has followed the guidance from the USEPA which has issued detailed and comprehensive guidance on the selection and use of air quality models(2-5). Based on guidance from the USEPA, the most appropriate regulatory model for the current application is the AERMOD model (Version 07026). The model is applicable in both simple and complex terrain, urban or rural locations and for all averaging periods(2,3). The terrain in the region of the proposed and existing facilities was obtained from Ordnance Survey Ireland and imported into the model using the AERMOD terrain pre-processor AERMAP (see Figure 8.3 of the Dublin WTE EIS)(1). An overview of the model is outlined in Appendix 8.1 of the Dublin WTE EIS(1).

CALPUFF modelling system has been recommended by the USEPA as a Guideline Model for source-receptor distances of greater than 50km and for use on a case-by-case basis in complex flow situations within 50km(2). CALPUFF has some important advantages over steady-state Gaussian models such as AERMOD in areas of complex meteorology. Firstly, AERMOD, being a steady state straight line plume model cannot respond to the terrain-induced spatial variability in wind fields. Secondly, as AERMOD is based on a single-station wind observation, the wind fields do not vary spatially within the modelling domain. Thirdly, AERMOD cannot treat calm conditions and does not calculate concentrations during these hours. Because of these limitations, CALPUFF would be expected to more accurately reflect the meteorological and dispersion characteristics of the modelling domain and thus lead to more accurate ambient air concentrations. As shoreline fumigation was also raised as a possible concern and AERMOD does not have the capability to model this phenomenon, CALPUFF was selected as the most appropriate model which could assess all possible meteorological conditions within the one air dispersion model.

1.2.2 MM5 / CALMET Set-Up

Meteorological data is an important input into the air dispersion model. The local airflow pattern will be greatly influenced by the geographical location. Important features will be the location of hills and valleys or land-water-air interfaces and whether the existing and proposed facilities are located in simple or complex terrain.

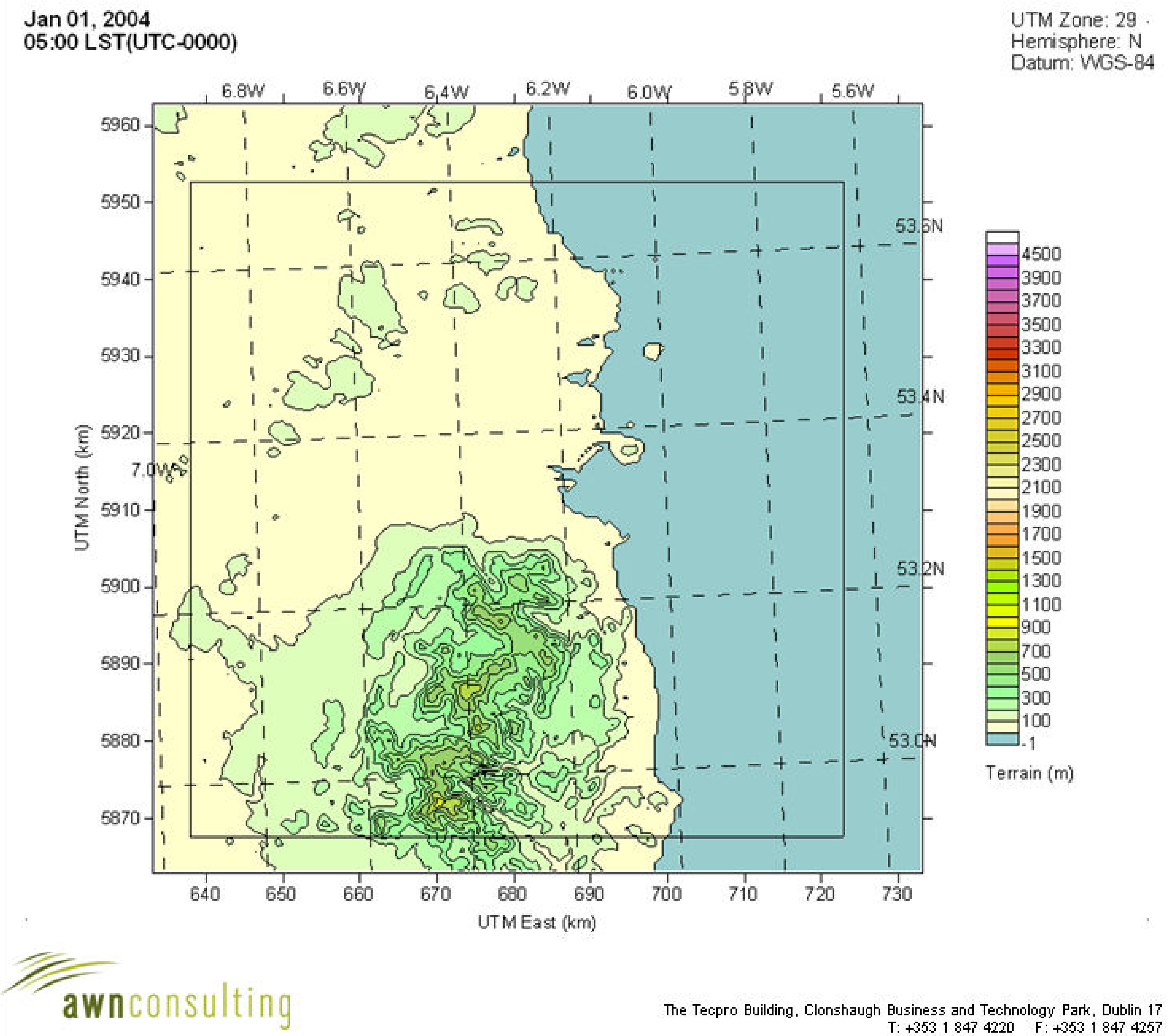
Meteorological data for the assessment was based on various sources of information. Firstly, Fifth Generation Penn State/NCAR (National Centre for Atmospheric Research) Mesoscale Model (known as MM5) was used for the year 2004. The model output consists of hourly values of wind speed, wind direction, temperature and pressure on a grid size of 100 km x 100 km centred at 53.33N, 6.25W (Dublin City Centre). The data had 18 vertical levels with a base level of 15m and a horizontal resolution of 4 km.

CALMET meteorological pre-processor used the three-dimensional MM5 data along with all available surface observations within the 100km x 100km grid. As no upper air observations station were located within or near to the modelling domain, upper air data was obtained from MM5 and extrapolation of surface observations. Two synoptic meteorological stations operated by Met Eireann were identified near the site – Casement Aerodrome and Dublin Airport. Data collection of greater than 90% for all parameters is required for air dispersion modelling. Both Casement Aerodrome and Dublin Airport fulfil this requirement. A third surface station operated by Dublin City Council / RPS as part of the Dublin WTE Dublin WTE facility was available for the year 2004 and thus was also used in the assessment. Buoy data for the station M2 for 2004 was obtained from the Marine Institute. Table 1.4 shows the station locations in Universal Transverse Mercator (UTM) coordinates.

The CALMET modelling domain covered an area of 100km x 100km centred at 53.33N, 6.25W. The CALMET wind field data had 11 vertical levels with a base level of 10m and a horizontal resolution of 0.5 km. The eleven vertical levels are at 20, 40, 80, 160, 320, 650, 1000, 1500, 2200, 3000 and 4000 metres.

