Appendix 10.1

Air Quality Assessment

Runcorn Energy from Waste Project

INEOS Chlor Limited

Environmental Statement
Appendix 10.1 – Air Quality Assessment

December 2006

Contents

Figures, Tables and Appendices

Figures

Tables

Annexes

1 Introduction

Background

1.1 INEOS Chlor Limited (INEOS) are proposing to develop an Energy from Waste (EfW) facility sized to accept the majority of the Solid Recovered Fuel (SRF) and Refuse Derived Fuel (RDF) produced in Greater Manchester and other local authorities in the area. All electricity and steam generated would be consumed within the INEOS Runcorn site, contributing approximately 20% of the site total energy requirement.

1.2 The proposed EfW facility would be located at the north (Weston Point) end of the Runcorn site, approximately 4km west of the centre of Runcorn.

1.3 As part of the Environmental Impact Assessment, RPS has undertaken a detailed air quality assessment to predict the potential effects of emissions from the EfW, generated by the construction and operation of the facility.

Scope of Study

1.4 The proposed EfW facility has been designed to minimise pollutant emissions using Best Available Techniques and to ensure minimal air quality effects from residual emissions by release through a stack of an appropriate height. The resulting potential effects to sensitive community and ecological receptors have been assessed utilising dispersion modelling techniques in accordance with good practice. The effect of traffic emissions has also been assessed, together with the effects of odour and plume visibility.

1.5 It is recognised that the nature of emissions from such a facility gives rise to concern in respect of potential health effects. While modern techniques are available for the treatment of such releases to achieve very high levels of control, it is recognised that an assessment of atmospheric emissions is a key issue. In addition, reference is made within this air quality assessment to another Technical Appendix that accompanies the Environmental Statement, namely the Human Health Risk Assessment.

1.6 This assessment has been undertaken with due consideration to EA guidance for detailed air dispersion modelling based upon the following:

- Identification of sensitive receptors
- Review of emissions from other existing and proposed local industrial sources
- Review of process design proposals and emission sources

- Compilation of the existing air quality baseline with due regard to relevant local authority Review and Assessment work
- Assessment of potential effects during the construction phase
- Calculation of process contribution to ground level concentrations and deposition for key pollutants emitted from the process
- Assessment of emissions from traffic to the site
- Consideration of cumulative effect
- Evaluation of effects on ecological receptors
- Sensitivity analyses of model input data.

1.7 This report is structured as follows:

- Section 2 provides a description of the site and other local emission sources
- Section 3 includes a process description and identification of emission sources associated with the proposed facility
- Section 4 presents the relevant emissions and air quality legislation and policy
- Section 5 derives baseline air quality for the basis of the assessment
- Section 6 describes the adopted methodology and approach to the air quality assessment
- Section 7 presents the results of the air quality assessment
- Section 8 identifies any mitigation proposals
- Section 9 describes any residual effects.

2 Site Description and Local Sources

Site Description

2.1 The proposed location of the EfW facility is within the Runcorn Site, which is owned and operated by INEOS. The Runcorn Site lies around the southern and western edge of the Runcorn peninsula, in Halton. The proposed EfW site occupies an area in the northern part of the Runcorn Site, lying between Picow Farm Road and the A557 Runcorn Expressway to the east and the Weston Docks and Weaver Navigation to the west.

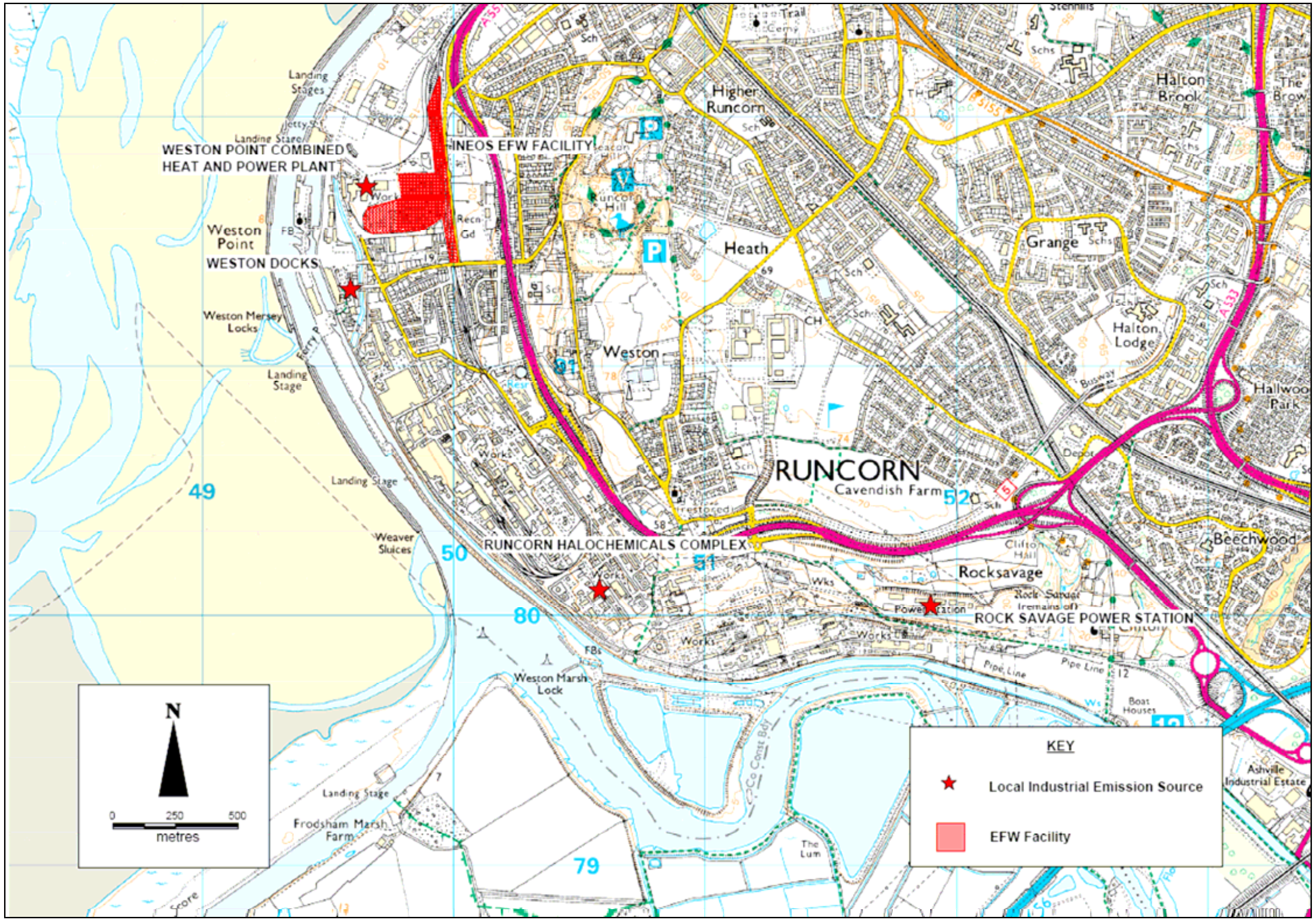
2.2 Residential development occupies land to the south of the site and to the east of the A557. The Mersey Estuary lies to the west of the site. The site is approximately 4km to the west of the centre of Runcorn, includes an existing rail facility and is close to the Weston Point Expressway.

Local Sources

Overview

2.3 There are a number of industries in the area of the proposed EfW facility. Those industries, which have the potential for combined effects with atmospheric emissions from the proposed EfW facility, are described below. The proposed EfW facility location in relation to the neighbouring industrial facilities is illustrated in Figure 2.1.

Figure 2.1: Proposed EfW Facility Location and Nearby Industries



Weston Point Combined Heat and Power Plant

2.4 The site is bordered by a Combined Heat and Power (CHP) plant, which is currently owned and operated by Scottish and Southern Energy (SSE). Stack emissions from the CHP plant include oxides of nitrogen (NO_x) and carbon monoxide (CO).

2.5 The construction of the proposed EfW facility could potentially affect the dispersion of emissions from the existing adjacent Weston Point CHP facility, due to the height of the proposed EfW facility buildings relative to the height of the CHP exhaust gas emissions stack. This potential effect is fully addressed in Annex C of this technical appendix together with combined effects arising from the simultaneous operation of the proposed EfW facility with the Weston Point CHP plant.

Port of Weston Docks

2.6 To the West and North of the proposed location lies the Port of Weston Docks, which are currently the subject of proposed redevelopment. Potential cumulative effects with the redevelopment of the Port of Weston Docks are addressed below.

Runcorn Site

2.7 To the South of the proposed location lies the Runcorn Site complex which consists of a number of integrated chemical plants based on the production and use of halogens and halogen based products.

2.8 INEOS imports brine by pipeline from Northwich, Cheshire, and converts the brine by electrolysis to chlorine, hydrogen and sodium hydroxide. The bulk of the chlorine produced by INEOS is used as feedstock for on-site downstream processes for the manufacture of PVC and other chlorinated derivatives. Chlorine is also shipped to external customers in cylinders, drums and road tankers.

2.9 The processes employed within the complex require a large amount of electricity and steam. Some of the required electricity and steam is currently provided by a number of on-site generation facilities. These include:

- Weston Point Power Station (four 75 MWth boilers firing natural gas and hydrogen);
- Weaver Power Station (140 MWth Combined Cycle Gas Turbine firing natural gas);
- Runcorn Boiler Plant (three 95 MWth boilers firing natural gas and hydrogen).

2.10 Emissions from these combustion sources include NO_x and CO. In addition, as the Weston Point Power Station and the Runcorn Boiler Plant use hydrogen fuel produced in the mercury cell rooms associated with the electrolysis process, trace emissions of mercury are also discharged to atmosphere.

2.11 The electrolysis plant includes a cellroom, which represents a source of atmospheric mercury discharges. A number of recent process improvements has resulted in a significant reduction in mercury emissions from the cellroom. The complex also includes a sulphur burning plant, which represents a source of atmospheric emissions of sulphur dioxide (SO_2).

Rocksavage Power Station

2.12 Rocksavage Power Station (operated by Rocksavage Power Company Limited) is located approximately 3km to the Southeast of the proposed EfW facility location and consists of a Combined Cycle Gas Turbine plant with a nominal electrical output of 770 MWe. The plant is fired on natural gas. Emissions from the Rocksavage Power Station therefore include NO_x and CO.

Combined Effects with Existing Sources

2.13 As identified above, there are a number of existing sources in the immediate vicinity of the proposed EfW facility location with which there are potential combined effects associated with atmospheric emissions. With the exception of the Runcorn Boiler Plant, these sources have been in operation for a number of years. Therefore, ambient air quality data collected in the vicinity of the site will already include effects associated with these facilities.

2.14 The Weston Point Power Station is due to be de-commissioned in the near future following the successful completion of commissioning of the Runcorn Boiler Plant. Consequently, emissions from the new Runcorn Boiler Plant will be offset by the termination of emissions from the Weston Point Power Station.

2.15 The mercury cellroom associated with the INEOS electrolysis operations is being phased out with replacement provided by new membrane plant. Over time, the complete replacement of the cellroom with membrane technology will significantly reduce direct emissions of mercury from the electrolysis process and secondary emissions of mercury associated with the use of hydrogen fuel produced in the electrolysis process in on-site power and steam generation facilities.

2.16 Taking into account the above, combined effects in this assessment will be addressed through the selection of robust baseline ambient air quality data, which will already include effects associated with the aforementioned facilities. As emissions from a number of these facilities will reduce in the future as a result of process improvement / commissioning of new technology, the selection of baseline ambient air quality using recent data is considered a robust approach to ensure that combined effects are addressed on a conservative basis.

Cumulative Effects with Future Development

2.17 There are a number of future development projects, which are described in Appendix 4.1 of the Environmental Statement.

2.18 Of the future developments identified, the proposed redevelopment of the Port of Weston Docks includes the potential for cumulative effects with respect to local air quality. To account for this, the air quality assessment addresses air quality effects associated with traffic effects from both developments.

Sensitive Receptors

2.19 The area immediately surrounding the site is predominantly industrial with the nearest residential properties located immediately to the south, approximately 50m from the proposed site boundary. Other residential receptors are located 240m to the east of the proposed site beyond playing fields and the A557 Weston Point Expressway. Effects across all residential areas are considered within this assessment. Consideration is also given to effects at Air Quality Management Areas (AQMAs), which have been declared by local authorities within the study area (extending to a 15km radius around the proposed EfW facility).

2.20 A number of specific sensitive receptors have been identified within the study area for the assessment of atmospheric emissions from the proposed EfW facility stack. These include:

- Vulnerable population centres (for example, local schools and health clinics);
- Agricultural areas, including dairy farms.

2.21 Sensitive receptors are illustrated in Figure 2.2 and detailed in Table 2.1 below.

Figure 2.2: Proposed EfW Facility Location and Sensitive Receptors

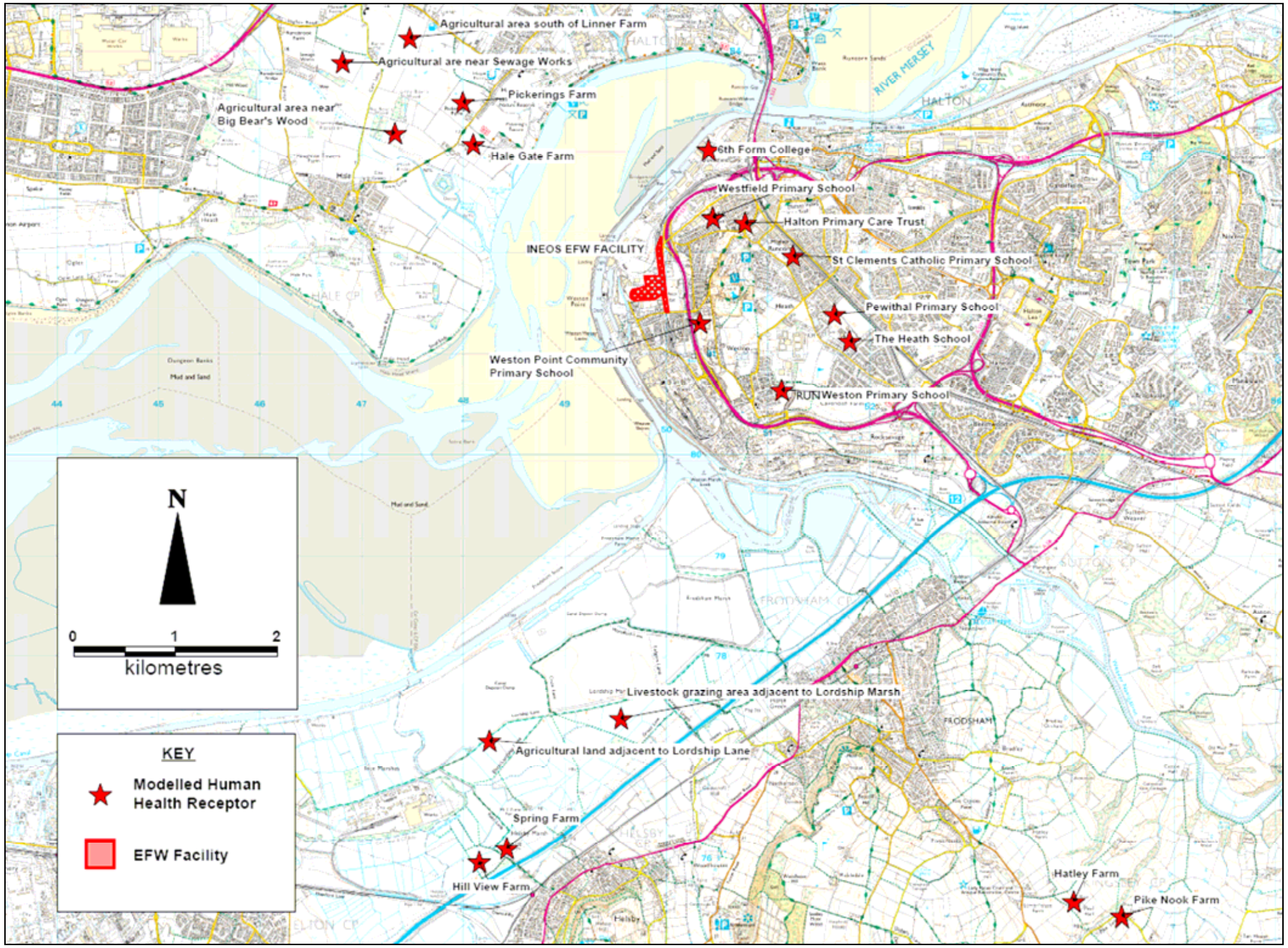


Table 2.1: Sensitive Receptor Locations

Sensitive Receptor Location	NGR [1]	Distance From Site	Bearing from Site
Agricultural area near sewage works	346800, 383897	3.7 km	NW
Agricultural area South of Linner Farm	347462, 384137	3.4 km	NW
Agricultural area near Big Bear's Wood	347317, 383191	2.9 km	NW
Pickerings Farm	347986, 383500	2.5 km	NW
Hale Gate Farm	348088, 383082	2.2 km	NW
6th Form College	350405, 383025	1.3 km	NNE
Westfield Primary School	350449, 382356	0.8 km	NE
Halton Primary Care Trust	350766, 382305	1.0 km	NE
St Clements Catholic Primary School	351238, 381978	1.4 km	E
Pewithal Primary School	351646, 381400	1.8 km	ESE
The Heath School	351795, 381134	2.0 km	ESE
Weston Point Community Primary School	350322, 381316	0.7 km	ESE
Weston Primary School	351126, 380647	1.7 km	SE
Livestock grazing area adjacent to Lordship Marsh	349542, 377392	4.4 km	S
Agricultural area adjacent to Lordship Lane	348247, 377172	4.9 km	SSW
Hill View Farm	348419, 376109	5.9 km	SSW
Spring Farm	348148, 375974	6.1 km	SSW
Hatley Farm	354003, 375579	7.5 km	SE
Pike Nook Farm	354475, 375435	7.9 km	SE

Note: [1] NGR – National Grid Reference

Sensitive Ecological Receptors

2.22 Certain types of vegetation, such as lichens, can be sensitive to poor air quality. Crop growth rates can be affected and some pollutants can be absorbed into the food chain. The proposed EfW facility location lies in close proximity to the Mersey Estuary, parts of which has been designated as a Ramsar site, a Special Protection Area (SPA) and a Site of Special Scientific Interest (SSSI). All Ramsar sites, SPAs, Special Areas of Conservation (SACs) and SSSIs located within 15km radius of the proposed EfW facility location have been included within this assessment (with the exception of geological designations). Details of these sites can be found in Section 6 below and are described in detail in Chapter 6 of the Environmental Statement.

3 Key Atmospheric Emissions

Overview

3.1 The proposed EfW facility will give rise to atmospheric emissions of a number of pollutants at low concentrations. Pollutants associated with each activity are summarised below.

3.2 The key air quality issues associated with waste receiving activities include emissions of dust and PM_{10}.

3.3 The key pollutants regulated under the Waste Incineration Directive (WID) 2000/76/EC (see Section 4) include:

- Oxides of nitrogen (NO_x);
- Particulates (assumed to all have an aerodynamic diameter less than 10 μm – i.e. PM_{10});
- Sulphur dioxide (SO_2);
- Carbon monoxide (CO);
- Hydrogen chloride (HCl);
- Hydrogen fluoride (HF);
- Group 1 metals:
  - Cadmium (Cd) and Thallium (Tl)
- Group 2 metals:
  - Mercury (Hg);
- Group 3 metals:
  - Antimony (Sb), Arsenic (As), Lead (Pb), Chromium (Cr), Cobalt (Co), Copper (Cu), Manganese (Mn), Nickel (Ni) and Vanadium (V);
- Total Organic Carbon (TOC);
- Polychlorinated dibenzo-p-dioxins (PCDDs – dioxins);
- Polychlorinated dibenzofurans (PCDFs – furans); and
- Carbon dioxide (CO_2).

3.4 The key pollutants of concern associated with road traffic to and from the site include:

- Oxides of nitrogen (NO_x);
- Particulates (assumed to all have an aerodynamic diameter less than 10 μm – i.e. PM_{10});
- Hydrocarbons (benzene, 1,3-butadiene);
- Carbon dioxide (CO_2).

3.5 Consistent with the requirements of the Stockholm Convention in reducing emissions of Persistent Organic Pollutants (POPs), which are organic compounds that are resistant to natural environmental degradation, TOC is regulated in accordance with BAT under the Waste Incineration Directive (WID) 2000/76/EC (see Section 4). In addition, dioxins and furans are POPs specifically regulated under the WID. Other POPs including Polychlorinated Biphenyls (PCBs) and Polycyclic Aromatic Hydrocarbons (PAHs) are not specifically regulated under the WID but are regulated through the limitation of TOC emissions.

3.6 This section presents a brief description of each of the pollutants referred to above and their behaviour in the atmosphere.

Oxides of Nitrogen

3.7 Oxides of nitrogen is a term used to describe a mixture of nitric oxide (NO) and nitrogen dioxide (NO_2), referred to collectively as NO_x. These are formed from atmospheric and fuel nitrogen as a result of high temperature combustion. The most important sources in the UK are road traffic and power generation.

3.8 During the process of combustion, atmospheric and fuel nitrogen is partially oxidised via a series of complex reactions to NO. The process is dependant on the temperature, pressure and residence time of the combustion gases in the combustion zone. Most NO_x exhausting from a combustion process is in the form of NO, which is a colourless and tasteless gas. It is readily oxidised to NO_2, a more harmful form of NO_x, by chemical reaction with ozone and other chemicals in the atmosphere. NO_2 is a yellowish-orange to reddish-brown gas with a pungent, irritating odour and is a strong oxidant.

Particulates

3.9 Particulate matter is a complex mixture of organic and inorganic substances present in the atmosphere. Sources are numerous and include power stations, other industrial processes, road transport, domestic coal burning and trans-boundary pollution. Secondary particulate, in the form of aerosols, attrition of natural materials and, in coastal areas, the constituents of sea spray, are significant contributors to the overall atmospheric loading of particulate. In urban areas, road traffic is generally the greatest source of fine particulate matter, although localised effects are also associated with construction and demolition activity.

Sulphur Dioxide

3.10 Sulphur dioxide (SO_2) is formed by the combustion of sulphur-containing fuel. SO_2 is a major contributor to acid deposition. Locally important habitats, such as the Mersey Estuary, are high in organic sources of sulphur and are considered to be of very low sensitivity to small additions such as would result from emissions from the EfW stack.

Carbon Monoxide

3.11 Carbon monoxide (CO) is a colourless, odourless gas produced by the incomplete combustion of carbon-based fuels and by biological and industrial processes. The major source of carbon monoxide is traffic, particularly in urban areas. CO is produced under conditions of inefficient combustion, is rapidly dispersed away from the source and is relatively inert over the timescales relevant for its dispersion.

Hydrogen Chloride

3.12 The major sources of hydrogen chloride (HCl) emissions are coal combustion and waste incineration. The decline in coal use and the installation of flue gas desulphurisation at remaining coal-fired power stations has resulted in a decline in HCl emissions of up to 55% since 1970. The decommissioning and upgrading of older incinerators, has also resulted in a decline of HCl emissions.

Dioxins and Furans

3.13 Polychlorinated dibenzo-p-dioxins (PCDDs) or "dioxins" and the closely related polychlorinated dibenzofurans (PCDFs) or "furans" constitute a group of chemicals that occur ubiquitously in the environment.

3.14 PCDD and PCDF have a number of recognised sources among which are their formation as by-products of chemical processes such as the manufacture of wood preservatives and herbicides, the smelting of copper and scrap metal, the recovery of plastic coated wire, fireworks and natural combustion such as forest and accidental fires.

3.15 More commonly, they are found in combustion products, the ash, stack effluents, water and other process fluids from the combustion of sewage sludge, coal, wood, municipal and industrial waste. PCDDs and PCDFs can enter the soil system through atmospheric deposition from combustion processes.

Heavy Metals

3.16 Combustion of waste in the EfW facility will give rise to small quantities of emissions of heavy metals to atmosphere. The intake of metals via inhalation is very small in comparison with the intake via food. The natural range of many metals in soils is very wide.

Hydrocarbons

3.17 Hydrocarbons can be emitted in both gaseous and liquid forms. Car exhaust emissions containing both uncombusted fuel and incompletely combusted fuel are the most significant source in most locations. Hydrocarbons are relatively inert over the timescales relevant for local pollution effects but are reactive over longer timescales in photochemical reactions. Individual components of this class of pollutants include benzene and 1,3-butadiene.

Carbon Dioxide

3.18 Carbon dioxide (CO_2) is formed by combustion of fuels and emissions are dependant on the carbon content of the fuel. CO_2 does not give rise to local health effects in ambient concentrations, but it is a significant contributor to the 'global warming' effect. This process allows incoming radiation to pass through the Earth's atmosphere but prevents much of the outgoing radiation from escaping to outer space. It is recognised that EfW projects are beneficial in the context of global warming, particularly where an outlet for waste heat can be secured.

Odour

3.19 Degradation of putrescible and green waste can give rise to odorous emissions. However, most waste to be received by the proposed EfW facility will be either RDF or SRF. Therefore the potential for odorous emissions is significantly reduced.

3.20 In contrast to the pollutants described above, potential effects from odours relate to the possibility of nuisance effects rather than health effects.

4 Emissions and Air Quality Legislation and Policy

Overview

4.1 A review of the development plan documents and planning context in relation to the development proposals is provided in Chapter 12 of the Environmental Statement.

4.2 This section details the legislation and policy that are directly relevant to air quality issues.

Waste Incineration Directive and Emission Limits

4.3 The design and operation of the facility will be governed by the Waste Incineration Directive (2000/76/EC), which requires adherence to emission limits for a range of pollutants (see Table 4.1). The emission limits specified under the Waste Incineration Directive (WID) have been used to define the scope of pollutants considered within this assessment.

Table 4.1: Relevant Waste Incineration Directive Air Emission Limit Values

Pollutant	Emission Levels (mg/Nm^3) [(a)]		
	Daily average values	Half-hourly average values	
		100th Percentile	97th Percentile
Particles	10	30	10
TOC	10	20	10
HCl	10	60	10
HF	1	4	2
SO_2	50	200	50
NO_x	200	400	200
CO [(b)]	50	-	-
Group 1 metals [(c)]	0.05 [(f)]		
Group 2 metals [(d)]	0.05 [(f)]		
Group 3 metals [(e)]	0.5 [(f)]		
Dioxins and furans	0.0000001 [(g)]		

Notes:
(a) Concentrations referenced to temperature 273 K, pressure 101.3 kPa, 11% oxygen, dry gas.
(b) 150 $mg.Nm^{-3}$ of combustion gas for at least 95% of all measurements determined as 10 minute averages or 100 $mg.Nm^{-3}$ of combustion gas of all measurements determined as half-hourly average values taken in any 24 hour period.
(c) Cadmium (Cd) and Thallium (Tl)
(d) Mercury (Hg)
(e) Antimony (Sb), Arsenic (As), Lead (Pb), Chromium (Cr), Cobalt (Co), Copper (Cu), Manganese (Mn), Nickel (Ni), and Vanadium (V).
(f) All average values over a sample period of a minimum of 30 minutes and a maximum of 8 hours
(g) Average values over a sample period of a minimum of 6 hours and a maximum of 8 hours. The emission limit value refers to the total concentration of dioxins and furans calculated using the concept of toxic equivalence (TEQ).

PPC Requirements and Associated Guidance

4.4 EU Directive 96/61/EC concerning Integrated Pollution Prevention and Control ("the IPPC Directive") applies an integrated environmental approach to the regulation of certain industrial activities. The Pollution Prevention and Control Regulations 2000 implement the IPPC Directive relating to installations in England and Wales.

4.5 The Regulations define activities that require a Pollution Prevention and Control (PPC) Permit from the EA. The proposed EfW facility is a 'Part A1' Activity, and falls within Chapter 5, Section 5.1, of Schedule 1 of these Regulations and therefore requires a PPC Permit.

4.6 PPC is a regulatory system that employs an integrated approach to control the environmental effects of certain listed industrial activities. It involves determination by the Regulator (the Environment Agency) of the appropriate controls for those industries to protect the environment through a single permitting process. To gain a permit, Operators have to demonstrate in their Applications, that the techniques they are using or are proposing to use are the Best Available Techniques (BAT) for their installation.

4.7 The essence of BAT is that the techniques selected to protect the environment should achieve an appropriate balance between environmental benefits, which go beyond legal requirements (for example, the Air Quality Strategy) and the costs incurred by Operators. Indicative BAT standards are laid out in national guidance and where relevant, should be applied, unless a different standard can be justified for a particular installation.

4.8 The preparation of PPC Permit Applications includes the requirement for an air quality assessment. Guidance is available to indicate what information should be included within the air quality assessment. This includes the Horizontal Guidance Note IPPC H1, which provides guidelines for air dispersion modelling, at Appendix E, and Environmental Assessment Levels (EALs) for Air, at Appendix D. Further guidance is available in the relevant IPPC sector guidance note for Incineration of Waste published by the Environment Agency in August 2004. This assessment includes consideration of the aforementioned guidance.

EU Directives, UK Air Quality Limit Values and Objectives

4.9 Various European Union (EU) Air Quality Directives and UK Air Quality Regulations will govern the operation of the proposed EfW facility. The following section provides a summary of the relevant legal framework.

4.10 EU Framework Directive 96/62/EEC 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. As a Framework Directive it requires the Commission to propose "Daughter" Directives setting air quality objectives, limit values, alert thresholds, guidance on monitoring, siting and measurement for individual pollutants. The Daughter Directives relevant to this assessment include:

- Directive 1999/30/EEC relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air
- Directive 2000/69/EEC relating to limit values for benzene and carbon monoxide in ambient air.

4.11 The Air Quality Limit Values Regulations 2003 and Air Quality Limit Values (Amendment) (England) Regulations 2004 implement Council Directive 96/62/EC and related Daughter Directives. The obligation for complying with these limit values rests with central government.

4.12 The Air Quality (England) Regulations 2000 and Air Quality (England) (Amendment) Regulations 2002 include air quality objectives that have different compliance target dates but which, in most cases, are numerically synonymous with the limit values. The air quality objectives are for specific use by local authorities in undertaking their local air quality management duties pursuant to Part IV of the Environment Act 1995.

Summary of Assessment Criteria

Air Quality Objectives and Limit Values

4.13 Table 4.2 presents the available air quality objectives and limit values for the pollutants relevant to this assessment.

Table 4.2: Summary of Air Quality Objectives and Limit Values

Pollutant	Averaging Period	Objectives / Limit Values	Not to be exceeded more than [f]	Target Date
Oxides of Nitrogen (NO_x)	Annual [a]	30 µg.m^{-3}	-	19.07.03 [e]
Nitrogen Dioxide (NO_2)	1 hour	200 µg.m^{-3}	> 18 times pcy	31.12.05 [d] 01.01.10 [e]
	Annual	40 µg.m^{-3}	-	31.12.05 [d] 01.01.10 [e]
Carbon Monoxide (CO)	8 hour	10,000 µg.m^{-3}	Maximum daily running 8-hour mean	31.12.03 [d] 01.01.05 [e]
Sulphur Dioxide (SO_2)	15 minute	266 µg.m^{-3}	> 35 times pcy	31.12.05 [d]
	1 hour	350 µg.m^{-3}	> 24 times pcy	31.12.04 [d] 01.01.05 [e]
	24 hour	125 µg.m^{-3}	> 3 times pcy	31.12.04 [d] 01.01.05 [e]
	Annual [b]	20 µg.m^{-3}	-	19.07.03 [e]
Particulate Matter (PM_{10})	24 hour	50 µg.m^{-3}	> 35 times pcy	31.12.04 [d] 01.01.05 [e]
	Annual	40 µg.m^{-3}	-	31.12.04 [d] 01.01.05 [e]
	24 hour [c]	50 µg.m^{-3}	> 7 times pcy	31.12.10
	Annual [c]	20 µg.m^{-3}	-	31.12.10
Lead	Annual	0.5 µg.m^{-3}	-	31.12.04 [d] 01.01.05 [e]

Notes:
(a) For the protection of vegetation.
(b) For the protection of ecosystems.
(c) Provisional (Stage 2) Objectives included under EU Directive 1999/30/EEC.
(d) The Air Quality (England) Regulations 2000 and Air Quality (England) (Amendment) Regulations 2002.
(e) The Air Quality Limit Values Regulations 2003 and Air Quality Limit Values (Amendment) (England) Regulations 2004
(f) pcy - per calendar year.

Environmental Assessment Levels

4.14 The Environment Agency Horizontal Guidance Note IPPC H1 provides further assessment criteria in the form of Environmental Assessment Levels (EALs). Table 4.3 presents the available EALs for the pollutants relevant to this assessment. Table 4.4 presents available soil quality criteria and maximum deposition rates for the pollutants relevant to this assessment from the same source. The implications of exposure to metals and dioxins are addressed through a Human Health Risk Assessment, which is included as part of the planning application.

