Air Quality Assessment of Emissions of Particulate Matter to Atmosphere from Advanced Recycling and Electricity Generation Facility, Oldbury

P1915

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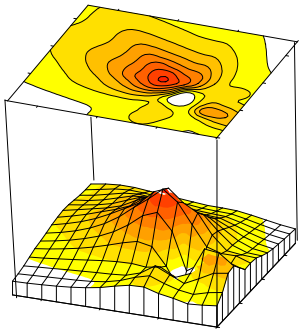

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1	INTRODUCTION	1
2	POLLUTANTS, ASSESSMENT AND SIGNIFICANCE CRITERIA	3
2.1	INTRODUCTION	3
2.2	ENVIRONMENTAL PERMITTING (ENGLAND AND WALES) (AMENDMENT) REGULATIONS 2018	3
2.2.1	Particulate Matter (PM_{10} & $PM_{2.5}$)	3
2.3	ENVIRONMENTAL ASSESSMENT LEVEL (EAL)	4
2.4	SIGNIFICANCE CRITERIA	4
2.4.1	Environment Agency (EA)	4
2.4.2	Institute of Air Quality Management (IAQM)	5
3	AMBIENT AIR QUALITY DATA	7
3.1	INTRODUCTION	7
3.2	SANDWELL MBC REVIEW AND ASSESSMENT OF AIR QUALITY	7
3.3	MEASURED POLLUTANT CONCENTRATIONS	7
3.4	ESTIMATED BACKGROUND CONCENTRATIONS	8
4	METHODOLOGY	9
4.1	INTRODUCTION	9
4.2	EMISSIONS DATA	9
4.3	RECEPTORS	9
4.4	FACTORS AFFECTING DISPERSION	10
4.4.1	Physical Characteristics of the Emissions	11
4.4.2	Climate	11
4.4.3	Building Downwash	11
4.4.4	Nature of the Surface	12
4.5	SELECTION OF SUITABLE DISPERSION MODEL	13
4.6	METEOROLOGICAL DATA	13
4.7	PERCENTAGE OXIDATION OF NITRIC OXIDE (NO) TO NITROGEN DIOXIDE (NO_2)	14
5	PREDICTIONS AND ASSESSMENT OF IMPACTS	15
5.1	INTRODUCTION	15
5.2	SCREENING: STAGE 1	15
5.3	SCREENING: STAGE 2	16
5.4	DETAILED MODELLING AND ASSESSMENT OF SIGNIFICANCE	16
6	SENSITIVITY ANALYSIS	23
6.1	INTRODUCTION	23
6.2	METEOROLOGICAL DATA	23
6.3	ROUGHNESS LENGTH	23
6.4	GRID SPACING	24
6.5	BUILDING DOWNWASH AND TERRAIN	24
6.6	STACK HEIGHT	25
7	SUMMARY AND CONCLUSIONS	27

1 INTRODUCTION

R Williams Consultants Ltd has commissioned Atmospheric Dispersion Modelling Ltd (ADM Ltd) to undertake an air quality assessment of emissions to the atmosphere of particulate matter relating to the proposed variation to the existing environmental permit **EPR/GP3739VR/V003 for Innovative Environmental Solutions UK Limited, Oldbury, West Midlands**.

The variation proposed is to add a new activity - 5.4 Part A(1)(b)(iv) (treatment in shredders of metal waste, including waste electrical and electronic equipment and end-of-life vehicles and their components) and retain the existing activity - Section 5.1 Part A(1)(b): the incineration of non-hazardous waste in an incineration plant with a capacity exceeding 3 tonnes per hour.

However, in order to include the new activity - an area within the existing permit boundary would be required.

The existing permit incorporated two incineration lines in total for the 5.1 Part A(1)(b) activity. Adding the 5.4 Part A(1)(b)(iv) activity would require using the area that was to be utilised by the second incineration line. Only one incineration line was ever built, so this means that the second incineration line will never be built. The impacts on air quality of the two incinerators lines were detailed in air quality assessment that supported the permit application (1). Given that only one line will now operate the presented impacts are conservative and there is only the need to consider and assess emissions of particulate matter from the new process.

The variation proposed also includes the reduction of the Section 5.1 Part A(1)(b) to just one incineration line processing only half of the currently permitted waste throughput.

As such, the main dual flue stack that was to serve both incineration lines will now just be a single flue stack.

With regards to the new Schedule 5.4 Part A(1)(b)(iv) activity:

There will be extensive use of air within this process to capture the dust produced by the new activity, to transport the materials and to separate heavy and light materials.

There will be five separate air systems, as follows:

- One preparation unit
- Three grinding units
- One separation unit

To minimise emissions of particulate matter, the air from each system will be passed through cyclones and baghouses before it is discharged to the atmosphere via five new separate 21.5 m high stacks (reference A04-A08).

(1) ADM Ltd (27 March 2013) Air Quality Assessment of Emissions to Atmosphere from Proposed Advanced Recycling and Electricity Generating Facility

Given that the only pollutant released to atmosphere from the proposed new process is particulate matter this assessment is limited to an assessment of the emissions of PM_{10}. $PM_{2.5}$ is also considered and assessed using the conservative assumption that all the PM_{10} is $PM_{2.5}$.

The impacts of emissions of PM_{10} and $PM_{2.5}$ from the proposed new process is considered and assessed both in isolation and in combination with the emissions to atmosphere from the existing process (now only one incineration line) which is released to atmosphere from a single flue in the existing 50 m stack.

The ADMS 5.2 dispersion model has been used to make predictions of ground-level concentrations of PM_{10} and $PM_{2.5}$.

The remainder of the report is structured as follows:

- *Section 2* description of the assessment criteria and planning policy.
- *Section 3* presents an assesses the existing air quality
- *Section 4* describes the modelling methodology
- *Section 5* presents the predicted concentrations
- *Section 6* sensitivity analysis
- *Section 7* provides a summary and conclusions.

2 POLLUTANTS, ASSESSMENT AND SIGNIFICANCE CRITERIA

2.1 INTRODUCTION

This section presents the assessment and significance criteria that are relevant to support an application to the Environment Agency (EA).

2.2 ENVIRONMENTAL PERMITTING (ENGLAND AND WALES) (AMENDMENT) REGULATIONS 2018

The Environmental Permitting (England and Wales) (Amendment) Regulations 2018 (referred to as EPR herein), came into force on 29 January 2018 (1). The 2018 as amended Regulations revoke the Environmental Permitting (England and Wales) 2007 (as amended) as well as the Environmental Permitting (England and Wales) Regulations 2010 (as amended). A further amendment (2019, EU Exit) comes into force on the day that the UK leaves the EU to ensure that the Environmental Permitting regulations will continue to function.

The PPC component of the EPR provides an integrated approach to controlling pollution from industrial sources. Its main aim is to achieve "*a high level of protection of the environment taken as a whole*…", by measures designed to prevent or, where that is not practicable, reduce emission to air, water and land. An operator is required to obtain an EPR permit from the regulatory authority which for Part A installations is the Environment Agency which has responsibility for determining applications for permits and setting appropriate permit conditions.

The PPC programme has several objectives that include the setting of emission limit values based on the assessment of Best Available Techniques (BAT) and the consideration of any relevant site-specific issues. BAT is defined as "*the most effective and advanced stage in the development of activities and their methods of operation which indicates the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole*".

Activity-specific guidance for the sectors regulated under the EPR is available to assist with the preparation of an application and the operation of a facility. Also, supplementary guidance is available that is relevant to all sectors and is referred to as horizontal guidance - for example, Environmental Risk Assessment (2).

2.2.1 Particulate Matter (PM_{10} & $PM_{2.5}$)

Particulate matter (PM) is a term used to describe all suspended matter, sometimes referred to as total suspended particulate matter. Sources of particles in the air include road transport, power stations and other industry, quarrying, mining and agriculture. Chemical processes in the air can also lead

(1) Environmental Permitting Regulations (England and Wales) (Amendment) Regulations 20186.
(2) https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit.

to the formation of particles. PM_{10} is the subject of health concerns because of the ability to penetrate and remain deep within the lungs. In recent years, epidemiological studies have shown increases in mortality correlated with concentrations of PM_{10} (COMEAP, 2009). There is an increasing focus on $PM_{2.5}$ (particulate matter with an aerodynamic diameter of less than 2.5 μm) that gives a stronger association with ill-health than PM_{10}. Given that $PM_{2.5}$ is a subset of PM_{10}. ie all $PM_{2.5}$ is also PM_{10}, consideration is made of the effects of $PM_{2.5}$ by making the conservative assumption that all the PM_{10} is $PM_{2.5}$.

It is sometimes suggested that $PM_{10}/PM_{2.5}$ or nano-particulates (particles between 1 and 100 nanometres, nm) emitted to the atmosphere from waste to energy facilities are more harmful than typical/normal prevailing background particulate matter. There is no evidence to support this; the health effects attributed to $PM_{10}/PM_{2.5}$ are derived from a large number of epidemiological studies from a full range of sources. In this context, the Health Protection Agency (HPA) state "*It is it is worth noting that PM_{10} and $PM_{2.5}$ samples from around the world can vary substantially in their chemical composition and size distribution but nonetheless exhibit similar concentration-response coefficients in time-series epidemiological studies".* (1)

2.3 ENVIRONMENTAL ASSESSMENT LEVEL (EAL)

Table 2.1 shows the Environmental Assessment Levels (EALs) used in the assessment to assess the impacts on human health.

Table 2.1 Environmental Assessment Level (EAL)

Pollutant	Concentration ($\mu g\ m^{-3}$)	Averaging Period	Allowable Number of Exceedences per year
Particulate matter (PM_{10})	50	24 hour	35
	40	Annual	-
Particulate matter ($PM_{2.5}$)	20	Annual	-

2.4 SIGNIFICANCE CRITERIA

2.4.1 Environment Agency (EA)

The Environment Agency's risk assessment guidance includes a test for insignificance and a second stage test to determine if detailed modelling is required.

Stage 1

The risk assessment guidance states that the process contribution (PC) can be considered as insignificant if:

- the long term PC is <1% of the assessment criteria

(1) Health Protection Agency (September 2009) The Impacts on Health of Emissions to Air from Municipal Waste Incinerators

- the short term PC is < 10% of the assessment criteria

This is not to say that if these thresholds are exceeded the Process Contribution (PC) is significant, just that it cannot be ruled out as being insignificant.

Stage 2

If the impact has not been screened out as being insignificant, then the second stage of screening can be used to determine if detailed modelling and assessment are needed.

Detailed modelling and assessment are needed if either of the following is the case:

- the short-term Process Contribution (PC) is more than 20% of the short-term Environmental Assessment Level (EAL) minus twice the long-term background concentration

- the long-term Predicted Environmental Concentration (PEC) is greater than 70% of the long-term EAL.

The Environment Agency (EA) does not provide guidance on what is an acceptable level of impact, so it is necessary to resort to alternative sources to determine if the predicted impacts are significant or not.

2.4.2 Institute of Air Quality Management (IAQM)

The impact refers to the change that is predicted to take place to the prevailing environment as a result of the proposed development (ie the incremental increase or decrease in pollutant concentration).

The significance of an impact is generally determined by the combination of the 'sensitivity' and 'value' of the affected environmental receptor and the predicted "extent" and "magnitude" of the impact or change. The impact descriptors used in this assessment are taken from the IAQM/EPUK guidance for planning and air quality (1). The assessment of significance ultimately relies on professional judgement, although comparing the extent of the impact with criteria and standards specific to each environmental topic can guide this judgement.

Details of the impact descriptors used in this assessment are shown in **Table 2.2.** It should be noted that the IAQM/EPUK impact descriptors refer to permanent changes in air quality brought about by a development and not short term or temporary changes. They also refer to locations where there is relevant exposure. The criteria, therefore, are only appropriate for changes to annual average concentrations at locations where there is relevant exposure; ie not generally the point of maximum impact.

(1) Environmental Protection UK/IAQM (January 2017) Land-Use Planning& Development Control: Planning for Air Quality.

Table 2.2 IAQM/EPUK Air Quality Impact Descriptors for Individual Receptors

Long Term Average Concentration at Receptor in Assessment Year	% Change in Concentration Relative to Air Quality Assessment Level (AQAL)			
	1	2-5	6-10	>10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
102%-109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial
Note: Changes less than 0.5% are Negligible.				

The IAQM guidance on significance shown in **Table 2.2** is only applicable to long term/annual average impacts.

IAQM provides the following guidance for peak short term concentrations from an elevated source, as shown below.

Magnitude of Impact (percentage of relevant Air Quality Assessment Level, AQAL):

- 10-20% Small;
- 20-50% Medium;
- >50% Large.

The corresponding severity of these impacts can be described as slight, moderate and substantial without the need to reference to background or baseline concentration.

3 AMBIENT AIR QUALITY DATA

3.1 INTRODUCTION

This section presents the available and relevant available information on ambient concentrations of PM_{10} in the region of the installation.

3.2 SANDWELL MBC REVIEW AND ASSESSMENT OF AIR QUALITY

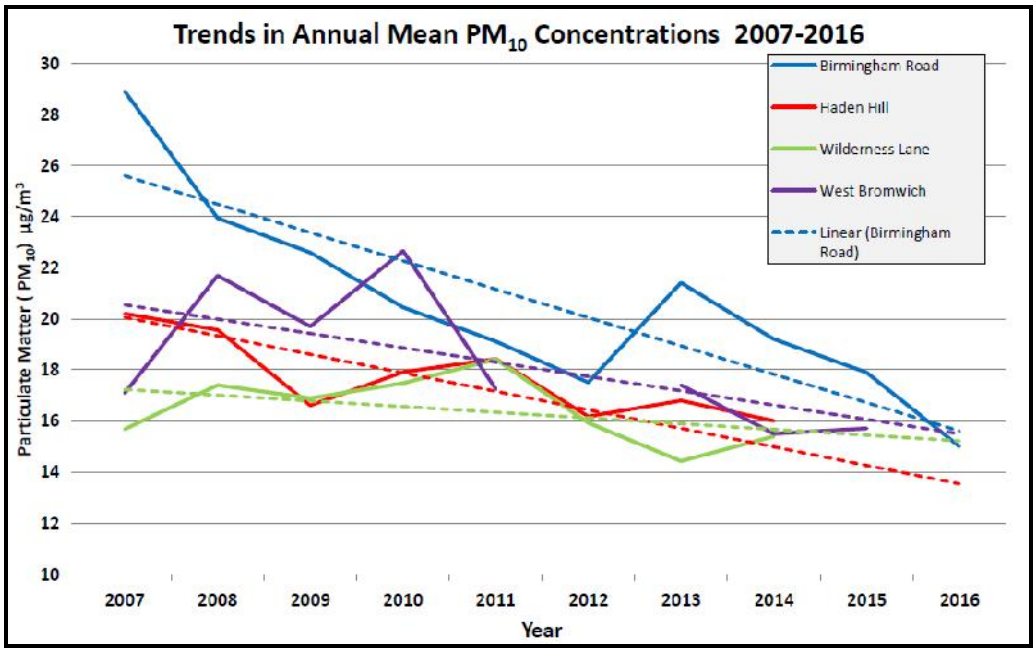
Sandwell's Borough Council identified several areas where objectives for nitrogen dioxide (NO_2) were being exceeded and in 2005 declared an AQMA for nitrogen dioxide (NO_2) covering the whole borough.

The measured concentrations of PM_{10} are all significantly below the annual average Air Quality Strategy (AQS) objective of 40 μg m^{-3}.

3.3 MEASURED POLLUTANT CONCENTRATIONS

Sandwell MBC operates an extensive monitoring network that includes both passive and continuous sampling. The closest monitoring site for PM_{10} is the Birmingham Road site which is 1.3 km to the east of the site. **Figure 3.1** shows that the measured concentration of PM_{10} is on a downward trend and are significantly below the Air Quality Strategy (AQS) objective of 40 μg m^{-3}. The measured annual average concentration of PM_{10} at Birmingham Road was for 15.0 μg m^{-3} in 2016.

Figure 3.1 Trends in Annual Mean PM_{10} Concentrations (2007-2016)



Source: Sandwell MBC (December 2017) Air Quality Annual Status Report

3.4 ESTIMATED BACKGROUND CONCENTRATIONS

Defra estimates the background concentration for several pollutants for many years on a 1 km grid resolution for the whole of the UK.

The closest grid point for which Defra estimates of background pollutant concentrations are available is 398500,290500, which is considered to be representative of the location of the installation.

Table 3.1 shows the Defra estimated background concentration for 2019.

Table 3.1 Estimated Annual Average Background Concentration of Particulate matter (PM_{10}) for 2019 ($\mu g\ m^{-3}$) for Grid Reference 398500,290500

Year	Particulate Matter (PM_{10})	Particulate Matter ($PM_{2.5}$)
2019	15.5	10.4
Assessment Criteria	**40**	**20**

Table 3.1 shows that Defra estimated background concentrations of particulate matter (PM_{10} and $PM_{2.5}$) are significantly less than the Air Quality Strategy objective of 40 $\mu g\ m^{-3}$ and 20 $\mu g\ m^{-3}$. It is considered that the background levels shown in **Table 3.1** provide a reasonable estimate of the background concentrations in the region of the installation.

4 METHODOLOGY

4.1 INTRODUCTION

This section describes the methodology and assumptions made for the air quality assessment. Also described are the emissions data used.

4.2 EMISSIONS DATA

Table 4.1 shows the parameters which describe the physical properties of emissions from the stack, as required for the definition of the emissions in dispersion modelling terms. These data are conservative estimates of the emission rates with the units operating continuously, at full load and at their emission limits.

Table 4.1 Emissions and Physical Properties

Stack Number	A01	A04	A05	A06	A07	A08
OS Grid Reference (m)	398429 290777	398462 290832	398470 290827	398485 290817	398483 290865	398492 290861
Release height above ground level (m)	50	21.5	21.5	21.5	21.5	21.5
Exhaust gas oxygen content (% v/v wet)	4.1	-	-	-	-	-
Exhaust gas water content (% v/v)	13.5	-	-	-	-	-
Flue diameter (m)	1.35	0.98	0.62	1.10	0.62	0.62
Exit velocity (m s^{-1})	30.6	9.9	13.8	11.7	13.8	13.8
Flue gas emission temperature (deg C)	150	20	20	20	20	20
Actual volumetric flow rate (Am^3 s^{-1})	43.8	7.5	4.2	11.1	4.2	4.2
Normalised volumetric flow (Nm^3 s^{-1}) (a)	40.1	7.5	4.2	11.1	4.2	4.2
PM_{10} emission conc (mg Nm^{-3})	10	5	5	5	5	5
PM_{10} emission rate (g s^{-1})	0.40	0.038	0.021	0.056	0.021	0.021

(a) Corrected for: temperature; 273 k; pressure; 101.3kPa (1 atmosphere); dry; 11% v/v O_2.

4.3 RECEPTORS

To determine the maximum ground-level concentrations occurring due to emissions to the atmosphere from the installation and the distribution of impacts, predictions are made of ground-level concentrations for a grid of receptors. The receptor grid is 1,000 m by 1,000 m with spacing of 10 m. Making predictions for a grid of receptors also allows the predicted ground-level concentrations to be presented as contour plots.

The specific receptors used in this assessment are locations where there is relevant exposure such as residential properties.

For the purposes of Local Air Quality Management (LAQM), the Air Quality Strategy Objectives (AQS) only apply where there is relevant exposure. 'Relevant exposure' is defined as being where members of the public are regularly present and are likely to be exposed for a period of time, appropriate to the averaging period of the objective. For the annual average objective, locations of relevant exposure include residential properties, schools and

hospitals.

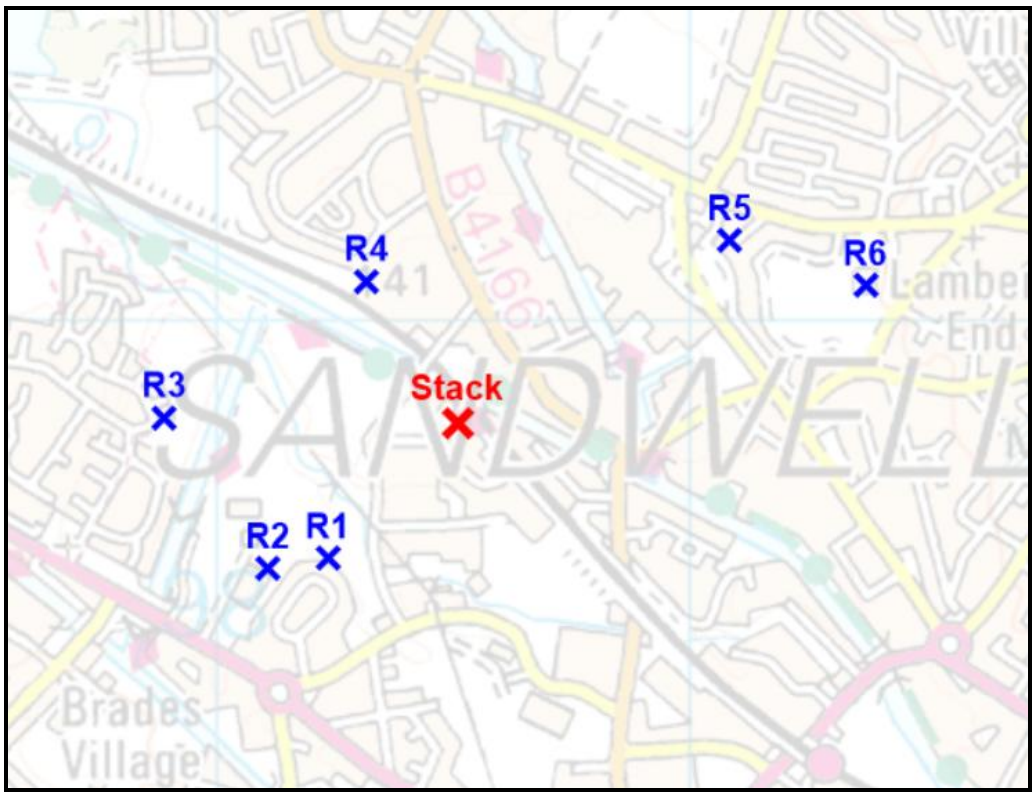
Table 4.2 presents details of the specific receptors included in the modelling which have been selected because of the potential for relevant exposure.