The horizontal resolution of 500 metres was used to resolve the terrain variations in the region. Terrain data was obtained from the Shuttle Radar Topography Mission (SRTM) which is a digital elevation data set that spans the globe from 60° north latitude to 56° south latitude. It has a horizontal grid spacing of 3 arc-seconds (approximately 90m) and is shown in Figure 1.1 for the CALMET modelling domain.

Land use data from the U.S. Geological Survey (USGS) and the European Commission's Joint Research Centre (JRC) based on a 1-km resolution Global Land Cover Characteristics (GLCC) database was processed to generate a gridded field of dominant land use categories and land-use weighted values of surface and vegetation properties for each grid cell. The predominant land use in the CALMET domain is shown in Figure 1.2.



The Tecpro Building, Clonshaugh Business and Technology Park, Dublin 17
T: +353 1 847 4220 F: +353 1 847 4257

Project

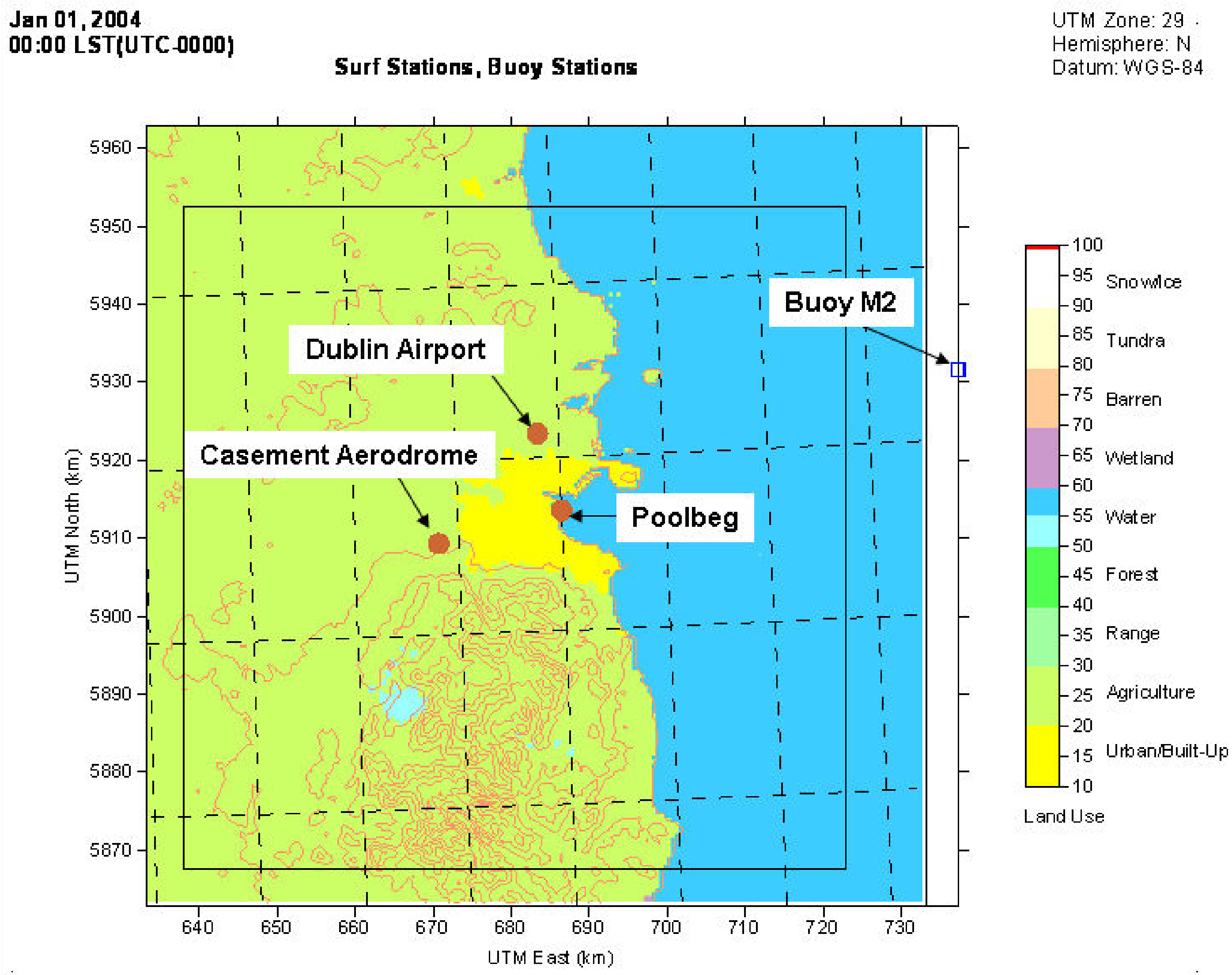
Poolbeg Project

Reference

08/4368AR01

Figure 1.1

SRTM90 Terrain Data



awnconsulting

The Tecpro Building, Clonshaugh Business and Technology Park, Dublin 17
T: +353 1 847 4220 F: +353 1 847 4257

Project	Poolbeg Project
Reference	08/4368AR01
Figure 1.2	GLCC Land Use Within CALMET Modelling Domain

Gridded MM5 meteorological fields, which was purchased from Lakes Environmental (Waterloo, Canada), was used to define the initial guess fields for the CALMET simulations. The MM5 simulations were made for the period January to December 2004, the same period selected for the CALMET/CALPUFF runs. The MM5 data were produced at a horizontal resolution of 4 km and at 18 vertical sigma levels.

Two stages are involved in developing the CALMET wind field. The first step, the Step 1 wind field, CALMET adjusts the initial guess field to reflect slope flows and blocking effects. Slope flows are a function of the local slope and altitude of the nearest crest. The crest is defined as the highest peak within a radius TERRAD around each grid point. A value of TERRAD of 15 km was considered most appropriate for the computational domain. The Step 1 field produces a flow field consistent with the fine-scale CALMET terrain resolution (0.5km).

In the second step, the Step 2 wind field, observations are incorporated into the Step 1 wind field to produce a final wind field. The philosophy behind the Step 2 wind field is to ensure that observational data strongly influences the final wind field in the region of the observational stations whilst the MM5 data is strongly weighted in the region were no observational data is available. Parameters R1 at the surface and R2 aloft determine the weighting of the Step 1 (MM5 data) and observational data. In the current application, relatively small values (5 km) for R1 and R2 were selected because the three meteorological stations in the vicinity of the proposed Dublin WTE facility and existing Power Plant facilities are located quite close to each other (at a distance of less than 20 km), and each of these stations should have an important weighting in the vicinity of each station.

A second set of parameters defines the area of influence of each station (parameters RMAX1 at the surface and RMAX2 aloft). Since the initial guess field is driven by the MM5 winds and terrain effects are expected to be important, RMAX1 and RMAX2 were set to 10 km in order to give greater weight to the surface station and RMIN=0.1 km. As the buoy (M2) is located at a distance 50km off-shore, RMAX3 which defines the radius of influence of the buoy was set to 100km.

1.2.3 Receptor Network

The receptor grid contained discrete receptors representative of the proposed tall buildings in Poolbeg. The discrete receptor points were derived from Ordnance Survey Ireland digital terrain files with flagpole receptors representative of both the initial proposed building height and intermediate heights for the proposed buildings. The final building heights were derived from iterative air dispersion modelling in order to obtain building heights which would not lead to or approach an ambient air quality standard.

1.2.4 Baseline Concentrations

The ambient concentrations detailed in the following sections include both the emissions from the proposed Dublin WTE facility and the ambient baseline concentration for that substance. Baseline concentrations have been derived from a worst-case analysis, of the cumulative sources in the region in the absence of the Dublin WTE facility. A detailed baseline air quality assessment (Section 1.1) was carried out to assess baseline levels of those pollutants, which have potential to be significant emissions from the Dublin WTE facility and other point sources in the area.