Table 4.3: Environmental Assessment Levels (EALs)

Pollutant	Long-term EAL, µg.m^{-3}	Short-term EAL, µg.m^{-3}
Nitrogen dioxide (NO_2)	40 [(a)]	200 [(a)]
Nitrogen monoxide (NO)	310	4400
Carbon monoxide (CO)	350	10,000 [(a)]
Sulphur dioxide (SO_2)	50	267
Particulates (PM_{10})	40 [(a)]	50 [(a)]
Hydrogen chloride (HCl)	20	800
Hydrogen fluoride (HF)	-	250
Arsenic (As)	0.2	15
Antimony (Sb)	5	150
Cadmium (Cd)	0.005	1.5
Chromium (Cr)	0.1	3
Cobalt (Co)	0.2	6
Copper (Cu)	2	60
Lead (Pb)	0.5	-
Manganese (Mn)	1	1500
Mercury (Hg)	0.25	7.5
Nickel (Ni)	1	30
Thallium (Tl)	1	30
Vanadium (V)	5	1

Notes:
(a) See Table 4.2 above.

Table 4.4: Maximum Deposition Rates (from Appendix D, H1)

Pollutant	Maximum Deposition Rate (mg m^{-2}.d^{-1})
Arsenic (As)	0.02
Cadmium (Cd)	0.009
Chromium (Cr)	1.5
Copper (Cu)	0.25
Lead (Pb)	1.1
Mercury (Hg)	0.004
Nickel (Ni)	0.11

Planning Policy

National Policy and Legislation

4.15 Policy Guidance on Local Air Quality Management PG(03), issued under Part IV of the Environmental Act 1995, is designed to help local authorities with their LAQM duties. The guidance requires that local authorities integrate air quality considerations into the planning process at the earliest possible stage. As a result, the land use planning system is integral to improving air quality.

4.16 Planning Policy Statement 23 - Planning and Pollution Control (PPS23) offers guidance to local authorities on the relationship between controls over development under planning law, and under pollution control legislation. It takes into account the AQS, the system of local air quality management under Part IV of the Environment Act 1995 and climate change.

4.17 PPS23 states that air quality is likely to be particularly important:

- where the development is proposed inside, or adjacent to, an air quality management area (AQMA) as designated under part IV of the Environment Act 1995;
- where the development could in itself result in the designation of an AQMA; and
- where to grant planning permission would conflict with, or render unworkable, elements of a local authority's air quality action plan.

4.18 However, not all planning applications for developments inside or adjacent to AQMAs should be refused, even if the development would result in a deterioration of local air quality. LPAs, transport authorities and pollution control authorities are required to explore the possibility of securing mitigation measures that would allow the proposal to proceed.

Local Policy

<u>Overview</u>

4.19 The proposed development site falls wholly within the administrative area of Halton Borough Council. The relevant Local Plan Policies for this area have been reviewed with respect to air quality.

<u>Unitary Development Plan for HBC, adopted April 2005</u>

4.20 The UDP combines both strategic and local planning functions and therefore contains all the planning policies relevant to Halton. These policies provide the guidance and control for the development and use of land in Halton up to and beyond 2016.

4.21 Chapter 3, The Green Environment, Chapter 4, Pollution and Risk, Chapter 5, Minerals and Waste Management and Chapter 6, Transport all contain policies and objectives relating to the protection and management of the wider environment. Chapter 4 explicitly describes the maintenance and improvement of air quality as defined policies.

4.22 Policy PR1 states that *"Development will not be permitted where it is likely to have an unacceptable effect on air quality. The phrase 'unacceptable effect' includes consideration of the following:*

- *Emissions which are likely to have a significantly unacceptable effect on the amenity of the local environment.*
- *Where there is the significant possibility that public health may be affected.*
- *Where there is a significant possibility that any proposed development will affect air quality standards.*
- *Where there is a significant possibility that investment confidence in respect of surrounding land uses may be affected.*
- *An air quality assessment may be required before determining applications with a potential to pollute".*

5 Existing Air Quality

Overview

5.1 Information on air quality in the UK is available from a variety of sources including local authorities, national network monitoring sites and other published sources. For the purposes of this assessment, data have been obtained from Halton Borough Council (HBC), Warrington Borough Council (WBC), Liverpool City Council (LCC), Vale Royal Borough Council (VRBC), Knowsley Metropolitan Borough Council (KMBC), the National Air Quality Information Archive (NAQIA) and the UK Heavy Metals Monitoring Network. Additional data have also been taken from previous monitoring in Runcorn and data reported for continuous monitoring stations in Liverpool Speke and in Tranmere, operated by the Defra Automatic Urban and Rural Network (AURN).

5.2 Where possible, data have been obtained from monitoring sites which are classified as 'urban background'. Pollutant levels at urban background monitoring sites are considered to be broadly representative of citywide background conditions and are therefore suitable for the purposes of deriving ambient air quality concentrations.

Local Authority Review and Assessment

Halton Borough Council

5.3 HBC completed the first round of its Review and Assessment (R&A) process in November 1999. The first round concluded that the air quality objectives for carbon monoxide (CO), benzene (C_6H_6), 1,3-butadiene (C_4H_6) and lead (Pb) would be achieved, and that the objectives for sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and particulate matter (PM_{10}) would be likely to be achieved. First round review and assessments did, however, identify two areas adjacent to the approach roads of the Silver Jubilee Bridge that were at risk of exceeding the air quality objectives for NO_2, SO_2 and PM_{10} as a result of road traffic and industrial emissions.

5.4 An Updating and Screening Assessment (USA), which focussed on SO_2, NO_2 and PM_{10}, was completed in 2003. The USA reported that air quality monitoring had demonstrated compliance with the air quality standards at the two problem areas identified in the previous round of R&A process. The USA reported that low sulphur fuels have been adopted for steam generation by industries in nearby West Bank Dock Estate, which may have contributed to improved air quality. Results of the USA did not highlight any additional areas of relevant exposure.

5.5 In 2006, HBC carried out a USA report as part of the third round of the review and assessment process, which confirmed findings of the previous round, i.e. that SO_2 and PM_{10} concentrations were within the AQS objectives. NO_2 concentrations were also within objectives except at two locations, Deacon Road and Hale Road, and further, detailed assessment of NO_2 was recommended for these areas.

5.6 To date, HBC has not declared any Air Quality Management Areas (AQMAs).

Warrington Borough Council

5.7 WBC completed the first round of its R&A process June 2000, concluding that road traffic emissions were likely to cause exceedences of the annual mean AQS objective for NO_2 within the borough.

5.8 In November 2001 WBC declared an AQMA encompassing residential properties within 50m of motorway corridors of the M6, M62 and the M56, with respect to NO_2 attributable to road traffic emissions. WBC's USA, published in 2003, confirmed the validity of the AQMA and supported the conclusion that the annual levels of NO_2 around major arterial routes remained close to the objective.

5.9 A Detailed Assessment undertaken in 2004, and a further Progress Report published in 2005 confirmed the continued need for the motorway related AQMA and the need to designate an additional AQMA close to the town centre. This AQMA was subsequently designated in February 2006.

5.10 In 2006 a USA confirmed the findings of the previous reports, and also identified the need to proceed to a detailed review for an area around Brian Bevan roundabout affected by vehicular emissions; this will be undertaken in 2006/07.

5.11 The locations of WBCs declared AQMAs are illustrated in Figure 5.1.

Liverpool City Council

5.12 LCC completed stage one of the R&A process in April 1999 and identified the need for further consideration of road traffic emissions and industrial process. Stages two and three of the R&A were completed in December 2000, concluding that some areas in Liverpool were likely to exceed the annual average NO_2 AQS objective. As a result, an area of the city centre (stretching from Boundary Street in the North to Coburg Dock in the South, and from the Mersey in the West to Grove Street and Hall Lane in the East) and an area around the M62 junction were declared as AQMAs with respect to NO_2.

5.13 In September 2003 a USA identified that further, detailed assessment of NO_2 was necessary. This Detailed Assessment was completed in June 2004 and identified another 12 potential AQMAs.

5.14 Stage four of the R&A process was completed in November 2003, which validated previous findings and identified road traffic emissions as the main source of pollution.

5.15 The latest progress report is being undertaken at present, to determine whether any of the 12 previously identified areas should be declared as AQMAs, or whether the whole city should be declared as one AQMA.

5.16 The locations of LCC's declared AQMAs are illustrated in Figure 5.1.

Vale Royal Borough Council

5.17 VRBC published its stage one R&A report in November 1998 and identified exceedences of the AQS objectives at some locations. Stages two and three of the R&A were published in 2000 and confirmed that there were areas where the objectives were likely to be breached. Therefore further investigations were carried out.

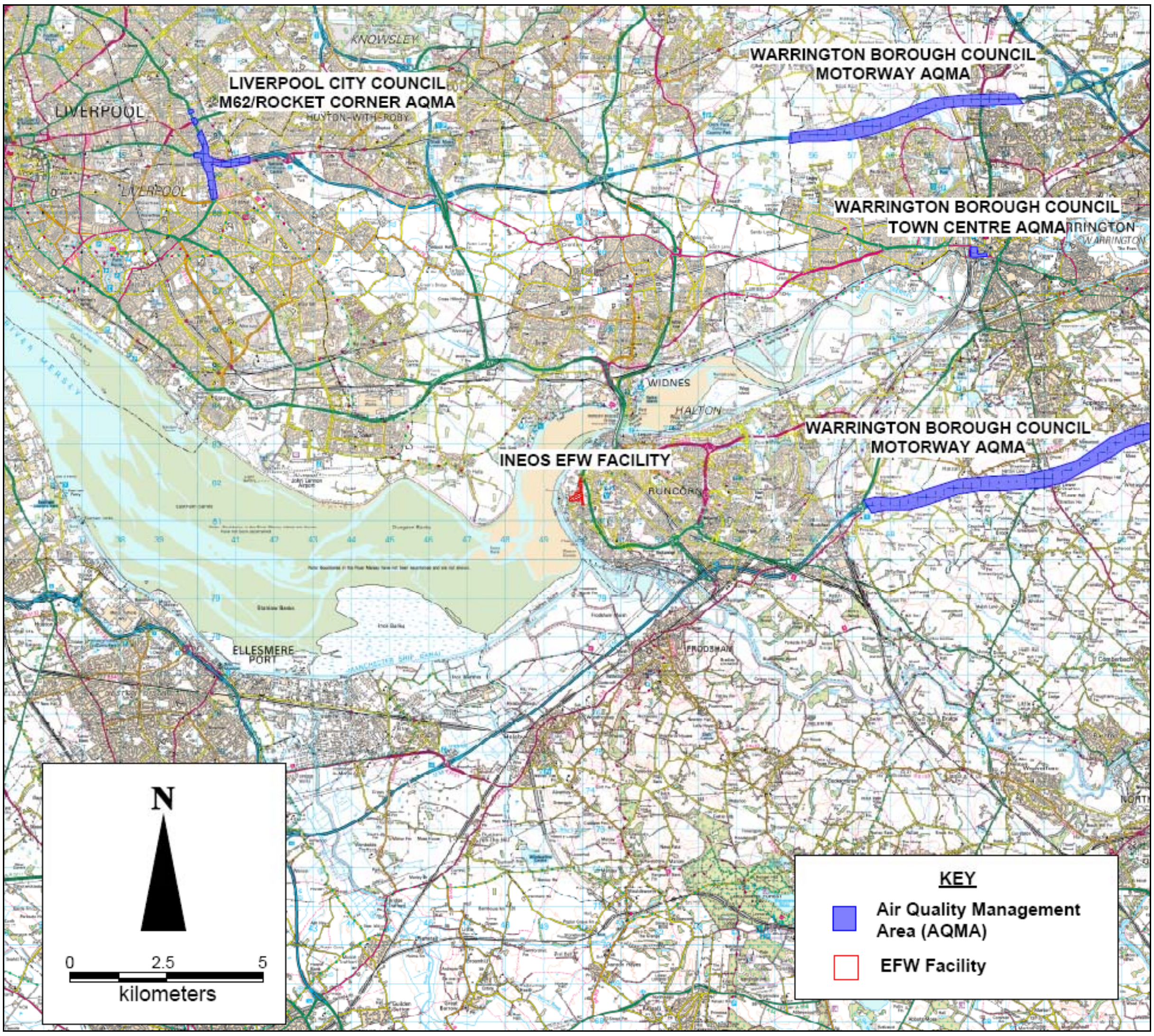
5.18 A USA, completed in 2003, concluded that a Detailed Assessment would be required for PM_{10} in areas previously highlighted as showing exceedences. Following the Detailed Assessment for PM_{10} issued in June 2004, exceedences were identified around Winnington in 2004. Additional monitoring was suggested by Defra and the conclusions of that additional monitoring were published in April 2005. Monitoring enabled VRBC to conclude that there would be no exceedences of the AQS objectives. Results of previous studies were rejected and no AQMA was declared.

Knowsley Metropolitan Borough Council

5.19 KMBC completed the first round of R&A in February 2001. The assessment concluded that the UK AQS objectives would be achieved throughout the district.

5.20 A USA was completed in December 2003 and confirmed that the air quality objectives for all pollutants were likely to met, with the exception of the provisional annual mean PM_{10} objective. for 2010. As this provisional objective is likely to be rescinded, KMBC was not required to proceed to a Detailed Assessment, and no AQMAs have been declared. A Progress Report was carried out in December 2005 and showed no further exceedences of PM_{10}, though monitoring will continue and will be reported in USA for 2006 (this has not been published at present).

Figure 5.1: Proposed EfW Facility Location and Declared AQMAs



Local Monitoring of Air Quality

Continuous Monitoring Data

5.21 HBC operates one mobile continuous automatic analyser measuring NO_2, SO_2 and PM_{10}.

5.22 Historically the mobile analyser has been used to measure urban background air quality, and since 2001 has been situated at the following locations:

- 2001 – 2002: West Bank School, Widnes;
- 2002 – 2003: All Saints School, Runcorn;
- 2003 – 2005: Runcorn Town Hall; and
- 2005 onwards: Lower House Lane, Widnes.

5.23 Summary data measured by the monitor up to the end of 2005, at three locations as above, are presented in Table 5.1.

Table 5.1: Annual Mean Pollutant Concentrations Monitored within Halton Borough (µg.m^{-3})

Location	Pollutant Measured	Distance to Site (km)	National Grid Reference	2001	2002	2003	2004	2005
West Bank School, Widnes	NO_2	2.7	351083, 383889	26	-	-	-	-
	SO_2			40	-	-	-	-
	PM_{10}			17	-	-	-	-
All Saints School, Runcorn	NO_2	2.1	351210, 383125		27	-	-	-
	SO_2			-	30	-	-	-
	PM_{10}			-	16	-	-	-
Runcorn Town Hall	NO_2	2.0	351327, 382952	-	-	24	25	26
	SO_2			-	-	24	19	20
	PM_{10}			-	-	19	17	23

5.24 WBC undertakes urban background monitoring of NO_2, SO_2 and PM_{10} using a monitor located within Penketh High School's playing field. WBC also carries out roadside NO_2 monitoring located along Parker Street, however, roadside data are not suitable for use in deriving baseline concentrations and hence are not presented here. Latest background monitoring data for 2005 are presented in Table 5.2.

Table 5.2: Pollutant Concentrations Monitored within Warrington Borough (g.m^{-3})

Location	Pollutant Measured	Distance to Site (km)	Data Capture	Averaging Period	2005 Results (µg.m^{-3})
Penketh High School Playing Field NGR: 356893, 388057	SO_2	9.6	99%	15 minute mean	100.3
	NO_2		99%	annual mean	23.7
	PM_{10}		97%	annual mean	15.9 (TEOM)
				annual mean	20.7 (gravimetric)

5.25 LCC began continuously monitoring PM_{10}, NO_2, SO_2 and CO at an urban background site, Liverpool Centre, in 2000 until the end of 2002 when the continuous monitor was moved to the urban background site, Liverpool Speke. NO_2, SO_2, PM_{10} and CO have been continuously monitored at Liverpool Speke urban background site since 2004. The Tranmere, Wirral AURN site also lies within the area governed by Liverpool City Council. Results of NO_2 and PM_{10} monitoring at these sites are provided in Table 5.3.

Table 5.3: Pollutant Concentrations Monitored within Liverpool City (g.m^{-3})

Location	Pollutant Measured	Distance to Site (km)	National Grid Reference	2001	2002	2003	2004	2005
Liverpool Speke AURN	NO_2	5.0	343800, 383500	-	-	27.3-	23	24
	SO_2			-	-	8.3	5	7
	PM_{10}			-	-	24.5	24	20
	CO			-	-	0.09	0.2	0.2
Liverpool Centre AURN	NO_2	17.3	334934, 390682	38.4	35.7	-	-	-
	SO_2			7.4	5.5	-	-	-
	PM_{10}			25	23.6	-	-	-
	CO			0.5	0.4	-	-	-
Tranmere, Wirral AURN	NO_2	19.0	332096, 386644	22	22	27	19	17.3-
	SO_2			13	9	8	6	-
	PM_{10}			20	21	20	19	19.3
	CO			0.3	-	0.2	0.2	0.2

5.26 KMBC operates one continuous air quality monitor measuring NO_2, SO_2 and PM_{10}, situated at Page Moss One Stop Shop. Table 5.4 summarises available monitoring data for 2002 to 2004.

Table 5.4: Urban Background Pollutant Concentrations Monitored within Knowsley Borough (g.m^{-3})

Location	Pollutant Measured	Distance to Site (km)	2002	2003	2004
Page Moss One Stop Shop NGR: 342887, 392123	NO_2	12.6	21.3	25.78	19.86
	SO_2		5.6	6.4	7.2
	PM_{10}		23.2	29.3	19.3

Passive Diffusion Tube Data

5.27 HBC operates a network of 14 passive NO_2 diffusion tubes. In addition to HBC's tubes, a further 20 NO_2 diffusion tubes, managed by Casella (in association with Mersey Gateway), are also located within the Borough. All of the tubes within HBC's district appear to be located at roadside and kerbside sites, which include the influence of road sources and are therefore not representative.

5.28 WBC, VRBC and KMBC also operate diffusion tube monitoring networks, with a limited number of those diffusion tube locations being classified as background locations. Table 5.5 presents the data obtained from relevant background diffusion tubes within the study area.

Table 5.5: Results for Background Diffusion Tubes Located within the Study Area ($\mu g.m^{-3}$)

Location	Distance to Site (km)	National Grid Reference	Exposure Period	Bias Corrected Annual Mean
Warrington Borough Council (WBC)				
Hilcliffe Road	11.8	360857, 385696	2005	29
Roastherne Close	10.8	358667, 387755		23
Bruche Avenue	15.2	362792, 389503		23
Risley Avenue	17.8	366939, 386194		28
Woodale Close	10.1	356448, 389245		19
Vale Royal Borough Council (VRBC),				
Spring Farm, Shays Lane, Oakmere	16.9	359300, 367600	2003	15.3
			2004	14.3
Hulme Hall Lane, Allostock, (triplicate site)	25.3	373200, 371900	2003	31.0
				32.0
				30.5
Knowsley Metropolitan Borough Council (KMBC)				
Park Road, Prescot	11.2	346350, 392250	2004	27.4
West St, Prescot	11.2	346350, 392250		24.4

Particulate Monitoring

5.29 Two Osiris particulate monitors have been located at Deacon Road and Hale Road by HBC, where traffic is thought to be a problem, since road traffic is also a significant contributor of particulate matter. Data are measured as a daily 24 hour averages and are presented in Table 5.6.

Table 5.6: Monitoring Results from the Particulate Monitors located within the borough ($\mu g.m^{-3}$)

Location	National Grid Reference	Approximate Distance to Proposed Site (km)	Monitoring Period	Period Mean	Number of Exceedences of 50 $\mu g.m^{-3}$
Deacon Road	351726, 386125	4.9	17th May 2005 – 27th Feb 2006	24.0	10
Hale Road	348842, 384427	3.1	9th June 2005 – 28th Feb 2006	29.9	24

National Air Quality Information Archive Data

Estimated and Projected Background Pollutant Concentrations

5.30 The National Air Quality Information Archive (NAQIA) provides estimates of pollution concentrations across the UK at a resolution of 1 km^2 for the AQS objective year of the specified pollutant.

5.31 Values from all grid squares within 15km of the proposed site have been used to calculate an average for background pollutant concentrations over the entire area. NAQIA projection factors have been used to calculate concentrations where the base data are not available. These data are presented in Table 5.7.

Table 5.7: Average NAQIA Projected Concentrations within 15 km of the Proposed Site

Pollutant	Annual Mean Concentration ($\mu g.m^{-3}$)		
	2001	**2006**	**2010**
NO_x	-	28.7	17.8
NO_2	-	19.7	17.8
PM_{10}	-	18.6	17.6
SO_2	4.74	-	-
Benzene	0.69	0.52	0.46
CO	350	220	170
1,3-Butadiene	0.24	0.14	0.11

Dioxins and Furans

5.32 Dioxins and Furans data are available from nine sites in the United Kingdom (UK), as part of the Toxic Organic Micropollutants (TOMPS) network. Table 5.8 presents available data from these sites for 2003 and 2004.

Table 5.8: Annual Mean Concentrations of Dioxins and Furans at UK Sites

Site	National Grid Reference	Site Classification	Approximate Distance to Proposed Site (km)	Dioxins & Furans (fg (TEQ) m^3) [(1)]	
				2003	2004 [(2)]
Hazelrigg	349350, 457850	Semi-rural	76	11	8
High Muffles	477650, 493950	Rural	167	8	4
Manchester	383450, 398250	Urban	39	86	51
Middlesbrough	450550, 519450	Urban	169	52	38
Stoke Ferry	570050, 298850	Rural	231	20	15

Note: (1) The Dioxin TEQ values are best case estimates. In samples in which a congener is not detected during analysis, the value used in calculating concentrations is zero rather than the detection limit. Concentrations of 17 of the most toxic dioxins including tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) are measured at each site

(2) indicates only data available for Quarter 1 and Quarter 2

Metals

5.33 Monitoring for lead and other metals has been carried out at a number of locations in the UK since 1976 as part of the Lead and Multi-Element Networks. Additionally, metals monitoring is undertaken by the Centre for Ecology and Hydrology (CEH) at several sites across the UK. The closest site to Ineos that monitors metals not covered by the Lead and Multi-Element Network is that at Cockley Beck, Cumbria, located approximately 120km north of Ineos. No data are available for the metal Thallium.

5.34 Table 5.9 presents data for metals from the Lead and Multi-Element Network sites in 2005. Table 5.10 presents data recorded at Cockley Beck.

Table 5.9: Annual Mean Concentrations of Metals Monitored at UK Sites

Monitoring Site	2005 Annual Mean Concentration (ng.m^{-3})								
	As	**Cd**	**Cr**	**Cu**	**Mn**	**Ni**	**Pb**	**V**	**Hg**
London Brent	1.4	0.6	4.3	24.1	7.6	3.5	23.5	4.2	0.6
London, Cromwell Road	1.1	0.4	5.5	41.8	10.1	4.5	14.6	6.3	0.8
London, Horseferry Road	1.3	0.4	2.4	22.4	6.4	3.5	15.9	3.7	0.2
Leeds, Vicar Lane	1.2	0.4	3.3	11.5	8.3	2.6	18.2	3.7	0.9
Motherwell Civic Centre	0.8	0.3	3.3	8.5	5.5	3.3	6.8	2.2	0.3
Manchester Newhall Green	1	0.3	5.3	52.9	11.7	3.7	12.6	3	0.3
Brookside Bilston Lane	1.3	3.3	3.5	48.1	8.5	5.5	76.3	4.1	0.4
Newcastle Upon Tyne, Arena Way	0.8	0.2	1.8	8.9	4.4	2.8	9.1	2.4	0.9
Runcorn, Castner Avenue	0.7	0.3	1.1	9.2	3.3	2.3	13.5	3.5	2
Sheffield, Bawtry Road	1.5	0.6	18.9	16.6	26.2	14.3	29	4.2	0.5
Avonmouth, Hallen Village	0.9	1.1	1.2	6	5.9	3.5	15	2.9	0.4
Bristol, Collins Street	1.1	0.5	2.2	5	5	4.1	15.2	4.2	1.2
IMI Walsall, Primley Avenue	1.2	0.6	2.5	15	8.5	2.8	17	3.3	0.5
Swansea, School Road	1.2	0.4	4.2	6.2	4.1	19.6	17.9	17.2	0.5
Glasgow, David Street	0.8	0.2	1.6	13.1	4.4	2.1	12.9	1.6	0.2
Dumfrieshire, Langholm	0.2	0.1	3.8	1.4	1	1.5	2.9	1.2	0.2
Cardiff, Fairwater	1.2	0.5	3.8	41.9	12.4	1.9	20.7	3.6	1.2

Table 5.10: Annual Mean Concentrations of Metals Measured at Cockley Beck ($ng.m^{-3}$)

Metal Species	Distance from Site (km)	2004	2005
Antimony (Sb)	approx. 120 km	0.22	0.11
Cobalt (Co)		0.16	0.02
Data capture (%)		88	86

UK Nitric Acid Monitoring Network

Hydrogen Chloride

5.35 HCl is monitored as part of the Nitric Acid Monitoring Network, which forms part of the Acid Deposition Monitoring Network. The nitric acid network was established in 1999 and covers twelve rural sites across the UK. Table 5.11 presents data from these sites from 1999 to 2002. Defra reports that total HCl emissions fell by 89% between 1990 and 2004.

Table 5.11: Annual Mean Concentrations of HCl at UK Sites 1999 to 2002

Site Name	Hydrogen Chloride Annual Mean Concentration ($\mu g.m^{-3}$)				
	1999	2000	2001	2002	Mean 1999 to 2002
Bush OTC	0.41	0.27	0.21	0.17	0.26
Glensaugh	0.39	0.31	0.31	0.3	0.32
Rothamsted	0.54	0.47	0.33	0.29	0.41
Strathvaich Dam	0.32	0.24	0.19	0.21	0.23
Eskdalemuir	0.21	0.21	0.19	0.18	0.2
High Muffles	0.39	0.36	0.32	0.25	0.34
Stoke Ferry	0.55	0.42	0.34	0.35	0.39
Yarner Wood	0.39	0.27	0.44	0.29	0.36
Barcombe Mills	-	0.34	0.42	0.41	0.39
Sutton Bonington	0.5	0.47	0.33	0.35	0.41
Lough Navar	0.13	0.19	0.13	0.11	0.12
Cwmystwyth	0.35	0.21	0.26	0.19	0.25

Expert Panel on Air Quality Standards

Hydrogen Fluoride

5.36 The Expert Panel on Air Quality Standards (EPAQS) was set up in 1991 to provide independent advice on air quality issues. In 2005 it published a draft report entitled 'Guidelines for halogen and hydrogen halides in ambient air for protecting human health against acute irritancy effects'. The report noted that only a small number of measurements of ambient concentrations of hydrogen fluoride have been made in the UK. All of these have been made in the vicinity of three industrial plants. Many samples were below the limit of detection, however, measurable values were in the range of $5x10^{-5}$ to $3.5x10^{-3}$ $mg.m^{-3}$ as approximate monthly averages.

5.37 The report concluded that it would be reasonable to expect maximum 1 hour mean hydrogen fluoride concentrations to reach about $2.46x10^{-3}$ $mg.m^{-3}$ at rural sites exposed to power station plumes.

Other Available Monitoring Data

Mercury

5.38 The effect of mercury releases from the INEOS operations at the Runcorn Site has been monitored for a number of years by measuring concentrations of mercury in the atmosphere at a monitoring station located at Sydney Street, in a nearby residential area. Monitoring is continuous, and measures weekly mean mercury concentrations. Table 5.12 presents data for this site, showing the annual averages for the period from 1987. The data clearly indicate that INEOS has significantly reduced ambient concentrations of mercury following process improvements in 1997.

5.39 Although reported within this assessment and well below relevant standards, ambient concentrations of mercury recorded at Sydney Street are not considered representative for the purposes of deriving a baseline for the whole study area. This is largely due to the monitoring site being located in very close proximity to the INEOS electrolysis process.

Table 5.12: Monitored Annual Mean Concentrations of Mercury (1987 – 2005)

Year	Annual Average concentration ($\mu g.m^{-3}$)
1987	**0.35**
1988	**0.33**
1989	**0.33**
1990	**0.41**
1991	**0.31**
1992	**0.336**
1993	**0.343**
1994	0.21
1995	**0.35**
1996	**0.35**
1997	**0.35**
1998	0.05
1999	0.05
2000	0.055
2001	0.076
2002	0.12
2003	0.098
2004	0.07
2005	0.088

Note: bold text indicates exceedence of objecive

Summary of Baseline Data

5.40 Monitored background annual mean NO_2, SO_2 and PM_{10} concentrations at Runcorn Town Hall are greater than the NAQIA mapped concentrations. The requirement for this assessment is to set the background concentration in the model at a realistic but conservative level. The Runcorn Town Hall continuous monitor annual mean concentration for 2005 has, therefore, been used within this assessment. Given that these measured concentrations are representative of background concentrations measured elsewhere or those projected by the NAQIA, this is considered a robust assumption. The 2005 concentration has been adjusted forwards to provide background values for 2006 and 2010 using NAQIA adjustment factors.

5.41 Background NO_x concentrations have been derived from NAQIA data for the purposes of this assessment, in the absence of local NO_x monitoring data. Background CO concentrations have also been derived from NAQIA data as these are marginally greater than local monitored concentrations.

5.42 Background concentrations of HCl have been derived from the highest measured annual mean concentration reported in the period 1999 to 2002 from any of the UK measurement sites. The highest annual mean HCl concentration was measured at Stoke Ferry in 1999 and this concentration has been conservatively assumed to be the background HCl concentration for the purposes of this assessment.

5.43 Background concentrations of HF have been derived from the Expert Panel on Air Quality Standards (EPAQS) report published in 2005.

5.44 Background metal concentrations assumed for the purposes of this assessment have been derived from the closest major urban area to the INEOS Runcorn Site. Levels recorded at an urban location are likely to be higher than those that would be representative of the more rural study area. In the case of the UK Lead and Multi-Element Networks, the closest urban monitoring location is Castner Avenue, Runcorn. The data from this urban site has, therefore, conservatively been assumed as the background metal concentrations. Where metals have not been reported for the Lead and Multi-Element Network, monitoring data collected by the Centre for Ecology and Hydrology (CEH) in 2004 have been used.

5.45 Background concentrations of dioxins and furans have been derived from the highest measurements taken from air quality monitoring of baseline conditions in Manchester, the closest TOMPS monitoring site to the proposed EfW facility location, in 2003. Being recorded in an urban area, these concentrations are considered to be very conservative in relation to the majority of the study area, a large part of which is rural. These measured concentrations are specific to Manchester but are more conservative than other monitored concentrations at urban sites across the UK.

5.46 For the purposes of air quality assessment of elevated point sources, a conservative assumption is to use the 90th percentile of the short-term observations as the background level during the assessment of short-term (e.g. maximum hourly) effects. This is approximately equivalent to twice the annual mean.

5.47 This approach has been used to account for ambient concentrations for the purposes of this assessment. Twice the average of the highest annual mean concentrations measured or projected for each pollutant has been added to the short-term (8 hourly average or less) modelled value.

5.48 For long-term averaging periods (daily or annual), the highest annual mean concentrations measured or projected for each pollutant has been added to the long-term modelled value.

5.49 Table 5.13 summarises the Ambient Concentrations assumed for this assessment and the source of the data.

Table 5.13: Summary of Assumed Background Concentrations ($\mu g.m^{-3}$)

Pollutant	Short-term	Long-term	Data Source
Nitrogen oxides (NO_x)	- [(a)]	29.8	Halton Borough Council's Runcorn Town Hall Monitor
Nitrogen dioxide (NO_2)	52.0	26.0	
Sulphur dioxide (SO_2)	40.0	20.0	
Particulates (PM_{10})	- [(a)]	25.6	
Carbon monoxide (CO)	480	240	NAQIA
Hydrogen chloride (HCl)	1.10	0.55	UK Nitric Acid Monitoring Network – Stoke Ferry 1999 annual mean
Hydrogen fluoride (HF)	4.92	2.46	EPAQS 2005
Arsenic (As)	1.4×10^{-3}	0.7×10^{-3}	Lead and Multi-Elements Network
Cadmium (Cd)	0.6×10^{-3}	0.3×10^{-3}	
Chromium (Cr)	2.2×10^{-3}	1.1×10^{-3}	
Copper (Cu)	1.8×10^{-2}	9.2×10^{-3}	
Lead (Pb)	2.8×10^{-3}	1.4×10^{-2}	
Manganese (Mn)	6.6×10^{-3}	3.3×10^{-3}	
Nickel (Ni)	4.6×10^{-3}	2.3×10^{-3}	
Vanadium (V)	7.0×10^{-3}	3.5×10^{-3}	
Mercury (Hg)	4.0×10^{-3}	2.0×10^{-3}	
Antimony (Sb)	0.44 ng/m³	0.22 ng/m³	CEH monitoring at Cockley Beck, 2004
Cobalt (Co)	0.32 ng/m³	0.16 ng/m³	
Thallium (Tl)	-	-	No data available
Dioxins and Furans	0.086 (pg TEQ m^{-3})		Manchester monitoring, 2003

Note: [(a)] No short-term background concentration required as shortest averaging period required for consideration is annual average for NO_x and daily average for PM_{10}.

