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EPA ORAL HEARING INTO THE DUBLIN WASTE TO ENERGY FACILITY BRIEF OF EVIDENCE AIR QUALITY

Report Prepared By

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Our Reference

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1.0 Edward S. Porter will say:

1.1 I hold a Bachelor of Science degree (1st Class (Hons)) in Chemistry (1991) from the University of Sussex and a Ph.D. in Chemistry (Air Quality) from University College Dublin (1997). I am a Charter Chemist and a full member of the Royal Society of Chemistry (C Chem MRSC), a requirement of membership being that I am active in the field of professional chemistry and satisfy the Society's requirements with regard to level of qualifications and experience.

1.2 I have been active in the field of chemistry for 17 years, the last eleven as an Environmental Consultant. I have considerable experience in the areas of planning with regard to air quality, assessment of air quality for compliance purposes and air quality mitigation measures in relation to both construction sites and operational developments.

1.3 I am currently Director with responsibility for Air Quality and Climate with AWN Consulting.

Recent Air Quality Project Experience

- Ringaskiddy Waste-to-Energy Plant Waste Licence & Oral Hearing (2005)
- Carranstown Waste-to-Energy Plant Waste Licence & Oral Hearing (2005)
- Wyeth Medica PNFX Extension EIS (2004)
- Pfizer Liquid Waste Incinerator EIS, Cork (2003)
- Courtlough Waste-to-Energy Power Plant EIS (2002)
- Alza Pharmaceuticals EIS (2001)
- Abbott Ireland SVP Facility IPC Licence (2002)
- Analog Devices IPC Licence Review (2003).
- Elan Pharmaceutical Technologies IPC Review (2001)
- 2nd Liffey Valley Bridge Oral Hearing (2000)
- Clifden Airstrip EIS & Oral Hearing (2000)
- Intel Fab24 IPC Application Review (2002)
- M3 Clonee to North of Kells EIS & Oral Hearing (2002)
- Dundalk Western By-Pass EIS Public Enquiry(1999)
- South Dublin Outer Ring Road EIS & Oral Hearing (2001)
- Spencer Dock Conference Centre EIS & Oral Hearing (2000)
- Heuston Office & Technology Park EIS & Oral Hearing (2002)
- University of Limerick Shannon River Crossing EIS & Oral Hearing (2002)
- Mahon Point Shopping Centre EIS & Oral Hearing (2002)
- Wicklow Port Access & Town Relief Road EIS & Oral Hearing (2003)
- M7/M8 Portlaoise to Cullahill / Castletown EIS & Oral Hearing (2004)

2.0 INTRODUCTION

2.1 AWN Consulting Limited was commissioned to conduct a detailed appraisal of the air quality impacts associated with the Dublin Waste To Energy Facility.

2.2 The existing ambient air quality was assessed by means of an extensive baseline air quality survey over a four year period.

2.3 Available published guidance documents and Directives which are relevant to assessing the air quality impacts from an incineration facility were consulted.

2.4 The air quality impact of the proposed Dublin Waste To Energy Facility was assessed. The assessment was carried out using the USEPA approved air dispersion model AERMOD which is specifically formulated for complex industrial sources in both flat and complex terrain and SCREEN3 which is a screening model for assessing the impact of shoreline fumigation. Modelling using CALPUFF, which is the USEPA approved air dispersion model for use in complex meteorological zones, has also been undertaken. CALPUFF was run to evaluate the results from AERMOD and SCREEN3 and their conclusions relative to compliance with the Ambient Air Quality Standards.

2.5 The cumulative impact of all major air quality sources in the area (background levels, the proposed facility, the existing industrial facilities and road traffic) was assessed and compared with the applicable ambient air quality standards.

3.0 ASSESSMENT APPROACH

3.1 The approach adopted for the air quality assessment firstly involved a detailed consideration of the available published guidance documents and Directives which are relevant to assessing the air quality impacts from an incineration facility. The key documents consulted in the assessment were:

- Council Directive 2000/76/EC (The Incineration Directive)
- USEPA Guidelines on Air Quality Models (updated every 1-2 years)
- USEPA (2003) Estimating Exposure to Dioxin-Like Compounds Volume IV, Chapter 3 - Evaluating Atmospheric Releases of Dioxin-Like Compounds from Combustion Sources (Draft)
- USEPA (2005) Human Health Risk Assessment Protocol, Chapter 3: Air Dispersion and Deposition Modelling
- Council Directives 96/62/EC, 1999/30/EC, 2000/69/EC, 2004/107/EC and the draft Council Directive on Ambient Air Quality and Cleaner Air for Europe.

3.2 Council Directive 2000/76/EC indicated that that the following substances released from the WTE facility may have the potential for significant human health or environmental effects in the vicinity of the facility:

- Nitrogen Dioxide (NO_2)
- Sulphur Dioxide (SO_2)
- Particular Matter (as PM_{10})
- Carbon Monoxide (CO)
- Volatile Organic Compounds (VOC)
- Acid Gases (HCl and HF)
- Dioxins and Furans
- Metals (particularly Mercury, Cadmium, Arsenic and Nickel).

3.3 The selection of the appropriate air quality model was based on the relevant USEPA documents referenced above and in consultation with the Irish EPA. The current USEPA regulatory model for complex industrial sources in both flat and complex terrain is AERMOD which has been used consistently in Ireland to determine the

impact from large industrial facilities. Thus, the AERMOD model was used in the assessment as outlined in the EIS.

3.4 Meteorological data for the AERMOD assessment was selected based on a review of available data in the region. The meteorological data of importance in terms of air quality modelling is wind speed, wind direction, temperature, cloud cover, stability index and mixing height. Dublin Airport is the nearest meteorological station and was used in the modelling assessment. In addition, on-site meteorological data was collected for Years 2004 and 2005 and this data was compared to the Dublin Airport data and the year which gave the highest ambient concentrations reported (On-site Data 2004).

3.5 A receptor grid measuring 20 km by 20 km with the site at the centre was mapped out with terrain information at each receptor location input into the model. The model receptor grid covered, in detail, the areas of Ringsend, Clontarf, Sandymount and the city centre. In addition, boundary, residential and sensitive receptors (such as schools) near the facility were discretely mapped into the model giving a total of 8,260 receptor points at which ambient ground levels concentrations were determined for each pollutant.

3.6 A conservative approach has been adopted in the current assessment using AERMOD. This will lead to estimated ground level concentrations which are likely to be over-estimates of the levels which will arise under normal operations. The conservative assumptions include:

- For the cumulative assessment, emissions from the site and all significant existing facilities were assumed to be operating at their maximum emission level (as outlined in the Waste Incineration Directive for the Dublin WTE facility and for existing facilities as outlined in their IPPC Licenses), 24 hours/day over the course of a full year.

- All emission points were assumed to be operating at their maximum volume flow, 24 hours/day over the course of a full year.

- Maximum predicted ambient concentrations were reported in this study even though, in most cases, no residential receptors were near the location of this maximum. The concentration gradient decreased significantly from the worst-case receptor to the nearest residential receptors by a factor of three for the annual average limit values.