Appropriate baseline values have been outlined in Table 1.5. In arriving at the combined annual baseline concentration; cognisance has been taken of the accuracy of the approach and the degree of double counting inherent in the assessment. In relation to NO_2, PM_{10}, $PM_{2.5}$ and benzene the baseline monitoring program will have taken into account both the existing traffic levels and existing domestic / industrial sources. The values have been rounded accordingly based on this conservative approach. A similar approach has been adopted for the other pollutants.

In order to obtain the predicted environmental concentration (PEC), baseline data was added to the process emissions. In relation to the annual averages, the ambient baseline concentration was added directly to the process concentration. However, in relation to the short-term peak concentrations, concentrations due to emissions from elevated sources cannot be combined in the same way. Guidance from the UK Environment DEFRA[6] advises that an estimate of the maximum combined pollutant concentration can be obtained by adding the maximum short-term (1-hr) concentration due to emissions from the source to twice the annual mean baseline concentration. In relation to PM_{10}, the guidance indicates that for the 90^{th}%ile of 24-hr means, an estimate of the maximum combined pollutant concentration can be obtained by adding the maximum 24-hr concentration due to emissions from the source directly to the annual mean baseline concentration.

1.2.5 Ambient Air Quality Standards

The relevant ambient air quality standards are outlined in Table 1.6. Ambient air quality legislation designed to protect human health is generally based on assessing ambient air quality at locations where the exposure of the population is significant, relevant to the averaging time of the pollutant.

Daily Average Values	**Concentration**	
Total Dust	10 mg/m^3	
Gaseous & vaporous organic substances expressed as total organic carbon (TOC)	10 mg/m^3	
Hydrogen Chloride (HCl)	10 mg/m^3	
Hydrogen Fluoride (HF)	1 mg/m^3	
Sulphur Dioxide (SO_2)	50 mg/m^3	
Nitrogen Oxides (as NO_2)(1)	200 mg/m^3	
Half-hourly Average Values	**Concentration**	
	(100%)	**(97%)**
Total Dust(2)	30 mg/m^3	10 mg/m^3
Gaseous & vaporous organic substances expressed as total organic carbon (TOC)	20 mg/m^3	10 mg/m^3
Hydrogen Chloride (HCl)	60 mg/m^3	10 mg/m^3
Hydrogen Fluoride (HF)	4 mg/m^3	2 mg/m^3
Sulphur Dioxide (SO_2)	200 mg/m^3	50 mg/m^3
Nitrogen Oxides (as NO_2)	400 mg/m^3(1)	200 mg/m^3
Average Value Over 30 mins to 8 Hours	**Concentration**(3)	
Cadmium and its compounds, expressed as Cd	Total 0.05 mg/m^3	
Thallium and its compounds, expressed as Tl		
Mercury and its compounds, expressed as Hg	0.05 mg/m^3	
Antimony and its compounds, expressed as Sb	Total 0.5 mg/m^3	
Arsenic and its compounds, expressed as As		
Lead and its compounds, expressed as Pb		
Chromium and its compounds, expressed as Cr		
Cobalt and its compounds, expressed as Co		
Copper and its compounds, expressed as Cu		
Manganese and its compounds, expressed as Mn		
Nickel and its compounds, expressed as Ni		
Vanadium and its compounds, expressed as V		
Average Values Over 6 – 8 Hours	**Concentration**	
Dioxins and furans	0.1 ng/m^3	
Average Value	**Concentration**(4)	
	Daily Average Value	**30 Min Average Value**
Carbon Monoxide	50 mg/m^3	100 mg/m^3

(1) Until 1/1/2007 the emission limit value for NO_x does not apply to plants only incinerating hazardous waste
(2) Total dust emission may not exceed 150 mg/m^3 as a half-hourly average under any circumstances
(3) These values cover also the gaseous and vapour forms of the relevant heavy metals as well as their compounds
(4) Exemptions may be authorised for incineration plants using fluidised bed technology, provided that emission limit values do not exceed 100 mg/m^3 as an hourly average value.

Table 1.2: Council Directive 2000/76/EC, Annex V Air Emission Limit Values

Table 1.3 Air Emission Values From Proposed Dublin Waste-to-Energy Facility, Poolbeg, Dublin 4

Daily Average Values	**EU Maximum Emission Concentration**	**Annual Average Daily Emission Concentration**	**Maximum Operating Values Combined (both stacks) Emission Rate (g/s)**	**Average Operating Values Combined (both stacks) Emission Rate (g/s)**
Total Dust	10 mg/m^3	5 mg/m^3	1.53	0.66
Gaseous & vaporous organic substances expressed as total organic carbon (TOC)	10 mg/m^3	5 mg/m^3	1.53	0.66
Hydrogen Chloride (HCl)	10 mg/m^3	8 mg/m^3	1.53	1.1
Hydrogen Fluoride (HF)	1 mg/m^3	0.8 mg/m^3	0.15	0.11
Sulphur Dioxide (SO_2)	50 mg/m^3	40 mg/m^3	7.6	5.3
Nitrogen Oxides (as NO_2)	200 mg/m^3	180 mg/m^3	30.6	23.9
Hourly Average Value	**Emission Concentration**	**Emission Concentration**	**Combined Emission Rate (g/s)**	**Combined Emission Rate (g/s)**
Cadmium and its compounds, expressed as Cd	Total 0.05 mg/m^3	Total 0.05 mg/m^3	0.0076	0.0066
Thallium and its compounds, expressed as Tl				
Mercury and its compounds, expressed as Hg	0.05 mg/m^3	0.02 mg/m^3	0.0076	0.0027
Antimony and its compounds, expressed as Sb	Total 0.5 mg/m^3	Total 0.40 mg/m^3	0.076	0.043
Arsenic and its compounds, expressed as As				
Lead and its compounds, expressed as Pb				
Chromium and its compounds, expressed as Cr				
Cobalt and its compounds, expressed as Co				
Copper and its compounds, expressed as Cu				
Manganese and its compounds, expressed as Mn				
Nickel and its compounds, expressed as Ni				
Vanadium and its compounds, expressed as V				
Average Values Over 6 – 8 Hours	**Emission Concentration**	**Emission Concentration**	**Combined Emission Rate (g/s)**	**Combined Emission Rate (g/s)**
Dioxins and furans	0.1 ng/m^3	0.05 ng/m^3	15.3×10^{-9}	10.6×10^{-9}
Average Value	**Emission Concentration**	**Emission Concentration**	**Combined Emission Rate (g/s)**	**Combined Emission Rate (g/s)**
Carbon Monoxide	150 mg/m^3	30 mg/m^3	22.9	4.0

Table 1.4 Meteorological Data Used In CALMET.

Station Name	Station Number	UTM Northing	UTM Eastling
Dublin Airport	39690	5923.405	683.313
Casement Aerodrome	39670	5909.321	670.645
Poolbeg	99999	5913.563	686.397
M2 Buoy	62091	5928.418	338.750

Table 1.5 Estimated annual background concentrations In The Poolbeg Region ($\mu g/m^3$).