6 Air Quality Assessment Methodology

Outline of Methodology

6.1 The air quality assessment has addressed the following key elements:

- Construction effects:
  - Emissions from construction vehicles;
  - Dust from construction activity.
- Operational effects:
  - Emissions from the EfW's exhaust stack;
  - Assessment of air quality effects on vegetation and ecosystems;
  - Emissions from operational vehicles;
  - Assessment of plume visibility;
  - Assessment of odour.

6.2 The methodologies employed to address each of the above elements is presented in the following sub-sections.

Construction Effects

Construction Traffic Effects

Overview

6.3 Construction traffic, comprising contractors' vehicles and heavy goods vehicles (HGVs), will emit a number of pollutants. The quantities of each pollutant emitted depend upon the type and quantity of fuel used, engine size, speed of the vehicle and the type of emissions abatement equipment fitted. Once emitted, these pollutants disperse in the air. Changes in traffic flow characteristics during the construction phase, therefore, may result in changes in pollutant concentrations at properties near to roads used by the construction traffic.

6.4 The pollutants commonly associated with road traffic emissions are nitrogen dioxide (NO_2), fine particulates (PM_{10}), carbon monoxide (CO), 1,3-butadiene and benzene, as well as carbon dioxide

(CO_2), which is of importance on a regional and global scale with respect to its global warming potential.

6.5 For the pollutants emitted by the construction traffic, it is unlikely that any problems will exist with respect to the attainment of the relevant objectives for CO, benzene and 1,3-butadiene, consistent with the findings of local assessments of air quality.

6.6 A temporary change in traffic flows, resulting from construction traffic, has been identified on the New Access Road, Picow Farm Road and the A557 Expressway (Northbound and Southbound). The potential effects on ground level concentrations of NO_2 and PM_{10} due to this temporary change in traffic have been assessed using the local air quality assessment methodology as provided in the Design Manual for Road and Bridges (DMRB). The effects have been assessed for the peak year of construction (2009) and compared with the relevant objectives.

DMRB Model Scenarios

6.7 Concentrations of NO_2 and PM_{10} have been predicted at 5m, 10m and 20m from the centre of the roads affected by construction vehicles for the following scenarios:

- Without Construction (Peak Year of Construction) – without the proposed construction traffic but including normal traffic growth;
- With Construction (Peak Year of Construction) – with the proposed construction traffic and normal traffic growth.

Traffic Input Data

6.8 The DMRB model requires input data of annual average daily traffic flow (AADT), annual average speeds, and the proportion of different vehicle types. RPS traffic consultants have provided these data, which are consistent with those used in the Transport Assessment. Table 6.1 below shows the AADT for each of the road links used within the DMRB assessment.

Table 6.1: Construction AADT Flows for Each Scenario

Road Link	Without Project 2009	With Project 2009	Average Speed (kph)
New Access Road	0	286	50
Picow Farm Road	3,222	3,707	55
Expressway South (A557)	19,608	19,884	80
Expressway North (A557)	20,327	20,726	80

Note: Percentage Increase in With Project Flow Compared with Without Project Flow Given in Brackets

6.9 Table 6.2 below shows the HGV percentages for each of the road links used in the DMRB assessment.

Table 6.2: Construction HGVs as % of AADT Flows for Each Scenario

Road Link	Without Project 2009	With Project 2009
New Access Road	-	100%
Picow Farm Road	11%	17.3%
Expressway South (A557)	27%	27.3%
Expressway North (A557)	27%	27.4%

Dust from Construction Activity

6.10 The major influence on air quality during the construction phase of the development is likely to be dust-generating activities such as movement of plant vehicles both on and around the site.

6.11 Nuisance caused by the deposition of construction dust is likely to be the most significant issue in relation to local air quality effects. No dust nuisance criteria have been formally adopted in the UK.

6.12 Activities that may cause fugitive dust emissions are as follows:

- earthworks;
- handling and disposal of spoil;
- wind-blow from stockpiles of particulate material;
- movement of vehicles, both on and off site; and
- handling of loose construction materials.

6.13 The level and distribution of construction dust emissions will vary according to factors such as the type of dust, duration and location of dust-generating activity, weather conditions and the effectiveness of suppression measures.

6.14 The main effect of any dust emissions, if not mitigated, would be nuisance due to soiling of surfaces, particularly windows, cars and laundry. The effect of the construction phase, if un-mitigated would be minor to moderate adverse in magnitude, short-lived and local in scale. Generally, site practices based on the Code of Construction Practice (CoCP) developed for the project will ensure that emissions of nuisance dusts will be minimised. Such practices are presented in this assessment and in Appendix 2.3 of the Environmental Statement.

Operational Effects

Emissions from the Proposed EfW Facilities Exhaust Stack

Outline of Methodology

6.15 The approach to the assessment of emissions after treatment in the air pollution control system from the EfW stack has involved the following key elements:

- Establishing the Ambient Concentration (AC) from consideration of relevant local authority Air Quality Review & Assessment findings and assessment of existing local air quality through a review of available air quality monitoring and NAQIA projections in the vicinity of the proposed site.
- Quantitative assessment of the operational effects on local air quality from stack emissions utilising "new generation" Gaussian dispersion models ADMS 3.3 and AERMOD.
- Assessment of Process Contributions (PC) from the proposed EfW facility in isolation and resultant Predicted Environmental Concentrations (PEC) taking into account cumulative effects through incorporation of the AC.

6.16 The AC has already been established in the previous sub-sections. The quantitative assessment includes consideration of two operational scenarios:

- Scenario 1: Operation of proposed EfW facility assuming emissions at the WID short-term limits (worst case for short-term averaging periods); and
- Scenario 2: Operation of proposed EfW facility assuming emissions at the WID long-term limits (worst case for long-term averaging periods).

6.17 Scenario 1 represents the worst-case scenario for the calculation of short-term effects from the proposed EfW facility. Scenario 2 represents the worst-case scenario for the calculation of long-term effects from the proposed EfW facility. In reality, emissions from the proposed EfW are likely to be less than the WID limits due to the effectiveness of the air pollution control system. Therefore, assessment of atmospheric emissions from the proposed EfW facility at WID limits is considered conservative.

Dispersion Model Selection

Overview

6.18 A number of commercially available dispersion models are available to predict ground level concentrations arising from emissions to atmosphere from elevated point sources such as an EfW facility. No dispersion model is wholly accurate and all models will produce variations in results under certain conditions. Model uncertainty has been addressed in this assessment by using two advanced dispersion models, ADMS and AERMOD PRIME. Such an approach is in line with good practice advocated by the Environment Agency. Descriptions of both models are provided below. In addition, model sensitivity analyses have been included within this assessment to further address model uncertainty.

ADMS 3.3

6.19 ADMS 3.3 is a practical dispersion model developed by Cambridge Environmental Research Consultants (CERC) which models a wide range of buoyant and passive releases to atmosphere either individually or in combination.

6.20 ADMS (the Atmospheric Dispersion Modelling System) brings together the results of recent research on dispersion modelling. The model calculates the mean concentration over flat terrain and also allows for the effect of plume rise, complex terrain, buildings, radioactive decay and deposition. The model has been subject to extensive validation and its sponsors include HMIP (Her Majesty's Inspectorate of Pollution, now part of the Environment Agency for England and Wales) and HSE (the UK Health and Safety Executive).

6.21 ADMS comprises a number of individual modules each representing one of the processes contributing to dispersion or an aspect of data input and output. Amongst the features of ADMS are:

- An up-to-date dispersion model in which the boundary layer structure is characterised by the height of the boundary layer and the Monin-Obukhov length, a length scale dependent on the friction velocity and the heat flux at the surface. This approach allows the vertical structure of the boundary layer, and hence concentrations, to be calculated more accurately than does the use of Pasquill-Gifford stability categories, which have been used in many previous models (e.g. ISCST3). The restriction implied by the Pasquill-Gifford approach that the dispersion parameters are independent of height is avoided. In ADMS the concentration distribution is Gaussian in stable and neutral conditions, but the vertical distribution is non-Gaussian in convective conditions, to take account of the skewed structure of the vertical component of turbulence.

- A number of complex modules including the effects of plume rise, complex terrain, coastlines, concentration fluctuations, radioactive decay and buildings.
- A facility to calculate long-term averages of hourly mean concentration, dry and wet deposition fluxes and radioactivity, and percentiles of hourly mean concentrations, from either statistical meteorological data or hourly average data.

AERMOD PRIME

6.22 AERMOD is a new generation dispersion model, the AMS/EPA Regulatory Model. A committee, AERMIC (the American Meteorological Society / Environmental Protection Agency Regulatory Model Improvement Committee), was formed to introduce state-of-the-art modelling concepts into the EPA's local-scale air quality models. AERMIC's focus was on a new platform for regulatory steady-state plume modelling; this platform would include air dispersion fundamentally based on planetary boundary layer turbulence structure, scaling and concepts. AERMOD was designed to treat both surface and elevated sources in simple and complex terrain.

6.23 Special features of AERMOD include its ability to treat the vertical heterogeneous nature of the planetary boundary layer, special treatment of surface releases, irregularly-shaped area sources, a three-plume model for the convective boundary layer, and limitation of vertical mixing in the stable boundary layer. A treatment of dispersion in the presence of intermediate and complex terrain is used that improves on that currently used in ISCST3 and other models.

6.24 AERMOD PRIME integrates the Plume Rise Model Enhancements (PRIME) algorithms into the AERMOD model. The PRIME model was designed to incorporate the two fundamental features associated with building downwash:

- enhance plume dispersion coefficients due to the turbulent wake;
- reduced plume rise caused by a combination of the descending streamlines in the lee of the building and the increase entrainment in the wake.

6.25 AERMOD is actually a modelling system with three separate components and these are as follows:

- AERMOD (AERMIC Dispersion Model);
- AERMAP (AERMOD Terrain Pre-processor);
- AERMET (AERMOD Meteorological Pre-processor).

6.26 AERMET is the meteorological pre-processor for AERMOD. Input data can come from hourly cloud cover observations, surface meteorological observations and twice-a-day upper air soundings. Output includes surface meteorological observations and parameters and vertical profiles of several atmospheric parameters.

6.27 AERMAP is a terrain pre-processor designed to simplify and standardise the input of terrain data for AERMOD. Input data include receptor terrain elevation data. For each receptor, the output includes a location and height scale, which is an elevation used for the computation of air-flow around hills.

Meteorological Data

6.28 The most important meteorological parameters governing the atmospheric dispersion of pollutants are wind direction, wind speed and atmospheric stability as described below:

- Wind direction determines the sector of the compass into which the plume is dispersed;
- Wind speed affects the distance, which the plume travels over time and 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, and particularly of its vertical motion. It therefore affects the spread of the plume as it travels away from the source. New generation dispersion models, such as ADMS and AERMOD, use a parameter known as the Monin-Obukhov length that, together with the wind speed, describes the stability of the atmosphere.

6.29 For meteorological data to be suitable for dispersion modelling purposes, a number of meteorological parameters need to be measured on an hourly basis. These parameters include wind speed, wind direction, cloud cover and temperature. There are only a limited number of sites where the required meteorological measurements are made.

6.30 The year of meteorological data that is used for a modelling assessment can have a significant effect on source contribution concentrations. Model simulations were performed for emissions from the proposed EfW facility using five years of data from Liverpool John Lennon Airport (Speke) between 2000 and 2004 (approximately 6.5km West of the proposed EfW facility location). Meteorological data collected at Liverpool John Lennon Airport (Speke) does not include precipitation data.

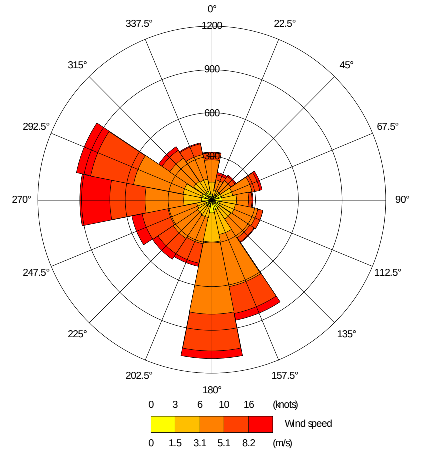
Therefore, precipitation data collected at Crosby (27km West of the proposed facility) was used as surrogate data. Measurements made at Liverpool John Lennon Airport (Speke) have been selected as the base meteorological data for this assessment for the following reasons:

- It is the most representative station at which most necessary measurements are made;
- It is currently operational so the study can be verified or extended in the future, if required, using a compatible data set.

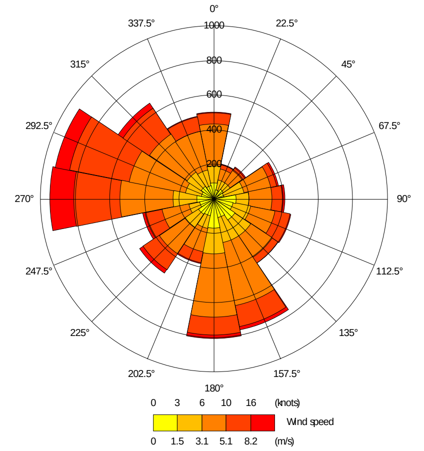
6.31 Alternative meteorological data from Ringway near Manchester approximately 32km East of the proposed EfW facility location has been used for sensitivity analyses presented within this assessment. This site was relocated in 2004 and therefore the most recent five years of hourly sequential historical data available is for the period 1999 to 2003.

6.32 Windroses have been constructed for each of the five years of Liverpool John Lennon Airport (Speke) and Ringway meteorological data used in this assessment (Figure 6.1 and Figure 6.2). Windroses for Liverpool John Lennon Airport (Speke) illustrate that in all five meteorological years there is a dominance of strong winds from the West and South, predominantly between speeds of between 3 and 8 m/s. Windroses constructed for Ringway are significantly different from those for Liverpool John Lennon Airport (Speke) with a dominance of winds from the South.

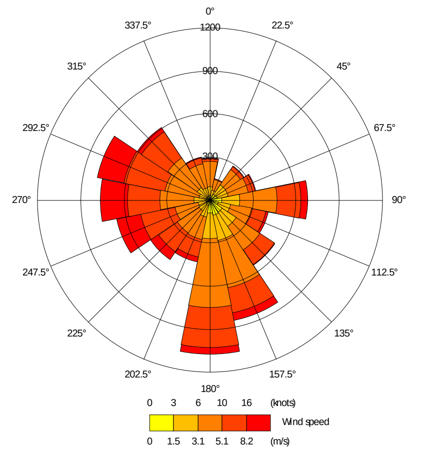
Figure 6.1: Liverpool John Lennon Airport Windroses (2000, 2001, 2002, 2003, 2004)



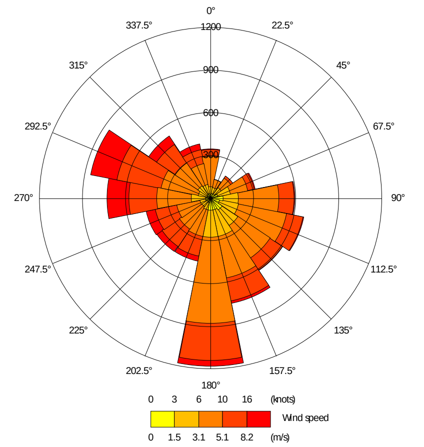
Meteorological Year 2000



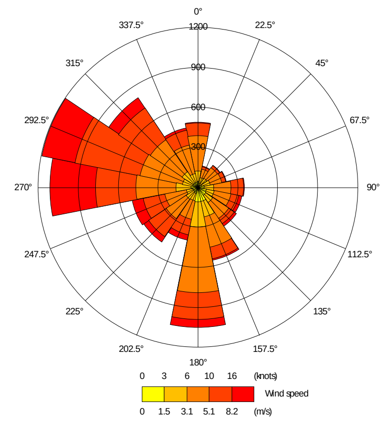
Meteorological Year 2001



Meteorological Year 2002

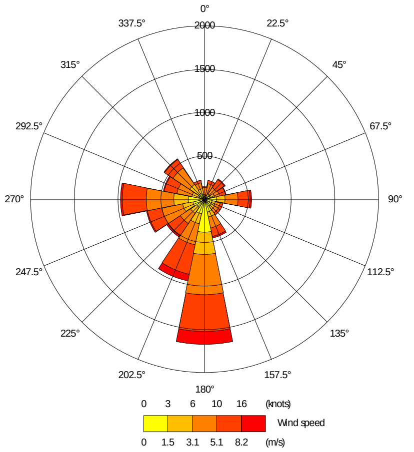


Meteorological Year 2003

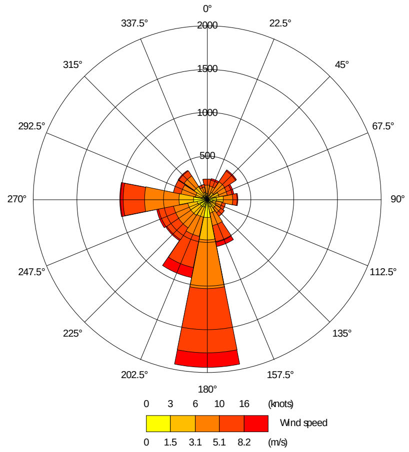


Meteorological Year 2004

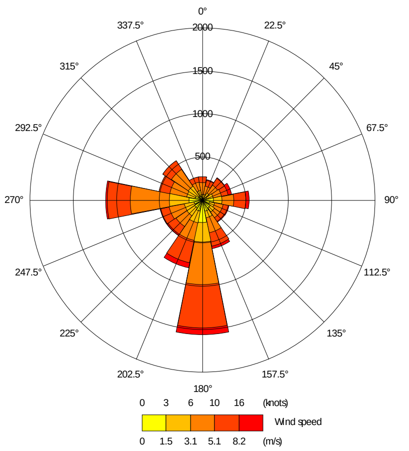
Figure 6.2: Ringway Windroses (1999, 2000, 2001, 2002, 2003)



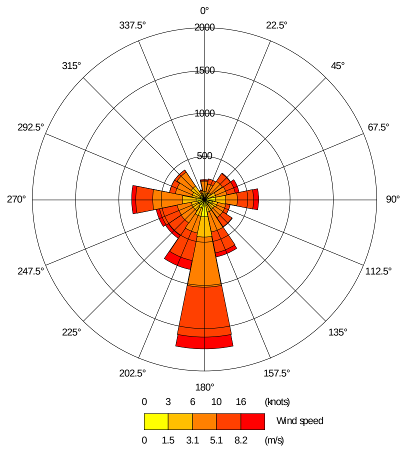
Meteorological Year 1999



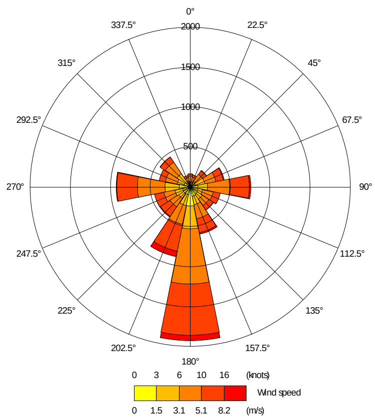
Meteorological Year 2000



Meteorological Year 2001



Meteorological Year 2002



Meteorological Year 2003

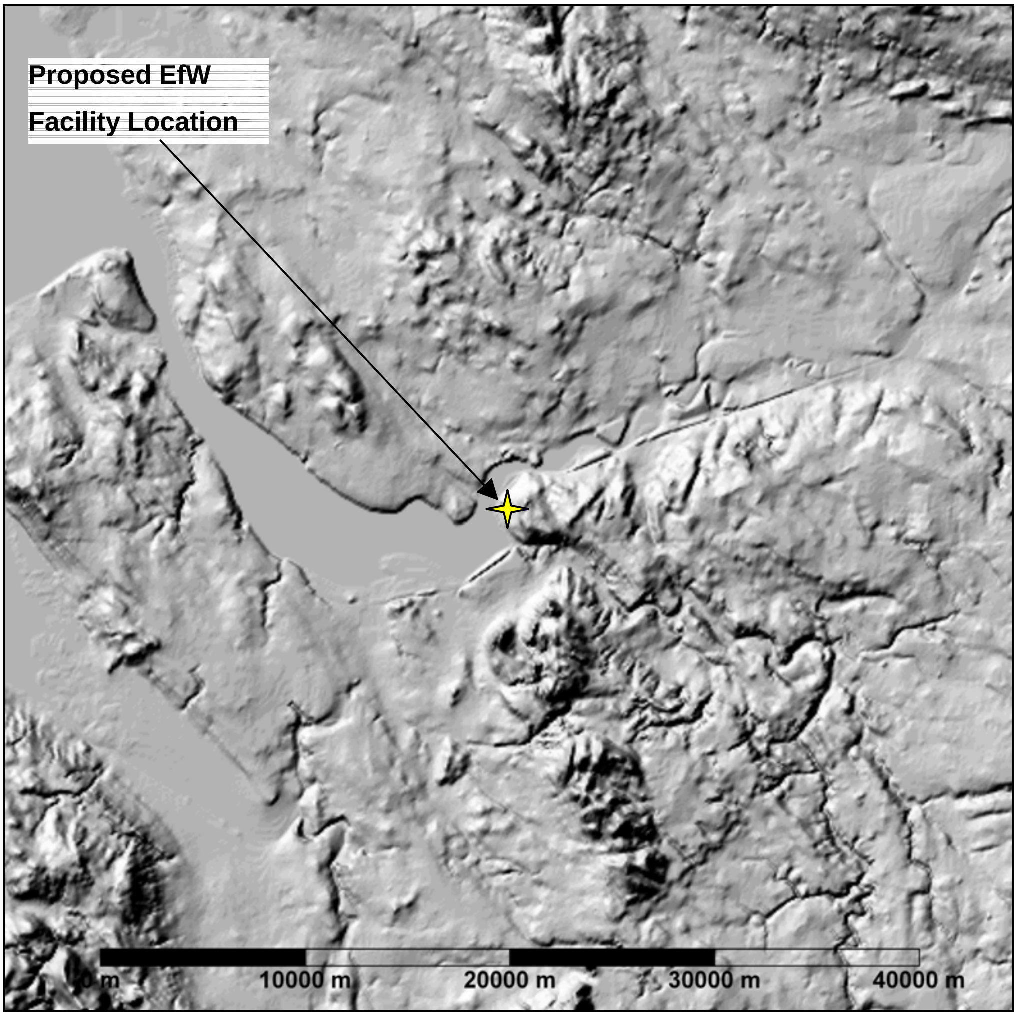
Terrain

6.33 The presence of elevated terrain can significantly affect (usually increase) ground level concentrations of pollutants emitted from elevated sources such as stacks, by reducing the distance between the plume centre line and ground level and increasing turbulence and, hence, plume mixing.

6.34 Terrain in the region of the proposed EfW is characterised by the Mersey Estuary and associated floodplains. However, Runcorn Hill (approximately 75m AOD) is located 1km to the East of the proposed EfW facility location. In addition, there is an area of complex terrain located approximately 5km South from the proposed site for the EfW facility. These include Beacon Hill and Helsby Hill, both in excess of 140m in height with gradients greater than 10%.

6.35 Terrain data have therefore been incorporated into the atmospheric dispersion modelling. Figure 6.3 illustrates a shaded relief map of terrain within the study area.

Figure 6.3: Shaded Relief Map of Terrain



Surface Roughness

6.36 The roughness of the terrain over which a plume passes can have a significant effect on dispersion by altering the velocity profile with height, and the degree of atmospheric turbulence. This is accounted for by a parameter called the surface roughness length. The land use within 15 km of the proposed EfW can be largely characterised as a mixture of urban and rural areas and large water body expanses.

6.37 To account for the varying nature of the study area, a surface roughness length of 0.5m has been assigned during the meteorological processing in ADMS. Given that much of the modelling domain comprises water bodies and rural areas (with much lower corresponding surface roughness lengths), the adopted length of 0.5m for the ADMS modelling is considered a conservative assumption in the context of this assessment.

6.38 AERMOD allows the user to divide the modelling domain according to land-use types for the purpose of meteorological processing. Surface roughness lengths adopted for the AERMOD modelling therefore reflect the landuse type within identified sectors in the modelling domain.

Building Wake Effects

6.39 The movement of air over and around buildings generates areas of flow circulation, which can lead to increased ground level concentrations in the building wakes. Where building heights are greater than about 30 - 40% of the stack height, downwash effects can be significant. The dominant structure (i.e. with the greatest dimensions likely to promote turbulence) is the proposed EfW building height.

6.40 ADMS and AERMOD include building effects modules (as described above) used to calculate the dispersion of pollution from sources near large structures. The buildings likely to have the dominant effect must be selected for use in the dispersion models. This assessment has conservatively assumed an EfW main building height of 47m.

6.41 The dimensions of the main EfW building assumed within the dispersion modelling are listed in Table 6.3.

Table 6.3: Dimension of Building Included Within the Dispersion Model

Building	National Grid Reference of Building Centre	Length (m)	Width (m)	Height (m)	Angle (°) From North
EfW Building	349873, 381687	84	50	47	5

Emissions Data

6.42 The proposed EfW plant will be specified to achieve stringent limits on releases to air, which include those required by Annex V of the Waste Incineration Directive (2000/76/EC). Poyry, the project's technology advisor, provided data on plant emission characteristics and concentrations for the proposed EfW facility.

6.43 The plant emission characteristics are summarised in Table 6.4. Annex A to this report includes an assessment of a range of stack heights to establish at what stack height local building wake effects are no longer significant thereby ensuring the adequate dispersion of pollutants. The conclusions to this assessment indicated that a 105m-stack height is appropriate for the proposed EfW facility. A conservative basis was adopted for the treatment of building downwash effects as part of this exercise.

Table 6.4: Plant Emission Characteristics

Parameter	Unit	Value
Stack Height [(a)]	m	105
Effective diameter	m	4.41
Efflux velocity	m/s	15
Efflux temperature	°C	140
Volumetric flow	$Am^3.s^{-1}$ (actual)	229

Notes:
(a) The selection of stack height is addressed in Annex A

6.44 The release concentrations of modelled substances have been evaluated on the assumption that emissions will be limited to the release concentrations identified in WID. The plant will be required to operate at or below these limits. The successful contractor for construction of the facility will be required to provide guarantees that these emission limits can be met. The use of WID concentration limits therefore comprises a worst-case assumption corresponding with the previously defined Scenarios 1 and 2 adopted for this assessment (see Paragraph 6.16 above).

6.45 Emission limits are specified in WID in the form of daily mean concentrations, half-hourly mean concentrations, mean concentrations over a period of between 30 minutes and 8 hours, or, for dioxins and furans, mean concentrations evaluated over a period of between six and eight hours. Short and long-term limits on emissions concentrations are specified for some substances. Where only one limit is placed on the emission concentrations of a substance, this value has been assumed in the dispersion modelling. Where more than one limit exists for a substance, the limit on half-hourly mean emission concentrations has been used to calculate short-term (less than 24-hour mean) peak ground-level concentrations corresponding to Scenario 1. The limit on daily mean emission concentrations has been used for substances where long-term (24 hours or more) mean ground-level concentrations are calculated corresponding to Scenario 2.

6.46 Table 6.5 to Table 6.6 summarises the mass emissions used in this assessment corresponding to each scenario and averaging period.

Table 6.5: Concentrations and Mass Emissions of Released Pollutants – Scenario 1

Pollutants	**Scenario 1 - Short-Term (WID) (a)**	
	Concentration ($mg.Nm^{-3}$) (b)	**Mass Emission ($g.s^{-1}$)**
Particles	30	6.0
TOC	20	4.0
HCl	60	12.0
HF	4	0.8
SO_2	200	40.0
NO_x	400	79.9

Notes:
(a) For averaging periods of 8 hours or less.
(b) Concentrations referenced to temperature 273 K, pressure 101.3 kPa, 11% oxygen, dry gas.

Table 6.6: Concentrations and Mass Emissions of Released Pollutants – Scenario 2

Pollutants	Scenario 2 - Long-Term (WID) [(a)]	
	Concentration ($mg.Nm^{-3}$) [(b)]	Mass Emission ($g.s^{-1}$)
Particles	10	2.0
TOC	10	2.0
HCl	10	2.0
HF	1	0.2
SO_2	50	10.0
NO_x	200	40.0
CO	50	10.0
Group 1 metals Total [(c)]	0.05	1.0×10^{-2}
Group 1 metals Each [(c) (f)]	0.025	5.0×10^{-3}
Group 2 metals Total / Each [(d)]	0.05	1.0×10^{-2}
Group 3 metals Total [(e)]	0.5	0.1
Group 3 metals Each [(e) (f)]	0.0056	1.1×10^{-2}
Dioxins and furans	0.1×10^{-6}	2.0×10^{-8}

Notes:

(a) For averaging periods of 24 hours or greater.

(b) Concentrations referenced to temperature 273 K, pressure 101.3 kPa, 11% oxygen, dry gas.

(c) Cadmium (Cd) and Thallium (Tl)

(d) Mercury (Hg)

(e) Antimony (Sb), Arsenic (As), Lead (Pb), Chromium (Cr), Cobalt (Co), Copper (Cu), Manganese (Mn), Nickel (Ni), and Vanadium (V).

(f) Emissions of individual metals are taken as an equal proportion of their respective total concentration, for instance, antimony emissions are taken as an equal proportion (one 9th) of the total Group 3 metals concentration value.

6.47 For the purposes of the Human Health Risk Assessment presented as part of the planning application, the dioxin and furan congener profiles are presented in Table 6.7 based on a standard profile for EfW plant derived by Her Majesty's Inspectorate of Pollution (HMIP), a forerunner of the Environment Agency. The emission rates for each congener based on the aforementioned profile are presented in Table 6.8.

Table 6.7: Congener Profile for the Proposed EfW Facility

Congener	Annual Mean Emission Concentration (ng Sm^{-3})	I-TEF (toxic equivalent factors)	I-TEQ (toxic equivalent quotient)
2,3,7,8-TCDD	0.0031	1	3.1×10^{-3}
1,2,3,7,8-PeCDD	0.025	0.5	1.3×10^{-2}
1,2,3,4,7,8-HxCDD	0.029	0.1	2.9×10^{-3}
1,2,3,7,8,9-HxCDD	0.021	0.1	2.1×10^{-3}
1,2,3,6,7,8-HxCDD	0.026	0.1	2.6×10^{-3}
1,2,3,4,6,7,8-HpCDD	0.17	0.01	1.7×10^{-3}
OCDD	0.4	0.001	4.0×10^{-4}
2,3,7,8-TCDF	0.027	0.1	2.7×10^{-3}
2,3,4,7,8-PeCDF	0.054	0.5	2.7×10^{-2}
1,2,3,7,8-PeCDF	0.028	0.05	1.4×10^{-3}
1,2,3,4,7,8-HxCDF	0.22	0.1	2.2×10^{-2}
1,2,3,7,8,9-HxCDF	0.0042	0.1	4.2×10^{-4}
1,2,3,6,7,8-HxCDF	0.081	0.1	8.1×10^{-3}
2,3,4,6,7,8-HxCDF	0.087	0.1	8.7×10^{-3}
1,2,3,4,6,7,8-HpCDF	0.44	0.01	4.4×10^{-3}
1,2,3,4,7,8,9-HpCDF	0.043	0.01	4.3×10^{-4}
OCDF	0.36	0.001	3.6×10^{-4}
Total (ng I-TEQ m^{-3})	-	-	0.1

Table 6.8: Dioxin / Furan Emission Rates Derived for Proposed EfW Facility

Congener	Emission Concentration ($mg.Sm^{-3}$)	Emission Rate ($g.s^{-1}$)
2,3,7,8-TCDD	3.1×10^{-9}	6.2×10^{-10}
1,2,3,7,8-PeCDD	2.5×10^{-8}	5.0×10^{-9}
1,2,3,4,7,8-HxCDD	2.9×10^{-8}	5.8×10^{-9}
1,2,3,7,8,9-HxCDD	2.1×10^{-8}	4.2×10^{-9}
1,2,3,6,7,8-HxCDD	2.6×10^{-8}	5.2×10^{-9}
1,2,3,4,6,7,8-HpCDD	1.7×10^{-7}	3.4×10^{-8}
OCDD	4.0×10^{-7}	8.0×10^{-8}
2,3,7,8-TCDF	2.7×10^{-8}	5.4×10^{-9}
2,3,4,7,8-PeCDF	5.4×10^{-8}	1.1×10^{-8}
1,2,3,7,8-PeCDF	2.8×10^{-8}	5.6×10^{-9}
1,2,3,4,7,8-HxCDF	2.2×10^{-7}	4.4×10^{-8}
1,2,3,7,8,9-HxCDF	4.2×10^{-9}	8.4×10^{-10}
1,2,3,6,7,8-HxCDF	8.1×10^{-8}	1.6×10^{-8}
2,3,4,6,7,8-HxCDF	8.7×10^{-8}	1.7×10^{-8}
1,2,3,4,6,7,8-HpCDF	4.4×10^{-7}	8.8×10^{-8}
1,2,3,4,7,8,9-HpCDF	4.3×10^{-8}	8.6×10^{-9}
OCDF	3.6×10^{-7}	7.2×10^{-8}

NOx to NO_2 Relationship

Background

6.48 The NO_x emissions associated with combustion activities at the proposed EfW facility will typically comprise approximately 90-95% nitrogen monoxide (NO) and 5-10% nitrogen dioxide (NO_2) at source. The NO oxidises in the atmosphere in the presence of sunlight, ozone and volatile organic compounds to form NO_2, which is the principal concern in terms of environmental health effects.