4.0 BASELINE ASSESSMENT

4.1 Information on the existing (baseline) air quality in the vicinity of the proposed WTE facility was obtained from monitoring surveys in the region of the facility:

- A detailed baseline survey of air quality was undertaken in the Poolbeg area over a four year period (see Figure 4.1).
- 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.

4.2 Results for each of the pollutants is detailed below:

- Nitrogen Dioxide (NO_2) – on-site measurements averaged 25.5 $\mu g/m^3$ over the March 2007 to October 2007~~February 2008~~ survey period whilst diffusion tube measurements in the surrounding environment averaged between 16 – 27~~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 40 - 68~~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 limit of 20 $\mu g/m^3$ for the protection of ecosystems. Thus, ambient levels of this compound are currently low.
- Particular Matter (as PM_{10}) – on-site measurements 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.
- 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 – on-site 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 – 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 – 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.

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Project
Dublin WTE Air Quality Assessment

Reference
06/3018AR01

Figure 4.1
Approximate location of air monitoring stations

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5.0 AIR MODELLING ASSESSMENT

5.1 Emission Data

5.1.1 Emissions from the WTE facility will occur from two emission points. Emissions from these emission points have been modelled under maximum volume flow conditions (115% of typical flow) and under typical flow conditions.

5.1.2 Emission concentrations were modelled at the maximum limits outlined in EU Directive 2000/76/EC. In addition, modelling was carried out at levels which will typically be expected. In some cases the variation between maximum levels and typical levels will be a factor of 5. In the interests of conciseness, the typical scenario is not reported here but is significantly lower than the maximum scenario.

5.2 AERMOD Air Dispersion Modelling Results

5.2.1 Modelling was carried out using AERMOD with meteorological data from Dublin Airport for the period 1993 - 2005 and using on-site data for the Years 2004 and Years 2005. The worst-case year (i.e. the year giving the highest ambient concentration for NO_2) was the on-site data for 2004. Modelling was carried out for three scenarios using the 2004 on-site meteorological data. Scenario one involved maximum volume flows and maximum emission rates whilst scenario two assessed the impact of typical volume flows and expected emission rates. Scenario three assessed the impact of abnormal operations on the predicted ambient concentration. The results for each of the parameters are outlined below:

- Nitrogen Dioxide (NO_2) and Nitrogen Oxides (NO_x) – This parameter formed the basis for the selection of stack height. The stack height was selected such that, at maximum volume flows and maximum emission rates, ambient levels were appreciably below the ambient air quality limit values at the worst-case receptor (including background concentration). In order to achieve this, a stack height of 100m (105 OD) was required for both stacks. Modelling results indicate that under maximum conditions, ambient levels ranged from 62 - 8063 - 83% of the ambient limit values at the worst-case sensitive receptor (including background concentration). Ambient concentrations away from the worst-case receptor are significantly lower and at the nearest sensitive receptors are significantly below the ambient limit values. The impact from the facility accounts for at most 11% of the short-term NO_2 limit value at the worst-case sensitive receptor near the facility. Annual average concentrations are significantly lower with sensitive receptors accounting for less than 3% of the annual limit value.

- Sulphur Dioxide (SO_2), Carbon Monoxide (CO) & Total Dust (as PM_{10} and $PM_{2.5}$) - modelling results indicate that under maximum conditions, ambient levels ranged from 11 - 73% of the ambient limit values at the worst-case sensitive receptor (including background concentration).

- Total Organic Carbon (TOC), HCl and HF – modelling results indicate that under maximum conditions, ambient levels ranging from 17 to 37% of the ambient limit values at the worst-case receptor (including background concentration).

- Dioxins and Furans – modelling results indicate that under maximum conditions, ambient levels will increase less than 4% above existing background concentrations at the nearest residential receptor.

- B[*a*]P - modelling results indicate that the ambient ground level concentrations are significantly below the EU target value for the protection of human health under maximum operation of the site. Emissions at maximum operations lead to ambient B[a]P particle-bound concentrations (including background concentrations) which are only 20% of the annual average limit value at the worst-case receptor.

- Mercury – modelling results indicate that under maximum conditions, ambient levels will peak at 0.2% of the ambient annual limit value at the worst-case receptor (including background concentration).

- Cadmium & thallium – modelling results indicate that under maximum conditions, ambient levels will peak at 43% of the ambient annual limit value at the worst-case receptor (including background concentration).

- Sum of Metals – modelling results indicate that under maximum conditions, ambient levels will peak at 19% of the worst-case ambient annual limit values at the worst-case receptor (including background concentration) for the most stringent standards for cobalt, nickel, chromium, copper, vanadium, manganese, lead and antimony.

- Arsenic– modelling results indicate that under maximum conditions, ambient levels will peak at 24% of the ambient annual limit value at the worst-case receptor (including background concentration).

5.2.2 There are a number of major industrial plants in the Poolbeg area. The cumulative emissions from the existing plants, road traffic and from the waste to energy facility were modelled to determine the cumulative impact of their combined emissions (background concentrations were also taken into account). The assessment indicated that the waste to energy facility had no significant impact on the cumulative air quality in the Poolbeg and surrounding area. Thus, assuming all industrial facilities simultaneously operating at maximum capacity for a full year, in addition to the current facility, levels will be significantly below all relevant air quality standards.

5.3 CALPUFF Modelling Assessment

5.3.1 Modelling using CALPUFF, which is the USEPA approved air dispersion model for use in complex meteorological zones, has also been undertaken. CALPUFF was run to evaluate the results from AERMOD and SCREEN3 and their conclusions relative to compliance with the Ambient Air Quality Standards.

5.3.2 The appropriate meteorological data for the CALPUFF assessment is the CALMET output file. The CALMET file is derived from surface meteorological stations, buoys, upper air stations and the output from mesoscale numerical weather modeling simulations. Penn State / NCAR Mesoscale Model (MM5) data covering a grid size of 100 km x 100 km with the site at the center was used in CALMET to derive the Step 1 Wind field at a resolution of 4km x 4km. In the Step 2 Wind field, actual meteorological data from Dublin Airport, Casement Aerodrome and the on-site station was used in conjunction with the Marine Institute M2 buoy located 50 km east of Dublin Bay to derive the final wind field. The actual data was interpolated such that the influence of the surface stations was greatest nearest each station whilst the MM5 data exerted a greater influence in the region where no surface station data was available. The MM5 data also extended over 11 levels from 50m to 4000m and was used to define the upper air data over the region with the exception of locations close to the surface station where similarity theory was used to extrapolate to upper levels.

5.3.3 A receptor grid measuring 80 km by 80 km with the site at the centre was mapped out with terrain information at each receptor, derived from Shuttle Radar Topography Mission (SRTM) with 90m resolution as input into the model. The model receptor grid covered, in detail, Dublin County, North County Wicklow, East Kildare and East Meath giving a total of 25,600 receptor points at which ambient ground levels concentrations were determined for each pollutant (inner grid at 100m resolution, outer grid at 500m grid resolution).