	NO_2	SO_2	PM_{10}	$PM_{2.5}$	CO	TOC(2)	HCl	HF	Dioxins(1)	Cd	Hg	As	Sb	Ni
Baseline Monitoring Program - Year 2007	25	5	30	11	-	1.6	1.0	0.02	0.020 pg/m^3 0.021 pg/m^3	0.001	0.001	0.001	0.003	0.003
Baseline Monitoring Program - Year 2012(3)	22.2	5	27.8	9.9	-	1.4	1.0	0.02	0.020 pg/m^3 0.021 pg/m^3	0.001	0.001	0.001	0.003	0.003
Cumulative Assessment	0.4	9	0.3	0.3	-	-	-	-	-	-	-	-	-	-
Annual Background Concentration - Year 2012	22.6	5	28.1	10	500	1.4	1.0	0.02	0.020 pg/m^3 0.021 pg/m^3	0.001	0.001	0.001	0.003	0.003
Development Traffic - Year 2012	2.2	-	2.3	2.3	130	0.1	-	-	-	-	-	-	-	-
Annual Background, Cumulative Impact & Site Traffic Concentration (Year 2012)	**24.8**	**14**	**30.4**	**12.3**	**630**	**1.5**	**1.0**	**0.02**	**0.020 pg/m^3** **0.021 pg/m^3**	**0.001**	**0.001**	**0.001**	**0.003**	**0.003**

(1) Dioxins reported as firstly non-detects as zero and secondly as non-detects equal to the limit of detection.
(2) Assumed to consist solely of benzene as a worst-case.
(3) Reduction in future years using the Netcen background calculator (January 2006).

Emission	Limit/Guideline	Council Directive 2008/50/EC ($\mu g/m^3$)	SI No. 271 of 2002 ($\mu g/m^3$)	UK EAL ($\mu g/m^3$)	WHO 2000 & 1999 ($\mu g/m^3$)	Council Directive 2004/107/ EC ($\mu g/m^3$)
NO_2	99.8^{th} percentile of 1-Hourly Averages	200	200			
NO_2	Annual Average	40	40			
NO_x	Annual Average(1)	30	30			
SO_2	99.7^{th} percentile of 1-Hourly Averages	350	350			
SO_2	99.2^{th} percentile of 24-Hourly Averages	125	125			
SO_2	Annual Average(2)	20	20			
PM_{10}	90^{th} percentile of 24-Hourly Averages	50	50			
PM_{10}	Annual Average	40	40			
$PM_{2.5}$	Annual Average	25				
TOC	Running Annual Average	5.0(3)	5.0(3)			
HCl	98^{th} percentile of 1-Hourly Averages			100(4)		
HF	98^{th} percentile of 1-Hourly Averages			3.0(5)		
HF	Annual Average				0.30	
PCDD / PCDF (5)	Annual Average					
Benzo[a]pyrene	Annual Average					0.001
Hg	Annual Average				1.0	
Cd & Tl	Annual Average (Cd)					0.005
Sum of 9 Heavy Metals	Annual Average (Pb)	0.50	0.50			
	Hourly Average (Sb)			150		
	Annual Average (As)					0.006
	Hourly Average (As)			15		
	Hourly Average (Cr)			3.0		
	Hourly Average (Co)			6.0		
	Hourly Average (Cu)			60		
	Annual Average (Mn)				1.0	
	Annual Average (Ni)					0.020
	Hourly Average (Ni)			30		
	Daily Average (V)				1.0	

(1) Limit value for the protection of vegetation.
(2) Limit value is for the protection of ecosystems.
(3) Limit value is for Benzene as a worst-case.
(4) German VDI (2002), "Technical Instructions on Air Quality Control".
(5) There are no air quality standard limit values for dioxins and furans. The WHO currently proposes a maximum TDI of between 1-4 pgTEQ/kg of body weight per day. A TDI of 4 pgTEQ/kg of body weight per day should be considered a maximal tolerable intake on a provisional basis and that the ultimate goal is to reduce human intake levels of below 1 pgTEQ/kg of body weight per day.

Table 1.6 Ambient Air Quality Standards

1.2.6 Air Dispersion Modelling Results

The results from the detailed air dispersion modelling of the Dublin WTE facility are summarised below, in Table 1.7 based on the optimised building heights outlined in Figure 1.3 for the surrounding area. These building heights were derived from iterative air dispersion modelling in order to obtain building heights which would not lead to or approach an ambient air quality standard. The modelling, undertaken using the USEPA regulatory model CALPUFF, are outlined as a graphical summary in Figure 1.4.

NO_2 & NO_X

NO_2 modelling results indicate that the ambient concentrations in the vicinity of the Poolbeg tall buildings will be below the relevant air quality standards for the protection of human health for nitrogen dioxide under maximum operation of the Dublin WTE facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at these locations. Emissions at maximum operations lead to ambient NO_2 concentrations (including baseline concentrations) which are 83% of the maximum ambient 1-hour limit value (measured as a 99.8th%ile) and 85% of the annual average limit value at the respective worst-case receptors.

SO_2, CO, PM_{10} & $PM_{2.5}$

Modelling results indicate that ambient concentrations are below the relevant air quality standards for the protection of human health for sulphur dioxide, carbon monoxide and PM_{10} under maximum operation of the Dublin WTE facility. Results are also below the proposed air quality standard for $PM_{2.5}$ under maximum operation of the Dublin WTE facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions in the vicinity of the Poolbeg tall buildings. Emissions at maximum operations equate to ambient concentrations (including baseline concentrations) ranging from 7% - 78% of the respective limit values at the worst-case receptors.

TOC, HCl & HF

Modelling results indicate that the ambient concentrations will be below the relevant air quality guidelines for the protection of human health for TOC (assumed pessimistically to consist solely of benzene), HCl and HF under maximum operation of the site. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions in the vicinity of the Poolbeg tall buildings. Emissions at maximum operations equate to ambient concentrations (including baseline concentrations) for HCl and TOC of only 33% and 42% respectively of the ambient limit values.

HF modelling results indicate that emissions at maximum operations equate to ambient HF concentrations (including baseline concentrations) which are 73% of the maximum ambient 1-hour limit value (measured as a 98th%ile) and 27% of the annual limit value.

PCDD / PCDFs (Dioxins/Furans)

Currently, no internationally recognised ambient air quality concentration or deposition standards exist for PCDD/PCDFs (Dioxins/Furans). Both the USEPA and WHO recommended approach to assessing the risk to human health from Dioxins/Furans entails a detailed risk assessment analysis involving the determination of the impact of Dioxins/Furans in terms of the TDI (Tolerable Daily Intake) approach. The WHO currently proposes a maximum TDI of between 1-4 pgTEQ/kg of body weight per day.

Baseline levels of Dioxins/Furans occur everywhere and existing levels in the Dublin WTE facility area have been extensively monitored as part of this study. Monitoring results indicate that the existing levels are similar to rural areas in the UK and Ireland. The contribution from the Dublin WTE facility in this context is minor, with levels at the worst-case receptor, under maximum operation, accounting for a small portion of existing levels. Levels in the vicinity of the Poolbeg tall buildings will be minor, with the annual contribution from the proposed Dublin WTE facility accounting for less than 30% of the existing baseline concentration under maximum operating conditions.

PAHs

PAHs modelling results indicate that the ambient concentrations will be below the relevant air quality target value for the protection of human health under maximum operation of the Dublin WTE facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions in the vicinity of the Poolbeg tall buildings. Emissions at maximum operations equate to ambient benzo[*a*]pyrene concentrations (including baseline concentrations) which are only 24% of the EU annual average target value at the worst-case receptor.