6.49 There are various techniques available for estimating the portion of the NO_x that is converted to NO_2. Methods used for calculation of annual mean NO_2 concentrations and short-term hourly NO_2 concentrations used within the assessment are detailed below.

Assumptions for Annual Mean Calculations

6.50 Total conversion is frequently used for the estimation of the annual mean NO_2 concentrations to determine the absolute upper limit of NO_2 formation. This technique is based on the assumption that all NO emitted is converted to NO_2 before it reaches ground level receptors.

6.51 The Environment Agency recommends that for a "worst case scenario", a 70% conversion of NO_x to NO_2 should be considered for calculation of annual average concentrations. If a breach of the annual average NO_2 objective/limit value occurs, the Environment Agency requires a more detailed assessment where operators are asked to justify the use of percentages lower than 70%.

6.52 For the purposes of this assessment, a 70% conversion of NO_x to NO_2 is assumed for annual average NO_2 concentrations in line with the Environment Agency's recommendations.

Assumptions for Hourly Mean Calculations

6.53 For the calculation of short-term contributions from the proposed EfW facility to ground level concentrations of NO_2, 35% of the modelled NO_x contribution was added to the background NO_2 concentration.

6.54 A 35% conversion follows the Environment Agency's recommendations for the calculation of "worst case scenario" short-term NO_2 concentrations. If a breach of the hourly NO_2 objective/limit value occurs, the Environment Agency requires a more detailed assessment where operators are asked to justify their use of percentages lower than 35%.

Assessment of Effects on Human Health Risk Assessment Receptors Method

6.55 The assessment of air quality effects at sensitive receptors identified for consideration in the Human Health Risk Assessment has used ADMS and AERMOD dispersion models retaining consistent input data as described above. As the Human Health Risk Assessment requires information on the deposition of pollutants to land as well as airborne concentrations, dispersion modelling was undertaken to predict the following:

- The airborne concentration of vapour, particle and particle bound pollutants emitted;
- The dry and wet deposition of particle and particle bound pollutants to land;
- The gaseous deposition of vapour pollutants to land.

6.56 Table 6.9 summarises the partitioning of pollutants into particle, particle bound and vapour phases based on the vapour pressure established for each. Particle and particle bound phase pollutants were modelled assuming a particle diameter of 10 μm and a density of 1 $g.cm^{-3}$.

Table 6.9: Phasing of Metals and Dioxins / Furans

Metal	Phasing	Dioxins / Furans	Phasing
Antimony	Particle	2,3,7,8-TCDD	Vapour
		1,2,3,7,8-PeCDD	Particle-bound
Arsenic	Particle	1,2,3,4,7,8-HxCDD	Particle-bound
		1,2,3,7,8,9-HxCDD	Particle
Cadmium	Particle	1,2,3,6,7,8-HxCDD	Particle
		1,2,3,4,6,7,8-HpCDD	Particle
Chromium	Particle	OCDD	Vapour
		2,3,7,8-TCDF	Particle-bound
Lead	Particle	2,3,4,7,8-PeCDF	Particle-bound
		1,2,3,7,8-PeCDF	Particle-bound
Mercury	Vapour	1,2,3,4,7,8-HxCDF	Particle
		1,2,3,7,8,9-HxCDF	Particle-bound
Nickel	Particle	1,2,3,6,7,8-HxCDF	Particle-bound
		2,3,4,6,7,8-HxCDF	Particle-bound
Thallium	Particle	1,2,3,4,6,7,8-HpCDF	Particle
		1,2,3,4,7,8,9-HpCDF	Particle
		OCDF	Particle

Assessment of Effects on Vegetation and Ecosystems Method

Overview

6.57 The assessment of the effects of emissions to air from the proposed EfW on European designated sites is required under the Habitats Regulations. Following good practice, all European sites and Sites of Special Scientific Interest (SSSI) within 15km have been considered within this assessment. Full details of the local European designated and SSSI sites, together with the regulations that relate to them are provided in Chapter 6 of the Environmental Statement.

6.58 Table 6.10 to Table 6.13 identifies designated sites for consideration within this air quality assessment. Due to the extensive nature of some designations identified, a series of discrete receptors were included within the dispersion modelling to account for the geographic variation of predicted concentrations.

6.59 The assessment of effects on ecological receptors has been undertaken for operational Scenario 2 only (emissions at the WID long-term emission limit). This is considered conservative, as expected emissions are likely to be much lower.

Critical Levels

6.60 Critical levels for the protection of vegetation and ecosystems are specified within relevant European air quality directives and corresponding UK air quality regulations (see Table 4.2). For European sites and SSSI's, process contributions and predicted environmental concentrations of NO_x and SO_2 have been calculated for comparison against critical level thresholds. Background NO_x and SO_2 concentrations at each designated site have been derived from the UK Air Pollution Information System (APIS) website (www.apis.ac.uk/) (see Table 6.10 to Table 6.13).

Critical Loads

Overview

6.61 Critical loads are a quantitative estimate of exposure to deposition of one or more pollutants, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge.

Critical Loads - Acidification

6.62 Percentage contributions to acid deposition have been derived from dispersion modelling using both ADMS and AERMOD. Deposition rates were calculated using empirical methods recommended by the Environment Agency as follows:

- Calculate dry deposition flux (0.0015 $m.s^{-1}$ for NO_x, 0.012 $m.s^{-1}$ for SO_2, and 0.025 $m.s^{-1}$ for HCl assumed as deposition velocities):

  - Dry deposition flux = ground level concentration x deposition velocity

    ($\mu g\ m^{-2}\ s^{-1}$) ($\mu g.m^{-3}$) (m/s)

- Convert units from $\mu g\ m^{-2}\ s^{-1}$ to units of kg ha^{-1} $year^{-1}$ by multiplying the dry deposition flux by standard conversion factors (96 for NO_x, 157.7 for SO_2, and 306.7 for HCl).

- Convert to units of equivalents (keq ha^{-1} $year^{-1}$), which is a measure of how acidifying the chemical species can be, by multiplying the dry deposition flux (kg ha^{-1} $year^{-1}$) by standard conversion factors (0.071428 for N, 0.0625 for S, 0.0282 for Cl).

- Calculate wet deposition flux for Cl only via use of dry to wet deposition ratio:

  - PC wet deposition flux = PC dry deposition flux x dry to wet deposition ratio

    (dry to wet deposition ratio for Cl conservatively assumed to be 2)

- Add dry and wet Cl deposition (keq ha^{-1} $year^{-1}$) to determine total Cl acid deposition

- Add predicted dry N and S and total Cl (wet and dry) deposition (keq ha^{-1} $year^{-1}$) to determine total acid deposition.

6.63 Wet deposition in the near field is not significant compared with dry deposition for N and S and therefore for the purposes of this assessment, wet deposition has not been considered for these species. However, because of HCl's high solubility, strong dissociation in solution and reactivity (it can also restrict the washout of other acid gases, especially SO_2), both wet and dry deposition for Cl is considered for the purposes of this assessment.

6.64 Predicted contributions to acid deposition have been calculated and compared with the relevant critical load range for the habitat types associated with each designated site as derived from the UK Air Pollution Information System (APIS) website (www.apis.ac.uk/) (see Table 6.10 to Table 6.13). Background acid deposition rates have also been derived from APIS specific to each designated area.

No background deposition rates are available for the Mersey Estuary due to tidal flushing and the high buffering capacity.

6.65 The significance of predicted acid deposition at the identified ecological receptors is addressed in Chapter 6 of the Environmental Assessment and its appendices.

Critical Loads - Eutrophication

6.66 Percentage contributions to nitrogen deposition have been derived from dispersion modelling using both ADMS and AERMOD. Deposition rates were calculated using empirical methods recommended by the Environment Agency, as follows:

- Calculate NO_x dry deposition flux (0.0015 $m.s^{-1}$ for NO_x assumed as deposition velocity):
  - Dry deposition flux = ground level concentration x deposition velocity

    ($\mu g\ m^{-2}\ s^{-1}$) ($\mu g.m^{-3}$) (m/s)
- Convert units from $\mu g\ m^{-2}\ s^{-1}$ to units of $kg\ ha^{-1}\ year^{-1}$ by multiplying the dry deposition flux by standard conversion factors (96 for NO_x).

6.67 Wet deposition of nitrogen in the near field has not been considered for the reasons given previously.

6.68 Predicted contributions to nitrogen deposition have been calculated and compared with the relevant critical load range for the habitat types associated with each designated site as derived from the UK Air Pollution Information System (APIS) website (www.apis.ac.uk/) (see Table 6.10 to Table 6.13). Background nitrogen deposition rates have also been derived from APIS specific to each designated area. No background deposition rates are available for the Mersey Estuary due to tidal flushing, the high inherent nutrient status of the estuarine environment and the high buffering capacity.

6.69 The significance of predicted nitrogen deposition at the identified ecological receptors is addressed in Chapter 6 of the Environmental Assessment and its appendices.

Table 6.10: Designated Ramsar Ecological Sites Within 15km Radius

Name of site	Distance To Site	Matching habitat types on APIS website	Critical Load for each habitat		Background NO_x ($\mu g.m^{-3}$)	Background N Deposition (kg N ha^{-1} yr^{-1})	Background Acid Deposition (keq ha^{-1} yr^{-1})	Background SO_2 ($\mu g.m^{-3}$)
			Nitrogen Deposition (kg N ha^{-1} yr^{-1})	Acid Deposition (keq ha^{-1} yr^{-1})				
Mersey Estuary	0.2km to 15km	Saltmarsh	Not Available	Not Available	28.7 (1)	Not Available	Not Available	4.7 (1)
		Grazing marsh						
		Shingle, rocks and cliffs						
		Shingle, rocks and cliffs						
Midland Meres & Mosses Phase 1	10.3km to 11.1km	Eutrophic standing waters	Not Available	Not Available	26.3	20.4	1.82	3.2
		Alkaline fens and reedbeds	10 to 20	0.1				
		Raised bog and blanket bog	5 to 10	0.1				
Midland Meres & Mosses Phase 2	11.8km to 14.7km	Eutrophic standing waters	Not Available	Not Available	26.3	23	2.05	3.8
		Alkaline fens and reedbeds	10 to 20	0.1				
		Raised bog and blanket bog	5 to 10	0.1				

Note: (1) Derived from National Air Quality Archive Information (see Table 5.7) in absense of APIS data

Table 6.11: Designated SPA[1] Ecological Sites Within 15km Radius

Name of site	Distance to Site	Matching habitat types on APIS website	Critical Load for each habitat		Background NO_x ($\mu g.m^{-3}$)	Background N Deposition (kg N ha^{-1} yr^{-1})	Background Acid Deposition (keq ha^{-1} yr^{-1})	Background SO_2 ($\mu g.m^{-3}$)
			Nitrogen Deposition (kg N ha^{-1} yr^{-1})	Acid Deposition (keq ha^{-1} yr^{-1})				
Mersey Estuary	0.2km to 15km	Saltmarsh	Not Available	Not Available	28.7 [(2)]	Not Available	Not Available	4.7 [(2)]
		Grazing marsh						
		Shingle, rocks and cliffs						
		Shingle, rocks and cliffs						

Note: (1) SPA – Special Protection Area
(2) Derived from National Air Quality Archive Information (see Table 5.7) in absense of APIS data

Table 6.12: Designated SAC[1] Ecological Sites Within 15km Radius

Name of site	Distance to Site	Matching habitat types on APIS website	Critical Load for each habitat		Background NO_x ($\mu g.m^{-3}$)	Background N Deposition (kg N ha^{-1} yr^{-1})	Background Acid Deposition (keq ha^{-1} yr^{-1})	Background SO_2 ($\mu g.m^{-3}$)
			Nitrogen Deposition (kg N ha^{-1} yr^{-1})	Acid Deposition (keq ha^{-1} yr^{-1})				
Oak Mere	14.7	Eutrophic standing waters	Not Available	Not Available	24	20	1.78	3.1
		Alkaline fens and reedbeds	10 to 20	0.1				
		Raised bog and blanket bog	5 to 10	0.1				

Note: (1) SAC – Special Area of Conservation

Table 6.13: Designated SSSI[1] Ecological Sites Within 15km Radius

Name of site	Distance to Site	Matching habitat types on APIS website	Critical Load for each habitat		Background NO_x ($\mu g.m^{-3}$)	Background N Deposition ($kg\ N\ ha^{-1}\ yr^{-1}$)	Background Acid Deposition ($keq\ ha^{-1}\ yr^{-1}$)	Background SO_2 ($\mu g.m^{-3}$)
			Nitrogen Deposition ($kg\ N\ ha^{-1}\ yr^{-1}$)	Acid Deposition ($keq\ ha^{-1}\ yr^{-1}$)				
Mersey Estuary	0.2km to 15km	Saltmarsh	Not Available	Not Available	28.7 (2)	Not Available	Not Available	4.7 (2)
		Grazing marsh						
		Shingle, rocks and cliffs						
		Shingle, rocks and cliffs						
Flood Brook Clough	3.6km	Ash woodland	10 to 15	0.87	37.6	35.4	2.95	7.7
Dunsdale Hollow	5.4km	Birch woodland	10 to 15	0.86	34.3	35.4	2.95	4.2
		Oak woodland	10 to 15	0.86				
Beechmill Wood and Pasture	5.9km	Oak Woodland	10 to 15	1.27	34.3	35.4	2.95	4.2
		Ash woodland	10 to 15	1.27				
Warburton's Wood and Well Wood	7.3km	Oak Woodland	10 to 15	1.32	30.3	40.5	3.26	3.3
		Ash woodland	10 to 15	1.32				
Hatton's Hey Wood, Whittle's Corner and Bank Rough	7.7km	Oak woodland	10 to 15	1.32	30.3	40.5	3.26	3.3
Hatch Mere	10.1km	Alkaline fens and reedbeds	10 to 20	0.1	26.2	20.4	1.82	3.2
		Raised bog and blanket bog	5 to 10	0.1				
Flaxmere Moss	10.1km	Alkaline fens and reedbeds	10 to 15	0.1	26.2	20.4	1.82	3.2
		Raised bog and blanket bog	5 to 10	0.1				

Name of site	Distance to Site	Matching habitat types on APIS website	Critical Load for each habitat		Background NO_x ($\mu g.m^{-3}$)	Background N Deposition (kg N ha^{-1} yr^{-1})	Background Acid Deposition (keq ha^{-1} yr^{-1})	Background SO_2 ($\mu g.m^{-3}$)
			Nitrogen Deposition (kg N ha^{-1} yr^{-1})	Acid Deposition (keq ha^{-1} yr^{-1})				
Black Lake, Delamere	11.2km	Raised bog and blanket bog	5 to 10	0.35	26.3	20.2	1.77	2.9
Linmer Moss	11.9km	Alkaline fens and reedbeds	10 to 20	0.1	26.3	20.2	1.77	2.9
Oak Mere	14.7km	Planted coniferous woodland	10 to 15	0.25	24	34.6	2.81	3.1
		Birch woodland	10 to 15	0.55				
		Oak woodland	10 to 15	0.55				
		Raised bog and blanket bog	5 to 10	0.1				

Note: (1) SSSI – Special Site of Scientific Interest
(2) Derived from National Air Quality Archive Information (see Table 5.7) in absense of APIS data

Assessment of Emissions from Operational Vehicles

Overview

6.70 Changes in traffic flow characteristics in the operational phase may result in changes in pollutant concentrations at properties near to roads used by vehicles generated by the project once in operation. The potential effects on ground level concentrations of NO_2 and PM_{10} due to changes in traffic have been assessed using the local assessment methodology as provided in the Design Manual for Roads and Bridges (DMRB). The effects have been assessed for the opening year of the project (2011) and compared with the relevant objectives.

DMRB Model Scenarios

6.71 Concentrations of NO_2 and PM_{10} have been predicted at 5m, 10m and 20m from the centre of the roads affected for the following scenarios:

- Without Project (Opening Year of Project) – without the proposed operational traffic but including normal traffic growth;
- With Project (Opening Year of Project) – with the proposed operational traffic and normal traffic growth;
- With Project and other committed development (Opening Year of Project) – with the proposed operational traffic and other permitted development traffic and normal traffic growth;

Traffic Input Data

6.72 The DMRB model requires input data of annual average daily traffic flow (AADT), annual average speeds, and the proportion of different vehicle types. RPS traffic consultants for the project provided these data, which are consistent with the Transport Assessment.

6.73 Table 6.14 below shows the AADT for each of the road links used within the DMRB assessment. Table 6.15 below shows the HGV percentages for each of the road links used in the DMRB assessment.

Table 6.14: Operational AADT Flows for Each Scenario

Road Link	Without Project 2011	With Project 2011	With Project and other committed development 2011
New Access Road	0	324	348
Picow Farm Road	3,341	3,665 (9.7)	3,689
Expressway South (A557)	20,332	20,484 (0.7)	20,613
Expressway North (A557)	21,078	21,240 (0.8)	21,369

Note: Percentage Increase in With Project Flow Compared with Without Project Flow Given in Brackets

Table 6.15: Operational HGVs as % of AADT Flows for Each Scenario

Road Link	Without Project 2011	With Project 2011	With Project and other committed development 2011
New Access Road	0	84.6%	82.8%
Picow Farm Road	11.0%	16.0%	17.8%
Expressway South (A557)	27%	27%	27%
Expressway North (A557)	27%	27%	27%

Assessment of Plume Visibility

6.74 With many processes a degree of atmospheric plume visibility from condensation of water vapour is unavoidable. Visible plumes arise from gas flows to air that are above ambient temperature and which, as the gases are cooled to ambient temperature, result in the condensation of water vapour and a white plume. The extent of the plume is dependent on the volumetric flow rate of gases from the source, amount of water vapour in the cooled gases, relative humidity of the atmosphere, and plume dispersion in the atmosphere.

6.75 Given that the plume from the facility is likely to be visible beyond the site boundary, the EA's H1 Guidance requires quantification of the potential effect from visible plumes.

6.76 The likely incidence and dimensions of a visible plume being emitted from the proposed stack has been predicted using the ADMS 3.3 dispersion model's plume visibility module, based on an initial mixing ratio of the plume of 0.09 kg/kg (mass of H_20). Modelling was undertaken using five years' worth of hourly sequential meteorological data. Resultant data have been used to determine:

- the amount of time that the length of the plume may exceed the average distance to the site boundary;
- the number of plumes that exceed the average distance to the site boundary during daylight hours.

6.77 Based on results of the above assessment, the facility has been scored based on criteria in H1, which classifies the effect of plume visibility on a scale ranging from 'zero' to 'high'.

Significance Criteria

6.78 A number of approaches can be used to determine whether the potential air quality effects of a development are significant. However, there remains no universally recognised definition of what constitutes 'significance'.

6.79 Guidance is available from a range of regulatory authorities and advisory bodies on how best to determine and present the significance of effects within an air quality assessment. It is generally considered good practice that, where possible, an assessment should communicate effects both numerically and descriptively.

6.80 In order to ensure that the descriptions of effects used within this report are clear, consistent and in accordance with recent guidance, definitions have been adapted from the National Society for Clean Air's (NSCA) Development Control: Planning for Air Quality document.

6.81 Table 6.16 provides magnitude descriptors used for changes in Predicted Contributions as a percentage of the Environmental Quality Standard as a result of the proposed development.

Table 6.16: Magnitude Descriptors for Predicted Contributions as a Percentage of EQS

Magnitude Descriptor	**Predicted Contribution as % of EQS**
Very large	Increase/decrease >25%
Large	Increase/decrease 15-25%
Medium	Increase/decrease 10-15%
Small	Increase/decrease 5-10%
Very Small	Increase/decrease 1-5%
Extremely Small	Increase/decrease <1%

Note: EQS- Environmental Quality Standard

6.82 The magnitude descriptor identified must be considered in the context of existing air quality conditions within the study area in order for the significance of that magnitude to be determined. The most important aspects to consider are whether existing concentrations are above or below the relevant AQS objective and limit value and whether existing receptors are within an Air Quality Management Area.

6.83 Table 6.17 provide descriptors for the significance of air quality effects based on the magnitude descriptors in the context of existing conditions. The NSCA recognise that professional judgement is required in the interpretation of air quality assessment significance. Table 6.17 is intended as a tool to help interpret the results to the air quality assessment.

Table 6.17: Descriptors for Effect Significance

Absolute Concentrations in Relation to Standard	**Extremely Small**	**Very Small**	**Small**	**Medium**	**Large**	**Very Large**
Increase with development						
Conflicts with AQAP	Slight adverse	Substantial adverse	Substantial adverse	Very substantial adverse	Very substantial adverse	Very substantial adverse
Above standard with scheme	Slight adverse	Slight adverse	Substantial adverse	Substantial adverse	Very substantial adverse	Very substantial adverse
Above standard without scheme, below with scheme	Slight adverse	Moderate adverse	Substantial adverse	Substantial adverse	Very substantial adverse	Very substantial adverse
Below standard without scheme, but not well below	Neutral	Slight adverse	Slight adverse	Moderate adverse	Moderate adverse	Substantial adverse
Well below standard without scheme	Neutral	Neutral	Slight adverse	Slight adverse	Slight adverse	Moderate adverse
Decrease with development						
Above standard with scheme	Slight beneficial	Slight beneficial	Substantial beneficial	Substantial beneficial	Very substantial beneficial	Very substantial beneficial
Above standard without scheme, below with scheme	Slight beneficial	Moderate beneficial	Substantial beneficial	Substantial beneficial	Very substantial beneficial	Very substantial beneficial
Below standard without scheme, but not well below	Neutral	Slight beneficial	Slight beneficial	Moderate beneficial	Moderate beneficial	Substantial beneficial
Well below standard without scheme	Neutral	Neutral	Slight beneficial	Slight beneficial	Slight beneficial	Moderate beneficial

7 Results of Air Quality Assessment

Construction Effect Assessment

Assessment of Emissions from Construction Vehicles

Overview

7.1 Table 7.1 to Table 7.3 summarises the NO_2 and PM_{10} concentrations predicted by DMRB for 2009, the peak construction year.

Table 7.1: Predicted Annual Mean NO_2 Concentrations ($\mu g.m^{-3}$) in 2009

Road Link	Distance to Centre of Road Link (m)	Without	With	PC	PC as % of EQS	Magnitude Of PC	Significance Descriptor
New Access Road	5	-	24.3	-	-	-	Neutral
	10	-	24.2	-	-	-	Neutral
	20	-	24.0	-	-	-	Neutral
Picow Farm Rd	5	24.9	25.8	0.8	2.0	Very Small	Neutral
	10	24.8	25.5	0.7	1.8	Very Small	Neutral
	20	24.5	25.0	0.5	1.3	Very Small	Neutral
Expressway South (A557)	5	38.5	38.7	0.2	0.5	Extremely Small	Neutral
	10	37.3	37.5	0.2	0.5	Extremely Small	Neutral
	20	34.6	34.7	0.1	0.3	Extremely Small	Neutral
Expressway North (A557)	5	38.7	38.9	0.2	0.5	Extremely Small	Neutral
	10	37.5	37.7	0.2	0.5	Extremely Small	Neutral
	20	34.7	34.9	0.2	0.5	Extremely Small	Neutral

Note: PC – Predicted Contribution; EQS – Environmental Quality Standard

Table 7.2: Predicted Annual Mean PM_{10} Concentrations ($\mu g.m^{-3}$) in 2009

Road Link	Distance to Centre of Road Link (m)	Without	With	PC	PC as % of EQS	Magnitude Of PC	Significance Descriptor
New Access Road	5	-	24.3	-	-	-	Neutral
	10	-	24.3	-	-	-	Neutral
	20	-	24.2	-	-	-	Neutral
Picow Farm Rd	5	24.5	24.7	0.2	0.5	Extremely Small	Neutral
	10	24.5	24.7	0.2	0.5	Extremely Small	Neutral
	20	24.4	24.5	0.1	0.25	Extremely Small	Neutral
Expressway South (A557)	5	29.2	29.2	0	0	Extremely Small	Neutral
	10	28.7	28.7	0	0	Extremely Small	Neutral
	20	27.6	27.6	0	0	Extremely Small	Neutral
Expressway North (A557)	5	29.3	29.3	0	0	Extremely Small	Neutral
	10	28.8	28.8	0	0	Extremely Small	Neutral
	20	27.6	27.7	0.1	0.25	Extremely Small	Neutral

Note: PC – Predicted Contribution; EQS – Environmental Quality Standard

Table 7.3: Predicted Number of Daily Mean PM_{10} Concentrations above 50 $\mu g.m^{-3}$

Road Link	Distance to Centre of Road Link (m)	Without	With	PC	PC as % of EQS	Magnitude Of PC	Significance Descriptor
New Access Road	5	-	10.8	-	-	-	Neutral
	10	-	10.7	-	-	-	Neutral
	20	-	10.6	-	-	-	Neutral
Picow Farm Rd	5	11.3	11.8	0.5	1.4	Very Small	Neutral
	10	11.2	11.6	0.4	1.1	Very Small	Neutral
	20	11	11.3	0.3	0.9	Extremely Small	Neutral
Expressway South (A557)	5	24.6	24.8	0.2	0.6	Extremely Small	Neutral
	10	22.9	23.1	0.2	0.6	Extremely Small	Neutral
	20	19.4	19.5	0.1	0.3	Extremely Small	Neutral
Expressway North (A557)	5	24.8	25.2	0.4	1.0	Very Small	Neutral
	10	23.1	23.4	0.3	0.9	Extremely Small	Neutral
	20	19.5	19.7	0.2	0.6	Extremely Small	Neutral

Note: PC – Predicted Contribution; EQS – Environmental Quality Standard

Annual Mean NO_2 Predicted Concentrations

7.2 Results presented Table 7.1 indicates that predicted annual mean NO_2 concentrations at all receptors are below the relevant objective/limit value of 40 ug.m^{-3} for all construction year scenarios considered. The magnitude of increases resulting from the project as a percentage of the EQS is described as either Very Small or Extremely Small. As annual mean NO_2 concentrations are below the relevant objective/limit value of 40 ug.m^{-3}, the effect significance can be described as neutral.

Hourly Mean NO_2 Predicted Concentrations

7.3 Research has shown that the hourly NO_2 objective of 200µg.m^{-3} is unlikely to be exceeded at a roadside location where the annual mean NO_2 concentration is less than 60µg.m^{-3}.

7.4 Using this guideline, predicted concentrations for all scenarios, regardless of distance bands, are expected to meet the hourly objective/limit value an, therefore, short term effects are not likely to be significant in relation to construction traffic effects.

Annual Mean PM_{10} Predicted Concentrations

7.5 Table 7.2 summarises the annual PM_{10} concentrations predicted by the model for 2009, the peak construction traffic. Predicted annual mean PM_{10} concentrations at all receptors are well below the relevant objective/limit value of 40µg.m^{-3} for all construction year scenarios considered. The magnitude of increases resulting from the project as a percentage of the EQS is described as Extremely Small. As annual mean PM_{10} concentrations are below the relevant objective/limit value of 40 ug.m^{-3}, the effect significance can be described as neutral.

Daily Mean PM_{10} Predicted Concentrations

7.6 Table 7.3 summarises the predicted number of daily mean PM_{10} concentrations above 50µg.m^{-3}. Results presented in Table 7.3 indicate that predicted number of days with PM_{10} concentrations greater than 50µg.m^{-3} at all receptors are below the relevant objective value of 35 exceedences for all construction scenarios considered. The magnitude of increases resulting from the project as a percentage of the EQS is described as either Very Small or Extremely Small. As daily mean PM_{10} concentrations are below the relevant objective/limit the effect significance can be described as neutral.

Summary and Conclusions

7.7 The long-term and short-term air quality objective / limit values for NO_2 and PM_{10} are likely to be met for both future scenarios considered either with or without the construction traffic.

7.8 The effect on air quality due to the additional emissions from construction traffic is considered as being neutral.

Operational Effect Assessment

Overview

7.9 This sub-section presents the results of the operational effect assessment. The effect on local air quality of emissions from the proposed EfW facilities exhaust stack has been quantified through the use of dispersion modelling. Traffic emissions associated with the operational phase have been assessed using the DMRB screening method. In addition to the above, plume visibility from water in stack emissions and the potential effects of odour from the tipping hall have been considered.

Emissions from EfW Facility Exhaust Stack

Determination of Appropriate Stack Height

7.10 The stack height selected for the optimum dispersion of pollutants is determined to be 105 m based on the findings of the stack height determination presented in Annex A. The dispersion modelling results indicate that local building wake effects do not materially affect dispersion above a height of 105 m.

Dispersion Modelling Assessment Results

Overview

7.11 The results of modelling atmospheric emissions from the proposed EfW facility are summarised and interpreted below for each of the assessment scenarios. The model results are presented in tabular form and as contour plots.

7.12 Model runs assumed a grid with 300m receptor spacing to a 15km radius around the facility. Meteorological data measured at Liverpool Airport (Speke) has been used as the basis of this assessment. For each of the five years of meteorological data (2000 to 2004), the maximum predicted ground level concentration in the modelled domain has been derived. Results presented in the following sub-sections are derived from the maximum predictions made by either ADMS or AERMOD. Full tabulated results for both models are presented in Annex B.

Scenario 1: Assessment of Operation at Short-Term WID Limits

7.13 The results of modelling maximum Predicted Contributions (PCs) to ground level concentrations from the proposed EfW and resultant Predicted Environmental Concentrations (PECs), including the Ambient Concentration (AC), of all relevant pollutants with short-term WID emission limits are summarised in Table 7.4 and Table 7.5 and compared with the relevant air quality criteria (Environmental Quality Standards – EQS).

7.14 In order to infer the maximum potential short-term effects, the proposed EfW facility is assumed to operate at the WID short-term emission limits with a 100% plant load factor to ensure that plant operation coincides with the worst-case meteorological conditions for dispersion.

Table 7.4: Predicted Maximum Contributions from EfW (Scenario 1) (μg.m^{-3})

Pollutant	Averaging Period	EQS	PC Max	Max PC as % of EQS	Magnitude of PC
HCl	1 hour (maximum)	800	16.0	2.0	Very Small
HF	1 hour (maximum)	250	1.1	0.4	Extremely Small
SO_2	15 minute (99.90th percentile)	266	41.5	15.6	Large
	1 hour (99.73th percentile)	350	33.9	9.7	Small
NO_2	1 hour (99.79th percentile)	200	26.5	13.2	Medium

Note: PC – Predicted Contribution
EQS – Environmental Quality Standard

Table 7.5: Predicted Environmental Concentrations from EfW (Scenario 1) (μg.m^{-3})

Pollutant	Averaging Period	EQS	AC	PEC Max	Max PEC as % of EQS	Significance Descriptor
HCl	1 hour (maximum)	800	1.1	17.1	2.1	Neutral
HF	1 hour (maximum)	250	4.92	6.0	2.4	Neutral
SO_2	15 minute (99.90th percentile)	266	40	81.5	30.6	Slight Adverse
	1 hour (99.73th percentile)	350		73.9	21.1	Slight Adverse
NO_2	1 hour (99.79th percentile)	200	52	78.5	39.2	Slight Adverse

Note: AC – Ambient Concentration; PEC – Predicted Environmental Concentration
EQS – Environmental Quality Standard

7.15 The results presented in Table 7.4 and Table 7.5 indicate that the predicted contributions and resultant environmental concentrations of all pollutants considered are well within the relevant EQS.