5.4 CALPUFF Air Dispersion Modelling Results

5.4.1 The CALPUFF modeling results for each of the parameters are outlined below:

- Nitrogen Dioxide (NO_2) and Nitrogen Oxides (NO_X) – modelling results indicate that under maximum conditions, ambient levels ranged from 56 - 8184% of the ambient limit values at the worst-case sensitive receptor (including background concentration).

- Sulphur Dioxide (SO_2), Carbon Monoxide (CO) & Total Dust (as PM_{10} and $PM_{2.5}$) - modelling results indicate that under maximum conditions, ambient levels ranged from 11 - 73% of the ambient limit values at the worst-case sensitive receptor (including background concentration).

- Total Organic Carbon (TOC), HCl and HF – modelling results indicate that under maximum conditions, ambient levels ranging from 17 - 37% of the ambient limit values at the worst-case receptor (including background concentration).

- Dioxins and Furans – modelling results indicate that under maximum operations ambient levels will increase by only 6% above existing background concentrations at the nearest residential receptor.

- B[*a*]P - modelling results indicate that the ambient ground level concentrations are significantly below the EU target value for the protection of human health under maximum operation of the site. Emissions at maximum operations lead to ambient B[a]P particle-bound concentrations (including background concentrations) which are only 22% of the annual average limit value at the worst-case receptor.

- Mercury – modelling results indicate that under maximum conditions, ambient levels will peak at 0.3% of the ambient annual limit value at the worst-case receptor (including background concentration).

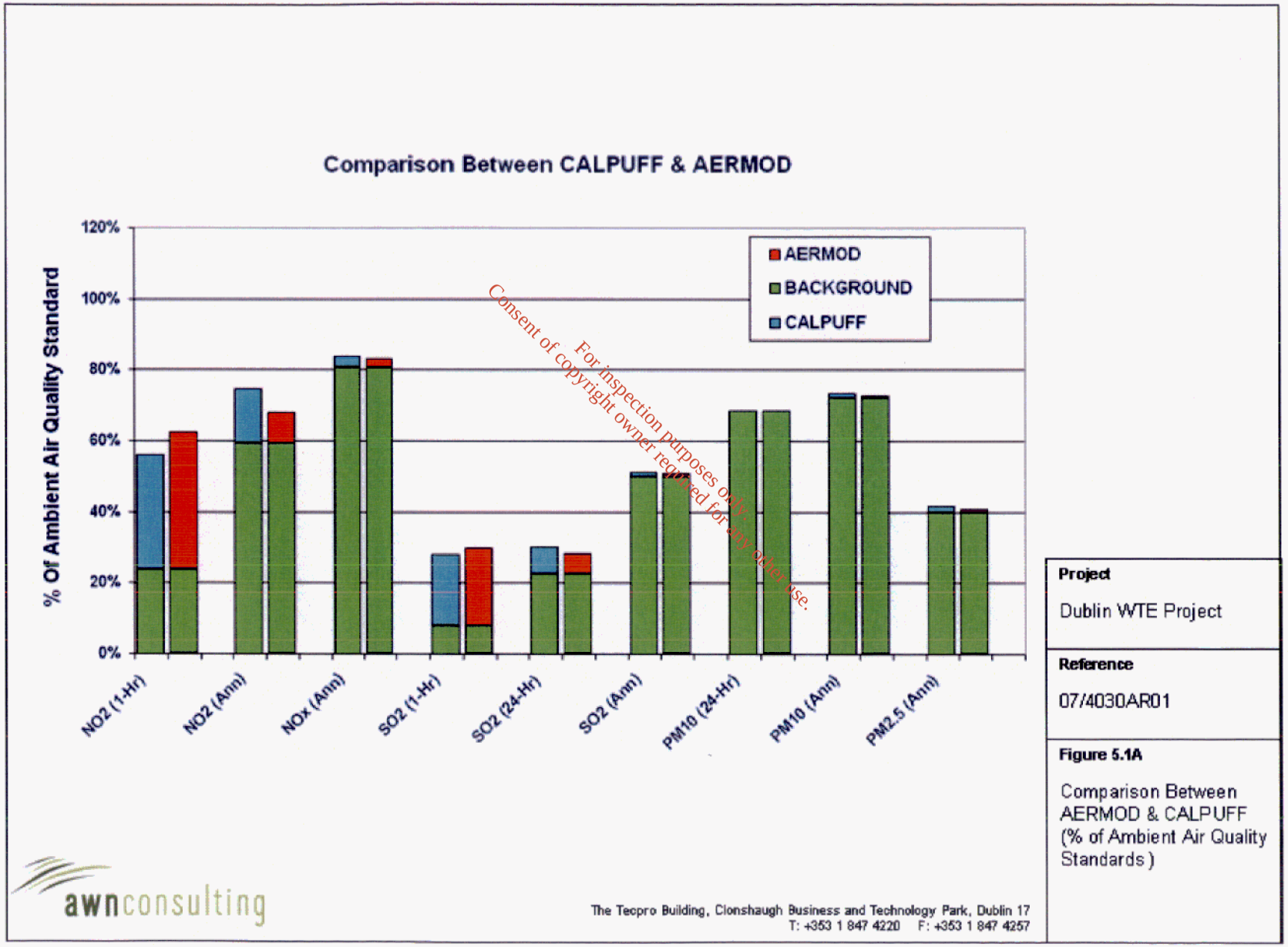
- Cadmium & thallium – modelling results indicate that under maximum conditions, ambient levels will peak at 61% of the ambient annual limit value at the worst-case receptor (including background concentration).