Table 4.2 Receptor Locations

No.	Description	Type	OS Grid Reference (m)
R1	Theodore Close	Residential	398236 290495
R2	Meadows Sport Club	Sport Club	398109 290474
R3	Palmerston Drive	Residential	397890 290794
R4	Whitgreave St	Residential	398318 291083
R5	Millward St	Residential	399086 291169
R6	Guns Village Primary	School	399373 291073

Figure 4.1 shows the locations of the receptors and the stack.

Figure 4.1 Location of Receptors and Stack



4.4 FACTORS AFFECTING DISPERSION

There are a number of factors that will affect how emissions disperse once released to atmosphere. The four factors having the greatest effect on dispersion are:

- physical characteristics of the emissions;
- climate;

- terrain; and
- building downwash.

4.4.1 Physical Characteristics of the Emissions

Provided that the exhaust gases have sufficient velocity at stack exit to overcome the effects of stack tip downwash, which is almost certainly the case for velocities of 15 m s^{-1} or more, the physical characteristics of the flue gases will determine the amount of plume rise and hence the effect on ground level pollutant concentrations. The degree of plume rise usually depends on the greater of the thermal buoyancy or momentum effects.

4.4.2 Climate

The most important meteorological parameters governing the atmospheric dispersion of pollutants are wind speed, wind direction and atmospheric stability.

- **Wind direction** determines the broad transport of the plume and the sector of the compass into which the plume is dispersed.

- **Wind speed** can affect plume dispersion by increasing the initial dilution of pollutants and inhibiting plume rise.

- **Atmospheric stability** is a measure of the turbulence of the air, particularly of the vertical motions present. For dispersion modelling purposes, one method of classifying stability is by the use of Pasquill Stability categories, A to F. Another is by reference to the surface heat flux present at the ground.

Dispersion models, such as ADMS and AERMOD, do not allocate the degree of atmospheric turbulence into six discrete categories. These models use a parameter known as the Monin-Obukhov length which, together with the wind speed, describes the stability of the atmosphere.

4.4.3 Building Downwash

The presence of buildings can significantly affect the dispersion of atmospheric emissions. Wind blowing around a building distorts the flow and creates zones of turbulence that are greater than if the building were absent. Increased turbulence causes greater plume mixing; the rise and trajectory of the plume may be depressed generally by the flow distortion. For elevated releases such as those from stacks, building downwash leads to higher ground level concentrations closer to the stack than those present if a building was not there. The effects of building down-wash are usually only significant where the buildings are more than 40% of the stack height.

Table 4.3 shows the dimensions of the buildings included in the modelling.

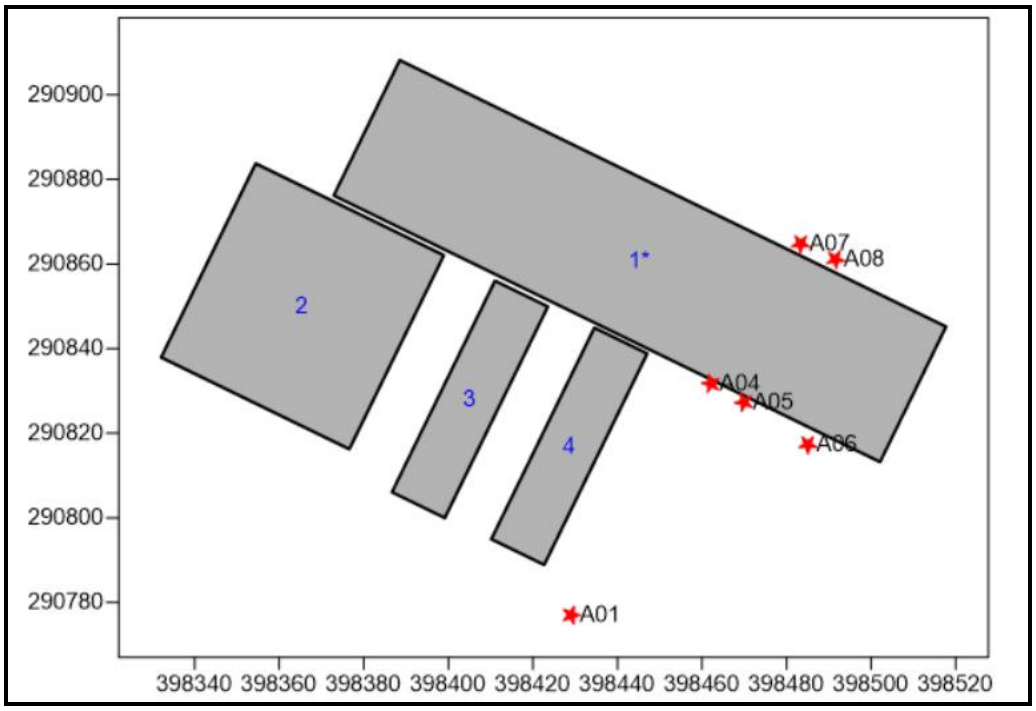
Table 4.3 Dimensions of Buildings Included in the Modelling

Building	OS Grid Reference	Height (m)	Length (m)	Width (m)	Angle (deg) [(a)]
1	398445 290861	18.5	144	35.6	116
2	398366 290849	13.1	49.5	51.0	116
3	398405 290828	19.0	13.9	55.6	116
4	398429 290817	19.0	13.9	55.6	116

(a) Angle building length makes to the north.

Figure 4.2 shows the modelled buildings and the location of existing stack (A01) and five new stacks (A04 – A08)

Figure 4.2 Locations of the Stacks and Modelled Buildings



4.4.4 Nature of the Surface

Terrain

The effects of elevated terrain can affect dispersion and have been included in this assessment.

Roughness

The nature of the surface of the terrain can have a significant influence on dispersion by affecting the velocity profile with height and the amount of atmospheric turbulence. A surface roughness length of 1.0 m has been assumed to be representative of the surrounding nature of the site.

4.5 SELECTION OF SUITABLE DISPERSION MODEL

The dispersion models which are widely used to predict ground-level pollutant concentrations are based on the concept of the time-averaged lateral and vertical concentration of pollutants in a plume being characterised by a *Gaussian* (1) distribution and the atmosphere is characterised by several discrete stability classes. So-called 'new generation' dispersion models have been developed which replace the description of the atmospheric boundary layer as being composed of discrete stability classes with an infinitely variable measure of the surface heat flux, which in turn influences the turbulent structure of the atmosphere and hence the dispersion of a plume.

There are two commercially available dispersion models that can predict ground-level concentrations arising from emissions to the atmosphere from elevated point sources (ie stacks), and are described by the Environment Agency as being 'new generation'.

- *AERMOD*: The US **A**merican Meteorological Society and **E**nvironmental Protection Agency **R**egulatory Model Improvement Committee developed a dispersion **MOD**del called *AERMOD* which incorporates the latest understanding of the atmospheric boundary layer.

- *Atmospheric Dispersion Modelling System (ADMS)*: The ADMS dispersion model was developed by the UK consultancy CERC. The model allows for the skewed nature of turbulence within the atmospheric boundary layer.

In many respects, the models are quite similar and in some situations generate similar predictions of ground-level concentrations. Two intercomparison studies commissioned by the Environment Agency (EA) however found there to be significant differences in calculated concentrations between the models (2). These reports highlight modelling uncertainties and do not suggest that any one of the models is considered to be the most accurate.

ADMS 5.2 was selected as the model for use in this assessment because of an inherent weakness in AERMOD which occurs when stack heights are a little less than 2.5 times the building height; for these circumstances, AERMOD can significantly overestimate maximum ground-level concentrations.

4.6 METEOROLOGICAL DATA

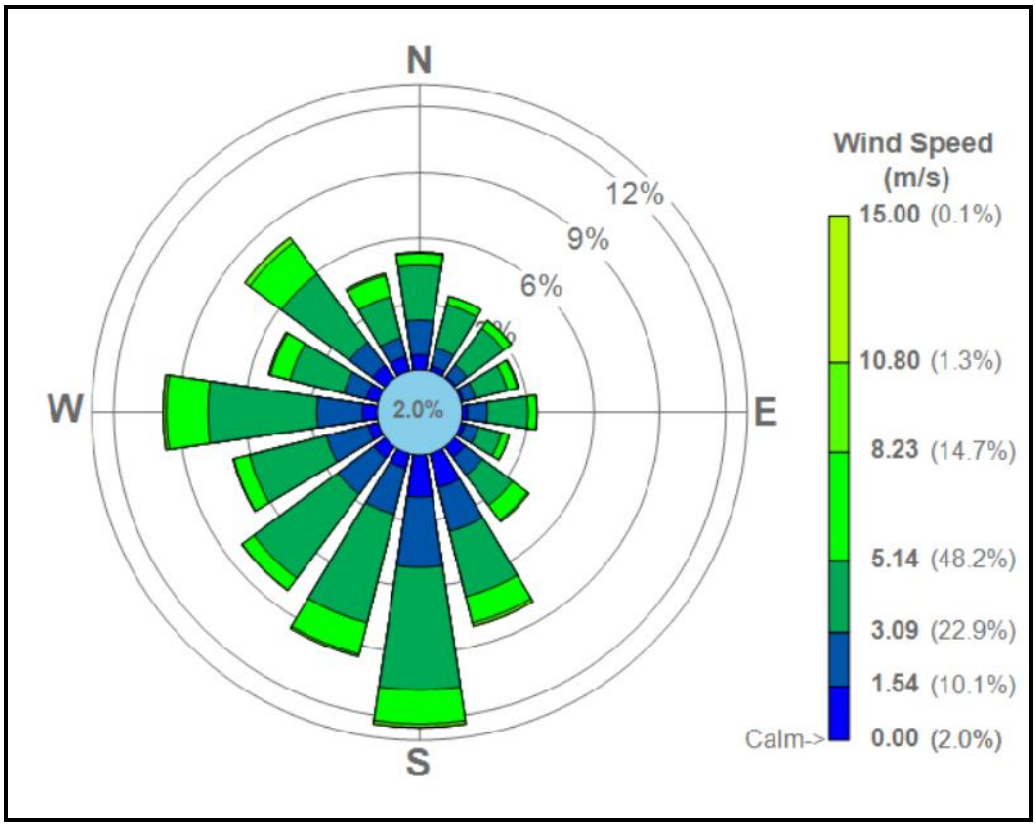
An important input to the dispersion model is the meteorological data. These data are important in determining the location of the maximum concentrations and their magnitude.

(1) A Gaussian distribution has the appearance of a bell shaped curve. The maximum concentration occurs on the centre line.

(2) R&D Technical Report P353: **A review of dispersion model intercomparison studies using ISC, R91, AERMOD and ADMS** (ISBN 1 85705 276 5) and R&D Technical Report P362: An intercomparison of the AERMOD, ADMS and ISC dispersion models for regulatory applications (ISBN 1 85705 340 0).

The closest observing station where data is available is Birmingham International Airport. **Figure 4.3** shows the windrose for Birmingham International Airport for 2014-2018, used in this assessment.

Figure 4.3 Wind Rose Birmingham International Airport (2014-2018)



4.7 PERCENTAGE OXIDATION OF NITRIC OXIDE (NO) TO NITROGEN DIOXIDE (NO_2)

Oxides of nitrogen (NO_x) emitted to the atmosphere as a result of gas combustion will consist largely of nitric oxide (NO), a relatively innocuous substance. Once released into the atmosphere, nitric oxide is oxidised to nitrogen dioxide (NO_2), which is of concern to health and other impacts. The proportion of nitric oxide oxidised to nitrogen dioxide depends on several factors, and the oxidation is limited by the availability of oxidants, such as ozone (O_3).

For hourly average concentrations, an oxidation percentage of 35% has been assumed for oxidation of nitric oxide (NO) to nitrogen dioxide (NO_2). For predictions of annual averages, it is assumed that 70% of the oxides of nitrogen (NO_x) are in the form of nitrogen dioxide (NO_2). These assumptions are recommended by the Environment Agency (1).

(1) Environment Agency (AQMAU): Conversion Ratios for NO_x and NO_2.

5 PREDICTIONS AND ASSESSMENT OF IMPACTS

5.1 INTRODUCTION

This section presents the incremental increase in ground-level concentrations predicted to occur as a consequence of emissions to the atmosphere of PM_{10} and $PM_{2.5}$ from the installation. Predictions are presented and an assessment made of the routine emissions to the atmosphere, assuming that the facility is operating continuously at its emission limits.

5.2 SCREENING: STAGE 1

Table 5.1 shows the maximum predicted Process Contribution (PC) ground level concentration of PM_{10} and $PM_{2.5}$ occurring as a consequence of emissions to the atmosphere from the facility for each of the five years of meteorological data. The predictions include the effects of terrain and building downwash.

Table 5.1 ADMS 5.2 Maximum Predicted (Process Contribution) Annual Average and 90.4th Percentile of 24 Hourly Average Concentrations of PM_{10} and Maximum Annual Average of $PM_{2.5}$ ($\mu g\ m^{-3}$)

Year	PM_{10}		$PM_{2.5}$ [(a)]
	Annual Average	90.4th Percentile of 24 Hour Averages	Annual Average
2014	3.35	5.39	3.35
2015	3.41	5.35	3.41
2016	3.21	5.25	3.21
2017	3.36	5.39	3.36
2018	3.35	5.39	3.35
Maximum	3.41	5.39	3.41
Environmental Assessment Level (EAL)	**40**	**50**	**20**
Max PC as %age of EAL	8.5%	10.8%	17.1%

(a) Assumes 100% of PM_{10} is $PM_{2.5}$.

Table 5.1 shows that there is only a small amount of year to year variation in the maximum predicted Process Contribution (PC).

Given that the long term Process Contribution (PC) is more an 1% of the Environmental Assessment Level (EAL) and the short term PC is more than 10% of the EAL the PC cannot be screened out as insignificant, which is not to say that it is significant.

5.3 SCREENING: STAGE 2

Table 5.2 shows the maximum Predicted Environmental Concentration (PEC) ground level concentration of PM_{10} and $PM_{2.5}$ occurring as a consequence of emissions to the atmosphere from the facility. The predictions include the effects of terrain and building downwash.

Table 5.2 ADMS 5.2 Maximum Predicted Environmental Concentration (PEC); Annual Average and 90.4th Percentile of 24 Hourly Average Concentrations of PM_{10} and Maximum Annual Average of $PM_{2.5}$ ($\mu g\ m^{-3}$)

	PM_{10}		$PM_{2.5}$ [a]
	Annual Average	**90.4th Percentile of 24 Hour Averages**	**Annual Average**
Maximum PC	3.41	5.4	3.41
Background	15.5	-	10.4
PEC	18.9	-	13.8
Environmental Assessment Level (EAL)	**40**	**50**	**20**
Max PEC as %age of EAL	47.3%	28.4% [b]	69.1%

(a) Assumes 100% of PM_{10} is $PM_{2.5}$.
(b) PC as a percentage of EAL minus twice the long term background

For detailed modelling to not be necessary both the annual average PECs would need to be below 70% of the EAL and the short-term PC be less than 20% of the short-term environmental standards minus twice the long-term background concentration.

Given that the maximum 90.4th percentile of 24 hourly average of 5.4 $\mu g\ m^{-3}$ is greater than 20% of the EAL (minus twice the annual average background concentration) detailed dispersion modelling is required to determine the significance of the environmental impact.

5.4 DETAILED MODELLING AND ASSESSMENT OF SIGNIFICANCE

Detailed modelling of the impacts of emissions of PM_{10} and $PM_{2.5}$ includes predictions at specific receptors and assessment of significance as well as the predictions already presented.

For determining the total annual average concentration (ie PEC long term) it is correct to add the predicted increment (PC) to the prevailing background. It is not correct to add the PC short-term to the short-term background concentrations. The exact way to determine the combined (total) 90.4th percentile of 24-hour averages is, for each 24-hour period during the year, to add the predicted to the measured 24-hour concentration and then calculate the resulting 90.4th percentile, this would result in very little change in the total 90.4th percentile compared to the background 90.4th percentile.

The Environment Agency's H1 Technical Guidance (now withdrawn) states:

$$PEC_{short\ term} = PC_{short\ term} + (2 \times Background_{long\ term})$$

Where PC is the Process Contribution, and PEC is the Predicted Environmental Concentration. It is considered that this is a conservative approach and is used in this assessment to determine the PEC short-term

Table 5.3 presents the maximum predicted Process Contribution and the maximum Predicted Environment Concentration (PEC)

Table 5.3 ADMS 5.2 Maximum Predicted Process Concentration (PC) and Environmental Concentration (PEC); Annual Average and 90.4th Percentile of 24 Hourly Average Concentrations of PM_{10} and Maximum Annual Average of $PM_{2.5}$ ($\mu g\ m^{-3}$)

	PM_{10}		$PM_{2.5}$ [a]
	Annual Average	**90.4th Percentile of 24-Hour Averages**	**Annual Average**
Process Concentration (PC)	3.41	5.4	3.41
Background	15.5	-	10.4
PEC	18.9	36.4 [b]	13.8
Environmental Assessment Level (EAL)	**40**	**50**	**20**
Max PEC as %age of EAL	47%	73%	69%

(a) Assumes 100% of PM_{10} is $PM_{2.5}$.
(b) PEC = PC + twice annual average background

Given the maximum Predicted Environmental Concentration (PEC) for both PM_{10} and $PM_{2.5}$ are below the Environmental Assessment Levels (EAL) which are the Air Quality Strategy (AQS) objectives the impacts are not of concern to human health.

Table 5.4 shows the predicted annual average concentration of PM_{10} at the specific receptors together with predictions at the point of maximum impact. Predictions are made for meteorological data from 2015 as this is the year that gives rise to the largest impact.

Table 5.4 ADMS 5.2 Predicted Annual Average Concentrations of PM_{10} at Specific Receptors, 2015 Meteorological Data ($\mu g\ m^{-3}$)

Location	**Description**		**Process Contribution (PC)**	**Predicted Environmental Concentration (PEC) [a]**	**Increment (PC) as Percentage of Objective (%)**
Point of Maximum Impact			3.41	18.9	8.5%
R1	Theodore Close	Residential	0.11	15.6	0.3%
R2	Meadows Sport Club	Sport Club	0.08	15.6	0.2%
R3	Palmerston Drive	Residential	0.06	15.6	0.2%
R4	Whitgreave St	Residential	0.36	15.9	0.9%
R5	Millward St	Residential	0.15	15.6	0.4%
R6	Guns Village Primary	School	0.10	15.6	0.2%
Environmental Assessment Level (EAL)			**40**		

(a) Includes background of 15.5 $\mu g\ m^{-3}$.

Table 5.4 shows that at the sensitive receptors considered the maximum increase is 0.36 μg m^{-3} which results in a total concentration of 15.9 μg m^{-3} which can be compared to the air quality strategy objective of 40 μg m^{-3}.

The IAQM/EPUK significance criteria applies to locations where there is relevant exposure which excludes the point of maximum impact. **Table 5.5** shows the IAQM/EPUK significance criteria applied to the receptors.

Table 5.5 IAQM/EPUK Significance Criteria (PM_{10})

Location	Description	PC (μg m^{-3})	PC as %age of EAL (%)	PEC (μg m^{-3})	PEC as %age of EAL	Impact Descriptor
R1	Theodore Close	0.11	0.3%	15.6	39.0%	Negligible
R2	Sport Club	0.08	0.2%	15.6	38.9%	Negligible
R3	Palmerstone	0.06	0.2%	15.6	38.9%	Negligible
R4	Whitgreave St	0.36	0.9%	15.9	39.7%	Negligible
R5	Millward St	0.15	0.4%	15.6	39.1%	Negligible
R6	School	0.10	0.2%	15.6	39.0%	Negligible

Table 5.5 shows that emissions to the atmosphere of PM_{10} from the proposed variation are predicted to have an impact of negligible significance on annual average concentrations of PM_{10} according to the IAQM/EPUK significance criteria.

Table 5.6 shows the predicted annual average concentration of $PM_{2.5}$ at the specific receptors together with predictions at the point of maximum impact. Predictions are made for meteorological data from 2015 as this is the year that gives rise to the largest impact.

Table 5.6 ADMS 5.2 Predicted Annual Average Concentrations of $PM_{2.5}$ at Specific Receptors, 2015 Meteorological Data (μg m^{-3})

Location	Description		Process Contribution (PC) [(a)]	Predicted Environmental Concentration (PEC) [(b)]	Increment (PC) as Percentage of Objective (%)
Point of Maximum Impact			3.41	17.8	17.1%
R1	Theodore Close	Residential	0.11	14.5	0.6%
R2	Meadows Sport Club	Sport Club	0.08	14.5	0.4%
R3	Palmerston Drive	Residential	0.06	14.5	0.3%
R4	Whitgreave St	Residential	0.36	14.8	1.8%
R5	Millward St	Residential	0.15	14.5	0.7%
R6	Guns Village Primary	School	0.10	14.5	0.5%
Environmental Assessment Level (EAL)			**20**		

(a) Assumes all PM_{10} is $PM_{2.5}$.
(b) Includes background of 14.4 μg m^{-3}.

Table 5.6 shows that at the sensitive receptors considered the maximum increase is 0.36 μg m^{-3} which results in a total concentration of 14.8 μg m^{-3} which can be compared to the air quality strategy objective, EAL of 20 μg m^{-3}.

The IAQM/EPUK significance criteria applies to locations where there is relevant exposure which excludes the point of maximum impact. **Table 5.7** shows the IAQM/EPUK significance criteria applied to the six human health receptors.