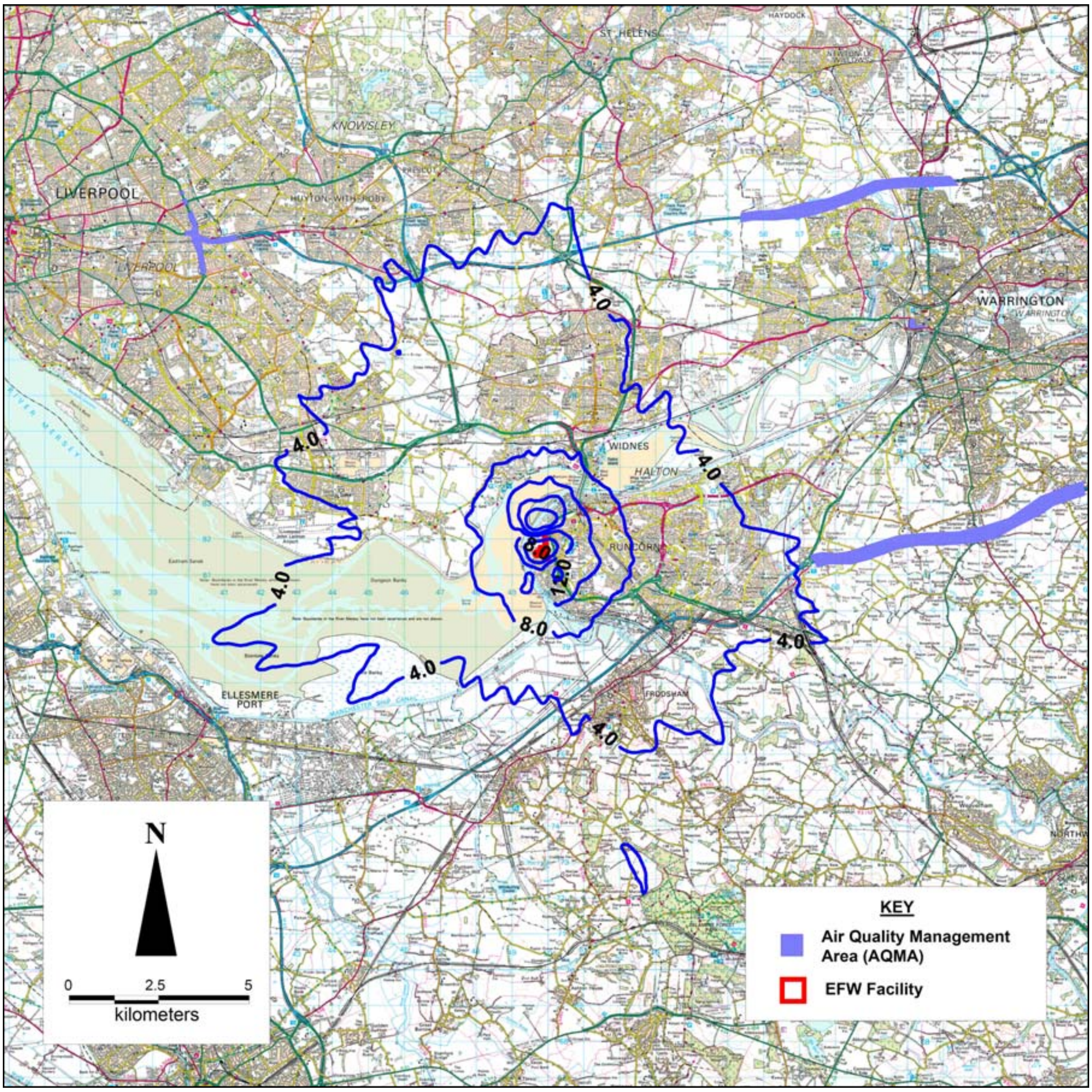
7.16 Although some short-term contributions are greater than 10% of the relevant EQS (15 minute 99.9th percentile SO_2 concentrations and 99.79th percentile NO_2 concentrations), all resultant environmental concentrations (including consideration of background concentrations) are less than 40% of the relevant EQS. Maximum short-term contributions are therefore considered to be of slight adverse significance.

7.17 Contour plots of short-term NO_2 and SO_2 contributions are presented in Figure 7.1 and Figure 7.2. Due to minimal predicted contributions of HCl and HF, no contour plots are presented for these pollutants.

7.18 The contour plots indicate that the highest short-term contributions of NO_2 and SO_2 are predicted to occur in the near vicinity of the site. The closest sensitive receptors as identified in Table 2.1 are minimally affected by short-term peak atmospheric emissions from the proposed EfW facility. Contributions to the declared AQMAs within the study area are predicted to be negligible.

7.19 To realise the effects presented in Table 7.4 and Table 7.5, the proposed EfW facility would need to operate at the short-term WID emission limits coinciding with the worst-case meteorological conditions for dispersion. In practice, such events are unlikely and represent the absolute upper limits for short-term effects from the facility.

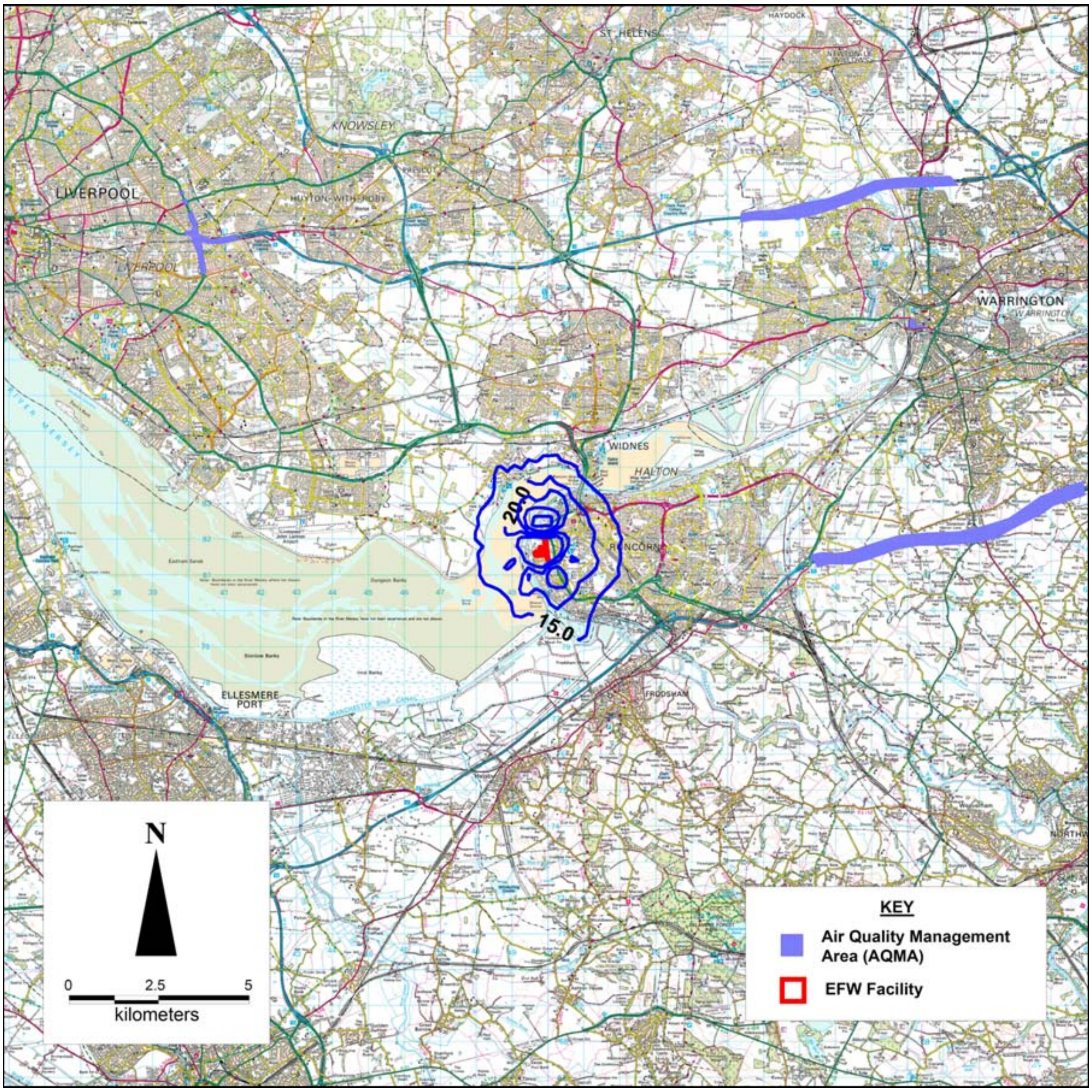
Figure 7.1: Contour Plot of Scenario 1 Predicted 99.79th Percentile Hourly NO_2 Contributions ($\mu g.m^{-3}$)



Assumptions:

- Concentrations in $\mu g.m^{-3}$
- Proposed EfW operating at WID short-term limits
- 35% NO_x to NO_2 conversion
- 2000 meteorological year (worst case)
- Derived from ADMS modelling (worst case)

Figure 7.2: Contour Plot of Scenario 1 Predicted 99.9th Percentile 15 Minute SO_2 Contributions ($\mu g.m^{-3}$)



Assumptions:

- Concentrations in $\mu g.m^{-3}$
- Proposed EfW operating at WID short-term limits
- 2000 meteorological year (worst case)
- Derived from ADMS modelling (worst case)

Scenario 2: Assessment of Operation at Long-Term WID Limits

7.20 The results of modelling maximum Predicted Contributions (PCs) to ground level concentrations from the proposed EfW facility and resultant Predicted Environmental Concentrations (PECs), including the Ambient Concentration (AC), of all relevant pollutants with long-term WID emission limits are summarised in Table 7.6 and Table 7.7 and compared with the relevant air quality criteria (Environmental Quality Standards – EQS). A full tabulation of results presented in Annex B.

7.21 The results in Table 7.6 indicate that predicted contributions of all pollutants are well within the relevant EQS. All short-term contributions are less than 10% of the relevant EQS and none are therefore considered significant. All long-term contributions are less than 1% of the relevant EQS with the exception of SO_2, NO_2 and the metal Cd. However, Table 7.7 indicates that the resultant PECs for SO_2, NO_2, Cd and all other pollutants are well within the relevant EQS. Overall, predicted pollutant concentrations from the project operating at the long-term WID emission limits are considered to be of neutral significance.

7.22 Contour plots of short-term and long-term NO_2 contributions are presented in Figure 7.3 and Figure 7.4. These contour plots are considered to be representative of the dispersion patterns for all pollutants.

7.23 The contour plots indicate that the highest short-term contributions of NO_2 from the proposed EfW facility are predicted to occur in the near vicinity of the site. Highest annual mean contributions are predicted to occur to the southeast of the site. NO_2 contributions at the declared AQMAs within the study area are negligible.

7.24 Predicted pollutant concentrations from the proposed EfW facility operating at the WID emission limits are considered to be of neutral significance. In addition, the results presented in Table 7.6 and Table 7.7 are considered to represent the "worst case" for the long-term operation of the plant as actual emissions are expected to be lower than the WID emission limits.

Table 7.6: Predicted Maximum Contributions from EfW (Scenario 2) ($\mu g.m^{-3}$)

Pollutant	Averaging Period	EQS	PC Max	Max PC as % of EQS	Magnitude of PC
PM_{10}	24 hour (90.41th percentile)	50	0.1	0.3	Extremely Small
	24 hour (98.08th percentile)	50	0.5	1.0	Very Small
	Annual	40	0.1	0.2	Extremely Small
HCl	1 hour (maximum)	800	2.7	0.3	Extremely Small
	Annual	20	0.1	0.5	Extremely Small
HF	1 hour (maximum)	250	0.3	0.1	Extremely Small
SO_2	15 minute (99.90th percentile)	266	10.4	3.9	Very Small
	1 hour (99.73th percentile)	350	8.5	2.4	Very Small
	24 hour (99.18th percentile)	125	3.5	2.8	Very Small
	Annual	50	0.5	1.0	Very Small
NO_2	1 hour (99.79th percentile)	200	13.3	6.6	Small
	Annual	40	1.4	3.5	Very Small
CO	8 hour (maximum daily running)	10000	9.3	0.1	Extremely Small
Cd	1 hour (maximum)	1.5	6.3×10^{-3}	0.4	Extremely Small
	Annual	0.005	2.2×10^{-4}	4.5	Very Small
Tl	1 hour (maximum)	30	6.3×10^{-3}	0.02	Extremely Small
	Annual	1	2.2×10^{-4}	0.02	Extremely Small
Hg	1 hour (maximum)	7.5	1.3×10^{-2}	0.18	Extremely Small
	Annual	0.25	4.6×10^{-4}	0.18	Extremely Small
Sb	1 hour (maximum)	150	1.4×10^{-2}	0.01	Extremely Small
	Annual	5	4.9×10^{-4}	0.01	Extremely Small
As	1 hour (maximum)	15	1.4×10^{-2}	0.09	Extremely Small
	Annual	0.2	4.9×10^{-4}	0.25	Extremely Small
Cr	1 hour (maximum)	3	1.4×10^{-2}	0.46	Extremely Small
	Annual	0.1	4.9×10^{-4}	0.49	Extremely Small
Co	1 hour (maximum)	6	1.4×10^{-2}	0.23	Extremely Small
	Annual	0.2	4.9×10^{-4}	0.25	Extremely Small
Cu	1 hour (maximum)	60	1.4×10^{-2}	0.02	Extremely Small
	Annual	2	4.9×10^{-4}	0.02	Extremely Small
Pb	Annual	0.5	4.9×10^{-4}	0.10	Extremely Small
Mn	1 hour (maximum)	1500	1.4×10^{-2}	0.00	Extremely Small
	Annual	1	4.9×10^{-4}	0.05	Extremely Small
Ni	1 hour (maximum)	30	1.4×10^{-2}	0.05	Extremely Small
	Annual	1	4.9×10^{-4}	0.05	Extremely Small
V	1 hour (maximum)	1	1.4×10^{-2}	1.38	Very Small
	Annual	5	4.9×10^{-4}	0.01	Extremely Small

Note: PC – Predicted Contribution; EQS – Environmental Quality Standard

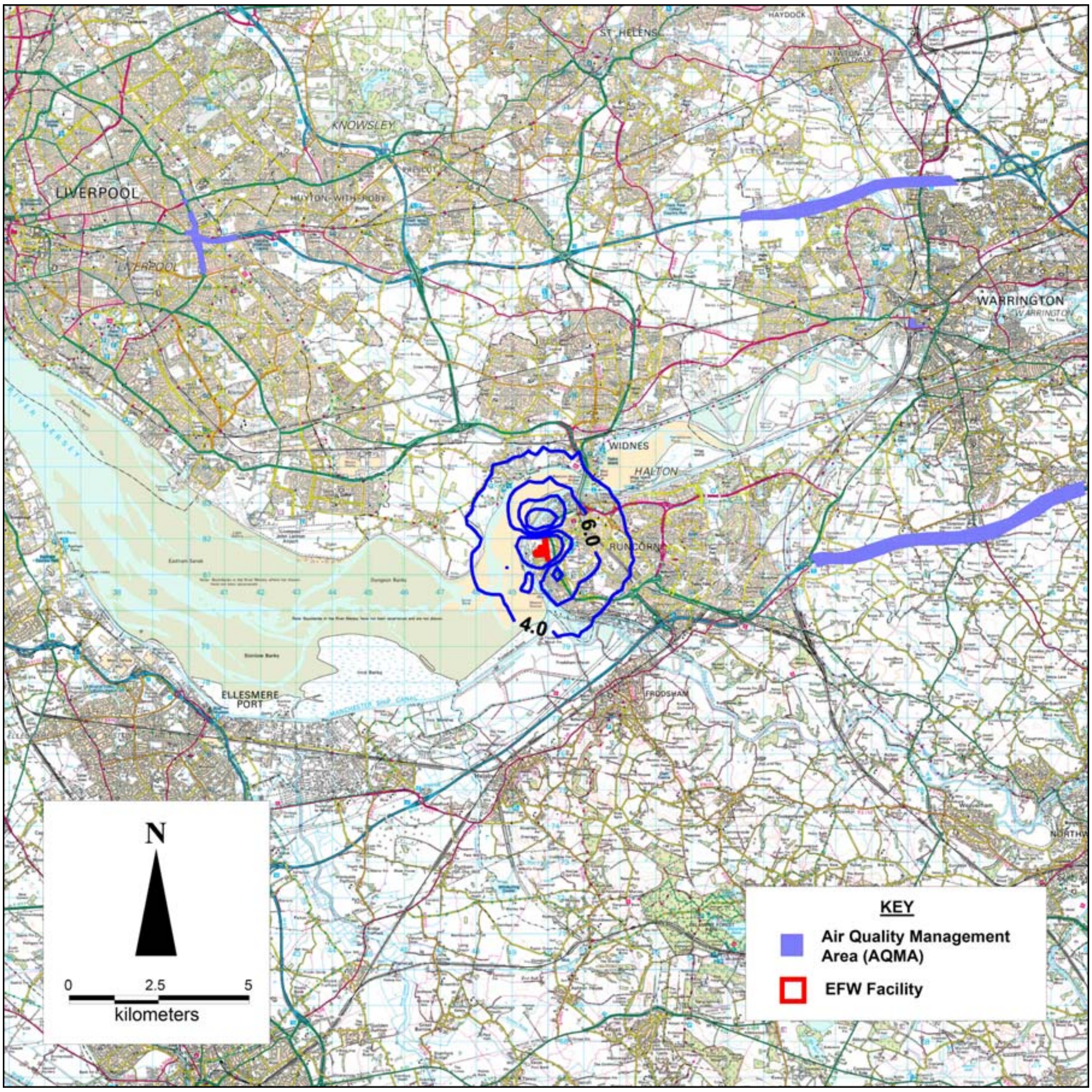
Table 7.7: Predicted Environmental Concentrations from EfW (Scenario 2) ($\mu g.m^{-3}$)

Pollutant	Averaging Period	EQS	AC	PEC Max	Max PEC as % of EQS	Significance Descriptor
PM_{10}	24 hour (90.41th percentile)	50	25.6	25.7	51.5	Neutral
	24 hour (98.08th percentile)	50	25.6	26.1	52.2	Neutral
	Annual	40	25.6	25.7	64.2	Neutral
HCl	1 hour (maximum)	800	1.1	3.8	0.5	Neutral
	Annual	20	0.55	0.6	3.2	Neutral
HF	1 hour (maximum)	250	4.92	5.2	2.1	Neutral
SO_2	15 minute (99.90th percentile)	266	40	50.4	18.9	Neutral
	1 hour (99.73th percentile)	350	40	48.5	13.9	Neutral
	24 hour (99.18th percentile)	125	40	43.5	34.8	Neutral
	Annual	50	20	20.5	41.0	Neutral
NO_2	1 hour (99.79th percentile)	200	52	65.3	32.6	Slight Adverse
	Annual	40	26	27.4	68.5	Neutral
CO	8 hour (maximum daily running)	10000	480	489.3	4.9	Neutral
Cd	1 hour (maximum)	1.5	6.0×10^{-4}	6.9×10^{-3}	0.5	Neutral
	Annual	0.005	3.0×10^{-4}	5.2×10^{-4}	10.5	Neutral
Tl	1 hour (maximum)	30	N/A	6.3×10^{-3}	0.0	Neutral
	Annual	1	N/A	2.2×10^{-4}	0.0	Neutral
Hg	1 hour (maximum)	7.5	4.0×10^{-3}	1.7×10^{-2}	0.2	Neutral
	Annual	0.25	2.0×10^{-3}	2.5×10^{-3}	1.0	Neutral
Sb	1 hour (maximum)	150	4.4×10^{-4}	1.4×10^{-2}	0.0	Neutral
	Annual	5	2.2×10^{-4}	7.1×10^{-4}	0.0	Neutral
As	1 hour (maximum)	15	1.4×10^{-3}	1.5×10^{-2}	0.1	Neutral
	Annual	0.2	7.0×10^{-4}	1.2×10^{-3}	0.6	Neutral
Cr	1 hour (maximum)	3	2.2×10^{-3}	1.6×10^{-2}	0.5	Neutral
	Annual	0.1	1.1×10^{-3}	1.6×10^{-3}	1.6	Neutral
Co	1 hour (maximum)	6	3.2×10^{-4}	1.4×10^{-2}	0.2	Neutral
	Annual	0.2	1.6×10^{-4}	6.5×10^{-4}	0.3	Neutral
Cu	1 hour (maximum)	60	1.8×10^{-2}	3.2×10^{-2}	0.1	Neutral
	Annual	2	9.2×10^{-3}	9.7×10^{-3}	0.5	Neutral
Pb	Annual	0.5	1.4×10^{-2}	1.4×10^{-2}	2.9	Neutral
Mn	1 hour (maximum)	1500	6.6×10^{-3}	2.0×10^{-2}	0.0	Neutral
	Annual	1	3.3×10^{-3}	3.8×10^{-3}	0.4	Neutral
Ni	1 hour (maximum)	30	4.6×10^{-3}	1.8×10^{-2}	0.1	Neutral
	Annual	1	2.3×10^{-3}	2.8×10^{-3}	0.3	Neutral
V	1 hour (maximum)	1	7.0×10^{-3}	2.1×10^{-2}	2.1	Neutral
	Annual	5	3.5×10^{-3}	4.0×10^{-3}	0.1	Neutral

Note: AC – Ambient Concentration; PEC – Predicted Environmental Concentration

EQS – Environmental Quality Standard

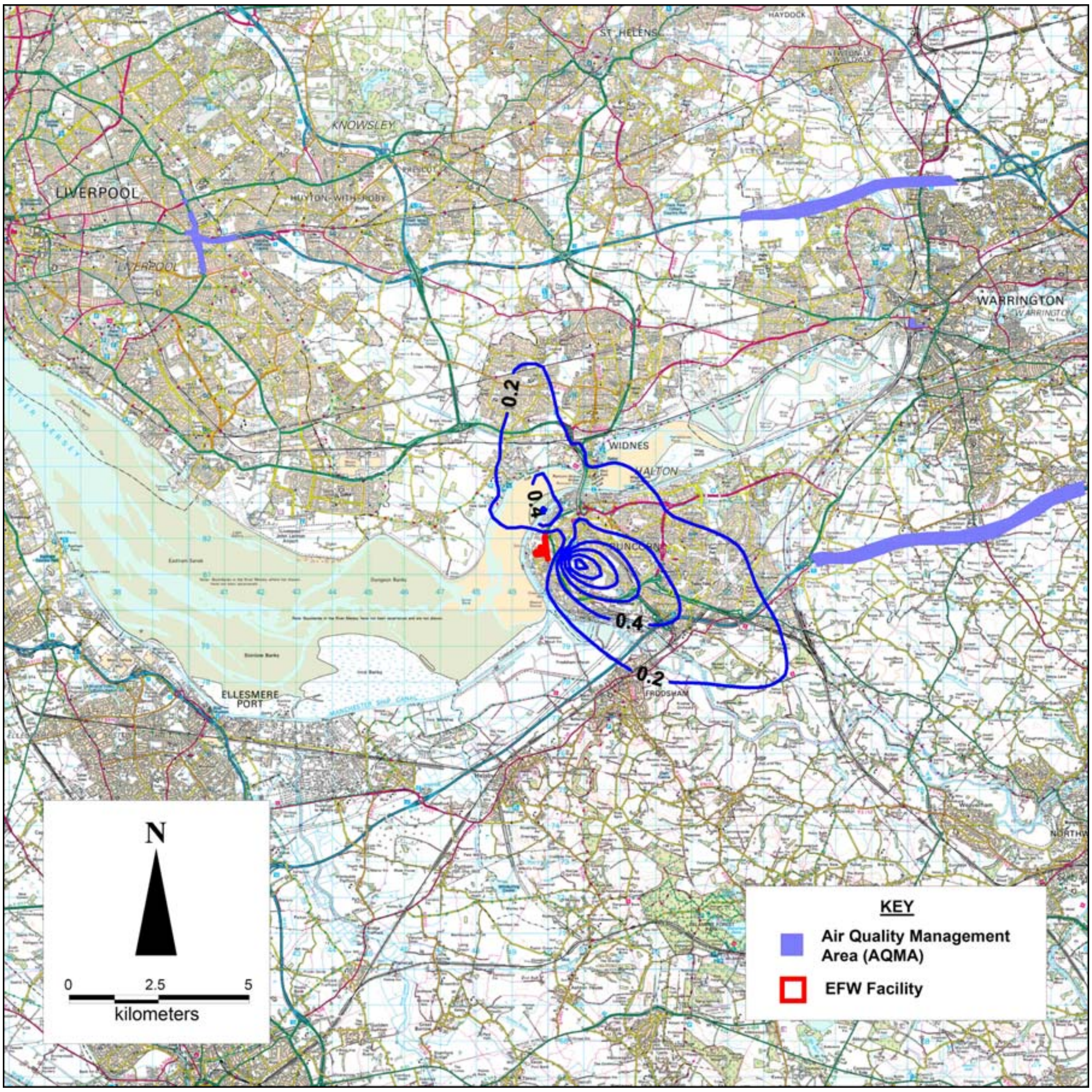
Figure 7.3: Contour Plot of Scenario 2 Predicted 99.79th Percentile Hourly NO_2 Contributions ($\mu g.m^{-3}$)



Assumptions:

- Concentrations in $\mu g.m^{-3}$
- Proposed EfW operating at WID long-term limits
- 35% NO_x to NO_2 conversion
- 2000 meteorological year (worst case)
- Derived from ADMS modelling (worst case)

Figure 7.4: Contour Plot of Scenario 2 Predicted Annual NO_2 Contributions ($\mu g.m^{-3}$)



Assumptions:

- Concentrations in $\mu g.m^{-3}$
- Proposed EfW operating at WID long-term limits
- 70% NO_x to NO_2 conversion
- 2004 meteorological year (worst case)
- Derived from ADMS modelling (worst case)

Assessment of Air Quality Effects at Humand Health Receptors

Metal Deposition

7.25 The results for the modelling of metal deposition at identified human health receptors for Scenarios 2 are presented in Table 7.8. Details of all receptor locations assumed are presented in Table 2.1 and all detailed results are presented in Annex B.

7.26 The maximum deposition rates for each scenario across all receptors (human health receptors and the whole modelling domain) are compared against the relevant deposition EALs in Table 7.12.

7.27 The results indicate that deposition rates are within all relevant EALs for deposition to land. The assessment is considered conservative as metal emissions from the plant are expected to be well below the relevant WID limits. The significance of predicted metal deposition rates are further addressed in the Human Health Risk Assessment submitted as part of the planning application.

Table 7.8: Predicted Metal Deposition Contributions (Scenario 2) (mg m^{-2}. d^{-1})

Receptor	**Cd + Tl (total)**	**Cd + Tl (per metal)**	**Hg**	**Sb, AS, Pb, Cr, Co, Cu, Mn, Ni, V (total)**	**Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V (per metal)**
Agricultural area near sewage works	4.3×10^{-4}	2.1×10^{-4}	1.7×10^{-4}	4.3×10^{-3}	4.7×10^{-4}
Agricultural area South of Linner Farm	4.5×10^{-4}	2.3×10^{-4}	1.7×10^{-4}	4.5×10^{-3}	5.0×10^{-4}
Agricultural area near Big Bear's Wood	7.8×10^{-4}	3.9×10^{-4}	2.3×10^{-4}	7.8×10^{-3}	8.7×10^{-4}
Pickerings Farm	6.1×10^{-4}	3.0×10^{-4}	2.1×10^{-4}	6.1×10^{-3}	6.7×10^{-4}
Hale Gate Farm	8.7×10^{-4}	4.4×10^{-4}	2.6×10^{-4}	8.7×10^{-3}	9.7×10^{-4}
6th Form College	1.6×10^{-3}	8.1×10^{-4}	3.3×10^{-4}	1.6×10^{-2}	1.8×10^{-3}
Westfield Primary School	2.3×10^{-3}	1.2×10^{-3}	3.4×10^{-4}	2.3×10^{-2}	2.6×10^{-3}
Halton Primary Care Trust	3.6×10^{-3}	1.8×10^{-3}	5.2×10^{-4}	3.6×10^{-2}	4.0×10^{-3}
St Clements Catholic Primary School	2.4×10^{-3}	1.2×10^{-3}	4.5×10^{-4}	2.4×10^{-2}	2.7×10^{-3}
Pewithal Primary School	4.3×10^{-3}	2.1×10^{-3}	6.6×10^{-4}	4.3×10^{-2}	4.8×10^{-3}
The Heath School	4.1×10^{-3}	2.0×10^{-3}	6.8×10^{-4}	4.1×10^{-2}	4.5×10^{-3}
Weston Point Community Primary School	2.8×10^{-3}	1.4×10^{-3}	4.1×10^{-4}	2.8×10^{-2}	3.2×10^{-3}
Weston Primary School	3.1×10^{-3}	1.6×10^{-3}	6.1×10^{-4}	3.1×10^{-2}	3.5×10^{-3}
Livestock grazing area adjacent to Lordship Marsh	1.6×10^{-4}	7.9×10^{-5}	4.6×10^{-5}	1.6×10^{-3}	1.7×10^{-4}
Agricultural area adjacent to Lordship Lane	1.3×10^{-4}	6.4×10^{-5}	3.2×10^{-5}	1.3×10^{-3}	1.4×10^{-4}
Hill View Farm	7.7×10^{-5}	3.9×10^{-5}	2.3×10^{-5}	7.7×10^{-4}	8.6×10^{-5}
Spring Farm	6.4×10^{-5}	3.2×10^{-5}	2.3×10^{-5}	6.4×10^{-4}	7.1×10^{-5}
Hatley Farm	1.8×10^{-4}	8.8×10^{-5}	6.4×10^{-5}	1.8×10^{-3}	2.0×10^{-4}
Pike Nook Farm	1.8×10^{-4}	9.0×10^{-5}	6.5×10^{-5}	1.8×10^{-3}	2.0×10^{-4}
Maximum across grid	8.1×10^{-3}	4.0×10^{-3}	1.1×10^{-3}	8.1×10^{-2}	9.0×10^{-3}

Table 7.9: Predicted Metal Deposition Contributions Relative to EAL (mg m^{-2}. d^{-1})

Pollutant	Maximum Deposition Rate EAL	Maximum Deposition Across All Receptors
Arsenic (As)	0.02	0.0090
Cadmium (Cd)	0.009	0.0040
Chromium (Cr)	1.5	0.0090
Copper (Cu)	0.25	0.0090
Lead (Pb)	1.1	0.0090
Mercury (Hg)	0.004	0.0011
Nickel (Ni)	0.11	0.0090

Dioxin and Furan Deposition

7.28 The results for the modelling of dioxin and furan deposition at identified human health receptors and the maximum deposition across the whole modelling domain for Scenario 2 are presented in Table 7.10. All detailed results are presented in Annex B.

7.29 The Human Health Risk Assessment submitted as part of the planning application concludes that the identified level of exposure to dioxins and furans is considered an acceptable risk to the identified sensitive receptors.