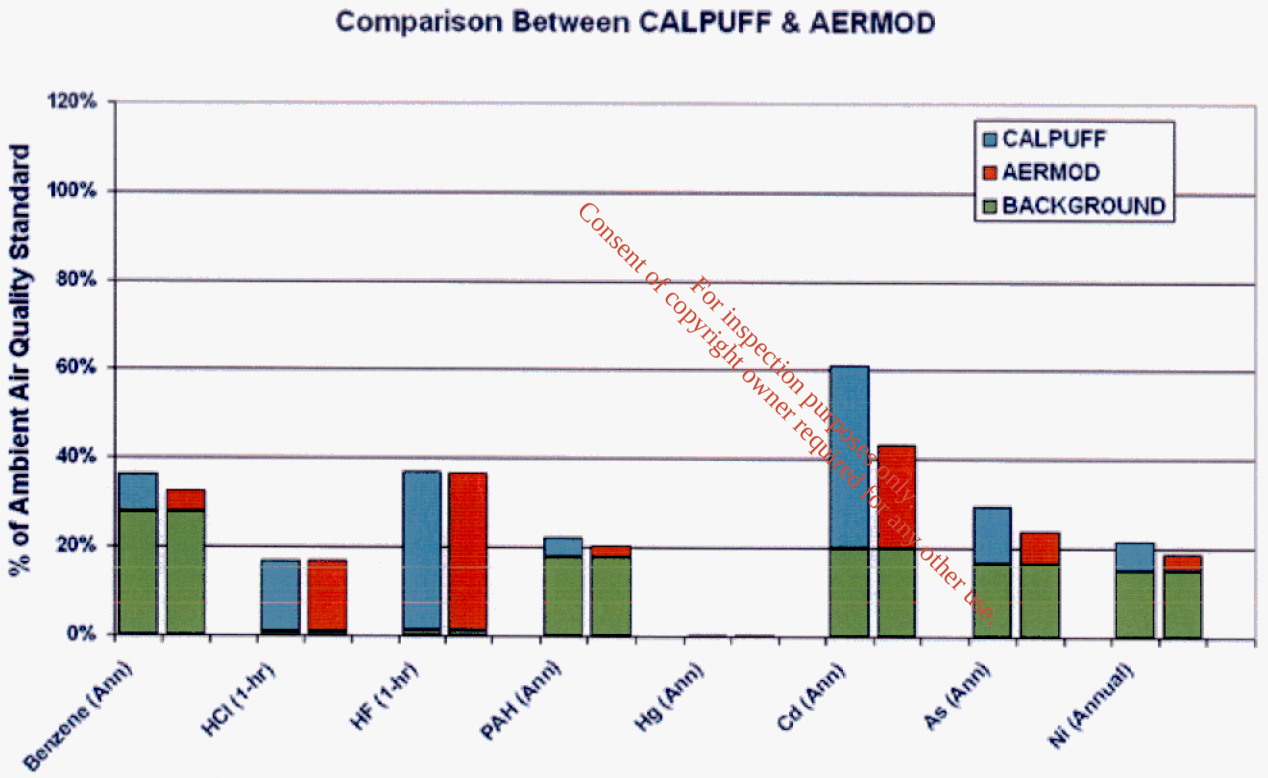
- Sum of Metals – modelling results indicate that under maximum conditions, ambient levels will peak at 22% of the worst-case ambient annual limit values at the worst-case receptor (including background concentration) for the most stringent standards for cobalt, nickel, chromium, copper, vanadium, manganese, lead and antimony.

- Arsenic– modelling results indicate that under maximum conditions, ambient levels will peak at 29% of the ambient annual limit value at the worst-case receptor (including background concentration).

5.5 Summary of Air Quality Assessment Using AERMOD & CALPUFF

AERMOD and SCREEN3 have been used to demonstrate that all air quality emissions from the facility will be in compliance with the ambient air quality standards. CALPUFF was also run and confirms the conclusions of the AERMOD and SCREEN3 assessment that the ambient air quality standards will not be exceeded as shown in Figure 5.1a and 5.1b. The results show that the combination of stringent emission limits laid down in the Waste Incineration Directive and the selected stack height are appropriate in ensuring that the ambient air quality standards are not exceeded.





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Project
Dublin WTE Project

Reference
07/4030AR01

Figure 5.1B
Comparison Between AERMOD & CALPUFF (% of Ambient Air Quality Standards)

6.0 REPLIES TO THIRD PARTY OBJECTIONS – AIR QUALITY

The Principle Objections Relate To:

Issue 1 - Shoreline Fumigation

Issue 2 - Baseline monitoring results - high levels of NO_X, PM_{10} & dioxins

Issue 3 - Impact on Wildlife, Flora & Fauna

Issue 4 - Dust, PM_{10} & Micro-particles, Toxic Metals

Issue 5 - Construction Dust

Issue 6 - Generic Letter - Dioxins, PAHs causing health impact

- Cause Pollution
- Cumulative impact of other pollution sources

Issue 1 - Shoreline Fumigation

Response

Shoreline fumigation may occur when tall stacks are located near shorelines. Guidance from the USEPA indicates that the recommended screening model for such conditions is the SCREEN3 model[1,2]. Shoreline fumigation is generally caused by the movement from a stable marine environment to an unstable inland environment (i.e due to the formation of a sea breeze in early morning) leading to rapid mixing to ground level at the point of contact[2]. The maximum ground-level shoreline fumigation concentration is assumed to occur where the top of the stable plume intersects the top of the well mixed thermal internal boundary layer (TIBL). The SCREEN3 modelling undertaken for the EIS showed that no exceedence of ambient air quality standards would occur under conditions of shoreline fumigation.

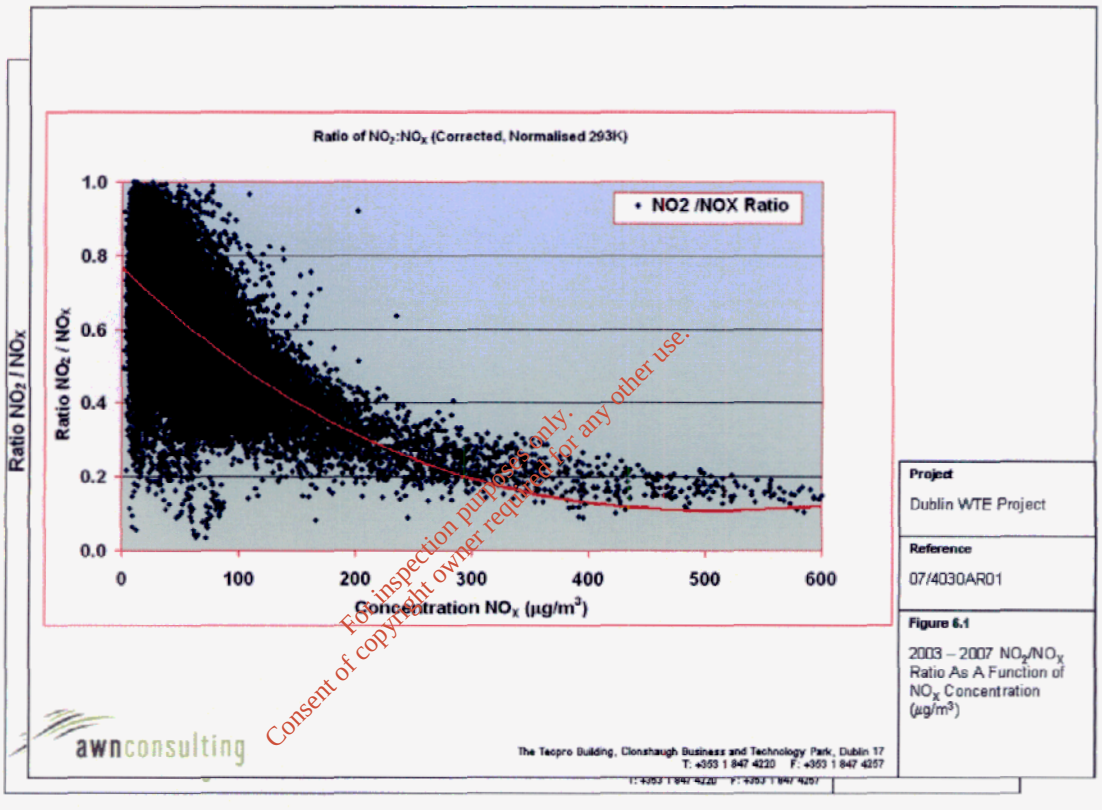
Shoreline fumigation was also examined using CALPUFF which explicitly treats shoreline fumigation episodes. For each modeled hour, the CALPUFF model looks for the conditions under which shoreline fumigation may occur. If the necessary conditions for shoreline fumigation are flagged, the model will calculate ambient concentrations under these conditions. As shown in Figure 5.1a and 5.1b, no ambient air quality standards will be exceeded under shoreline fumigation episodes according to both SCREEN3 and CALPUFF.