Table 5.7 IAQM/EPUK Significance Criteria ($PM_{2.5}$)

Location	Description	PC ($\mu g\ m^{-3}$)	PC as %age of EAL (%)	PEC ($\mu g\ m^{-3}$)	PEC as %age of EAL	Impact Descriptor
R1	Theodore Close	0.11	0.6%	14.5	72.6%	Negligible
R2	Sport Club	0.08	0.4%	14.5	72.4%	Negligible
R3	Palmerstone	0.06	0.3%	14.5	72.3%	Negligible
R4	Whitgreave St	0.36	1.8%	14.8	73.8%	Negligible
R5	Millward St	0.15	0.7%	14.5	72.7%	Negligible
R6	School	0.10	0.5%	14.5	72.5%	Negligible

Table 5.7 shows that emissions to atmosphere of $PM_{2.5}$, after making the conservative assumption that all the PM_{10} is $PM_{2.5}$, are predicted to have an impact of negligible significance on annual average concentrations of $PM_{2.5}$ according to the IAQM/EPUK significance criteria.

For short term impacts the maximum 90.4^{th} percentile of 24-hour average of 5.35 $\mu g\ m^{-3}$ is 11% of the assessment criteria. This falls in the 10-20% bracket which is described by IAQM/UKIP as being a 'small' magnitude of change.

The following figures are presented to illustrate the distribution of concentrations of PM_{10} and $PM_{2.5}$. Predictions are presented for 2015 meteorological data as this is the year that gives rise to the largest impact.

- **Figure 5.1:** Annual Average PM_{10}
- **Figure 5.2**: 90.4^{th} Percentile of 24-hour average PM_{10}
- **Figure 5.3**: Annual Average $PM_{2.5}$

The figures show that peak predicted increments to ground level concentrations occur within 50 m of the installation.

Figure 5.1 ADMS 5.2 Predicted Annual Average Ground Level Concentrations (Process Contribution, PC) of PM_{10}; 2015 Meteorological Data ($\mu g\ m^{-3}$)

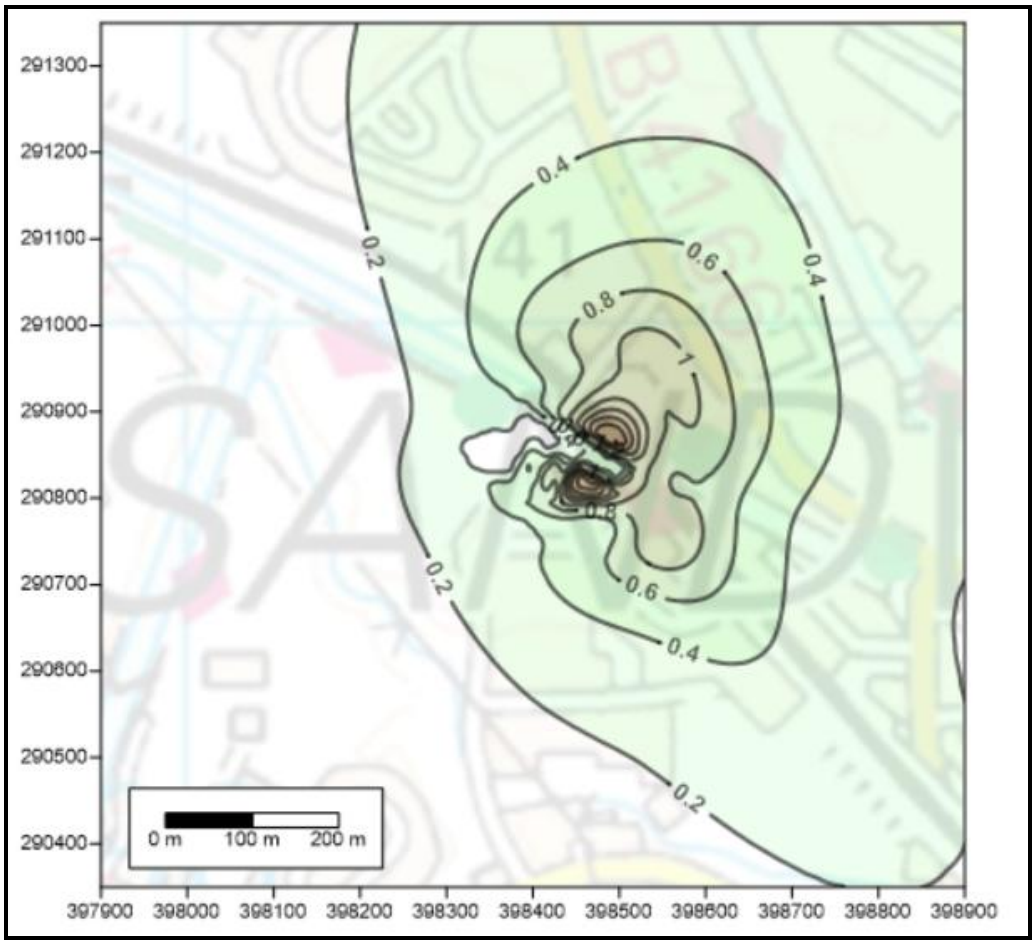


Figure 5.2 ADMS 5.2 Predicted 90.4th Percentile of 24-Hour Average Ground Level Concentrations (Process Contribution, PC) of PM_{10}; 2015 Meteorological Data ($\mu g\ m^{-3}$)

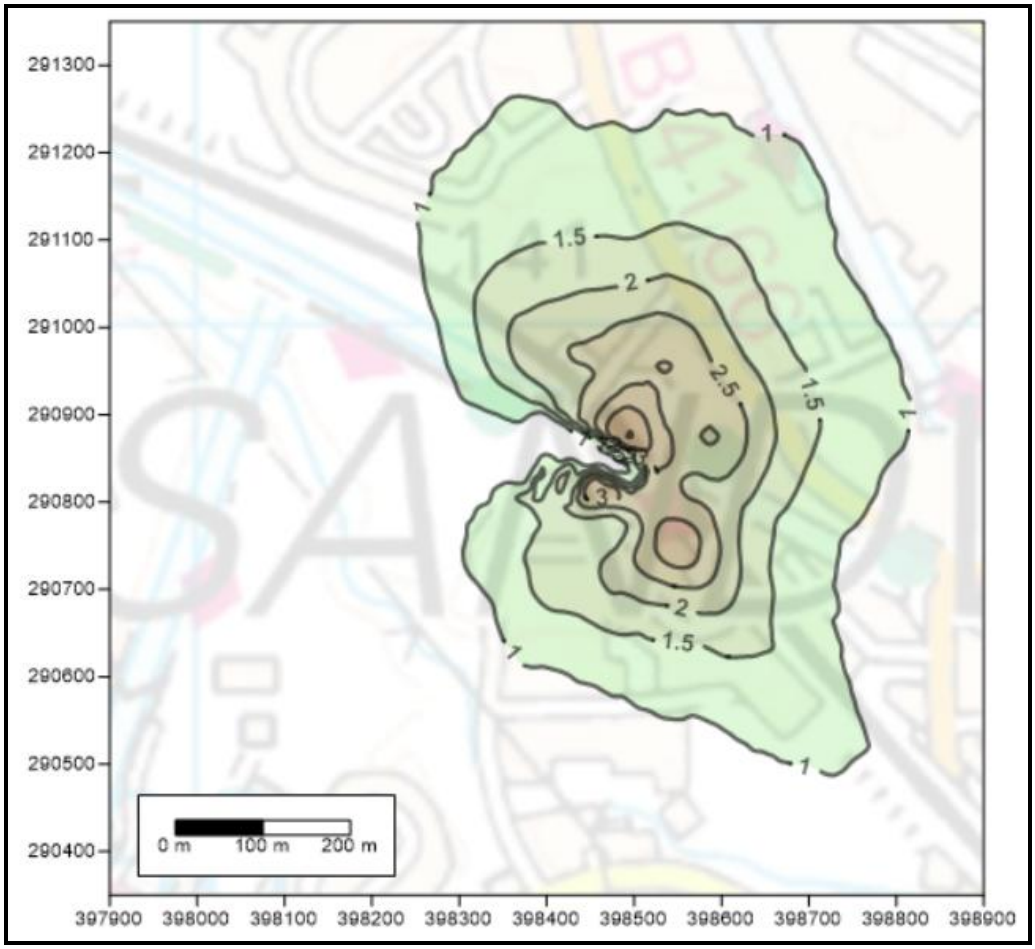


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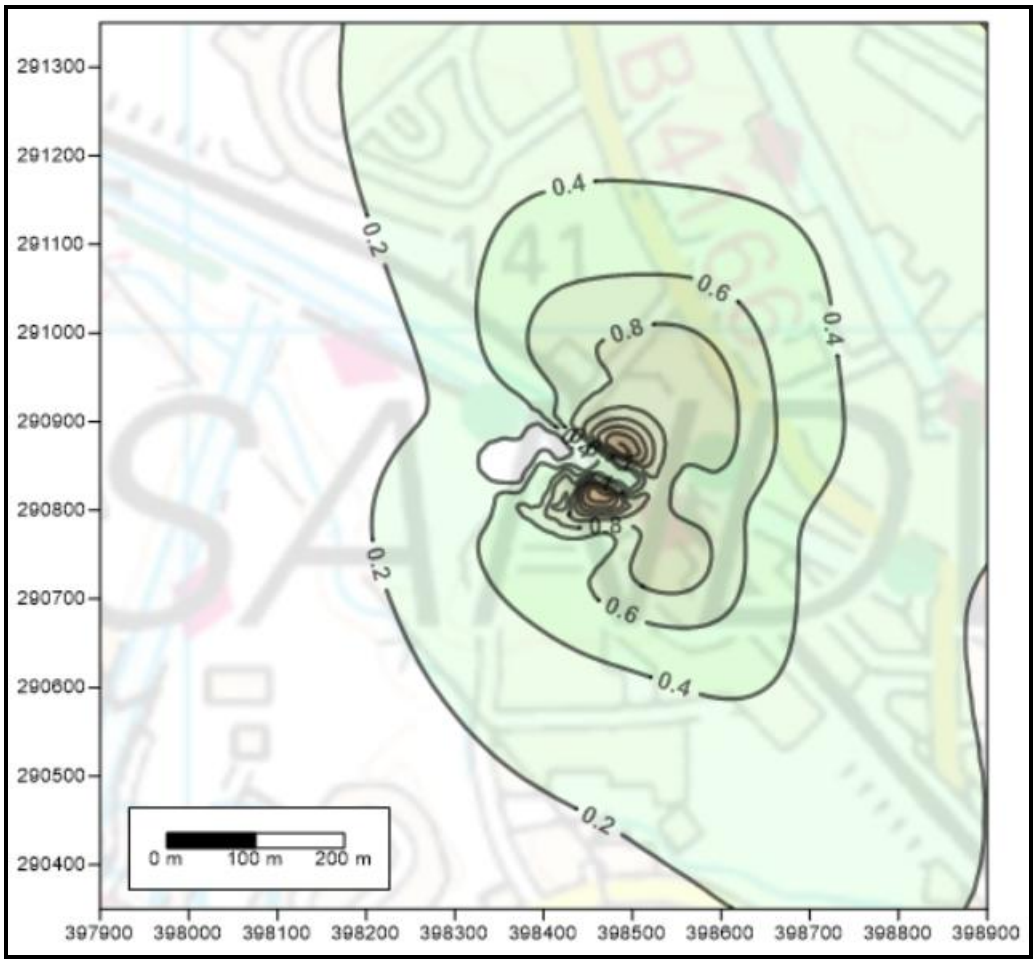
Figure 5.3 ADMS 5.2 Predicted Annual Average Ground Level Concentrations (Process Contribution PC) of $PM_{2.5}$; 2015 Meteorological Data ($\mu g\ m^{-3}$)



6 SENSITIVITY ANALYSIS

6.1 INTRODUCTION

This section considers the sensitivity of model-predicted concentrations to the following:

- Meteorological data;
- Roughness length;
- Grid spacing;
- Building downwash;
- Terrain; and
- Stack height.

6.2 METEOROLOGICAL DATA

The assessment presented in this report is based on predictions made using five years (2014-2018) of meteorological data from Birmingham Airport.

To illustrate the year to year variation in meteorological data, **Table 6.1** shows the maximum predicted ground level concentration of PM_{10} for each of five years of meteorological data from Birmingham Airport together with predictions made with 2015 meteorological data from Coventry Airport.

Table 6.1 ADMS 5.2 Maximum Predicted Annual Average and 90.48th Percentile of 24-Hour Average Concentrations of PM_{10} ($\mu g\, m^{-3}$)

Year and Source	Annual Average	90.4th Percentile of 24-Hour Averages
Birmingham 2014	3.3	5.4
Birmingham 2015	**3.4**	**5.4**
Birmingham 2016	3.2	5.3
Birmingham 2017	3.4	5.4
Birmingham 2018	3.3	5.4
Coventry 2015	**3.6**	**5.4**
Assessment Criteria	**40**	**50**

Table 6.1 shows that there is some year to year variation in predicted concentrations, although it is not considered to be significant. The maximum predicted annual average concentration using meteorological data from Coventry Airport is a little higher than using data from Birmingham Airport for 2015, the maximum predicted 90.4th percentile are similar.

6.3 ROUGHNESS LENGTH

The roughness length of 1.0 m used in this assessment was selected using professional judgement because roughness length is not something that can be directly measured. In practice, there is no one unique roughness that fits a given wind speed profile. Roughness length will also vary depending on wind direction and other factors such as season of the year.

It is therefore of interest to see how sensitive the model predictions are to roughness length.

Table 6.2 shows the maximum predicted ground level concentration of PM_{10} for roughness lengths in the range of 0.5 m to 1.5 m using 2015 meteorological data.

Table 6.2 ADMS 5.2 Maximum Predicted Annual Average and 90.4th Percentile of 24-Hour Average Concentrations of PM_{10} ($\mu g\, m^{-3}$)

Roughness Length (m)	Annual Average	90.4th Percentile of 24-Hour Averages
0.5	2.8	4.4
1.0	3.4	5.4
1.5	3.8	4.4
Assessment Criteria	**40**	**50**

Table 6.2 shows that in this modelling situation, increasing roughness length increases the maximum predicted annual average concentration but the effect is not significant.

6.4 GRID SPACING

If the grid spacing is too large, then it is possible that the reported maximum concentrations will not be the actual maxima. This assessment uses a grid spacing of 10 m which at less than 1.5 times the stack height is appropriate. One way to demonstrate this is to model with smaller grid spacing, and if the maximum concentration is not significantly different then one can be confident that the grid spacing is adequate.

Table 6.3 shows the maximum predicted ground level concentration of PM_{10} for the grid spacing of 10 m used in this assessment and also 5 m. Predictions are made using 2015 meteorological data.

Table 6.3 ADMS 5.2 Maximum Predicted Annual Average and 90.4th Percentile of 24-Hour Average Concentrations of PM_{10} ($\mu g\, m^{-3}$)

Grid Spacing (m)	Annual Average	90.4th Percentile of 24-Hour Averages
10	3.41	5.35
5	3.55	5.55
Assessment Criteria	**40**	**50**

Table 6.3 shows that halving the grid spacing does not significantly affect the maximum predicted concentrations.

6.5 BUILDING DOWNWASH AND TERRAIN

The modelling presented in this assessment includes both the effects of building downwash and terrain. **Table 6.4** shows the predicted maximum

ground level concentration of PM_{10} both with and without the effects of building downwash and terrain using 2015 meteorological data.

Table 6.4 ADMS 5.2 Maximum Predicted Annual Average and 90.4th Percentile of 24-Hour Average Concentrations of PM_{10} ($\mu g\, m^{-3}$)

Building Downwash Effects	Terrain Effects	Annual Average	90.4th Percentile of 24-Hour Averages
Yes	Yes	3.41	5.35
No	Yes	0.57	1.64
Yes	No	3.49	5.52
No	No	0.62	1.75
Assessment Criteria		**40**	**50**

Table 6.4 shows that building downwash effects are predicted to affect dispersion. The effects of terrain on dispersion are not significant; the effects of building downwash are significant.

6.6 STACK HEIGHT

Table 6.5 and **Figure 6.1** show the ADMS 5.2 maximum predicted annual average and 90.4th percentile of 24-hour average concentrations of PM_{10} for stack heights in the range of 19.5 m to 23.5 m. Predictions are made for 2015 meteorological data.

Table 6.5 ADMS 5.2 Maximum Predicted Annual Average and 90.4th Percentile of 24-Hour Average Concentrations of PM_{10} ($\mu g\, m^{-3}$) Effect of Stack Height

Stack Height (m)	Annual Average	90.4th Percentile
19.5	4.94	7.73
20.5	4.10	6.39
21.5	3.41	5.35
22.5	2.83	4.49
23.5	2.35	3.81

Figure 6.1 ADMS 5.2 Maximum Predicted Annual Average and 90.4th Percentile of 24-Hour Average Concentrations of PM_{10} ($\mu g\, m^{-3}$) Effect of Stack Height

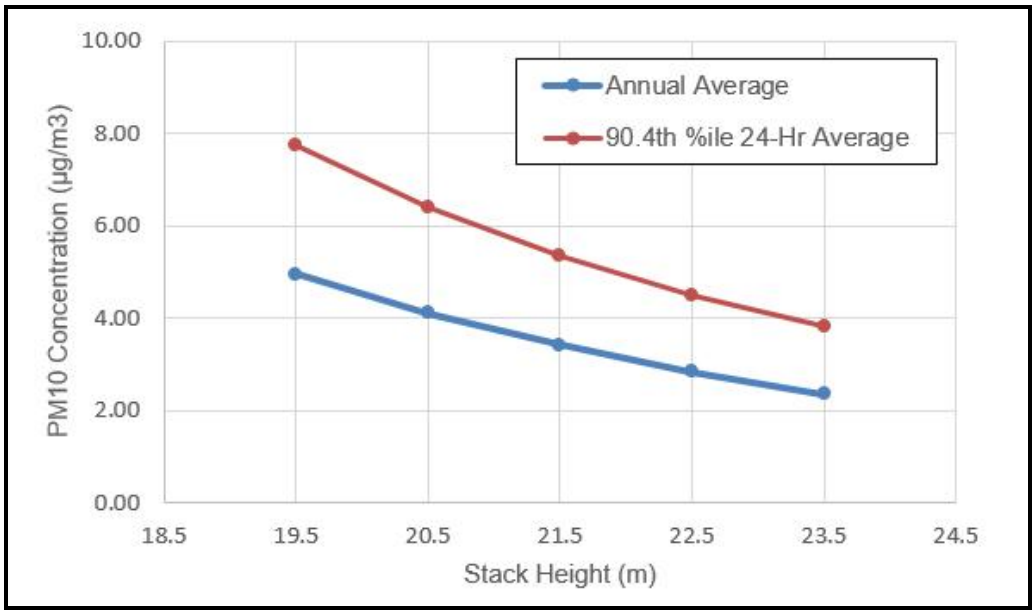


Table 6.5 and Figure 6.1 show that the benefits in terms of reduction in the maximum ground level concentration of PM_{10} for stack heights above the proposed height of 21.5 m are minimal.

7 SUMMARY AND CONCLUSIONS

R Williams Consultants Ltd has commissioned Atmospheric Dispersion Modelling Ltd (ADM Ltd) to undertake an air quality assessment of emissions to the atmosphere of particulate matter relating to the proposed variation to the existing environmental permit EPR/GP3739VR/V003 for Innovative Environmental Solutions UK Limited, Oldbury, West Midlands.

There will be extensive use of air within the process to capture the dust produced by the new activity, to transport the materials and to separate heavy and light materials. To minimise emissions of particulate matter, the air from each of five new systems will be passed through cyclones and baghouses before it is discharged to the atmosphere via five new separate 21.5 m high stacks (reference A04-A08).

Given that the only pollutant released to atmosphere from the proposed new process is particulate matter (PM_{10}) this assessment is limited to an assessment of the emissions of PM_{10}. $PM_{2.5}$ is also considered and assessed using the conservative assumption that all the PM_{10} is $PM_{2.5}$.

The ADMS 5.2 dispersion model has been used to make predictions of ground-level concentrations of PM_{10} and $PM_{2.5}$ released to atmosphere from the installation.

The following are the principal conclusions that can be drawn from this assessment which has been undertaken using the emissions data provided and the assumptions specified:

- Emissions to the atmosphere from the proposed five new 21.5 m high stack together with emissions from the existing 50 m stack will not significantly affect air quality at ground level, the impact is considered to be insignificant.

- The sensitivity analysis shows in the most part, that the predicted concentrations are not overly sensitive to assumptions made and methods used.

- It is considered that the overall impact on air quality of emissions to atmosphere from the proposed variation to the installation can be described as of **minor significance**. This conclusion is based on all the impacts presented in this assessment and takes into account the localised nature of the area of maximum impact.