7.30 The following list presents the key to the individual congener results presented in Table 7.10.

A: 2,3,7,8-TCDD
B: OCDD
C: 1,2,3,7,8-PeCDD
D: 1,2,3,4,7,8-HxCDD
E: 1,2,3,7,8,9-HxCDD
F: 1,2,3,6,7,8-HxCDD
G: 1,2,3,4,6,7,8-HpCDD
H: 2,3,7,8-TCDF
I: 2,3,4,7,8-PeCDF
J: 1,2,3,7,8-PeCDF
K: 1,2,3,4,7,8-HxCDF
L: 1,2,3,7,8,9-HxCDF
M: 1,2,3,6,7,8-HxCDF
N: 2,3,4,6,7,8-HxCDF
O: 1,2,3,4,6,7,8-HpCDF
P: 1,2,3,4,7,8,9-HpCDF
Q: OCDF

Table 7.10: Predicted Maximum Dioxin / Furan Deposition Contributions (mg m^{-2} d^{-1})

Receptor	I-TEQ	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Agricultural area near sewage works	0.31	<0.01	0.11	0.08	0.09	0.07	0.08	0.53	0.08	0.17	0.09	0.68	0.01	0.25	0.27	1.37	0.13	1.12
Agricultural area South of Linner Farm	0.33	<0.01	0.13	0.08	0.10	0.07	0.09	0.56	0.09	0.18	0.09	0.72	0.01	0.27	0.29	1.45	0.14	1.18
Agricultural area near Big Bear's Wood	0.57	<0.01	0.13	0.14	0.17	0.12	0.15	0.97	0.15	0.31	0.16	1.26	0.02	0.46	0.50	2.51	0.25	2.06
Pickerings Farm	0.44	<0.01	0.17	0.11	0.13	0.09	0.11	0.75	0.12	0.24	0.12	0.97	0.02	0.36	0.38	1.94	0.19	1.59
Hale Gate Farm	0.64	<0.01	0.19	0.16	0.19	0.13	0.17	1.08	0.17	0.34	0.18	1.40	0.03	0.52	0.56	2.81	0.27	2.30
6th Form College	1.19	<0.01	0.28	0.30	0.34	0.25	0.31	2.02	0.32	0.64	0.33	2.61	0.05	0.96	1.03	5.22	0.51	4.27
Westfield Primary School	1.68	<0.01	0.17	0.42	0.49	0.35	0.44	2.85	0.45	0.91	0.47	3.69	0.07	1.36	1.46	7.38	0.72	6.04
Halton Primary Care Trust	2.63	<0.01	0.27	0.66	0.76	0.55	0.68	4.47	0.71	1.42	0.74	5.78	0.11	2.13	2.29	11.57	1.13	9.47
St Clements Catholic Primary School	1.76	<0.01	0.24	0.44	0.51	0.37	0.46	3.00	0.48	0.95	0.49	3.88	0.07	1.43	1.53	7.76	0.76	6.35
Pewithal Primary School	3.12	<0.01	0.63	0.78	0.90	0.66	0.81	5.30	0.84	1.68	0.87	6.86	0.13	2.53	2.71	13.73	1.34	11.23
The Heath School	2.96	<0.01	0.64	0.74	0.86	0.62	0.77	5.03	0.80	1.60	0.83	6.51	0.12	2.40	2.58	13.02	1.27	10.66
Weston Point Community Primary School	2.07	<0.01	0.27	0.52	0.60	0.43	0.54	3.52	0.56	1.12	0.58	4.55	0.09	1.68	1.80	9.10	0.89	7.45
Weston Primary School	2.29	<0.01	0.55	0.57	0.66	0.48	0.59	3.88	0.62	1.23	0.64	5.03	0.10	1.85	1.99	10.05	0.98	8.23
Livestock grazing area adjacent to Lordship Marsh	0.11	<0.01	0.04	0.03	0.03	0.02	0.03	0.20	0.03	0.06	0.03	0.25	0.00	0.09	0.10	0.50	0.05	0.41
Agricultural area adjacent to Lordship Lane	0.09	<0.01	0.03	0.02	0.03	0.02	0.02	0.16	0.03	0.05	0.03	0.21	0.00	0.08	0.08	0.41	0.04	0.34
Hill View Farm	0.06	<0.01	0.02	0.01	0.02	0.01	0.01	0.10	0.02	0.03	0.02	0.12	0.00	0.05	0.05	0.25	0.02	0.20
Spring Farm	0.05	<0.01	0.02	0.01	0.01	0.01	0.01	0.08	0.01	0.03	0.01	0.10	0.00	0.04	0.04	0.21	0.02	0.17
Hatley Farm	0.13	<0.01	0.06	0.03	0.04	0.03	0.03	0.22	0.03	0.07	0.04	0.28	0.01	0.10	0.11	0.56	0.06	0.46
Pike Nook Farm	0.13	<0.01	0.07	0.03	0.04	0.03	0.03	0.22	0.04	0.07	0.04	0.29	0.01	0.11	0.11	0.58	0.06	0.47
Maximum across grid	5.9	<0.01	0.6	1.5	1.7	1.2	1.5	10.0	1.6	3.2	1.7	13.0	0.2	4.8	5.1	25.9	2.5	21.2

Assessment of Air Quality Effects on Vegetation and Ecosystems

Overview

7.31 Dispersion modelling has been undertaken using ADMS and AERMOD to determine contributions of NO_x and SO_2 to all Ramsar sites, Special Protection Areas (SPAs) and Sites of Special Scientific Interest (SSSIs) within 15km of the site. The assessment considers operational Scenario 2 only (long-term emissions at WID emission limit). This is considered conservative, as expected emissions are likely to be much lower. The significance of these predicted air pollutant contributions at the identified ecological receptors is addressed in Chapter 6 of the Environmental Statement.

Critical Levels

7.32 Maximum results from the two dispersion models are reported in Table 7.11 and Table 7.12 for NO_x and SO_2 respectively. Due to the extensive area of some designations identified, a series of discrete receptors were included to account for the geographic variation of predicted concentrations. Details of all receptor locations assumed and all detailed results at all locations assumed are presented in Annex C.

7.33 The results presented in Table 7.11 indicate that the highest NO_x contribution of 1.17 $\mu g.m^{-3}$ from the proposed EfW facility at identified ecological receptors occurs at the Mersey Estuary. However, this maximum contribution is predicted to occur over mud and sand that is regularly inundated by the open water of the estuary and hence the annual mean limit value of 30 $\mu g.m^{-3}$ for the protection of vegetation is not valid. Average NOx contributions across the Mersey Estuary, including the fringes where vegetation is present, are significantly less (less than 0.5% of the critical level). Contributions of NOx to all other designated sites are less than 1% of the critical level threshold (and hence considered insignificant) with the exception of Flood Brook Clough SSSI where contributions are predicted to be 2.1% of the annual mean limit value of 30 $\mu g.m^{-3}$ for the protection of vegetation. Ambient concentrations of NO_x at this site already exceed the critical level threshold, as the site is significantly affected by local traffic emissions.

Table 7.11: Critical Level Contributions at Ecological Receptors (NO_x) ($\mu g.m^{-3}$)

Receptor	AC	PC max	PEC	EQS	Maximum PC as % of EQS	Maximum PEC as % of EQS
Ramsar Sites						
Midland Meres & Mosses - Phase 1	26.3	0.15	26.45	30	0.5	88.2
Midland Meres & Mosses Phase 2	24.8	0.13	24.93		0.4	83.1
Mersey Estuary (minimum)	28.7	0.04	28.74		0.1	95.8
Mersey Estuary (average)		0.12	28.82		0.4	96.1
Mersey Estuary (maximum)		1.17	29.87		3.9	99.6
Special Protection Areas						
Mersey Estuary	As Above (Ramsar)					
Special Areas of Conservation						
Oak Mere	24	0.11	24.11	30	0.4	80.4
Sites of Special Scientific Interest						
Mersey Estuary	As Above (Ramsar)					
Flood Brook Clough	37.6	0.64	38.24	30	2.1	127.5
Dunsdale Hollow	34.3	0.18	34.48		0.6	114.9
Beechmill Wood & Pasture	34.3	0.22	34.52		0.7	115.1
Warburton's Wood & Well Wood	30.3	0.20	30.50		0.7	101.7
Hatton's Hey Wood, Whittle's Corner & Bank Rough	30.3	0.24	30.54		0.8	101.8
Hatch Mere	26.2	0.15	26.35		0.5	87.8
Flaxmere Moss	26.2	0.15	26.35		0.5	87.8
Black Lake, Delamere	26.3	0.13	26.43		0.4	88.1
Linmer Moss	26.3	0.13	26.43		0.4	88.1
Oak Mere	24	0.11	24.11		0.4	80.4

Note: AC – Ambient Concentration; PC – Predicted Contribution;
PEC – Predicted Environmental Concentration; EQS – Environmental Quality Standard

7.34 The results presented in Table 7.12 indicate that the highest SO_2 contribution of 0.29 $\mu g.m^{-3}$ from the proposed EfW facility at identified ecological receptors occurs at the Mersey Estuary. This is regularly inundated by the open water of the estuary and hence the annual mean limit value of 20 $\mu g.m^{-3}$ for the protection of ecosystems is not valid. Average SO_2 contributions across the Mersey Estuary, including the fringes where vegetation is present, are significantly less (less than 0.2% of the critical level). Contributions of SO_2 to all other designated sites are less than 1% of the critical level threshold and hence considered insignificant. Annual mean concentrations of SO_2 (PECs) are predicted to remain well below the limit value of 20 $\mu g.m^{-3}$ for the protection of ecosystems at all designated sites.

Table 7.12: Critical Level Contributions at Ecological Receptors (SO_2) ($\mu g.m^{-3}$)

Receptor	AC	PC max	PEC	EQS	Maximum PC as % of EQS	Maximum PEC as % of EQS
Ramsar						
Midland Meres & Mosses - Phase 1	3.2	0.04	3.24	20	0.2	16.2
Midland Meres & Mosses Phase 2	3.8	0.03	3.83		0.2	19.2
Mersey Estuary (minimum)	4.7	0.01	4.71		0.1	23.6
Mersey Estuary (average)		0.03	4.73		0.2	23.7
Mersey Estuary (maximum)		0.29	4.99		1.5	25.0
Special Protection Areas						
Mersey Estuary	As Above (Ramsar)					
Special Areas of Conservation						
Oak Mere	3.1	0.03	3.13	20	0.1	15.6
Sites of Special Scientific Interest						
Mersey Estuary	As Above (Ramsar)					
Flood Brook Clough	7.7	0.16	7.86	20	0.8	39.3
Dunsdale Hollow	4.2	0.04	4.24		0.2	21.2
Beechmill Wood & Pasture	4.2	0.05	4.25		0.3	21.3
Warburton's Wood & Well Wood	3.3	0.05	3.35		0.3	16.8
Hatton's Hey Wood, Whittle's Corner & Bank Rough	3.3	0.06	3.36		0.3	16.8
Hatch Mere	3.2	0.04	3.24		0.2	16.2
Flaxmere Moss	3.2	0.04	3.24		0.2	16.2
Black Lake, Delamere	2.9	0.03	2.93		0.2	14.7
Linmer Moss	2.9	0.03	2.93		0.2	14.7
Oak Mere	3.1	0.03	3.13		0.1	15.6

Note: AC – Ambient Concentration; PC – Predicted Contribution;
PEC – Predicted Environmental Concentration; EQS – Environmental Quality Standard

Critical Loads - Acidification

7.35 Maximum predicted contributions from the two dispersion models are reported in Table 7.13. The results are compared with the Critical Load for the habitat types for which Critical Loads are available from the UK Air Pollution Information System (APIS) website (www.apis.ac.uk/). Background deposition rates have been derived from the same source and total acid deposition at each designated site is presented in Table 7.14 and compared against the relevant critical loads.

7.36 Due to the extensive area of some designations identified, a series of discrete receptors were included to account for the geographic variation of predicted concentrations. Details of all receptor locations assumed and all detailed results at all locations assumed are presented in Annex B.

7.37 The results presented in Table 7.13 indicate that the highest acid deposition contribution from the proposed EfW facility to identified ecological receptors occurs within the Mersey Estuary designated area. There are no critical loads for acid deposition available for the Mersey Estuary due to the buffering capacity of the estuary waters. The results of acid deposition modelling presented in Table 7.13 indicate that predicted contributions from the proposed EfW facility are greater than 10% of the critical load at three designated sites. This is due to the low critical loads (0.1 keq ha^{-1} $year^{-1}$) assigned to a large number of the designated sites in the study area.

7.38 The results presented in Table 7.14 indicate that total acid deposition exceeds the relevant critical load at all designated sites within the study area. In all cases, this is due to the elevated background deposition rates. At all sites (with the exception of one), predicted acid deposition contributions from the proposed EfW at this site represent less than 1% of the current background deposition rates. As such, contributions from the EfW facility can be considered negligible when compared against current deposition rates.

Table 7.13: Maximum Predicted Acid Deposition Contribution at Ecological Receptors (keq ha^{-1} $year^{-1}$)

Receptor	Maximum Predicted N Acid Deposition Contribution (dry)	Maximum Predicted S Acid Deposition Contribution (dry)	Maximum Predicted Cl Acid Deposition Contribution (wet and dry)	Maximum Predicted Total Acid Deposition Contribution	Critical Load (EQS)	Maximum Acid Deposition Contribution as % of Critical Load Range
Ramsar Sites						
Midland Meres & Mosses - Phase 1	0.002	0.005	0.005	0.011	0.10	11.1
Midland Meres & Mosses Phase 2	0.001	0.004	0.004	0.009	0.10	9.4
Mersey Estuary (minimum)	0.000	0.001	0.001	0.003	N/A	N/A
Mersey Estuary (average)	0.001	0.004	0.004	0.009	N/A	N/A
Mersey Estuary (maximum)	0.012	0.035	0.038	0.085	N/A	N/A
Special Protection Areas						
Mersey Estuary	As above (Ramsar Site)					
Special Areas of Conservation						
Oak Mere	0.001	0.003	0.004	0.008	0.10	8.2
Sites of Special Scientific Interest						
Beechmill Wood & Pasture	0.002	0.006	0.007	0.016	1.27	1.2
Black Lake, Delamere	0.001	0.004	0.004	0.010	0.35	2.7
Dunsdale Hollow	0.002	0.005	0.006	0.013	0.86	1.5
Flaxmere Moss	0.002	0.005	0.005	0.011	0.10	11.1
Flood Brook Clough	0.007	0.019	0.021	0.047	0.87	5.3
Hatch Mere	0.002	0.004	0.005	0.011	0.10	10.6

Receptor	Maximum Predicted N Acid Deposition Contribution (dry)	Maximum Predicted S Acid Deposition Contribution (dry)	Maximum Predicted Cl Acid Deposition Contribution (wet and dry)	Maximum Predicted Total Acid Deposition Contribution	Critical Load (EQS)	Maximum Acid Deposition Contribution as % of Critical Load Range
Hatton's Hey Wood, Whittle's Corner & Bank Rough	0.002	0.007	0.008	0.017	1.31	1.3
Linmer Moss	0.001	0.004	0.004	0.009	0.10	9.4
Oak Mere	0.001	0.003	0.004	0.008	0.10	8.2
Warburton's Wood & Well Wood	0.002	0.006	0.007	0.015	1.32	1.1
Mersey Estuary	As above (Ramsar Site)					

Table 7.14: Maximum Total Predicted Acid Deposition at Ecological Receptors (keq ha^{-1} $year^{-1}$)

Receptor	Background Acid Deposition	Maximum Predicted Acid Deposition Contribution	Maximum Predicted Total Acid Deposition	Critical Load (EQS)	Critical Load Exceeded?	Maximum Predicted Total Acid Deposition Contribution as % of Background
Ramsar Sites						
Midland Meres & Mosses - Phase 1	1.82	0.011	1.83	0.1	Yes	0.6
Midland Meres & Mosses Phase 2	2.05	0.009	2.06	0.1	Yes	0.5
Mersey Estuary (minimum)	N/A	0.003	N/A	N/A	N/A	N/A
Mersey Estuary (average)	N/A	0.009	N/A	N/A	N/A	N/A
Mersey Estuary (maximum)	N/A	0.085	N/A	N/A	N/A	N/A
Special Protection Areas						
Mersey Estuary	As above (see Ramsar site)					
Special Areas of Conservation						
Oak Mere	1.78	0.008	1.79	0.10	Yes	0.5
Sites of Special Scientific Interest						
Beechmill Wood & Pasture	2.95	0.016	2.97	1.27	Yes	0.5
Black Lake, Delamere	1.77	0.010	1.78	0.35	Yes	0.5
Dunsdale Hollow	2.95	0.013	2.96	0.86	Yes	0.4
Flaxmere Moss	1.82	0.011	1.83	0.10	Yes	0.6
Flood Brook Clough	2.95	0.047	3.00	0.87	Yes	1.6
Hatch Mere	1.82	0.011	1.83	0.10	Yes	0.6

Receptor	Background Acid Deposition	Maximum Predicted Acid Deposition Contribution	Maximum Predicted Total Acid Deposition	Critical Load (EQS)	Critical Load Exceeded?	Maximum Predicted Total Acid Deposition Contribution as % of Background
Hatton's Hey Wood, Whittle's Corner & Bank Rough	3.26	0.017	3.28	1.31	Yes	0.5
Linmer Moss	1.77	0.009	1.78	0.10	Yes	0.5
Oak Mere	1.78	0.008	1.79	0.10	Yes	0.5
Warburton's Wood & Well Wood	3.26	0.015	3.27	1.32	Yes	0.4
Mersey Estuary	As above (see Ramsar site)					

Critical Loads - Eutrophication

7.39 Maximum predicted contributions from the two dispersion models are reported in Table 7.15. The results are compared with the lowest Critical Load for the habitat types for which Critical Loads are available from the UK Air Pollution Information System (APIS) website (www.apis.ac.uk/). Comparison with the lowest critical load is considered conservative. Background deposition rates have been derived from the same source and total nutrient nitrogen deposition at each designated site is presented in Table 7.16 and compared against the relevant critical loads.

7.40 Due to the extensive area of some designations identified, a series of discrete receptors were included to account for the geographic variation of predicted concentrations. Details of all receptor locations assumed and all detailed results at all locations assumed are presented in Annex B.

7.41 The results presented in Table 7.15 indicate that the highest nutrient nitrogen deposition contribution from the proposed EfW facility to identified ecological receptors occurs within the Mersey Estuary designated area. However, there are no critical loads for nutrient nitrogen deposition available for the Mersey Estuary due to the buffering capacity of the estuary waters and the high inherent fertility. The results of nutrient nitrogen deposition modelling presented in Table 7.15 indicate that predicted contributions from the proposed EfW facility are less than 0.5% of the critical load for all designated sites with the exception of one which is less than 1% of the critical load (Flood Brook Clough). These contributions are therefore considered negligible.

7.42 The results presented in Table 7.16 indicate that total nutrient nitrogen deposition exceeds the relevant critical load at all designated sites within the study area. In all cases, this is due to the elevated background deposition rates. At all sites, predicted nutrient nitrogen deposition contributions from the proposed EfW at this site represent less than 0.1% of the current background deposition rates, with the exception of Flood Brook Clough which represents 0.3% of the current background deposition rate. As such, contributions from the EfW facility can be considered negligible when compared against current deposition rates.

Table 7.15: Predicted N Deposition Contribution at Ecological Receptors (kg N ha^{-1} yr^{-1})

Receptor	Maximum Predicted N Deposition Contribution	Lowest Critical Load (EQS)	Maximum N Deposition Contribution as % of Lowest Critical Load
Ramsar Sites			
Midland Meres & Mosses - Phase 1	0.022	5.0	0.4
Midland Meres & Mosses Phase 2	0.019	5.0	0.4
Mersey Estuary (minimum)	0.006	N/A	N/A
Mersey Estuary (average)	0.018	N/A	N/A
Mersey Estuary (maximum)	0.169	N/A	N/A
Special Protection Areas			
Mersey Estuary	See above (Ramsar site)		
Special Areas of Conservation			
Oak Mere	0.016	5.00	0.3
Sites of Special Scientific Interest			
Beechmill Wood & Pasture	0.031	10.00	0.3
Black Lake, Delamere	0.019	5.00	0.4
Dunsdale Hollow	0.026	10.00	0.3
Flaxmere Moss	0.022	5.00	0.4
Flood Brook Clough	0.093	10.00	0.9
Hatch Mere	0.021	5.00	0.4
Hatton's Hey Wood, Whittle's Corner & Bank Rough	0.034	10.00	0.3
Linmer Moss	0.019	10.00	0.2
Oak Mere	0.016	5.00	0.3
Warburton's Wood & Well Wood	0.029	10.00	0.3
Mersey Estuary	See above (Ramsar site)		

Table 7.16: Predicted Total N Deposition at Ecological Receptors (kg N ha^{-1} yr^{-1})

Receptor	Background N Deposition	Maximum Predicted N Deposition Contribution	Maximum Predicted Total N Deposition	Critical Load (EQS)	Critical Load Exceeded?	Maximum Predicted Total N Deposition Contribution as % of Background
Ramsar Sites						
Midland Meres & Mosses - Phase 1	20.4	0.022	20.42	5.0	Yes	0.1
Midland Meres & Mosses Phase 2	20.4	0.019	20.42	5.0	Yes	0.1
Mersey Estuary (minimum)	N/A	0.006	N/A	N/A	N/A	N/A
Mersey Estuary (average)	N/A	0.018	N/A	N/A	N/A	N/A
Mersey Estuary (maximum)	N/A	0.169	N/A	N/A	N/A	N/A
Special Protection Areas						
Mersey Estuary	See above (Ramsar site)					
Special Areas of Conservation						
Oak Mere	20	0.016	20.02	5.00	Yes	0.1
Sites of Special Scientific Interest						
Beechmill Wood & Pasture	35.40	0.031	35.43	10.00	Yes	0.1
Black Lake, Delamere	20.20	0.019	20.22	5.00	Yes	0.1
Dunsdale Hollow	35.40	0.026	35.43	10.00	Yes	0.1
Flaxmere Moss	20.40	0.022	20.42	5.00	Yes	0.1
Flood Brook Clough	35.40	0.093	35.49	10.00	Yes	0.3
Hatch Mere	26.20	0.021	26.22	5.00	Yes	0.1

Hatton's Hey Wood, Whittle's Corner & Bank Rough	40.50	0.034	40.53	10.00	Yes	0.1
Linmer Moss	20.20	0.019	20.22	10.00	Yes	0.1
Oak Mere	34.60	0.016	34.62	5.00	Yes	0.0
Warburton's Wood & Well Wood	40.50	0.029	40.53	10.00	Yes	0.1
Mersey Estuary	See above (Ramsar site)					

Dispersion Model Sensitivity Analysis

7.43 Further dispersion modelling was undertaken to investigate the sensitivity of both dispersion models used in this assessment (ADMS and AERMOD) to changes in model input parameters (terrain data and meteorology) and hence variability of results. As mentioned previously, Liverpool meteorological data was used within this assessment as it is considered the most appropriate for representing meteorology within the area of Runcorn. Although five years worth of meteorological data should comprise most possible meteorological phenomena, further modelling of NO_2 concentrations was undertaken using five years' worth of hourly sequential meteorological data from Manchester Ringway for 1999 to 2003. Results to sensitivity analyses are presented in Table 7.17.

Table 7.17: Results of Sensitivity Analyses (μg.m^{-3})

Sensitivity Run Scenario		Liverpool Met, With Terrain	Liverpool Met, No Terrain	Ringway Met, With Terrain
NO_2	1 hour (99.79th percentile)	13.3	12.7	12.7
	Annual	1.4	1.2	1.4

7.44 Results in Table 7.17 indicate that modelled NO_2 concentrations are lower if modelling is undertaken without incorporating terrain height information. Modelled hourly results using Manchester Ringway meteorological data are also lower than the modelled NO_2 concentrations using Liverpool meteorological data.

7.45 The results presented in Table 7.17 indicate that the assumptions assumed within the assessment provide the more conservative predictions and confirm the robustness of the dispersion modelling results comprising this assessment.

Emissions from Operational Vehicles

Overview

7.46 Table 7.18 to Table 7.20 summarises the NO_2 and PM_{10} concentrations predicted by DMRB for 2011, the opening year.

Table 7.18: Predicted Annual Mean NO_2 Concentrations (μg.m^{-3}) and % change

Road Link	Distance to Centre of Road Link (m)	2011 Without EfW	2011 With EfW	2011 With Committed Development	PC	PC as % of EQS	Magnitude of PC	Significance Descriptor
New Access Road	5	-	23.0	23.1		-	-	Neutral
	10	-	22.9	23.0		-	-	Neutral
	20	-	22.8	22.8		-	-	Neutral
Picow Farm Rd	5	23.7	24.2	24.4	0.5	1.25	Very Small	Neutral
	10	23.6	24.1	24.2	0.5	1.25	Very Small	Neutral
	20	23.3	23.6	23.8	0.3	0.75	Extremely Small	Neutral
Expressway South (A557)	5	35.5	35.7	35.6	0.2	0.5	Extremely Small	Neutral
	10	34.5	34.6	34.6	0.1	0.25	Extremely Small	Neutral
	20	32.0	32.1	32.1	0.1	0.25	Extremely Small	Neutral
Expressway North (A557)	5	35.6	35.8	35.8	0.2	0.5	Extremely Small	Neutral
	10	34.6	34.8	34.7	0.2	0.5	Extremely Small	Neutral
	20	32.1	32.2	32.2	0.1	0.25	Extremely Small	Neutral

Note: PC – Predicted Contribution; EQS – Environmental Quality Standard

Table 7.19: Predicted Annual Mean PM_{10} Concentrations ($\mu g.m^{-3}$) and % change

Road Link	Distance to Centre of Road Link (m)	2011 Without EfW	2011 With EfW	2011 With Committed Development	PC	PC as % of EQS	Magnitude of PC	Significance Descriptor
New Access Road	5	-	23.7	23.7		-	-	Neutral
	10	-	23.7	23.7		-	-	Neutral
	20	-	23.7	23.7		-	-	Neutral
Picow Farm Rd	5	24.0	24.1	24.1	0.1	0.25	Extremely Small	Neutral
	10	23.9	24.0	24.1	0.1	0.25	Extremely Small	Neutral
	20	23.9	23.9	23.9	0	0	Extremely Small	Neutral
Expressway South (A557)	5	27.5	27.6	27.6	0.1	0.25	Extremely Small	Neutral
	10	27.1	27.2	27.2	0.1	0.25	Extremely Small	Neutral
	20	26.3	26.3	26.3	0	0	Extremely Small	Neutral
Expressway North (A557)	5	27.6	27.6	27.6	0	0	Extremely Small	Neutral
	10	27.2	27.2	27.2	0	0	Extremely Small	Neutral
	20	26.3	26.4	26.4	0.1	0.25	Extremely Small	Neutral

Note: PC – Predicted Contribution; EQS – Environmental Quality Standard

Table 7.20: Predicted Number of Daily Mean PM_{10} Concentrations above 50 $\mu g.m^{-3}$

Road Link	Distance to Centre of Road Link (m)	2011 Without EfW	2011 With EfW	2011 With Committed Development	PC	PC as % of EQS	Magnitude of PC	Significance Descriptor
New Access Road	5	-	9.6	9.6		-	-	Neutral
	10	-	9.5	9.6		-	-	Neutral
	20	-	9.5	9.5		-	-	Neutral
Picow Farm Rd	5	10.1	10.3	10.4	0.2	0.6	Extremely Small	Neutral
	10	10.0	10.2	10.3	0.2	0.6	Extremely Small	Neutral
	20	9.8	10.0	10.0	0.2	0.6	Extremely Small	Neutral
Expressway South (A557)	5	19.2	19.4	19.4	0.2	0.6	Extremely Small	Neutral
	10	18.1	18.2	18.2	0.1	0.3	Extremely Small	Neutral
	20	15.7	15.8	15.8	0.1	0.3	Extremely Small	Neutral
Expressway North (A557)	5	19.4	19.5	19.5	0.1	0.3	Extremely Small	Neutral
	10	18.2	18.4	18.4	0.2	0.6	Extremely Small	Neutral
	20	15.8	15.9	15.9	0.1	0.3	Extremely Small	Neutral

Note: PC – Predicted Contribution; EQS – Environmental Quality Standard

Annual Mean NO_2 Predicted Concentrations

7.47 Table 7.18 indicates annual mean NO_2 concentrations at all receptors are well below the relevant objective/limit value of 40µg.m^{-3} with or without the project. The magnitude of increases resulting from the project as a percentage of the EQS is described as either Very Small or Extremely Small. As annual mean NO_2 concentrations are below the relevant objective/limit value of 40 ug.m^{-3}, the effect significance can be described as neutral.

Hourly Mean NO_2 Predicted Concentrations

7.48 Research has shown that the hourly NO_2 objective of 200µg.m^{-3} is unlikely to be exceeded at a roadside location where the annual mean NO_2 concentration is less than 60µg.m^{-3}. Using this guideline, predicted concentrations for all scenarios, regardless of distance bands, are expected to meet the hourly objective/limit value an, therefore, short term effects are not likely to be significant in relation to operational traffic effects.

Annual Mean PM_{10} Predicted Concentrations

7.49 Table 7.19 indicates annual mean PM_{10} concentrations at all receptors are well below the relevant objective/limit value of 40µg.m^{-3} with or without the project. The magnitude of increases resulting from the project as a percentage of the EQS is described as Extremely Small. As annual mean PM_{10} concentrations are below the relevant objective/limit value of 40 ug.m^{-3}, the effect significance can be described as neutral.

Daily Mean PM_{10} Predicted Concentrations

7.50 Results presented in Table 7.20 indicate that predicted number of days with PM_{10} concentrations greater than 50□g.m^{-3} at all receptors are below the relevant objective value of 35 exceedences with or without the proejct. The magnitude of increases resulting from the project as a percentage of the EQS is described as either Extremely Small. As daily mean PM_{10} concentrations are below the relevant objective/limit the effect significance can be described as neutral.

Summary and Conclusions

7.51 The long-term and short-term air quality objective / limit values for NO_2 and PM_{10} are likely to be met for both future scenarios considered either with or without the operational traffic. The effect on air quality due to the additional emissions from operational traffic is considered as being neutral.

Assessment of Plume Visibility

7.52 Results derived from modelling plume visibility from the EfW facility stack and cooling towers are presented in Table 7.21 and Table 7.22 respectively.

Table 7.21: Plume Visibility Modelling Results – EfW Facility Stack

Parameter	2000	2001	2002	2003	2004	max	unit
Percent of the year that a visible plume is predicted	4.8	7.9	2.8	5.3	2.7	7.9	%
Number of visible plumes	394.0	669.0	242.0	457.0	227.0	669	-
Maximum plume length	205.1	175.5	259.8	183.1	190.2	259.8	m
Average plume length	50.0	44.5	59.4	51.8	41.0	59.4	m
Minimum plume length	1.1	0.2	0.2	1.6	0.2	1.6	m
Time when length of plume exceeds stack to average site boundary distance	12	11	21	16	3	21	hr/yr
Environment Agency H1 classification						low	

Note: Average distance from the stack to the site boundary = 105m (taking the mean of 10 boundary points)

Table 7.22: Plume Visibility Modelling Results – Cooling Towers

Parameter	2000	2001	2002	2003	2004	max	unit
Percent of the year that a visible plume is predicted	24.8	29.6	15.1	17.2	15.7	29.6	%
Number of visible plumes	2044	2518	1308	1474	1344	2518	-
Maximum plume length	266.6	276.9	327.1	267.3	217.9	327.1	m
Average plume length	41.3	44.0	48.4	47.4	35.0	48.4	m
Minimum plume length	0.2	0.3	0.1	0.1	0.2	0.3	m
Time when length of plume exceeds stack to average site boundary distance	52	120	117	79	21	120	hr/yr
Environment Agency H1 classification						low	

Note: Average distance from the stack to the site boundary = 105m (taking the mean of 10 boundary points)

7.53 Based on modelled results using five years' worth of hourly sequential meteorological data, the values presented in Table 7.21 indicate that a visible plume from the EfW facility stack could be expected for a maximum of 7.9% of hours in a year. The maximum number of visible plumes is likely to be in the region of 669, with an average plume length of 59m and a maximum plume length of around 260m.

7.54 Results for the worst case modelled year (2002) predict that a visible plume that extends further from the stack than the average stack-to-site boundary distance could be expected for only 21 hours in the year (equivalent to 0.2% of the time).

7.55 Values presented Table 7.22 indicate that a visible plume from the Cooling Towers could be expected for a maximum of 29.6% of hours in a year. The maximum number of visible plumes is likely to be in the region of 2518, with an average plume length of 48m and a maximum plume length of around 327m.

7.56 Results for the worst case modelled year (2001) predict that a visible plume that extends further from the stack than the average stack-to-site boundary distance could be expected for only 120 hours in the year (equivalent to 1.4% of the time).

7.57 Visible plumes can occur at any time, but predominantly occur during night-time hours when the ambient temperature is cooler. Model results indicated that a plume would not be visible at release or at grounding for any modelled hour from either the EfW Stack or Cooling Towers.

7.58 Based on the above results, the significance of the effect of plume visibility is 'low' with reference to the EA's criteria. Classification of the effect as low significance reflects the fact that results predict:

- regular small effect from operation of the process; and
- plume length that exceeds the site boundary for <5% of daylight hours per year.

Assessment of Odour

7.59 Defra published a "Review of Environmental and Health Effects of Waste Management" in 2004. This publication included a literature review, which revealed that odour is potentially significant from the waste storage and processing phases of incineration, but that odours are normally controlled via the combustion air.

7.60 The proposed EfW facility will receive either RDF or SRF as fuel. The preparation of the fuel includes a biological treatment process in which the volatile organic content of the raw material is substantially neutralised by bacteriological action, resulting in a relatively dry and stable fuel. The odour potential of this material is considered minimal.

7.61 All RDF and SRF will be delivered to the site in sealed containers or covered bulk transporters. The waste reception hall will be fully enclosed and the roller shutter doors will be kept in a closed position, save for when a vehicle is entering or leaving the unloading hall. The air within the unloading hall will form the primary air feed supply to the furnace and will be under a slight negative pressure, ensuring combustion (and thus minimising the potential for emissions) of odorous gases and dust.

7.62 All RDF and SRF will enter the plant by sealed conveyors. All chemicals stored on-site will be in enclosed tanks or areas. All flue gases are scrubbed to remove pollutants prior to discharge from the 105m high stack. The stack is of sufficient height to ensure that no odours will be detectable at ground level.