Issue 2 - Baseline monitoring results - high levels of NO_2, PM_{10} & dioxins

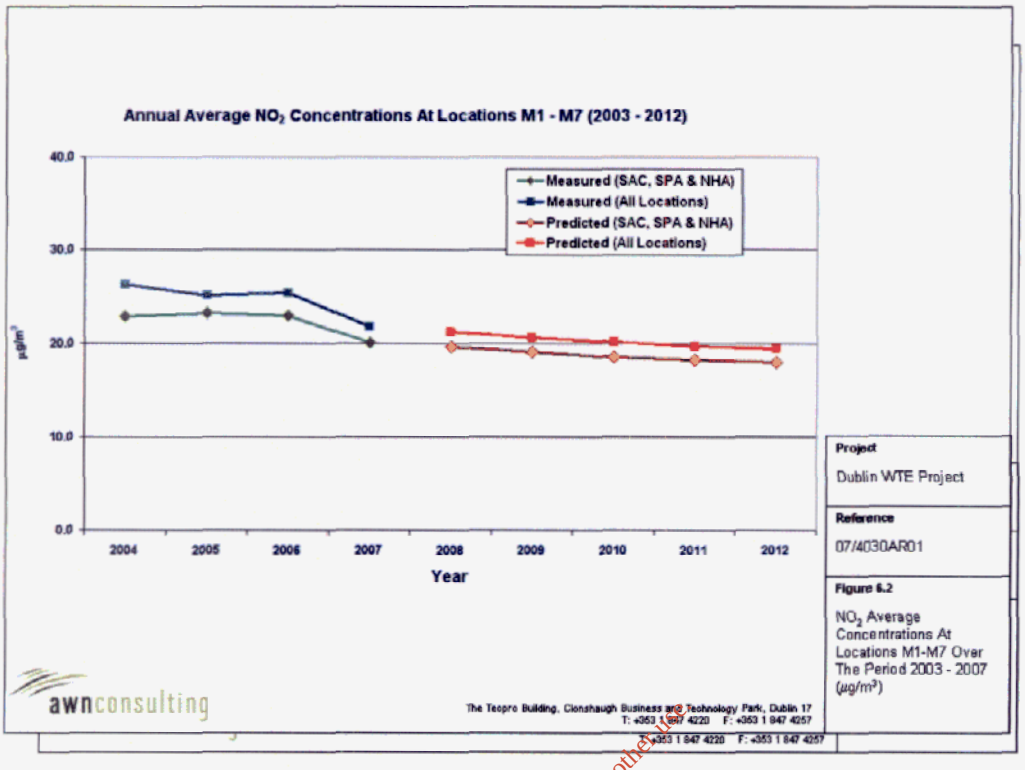
Response

NO_2 & NO_X Baseline Levels

Levels of NO_2 and NO_X have been measured continuously at the M1 monitoring location (Irish Glass Ltd) over the period 2003 - 2007. From this a correlation between the concentration of NO_2 and NO_X has been derived as shown in Figure 6.1:

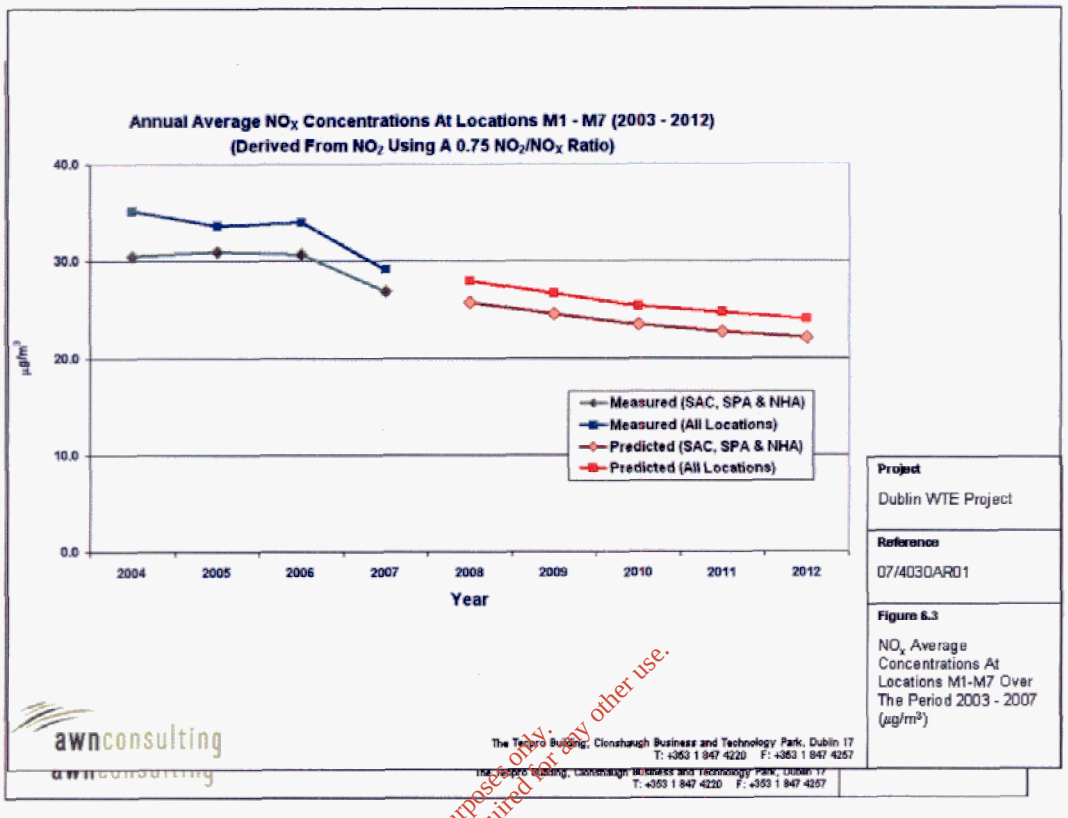


In addition, monitoring for NO_2, using diffusion tubes, has been conducted at six additional locations over the last four years. The average concentrations and the trend in the data at these locations is shown in Figure 6.2: Three of the locations (M2 - Irishtown Nature Reserve, M3 - Sean Moore Road and M6 - Bull Island) would be broadly representative of the average NO_2 concentration in the region of the SAC, SPA and NHA. These three locations have been averaged to determine existing and predicted NO_2 levels on an area-wide basis in the region of the SAC, SPA and NHA.



As can be seen in Figure 6.2, levels have decreased over the period 2003 - 2007. Guidance from the UK[3] predicts levels will continue to decrease in future years as a result of EU legislation which has focussed on reducing emissions from vehicles and large combustion plants. Using the recommended UK emission factors for future years[4] leads to the trend shown in Figure 6.2 over the period 2008 - 2012. A comparison between the trend over the period 2003 - 2007 and the predicted trend over the period 2008 - 2012 shows that they are consistent.