Air Quality Assessment of Emissions to Atmosphere from Proposed Advanced Recycling and Electricity Generation Facility

P1205

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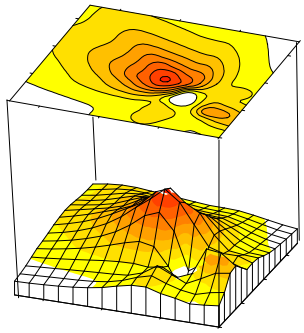

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1	INTRODUCTION	1
2	PLANNING CONTEXT, POLLUTANTS, ASSESSMENT AND SIGNIFICANCE CRITERIA	3
2.1	INTRODUCTION	3
2.2	PLANNING CONTEXT	3
2.2.1	European Legislation	3
2.2.2	National Legislation and Guidance	3
2.2.3	Environmental Agency Guidance	4
2.2.4	National Planning Policy Framework	5
2.2.5	Planning Policy Statement 23: Planning and Pollution Control	5
2.2.6	Development Control: Planning for Air Quality	5
2.2.7	Review and Assessment	6
2.2.8	Environmental Permitting (England and Wales) Regulations 2010	6
2.3	DESCRIPTION OF POLLUTANTS	7
2.3.1	Nitrogen Dioxide (NO_2)	7
2.3.2	Particulate Matter	7
2.3.3	Sulphur Dioxide (SO_2)	8
2.3.4	Dioxins and Furans	8
2.3.5	Metals	8
2.3.6	Hydrogen Chloride (HCl)	8
2.3.7	Hydrogen Fluoride (HF)	8
2.4	ASSESSMENT CRITERIA	9
2.4.1	Human Health	9
2.4.2	Vegetation and Ecosystems	10
2.5	SIGNIFICANCE CRITERIA	11
3	AMBIENT AIR QUALITY DATA	13
3.1	INTRODUCTION	13
3.2	SANDWELL MBC REVIEW AND ASSESSMENT OF AIR QUALITY	13
3.2.1	Sandwell MBC Air Quality Action Plan	13
3.3	ESTIMATED BACKGROUND CONCENTRATIONS	14
3.4	MEASURED POLLUTANT CONCENTRATIONS	15
4	METHODOLOGY	18
4.1	INTRODUCTION	18
4.2	EMISSIONS DATA	18
4.3	ROAD TRAFFIC DATA	19
4.4	RECEPTORS	21
4.5	FACTORS AFFECTING DISPERSION	23
4.5.1	Physical Characteristics of the Emissions	23
4.5.2	Climate	23
4.5.3	Building Downwash	23
4.5.4	Nature of the Surface	24
4.6	SELECTION OF SUITABLE DISPERSION MODEL	24
4.7	METEOROLOGICAL DATA	25
4.8	PERCENTAGE OXIDATION OF NITRIC OXIDE (NO) TO NITROGEN DIOXIDE (NO_2)	26

5	PREDICTIONS AND ASSESSMENT OF IMPACTS	27
5.1	INTRODUCTION	27
5.2	CONSTRUCTION	27
5.3	OPERATION	27
5.3.1	Stack Emissions	27
5.3.2	Emissions from Road Traffic	37
6	SENSITIVITY ANALYSIS	39
6.1	INTRODUCTION	39
6.2	METEOROLOGICAL DATA	39
6.3	ROUGHNESS LENGTH	39
6.4	GRID SPACING	40
6.5	BUILDING DOWNWASH AND TERRAIN	41
6.6	SINGLE UNIT OPERATION	41
6.7	DISPERSION MODEL SELECTION	42
6.8	STACK HEIGHT	42
7	MITIGATION AND RESIDUAL IMPACTS	44
7.1	INTRODUCTION	44
7.2	CONSTRUCTION	44
7.3	OPERATION	44
8	SUMMARY AND CONCLUSIONS	45

1 INTRODUCTION

Chinook Sciences Ltd has commissioned Atmospheric Dispersion Modelling Ltd (ADM Ltd) to undertake an air quality assessment of emissions to atmosphere from the proposed advanced recycling and electrical generation facility, Oldbury, West Midlands.

The assessment for this facility was first undertaken in 2010 and was update in March 2011 as a result of further design work which has reduced the emissions to atmosphere from the facility. The assessment was updated in March 2012 as a result of a number of changes to the design and layout and also comments received from the Environment Agency (EA), in May 2012 as a result of an small increase in the flue diameter and again in March 2013 to bring it up to date with current legislation and guidance [(1)].

The facility will process approximately 250,000 tonnes per year of raw Automotive Shredder Residue (ASR), transported to the facility by rail from European Metal Recycling (EMR) shredders around the country. There are two stages to the process; in stage one metals, aggregates and plastic are separated out and sent off site for reprocessing, the remaining combustible waste which includes foam, wood and plastic are retained on site to be used as fuel for the gasification process which is stage two. The Chinook Sciences gasification technology is called RODECS®. The system employs the '*active pyrolysis*' process which generates synthetic gas know as '*syngas*' which is combusted to generate steam used to drive a steam turbine to generate electrical power. The proposed facility will have four units which together will generate 32 MW_e of electrical power. The products of combustion from two boilers will be combined and will be released to atmosphere via a single 50 m high twin flue stack.

Emissions to atmosphere will occur from the following sources:

- Construction.
- The twin flue 50 m high stack.

Emissions from road traffic during construction have been screened out as being insignificant because of the small number of additional vehicles compared to the existing numbers on the roads around the proposed facility.

Although it is expected that rail transport will be ultimately used to transport around 50% of the material to the proposed facility, this assessment assumes that road transport will be used as this will be the initial method and represents a worst case for air quality. The Department of Transports Design Manual for Roads and Bridges (DMRB) method has been used to quantify the impacts on air quality of emissions from road traffic associated with the proposed development.

(1) Email (6 June 2011) Stephen Thomason, Environment Agency, PPC Compliance Officer.

The ADMS 4.2 dispersion model has been used to make predictions of ground level concentrations of the following pollutants released to atmosphere from the facility:

- the oxides of nitrogen (NO_x);
- sulphur dioxide (SO_2);
- fine particulate matter (PM_{10});
- carbon monoxide (CO);
- hydrogen chloride (HCl);
- hydrogen fluoride (HF);
- dioxins and furans; and
- metals.

The remainder of the report is structured as follows:

- *Section 2* - description of the assessment criteria and planning policy.
- *Section 3* - presents and assesses the existing air quality
- *Section 4* - describes the modelling methodology
- *Section 5* - presents the predicted concentrations
- *Section 6* – sensitivity analysis
- *Section 7* – mitigation and residual impacts.
- *Section 8* - provides a summary and conclusions.

2 PLANNING CONTEXT, POLLUTANTS, ASSESSMENT AND SIGNIFICANCE CRITERIA

2.1 INTRODUCTION

This section presents the planning context with regard to air quality, together with the assessment and significance criteria.

2.2 PLANNING CONTEXT

2.2.1 European Legislation

The air quality criteria used in this assessment have been taken from European and national legislation. The EU Framework Directive 96/62/EC on ambient air quality assessment and management came into force in November 1996 and had to be implemented by Member States by May 1998. The Directive aims to protect human health and the environment by avoiding, reducing or preventing harmful concentrations of air pollutants.

The European Commission worked together with Clean Air For Europe (CAFE) to produce and publish a new European Directive in 2008 (Directive 2008/50/EC). Key changes include a new air quality objective for particulate matter smaller than 2.5 microns (μm) in aerodynamic diameter ($PM_{2.5}$). The objective includes a limit value and exposure reduction target. Member states had until 2010 to transpose the new directive into national law. Under the Directive, Member States are required to reduce exposure to $PM_{2.5}$ in urban areas by an average of 20% by 2020 based on 2010 levels. It obliges them to bring exposure levels below 20 μg m^{-3} by 2015 in these areas. Throughout their territory, Member States will need to respect the $PM_{2.5}$ limit value set at 25 μg m^{-3}. This value must be achieved by 2015 or, where possible, by 2010.

The new directive introduces new objectives for ultra fine particulate matter $PM_{2.5}$ but does not change existing air quality standards. It does, however, give Member States greater flexibility in meeting some of these standards in areas where they have difficulty complying.

The Air Quality Standards Regulations 2010 implement the new EU Directive (2008/50/EC) on ambient air quality. These regulations supersede earlier regulations. The obligation for complying with these limit values rests with central government. Local Authorities currently have no statutory obligation to assess air quality against European limit values but are encouraged to do so.

2.2.2 National Legislation and Guidance

The Government's policy on air quality within the UK is set out in the Air Quality Strategy for England, Scotland, Wales & Northern Ireland Strategy (AQS), published in July 2007 in accordance with the requirements of Part IV of the Environment Act 1995. The AQS (Defra, 2007) sets out a framework to reduce adverse health effects from air pollution and ensures that international commitments are met. The AQS sets standards and objectives for pollutants to protect human health, vegetation and ecosystems.

Air quality objectives, limit values and guidelines which currently apply in the United Kingdom can be divided into four groups:

- United Kingdom air quality objectives set down in regulations for the purpose of Local Air Quality Management (LAQM);
- United Kingdom air quality objectives not included in regulations;
- European Union (EU) Limit Values transcribed into UK legislation; and
- Guidelines: eg World Health Organization (WHO) guidelines.

Many of the objectives in the Air Quality Strategy (AQS) were made statutory in England with the Air Quality (England) (Amendment) Regulations 2002 for the purpose of Local Air Quality Management (LAQM).

The principal difference, with regard to the assessment of impacts on air quality, between the Air Quality Standards Regulations which implement EU Directives and the Air Quality (England) Regulations (as amended) is the location that they apply to. The Air Quality Standards Regulation apply to '*ambient air*' which is defined as '*outdoor air in the troposphere, excluding workplaces where members of the public do not have regular access'* which essentially is any off-site location. The Air Quality (England) Regulations apply to places where '*members of the public are regularly present*' and this is interpreted as being 'regularly present' for the averaging time of the objective.

For example, the Air Quality (England) Regulations annual average objective apply to locations such as houses but not pavements whereas the Standards Regulations limit values annual average apply to any off-site location including pavements.

It should be noted that the Air Quality Standards Regulations 2010 do not supersede the 2002 regulations and are to ensure full compliance with the UK obligations under the various EU air quality directives. For the purpose of this assessment, which is to support the planning application to the Local Authority, the 2002 regulations are the most relevant assessment criteria.

In the context of the proposed development, the main potential for nuisance will arise during the construction phase; potential sources being dust emissions occurring during demolition, site clearance, earthworks, construction and landscaping processes.

2.2.3 Environmental Agency Guidance

The Environment Agency H1 guidance benchmark levels are used in this assessment where assessment criteria are not available from EU Directives or the Air Quality Strategy [(1)].

(1) Environment Agency (April 2010) Horizontal Guidance Note H1 - Annex (f).

2.2.4 National Planning Policy Framework

In March 2012 the Department of Communities and Local Government published the National Planning Policy Framework (NPPF) [1]. The purpose of the framework is to help achieve sustainable development. Section 11 of the policy makes the following references to air quality.

- The planning system should contribute to and enhance the natural and local environment by preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability.

- Planning policies should sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative impacts on air quality from individual sites in local areas. Planning decisions should ensure that any new development in Air Quality Management Areas is consistent with the local air quality action plan.

2.2.5 Planning Policy Statement 23: Planning and Pollution Control

Policy guidance for Local Authorities regarding local air quality and new development is provided in a Planning Policy Statement 23 (PPS 23). Although PPS23 has been replaced by the National Planning Policy Framework (NPPF) it contains useful principals relating to how air quality is considered in the planning system. PPS 23 advises on the policies and practices that should be taken into account by those involved in the planning of any development that has the potential to cause pollution. With regard to emissions to air, PPS 23 states that, 'any air quality consideration that relates to land use and development is capable of *being a material planning consideration*'. This is most likely to be the case in situations where the proposed development could produce an exceedence of an AQS objective and result in the designation of an Air Quality Management Area (AQMA), or where development is proposed in an AQMA, or where a proposed development renders a local planning authority's Air Quality Action Plan unworkable. PPS 23 also re-iterates that the presence of an AQMA should not result in the '*sterilisation*' of a site from development.

2.2.6 Development Control: Planning for Air Quality

In April 2010 Environmental Protection UK (EPUK, formally the National Society for Clean Air, NSCA) published an update to its guidance document that contains a framework for air quality consideration to be accounted for in local development control [2]. The EPUK guidance has been taken into account when undertaking this assessment.

A key part of the guidance is advice on describing air quality impacts and assessing their significance which has been followed in this assessment. In November 2009 the Institute of Air Quality Management (IAQM) published an update to its significance criteria which was incorporated into an

(1) Department of Communities and Local Government (March 2012) National Planning Policy Framework.
(2) EPUK (2010) Development Control for Air Quality (2010 Update).

Environmental Protection UK's development control, planning and air quality guidance.

2.2.7 Review and Assessment

Under Part IV of the Environment Act, local planning authorities must review and assess the air quality within their area by way of staged appraisals; with the aim of meeting the objectives by target dates defined in the Air Quality (England) (Amendment) Regulations. Where the air quality objectives are unlikely to be or have not been achieved by the target date, a local planning authority is required to designate an AQMA and to draw up an air quality action plan (AQAP) towards achieving air quality objectives in the future.

The Department for Environment, Food and Rural Affairs (Defra) has published technical guidance for use by local planning authorities in their review and assessment work (1).

The proposed development is in the Sandwell MBC area who have undertaken regular review and assessments of their region and determined that the prevailing air quality is a number of areas does not meets the objectives in the Air Quality Strategy (AQS) and therefore have declared a number of Air Quality Management Areas (AQMAs).

2.2.8 Environmental Permitting (England and Wales) Regulations 2010

The Environmental Permitting (England and Wales) Regulations 2010 (referred to as EPR herein), which came into force in March 2010, integrates the former Waste Management Licensing and Pollution Prevention Control (PPC) programmes to provide a single Environmental Permit System (2).

The PPC component of the EPR provides an integrated approach to controlling pollution from industrial sources. Its main aim is to achieve "*a high level of protection of the environment taken as a whole*…", by measures designed to prevent or, where that is not practicable, reduce emission to air, water and land. An operator is required to seek an EPR permit from the regulatory authority which for Part A installations is the Environment Agency which has responsibility for determining applications for permits and setting appropriate permit conditions.

The PPC programme has a number of objectives which include the setting of emission limit values based on the assessment of Best Available Techniques (BAT) and the consideration of any relevant site-specific issues. BAT is defined as "*the most effective and advanced stage in the development of activities and their methods of operation which indicates the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole*".

(1) DEFRA (2009) Local Air Quality Management, Technical Guidance LAQM TG(09).
(2) Environmental Permitting Regulations (England and Wales) Regulations 2010.

Activity-specific guidance for the sectors regulated under the EPR is available to assist with the preparation of an application and the operation of a facility. In addition, supplementary guidance is available that is relevant to all sectors and is referred to as horizontal guidance for example H1 Environmental Risk Assessment.

An application will be made to the Environment Agency for a permit to operate the facility which will be required to comply with the requirements of the Waste Incineration Directive (WID) (1).

2.3 DESCRIPTION OF POLLUTANTS

This section describes the pollutants considered in this assessment.

2.3.1 Nitrogen Dioxide (NO_2)

Where road traffic is the dominant source of air pollution, which is usually the case in urban environments, Local Authorities have found that the objectives for nitrogen dioxide (NO_2) and particulate matter (PM_{10}) are the most difficult to achieve. It is also generally the case that, where annual average concentrations of nitrogen dioxide (NO_2) and fine particulate matter (PM_{10}) meet their respective objectives and where there are no other local significant sources of air pollution, concentrations of all other pollutants in the air quality strategy will also be achieved.

Nitrogen dioxide (NO_2) is a reddish brown gas (at sufficiently high concentrations) and occurs as a result of the oxidation of nitric oxide (NO), which in turn originates from the combination of atmospheric nitrogen (N_2) and oxygen (O_2) during combustion processes. In terms of ground level concentrations in many parts of the United Kingdom, concentrations of nitrogen dioxide (NO_2) are dominated by emissions from road transport. This applies particularly in urban areas, where traffic densities are at their highest.

2.3.2 Particulate Matter

Particulate matter (PM) is a term used to describe all suspended matter, sometimes referred to as total suspended particulate matter. Sources of particles in the air include road transport, power stations and other industry, quarrying, mining and agriculture. Chemical processes in the air can also lead to the formation of particles. PM_{10} is the subject of health concerns because of the ability to penetrate and remain deep within the lungs. In recent years, epidemiological studies have shown increases in mortality correlated with concentrations of PM_{10} (COMEAP, 2009). There is increasing focus on $PM_{2.5}$ (particulate matter with an aerodynamic diameter of less than 2.5 μm) which gives a stronger association with ill-heath than PM_{10}. This assessment however uses PM_{10} because of the lack of availability of both monitoring and emissions data for this size fraction, which includes $PM_{2.5}$.

(1) Directive 2000/76/EC of the European Parliament and of the Council (4 December 2000) on the incineration of waste.

2.3.3 Sulphur Dioxide (SO_2)

Sulphur dioxide (SO_2) is a colourless gas which is produced from some natural processes, notably volcanoes, but is associated most strongly with the combustion of fossil fuels containing sulphur. When coal burning was more widespread in the UK than it is at present, sulphur dioxide (SO_2) concentrations were monitored extensively. Since coal has ceased to be used as a common fuel in homes, concentrations of sulphur dioxide (SO_2) in urban areas have fallen dramatically. Partly as a result of this improvement, sulphur dioxide (SO_2) is not regarded as a serious threat to air quality in the way it once was.

Sulphur dioxide (SO_2) is a potent respiratory irritant when inhaled at high concentrations, both in laboratory conditions and during air pollution episodes; especially for asthmatics.

2.3.4 Dioxins and Furans

Dioxins and furans are a group of organic compounds that are formed as a result of incomplete combustion in the presence of chlorine. Sources include vehicles, domestic and industrial coal burning, power generation and incinerators.

There are no regulatory air quality standards set for dioxins and furans. This group of substances, however, are important in terms of the risk of health effects on humans. A health risk assessment is the method by which the effect of dioxins can be assessed. This is however beyond the scope of this assessment which considers the significance of emissions of dioxins by comparing predicted concentrations with typical ambient concentrations.

2.3.5 Metals

The metals considered in this report can be released from both natural sources and man's activities. The contribution of the possible sources varies for each metal, both temporally and spatially. Natural sources include wind blown material, sea salt aerosols and forest fires. Man made sources include metal industries, coal combustion, vehicles, cement production, fertiliser plants and incineration.

2.3.6 Hydrogen Chloride (HCl)

Hydrogen chloride (HCl) is a colourless gas at room temperature, which dissociates readily in water, forming an acidic solution. Sources of HCL include combustion of coal and waste incineration, although it is also produced from marine aerosols.

2.3.7 Hydrogen Fluoride (HF)

Hydrogen fluoride (HF) is a colourless gas at room temperature, which dissociates readily in water, forming an acidic solution. Sources of HF include combustion of coal, steel, tile, brick and glass works and aluminium

processing plants. The EA proposes a short term Environmental Benchmark of 250 μg m^{-3} (1 hour average).

2.4 ASSESSMENT CRITERIA

This section describes the criteria use to assess the impacts on air quality of emissions to atmosphere from the proposed facility both in terms of the impacts on human health and vegetation and ecosystems.

2.4.1 Human Health

Table 2.1 shows the assessment criteria used in the assessment to assess the impacts on human health.

Table 2.1 Assessment Criteria

Pollutant	Concentration ($\mu g\ m^{-3}$)	Source	Averaging Period	Allowable Number of Exceedences per year
Nitrogen dioxide (NO_2)	200	Air Quality Strategy	1 hour	18
	40		Annual	-
Particulate matter (PM_{10})	50		24 hour	35
	40		Annual	-
Sulphur dioxide (SO_2)	266		15 minutes	35
	350		1 hour	24
	125		24 hour	3
Carbon monoxide (CO)	10,000		8 Hour	-
Hydrogen chloride (HCl)	750	Environment Agency (H1)	1 Hour	-
Hydrogen fluoride (HF)	16		Annual	-
	160		1 Hour	-
Antimony (Sb) [(a)]	5		Annual	-
	150		1 Hour	-
Arsenic (As)	0.003		Annual	-
Cadmium (Cd)	0.005		Annual	-
Chromium (Cr) [(b)]	5		Annual	-
	150		1 Hour	-
Chromium (Cr, VI) [(c)]	0.0002		Annual	-
Cobalt (Co)	0.2		Annual	-
Copper (Cu)	10		Annual	-
	200		1 Hour	-
Lead (Pb)	0.25		Annual	-
Manganese (Mn)	150		Annual	-
	1,500		1 Hour	-
Mercury (Hg)	0.25		Annual	-
	7.5		1 Hour	-
Nickel (Ni)	0.020		Annual	-
Tin (Sn)	n/a		-	-
Vanadium (Vn)	5		Annual	-
	1		1 Hour	-

(a) Antimony and compounds (as Sb) except antimony trisulphide and antimony trioxide.
(b) Chromium, chromium (II) compounds and chromium (III) compounds (as Cr).
(c) Chromium (VI) oxidation state in PM_{10} fraction.

The Environment Agency H1 guidance does not provide and an assessment criterion for thallium (Tl) and therefore this metal has not been considered further. The Air Quality Strategy (AQS) includes a 15% exposure reduction target for $PM_{2.5}$ cannot be assessed when considering the incremental impacts of a single development.

2.4.2 Vegetation and Ecosystems

Atmospheric pollutants and deposition of pollutants can directly or indirectly affect plants and ecosystems.

Oxides of Nitrogen (NO_x)

The atmospheric pollutant of most concern for sensitive vegetation and best understood is the oxides of nitrogen (NO_x). Both the EU and WHO have set limit and guidelines for the annual average concentration of NO_x for the protection of vegetation. For the protection of vegetation and ecosystems there is an Air Quality Objective (AQS) and an EU target of 30 μg m^{-3}. This objective does not apply to locations within 5 km of built up areas of more than 5,000 people, or industrial sources regulated under Part A of the 1990 Environment Act. However for the purpose of this assessment this objective is used.

Nitrogen Deposition

The deposition of nitrogen (N) from the atmosphere acts as a fertiliser which affects the natural balance of vegetation. The critical load for the deposition of nitrogen, normally expressed as Kg N ha^{-1} $year^{-1}$, is the exposure below which there should be no harmful effects on sensitive elements of the ecosystem. The critical loads vary for the type of ecosystem from as low as 5-10 Kg N ha^{-1} $year^{-1}$ for sensitive lichen found on mountain tops to 20-30 Kg N ha^{-1} $year^{-1}$ for some type of meadows.

Given the range of ecosystems in the vicinity of the proposed development and the lack of information on any particularly sensitive vegetation, a critical load of 10-15 Kg N ha^{-1} $year^{-1}$ has been assumed and the predicted increment to nitrogen deposition is compared against this critical load range.