Hg

Hg modelling results indicate that the ambient concentrations will be below the relevant air quality standards for the protection of human health under maximum operation of the Dublin WTE facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions in the vicinity of the Poolbeg tall buildings. Emissions at maximum operations equate to ambient mercury concentrations (including baseline concentrations) which are only 0.4% of the annual average limit value at the worst-case receptor.

Cd and Tl

Modelling results indicate that the ambient concentrations will be below the relevant air quality standard for the protection of human health for cadmium under maximum operation from the Dublin WTE facility. Emissions at maximum levels equate to ambient Cd and Tl concentrations (including baseline concentrations) which are 81% of the EU annual target value for Cd in the vicinity of the Poolbeg tall buildings (the comparison is made with the Cd limit value as this is more stringent than that for Tl).

Sum of As, Sb, Pb, Cr, Co, Cu, Ni, Mn and V

Modelling results indicate that the ambient concentrations will be below the relevant air quality standards for the protection of human health for arsenic (As) and nickel (Ni) (the metals with the most stringent limit values) under maximum operation emissions from the Dublin WTE facility (based on the ratio of metals measured at a Waste to Energy facility in Belgium). Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions in the vicinity of the Poolbeg tall buildings. Ambient concentrations have been compared to the annual target value for As and Ni as these represent the most stringent limit values for the suite of metals.

Emissions at maximum operations equate to ambient As concentrations (including baseline concentrations) which are 35% of the EU annual target value at the worst-case receptor whilst emissions at maximum operations equate to ambient Ni concentrations (including baseline concentrations) which are only 10% of the EU annual target value at the worst-case receptor.

1.2.7 Summary

Modelling results indicate that the ambient concentrations, at both ground level and at all heights up to the proposed building heights as outlined in Figure 1.3, in the vicinity of the proposed Poolbeg Planning Scheme, will be below the relevant air quality standards or guidelines for the protection of human health for all compounds under maximum operation of the Dublin WTE facility. Maximum operations are based on the emission concentrations outlined in EU Directive 2000/76/EC. The building heights are based on iterative modelling carried out in order to obtain the optimum building heights in the region without compromising ambient air quality.

An appropriate stack height has been selected to ensure that ambient air quality standards for the protection of human health will not be approached under maximum operating scenarios. The stack height determined by air dispersion modelling which will lead to adequate dispersion was 100 metres for both stacks.

1.3 REFERENCES

(1) Dublin City Council /RPS Ltd (2006) Dublin Waste To Energy EIS
(2) USEPA (2005) Guidelines on Air Quality Models, Appendix W to Part 51, 40 CFR Ch.1
(3) USEPA (2004) AERMOD Description of Model Formulation
(4) USEPA (2004) Estimating Exposure to Dioxin-Like Compounds Volume IV, Chapter 3 Evaluating Atmospheric Releases of Dioxin-Like Compounds from Combustion Sources (Draft)
(5) USEPA (2005) Human Health Risk Assessment Protocol, Chapter 3: Air Dispersion and Deposition Modelling, Region 6 Centre for Combustion Science and Engineering
(6) UK Environment Agency (2003) IPPC H1

Pollutant	**NO_2**		**SO_2**		**PM_{10}**		**$PM_{2.5}$**	**CO**	**TOC[3]**	**HCl**
Averaging Period[1]	1-hr	Annual	1-hr	24-hr	24-hr	Annual	Annual	8-hr	Annual	1-hr
Annual Baseline & Development Traffic Concentration (Year 2012)	49.6	24.8	28	28	31.3	30.4	12.3	630	1.5	1.0
Process Emissions	115	9.2	238	40.0	1.0	0.6	0.6	100	0.6	32
Predicted Environmental Concentration (Year 2012)	165	34.0	266	68.0	32.3	31.0	12.9	730	2.1	33
Ambient Air Quality Standard	**200**	**40**	**350**	**125**	**50**	**40**	**25**	**10000**	**5.0**	**100**

(1) For the 1-hr and 24-hr averages, the relevant percentages as detailed in Table 1.6 have been used
(2) TOC assumed to consist solely of benzene as a worst-case.

Table 1.7: Modelling Results Under Maximum Operations ($\mu g/m^3$).

Pollutant	**HF**		**Dioxins**	**PAHs**	**Hg**	**Cd**	**As**	**Ni**
Averaging Period	1-hr	Annual	Annual	Annual	Annual	Annual	Annual	Annual
Annual Baseline & Development Traffic Concentration (Year 2012)	0.04	0.02	21 fg/m^3	180 pg/m^3	0.001	0.001	0.001	0.003
Process Emissions	2.1	0.06	6.1 fg/m^3	60 pg/m^3	0.003	0.003	0.001	0.002
Predicted Environmental Concentration (Year 2012)	2.1	0.08	27.1 fg/m^3	240 pg/m^3	0.004	0.004	0.002	
Ambient Air Quality Standard	**3.0**	**0.30**	**N/A**	**1,000**	**1.0**	**0.005**	**0.006**	**0.020**

Table 1.7(continued): Modelling Results Under Maximum Operations ($\mu g/m^3$).