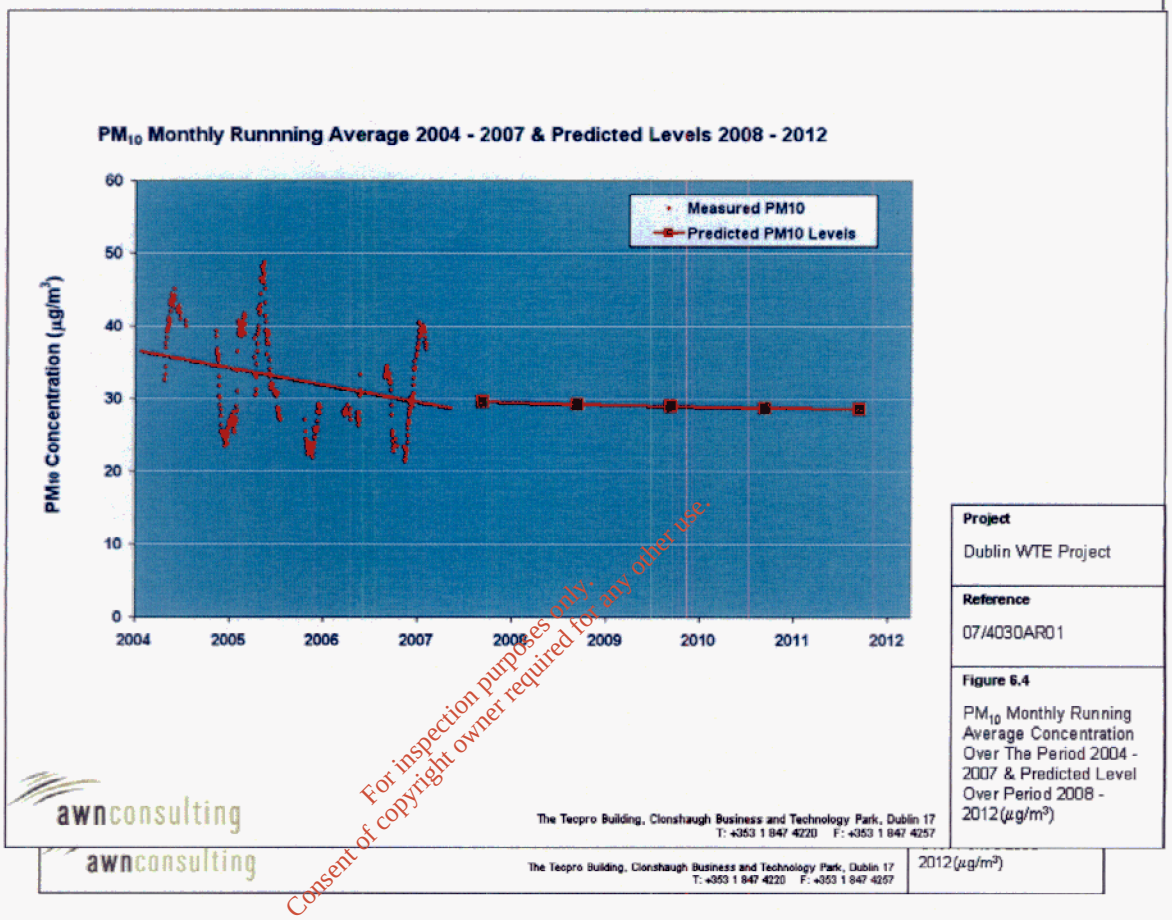
Using the correlation between NO_2 and NO_X as outlined in Figure 6.1 and the measured and predicted NO_2 levels in Figure 6.2, we can derive existing and predicted levels of NO_X in future years both overall and in the region of the ecologically sensitive areas as shown in Figure 6.3:



Based on this analysis, the background level of NO_X in the SAC, SPA & NHA is predicted to be 22.1~~23.7~~ µg/m³ in 2012. Based on an analysis of existing process emissions from the nearby power plants (1.0~~.5~~ µg/m³ based on the average cumulative concentration at Sean Moore Rd, Bull Island and Irishtown Nature Reserve monitoring locations) and the proposed additional traffic due to the facility (0.1 µg/m³), the existing NO_X concentration in the SAC, SPA & NHA is predicted to be 23.~~24.~~2 µg/m³ in 2012.

PM_{10} Baseline Levels

In relation to background levels of PM_{10}, the trend in the data over the last 2-3 years indicates a gradual decrease in annual average data as shown in Figure 6.4 from a level approaching 36 $\mu g/m^3$ in 2004 to approximately 30 $\mu g/m^3$ in 2007.



The UK DEFRA publication "Local Air Quality Management" (LAQM.TG(03))[3] outlines the approach for extrapolating from the current year to the year of opening of the facility (2012). The emission factor tool incorporates the predicted reductions in PM_{10} concentrations in future years. Levels in 2012 using the emission factor tool are predicted to reduce to 28.9 $\mu g/m^3$ as an annual average (including cumulative impacts and additional traffic due to the scheme) (as shown in Figure 6.4). In order to extrapolate from the annual mean to the number of exceedences of the 50 $\mu g/m^3$ 24-hour limit value, the UK LAQM.TG03 has derived an empirical relationship between the number of 24-hour exceedences of 50 $\mu g/m^3$ and the annual mean concentration (which is derived from the UK Automatic Network sites over the period 1997 - 2001). The formula is[3]:

$$Y = -18.5 + 0.00145x \text{ annual mean}^3 + 206/\text{annual mean}$$

$$Y = -18.5 + 0.00145x (28.9)^3 + 206/(28.9)$$

Y = 24 exceedences of the 50 µg/m^3 limit value (35 exceedences are allowable in any one year)

Thus, background levels of PM_{10} in 2012 are predicted to be well in compliance with the ambient air quality standard. Predicted impacts are insignificant as shown in Table 6.1 using AERMOD and Table 6.2 using CALPUFF. In terms of the 24-hour PM_{10} limit value, a breach of the Ambient Air Quality Standard does not have effect unless greater than 35 daily exceedences of the 50 µg/m^3 limit value occurs in a calendar year (as outlined in Council Directive 1999/30/EC):

Table 6.1 AERMOD Model Results – Total Dust (referenced to PM_{10})

Pollutant / Scenario	Averaging Period	Process Contribution	Background	Predicted Emission Concentration (µg/Nm^3)	Standard[1]
PM_{10} / Maximum	Number of exceedences of 50 µg/m^3	none	24 exceedences	24 exceedences	35 exceedences
	Annual mean	0.23	28.9	29.1	40
PM_{10} / Abnormal Operation	Number of exceedences of 50 µg/m^3	One exceedence	24 exceedences	25 exceedences	35 exceedences
	Annual mean	0.27	28.9	29.2	40

(1) Directive 1999/30/EC

Table 6.2 CALPUFF Model Results – Total Dust (referenced to PM_{10})

Pollutant / Scenario	Averaging Period	Process Contribution	Background	Predicted Emission Concentration (µg/Nm^3)	Standard[1]
PM_{10} / Maximum	Number of exceedences of 50 µg/m^3	One exceedence~~n one~~	24 exceedences	25~~24~~ exceedences	35 exceedences
	Annual mean	0.41~~47~~	28.9	29.3~~4~~	40
PM_{10} / Abnormal Operation	Number of exceedences of 50 µg/m^3	One exceedence	24 exceedences	25 exceedences	35 exceedences
	Annual mean	0.49~~56~~	28.9	29.4~~5~~	40

(2) Directive 1999/30/EC

As outlined above both the 24-hour and annual average PM_{10} concentration is within the ambient air quality standards. It should be noted that the release of PM_{10} from the facility will be very low and during maximum operation of the facility will account for less than 1% of the ambient annual average limit value.