Sulphur dioxide (SO_2)

For the protection of vegetation and ecosystems there is an Air Quality Objective and an EU target of 20 μg m^{-3} (annual and winter average). This objective does not apply to locations within 5 km of built up areas of more than 5,000 people or industrial sources regulated under Part A of the 1990 Environment Act. However for the purpose of this assessment this objective is used.

2.5 SIGNIFICANCE CRITERIA

The impact refers to the change that is predicted to take place to the prevailing environment as a result of the proposed development.

The significance of an impact is generally determined as the combination of the 'sensitivity' and/or 'value' of the affected environmental receptor and the predicted “extent” and/or “magnitude” of the impact or change. The descriptors for the magnitude of change are the same as those suggested in EPUK Development Control: Planning for Air Quality. The assessment of significance ultimately relies on professional judgement, although comparing the extent of the impact with criteria and standards specific to each environmental topic can guide this judgement.

Details of criteria specific to this assessment are defined in **Table 2.2** and **Table 2.3**. It should be noted that the EPUK descriptors of significance refer to permanent changes in air quality brought about by a development and not short term or temporary changes and refer to locations where there is relevant exposure and not therefore necessarily the location of the maximum impact. The criteria are only appropriate for changes to annual average annual concentrations of nitrogen dioxide (NO_2) and PM_{10} are locations where there is relevant exposure; ie not generally the point of maximum impact.

Table 2.2 EPUK Definition of Impact Magnitude for Changes in Pollutant Concentrations

Magnitude of Change	Increase In Annual Mean (%) [(a)]	Increase in NO_2/PM_{10} ($\mu g\ m^{-3}$)
Large	> 10	> 4
Medium	5 - 10	2 - 4
Small	1 - 5	0.4 - 2
Imperceptible	< 1	< 0.4
(a) Percentage of assessment level.		

Table 2.3 EPUK Air Quality Impact Descriptors for Increase Due to Development

Absolute Concentrations in Relation to Objective Values	Change in Concentration		
	Small	Medium	Large
Above Objective with Development (>40 $\mu g\ m^{-3}$)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective with Development (36-40 $\mu g\ m^{-3}$)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective with Development (30-36 $\mu g\ m^{-3}$)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective with Development (<36 $\mu g\ m^{-3}$)	Negligible	Negligible	Slight Adverse

3 AMBIENT AIR QUALITY DATA

3.1 INTRODUCTION

This section presents a description of the ambient air quality in the region of the proposed facility. Given the large degree of variation in pollutant concentrations, both with time and location, it is desirable to have measurements over a period of time that is long enough to ensure that a complete range of meteorological conditions and emissions have been experienced.

The assessment criteria used throughout this assessment are compared to the incremental increase occurring due to emissions to atmosphere from the proposed facility and therefore an accurate determination of the prevailing concentration is not necessary except in the case of nitrogen dioxide (NO_2) and particulate matter (PM_{10}) where prevailing concentrations may be close to or exceeding air quality objectives.

3.2 SANDWELL MBC REVIEW AND ASSESSMENT OF AIR QUALITY

Sandwell's first review and assessment of air quality was in 2000 and identified six areas that were likely to exceed the annual average nitrogen dioxide (NO_2) objective and as a result six Air Quality Management Areas (AQMAs) were declared in August 2002. All six AQMA were located close to either the M5 or M6 motorways.

As a result of the further detailed review and assessment work undertaken in 2005 which identified a further nine areas where objectives were being exceeded and seven locations where concentrations were close to objectives, Sandwell MBC recommended that the existing six AQMAs be replaced with one AQMA covering the whole borough (1). This recommendation was reported to full council and approved on 8th March 2005.

Following the declaration of an Air Quality Management Area (AQMA) the Local Authority is required to prepare an Air Quality Action Plan (AQAP) detailing measures that will be implemented to improve air quality. The Air Quality Action plan was published in September 2009 (2).

3.2.1 Sandwell MBC Air Quality Action Plan

Sandwell MBC published their Air Quality Action Plan (AQAP) in September 2009 which sets out work that is currently being undertaken to improve air quality in the whole borough. The AQAP details 23 actions that will reduce concentrations of nitrogen dioxide (NO_2) within specific areas and 30 actions to improve concentrations generally across the borough. The AQAP states that '*It will be challenging to achieve the level of NO_x reduction required in order to achieve the NO_2 annual mean objective in a number of areas across the borough. However the implementation of the actions outlined in this plan*

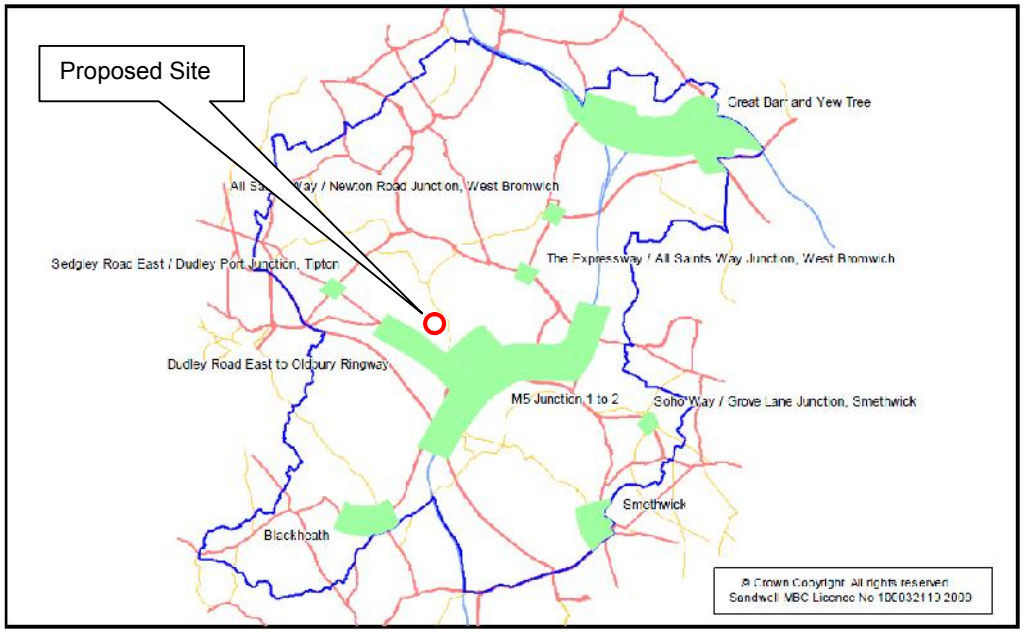
(1) Sandwell MBC (January 2005) 2nd Round Review and Assessment of Air Quality; Detailed Assessment.
(2) Sandwell MBC (September 2009) Air Quality Action Plan.

will contribute to achieving the required reduction and Sandwell MBC will continue to pursue reduction strategies'.

The AQAP also states '*As it has been identified that traffic is the main source of NO_x in Sandwell's exceedence areas, the source apportionment work has focused entirely on traffic sources. The contribution of industrial, commercial and domestic sources is minimal across the borough and will not be a focus for action planning*.'

Figure 3.1 is from the AQAP and shows the location of the proposed facility and the areas identified where there are exceedences.

Figure 3.1 Areas of Exceedence; Sandwell BC



Source: Sandwell MBC (2009) Air Quality Action Plan

Figure 2.1 shows that the proposed site is close to an area where there are exceedences. The contribution to ground level pollutant concentrations within this area of exceedence occurring as a consequence of emissions to atmosphere from the proposed facility will be carefully considered in this assessment.

3.3 ESTIMATED BACKGROUND CONCENTRATIONS

On behalf of Defra, NETCEN estimate the background concentration for a number of pollutants for a number of years on a 1 km grid resolution for the whole of the UK. The closest grid point for which NETCEN estimates of background pollutant concentrations are available is 398500,290500 which is considered to be representative of the location of the proposed facility.

Table 3.1 shows the NETCEN estimated background concentration. Estimates are presented for both 2010 and 2015. 2010 is selected as it is representative of current air quality and 2015 is selected to illustrate how background concentrations are expected to decrease in the future.

Table 3.1 Estimated Annual Average Background Concentration of Nitrogen Dioxide (NO_2), Oxides of Nitrogen (NO_x) and fine particulate matter (PM_{10}) in 2010 and 2015 ($\mu g\ m^{-3}$) for Grid Reference 398500,290500

Year	Nitrogen Dioxide (NO_2)	Oxides of Nitrogen (NO_x)	Particulate Matter (PM_{10})
2010	30.0	48.7	18.9
2015	24.7	37.7	17.6
Assessment Criteria	**40**	**-**	**40**

Table 3.1 shows that current NETCEN estimated background concentrations of nitrogen dioxide (NO_2) and fine particulate matter (PM_{10}) are less than the air quality strategy objective of 40 $\mu g\ m^{-3}$ and is expected to fall by 2015. It is considered that the background levels shown in **Table 3.1** provide a reasonable estimate of current and expected background concentrations in the region of the proposed facility. However concentrations close to busy roads in the region will be significantly higher than the estimated background and need also to be considered.

3.4 MEASURED POLLUTANT CONCENTRATIONS

Sandwell MBC operates an extensive monitoring network that includes both passive and continuous sampling. **Figure 3.1** shows the locations of nitrogen dioxide (NO_2) diffusion tubes in the vicinity of the proposed development, indicated with an 'i'. To reduce the number of specific receptors included in this assessment the impacts at the monitoring locations are modelled for each of five locations representative of the five groups of monitors, these locations are indicated on the figure with a red cross.

Figure 3.1 **Location of Proposed Facility (Red Circle) and Nitrogen Dioxide (NO_2) Diffusion Tube Monitoring Sites**

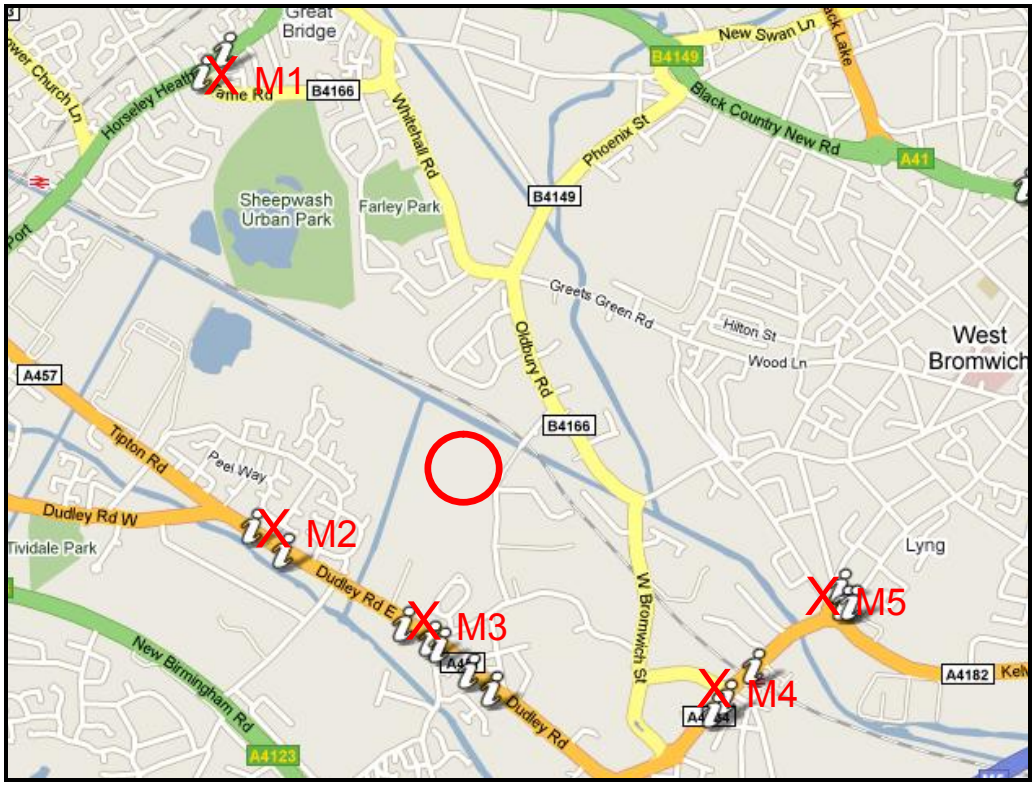


Table 3.2 provides details of the nitrogen dioxide (NO_2) diffusion tube monitoring sites.

Table 3.2 **Details of Sandwell Diffusion Tubes in the Locality of the Proposed Facility**

Location	Tube Numbers	OS Grid Reference (m) [(a)]	
M1	DP1, DP2	397401	292253
M2	C7G, C7F	397584	290628
M3	C7E, C7D, C7I	398120	290299
M4	C5E, C5A	399156	290063
M5	N1C, N1A	399546	290396

(a) Representative grid reference for each group of tubes.

Table 3.3 provides details of the measured annual average concentration of nitrogen dioxide (NO_2) at each monitoring site, data are only available to 2009.

Table 3.3 Measured Annual Average Concentrations of Nitrogen Dioxide (NO_2, $\mu g\ m^{-3}$)

Tube Number	Location	2006	2007	2008	2009	Average (2006-2009)
DP1	M1	**46.9**	**40.9**	**46.7**	**42.7**	**44.3**
DP2	M1	33.7	28.6	34.2	31.4	32.0
C7G	M2	31.3	26.2	35.3	26.1	29.7
C7F	M2	**48.8**	**42.8**	**49.4**	**50.2**	**47.8**
C7E	M3	39.4	37.1	37.9	37.6	38.0
C7D	M3	**44.4**	**40.4**	**44.1**	**40.0**	**42.2**
C71	M3	37.2	33.2	39.2	34.0	35.9
C5E	M4	**50.2**	39.2	**49.3**	**45.4**	**46.0**
C5A	M4	**42.3**	38.9	**47.1**	**41.6**	**42.5**
N1C	M5	26.5	24.0	30.1	24.0	26.2
N1A	M5	**43.3**	36.8	39.2	**40.1**	39.9
Assessment Criteria				**40**		

Table 3.3 shows that there are a number of locations where the measured annual average concentration exceeds the Air Quality Strategy objective for nitrogen dioxide (NO_2) which is an annual average of 40 $\mu g\ m^{-3}$. This assessment presents predictions of the increment to annual average concentrations that will occur at each of the monitoring sites due to emissions to atmosphere from the proposed facility.

Although some other pollutants are measured by Sandwell MBC these are not relevant to this assessment given that the measurements are not close to the facility and that the focus of this assessment of the impacts is at the point of maximum impact.

4 METHODOLOGY

4.1 INTRODUCTION

This section describes the methodology and assumptions made for the air quality assessment. Also described are the emissions data used.

4.2 EMISSIONS DATA

The application is for four RODECS® units which employ '*active pyrolysis'* to generate synthetic gas known as 'syngas'. The syngas is combusted at a temperature greater than 850 deg C with a residence time of more than 2 seconds, to comply with the requirements of the Waste Incineration Directive (WID) (1). The heat generated from the syngas combustion is used to generate steam which drives a 32 MW_e steam turbine.

The products of combustion pass through an air pollution control system which removes pollutants and ensures that the emissions to atmosphere comply with the requirements of WID. The emissions are released to atmosphere via a single twin flue stack.

Table 4.1 and Table 4.2 show the parameters which describe the physical properties of emissions from the stack, as required for definition of the emissions in dispersion modelling terms. These data are conservative estimates of the emission rates with the units operating at full load and at their emissions limit.

Table 4.1 Emissions and Physical Properties

Parameter	Value
Number of units	4
Number of flues	2
Number of stacks	1
OS Grid Reference (m)	398429 290777
Release height above ground level (m)	50
Exhaust gas oxygen content (% v/v wet)	4.1
Exhaust gas water content (% v/v)	13.5
Flue diameter (m)	1.35
Exit velocity (m s^{-1})	30.6
Flue gas emission temperature (deg C)	150
Actual volumetric flow rate for each flue (Am^3 s^{-1})	43.8
Normalised volumetric flow for each flue (Nm^3 s^{-1}) (a)	40.1
(a) Corrected for: temperature; 273 k; pressure; 101.3kPa (1 atmosphere); dry; 11% v/v O_2.	

(1) Directive 2000/76/EC of the European Parliament and of the Council (4 December 2000) on the incineration of waste.

Table 4.2 Pollutant Emissions Rate from Each Flue

Pollutant	Concentration (mg Nm^{-3}) [(a)]	Emission Rate
Oxides of nitrogen (NO_x as NO_2)	200	8.02 g s^{-1}
Sulphur dioxide (SO_2)	50	2.00 g s^{-1}
Particulate matter (PM_{10})	10	0.40 g s^{-1}
Carbon monoxide (CO)	50	2.00 g s^{-1}
Hydrogen chloride (HCl)	10	0.40 g s^{-1}
Hydrogen fluoride (HF)	1	0.040 g s^{-1}
Cadmium (Cd)	0.025 [(b)]	1.0 mg s^{-1}
Mercury (Hg)	0.05	2.0 mg s^{-1}
Eight metals (Sb, Pb, Cr, Co, Cu, Mn, Ni, V)	0.056 [(c)]	2.2 mg s^{-1}
Arsenic (As)	0.0007 [(d)]	28.0 µg s^{-1}
Chromium (VI)	0.000005 [(e)]	200.3 ng s^{-1}
Dioxins and furans (I-TEQ)	0.1 ng Nm^{-3}	4.01 ng s^{-1}

(a) Corrected for: Temperature; 273 K; Pressure; 101.3 kPa (1 atmosphere); dry; 11% v/v O_2.
(b) Assumes that cadmium is 50% of the total of cadmium plus thallium (tl).
(c) The WID limit for nine metals including arsenic (As) and lead (pb) is 0.5 mg Nm^{-3} this assessment assumes that these metals are no more than 1/9 of this limit.
(d) Environment Agency Guidance (June 2011); Mean measured concentration from 20 WID plants used.
(e) Environment Agency Guidance (June 2011); Proportion of Cr (VI) in total Cr is taken as the average proportion for 20 WID plant reported by the Environment Agency.

The modelling assumes that the emissions from the two flues will combine on release to atmosphere increasing plume rise. The modelling therefore assumes an effective diameter of 1.91 m for the two flues and the total pollutant mass emission rate for the combined emissions will be twice the rates shown in **Table 4.2** for each of the two flues.

4.3 ROAD TRAFFIC DATA

Traffic data are available for three junctions close to the proposed development site that will be most affected by traffic generated as a consequence of the operation of the development. The three junctions are:

- Junction 1: Roway Lane, Dudley Road and Brades Road
- Junction 2: Roway Lane and Union Road; and
- Junction 3: Roway Lane, Oldbury Road and West Bromwich Street.

Figure 4.1 shows the location of each of the three junctions for which traffic data are available.

Figure 4.1 Location of the Site and the Road Junctions

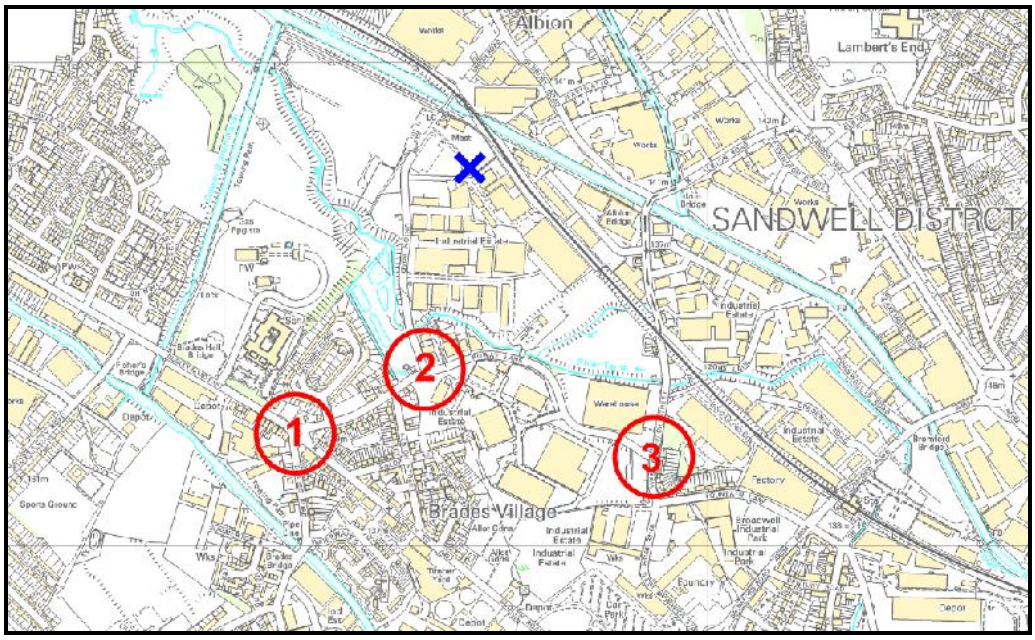


Table 4.3 shows the 2010 baseline and 2012 with and without development traffic data for the roads leading into each of the three junctions. **Table 4.4** shows the estimated increase in traffic due to the proposed development.

Table 4.3 Traffic Flows and Percentage HGV at Three Junctions

			2010		2012			
					Baseline		With Development	
Junction	No.	Road Name	AADT [(a)]	%HGV	AADT [(a)]	%HGV	AADT [(a)]	%HGV
1	1	Roway Lane	9,158	10.3	9,421	10.3	9,564	11.1
1	2	Dudley Road (West)	19,359	9.0	19,915	9.0	20,013	9.4
1	3	Dudley Road (East)	24,223	9.0	24,918	9.0	24,947	9.0
1	4	Brades Road	7,255	9.9	7,463	9.9	7,478	9.9
2	5	Roway Lane (West)	9,464	11.0	9,736	11.0	9,879	11.8
2	6	Union Road	2,081	23.7	2,141	23.7	2,325	25.9
2	7	Roway Lane (East)	9,434	12.1	9,705	12.1	9,746	12.0
3	8	Roway Lane	10,113	11.6	10,403	11.6	10,444	11.6
3	9	Oldbury Rd	13,074	12.2	13,449	12.2	13,472	12.2
3	10	West Bromwich St	11,981	12.1	12,325	12.1	12,343	12.1

(a) AADT: Annual Average Daily Traffic.