Project

Poolbeg Project

Reference

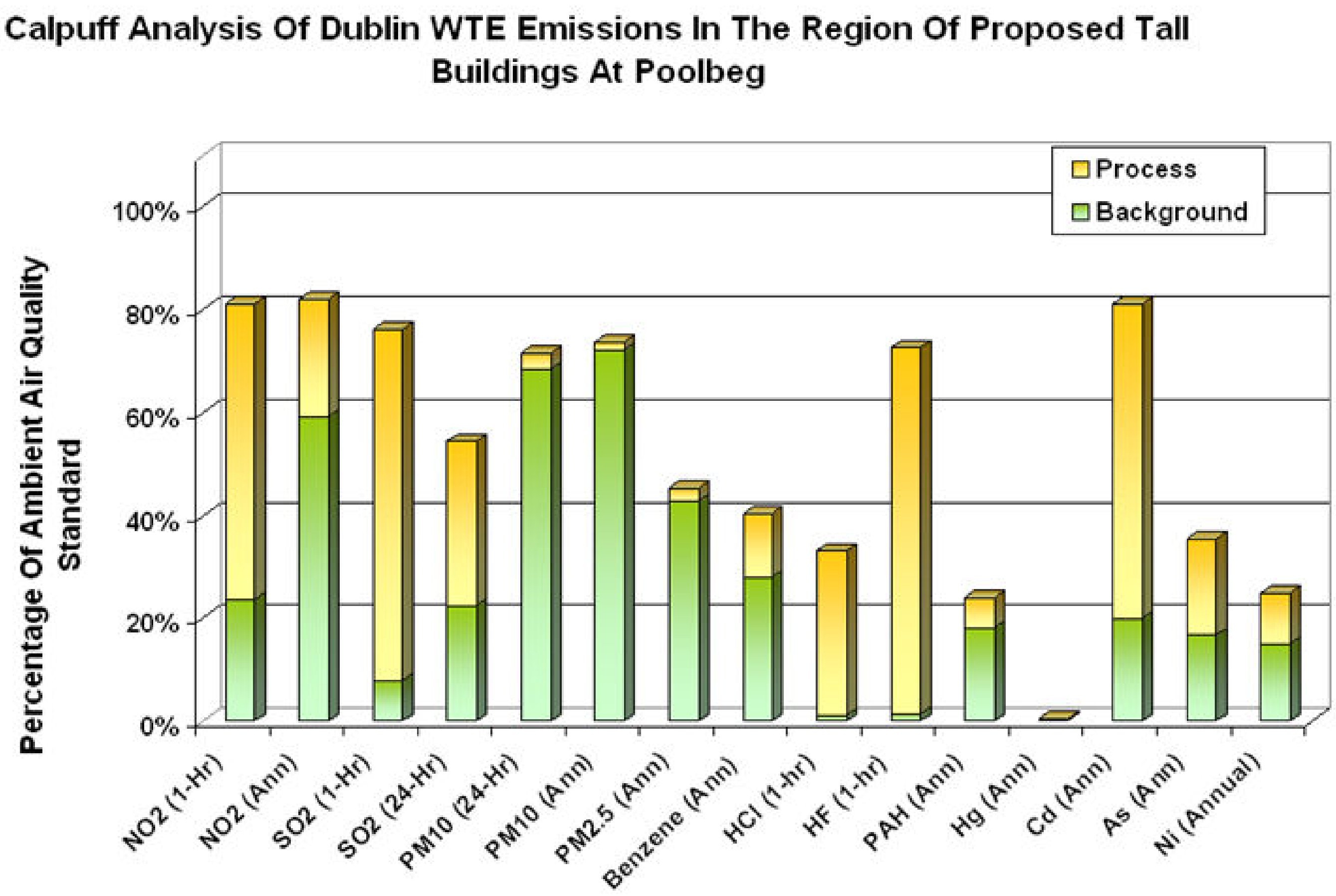
08/4368AR01

Figure 1.3

Maximum Building Heights To Ensure Compliance With Air Quality Standards

awnconsulting

The Tecpro Building, Clonshaugh Business and Technology Park, Dublin 17
T: +353 1 847 4220 F: +353 1 847 4257



awnconsulting

The Tecpro Building, Clonshaugh Business and Technology Park, Dublin 17
T: +353 1 847 4220 F: +353 1 847 4257

Project	Poolbeg Project
Reference	08/4368AR01
Figure 1.4	Baseline & Process Concentrations As Percentage of Limit Value (%)

Appendix 9.2

Dispersion Modelling of Road Traffic Emissions in Poolbeg, AWN Consulting.

awnconsulting

The Tecpro Building,
Clonshaugh Business & Technology Park,
Dublin 17, Ireland.

T: + 353 1 847 4220
F: + 353 1 847 4257
E: info@awnconsulting.com
W: www.awnconsulting.com

DISPERSION MODELLING OF ROAD TRAFFIC EMISSIONS IN POOLBEG

Technical Report Prepared For

Malone O'Regan
2B Richview Office Park,
Clonskeagh,
Dublin 14

Technical Report Prepared By

Dr. Eoin Collins MRSC

Our Reference

EC/08/4368AR02_1

Date Of Issue

04 December 2008

Cork Office
Unit 5, ATS Building,
Carrigaline Industrial Estate,
Carrigaline, Co. Cork.
T: +353 21 438 7400
F: +353 21 483 4606

AWN Consulting Limited
Registered in Ireland No. 319812
Directors: F Callaghan, C Dilworth,
T Donnelly, E Porter
Associate Director: D Kelly

TRAFFIC EMISSIONS AIR QUALITY ASSESSMENT

1.0 INTRODUCTION

Dublin Docklands Development Authority has commissioned an assessment of road traffic emissions resulting from the proposed Poolbeg Planning Scheme. This report describes the results of a detailed air dispersion modelling assessment of road traffic emissions in the Poolbeg region for the opening year 2012.

2.0 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.

The applicable standards in Ireland include the Air Quality Standards Regulations 2002, which incorporate EU Directives 1999/30/EC and 2000/69/EC. These directives shall soon be superseded in Irish law by Council Directive 2008/50/EC (published 11/06/08), which combines the previous air quality framework and subsequent daughter directives (see Table 1).

The predicted ambient pollutant concentrations derived from the dispersion modelling results were compared to their ambient limit values as outlined above.

3.0 STUDY METHODOLOGY

3.1 Air Dispersion Model

The assessment focussed firstly on identifying do minimum levels of NO_2, PM_{10}, $PM_{2.5}$ and benzene in the region of the proposed Poolbeg Planning Scheme (CO was also assessed as the model was originally derived for this pollutant). Thereafter, the impact of the traffic associated with the proposed developments on air quality at the neighbouring sensitive receptors (do something scenario) was determined relative to the do minimum scenario. The assessment methodology involved detailed air dispersion modelling using the US Environmental Protection Agency (USEPA) approved air dispersion model CAL3QHCR(1) and following guidance issued by the California Department of Transportation and USEPA(2-4). The inputs to the air dispersion model consist of information on road layouts, hourly traffic movements, site-specific composite vehicle emission factors and a full year of Dublin Airport meteorological data (Year 2001). Using this input data the model predicts ambient ground level concentrations at each sensitive receptor for each hour of the modelled meteorological year. The worst-case concentration is then added to the existing background concentration to give the worst-case predicted ambient concentration.

3.2 Dispersion Modelling Approach

Peak, one-hour concentrations for CO, benzene, NO_2, PM_{10} and $PM_{2.5}$ for the opening year (Year 2012), at the nearest occupational receptors to the road development, have been modelled using the USEPA approved CAL3QHCR(1) dispersion model in conjunction with the COPERT III European emissions database from the CORINAIR working group (Version 2.3, July 2002)(5).

Nitrogen oxide (NO_X) emissions were modelled as inert pollutants following UK DEFRA guidance[6]. Thereafter, the conversion to nitrogen dioxide followed the UK DEFRA empirical relationship between NO_X and NO_2 derived from monitoring data from the UK over the period 1998-2001[6,7]:

$$NO_{2\ \text{ROADSIDE INCREMENT}}\ (\mu g/m^3) = NO_{X\ \text{ROADSIDE INCREMENT}}\ (\mu g/m^3,\ \text{as } NO_2)*(-0.068*\ln(\text{total roadside } NO_X \text{ concentration } (\mu g/m^3, \text{ as } NO_2)) + 0.53)$$

The on-site correlation between NO_2 and NO_X was also investigated in order to determine which relationship gave a more realistic correlation.

CAL3QHCR allows a two-tiered approach to traffic data. In the first approach, called Tier I, a full year of hourly meteorological data is entered into CAL3QHCR as well as one hour of ETS data (vehicular emissions, traffic volume and signalisation). In the Tier II approach the same meteorological data as Tier I is used. The ETS data however, are more detailed and reflect traffic conditions for each hour of a week. The weekly traffic data conditions are assumed to be the same for each week throughout the modelled period. In the current assessment, a Tier I approach was followed using peak traffic conditions for each hour of the day over a full year. This represents a worst-case assessment.

3.3 Emission Formulation

The vehicle fleet for the Poolbeg region was assumed to be in line with the national fleet[8] for petrol and diesel LVs. Cold starts were assumed to be 75% for all model scenarios. Worst-case assumptions were used throughout the formulation, and an increase of 10% was applied to derived emission factors to allow for inaccuracies in their formulation.

Emission rates were derived from COPERT III (Version 2.3, July 2002) which was developed by the CORINAIR working group and follows on from extensive work carried out by the MEET program (Methodologies for Estimating Air Pollutant Emissions from Transport) and COST 319 – “Estimating of Pollutant Emissions From Transport”[9].