Dioxins / Furans Baseline Levels

Dioxin measurements averaged 20 - 21 fg/m^3 over the most recent survey period in 2007. This range is similar to previous ambient measurements in urban and suburban areas of the UK and Europe.

Issue 3 - Impact on Wildlife, Flora & Fauna

Council Directive 1999/30/EC, which has been transposed into Irish Law as S.I. 271 of 2002 has set an annual average limit for NO_x (NO and NO_2) for the protection of vegetation and an annual average and winter average limit value for SO_2 for the protection of ecosystems.

These standards are generally applicable for the protection of vegetation and ecosystems in highly rural areas away from major sources of NO_x such as large conurbations, factories and high road vehicle activity such as a dual carriageway or motorway. Annex VI of EU Directive 1999/30/EC identifies that monitoring to demonstrate compliance with the NOx limit for the protection of vegetation should be carried out at distances greater than:

- 5 km from the nearest motorway or dual carriageway,
- 5 km from the nearest major industrial installation,
- 20 km from a major urban conurbation.

As a guideline, a monitoring station should be indicative of approximately 1000 km^2 of surrounding area. However, representing a worst-case approach, these standards for NO_x and SO_2 has been applied in the region of the surrounding SAC, SPA and NHA which covers Bull Island, the Dublin Bay coastline and the surrounding waters which covers an area of approximately 80km^2.

SO_2

Current levels of SO_2 are low in Dublin and the impact of the facility will be insignificant as shown in Table 6.3 for AERMOD and Table 6.4 for CALPUFF:

Table 6.3 AERMOD Model Results – Sulphur Dioxide In The Region of The SAC, SPA & NHA

Pollutant / Scenario	Averaging Period	Process Contribution ($\mu g/m^3$)(3)	Background ($\mu g/m^3$)(1)	Predicted Emission Concentration ($\mu g/Nm^3$)	Standard(2) ($\mu g/Nm^3$)
SO_2 / Maximum	Annual Average	0.22	10	10.2	20
SO_2 / Abnormal	Annual Average	0.22	10	10.2	20

(1) Background based on 2006 baseline measurement data in the region of the SAC, SPA & NHA
(2) Directive 1999/30/EC for the protection of ecosystems
(3) Based on an 80km^2 area-wide average of process emissions in the region of the SAC, SPA & NHA.

Table 6.4 CALPUFF Model Results – Sulphur Dioxide In The Region of The SAC, SPA & NHA

Pollutant / Scenario	Averaging Period	Process Contribution ($\mu g/m^3$)(3)	Background ($\mu g/m^3$)(1)	Predicted Emission Concentration ($\mu g/Nm^3$)	Standard(2) ($\mu g/Nm^3$)
SO_2 / Maximum	Annual Average	0.25	10	10.3	20
SO_2 / Abnormal	Annual Average	0.25	10	10.3	20

(1) Background based on 2006 baseline measurement data in the region of the SAC, SPA & NHA
(2) Directive 1999/30/EC for the protection of ecosystems
(3) Based on an 80km^2 area-wide average of process emissions in the region of the SAC, SPA & NHA.

NO_X

In relation to NO_X, as outlined in Section 6.2, existing NO_X concentration in the SAC, SPA & NHA is predicted to be of the order of 2324.2 $\mu g/m^3$ in 2012 based on an area-wide average.

The NO_X standard for the protection of vegetation, EU Council Directive 1999/30/EC, is clear in regards to the extent of spatial averaging which should be employed for the purpose of determining compliance with the Directive. Annex VI 1(b) states:

"*Sampling points targeted at the protection of ecosystems or vegetation should be sited more than 20km from agglomerations or more than 5 km from other built-up areas, industrial installations or motorways. As a guideline, a sampling point should be sited to be representative of air quality in a surrounding area of at least* ***1000 km²***."

The geographical extent of the SAC, SPA and NHA in the region of Dublin Bay extends to approximately 80km^2. Thus, mindful of the guidance in the Directive, the process emissions from the facility have been averaged over the region of the SAC, SPA and NHA. This is in line with the approach used to derive the background levels in the region also.

Results for NO_X, based on this approach, using AERMOD are shown in Table 6.5 and using CALPUFF are shown in Table 6.6. Full compliance with the ambient air quality standards for NO_X is achieved. Thus the impact of the facility will not lead to an exceedence of the ambient air quality standard for NO_X for the protection of vegetation.

Table 6.5 AERMOD Dispersion Model Results – Nitrogen Dioxide & Nitrogen Oxides (Year 2012)

Pollutant / Scenario	Averaging Period	Process Contribution (µg/m^3)	Background Concentration (µg/m^3)(1)	Predicted Emission Concentration (µg/Nm^3)	Standard(2) (µg/Nm^3)	Dublin WTE emissions as a % of ambient limit value
NO_2 / Maximum	Annual Mean(3)	3.5	23.21	26.76	40	8.8%
	99.8th%ile of 1-hr means(4)	77.6	46.42	124	200	24%
NO_2 / Abnormal Operation	Annual Mean(3)	3.5	23.21	26.76	40	8.8%
	99.8th%ile of 1-hr means(4)	79.1	46.62	126125	200	40%
NO_X / Maximum	Annual Mean	0.8(6)	2324.2(5)	2425.0	30	3%
NO_X / Abnormal Operation	Annual Mean	0.8(6)	2324.2(5)	2425.0	30	3%

(1) Includes contribution from traffic and background sources (based on results from diffusion tubes) and incorporating the cumulative assessment results.
(2) Directive 1999/30/EC
(3) Conversion factor following guidance from USEPA (Tier 2 analysis, annual average) based on the site-specific ratio of 0.75.
(4) Conversion factor, following guidance from USEPA (Tier 3 analysis), based on empirically derived site-specific maximum 1-hour value for NO_2 / NO_X of 0.50
(5) Conversion factor from NO_2 to NO_X based on the site-specific ratio of 0.75 and using average of annual average NO_2 levels for Bull Island, Sean Moore Road and Irishtown Nature Reserve (corrected to Year 2012 based on background NO_X conversion factors for future years).
(6) Based on an 80km^2 area-wide average of process emissions in the region of the SAC, SPA & NHA.