7.63 Due to the nature of the fuel, there are no areas on site, which have the potential to emit significant odours.

Cumulative Effects

7.64 Cumulative traffic effects on local air quality with the future redevelopment of the Weston Docks have been addressed. Results presented in Table 7.18 to Table 7.20 indicates that the effect on air quality due to the cumulative emissions from both developments is not considered significant.

Combined Effects

7.65 Combined effects with adjacent industrial sources have been accounted for within the assessment through the adoption of conservative ambient concentrations, which are considered representative of the area of the proposed EfW facility. No other new industrial facility contributing combustion products is proposed in the locality. The assessment has therefore accounted for combined effects by combining predicted contributions (PCs) from the proposed EfW facility with representative ambient concentrations (ACs) to derive predicted environmental concentrations (PECs), which are within all relevant environmental quality standards for all scenarios considered.

8 Mitigation

Construction Phase

Overview

8.1 A Code of Construction Practice (CoCP) has been drafted for the project, which explains the management of construction activities throughout the implementation of the scheme.

8.2 The CoCP sets out objectives and measures to be applied throughout the construction of the project and associated infrastructure. The objectives and measures relating to the protection of air quality are set out below.

Objectives

8.3 To minimise the emissions to air of pollutants (particularly dust, fine particles (PM_{10}) and nitrogen dioxide) and ensure that best practicable means are employed.

Control Measures

Overview

8.4 Where the potential for an effect on air quality exists, "Best Practicable Means" would be used to reduce the effect, including the following control measures as appropriate.

Materials Storage and Handling

- Materials handling and storage areas would be sited as far away as reasonably practicable from public/residential areas. Stockpiles would be watered.
- Handling areas would be kept as clean as practicable to avoid nuisance from dust.
- Bunds or screens may be constructed as wind breaks to reduce wind speeds. Earth bunds should be seeded as soon as possible.
- Other dusty materials would be dampened down using water sprays in dry weather.

Construction Plant

- Site plant and equipment would be kept in good repair and maintained in accordance with the manufacturer's specifications.
- Plant would not be left running when not in use.
- Any fixed plant and equipment would be located away from sensitive receptors near the site as far as is practicable.
- Plant with dust arrestment equipment (such as particle traps) would be used where practicable.
- All site vehicles and plant to have upward-facing exhausts where practicable to minimise surface dust re-suspension.

Vehicle Movements

- All-weather surfaces would be provided on the main access route into the site. This area would be regularly cleaned to prevent mud/dust leaving the site.
- Haul routes would be located away from sensitive properties and to be watered regularly.
- Effective wheel cleaning would be undertaken of traffic leaving the construction sites onto public highway roads by the use of wheel washes.
- Speeds would be restricted to 10 mph on haul roads across the site.
- All site vehicles would be kept in a good state of repair and maintenance.
- All vehicles carrying dusty materials into or out of the site would be sheeted to prevent escape of materials.

Operational Control

- The appropriate control measures for specific site operations would be agreed, taking into account local topography, prevailing wind patterns and local sensitive receptors.
- Burning of materials on site would be prohibited.
- Loading and unloading would only be permitted on designated areas.
- Appropriate dust controls would be employed for the demolition work, including sheeting, use of enclosed rubble shutes, etc.

- Where mobile concrete crushers are used during demolition, these would be sited away from sensitive receptors, and authorisation would be required prior to use from the Local Authority in whose area the operating company's registered office is situated.
- Dust controls for 'special operations' would be specified, e.g. cutting or grinding of stone or metalwork.
- Regular site inspections to identify significant dust sources.
- Immediate clean up of spillage would be employed.
- Completed earthworks would be sealed or planted as early as practicable.
- Where parts of the site have been identified as potentially contaminated, any necessary precautions indicated by risk assessments would be specified for dust control, spoil removal and disposal.

Operational Phase

Abatement of EfW Stack Emissions to Air

8.5 Mitigation measures included in the EfW facility design, incorporating the flue gas treatment system, will ensure that air pollution effects during operation are minimal. The precise configuration of the flue gas cleaning equipment will be determined as part of the Best Available Technology (BAT) assessment that will be prepared for the PPC application.

Monitoring

8.6 Emissions from the proposed EfW facility will be monitored in accordance with the requirements of the PPC permit to operate required from the Environment Agency. Emissions will be reported on a monthly and annual basis, together with any significant excursions from normal operating conditions. Continuous monitoring of CO will provide an effective indication to the control room of the efficiency of combustion. The data will be recorded by the plant distributed control system and alarm system. Operators will be alerted if atmospheric emissions approach the authorised limits.

9 Residual Effects

Construction Phase

9.1 The construction phase will generate only very minor emissions from the exhausts of construction vehicles. The effect of dust during this phase will not be significant for nearby residents, assuming that the mitigation measures identified in Section 8 are implemented.

Operational Phase

9.2 Section 7 presents the results of dispersion modelling of the proposed EfW facility. No additional mitigation, other than that incorporated within the proposed plant design, is considered to be necessary for the dispersion of emissions from the proposed EfW facility stack. Residual effects are therefore those predicted in Section 7, which are considered to be of slight averse significance when operating at short term WID limits and of neutral significance when operating at long term WID limits.

9.3 When the maximum additional contributions are added to derived background concentrations, the cumulative concentrations are estimated to be significantly lower than the relevant assessment criteria for all pollutants. Where critical loads at ecological sites are exceeded, it is due to elevated background deposition rates, which are already in excess of relevant criteria. Emissions have been assessed assuming that the plant operates at the WID limits. In practice, it will operate within these limits and effects will therefore be lower than those predicted in this assessment.

9.4 The effect of additional traffic associated with the operational phase is of neutral significance with respect to roadside air quality.

9.5 Odour generation during the operational phase is likely to be of netural significance, assuming that the mitigation measures identified in Section 8 are implemented.

10 Summary and Conclusions

10.1 INEOS are proposing to develop an Energy from Waste (EfW) facility sized to accept the majority of the Solid Recovered Fuel (SRF) and Refuse Derived Fuel (RDF) produced in Greater Manchester and other local authorities in the area. The proposed EfW facility would be located at the north (Weston Point) end of the Runcorn site, approximately 4km west of the centre of Runcorn, immediately adjacent to an existing rail facility and close to the Runcorn Expressway.

10.2 Construction phase dust effects would be controlled through the Code of Construction Practice (CoCP) developed for the project. This has been developed using a risk-based approach and therefore the effects are considered to be neutral. The effect on air quality due to the additional emissions from construction traffic is also considered to be neutral.

10.3 The proposed EfW facility will be designed to minimise emissions from the stack via an air pollution control system to limits specified within the EU Waste Incineration Directive. Residual emissions will be dispersed from a 105m stack, the height of which was determined as the optimum for the effective dispersion of pollutants taking into account local building heights.

10.4 Baseline air quality concentrations have been derived from a variety of sources including local authorities, national network monitoring sites and other published sources.

10.5 Emissions from the proposed EfW facility have been assessed through detailed dispersion modelling following the Environment Agency's good practice guidelines. The assessment has been undertaken assuming a number of worst-case assumptions. This is likely to result in an over-estimate of the contributions from the proposed EfW facility that will arise in practice.

10.6 The results to dispersion modelling reported in this assessment indicate that predicted contributions and resultant environmental concentrations of all pollutants considered are well within the relevant air quality objectives and limit values.

10.7 Overall, it is considered that maximum short-term contributions from the project are considered to be slight adverse. To realise these impacts, the project would need to operate at the short-term WID emission limits during periods coinciding with the worst-case meteorological conditions for dispersion. In practice, such events are unlikely and represent the absolute upper limits for short-term effects from the facility.

10.8 Overall, predicted pollutant concentrations from the project operating at the long-term WID emission limits are considered to be neutral. In addition, the results presented in the assessment are considered to represent the worst case for the long-term operation of the plant. Actual emissions are expected to be lower than the WID emission limits.

10.9 The results of the human health risk assessment demonstrated that none of the chemicals exceeded the hazard index or the cancer risk for all default pathways of exposure for any receptor considered. Therefore, the human health risk assessment concludes that the identified levels of exposure are not considered to pose unacceptable risks to the identified receptors.

10.10 Contributions of air pollutant concentrations and deposition from the proposed EfW facility to designated ecological sites have been calculated based on dispersion modelling results and compared against relevant critical levels and critical loads. Effects on vegetation and ecosystems are addressed within Chapter 6 of the Environmental Statement.

10.11 The effect on air quality due to the additional emissions from operational traffic is considered as being neutral.

10.12 Dispersion modelling has been undertaken to determine the frequency of visible plumes from the proposed EfW facility. Based on the derived result, the significance of the impact of plume visibility is low with reference to the Environment Agency's significance criteria.

10.13 Due to the nature of the fuel, there are no areas on site that have the potential to emit significant odours.

10.14 Table 10.1 summarises the significance of effects for the construction and the operational phases for the project. Overall, effects are considered to be neutral significance for both phases of development.

Table 10.1: Summary of Effects

Phase	**Effect**	**Significance of Effects**
Construction	Construction Dust	Neutral
	Air Quality Impact from Construction Traffic	Neutral
	Overall Effect	*Neutral*
Operational	Air Quality Impacts from EfW Facility Emissions (Scenario 1)	Slight Adverse
	Air Quality Impacts from EfW Facility Emissions (Scenario 2)	Neutral
	Human Health	Neutral
	Assessment of Emissions from Operational Vehicles	Neutral
	Assessment of Plume Visibility	Low Risk
	Assessment of Odour	Neutral
	Overall Effect	*Neutral*

Annexes

Annex A

Stack Height Determination

Introduction

This appendix presents a stack height determination undertaken for the proposed EfW facility. The underlying principle of air pollution control is to:

- minimise the release of pollutants to the atmosphere; and
- promote sufficient dispersion and dilution of released pollutants within the atmosphere.

The first part of this principle is controlling emissions at sources through abatement techniques. These are well established for EfW plant and are fully documented in the Environmental Statement for the proposed facility. The second part is the determination of the optimum release conditions, including stack height determination to ensure that subsequent ground level concentrations of the released pollutants remain within acceptable limits.

The objective of the stack height determination is to establish at what chimney height local building wake effects are no longer significant thereby ensuring the adequate dispersion of pollutants. The primary determinant of the chimney height is therefore the local building height.

For the purposes of planning, the stack height determination has been based on a 47m high main building.

On the basis of the above, the stack height determination considers:

- a unit emission rate of 1 $g.s^{-1}$ enabling the influence of meteorological conditions to be determined;
- all averaging periods relevant to the air quality assessment;
- a range of all likely meteorological conditions through the use of five years of hourly sequential meteorological data from a representative measuring station (Liverpool John Lennon Airport).

Methodology

Emissions data assumed is summarised in the air quality assessment.

Simulations have been run using both ADMS 3.3 and AERMOD initially assuming flat terrain to determine what stack height is required to overcome local building wake effects. Further modelling with complex terrain incorporated was undertaken to determine whether the presence of local terrain (most notably Runcorn Hill) would necessitate an increase in stack height.

Assuming flat terrain, the model was run assuming stack heights of 55m, through to 125m at 10m incremental spacing. Further model runs were undertaken incorporating complex terrain assuming stack heights of 75m through to 115m at 10m incremental spacing. Results were obtained for all relevant averaging periods to this assessment.

The dispersion modelling for the purposes of stack height determination assumed a domain of 15km by 15km centred on the proposed facility and a 300 m grid spacing in both ADMS and AERMOD. Results are reported for the maximum affected location. This is considered a robust and conservative approach.

Results

Overview

The predicted maximum contributions for all averaging periods and stack heights considered are plotted in Figure A.1 to Figure A.4 for ADMS and AERMOD results.

Flat Terrain

AERMOD results assuming flat terrain (Figure A.1) illustrate that for stack heights below 75m, local building wake effects are predicted to affect dispersion substantially. For stack heights above 95m, ground level contributions do not reduce materially with increasing stack height.

ADMS results assuming flat terrain (Figure A.2) illustrate that for stack heights below 65m, local building wake effects are predicted to affect dispersion substantially. There is a linear decrease in predicted ground level concentrations between 65m and 115m, above which ground level contributions do not reduce materially with increasing stack height.

On the basis of the above, assuming flat terrain, AERMOD results would indicate a stack height of 95 while ADMS results would indicate a stack height of 115m.

Complex Terrain

AERMOD results assuming complex terrain (Figure A.3) illustrate that for stack heights above 105m, ground level contributions do not reduce materially with increasing stack height.

ADMS results assuming complex terrain (Figure A.4) follow a similar profile to those derived for flat terrain with ground level contributions not reducing materially with increasing stack height beyond 115m.

Discussion

The dispersion modelling results using AERMOD indicate that a stack height of 105m is appropriate (taking local terrain influences into account). However, the dispersion modelling results using ADMS indicate that for both flat and complex terrain, a stack height of 115m is appropriate.

Consultation by INEOS with Liverpool Airport has confirmed that the maximum stack height at the proposed project location is limited to 106m due to aviation safety issues. Taking this into account, a stack height of 105m (as confirmed through AERMOD modelling) is recommended for the proposed EfW facility, as a higher stack height of 115m (as confirmed through ADMS modelling) will not be acceptable under aviation safety regulations.

The stack height would be subject to agreement with the EA when IPPC permitting for the EfW proposals is progressed in the future. If a shorter local building height than 47m is developed, both AERMOD and ADMS are likely to represent 105m as an appropriate stack height for the facility.

Summary

Taking into account modelling results using both ADMS and AERMOD, a stack height of 105m is recommended for the proposed EfW facility. Any further increase in stack height is restricted by aviation safety regulations.

Figure A.1: Predicted Contributions for Different Stack Heights (AERMOD No Terrain)

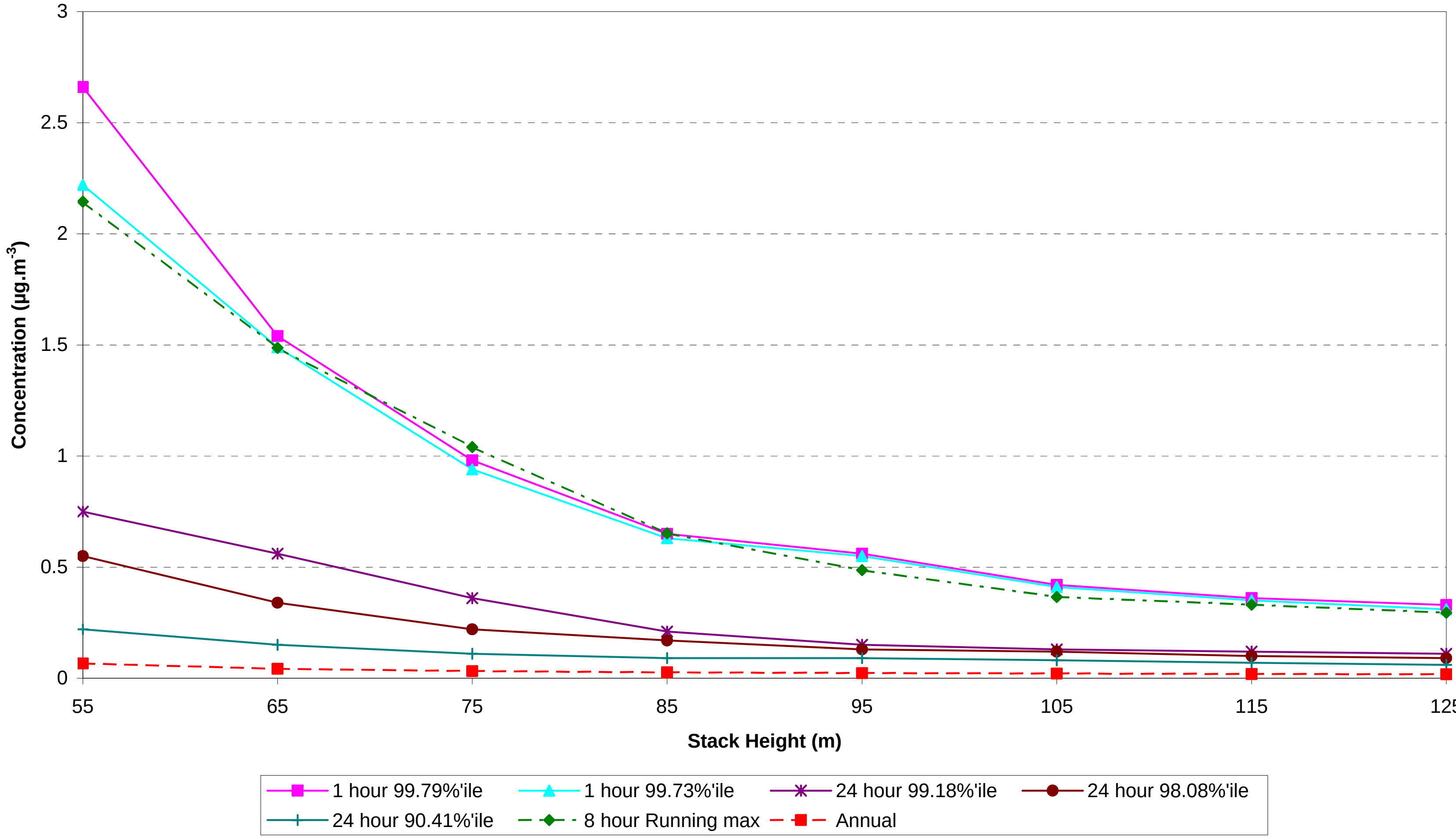


Figure A.2: Predicted Contributions for Different Stack Heights (ADMS No Terrain)

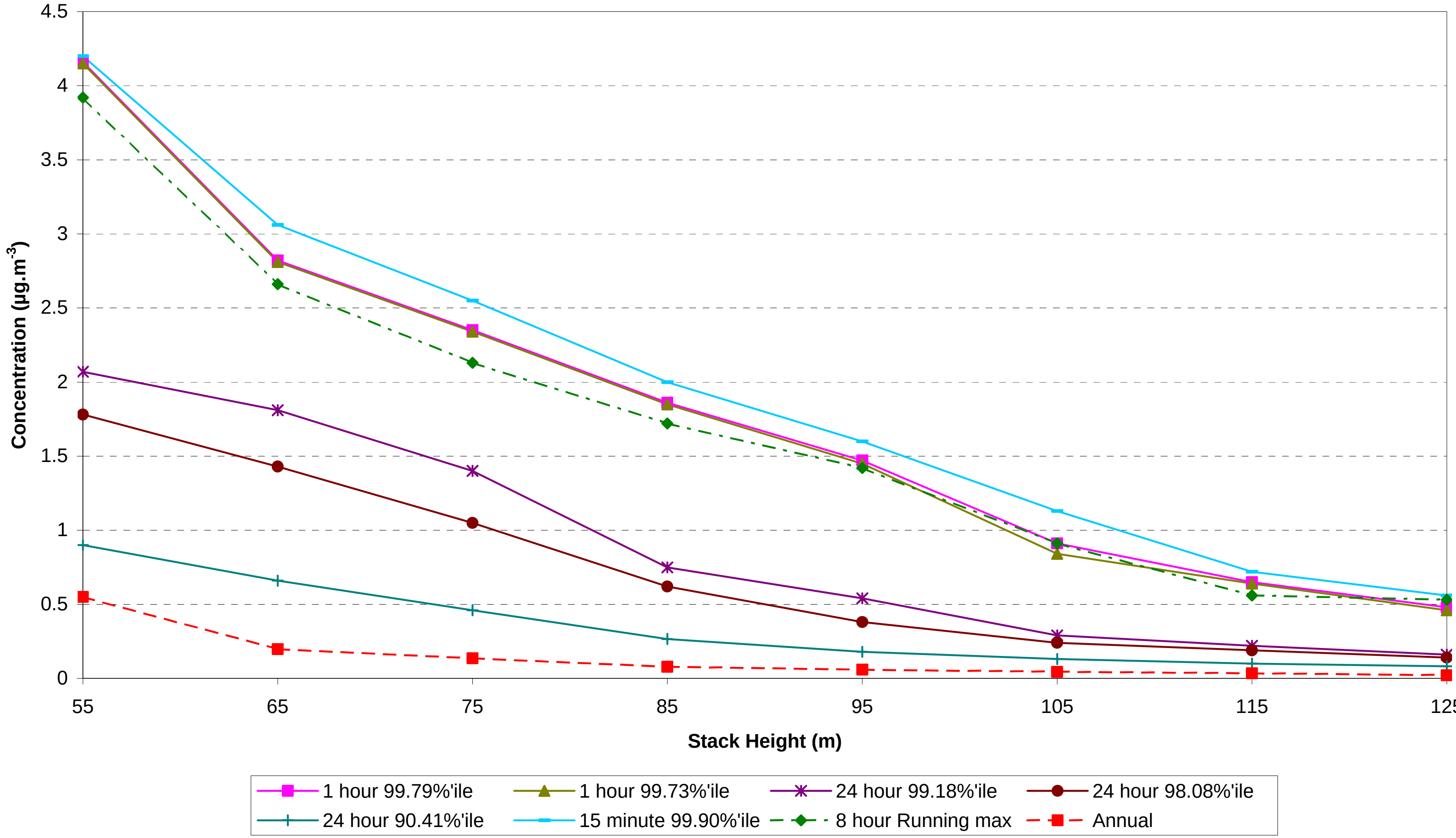


Figure A.3: Predicted Contributions for Different Stack Heights (AERMOD with Terrain)

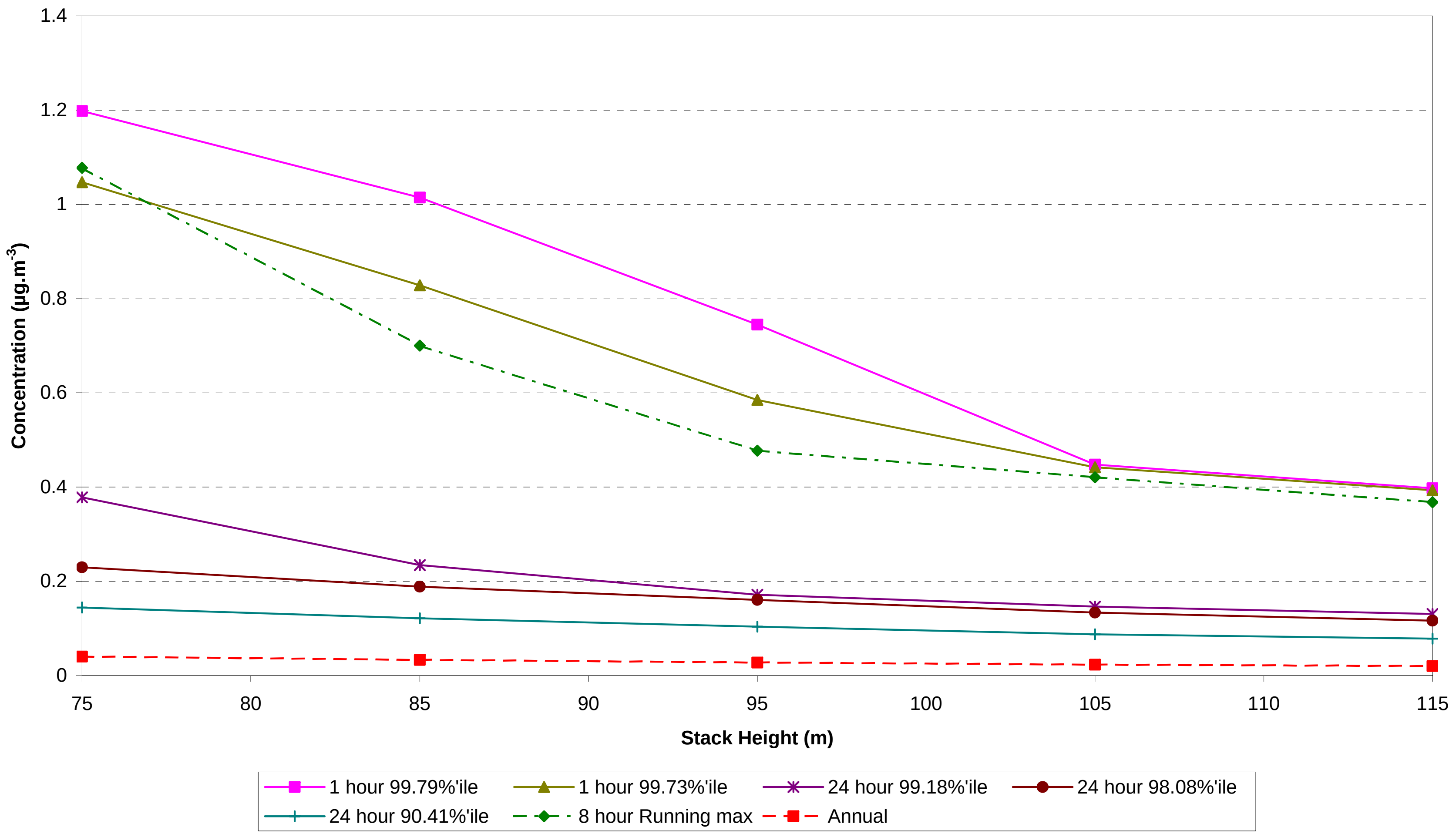
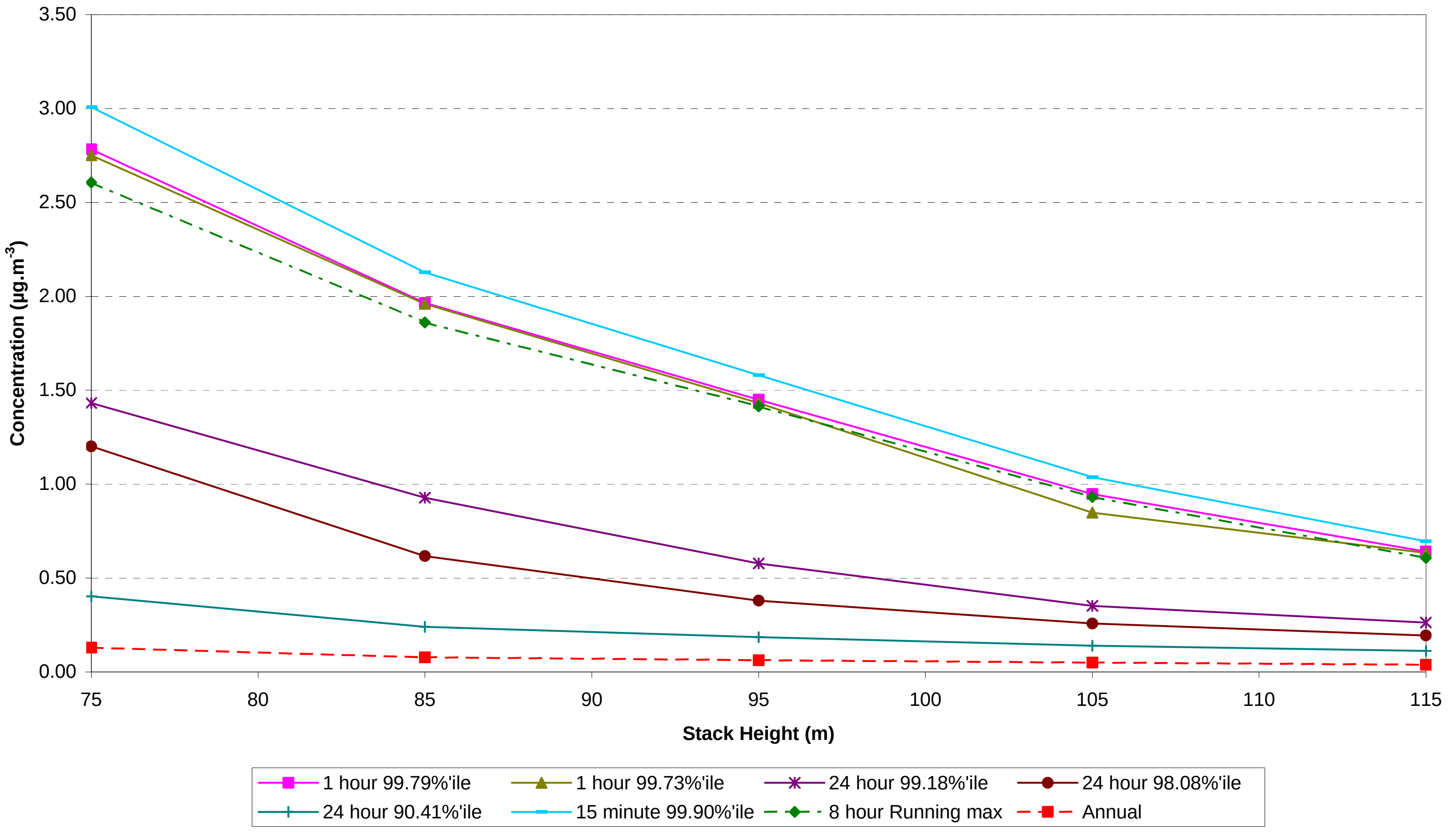


Figure A.4: Predicted Contributions for Different Stack Heights (ADMS with Terrain)



Annex B

Detailed Dispersion Modelling Results

Scenario 1: Short-Term Emissions at WID Limits

Table B.1: ADMS Predicted Contributions – Scenario 1 ($\mu g.m^{-3}$)

Pollutant	Averaging Period	EQS	ADMS Maximum Predicted Contribution					Max PC as % of EQS
			2000	2001	2002	2003	2004	
HCl	1 hour (maximum)	800	12.99	12.57	13.50	12.96	12.96	1.7
HF	1 hour (maximum)	250	0.87	0.84	0.90	0.86	0.86	0.4
SO_2	15 minute (99.90th percentile)	266	41.48	35.08	40.31	38.61	38.31	15.6
	1 hour (99.73th percentile)	350	33.64	30.72	33.94	32.85	33.26	9.7
NO_2	1 hour (99.79th percentile)	200	26.49	21.97	23.87	24.72	23.90	13.2

Table B.2: AERMOD Predicted Contributions – Scenario 1 ($\mu g.m^{-3}$)

Pollutant	Averaging Period	EQS	AERMOD Maximum Predicted Contribution					Max PC as % of EQS
			2000	2001	2002	2003	2004	
HCl	1 hour (maximum)	800	13.68	15.47	16.04	15.47	13.40	2.0
HF	1 hour (maximum)	250	0.91	1.03	1.07	1.03	0.89	0.4
SO_2	1 hour (99.73th percentile)	350	16.32	17.20	17.20	16.96	17.69	5.1
NO_2	1 hour (99.79th percentile)	200	11.74	12.32	12.33	12.15	12.53	6.3

Scenario 2: Long-Term Emissions at WID Limits

Table B.3: ADMS Predicted Contributions – Scenario 2 ($\mu g.m^{-3}$)

Pollutant	Averaging Period	EQS	ADMS Maximum Predicted Contribution					Max PC as % of EQS
			2000	2001	2002	2003	2004	
PM_{10}	24 hour (90.41th percentile)	50	0.21	0.23	0.23	0.23	0.28	0.56
	24 hour (98.08th percentile)	50	0.52	0.45	0.45	0.50	0.48	1.03
	Annual	40	0.06	0.07	0.07	0.07	0.10	0.25
HCl	1 hour (maximum)	800	2.17	2.10	2.25	2.16	2.16	0.28
	Annual	20	0.06	0.07	0.07	0.07	0.10	0.49
HF	1 hour (maximum)	250	0.22	0.21	0.23	0.22	0.22	0.09
SO_2	15 minute (99.90th percentile)	266	10.37	8.77	10.08	9.65	9.58	3.90
	1 hour (99.73th percentile)	350	8.41	7.68	8.49	8.21	8.32	2.42
	24 hour (99.18th percentile)	125	3.30	3.05	3.52	2.98	2.98	2.82
	Annual	50	0.30	0.34	0.34	0.35	0.49	0.99
NO_2	1 hour (99.79th percentile)	200	13.26	11.00	11.95	12.38	11.96	6.63
	Annual	40	0.85	0.95	0.94	0.97	1.39	3.46
CO	8 hour (maximum daily running)	10000	8.83	7.47	9.32	9.13	8.15	0.09
Cd	1 hour (maximum)	1.5	4.2×10^{-3}	4.2×10^{-3}	4.5×10^{-3}	4.1×10^{-3}	4.1×10^{-3}	0.30
	Annual	0.005	1.5×10^{-4}	1.5×10^{-4}	1.5×10^{-4}	1.5×10^{-4}	2.2×10^{-4}	4.46
Tl	1 hour (maximum)	30	4.2×10^{-3}	4.2×10^{-3}	4.5×10^{-3}	4.1×10^{-3}	4.1×10^{-3}	0.01
	Annual	1	1.5×10^{-4}	1.5×10^{-4}	1.5×10^{-4}	1.5×10^{-4}	2.2×10^{-4}	0.02
Hg	1 hour (maximum)	7.5	3.0×10^{-4}	8.3×10^{-3}	8.9×10^{-3}	8.1×10^{-3}	8.2×10^{-3}	0.12