Emission rates for CO, VOC, NO_2 and PM_{10} used to predict air pollutant concentrations for the year 2012 were calculated assuming a vehicle fleet breakdown in 2005 as predicted from the National Fleet age breakdown in 2005 and by applying the emissions factors outlined in COPERT III[5]. In addition, emission factors for NO_2 and PM_{10} were compared with revised emission factors from the Transport Research Laboratory (TRL) in the UK which was published in March 2002[10]. For the purposes of deriving the worst-case emission factors, the higher of each comparable emission factor for each category of vehicle was selected from an analysis of both databases.

In relation to PM_{10}, both the tail-pipe emissions and fugitive emissions from re-suspended dust were included in the calculation. Although COPERT III does not assess fugitive dust, this will be a significant fraction of measured PM_{10} for all roads. Detailed calculations have been carried out by the USEPA AP-42 Document[11] on fugitive dust emissions from paved roads and other sources. The calculation is based on the average weight of the vehicles, the number of vehicles and the silt loading of the road.

Idling emission factors were derived from COPERT III using a traffic speed of 5 km/hr and by applying a factor of two in order to allow for any inaccuracies in the formulation[12]. Future year emission factor reductions, for both LV and HGV, were assumed to be in accordance with the relative reductions cited in COPERT III.

3.4 Air Quality Impact Assessment Methodology

The impact of a development on local air quality should be assessed in terms of the relative additional contribution of the development to pollutant levels in the region (expressed as a percentage of the limit value). Although no relative impact, as a percentage of the limit value, is enshrined in EU or Irish Legislation, the National Roads Authority document *"Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes (2006)"*[13] details a methodology for determining air quality impact significance criteria for road schemes. The degree of impact is determined based on both the absolute and relative impact of the development. The NRA significance criteria have been adopted for the current development and are detailed in Tables 2 - 3. The significance criteria are based on PM_{10} and NO_2 only as these pollutants are most likely to exceed the limit values. However the criteria have also been applied to the predicted 8-hour CO, annual benzene and annual $PM_{2.5}$ concentrations for the purposes of this assessment.

4.0 RESULTS & DISCUSSION

4.1 Do Minimum Scenario Results

NO_2

The results of the do minimum assessment for NO_2 in the opening year are shown in Table 4. Concentrations are significantly within the annual limit values, reaching at most 74% of the annual limit value in 2012.

The EU limit value for the maximum one-hour standard for NO_2 is based on a one-hour mean not to be exceeded more than 18 times a year (99.8th%ile). Do minimum levels in 2012 will be significantly below this limit value, with levels at the worst-case receptor peaking at 74% of the EU limit value.

CO and Benzene

The results of the do minimum modelling assessment for CO and benzene in the opening year are shown in Table 4. Concentrations are significantly within the limit value, with levels ranging from 9 - 34% of the respective limit values in 2012.

PM_{10}

The results of the do minimum modelling assessment for PM_{10} in the opening year are shown in Table 4. Concentrations are significantly within the limit value. Levels at the worst-case receptor reach at most 83% of the annual limit value and 74% of the 24-hour limit value in 2012.

$PM_{2.5}$

The results of the do minimum modelling assessment for $PM_{2.5}$ in the opening year are shown in Table 4. Concentrations are significantly within the limit value, reaching at most 60% of the annual limit value in 2012.

4.2 Do Something Scenario Results

NO_2

The results of dispersion modelling of additional traffic resulting from the Poolbeg Planning Scheme in the opening year are shown in Table 4. Annual average and maximum 1-hour NO_2 concentrations are significantly within the annual limit values, reaching at most 79% of the annual limit value in 2012.

The impact of the proposed developments will account at most 5% of the annual limit value in 2012. Thus, using the assessment criteria outlined in Tables 2 and 3, the impact of the Poolbeg Planning Scheme in terms of NO_2 is slight adverse.

CO and Benzene

The results of do something modelling assessment in the opening year are shown in Table 4. CO and benzene concentrations are significantly within the limit value, with levels ranging from 10 - 36% of the respective limit values in 2012.

The impact of the proposed developments will account for at most 1 - 2% of the CO and benzene limit values in 2012. Thus, using the assessment criteria outlined in Tables 2 and 3, the impact of the Poolbeg Planning Scheme in terms of CO and benzene is negligible.

PM_{10}

The results of do something modelling assessment in the opening year are shown in Table 4. Concentrations are significantly within the limit value. Levels at the worst-case receptor reaching at most 88% of the annual limit value and 80% of the 24-hour limit value in 2012.

The impact of the proposed developments will account at most 6% of the annual and 24-hour limit values in 2012. Thus, using the assessment criteria outlined in Tables 2 and 3, the impact of the Poolbeg Planning Scheme in terms of PM_{10} is slight adverse.

$PM_{2.5}$

The results of do something modelling assessment in the opening year are shown in Table 4. Concentrations are significantly within the limit value. Levels at the worst-case receptor reach at most 68% of the annual limit value in 2012.

The impact of the proposed developments will account at most 8% of the limit value in 2012. Thus, using the assessment criteria outlined in Tables 2 and 3, the impact of the Poolbeg Planning Scheme in terms of $PM_{2.5}$ is slight adverse.

4.3 Summary of Modelling Assessment

The modelling assessment for NO_2 indicates that annual and maximum 1-hour concentrations will be significantly within the air quality standards, with the proposed developments in place. Levels of NO_2 are predicted to reach at most 78% of the respective limit values in 2012. The impact of the Poolbeg Planning Scheme on NO_2 concentrations will account for at most 5% of the limit values. Thus, based on the relevant assessment criteria, the impact of the facility for these pollutants is slight adverse.

The results of the assessments for CO and benzene indicate that concentrations will be significantly within the ambient air quality standards. In addition, the impact of the Poolbeg Planning Scheme will account for only 1 - 2% of the respective limit values. Levels of both pollutants, with the proposed developments in place, are predicted to range from 10 - 36% of the respective limit values in 2012. Thus, based on the relevant assessment criteria, the impact of the facility for these pollutants is negligible.

The modelling assessment for PM_{10} indicates that annual and 24-hour concentrations will be significantly within the air quality standards, with the proposed developments in place. Levels of PM_{10} are predicted to reach at most 88% of the annual limit value and 80% of the 24-hour limit value in 2012. The impact of the Poolbeg Planning Scheme on PM_{10} concentrations will account for at most 6% of the limit values. Thus, based on the relevant assessment criteria, the impact of the facility for these pollutants is slight adverse.

The modelling assessment for $PM_{2.5}$ indicates that annual concentrations will be significantly within the air quality standards. Levels of $PM_{2.5}$, with the proposed developments in place, are predicted to reach at most 68% of the annual limit value in 2012. The impact of the Poolbeg Planning Scheme on $PM_{2.5}$ concentrations will account for at most 9% of the limit values. Thus, based on the relevant assessment criteria, the impact of the facility for these pollutants is slight adverse.