Table 4.4 Increase in Traffic Flows at the Three Junctions

Junction Number	Link No.	Road Name	Increase (24 Hour Flows) Total Traffic	HGVs
1	1	Roway Lane	143	95
1	2	Dudley Road (West)	98	95
1	3	Dudley Road (East)	29	0
1	4	Brades Road	15	0
2	5	Roway Lane (West)	143	95
2	6	Union Road	185	95
2	7	Roway Lane (East)	41	0
3	8	Roway Lane	41	0
3	9	Oldbury Rd	23	0
3	10	West Bromwich St	18	0

Table 4.3 shows that the road link with the highest traffic flows is link number 3, Dudley Road, east of Roway Lane. **Table 4.4** shows that the road link with the largest increase in traffic occurring due to the proposed development is link number 6, Union Road. This assessment presents estimates of pollutant concentration at a distance of 5 m from the centre of road for these two road links to show the worst case impacts occurring due to traffic.

4.4 RECEPTORS

To determine the maximum ground level concentrations occurring due to emissions to atmosphere from the proposed facility and the distribution of impacts, predictions are made of ground level concentrations for a grid of receptors. The receptor grid is 3,000 m by 3,000 m with spacing of 75 m. Making predictions for a grid of receptors also allows the predicted ground level concentrations to be presented as contour plots.

The specific receptors used in this assessment can be divided into three groups

- Monitoring locations, as detailed in **Section 3.2**, this allows for the predicted impacts to be directly compared and added to measured concentrations.
- Locations where there is relevant exposure such as residential properties.
- Statutory sites of ecological importance.

For the purpose of Local Air Quality Management (LAQM) the Air Quality Strategy Objectives (AQS) only apply where there is relevant exposure. This is defined as being where members of the public are regularly present and are likely to be exposed for a period of time, appropriate to the averaging period of the objective. For the annual average objective, locations of relevant exposure include residential properties, schools and hospitals.

Table 4.5 presents details of the specific receptors included in the modelling which have been selected because of the potential for relevant exposure.

Table 4.5 also shows the six statutorily designated ecological sites which are

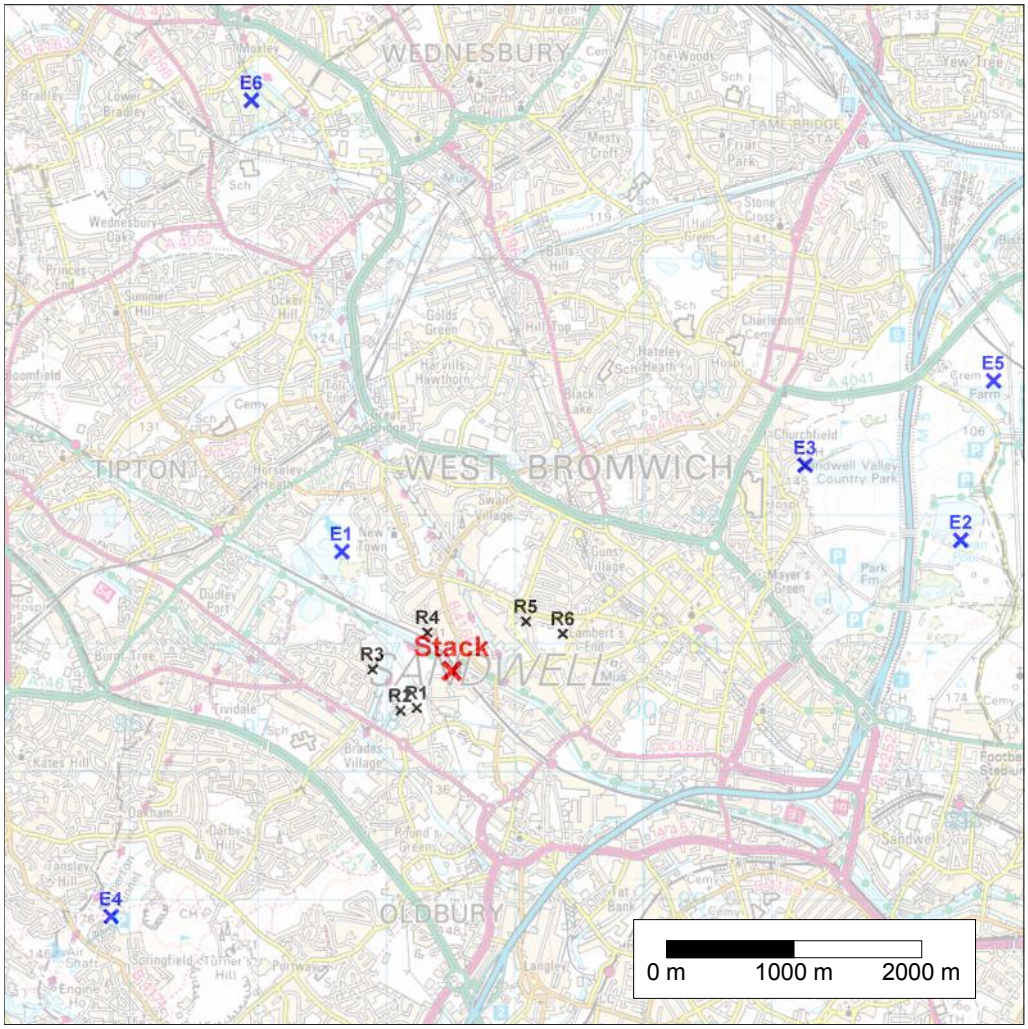
all Local Nature Reserves within 5 km of the proposed development site.

Table 4.5 Receptor Locations (Excluding Monitoring Locations)

No.	Description	Type	OS Grid Reference (m)	
R1	Theodore Close	Residential	398236	290495
R2	Meadows Sport Club	Sport Club	398109	290474
R3	Palmerston Drive	Residential	397890	290794
R4	Whitgreave St	Residential	398318	291083
R5	Millward St	Residential	399086	291169
R6	Guns Village Primary	School	399373	291073
E1	Sheepwash	Local Nature Reserve	397652	291714
E2	Priory Woods	Local Nature Reserve	402472	291803
E3	Sot's Hole	Local Nature Reserve	401260	292387
E4	Warren's Hall	Local Nature Reserve	395855	288869
E5	Forge Mill Lake	Local Nature Reserve	402727	293046
E6	Moorcroft Wood	Local Nature Reserve	396948	295232

Figure 4.2 shows the locations of the receptors and the stack.

Figure 4.2 Location of Receptors and Stack



4.5 FACTORS AFFECTING DISPERSION

There are a number of factors that will affect how emissions disperse once released to atmosphere. The four factors having the greatest effect on dispersion are:

- physical characteristics of the emissions;
- climate;
- terrain; and
- building downwash.

4.5.1 Physical Characteristics of the Emissions

Provided that the exhaust gases have sufficient velocity at stack exit to overcome the effects of stack tip downwash, which is almost certainly the case for velocities of 15 m s^{-1} or more, the physical characteristics of the flue gases will determine the amount of plume rise and hence the effect on ground level pollutant concentrations. The degree of plume rise usually depends on the greater of the thermal buoyancy or momentum effects.

4.5.2 Climate

The most important meteorological parameters governing the atmospheric dispersion of pollutants are wind speed, wind direction and atmospheric stability.

- **Wind direction** determines the broad transport of the plume and the sector of the compass into which the plume is dispersed.

- **Wind speed** can affect plume dispersion by increasing the initial dilution of pollutants and inhibiting plume rise.

- **Atmospheric stability** is a measure of the turbulence of the air, particularly of the vertical motions present. For dispersion modelling purposes, one method of classifying stability is by the use of Pasquill Stability categories, A to F. Another is by reference to the surface heat flux present at the ground.

Dispersion models, such as ADMS and AERMOD, do not allocate the degree of atmospheric turbulence into six discrete categories. These models use a parameter known as the Monin-Obukhov length which, together with the wind speed, describes the stability of the atmosphere.

4.5.3 Building Downwash

The presence of buildings can significantly affect the dispersion of the atmospheric emissions. Wind blowing around a building distorts the flow and creates zones of turbulence that are greater than if the building were absent. Increased turbulence causes greater plume mixing; the rise and trajectory of the plume may be depressed generally by the flow distortion. For elevated

releases such as those from stacks, building downwash leads to higher ground level concentrations closer to the stack than those present if a building was not there. The effects of building down wash are usually only significant where the buildings are more than 40% of the stack height. In this case the maximum building height is 36% of the stack height and therefore the effects could be screened out as being insignificant. However, for completeness, the effects of building down wash have been included in this assessment.

Table 4.6 shows the dimensions of the buildings included in the modelling.

Table 4.6 Dimensions of Buildings Included in the Modelling

Building	Height (m)	Length (m)	Width (m)	Angle (deg) [a]
Main	18.2	360	100	115
(a) Angle building length makes to north.				

The sensitivity of model predicted concentrations to the effects of are presented in **Section 6**

4.5.4 Nature of the Surface

Terrain

The effects of elevated terrain can affect dispersion and have been included in this assessment. The sensitivity of model predicted concentrations to the elevated terrain are presented in **Section 6**.

Roughness

The nature of the surface of the terrain can have a significant influence on dispersion by affecting the velocity profile with height and the amount of atmospheric turbulence. To account for the surrounding nature of the proposed site, a surface roughness length of 1.0 m has been assumed for the dispersion modelling. The sensitivity of model predicted concentrations to roughness length are presented in **Section 6**.

4.6 SELECTION OF SUITABLE DISPERSION MODEL

The dispersion models which are widely used to predict ground level pollutant concentrations are based on the concept of the time averaged lateral and vertical concentration of pollutants in a plume being characterised by a *Gaussian* (1) distribution and the atmosphere is characterised by a number of discrete stability classes. So called 'new generation' dispersion models have been developed which replace the description of the atmospheric boundary layer as being composed of discrete stability classes with an infinitely variable measure of the surface heat flux, which in turn influences the turbulent structure of the atmosphere and hence the dispersion of a plume.

(1) A Gaussian distribution has the appearance of a bell shaped curve. The maximum concentration occurs on the centre line.

There are two commercially available dispersion models that are able to predict ground level concentrations arising from emissions to atmosphere from elevated point sources (ie stacks), and are described by the Environment Agency as being 'new generation'.

- *AERMOD*: The US **A**merican Meteorological Society and **E**nvironmental Protection Agency **R**egulatory Model Improvement Committee developed a dispersion **MOD**del called *AERMOD* which incorporates the latest understanding of the atmospheric boundary layer.

- *Atmospheric Dispersion Modelling System (ADMS)*: This dispersion model was developed by the UK consultancy CERC. The model allows for the skewed nature of turbulence within the atmospheric boundary layer.

In many respects the models are quite similar and in some situations generate similar predictions of ground level concentrations. Two intercomparison studies commissioned by the Environment Agency however found there to be significant differences in calculated concentrations between the models [(1)]. These reports highlight modelling uncertainties and do not suggest that any one of the models is considered to be the most accurate.

ADMS 4.2 was selected as the model for use in this assessment because of an inherent weakness in AERMOD which occurs when stack heights are a little less than 2.5 times the building height; for these circumstances AERMOD can significantly over estimate maximum ground level concentrations. The sensitivity of predicted ground level concentrations to the selection of dispersion model is presented in **Section 6**.

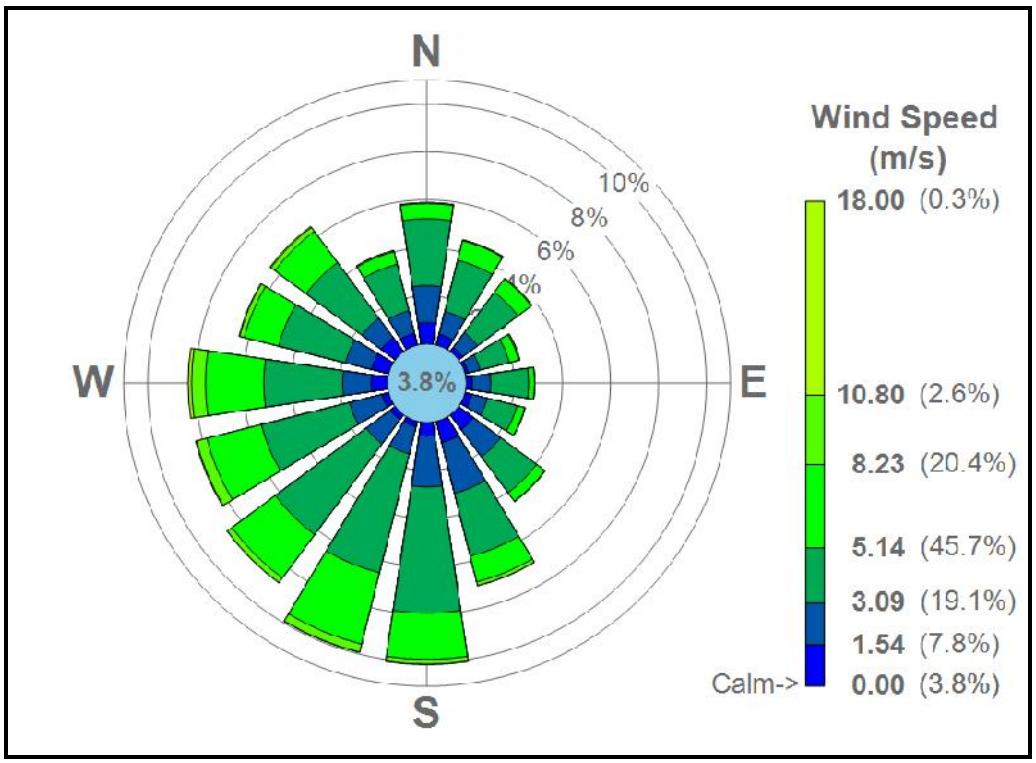
4.7 METEOROLOGICAL DATA

An important input to the dispersion model is the meteorological data. These data are important in determining the location of the maximum concentrations and their magnitude.

The closest observing station where data is available is Birmingham International Airport. For some years there is more than 10% missing cloud data. The missing cloud data is taken from Coventry airport. Five years of hourly meteorological data for 2007-2011 have been used in this assessment. **Figure 4.2** shows the windrose for Birmingham International Airport for 2007-2011, used in this assessment, which shows that the prevailing wind is from the south west, which will transport emissions to the north east.

(1) R&D Technical Report P353: **A review of dispersion model intercomparison studies using ISC, R91, AERMOD and ADMS** (ISBN 1 85705 276 5) and R&D Technical Report P362: An intercomparison of the AERMOD, ADMS and ISC dispersion models for regulatory applications (ISBN 1 85705 340 0).

Figure 4.2 Wind Rose Birmingham International Airport (2007-2011)



4.8 PERCENTAGE OXIDATION OF NITRIC OXIDE (NO) TO NITROGEN DIOXIDE (NO_2)

Oxides of nitrogen (NO_x) emitted to atmosphere as a result of gas combustion will consist largely of nitric oxide (NO), a relatively innocuous substance. Once released into the atmosphere, nitric oxide is oxidised to nitrogen dioxide (NO_2), which is of concern with respect to health and other impacts. The proportion of nitric oxide oxidised to nitrogen dioxide depends on a number of factors and the oxidation is limited by the availability of oxidants, such as ozone (O_3).

An oxidation of 35% has been assumed for oxidation of nitric oxide (NO) to nitrogen dioxide (NO_2) for short-term concentrations. For predictions of annual averages, it is assumed that 70% of the oxides of nitrogen (NO_x) are in the form of nitrogen dioxide (NO_2). These assumptions are recommended by the Environment Agency [(1)].

(1) Environment Agency (AQMAU): Conversion Ratios for NO_x and NO_2.

5 PREDICTIONS AND ASSESSMENT OF IMPACTS

5.1 INTRODUCTION

This section presents the incremental increase in ground level concentrations predicted to occur as a consequence of emissions to atmosphere from the construction and operation of the proposed facility. Predictions are presented and assessment made of the routine emissions to atmosphere assuming that the facility is operating at its emission limits.

5.2 CONSTRUCTION

During construction of the facility there is the potential for emissions of dust to cause a soiling nuisance. Also emissions to atmosphere from construction vehicles will affect air quality.

Emissions of dust have the potential to affect locations within about 200 m and give rise to a nuisance through soiling, the nearest properties are about 100 m to the north of the site and therefore without appropriate mitigation there is the potential for emissions of dust to cause a soiling nuisance. Emissions of dust can however be almost entirely abated by mitigation measures should these be necessary. It is considered that through the employment of appropriate mitigation measures, the potential for emissions of dust to give rise to a nuisance is minimal. The mitigation measures, which will be agreed with Sandwell MBC prior to construction, will be drawn from a number of sources eg BRE's Control of Dust from Construction and Demolition Activities or London Councils best practice guidance for the control of dust from construction sites [1][2]. Should any nuisance occur during construction additional mitigation measures will be implemented to reduce emissions further.

It is considered that with an appropriate level of mitigation that the potential for emission of dust to cause annoyance is minor.

The effect on air quality of emissions to atmosphere from construction vehicles will be negligible.

5.3 OPERATION

5.3.1 Stack Emissions

Defra TG(09) guidance states that for elevated point sources the focus of the assessment should be on short term impacts [3]. However for urban areas where the prevailing annual average concentration of nitrogen dioxide (NO_2) are close to or exceeding the Air Quality Strategy objectives, even for point

(1) BRE (February 2003) Vina Kukadia, Stuart Upton, David Hall; Control of Dust from Construction and Demolition Activities.
(2) London Councils (November 2006) Best Practice Guidance; The Control of dust and emissions from construction and demolition.
(3) Defra (2009) Local Air Quality Management Technical Guidance LAQM TG(09).

sources, it is often the case the increment to the annual average is of more significance that the short term impact. This is also because the effect on the total 99.8th percentile can be negligible because the peak ground level concentrations from point sources do not coincide with the peak background concentrations because the meteorological conditions that give rise to maximum ambient pollutant levels, eg still conditions, are not those that give rise to maximum impacts from point sources eg high wind speeds or unstable conditions. For this assessment equal weight is given to both long and short term impacts although it is considered that the increment to the annual average concentration are of more significance than the short term impact.

Nitrogen Dioxide (NO_2)

The principal pollutant released to atmosphere from the proposed facility is the oxides of nitrogen (NO_x) which will progressively oxidise to nitrogen dioxide (NO_2) in the atmosphere. **Table 5.1** shows the maximum predicted ground level concentration of nitrogen dioxide (NO_2) occurring as a consequence of emissions to atmosphere from the facility for each of the five years of meteorological data. The predictions include the effects of terrain and building downwash.

Table 5.1 ADMS 4.2 Maximum Predicted (Process Contribution) Annual Average and 99.8th Percentile of Hourly Average Concentrations of Nitrogen Dioxide (NO_2, $\mu g\ m^{-3}$) [(a)]

Year	Annual Average	99.8th Percentile of Hourly Averages
2007	2.2	19.1
2008	2.5	18.7
2009	2.2	18.4
2010	1.6	17.3
2011	2.7	18.7
Background Concentration	30.0	-
Background + Maximum Impact (PEC) [(b)]	32.7	79.1 [(c)]
Assessment Criteria	**40**	**200**

(a) Assumes 70% oxidation for annual average and 35% for 99.8th percentile.
(b) Predicted Environmental Concentration
(c) Defra (TG4(00)) and Environment Agency (H1) guidance; 99.8th + 2 x annual average background.

For determining the total annual average concentration it is correct to add the predicted increment to the prevailing background. For reasons described above this is not the case for the 99.8th percentile. The exact way to determine the combined 99.8th percentile is, for each hour of the year, to add the predicted to the measured hourly concentration and then calculate the resulting 99.8th percentile. This would result in no change or very little change in the total 99.8th percentile. Defra TG(09) guidance offers an approach for estimating the total 99.8th percentile. A conservative approach to the guidance method is as follows:

The total 99.8th percentile being the maximum of either:

- 99.8th percentile process contribution NO_x + twice the annual mean background NO_2; or

- 99.8th percentile hourly background NO_2 + twice annual mean process contribution NO_x

However it has been found that the TG(09) guidance method gives rise to total 99.8th percentile concentrations that are implausible because they are larger than the baseline plus process contribution 99.8th even assume that the 18 highest hours per year of baseline concentration were to coincide with the 18 highest hours per year of process contribution concentrations. For the purpose of this assessment it is considered more reasonable to used the Defra TG4(00) guidance method that suggests the total 99.8th percentile being: (1)

- 99.8th percentile process contribution NO_2 + twice the annual mean background NO_2.

It is considered that this method gives plausible total concentrations. It should also be remembered that the impact of the development on air quality is best assessed by considered the incremental impact. It should also be remembered that TG(09) is a *guidance* document.

The Environment Agency's H1 Technical Guidance also states:

$$PEC_{short\ term} = PC_{short\ term} + (2 \times Background_{long\ term})$$

where PC is the Process Contribution and PEC is the Predicted Environmental Concentration.

Table 5.1 shows that 2008 meteorological data gives rise to the highest predicted increment to annual average ground level concentrations, there is very little difference in the maximum predicted 99.8th percentile between the different years of meteorological data.

For 2011 meteorological data, at the point of maximum predicted impact, the incremental increase in annual average ground level concentration is 2.7 μg m^{-3} which can be compared to the air quality strategy objective of 40 μg m^{-3}. When added to the prevailing background concentration of 30.0 μg m^{-3}, the resulting total concentration of 32.7 μg m^{-3} is less than the objective.