Table 6.6 CALPUFF Dispersion Model Results – Nitrogen Dioxide & Nitrogen Oxides (Year 2012)

Pollutant / Scenario	Averaging Period	Process Contribution ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)(1)	Predicted Emission Concentration ($\mu g/Nm^3$)	Standard(2) ($\mu g/Nm^3$)	Dublin WTE emissions as a % of ambient limit value
NO_2 / Maximum	Annual Mean(3)	7.1	23.21	30.32	40	17.8%
	99.8th%ile of 1-hr means(4)	65.9	46.62	112	200	33%
NO_2 / Abnormal Operation	Annual Mean(3)	7.1	23.21	30.32	40	17.8%
	99.8th%ile of 1-hr means(4)	65.9	46.62	112	200	33%
NO_X / Maximum	Annual Mean	1.0(6)	2324.2(5)	2425.2	30	3%
NO_X / Abnormal Operation	Annual Mean	1.0(6)	2324.2(5)	2425.2	30	3%

(1) Includes contribution from traffic and background sources (based on results from diffusion tubes) and incorporating the cumulative assessment results.
(2) Directive 1999/30/EC
(3) Conversion factor following guidance from USEPA (Tier 2 analysis, annual average) based on the site-specific ratio of 0.75.
(4) Conversion factor, following guidance from USEPA (Tier 3 analysis), based on empirically derived site-specific maximum 1-hour value for NO_2 / NO_X of 0.50
(5) Conversion factor from NO_2 to NO_X based on the site-specific ratio of 0.75 and using average of annual average NO_2 levels for Bull Island, Sean Moore Road and Irishtown Nature Reserve (corrected to Year 2012 based on background NO_X conversion factors for future years).
(6) Based on an $80km^2$ area-wide average of process emissions in the region of the SAC, SPA & NHA.

Issue 4 - Dust, PM_{10} & Micro-particles, Toxic Metals

Response

Current legislation in relation to dust / particulates is referenced in terms of PM_{10} (i.e. particulate matter less than 10 microns) (Council Directive 1999/30/EC). Although the Incineration Directive (2000/76/EC) refers only to dust, as a worst-case, emissions at the maximum emission limits outlined in the Directive were assumed to consist of solely PM_{10}. Results indicated that ambient ground level concentrations, due to emissions from the facility, accounted for less than 0.6% of the ambient annual limit value. In relation to the metal fraction of the dust, each specific metal which is regulated under Council Directive 2000/76/EC has been modelled to ensure ambient levels are below the relevant ambient air quality limit values.

Proposed Directive COM(2005) 447 on Ambient Air Quality and Cleaner Air for Europe (21/09/2005) has recently outlined proposals to revise and combine several existing Ambient Air Quality Standards including Council Directives 96/62/EC, 1999/30/EC and 2000/69/EC. In regards to existing ambient air quality standards, it is not proposed to modify the standards but to strengthen existing provisions to ensure that non-compliances are removed. It is however proposed to set new ambient standards for $PM_{2.5}$.

The proposed approach for $PM_{2.5}$ is to establish a concentration cap of 25 $\mu g/m^3$, as an annual average (to be attained by 2010), coupled with a non-binding target to reduce human exposure generally to $PM_{2.5}$ between 2010 and 2020. This exposure reduction target is currently proposed at 20% of the average exposure indicator (AEI). The AEI is based on measurements taken in urban background locations averaged over a three year period.

Thus, the assessment also assumed all dust emissions from the facility was emitted as $PM_{2.5}$ with ambient ground level concentrations significantly below the air quality standards for $PM_{2.5}$ under both typical and maximum operation of the site. Thus, no adverse environmental impact is envisaged to occur under these conditions at or beyond the site boundary. Emissions at maximum operations equate to an ambient $PM_{2.5}$ concentration (excluding background concentrations) which are less than 1% of the annual limit value at the worst-case receptor.

No ambient air quality standards are expressed in terms of particle numbers or in terms of size distributions. However, a recent research paper[5] has studied in detail the emission of particles from modern municipal waste incinerators including a detailed investigation of particle numbers and particle size distribution. The study concluded that:

> *"The removal efficiency for PM_{10} of the flue gas treatment systems in all plants is very good. The number concentration of most plants is in the same order of magnitude as ambient air. According to our measurements we can state that waste incineration plants with up-to-date flue gas cleaning systems are not a*

relevant source for the emission of ultra fine particles into the environment. Particles above 1 micron are almost completely eliminated".[5]

Issue 5 - Construction Dust

Response

A dust minimisation plan will be formulated for the construction phase of the project, as construction activities are likely to generate some dust emissions.

In order to ensure that no dust nuisance occurs, a series of measures will be implemented.

- Hard surface roads will be swept to remove mud and aggregate materials from their surface while any un-surfaced roads will be restricted to essential site traffic only apart from the contractor's car park which will be hardcore only.

- Furthermore, any road that has the potential to give rise to fugitive dust must be regularly watered, as appropriate, during dry and/or windy conditions.

- Vehicles using site roads will have their speed restricted, and this speed restriction must be enforced rigidly. Indeed, on any un-surfaced site road, this will be 20 kph, and on hard surfaced roads as site management dictates.

- Vehicles delivering material with dust potential (soil, aggregates) will be enclosed or covered with tarpaulin at all times to restrict the escape of dust.

- Wheel washing facilities will be provided for vehicle exiting site in order to ensure that mud and other wastes are not tracked onto public roads.

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

- Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind. Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods.

- During movement of materials both on and off-site, trucks will be stringently covered with tarpaulin at all times. Before entrance onto public

roads, trucks will be adequately inspected to ensure no potential for dust emissions.

At all times, these procedures will be strictly monitored and assessed. In the event of dust nuisance occurring outside the site boundary, movements of materials likely to raise dust would be curtailed and satisfactory procedures implemented to rectify the problem before the resumption of construction operations.

Issue 6 - Generic Letter - Dioxins, PAHs causing health impact

Response

The modelling of emissions to air from the Dublin Waste To Energy facility indicates that the ambient ground level concentrations will be below the relevant air quality standards or guidelines for all compounds emitted from the facility even under abnormal operating conditions. A detailed cumulative assessment was also undertaken and assessed the impact of background levels of pollutants, traffic-derived sources and other industrial sources in the region. The results show that the combination of stringent emission limits laid down in the Waste Incineration Directive and the selected stack height are appropriate in ensuring that the ambient air quality standards are not exceeded.

References

(1) USEPA (2005) Guidelines on Air Quality Models, Appendix W to Part 51, 40 CFR Ch.1
(2) USEPA (1995) SCREEN3 Model User's Guide
(3) UK DEFRA (2003) Part IV of the Environment Act 1995: Local Air Quality Management, LAQM.TG(03)
(4) http://www.airquality.co.uk/archive/laqm/tools.php?tool=year04
(5) Zurcher et al "Ultra Fine Particles From Municipal Solid Waste Incineration" Proceedings from Waste-to-Energy State of the Art & Latest News, Malmo, Sweden, 2001.