REFERENCES

(1) US EPA (1995) Addendum To The User's Guide To CAL3QHC Version 2 (CAL3QHCR User's Guide)
(2) California Department of Transportation (1997) Transportation Project-Level Carbon Monoxide Protocol
(3) USEPA (1992) Guideline For Modelling Carbon Monoxide From Roadway Intersections
(4) SCAG (1993) Carbon Monoxide Transportation Project Protocol Chapter 2: Key Transportation Variables Required For Air Quality Modelling
(5) European Environment Agency (2002) COPERT III, Computer Programme to Calculate Emissions from Road Transport: Methodology & Emission Factors (Version 2.3)
(6) UK DEFRA (2003) Part IV of the Environment Act 1995: Local Air Quality Management, LAQM. TG(03)
(7) DEFRA (2004) Air Quality Expert Group – Nitrogen Dioxide In The UK
(8) DoEHLG (2006) Irish Bulletin of Vehicle and Driver Statistics 2005
(9) European Commission (1999) MEET - Estimating of Pollutant Emissions From Transport
(10) NAEI (2002) Road Traffic Emission Inventory Update (available at www.naei.org.uk/emissions)
(11) USEPA (1997) AP42 – Mobile Emissions – Paved Roads
(12) Raine et al (1999) Measured Tailpipe Emission Performance of New Zealand Vehicles *IPENZ Transactions*, Vol. 26, No. 1
(13) National Roads Authority (2006) Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes

Pollutant	Regulation [Note 1]	Limit Type	Margin of Tolerance	Value
Nitrogen Dioxide	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 18 times/year	40% until 2003 reducing linearly to 0% by 2010	200 μg/m^3 NO_2
		Annual limit for protection of human health	40% until 2003 reducing linearly to 0% by 2010	40 μg/m^3 NO_2
		Annual limit for protection of vegetation	None	30 μg/m^3 NO + NO_2
Lead	2008/50/EC	Annual limit for protection of human health	100% [Note 2]	0.5 μg/m^3
Sulphur dioxide	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 24 times/year	150 μg/m^3	350 μg/m^3
		Daily limit for protection of human health - not to be exceeded more than 3 times/year	None	125 μg/m^3
		Annual & Winter limit for the protection of ecosystems	None	20 μg/m^3
Particulate Matter (as PM_{10})	2008/50/EC	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50%	50 μg/m^3 PM_{10}
		Annual limit for protection of human health	20%	40 μg/m^3 PM_{10}
$PM_{2.5}$ (Stage 1)	2008/50/EC	Annual limit for protection of human health	20% from June 2008. Decreasing linearly to 0% by 2015	25 μg/m^3 $PM_{2.5}$
$PM_{2.5}$ (Stage 2)[Note 3]	-	Annual limit for protection of human health	None	20 μg/m^3 $PM_{2.5}$
Benzene	2008/50/EC	Annual limit for protection of human health	100% until 2006 reducing linearly to 0% by 2010	5 μg/m^3
Carbon Monoxide	2008/50/EC	8-hour limit (on a rolling basis) for protection of human health	60%	10 mg/m^3 (8.6 ppm)

[Note 1] EU 2008/50/EC – Clean Air For Europe (CAFÉ) Directive replaces the previous Air Framework Directive (1996/30/EC) and daughter directives 1999/30/EC and 2000/69/EC.

[Note 2] EU 2008/50/EC states - *'Limit value to be met only by 1 January 2010 in the immediate vicinity of the specific industrial sources situated on sites contaminated by decades of industrial activities. In such cases the limit value will be 1.0 μg/m^3. The area in which higher limit values apply must not extend further than 1000 m from such specific sources'.*

[Note 3] EU 2008/50/EC states - *'Stage 2 — indicative limit value to be reviewed by the Commission in 2013 in the light of further information on health and environmental effects, technical feasibility and experience of the target value in Member States'.*

Table 1 EU Air Quality Standards (based on EU Council Directive 2008/50/EC).

Magnitude of Change	Annual Mean NO_2 / PM_{10}	Days PM_{10} > 50 µg/m^3
Very Large	Increase / decrease >25%	Increase / decrease >25 days
Large	Increase / decrease 15-25%	Increase / decrease 15-25 days
Medium	Increase / decrease 10-15%	Increase / decrease 10-15 days
Small	Increase / decrease 5-10%	Increase / decrease 5-10 days
Very Small	Increase / decrease 1-5%	Increase / decrease 1-5 days
Extremely Small	Increase / decrease <1%	Increase / decrease <1 days

Source: *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* - National Roads Authority (2006)

Table 2 Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations

Absolute Concentration in Relation to Standard[Note 1]	Change in Concentration					
	Extremely Small	**Very Small**	**Small**	**Moderate**	**Large**	**Very Large**
Decrease with Scheme						
Above Standard with Scheme	slight beneficial	slight beneficial	substantial beneficial	substantial beneficial	very substantial beneficial	very substantial beneficial
Above Standard in Do-min, Below with Scheme	slight beneficial	moderate beneficial	substantial beneficial	substantial beneficial	very substantial beneficial	very substantial beneficial
Below Standard in Do-min, but not Well Below	negligible	slight beneficial	slight beneficial	moderate beneficial	moderate beneficial	substantial beneficial
Well Below Standard in Do-min	negligible	negligible	slight beneficial	slight beneficial	slight beneficial	moderate beneficial
Increase with Scheme						
Above Standard in Do-min	slight adverse	slight adverse	substantial adverse	substantial adverse	very substantial adverse	very substantial adverse
Below Standard in Do-min, Above with Scheme	slight adverse	moderate adverse	substantial adverse	substantial adverse	very substantial adverse	very substantial adverse
Below Standard with Scheme, but not Well Below	negligible	slight adverse	slight adverse	moderate adverse	moderate adverse	substantial adverse
Well Below Standard with Scheme	negligible	negligible	slight adverse	slight adverse	slight adverse	moderate adverse

[Note 1] Well Below Standard = <75% of limit value.

Source: *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* - National Roads Authority (2006)

Table 3 Air Quality Impact Significance Criteria

Scenarios	Source	Carbon Monoxide (mg/m^3)	Benzene ($\mu g/m^3$)	Nitrogen Dioxide ($\mu g/m^3$)		Particulates ($\mu g/m^3$)		
		Maximum 8-hour	Annual mean	99.8th%ile of 1-hr NO_2	Annual average NO_2	Annual average PM_{10}	90th%ile of 24-hr PM_{10}	Annual average $PM_{2.5}$
2012	Background	0.5	1.4	113	22.6	28.1	28.1	10.2
Do Minimum: Worst-case Receptor	Roadside Increment + Background	0.9	1.7	147	29.4	33.0	37.0	15.1
2012	Background	0.5	1.4	111	22.6	28.1	28.1	10.2
Do Something: Worst-case Receptor	Roadside Increment + Background	1.0	1.8	157	31.4	35.0	39.8	17.1
Do Something: Impact	Development Traffic	0.1	0.1	9.5	1.9	2.0	2.8	2.0
Standards Note 1		10	5	200 Note 2	40	40	50 Note 3	25

Note 1 EU Council Directive 2008/50/EC & & S.I. 271 of 2002.

Note 2 1-hr limit of 200 $\mu g/m^3$ not to be exceeded >18 times/year (99.8th %ile).

Note 3 24-Hr limit of 50 $\mu g/m^3$ not to be exceeded >35 times/year (90.4th%ile).

Table 4 Road Traffic Air Quality Assessment, Poolbeg Planning Scheme. Summary Of Predicted Air Quality At Worst-Case Receptors Located in Poolbeg.

Appendix 9.3

Figure 8.1 taken from the Waste to Energy EIS, 2006 depicting approximate locations of air monitoring stations.

Figure 8.1 Approximate location of air monitoring stations

Reproduced from
Ordnance Survey
Ireland
Permit No: EN0007506

Project	Dublin WTE Air Quality Assessment
Reference	06/3018AR01
Figure 8.1	Approximate location of air monitoring stations

awn consulting

The Tecpro Building, Clonshaugh Business and Technology Park, Dublin 17 .
Tel: +353 (0)1 847 4220 Fax: +353 (0)1 847 4257