The maximum predicted 99.8th percentile of 19.1 μg m^{-3} is small compared to the air quality strategy objective of 200 μg m^{-3}. To determine the incremental increase to background occurring due to the proposed facility, the Defra TG04(00)/H1 guidance is used. The resulting total 99.8th percentile is 79 μg m^{-3}. The reason why the process contribution 99.8th of 19.1 μg m^{-3} is

(1) Department of the Environment, Transport and the Region (May 2000) Review and Assessment: Pollutant Specific Guidance LAQM TG4(00).

unlikely to effect the prevailing 99.8th percentile is that the 18 hours per year that gives rise to the maximum 99.8th percentile for emissions from the proposed facility occur during either high wind speeds or high atmospheric stability. These will not coincide with the highest background concentrations which will occur for low wind speeds/calms and stable atmospheric conditions. For this reason, and because the maximum process contribution is small compared to the objective, it is considered that the short term impact are insignificant.

Table 5.2 shows the predicted annual average concentration at the specific receptors for human exposure and at the monitoring locations using 2011 meteorological data together with predictions at the point of maximum impact.

Table 5.2 ADMS 4.2 Predicted Annual Average Concentrations of Nitrogen Dioxide (NO_2) at Specific Receptors, 2011 Meteorological Data (NO_2, μg m^{-3}) [(a)]

Location	Description	Predicted Increment (Process Contribution, PC)	Prevailing Conc. [(b)]	Predicted Increment + Prevailing (Predicted Environmental Concentration, PEC)	Increment (PC) as Percentage of Objective (%)
Maximum Impact		2.71	30.0	32.7	6.8%
R1	Theodore Cls	0.61	30.0	30.6	1.5%
R2	Sport Club	0.63	30.0	30.6	1.6%
R3	Palmerstone	0.33	30.0	30.3	0.8%
R4	Whitgreave St	0.93	30.0	30.9	2.3%
R5	Millward St	1.93	30.0	31.9	4.8%
R6	School	1.17	30.0	31.2	2.9%
M1	DP1	0.29	**44.3**	**44.6**	0.7%
M1	DP2	0.29	32.0	32.3	0.7%
M2	C7G	0.27	29.7	30.0	0.7%
M2	C7F	0.27	**47.8**	**48.1**	0.7%
M3	C7E	0.71	38.0	38.7	1.8%
M3	C7D	0.71	**42.2**	**42.9**	1.8%
M3	C7I	0.71	35.9	36.6	1.8%
M4	C5E	0.56	**46.0**	**46.6**	1.4%
M4	C5A	0.56	**42.5**	**43.1**	1.4%
M5	N1C	0.58	26.2	26.8	1.5%
M5	N1A	0.58	39.9	**40.5**	1.5%
Assessment Criteria			**40**		

(a) Assumes 70% oxidation.
(b) Either measured values or NETCEN estimated background values.

Table 5.2 shows that at the monitoring locations the maximum predicted increment to annual average ground level concentrations of nitrogen dioxide (NO_2) is 0.71 μg m^{-3} and the maximum percentage increase is 1.8% of the air quality strategy objective. At the sensitive receptors considered the maximum increase is 1.9 μg m^{-3} which is result in a total concentration of 31.9 μg m^{-3} which can be compared to the air quality strategy objective of 40 μg m^{-3}.

At one receptor, monitoring location N1A, the incremental increase is predicted to give rise to an exceedence. It should however be noted that this

is a direct consequence of the measured concentration, which is a four year average, being only 0.1 μg m^{-3} below the objective. The predicted incremental increase is small compared to the normally quoted accuracy (eg Defra TG(09)) of diffusion tubes of +/- 25% which in this case would equate to +/- 10 μg m^{-3}.

The EPUK significance criteria are applicable to locations where there is relevant exposure, in this case it is specific receptors 1 to 6. **Table 5.3** shows the EPUK significance criteria applied to the six residential receptors.

Table 5.3 EPUK Significance Criteria

Location	Description	Predicted Increment	Increase (%)	Magnitude of Change	PEC	Impact Descriptor
R1	Theodore Cls	0.61	1.5%	Small	30.6	Negligible
R2	Sport Club	0.63	1.6%	Small	30.6	Negligible
R3	Palmerstone	0.33	0.8%	Imperceptible	30.3	Negligible
R4	Whitgreave St	0.93	2.3%	Small	30.9	Negligible
R5	Millward St	1.93	4.8%	Small	31.9	Negligible
R6	School	1.17	2.9%	Small	31.2	Negligible

Table 5.3 shows that the proposed development is predicted to have an impact of negligible significance on annual average concentrations of nitrogen dioxide (NO_2) according to the EPUK significance criteria.

Table 5.4 shows the predicted 99.8th percentile concentration at the specific receptors using 2011 meteorological data together with predictions at the point of maximum impact.

Table 5.4 ADMS 4.2 Predicted 99.8th Percentile Concentrations of Nitrogen Dioxide (NO_2) at Specific Receptors, 2011 Meteorological Data (NO_2, μg m^{-3}) [(a)]

Location	Description	Predicted Increment	Predicted Increment + Prevailing [(b)]	Increment as Percentage of Objective (%)
Maximum Impact		19.1	79.1	9.5%
R1	Theodore Close	12.6	72.6	6.3%
R2	Sport Club	12.4	72.4	6.2%
R3	Palmerston	10.8	70.8	5.4%
R4	Whitgreave St	14.3	74.3	7.2%
R5	Millward St	9.4	69.4	4.7%
R6	School	7.2	67.2	3.6%
M1	DP1	3.9	92.5	1.9%
M1	DP2	3.9	67.9	1.9%
M2	C7G	7.6	67.0	3.8%
M2	C7F	7.6	103.2	3.8%
M3	C7E	11.1	87.1	5.5%
M3	C7D	11.1	95.5	5.5%
M3	C7I	11.1	82.9	5.5%
M4	C5E	7.0	99.0	3.5%
M4	C5A	7.0	92.0	3.5%
M5	N1C	5.9	58.3	3.0%
M5	N1A	5.9	85.7	3.0%
Assessment Criteria			**200**	

(a) Assumes 35% oxidation.
(b) Defra guidance (TG4(00)); NO_2 99.8th + 2 x annual average NO_2 background.

Table 5.4 shows that the maximum predicted 99.8th percentile of hourly average nitrogen dioxide (NO_2) concentrations is 14.3 μg m^{-3} at any of the specific receptors which is 7.2% of the objective. It is not appropriate to use the EPUK significance criteria on short term concentrations of nitrogen dioxide (NO_2) however the impacts are considered to be negligible.

Tables 5.1 to 5.4 show that at the specific receptors, the predicted incremental increase in concentrations of nitrogen dioxide (NO_2) occurring due to emissions from the proposed facility are small compared to the assessment criteria and are not of concern to human health.

The following figures are presented to illustrate the distribution of concentrations of the oxides of nitrogen (NO_x). Predictions are presented for 2011 meteorological data.

- **Figure 5.3;** Annual Average
- **Figure 5.4**; 99.8th percentile of hourly averages

It should be noted that the figures are for the oxides of nitrogen (NO_x) and not for nitrogen dioxide (NO_2). An oxidation of 35% has been assumed for oxidation of nitric oxide (NO) to nitrogen dioxide (NO_2) for short-term concentrations and 70% annual average.

The figures show that peak predicted increments to ground level concentrations occur within about 400 m of the facility and for increments to

annual average concentrations this occurs to the north east of the facility in an industrial area.

Figure 5.3 ADMS 4.2 Predicted Annual Average Ground Level Concentrations of the Oxides of Nitrogen (NO_x); 2011 Meteorological Data ($\mu g\ m^{-3}$)

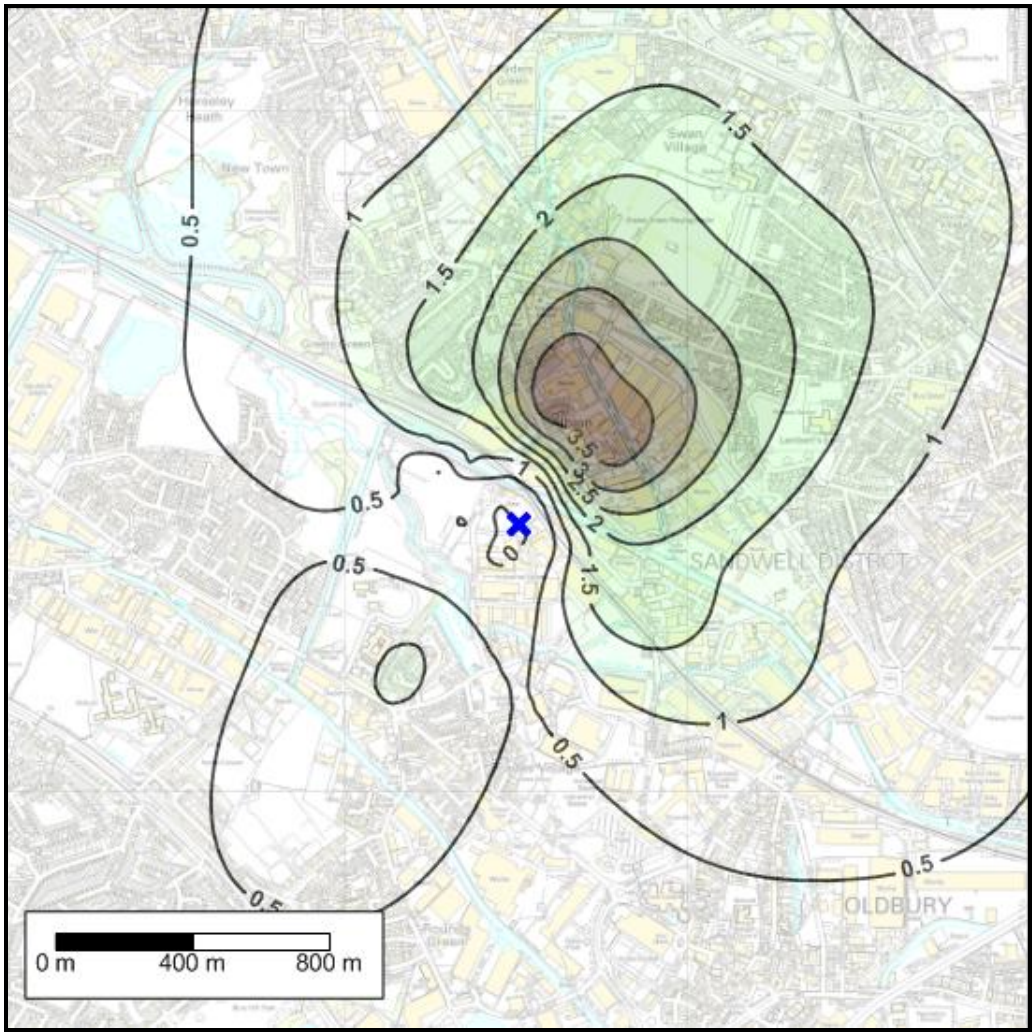
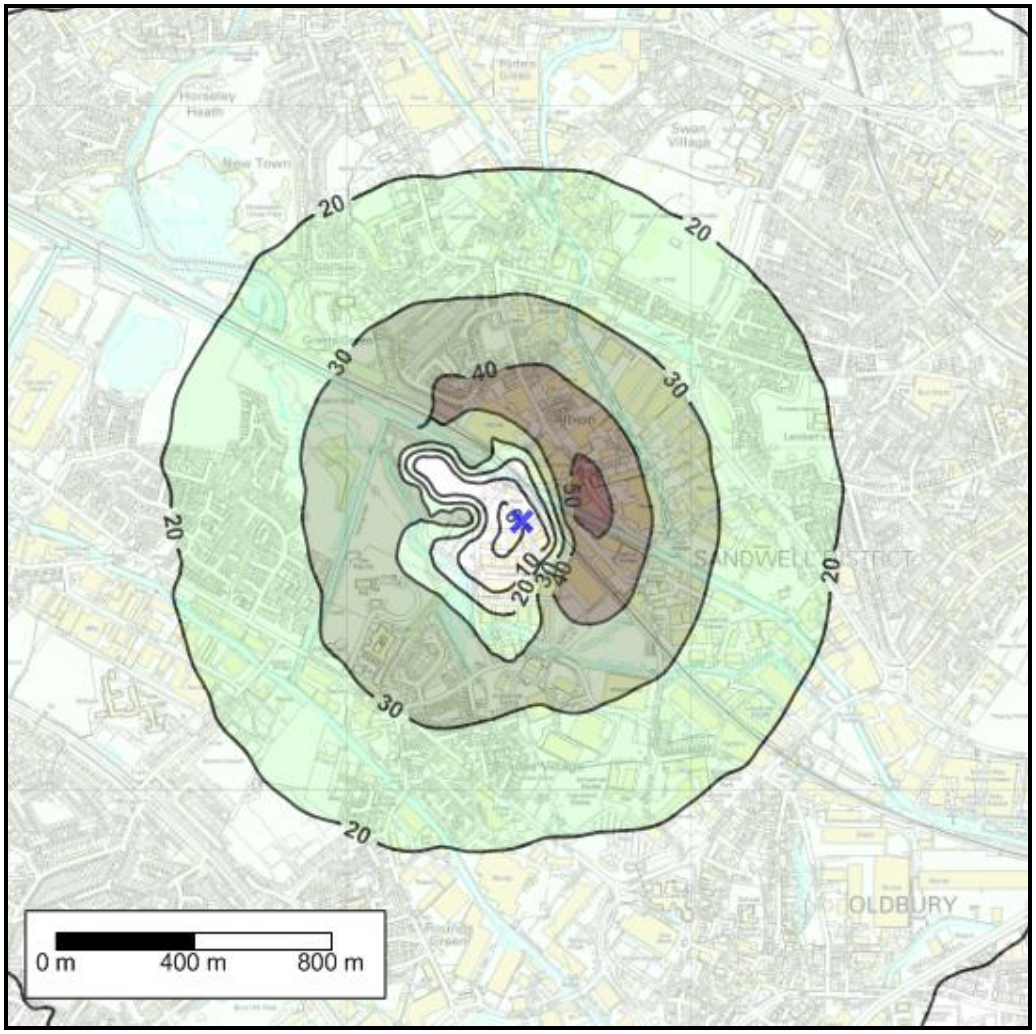


Figure 5.4 **ADMS 4.2 Predicted 99.8th Percentile of Hourly Average Ground Level Concentrations of the Oxides of Nitrogen (NO_x); 2011 Meteorological ($\mu g\ m^{-3}$)**



Remaining Pollutants

This section presents an assessment of the pollutants other than nitrogen dioxide (NO_2) that will be released to atmosphere from the proposed facility as the oxides of nitrogen (NO_x). The assessment assumes full load continuous operation at the WID limits and uses 2011 meteorological data because this gives rise to the largest increment to annual average concentrations. The distribution of all the predicted ground level pollutant concentrations will be the same as those for the oxides of nitrogen (NO_x) and therefore have not been presented.

Table 5.5 shows the maximum predicted increments to ground level concentrations for all the pollutants considered in this assessment.

Table 5.5 ADMS 4.2 Maximum Predicted Incremental Concentrations due to Emissions to Atmosphere from the Proposed (μg m^{-3}, 2011 Meteorological Data

Pollutant	Averaging Period	Allowable Number of Exceedences per year	Predicted Concentration (μg m^{-3})	Assessment Criteria (μg m^{-3})	Percentage of Assessment Criteria (%)
Nitrogen dioxide (NO_2)	1 hour	18	18.7	200	9.4%
	Annual	-	2.7	40	6.8%
Particulate matter (PM_{10})	24 hour	35	0.65	50	1.3%
	Annual	-	0.19	40	0.5%
Sulphur dioxide (SO_2)	15 minutes	35	14.0	266	5.3%
	1 hour	24	13.1	350	3.7%
	24 hour	3	8.2	125	6.5%
Carbon monoxide	8 Hour	-	12.3	10,000	0.1%
Hydrogen chloride	1 Hour	-	6.3	750	0.8%
Hydrogen fluoride (HF)	Annual	-	0.019	16	0.1%
	1 Hour	-	0.63	160	0.4%
Antimony (Sb) [(a)]	Annual	-	0.0011	5	0.0%
	1 Hour	-	0.035	150	0.0%
Arsenic (As)	Annual	-	0.000014	0.003	0.5%
Cadmium (Cd)	Annual	-	0.0005	0.005	9.7%
Chromium (Cr) [(b)]	Annual	-	0.0011	5	0.0%
	1 Hour	-	0.035	150	0.0%
Chromium (Cr, VI) [(c)]	Annual	-	0.0000001	0.0002	0.0%
Cobalt (Co)	-	-	0.0011	0.2	0.5%
Copper (Cu)	Annual	-	0.0011	10	0.0%
	1 Hour	-	0.035	200	0.0%
Lead (Pb)	Annual	-	0.0011	0.25	0.4%
Manganese (Mn)	Annual	-	0.0011	150	0.0%
	1 Hour	-	0.035	1,500	0.0%
Mercury (Hg)	Annual	-	0.0010	0.25	0.4%
	1 Hour	-	0.031	7.5	0.4%
Nickel (Ni)	Annual	-	0.0011	0.02	5.4%
Vanadium (Vn)	Annual	-	0.0011	5	0.0%
	1 Hour	-	0.035	1	3.5%
Dioxins	Annual	-	1.9 (fg m^{-3})	-	-

(a) Antimony and compounds (as Sb) except antimony trisulphide and antimony trioxide.
(b) Chromium, chromium (II) compounds and chromium (III) compounds (as Cr).
(c) Chromium (VI) oxidation state in PM_{10} fraction.

Table 5.5 shows that, as a percentage of the short term assessment criteria, it is the 99.8th percentile of hourly average concentration of nitrogen dioxide (NO_2) which is 9.4% of the assessment criteria that has the largest impact. Given that this is less than 10% which is the threshold suggest by the Environment Agency in their H1 guidance for screening out insignificant short term impacts it is concluded that the impacts on air quality of emissions to atmosphere from the proposed facility for all the pollutants are insignificant.

For annual average impacts the increment to annual average concentration of cadmium is predicted to give rise to the largest percentage of the assessment criteria of 9.7%. It should be noted that the assessment criteria of 0.005 μg m^{-3} is from the World Health Organisation Air Quality guidelines (2000) which state that the guideline is set to *'prevent any further increase of cadmium in agricultural soils*'. Given that the maximum predicted concentration is substantial less than the assessment criteria and that the area is predominantly urban it is considered that there is no concern to human health.

Dioxins and furans are a group of organic compounds that are formed as a result of incomplete combustion in the presence of chlorine. Sources include vehicles, domestic and industrial coal burning, power generation and incinerators. There are no regulatory air quality standards set for dioxins and furans. There are only limited data available on airborne dioxins and furans in the urban environment in the UK; these show concentrations in the range of 146-188 fg I-TEQ m^{-3} (1) (2). The maximum predicted ground level concentration of dioxin of 1.9 fg I-TEQ m^{-3} is small compared to the reported range of urban dioxin concentrations.

A Heath Risk Assessment (HRA) has been undertaken to determine the risk to health of the incremental concentrations of dioxins which shows that there is not a significant additional risk (3).

So far this assessment has focused on the potential impacts to human health of emissions to atmosphere from the proposed facility. There is also the potential for the facility to effect vegetation and ecosystems. The potential effects are assessed by comparing the predicted increment to annual average ground level concentrations of the oxides of nitrogen (NO_x) and sulphur dioxide (SO_2) to the air quality strategy objectives for the protection of vegetation and ecosystems. Predictions have been made at the six statutory sites within 5 km of the proposed facility and are presented in **Table 5.6**.

(1) fg (femto gram) is 10^{-15} g.

(2) Duarte-Davidson R, Clayton P, Davis B, Jones KC and Jones P (1994) **PCDDs and PCDFs in British Urban Air and Deposition** Environ. Sci. Pollut. Res. 1 pp262-270

(3) ADM (March 2013) Health Risk Assessment of Emissions to Atmosphere from Proposed Advances Recycling and Electrical Generating Facility.

Table 5.6 ADMS 4.2 Predicted Annual Average Concentrations of Oxides of Nitrogen (NO_x) and Sulphur Dioxide (SO_2) at Ecological Specific Receptors, 2008 Meteorological Data ($\mu g\ m^{-3}$)

Location	Description	Oxides of Nitrogen (NO_x)	Sulphur Dioxide (SO_2)
E1	Sheepwash	0.57	0.14
E2	Priory Woods	0.23	0.06
E3	Sot's Hole	0.44	0.11
E4	Warren's Hall	0.12	0.03
E5	Forge Mill Lake	0.26	0.06
E6	Moorcroft Wood	0.20	0.05
Assessment Criteria		**30**	**20**

Table 5.6 shows that the maximum impact at the six ecological sites occurs at Sheepwash Local Nature Reserve is less than 2% of the assessment criteria and therefore insignificant and do not require further consideration.

5.3.2 Emissions from Road Traffic

The DMRB method has been used to estimated the annual average concentrations of nitrogen dioxide (NO_2) and fine particulate matter (PM_{10}) at a distance of 5 m from the centre of road link 3, Dudley Road which is the road with the highest traffic flows and road link 6, Union road which is the link with the largest increase due to the proposed development (1). The distance of 5 m is selected as this is conservative as there will not be any relevant exposure (eg residential properties) at distance closer than 5 m.

Table 5.6 shows the DMRB estimated total annual average concentration of nitrogen dioxide (NO_2) and fine particulate matter (PM_{10}) at a distance of 5 m from the centre of the road.

Table 5.6 DMRB Estimated Annual Average Concentrations of Nitrogen Dioxide (NO_2) and Fine Particulate Matter (PM_{10}) at 5 m From Road Centre ($\mu g\ m^{-3}$)

Link	Road Name	2010 Base	2012 Base	2012 Development	Increase
Nitrogen Dioxide (NO_2)					
3	Dudley Road	36.6	33.8	33.8	0.0
6	Union Road	31.6	29.4	29.6	0.2
Assessment Criteria				**40**	
Fine Particulate Matter (PM_{10})					
3	Dudley Road	21.8	20.9	20.9	0.0
6	Union Road	19.4	18.9	18.9	0.0
Assessment Criteria				**40**	

Table 5.6 shows that the estimated annual average concentration of nitrogen dioxide (NO_2) and fine particulate matter (PM_{10}) at a distance of 5 m from the centre of the two road links are below the assessment criteria for all three

(1) Version 1.03c (July) available from www.highways.gov.uk.

scenarios considered. The table also shows that the estimated increase in annual average concentrations due to emissions from road traffic occurring due to the proposed development is negligible.

6 SENSITIVITY ANALYSIS

6.1 INTRODUCTION

This section considers the sensitivity of model predicted concentrations to the following:

- Meteorological data;
- Roughness length;
- Grid spacing;
- Building downwash;
- Terrain;
- Single unit operation;
- Dispersion model; and
- Stack height.

6.2 METEOROLOGICAL DATA

The assessment presented in this report is based on predictions made using five years (2007-2011) of meteorological data from Birmingham Airport.

To illustrate the year to year variation in meteorological data, **Table 6.1** shows the maximum predicted ground level concentration of nitrogen dioxide (NO_2) for each of five years of meteorological data from Birmingham Airport together with predictions made with 2008 meteorological data from Coventry airport.

Table 6.1 ADMS 4.2 Maximum Predicted Annual Average and 99.8th Percentile of Hourly Average Concentrations of Nitrogen Dioxide (NO_2, $\mu g\,m^{-3}$) [(a)]

Year and Source	Annual Average	99.8th Percentile of Hourly Averages
Birmingham 2007	2.2	19.1
Birmingham 2008	2.5	18.7
Birmingham 2009	2.2	18.4
Birmingham 2010	1.6	17.3
Birmingham 2011	2.7	18.7
Coventry 2008	3.5	18.6
Assessment Criteria	**40**	**200**

(a) Assumes 70% oxidation for annual average and 35% for 99.8th percentile.

Table 6.1 shows that there is some year to year variation in predicted concentration although it is not considered to be significant. The maximum predicted annual average concentration using meteorological data from Coventry Airport is a little higher than using data from Birmingham, the maximum predicted 99.8th percentile are similar.

6.3 ROUGHNESS LENGTH

The roughness length of 1.0 m used in this assessment was selected using professional judgement because roughness length is not something that can be directly measured. In practice, there is no one unique roughness that fits a

given wind speed profile. Roughness length will also vary depending on wind direction and other factors such as season of the year.

It is therefore of interest to see how sensitive the model predictions are to roughness length.

Table 6.2 shows the maximum predicted ground level concentration of nitrogen dioxide (NO_2) for roughness lengths in the range of 0.5 m to 1.5 m using 2008 meteorological data.

Table 6.2 ADMS 4.2 Maximum Predicted Annual Average and 99.8th Percentile of Hourly Average Concentrations of Nitrogen Dioxide (NO_2, $\mu g\,m^{-3}$) [(a)]

Roughness Length (m)	Annual Average	99.8^{tn} Percentile of Hourly Averages
0.5	1.8	18.0
1.0	2.5	18.7
1.5	3.2	19.2
Assessment Criteria	**40**	**200**
(a) Assumes 70% oxidation for annual average and 35% for 99.8th percentile.		

Table 6.2 shows that in this modelling situation, increasing roughness length increases the maximum predicted concentrations but the effect is not significant.

6.4 GRID SPACING

If the grid spacing is too large then it is possible that the reported maximum concentrations will not be the actual maxima. This assessment uses a grid spacing of 75 m which at 1.5 times the stack height is appropriate. One way to demonstrate this is to model with smaller grid spacing and if the maximum concentration is not significantly different then one can be confident that the grid spacing it adequate.

Table 6.3 shows the maximum predicted ground level concentration of nitrogen dioxide (NO_2) for the grid spacing of 75 m used in this assessment and also 37.5 m, predictions are made using 2008 meteorological data.

Table 6.3 ADMS 4.2 Maximum Predicted Annual Average and 99.8th Percentile of Hourly Average Concentrations of Nitrogen Dioxide (NO_2, $\mu g\,m^{-3}$) [(a)]

Grid Spacing (m)	Annual Average	99.8^{tn} Percentile of Hourly Averages
75	2.5	18.7
37.5	2.5	18.7
Assessment Criteria	**40**	**200**
(b) Assumes 70% oxidation for annual average and 35% for 99.8th percentile.		

Table 6.3 shows that halving the grid spacing does not affect the maximum predicted concentrations.

6.5 BUILDING DOWNWASH AND TERRAIN

This modelling presented in this assessment includes both the effects of building downwash and terrain. **Table 6.4** shows the predicted maximum ground level concentration of nitrogen dioxide (NO_2) both with and without the effects of building downwash and terrain using 2008 meteorological data.

Table 6.4 ADMS 4.2 Maximum Predicted Annual Average and 99.8th Percentile of Hourly Average Concentrations of Nitrogen Dioxide (NO_2, $\mu g\,m^{-3}$) [(a)]

Building Downwash Effects	Terrain Effects	Annual Average	99.8th Percentile of Hourly Averages
Yes	Yes	2.5	18.7
No	Yes	2.2	11.8
Yes	No	2.5	17.9
No	No	2.1	11.6
Assessment Criteria		**40**	**200**
(c) Assumes 70% oxidation for annual average and 35% for 99.8th percentile.			

Table 6.4 shows that building downwash effects are predicted to effect dispersion but the effect is not significant, this is because that stack is more than 2.5 times the maximum building height. The effects of terrain are insignificant.

6.6 SINGLE UNIT OPERATION

The modelling presented in this assessment is for two units operating on each of the two flues. It is possible that the facility could operate with one unit on each flue which halve the exit velocity.

Table 6.5 shows the predicted maximum ground level nitrogen dioxide (NO_2) concentrations for 2008 meteorological data for both full load and 50% operation with one unit operating for each flue.

Table 6.5 ADMS 4.2 Predicted Maximum Annual Average and 99.8th Percentile of Hourly Average Concentrations of Nitrogen Dioxide (NO_2, $\mu g\,m^{-3}$) [(a)]

Dispersion Model	Annual Average	99.8th Percentile of Hourly Averages
Full Load (two unit for each flue)	2.5	18.7
50% load (one unit for each flue)	2.3	15.1
Assessment Criteria	**40**	**200**
(a) Assumes 70% oxidation for annual average and 35% for 99.8th percentile.		

Table 6.5 shows that the maximum predicted ground level concentration for 50% load for each flue is less than for full load but not substantially less. The reduction in the emissions rate of 50% is largely, but not entirely off set but the reduced dispersion occurring due to the lower exit velocity. This prediction confirms however that the full load operation considered in this assessment is the worst case.

6.7 DISPERSION MODEL SELECTION

The predictions presented in this assessment were made using the ADMS 4.2 dispersion model. An equally acceptable model would have been AERMOD. **Table 6.6** shows the predicted maximum ground level nitrogen dioxide (NO_2) concentrations for both the ADMS 4.2 and AERMOD models for 2008 meteorological data.

Table 6.6 ADMS 4.2 and AERMOD Predicted Maximum Annual Average and 99.8th Percentile of Hourly Average Concentrations of Nitrogen Dioxide (NO_2, $\mu g\ m^{-3}$) [(a)]

Dispersion Model	Annual Average	99.8th Percentile of Hourly Averages
ADMS 4.2	2.5	18.7
AERMOD	1.8	10.9
Assessment Criteria	**40**	**200**
(b) Assumes 70% oxidation for annual average and 35% for 99.8th percentile.		

Table 6.6 shows that the AERMOD predicted maximum concentrations are a little lower than those predicted by ADMS 4.2. It should be noted that the Environment Agency regard both ADMS and AERMOD as equally acceptable models.

6.8 STACK HEIGHT

Table 6.7 and **Figure 6.1** show the ADMS 4.2 maximum predicted annual average and 99.8th percentile of hourly average concentrations of nitrogen dioxide (NO_2) for stack heights in the range of 20 m to 65 m. Predictions are made for 2008 meteorological data.

Table 6.7 ADMS 4.2 Maximum Predicted Annual Average and 99.8th Percentile of Hourly Average Concentrations of Nitrogen Dioxide ($NO_2\ m^{-3}$) Effect of Stack Height [(a)]

Stack Height (m)	Annual Average	99.8th Percentile
20	23.8	102.0
25	16.2	87.7
30	11.8	75.7
35	8.2	70.3
40	5.8	54.5
45	3.5	31.5
50	2.5	18.7
55	1.8	10.6
60	1.6	9.4
65	1.3	8.6
(a) Assumes 70% oxidation for annual average and 35% for 99.8th percentile.		

Figure 6.1 **ADMS 4.2 Maximum Predicted Annual Average and 99.8th Percentile of Hourly Average Concentrations of Nitrogen Dioxide (NO_2 m^{-3}) Effect of Stack Height**

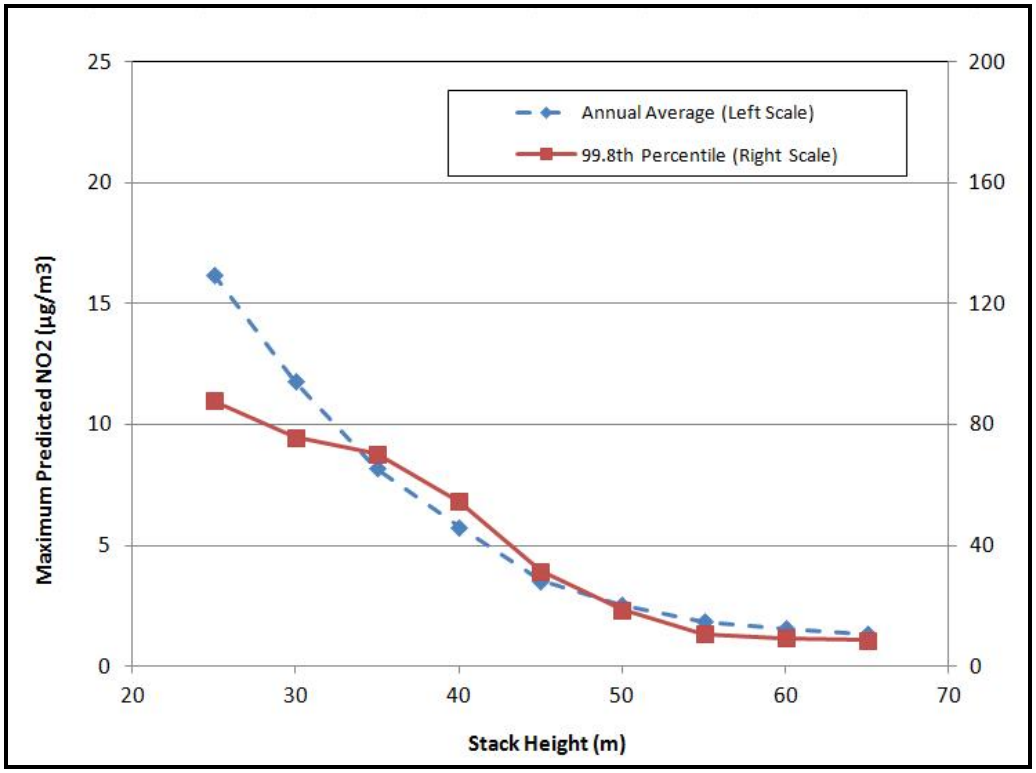


Table 6.7 and Figure 6.1 show that the benefits in terms of reduction in the maximum ground level concentration of nitrogen dioxide (NO_2) for stack heights above the proposed height of 50 m is minimal.

7 MITIGATION AND RESIDUAL IMPACTS

7.1 INTRODUCTION

The assessment presented in this report assumes an appropriate level of mitigation and therefore the predicted impacts are following mitigation and therefore can be considered to be also the residual impacts.

This section outlines the mitigation measures that are inherent in the design, construction and operation of the facility.

7.2 CONSTRUCTION

Emissions of dust generated during construction can be almost entirely abated by mitigation measures should these be necessary. The mitigation measures that will be employed during construction will be those considered adequate by the construction company. The measures will be discussed and agreed with the Sandwell MBC prior to commencement of construction. The measures used will be drawn from a number of sources.

7.3 OPERATION

The assessment presented here shows that the dispersion provided by 50 m stacks is sufficient to render the emissions harmless at ground level and therefore no further mitigation measures are required.

8 SUMMARY AND CONCLUSIONS

Chinook Sciences Ltd has commissioned Atmospheric Dispersion Modelling Ltd (ADM Ltd) to undertake an air quality assessment of emissions to atmosphere from the proposed advanced recycling and electrical generation facility, Oldbury, West Midlands.

The facility will process approximately 250,000 tonnes per year of raw Automotive Shredder Residue (ASR), transported to the facility by rail from European Metal Recycling (EMR) shredders around the country.

Emissions to atmosphere will occur from the following sources:

- Construction.
- The twin flue 50 m high stack.

Emissions from road traffic during both construction have been screened out as being insignificant because of the small number of additional vehicles.

The ADMS 4.2 dispersion model has been used to make predictions of ground level concentrations of the following pollutants released to atmosphere from the facility:

The following are the principal conclusions that can be drawn from this assessment which has been undertaken using the emissions data provided and the assumptions specified:

- During construction there is the potential for emissions of dust to cause a soiling nuisance, however with appropriate mitigation measures that will be employed, the potential for soiling nuisance is minimal.

- Emissions to atmosphere from the 50 m stack will not significantly affect air quality at ground level and the impact is considered to be insignificant.

- The effect on air quality of emissions to atmosphere from road traffic occurring due to the proposed development is predicted to be negligible.

- The sensitivity analysis shows in the most part that the predicted concentrations are not overly sensitive to assumptions made and methods used.

- It is considered that the overall the impact on air quality of emissions to atmosphere from the proposed facility can be described as of **minor significance**. This conclusion is based on all the impacts presented in the assessment and takes account of the localised nature of the area of maximum impact.

Addendum to:
Air Quality Assessment of Emissions to Atmosphere from Proposed Waste to Energy Facility Oldbury (March 2013)

P1205

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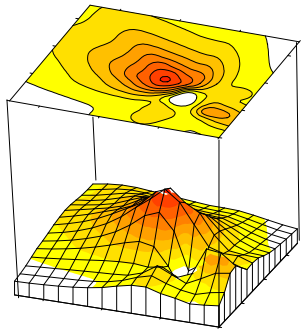

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1 INTRODUCTION

This Addendum should be read in conjunction with the March 2013 air quality assessment report undertaken for proposed energy facility, to be located in Oldbury, West Midlands (1).

This Addendum presents the results predictions of plume visibility and pollutant deposition rates.

Only changes to the data and additional assessment are presented in this Addendum.

2 PLUME VISIBILITY

2.1 INTRODUCTION

The water content of the emissions to atmosphere from the stack is 13.5% (v/v) which equated to a mixing ratio of 0.084 kg/kg (2). The temperature of the emissions on release to atmosphere is 150 deg C.

Once released to atmosphere, the emissions will dilute, cool and, depending of the prevailing ambient temperature and relative humidity, may condense to form a visible vapour plume. The frequency and extent of any visible plume depends on the ambient temperature and relative humidity and the rate of plume dilution.

The ADMS 5.0 dispersion model has been used to predict the frequency and extent of a visible vapour plume.

2.2 PREDICTIONS OF VISIBLE VAPOUR PLUME

Predictions of the frequency and extent of a visible vapour plume have been made with the ADMS 5.0 plume visibility module. **Table A1** summarises the predictions of visible vapour plume length and frequency for each year of meteorological data. These predictions are for all hours.

Table A1 Summary of ADMS 5.0 Predictions for Visible Vapour Plume (All Hours)

Year of Meteorological Data	2007	2008	2009	2010	2011	Average
%age occurrence of visible vapour plume (%)	9.3%	11.8%	13.4%	20.7%	10.8%	13.2%
%age visible plume length < 50 m (%)	5.2%	7.4%	7.0%	11.4%	6.8%	7.6%
%age visible plume length 50 m - 100 m (%)	2.2%	2.3%	3.2%	6.1%	2.4%	3.2%
%age visible plume length 100 m - 200 m (%)	0.9%	1.0%	1.4%	2.1%	0.8%	1.2%
%age visible plume length > 200 m (%)	0.9%	1.2%	1.8%	1.1%	0.8%	1.2%
Average length of vapour plume (m)	114	105	130	78	94	104

(1) ADM Ltd (27 March 2013) Air Quality Assessment of Emissions to Atmosphere from Proposed Waste to Energy Facility.

(2) www.humidity-calculator.com.

Table A1 shows that for the year that gives rise to the highest frequency occurrence of visible vapour plumes the predicted occurrence is 20.7% of the time. The average percentage occurrence for the five years of meteorological data is 13.2%.

Environment Agency guidance (H1) suggests that the significance of the occurrence of visible vapour plumes should be determined by consideration of the frequency of occurrences of visible vapour plumes during day time hours that extend beyond the site boundary.

The ADMS model has been run to make predictions of the occurrences of only day time condensing/visible plumes. Post processing of the day time vapour plume length with the distance to the site boundary for the wind direction for which the plume occurred has been undertaken to determine the number of hours a day time plume extends beyond the site boundary. **Table A2** shows a summary of these data.

Table A2 Summary of ADMS 5.0 Predictions for Number of Hours per Year a Condensing Vapour Plume

Meteorological Data Year	All Hours (Day and Night)	Day-time Hours Only	Daytime Hours where Plume Length Exceeds Site Boundary
2007	815	166	132
2008	1,037	317	132
2009	1,174	320	150
2010	1,813	548	314
2011	946	278	106
Average	1,157	326	167

Condensing vapour plume are less likely to occur during daytime hours because temperatures are higher and relative humidity is lower than night time hours. Therefore a larger proportion (frequency) of visible/condensing vapour plume (condensed plumes) will occur at night time.

Table A3 shows the percentage of a condensing vapour plumes for all hours during the year that a visible vapour plumes (taking the view that a condensing vapour plume will only be visible if it occurs during day time hours) as a percentage of hours in the year and visible/condensing vapour plume that occurring during day time as a percentage of day time hours only.

Table A3 Summary of ADMS 5.0 Predictions Percentages of Condensing and Visible Vapour Plumes

Meteorological Data Year	All Occurrences of Condensing Plume as Percentage of all Hours in the Year	Day-time (Visible) Condensing Plume as Percentage of all Hours in Year	Day-time (Visible) Condensing Plume as Percentage of Daytime Hours in Year
2007	9.3%	1.9%	4.3%
2008	11.8%	3.6%	7.8%
2009	13.4%	3.7%	8.1%
2010	20.7%	6.3%	14.3%
2011	10.8%	3.2%	7.1%
Average	**13.2%**	**3.7%**	**8.3%**

Table A4 shows the percentage visible vapour plumes (taking the view that a condensing vapour plume will only be visible if it occurs during day time hours) that exceed the site boundary as a percentage of hours in the year and as a percentage of daytime hours only.

Table A4 Summary of ADMS 5.0 Predictions Percentages Visible (Daytime) Vapour Plumes that exceed the Site Boundary

Meteorological Data Year	Day-time (Visible) Condensing Plume as Percentage of Daytime Hours in Year	Day-time (Visible) Condensing Plume as Percentage of all Hours in Year
2007	3.4%	1.5%
2008	3.3%	1.5%
2009	3.8%	1.7%
2010	8.2%	3.6%
2011	2.7%	1.2%
Average	**4.3%**	**1.9%**

3 DEPOSITION RATES

Present here are the deposition rates for the pollutants released to atmosphere from the proposed facility where the Environment Agency (EA) H1 guidance provides maximum deposition rates (1).

The Environment Agency H1 guidance states that the process contribution of air emissions deposited to land can be calculated by:

$PC_{ground} = (PC_{air} \times RR \times DV \times 3 \times 86400)/1000$

Where:

PCground = process contribution to daily deposition rate (mg m^{-2} day^{-1})
RR = release rate (g s^{-1})
DV = deposition velocity (taken to be 0.01 m s^{-1})

(1) Environment Agency (April 2010) Horizontal Guidance Note H1 - Annex (f), Table B8.

PC_{air} = process contribution to air base on maximum annual average ground level concentration per unit mass release rate ($\mu g\ m^{-3}/g\ s^{-1}$)

Value of 3 is nominal factor to convert dry deposition to total deposition.

Table A3 shows the estimated deposition rate at the point of maximum impact for the year that give rise to the largest impact (2011).

Table A3 Deposition Rate

Pollutant	Emission Rate ($g\ s^{-1}$)	Deposition Rate ($mg\ m^{-2}\ day^{-1}$)		Deposition Rate as a Percentage of the Max (%)
		Process Contribution	Maximum Rate [(a)]	
Arsenic (As)	0.0000280	0.000035	0.02	0.2%
Cadmium (Cd)	0.0010000	0.001254	0.009	13.9%
Chromium (VI)	0.0000002	0.000000	1.5	0.0%
Copper (Cu)	0.0022000	0.002759	0.25	1.1%
Lead (Pb)	0.0022000	0.002759	1.1	0.3%
Mercury (Hg)	0.0020000	0.002508	0.004	62.7%
Nickel (Ni)	0.0022000	0.002759	0.11	2.5%
(a) From Environment Agency H1 Guidance.				

The deposition rates presented in **Table A3** show that the maximum rate is not exceeded by the process contribution. It should be noted that for cadmium and mercury, which has the highest percentages of the maximum allowable deposition rates, the modelling was undertaken assuming these are at their emission limits. In practice the emissions rates will be less than the emission limits. It should also be noted that the table shows the maximum impact for the year that gives rise to the largest impact. Deposition rates at all other locations and years of metrological data will be less than the values shown.

Given the conservative nature of the assessment, it is considered that the deposition rates presented here show an acceptable impact.