Pollutant	Averaging Period	EQS	ADMS Maximum Predicted Contribution					Max PC as % of EQS
			2000	2001	2002	2003	2004	
	Annual	0.25	3.0×10^{-4}	3.2×10^{-4}	3.0×10^{-4}	3.0×10^{-4}	4.6×10^{-4}	0.18
Sb	1 hour (maximum)	150	9.3×10^{-3}	9.1×10^{-3}	9.8×10^{-3}	8.9×10^{-3}	9.0×10^{-3}	0.01
	Annual	5	3.2×10^{-4}	3.4×10^{-4}	3.2×10^{-4}	3.3×10^{-4}	4.9×10^{-4}	0.01
As	1 hour (maximum)	15	9.3×10^{-3}	9.1×10^{-3}	9.8×10^{-3}	8.9×10^{-3}	9.0×10^{-3}	0.07
	Annual	0.2	3.2×10^{-4}	3.4×10^{-4}	3.2×10^{-4}	3.3×10^{-4}	4.9×10^{-4}	0.25
Cr	1 hour (maximum)	3	9.3×10^{-3}	9.1×10^{-3}	9.8×10^{-3}	8.9×10^{-3}	9.0×10^{-3}	0.33
	Annual	0.1	3.2×10^{-4}	3.4×10^{-4}	3.2×10^{-4}	3.3×10^{-4}	4.9×10^{-4}	0.49
Co	1 hour (maximum)	6	9.3×10^{-3}	9.1×10^{-3}	9.8×10^{-3}	8.9×10^{-3}	9.0×10^{-3}	0.16
	Annual	0.2	3.2×10^{-4}	3.4×10^{-4}	3.2×10^{-4}	3.3×10^{-4}	4.9×10^{-4}	0.25
Cu	1 hour (maximum)	60	9.3×10^{-3}	9.1×10^{-3}	9.8×10^{-3}	8.9×10^{-3}	9.0×10^{-3}	0.02
	Annual	2	3.2 x 10-4	3.4 x 10-4	3.2 x 10-4	3.3 x 10-4	4.9 x 10-4	0.02
Pb	Annual	0.5	3.2 x 10-4	3.4 x 10-4	3.2 x 10-4	3.3 x 10-4	4.9 x 10-4	0.10
Mn	1 hour (maximum)	1500	9.3×10^{-3}	9.1×10^{-3}	9.8×10^{-3}	8.9×10^{-3}	9.0×10^{-3}	0.00
	Annual	1	3.2×10^{-4}	3.4×10^{-4}	3.2×10^{-4}	3.3×10^{-4}	4.9×10^{-4}	0.05
Ni	1 hour (maximum)	30	9.3×10^{-3}	9.1×10^{-3}	9.8×10^{-3}	8.9×10^{-3}	9.0×10^{-3}	0.03
	Annual	1	3.2×10^{-4}	3.4×10^{-4}	3.2×10^{-4}	3.3×10^{-4}	4.9×10^{-4}	0.05
V	1 hour (maximum)	1	9.3×10^{-3}	9.1×10^{-3}	9.8×10^{-3}	8.9×10^{-3}	9.0×10^{-3}	0.98
	Annual	5	3.2×10^{-4}	3.4×10^{-4}	3.2×10^{-4}	3.3×10^{-4}	4.9×10^{-4}	0.01
Dioxins / Furans	Annual	-	5.9×10^{-10}	6.2×10^{-10}	5.8×10^{-10}	6.0×10^{-10}	8.9×10^{-10}	-

Table B.4: AERMOD Predicted Contributions – Scenario 2 ($\mu g.m^{-3}$)

Pollutant	Averaging Period	EQS	AERMOD Maximum Predicted Contribution					Max PC as % of EQS
			2000	2001	2002	2003	2004	
PM_{10}	24 hour (90.41th percentile)	50	0.13	0.13	0.15	0.15	0.18	0.35
	24 hour (98.08th percentile)	50	0.24	0.25	0.24	0.26	0.27	0.54
	Annual	40	0.04	0.04	0.04	0.04	0.05	0.12
HCl	1 hour (maximum)	800	2.28	2.58	2.67	2.58	2.23	0.33
	Annual	20	0.04	0.04	0.04	0.04	0.05	0.23
HF	1 hour (maximum)	250	0.23	0.26	0.27	0.26	0.22	0.11
SO_2	1 hour (99.73th percentile)	350	4.08	4.30	4.30	4.24	4.42	1.26
	24 hour (99.18th percentile)	125	1.47	1.36	1.35	1.46	1.45	1.17
	Annual	50	0.19	0.20	0.19	0.20	0.23	0.46
NO_2	1 hour (99.79th percentile)	200	5.88	6.17	6.17	6.08	6.27	3.14
	Annual	40	0.53	0.56	0.52	0.55	0.65	1.63
CO	8 hour (maximum daily running)	10000	3.60	3.48	3.60	4.21	3.75	0.04
Cd	1 hour (maximum)	1.5	5.3×10^{-3}	6.1×10^{-3}	6.3×10^{-3}	5.5×10^{-3}	6.2×10^{-3}	0.42
	Annual	0.005	9.3×10^{-5}	1.0×10^{-4}	8.8×10^{-5}	9.0×10^{-5}	1.1×10^{-4}	2.30
Tl	1 hour (maximum)	30	5.3×10^{-3}	6.1×10^{-3}	6.3×10^{-3}	5.5×10^{-3}	6.2×10^{-3}	0.02
	Annual	1	9.3×10^{-5}	1.0×10^{-4}	8.8×10^{-5}	9.0×10^{-5}	1.1×10^{-4}	0.01
Hg	1 hour (maximum)	7.5	1.1×10^{-2}	1.3×10^{-2}	1.3×10^{-2}	1.3×10^{-2}	1.3×10^{-2}	0.18
	Annual	0.25	1.9×10^{-4}	2.1×10^{-4}	1.8×10^{-4}	1.8×10^{-4}	2.3×10^{-4}	0.09
Sb	1 hour (maximum)	150	1.2×10^{-2}	1.3×10^{-2}	1.4×10^{-2}	1.2×10^{-2}	1.4×10^{-2}	0.01
	Annual	5	2.0×10^{-4}	2.3×10^{-4}	1.9×10^{-4}	2.0×10^{-4}	2.5×10^{-4}	0.01

Pollutant	Averaging Period	EQS	AERMOD Maximum Predicted Contribution					Max PC as % of EQS
			2000	2001	2002	2003	2004	
As	1 hour (maximum)	15	1.2×10^{-2}	1.3×10^{-2}	1.4×10^{-2}	1.2×10^{-2}	1.4×10^{-2}	0.09
	Annual	0.2	2.0×10^{-4}	2.3×10^{-4}	1.9×10^{-4}	2.0×10^{-4}	2.5×10^{-4}	0.13
Cr	1 hour (maximum)	3	1.2×10^{-2}	1.3×10^{-2}	1.4×10^{-2}	1.2×10^{-2}	1.4×10^{-2}	0.46
	Annual	0.1	2.0×10^{-4}	2.3×10^{-4}	1.9×10^{-4}	2.0×10^{-4}	2.5×10^{-4}	0.25
Co	1 hour (maximum)	6	1.2×10^{-2}	1.3×10^{-2}	1.4×10^{-2}	1.2×10^{-2}	1.4×10^{-2}	0.23
	Annual	0.2	2.0×10^{-4}	2.3×10^{-4}	1.9×10^{-4}	2.0×10^{-4}	2.5×10^{-4}	0.13
Cu	1 hour (maximum)	60	1.2×10^{-2}	1.3×10^{-2}	1.4×10^{-2}	1.2×10^{-2}	1.4×10^{-2}	0.02
	Annual	2	2.0×10^{-4}	2.3×10^{-4}	1.9×10^{-4}	2.0×10^{-4}	2.5×10^{-4}	0.01
Pb	Annual	0.5	2.0×10^{-4}	2.3×10^{-4}	1.9×10^{-4}	2.0×10^{-4}	2.5×10^{-4}	0.05
Mn	1 hour (maximum)	1500	1.2×10^{-2}	1.3×10^{-2}	1.4×10^{-2}	1.2×10^{-2}	1.4×10^{-2}	0.00
	Annual	1	2.0×10^{-4}	2.3×10^{-4}	1.9×10^{-4}	2.0×10^{-4}	2.5×10^{-4}	0.03
Ni	1 hour (maximum)	30	1.2×10^{-2}	1.3×10^{-2}	1.4×10^{-2}	1.2×10^{-2}	1.4×10^{-2}	0.05
	Annual	1	2.0×10^{-4}	2.3×10^{-4}	1.9×10^{-4}	2.0×10^{-4}	2.5×10^{-4}	0.03
V	1 hour (maximum)	1	1.2×10^{-2}	1.3×10^{-2}	1.4×10^{-2}	1.2×10^{-2}	1.4×10^{-2}	1.38
	Annual	5	2.0×10^{-4}	2.3×10^{-4}	1.9×10^{-4}	2.0×10^{-4}	2.5×10^{-4}	0.01
Dioxins / Furans	Annual	-	3.7×10^{-10}	4.2×10^{-10}	$3. \times 10^{-10}$	3.6×10^{-10}	4.6×10^{-10}	-

Detailed Ecological Results

Table B.5: Critical Level Results at Ecological Receptors (NO_x)

Receptor name	X(m)	Y(m)	Distance from stack (km)	Predicted NO_x Contribution (μg/m³)*	
				AERMOD	ADMS
Ramsar Sites					
Midland Meres & Mosses - Phase 1	355660	372296	10.3km to 11.1km	0.068	0.153
Midland Meres & Mosses Phase 2	359789	369064	11.8km to 14.7km	0.062	0.129
Mersey Estuary (minimum)	N/A		0.2km to 15km	0.044	0.045
Mersey Estuary (average)				0.107	0.124
Mersey Estuary (maximum)				0.549	1.170
Special Protection Areas					
Mersey Estuary	As above (see Ramsar site)				
Special Areas of Conservation					
Oak Mere	357489	367736	14.7	0.050	0.113
Sites of Special Scientific Interest					
Beechmill Wood & Pasture	354075	376926	3.6	0.143	0.218
Black Lake, Delamere	353749	370917	5.4	0.049	0.132
Dunsdale Hollow	351450	376268	5.9	0.096	0.178
Flaxmere Moss	355660	372296	7.3	0.068	0.153
Flood Brook Clough	353190	379904	7.7	0.396	0.644
Hatch Mere	355249	372130	10.1	0.063	0.147
Hatton's Hey Wood, Whittle's Corner & Bank Rough	356440	377173	10.1	0.181	0.236
Linmer Moss	354735	370769	11.2	0.053	0.129
Oak Mere	357489	367736	11.9	0.050	0.113
Warburton's Wood & Well Wood	355241	376586	14.7	0.148	0.201
Mersey Estuary	As above (see Ramsar site)				

Notes: * Maximum over all meteorological years

Table B.6: Critical Level Results at Ecological Receptors (SO_2)

Receptor name	X(m)	Y(m)	Distance from stack (km)	Predicted SO_2 Contribution (µg/m³)*	
				AERMOD	ADMS
Ramsar Sites					
Midland Meres & Mosses - Phase 1	355660	372296	10.3km to 11.1km	0.017	0.038
Midland Meres & Mosses Phase 2	359789	369064	11.8km to 14.7km	0.015	0.032
Mersey Estuary (minimum)	N/A		0.2km to 15km	0.011	0.011
Mersey Estuary (average)				0.027	0.031
Mersey Estuary (maximum)				0.137	0.293
Special Protection Areas					
Mersey Estuary	As above (see Ramsar site)				
Special Areas of Conservation					
Oak Mere	357489	367736	14.7	0.012	0.028
Sites of Special Scientific Interest					
Beechmill Wood & Pasture	354075	376926	3.6	0.036	0.054
Black Lake, Delamere	353749	370917	5.4	0.012	0.033
Dunsdale Hollow	351450	376268	5.9	0.024	0.045
Flaxmere Moss	355660	372296	7.3	0.017	0.038
Flood Brook Clough	353190	379904	7.7	0.099	0.161
Hatch Mere	355249	372130	10.1	0.016	0.037
Hatton's Hey Wood, Whittle's Corner & Bank Rough	356440	377173	10.1	0.045	0.059
Linmer Moss	354735	370769	11.2	0.013	0.032
Oak Mere	357489	367736	11.9	0.012	0.028
Warburton's Wood & Well Wood	355241	376586	14.7	0.037	0.050
Mersey Estuary	As above (see Ramsar site)				

Notes: * Maximum over all meteorological years

Table B.7: Critical Load Results at Ecological Receptors (Nitrogen Deposition)

Receptor name	X(m)	Y(m)	Distance From stack (km)	Predicted Nitrogen Deposition Contribution (kg/ha/yr)*	
				AERMOD	ADMS
Ramsar Sites					
Midland Meres & Mosses - Phase 1	355660	372296	10.3km to 11.1km	0.010	0.022
Midland Meres & Mosses Phase 2	359789	369064	11.8km to 14.7km	0.009	0.019
Mersey Estuary (minimum)	N/A		0.2km to 15km	0.006	0.006
Mersey Estuary (average)				0.015	0.018
Mersey Estuary (maximum)				0.079	0.169
Special Protection Areas					
Mersey Estuary	As above (see Ramsar site)				
Special Areas of Conservation					
Oak Mere	357489	367736	14.7	0.007	0.016
Sites of Special Scientific Interest					
Beechmill Wood & Pasture	354075	376926	3.6	0.021	0.031
Black Lake, Delamere	353749	370917	5.4	0.007	0.019
Dunsdale Hollow	351450	376268	5.9	0.014	0.026
Flaxmere Moss	355660	372296	7.3	0.010	0.022
Flood Brook Clough	353190	379904	7.7	0.057	0.093
Hatch Mere	355249	372130	10.1	0.009	0.021
Hatton's Hey Wood, Whittle's Corner & Bank Rough	356440	377173	10.1	0.026	0.034
Linmer Moss	354735	370769	11.2	0.008	0.019
Oak Mere	357489	367736	11.9	0.007	0.016
Warburton's Wood & Well Wood	355241	376586	14.7	0.021	0.029
Mersey Estuary	As above (see Ramsar site)				

Notes: * Maximum over all meteorological years

Table B.8: Critical Load Results at Ecological Receptors (Acid Deposition, AERMOD)

Receptor name	X(m)	Y(m)	Distance from stack (km)	Predicted N Acid Deposition Contribution (keq/ha/yr)	Predicted S Acid Deposition Contribution (keq/ha/yr)*	Predicted CL Acid Deposition Contribution (keq/ha/yr)*	Predicted Total Acid Deposition Contribution (keq/ha/yr)*
Ramsar Sites							
Midland Meres & Mosses - Phase 1	355660	372296	10.3km to 11.1km	0.001	0.002	0.002	0.005
Midland Meres & Mosses Phase 2	359789	369064	11.8km to 14.7km	0.001	0.002	0.002	0.004
Mersey Estuary (minimum)	N/A		0.2km to 15km	0.000	0.001	0.001	0.003
Mersey Estuary (average)				0.001	0.003	0.003	0.008
Mersey Estuary (maximum)				0.006	0.016	0.018	0.040
Special Protection Areas							
Mersey Estuary	As above (see Ramsar site)						
Special Areas of Conservation							
Oak Mere	357489	367736	14.7	0.001	0.001	0.002	0.004
Sites of Special Scientific Interest							
Beechmill Wood & Pasture	354075	376926	3.6	0.001	0.004	0.005	0.010
Black Lake, Delamere	353749	370917	5.4	0.001	0.001	0.002	0.004
Dunsdale Hollow	351450	376268	5.9	0.001	0.003	0.003	0.007
Flaxmere Moss	355660	372296	7.3	0.001	0.002	0.002	0.005

Flood Brook Clough	353190	379904	7.7	0.004	0.012	0.013	0.029
Hatch Mere	355249	372130	10.1	0.001	0.002	0.002	0.005
Hatton's Hey Wood, Whittle's Corner & Bank Rough	356440	377173	10.1	0.002	0.005	0.006	0.013
Linmer Moss	354735	370769	11.2	0.001	0.002	0.002	0.004
Oak Mere	357489	367736	11.9	0.001	0.001	0.002	0.004
Warburton's Wood & Well Wood	355241	376586	14.7	0.002	0.004	0.005	0.011
Mersey Estuary	As above (see Ramsar site)						

Notes: * Maximum over all meteorological years

Table B.9: Critical Load Results at Ecological Receptors (Acid Deposition, ADMS)

Receptor name	X(m)	Y(m)	Distance from stack (km)	Predicted N Acid Deposition Contribution (keq/ha/yr)	Predicted S Acid Deposition Contribution (keq/ha/yr)*	Predicted CL Acid Deposition Contribution (keq/ha/yr)*	Predicted Total Acid Deposition Contribution (keq/ha/yr)*
Ramsar Sites							
Midland Meres & Mosses - Phase 1	355660	372296	10.3km to 11.1km	0.002	0.005	0.005	0.011
Midland Meres & Mosses Phase 2	359789	369064	11.8km to 14.7km	0.001	0.004	0.004	0.009
Mersey Estuary (minimum)	N/A		0.2km to 15km	0.000	0.001	0.001	0.003
Mersey Estuary (average)				0.001	0.004	0.004	0.009
Mersey Estuary (maximum)				0.012	0.035	0.038	0.085
Special Protection Areas							
Mersey Estuary	As above (see Ramsar site)						
Special Areas of Conservation							
Oak Mere	357489	367736	14.7	0.001	0.003	0.004	0.008
Sites of Special Scientific Interest							
Beechmill Wood & Pasture	354075	376926	3.6	0.031	0.002	0.007	0.016
Black Lake, Delamere	353749	370917	5.4	0.019	0.001	0.004	0.010
Dunsdale Hollow	351450	376268	5.9	0.026	0.002	0.006	0.013
Flaxmere Moss	355660	372296	7.3	0.022	0.002	0.005	0.011

Flood Brook Clough	353190	379904	7.7	0.093	0.007	0.021	0.047
Hatch Mere	355249	372130	10.1	0.021	0.002	0.005	0.011
Hatton's Hey Wood, Whittle's Corner & Bank Rough	356440	377173	10.1	0.034	0.002	0.008	0.017
Linmer Moss	354735	370769	11.2	0.019	0.001	0.004	0.009
Oak Mere	357489	367736	11.9	0.016	0.001	0.004	0.008
Warburton's Wood & Well Wood	355241	376586	14.7	0.029	0.002	0.007	0.015
Mersey Estuary	As above (see Ramsar site)						

Notes: * Maximum over all meteorological years

Detailed Results at Human Health Receptors

Table B.10: Metal Concentrations at Human Health Receptors (AERMOD, Scenario 2)

Receptor name	Cd+Tl (total) (mg/m²/day)	Cd+Tl (per metal) (mg/m²/day)	Hg (mg/m²/day)	Sb,AS,Pb, Cr,Co,Cu, Mn,Ni,V (total) (mg/m²/day)	Sb,AS,Pb, Cr,Co,Cu, Mn,Ni,V (per metal) (mg/m²/day)
Agricultural area near sewage works	3.12×10^{-4}	1.56×10^{-4}	6.23×10^{-6}	3.12×10^{-3}	3.47×10^{-4}
Agricultural area South of Linner Farm	4.51×10^{-4}	2.26×10^{-4}	9.05×10^{-6}	4.51×10^{-3}	5.01×10^{-4}
Agricultural area near Big Bear's Wood	3.79×10^{-4}	1.90×10^{-4}	7.29×10^{-6}	3.79×10^{-3}	4.21×10^{-4}
Pickerings Farm	6.03×10^{-4}	3.02×10^{-4}	1.12×10^{-5}	6.03×10^{-3}	6.70×10^{-4}
Hale Gate Farm	5.89×10^{-4}	2.95×10^{-4}	1.06×10^{-5}	5.89×10^{-3}	6.55×10^{-4}
6th Form College	1.25×10^{-3}	6.26×10^{-4}	2.09×10^{-5}	1.25×10^{-2}	1.39×10^{-3}
Westfield Primary School	1.30×10^{-3}	6.52×10^{-4}	1.88×10^{-5}	1.30×10^{-2}	1.45×10^{-3}
Halton Primary Care Trust	1.07×10^{-3}	5.34×10^{-4}	1.67×10^{-5}	1.07×10^{-2}	1.19×10^{-3}
St Clements Catholic Primary School	8.43×10^{-4}	4.21×10^{-4}	1.61×10^{-5}	8.43×10^{-3}	9.36×10^{-4}
Pewithal Primary School	1.64×10^{-3}	8.22×10^{-4}	2.77×10^{-5}	1.64×10^{-2}	1.83×10^{-3}
The Heath School	1.65×10^{-3}	8.26×10^{-4}	2.70×10^{-5}	1.65×10^{-2}	1.84×10^{-3}
Weston Point Community Primary School	1.48×10^{-3}	7.42×10^{-4}	2.16×10^{-5}	1.48×10^{-2}	1.65×10^{-3}
Weston Primary School	1.45×10^{-3}	7.23×10^{-4}	2.33×10^{-5}	1.45×10^{-2}	1.61×10^{-3}
Livestock grazing area adjacent to Lordship Marsh	1.57×10^{-4}	7.87×10^{-5}	3.84×10^{-6}	1.57×10^{-3}	1.75×10^{-4}
Agricultural area adjacent to Lordship Lane	8.52×10^{-5}	4.26×10^{-5}	2.16×10^{-6}	8.52×10^{-4}	9.47×10^{-5}
Hill View Farm	7.72×10^{-5}	3.86×10^{-5}	2.03×10^{-6}	7.72×10^{-4}	8.58×10^{-5}
Spring Farm	6.40×10^{-5}	3.20×10^{-5}	1.76×10^{-6}	6.40×10^{-4}	7.11×10^{-5}
Hatley Farm	1.54×10^{-4}	7.70×10^{-5}	3.62×10^{-6}	1.54×10^{-3}	1.71×10^{-4}
Pike Nook Farm	1.62×10^{-4}	8.09×10^{-5}	3.85×10^{-6}	1.62×10^{-3}	1.80×10^{-4}
Maximum across grid	4.18×10^{-3}	2.09×10^{-3}	9.04×10^{-5}	4.18×10^{-2}	4.65×10^{-3}

Table B.11: Metal Concentrations at Human Health Receptors (ADMS, Scenario 2)

Receptor name	Cd+Tl (total) (mg/m²/day)	Cd+Tl (per metal) (mg/m²/day)	Hg (mg/m²/day)	Sb,AS,Pb, Cr,Co,Cu, Mn,Ni,V (total) (mg/m²/day)	Sb,AS,Pb, Cr,Co,Cu, Mn,Ni,V (per metal) (mg/m²/day)
Agricultural area near sewage works	4.27×10^{-4}	2.13×10^{-4}	1.66×10^{-4}	4.27×10^{-3}	4.74×10^{-4}
Agricultural area South of Linner Farm	4.44×10^{-4}	2.22×10^{-4}	1.67×10^{-4}	4.44×10^{-3}	4.93×10^{-4}
Agricultural area near Big Bear's Wood	7.83×10^{-4}	3.92×10^{-4}	2.27×10^{-4}	7.83×10^{-3}	8.70×10^{-4}
Pickerings Farm	6.05×10^{-4}	3.03×10^{-4}	2.12×10^{-4}	6.05×10^{-3}	6.72×10^{-4}
Hale Gate Farm	8.75×10^{-4}	4.37×10^{-4}	2.65×10^{-4}	8.75×10^{-3}	9.72×10^{-4}
6th Form College	1.63×10^{-3}	8.14×10^{-4}	3.31×10^{-4}	1.63×10^{-2}	1.81×10^{-3}
Westfield Primary School	2.30×10^{-3}	1.15×10^{-3}	3.42×10^{-4}	2.30×10^{-2}	2.56×10^{-3}
Halton Primary Care Trust	3.61×10^{-3}	1.80×10^{-3}	5.23×10^{-4}	3.61×10^{-2}	4.01×10^{-3}
St Clements Catholic Primary School	2.42×10^{-3}	1.21×10^{-3}	4.52×10^{-4}	2.42×10^{-2}	2.69×10^{-3}
Pewithal Primary School	4.28×10^{-3}	2.14×10^{-3}	6.63×10^{-4}	4.28×10^{-2}	4.75×10^{-3}
The Heath School	4.06×10^{-3}	2.03×10^{-3}	6.77×10^{-4}	4.06×10^{-2}	4.51×10^{-3}
Weston Point Community Primary School	2.84×10^{-3}	1.42×10^{-3}	4.06×10^{-4}	2.84×10^{-2}	3.15×10^{-3}
Weston Primary School	3.13×10^{-3}	1.57×10^{-3}	6.12×10^{-4}	3.13×10^{-2}	3.48×10^{-3}
Livestock grazing area adjacent to Lordship Marsh	1.45×10^{-4}	7.25×10^{-5}	4.57×10^{-5}	1.45×10^{-3}	1.61×10^{-4}
Agricultural area adjacent to Lordship Lane	1.29×10^{-4}	6.44×10^{-5}	3.24×10^{-5}	1.29×10^{-3}	1.43 X 10-4
Hill View Farm	6.15×10^{-5}	3.07×10^{-5}	2.33×10^{-5}	6.15×10^{-4}	6.83×10^{-5}
Spring Farm	6.19×10^{-5}	3.10×10^{-5}	2.27×10^{-5}	6.19×10^{-4}	6.88×10^{-5}
Hatley Farm	1.76×10^{-4}	8.79×10^{-5}	6.37×10^{-5}	1.76×10^{-3}	1.95×10^{-4}
Pike Nook Farm	1.80×10^{-4}	9.01×10^{-5}	6.46×10^{-5}	1.80×10^{-3}	2.00×10^{-4}
Maximum across grid	8.08×10^{-3}	4.04×10^{-3}	1.14×10^{-3}	8.08×10^{-2}	8.98×10^{-3}

Table B.12: Dioxin and Furan Concentrations at Human Health Receptors

Receptor name	Dioxins and Furans ($ng/m^2/yr$)	
	AERMOD	ADMS
Agricultural area near sewage works	0.23	0.31
Agricultural area South of Linner Farm	0.33	0.32
Agricultural area near Big Bear's Wood	0.28	0.57
Pickerings Farm	0.44	0.44
Hale Gate Farm	0.43	0.64
6th Form College	0.91	1.19
Westfield Primary School	0.95	1.68
Halton Primary Care Trust	0.78	2.63
St Clements Catholic Primary School	0.61	1.76
Pewithal Primary School	1.20	3.12
The Heath School	1.20	2.96
Weston Point Community Primary School	1.08	2.07
Weston Primary School	1.05	2.29
Livestock grazing area adjacent to Lordship Marsh	0.11	0.11
Agricultural area adjacent to Lordship Lane	0.06	0.09
Hill View Farm	0.06	0.04
Spring Farm	0.05	0.05
Hatley Farm	0.11	0.13
Pike Nook Farm	0.12	0.13
Maximum across grid	3.05	5.89

Annex C

Consideration of Combined Effects with Weston Point CHP Plant

Introduction

RPS has identified that the construction of the proposed Ineos EfW facility could potentially effect the dispersion of emissions from the existing adjacent CHP facility, due to the height of the proposed EfW facility buildings relative to the height of the CHP exhaust gas emissions stack.

Pollutant concentrations have been predicted for the existing conditions and compared with predicted pollutant concentrations with the EfW facility buildings.

A sensitivity analysis has been undertaken to determine the effects on process contributions of a range of heights for the CHP exhaust gas emissions stack. The outcome of this analysis is to determine the stack height at which the effects of the EfW facility main building are no longer significant thereby ensuring the adequate dispersion of pollutants.

Methodology

Relevant model input data for the Weston Point CHP Plant were inferred from recent dispersion modelling undertaken by URS on behalf of Scottish and Southern Energy for the purposes of supporting a PPC application for the facility[1]. Only emissions of oxides of nitrogen (NO_x) and resultant nitrogen dioxide (NO_2) ground level concentrations have been considered in this assessment, as these are the key atmospheric emissions relative to relevant air quality objectives and limit values and existing baseline concentrations. The modelling methodology is consistent with that undertaken for the assessment of the proposed EfW facility reported in this technical appendix.

Table C-1 summarises the model input data assumed for the Weston Point CHP Plant.

[1] URS, March 2006, Weston Point CHP Plant – IPPC Application Emissions Inventory and Impact Assessment.

Table C-1: Weston Point CHP Plant Emissions Data

Parameter	Unit	Value
Stack Height	m	45
Stack Diameter	m	3.5
Efflux Velocity	$m.s^{-1}$	18.1
Efflux Temperature	°C	140
Volumetric Flow Rate	$Am^3.s^{-1}$	174
NO_x Emission	$g.s^{-1}$	6.7

Modelling of the CHP plant in isolation has been undertaken using hourly sequential meteorological data collected at Liverpool John Lennon Airport for the period 2000 to 2004 to determine a PC for NO_2 for the following scenarios:

- without an adjacent EfW facility;
- with an adjacent EfW facility with a main building height of 47m; and
- Cumulative modelling with the proposed EfW facility.

The PCs for each scenario have been added to the ambient concentration (AC) to determine a predicted environmental concentration (PEC). The PECs for each scenario have been compared with the relevant air quality objectives and limit values for NO_2. The AC assumed within this annex is derived from Section 5.

For the purposes of determining an appropriate stack height, PCs were predicted for the CHP plant with the EfW facility main building assuming stack heights of 45m, through to 85m, at 10m incremental spacing. Maximum 99.79th percentile hourly and annual mean contributions were modelling. Results are reported for the maximum affected location. This is considered a robust and conservative approach.

The objective of determining an appropriate stack height is to establish at what stack height local building wake effects are no longer significant thereby ensuring the adequate dispersion of pollutants. The primary determinant of the chimney height is therefore the local building height. On this basis, the stack height determination considers a unit emission rate of 1 $g.s^{-1}$ and the use of five years of hourly sequential meteorological data from Liverpool John Lennon Airport enabling the influence of meteorological conditions to be determined. In addition, no terrain is included in the stack height determination modelling.

Dispersion Modelling Results

Table C-2 below summarises the modelling results of the CHP plant without an adjacent EfW facility main building. These results are therefore reflective of the current air quality effects resulting from the operation of the CHP plant.

Table C-2: NO_2 Modelling Results - CHP Without Influence of EfW Facility (µg.m^{-3})

Averaging Period	EQS	AC	PC	PC as % of EQS	PEC	Magnitude of PC	Significance Descriptor
1 hour (99.79th percentile)	200	52	4.4	2.2	56.4	Very Small	Neutral
Annual	40	26	0.8	2	26.8	Very Small	Neutral

The modelling results presented in Table C-2 indicate that the operation of the CHP plant does not result in any breaches of relevant air quality objectives or limit values. The air quality effects are considered to be neutral.

Table C-3 below summarises the modelling results of the CHP plant with an adjacent EfW facility main building.

Table C-3: NO_2 Modelling Results - CHP With Influence of EfW Facility (µg.m^{-3})

Averaging Period	EQS	AC	PC	PC as % of EQS	PEC	Magnitude of PC	Significance Descriptor
1 hour (99.79th percentile)	200	52	29.6	14.8	81.6	Medium	Slight Adverse
Annual	40	26	2.4	5.9	28.4	Small	Slight Adverse

The modelling results presented in Table C-3 indicate that the operation of the CHP plant is affected by the adjacent EfW facility building and resultant effects are considered to be slight adverse. However, despite the increase in contributions, resultant NO_2 concentrations are unlikely to breach relevant air quality objectives and limit values.

Table C-4 below summarises the individual and combined modelling results of the CHP plant and the adjacent EfW facility.

Table C-4: NO_2 Modelling Results – Combined CHP and EfW Facility (µg.m^{-3})

Averaging Period	Source	EQS	AC	PC	PC as % of EQS	PEC	Magnitude of PC	Significance Descriptor
1 hour (99.79th percentile)	CHP	200	52	29.6	14.8	81.6	Medium	Slight Adverse
	EfW			13.3	6.7	65.3	Small	Slight Adverse
	Combined			29.6	14.8	81.6	Medium	Slight Adverse
Annual	CHP	40	26	2.4	5.9	28.4	Small	Slight Adverse
	EfW			1.4	3.5	27.4	Very Small	Neutral
	Combined			3.0	7.4	29.0	Small	Slight Adverse

The model results presented in Table C-4 indicate that the combined effects of the CHP plant and the EfW facility are considered to be slight adverse. However, resultant NO_2 concentrations are unlikely to breach relevant air quality objectives and limit values.

Figure C-1 and Figure C-2 summarise the dispersion modelling results for different CHP plant stack heights with an adjacent EfW facility building. The stack height determination has been undertaken assuming a unit emission rate and flat terrain in order to infer when building wake effects are no longer significant.

Figure C-1: Predicted Contributions for Different Stack Heights (Annual Average)

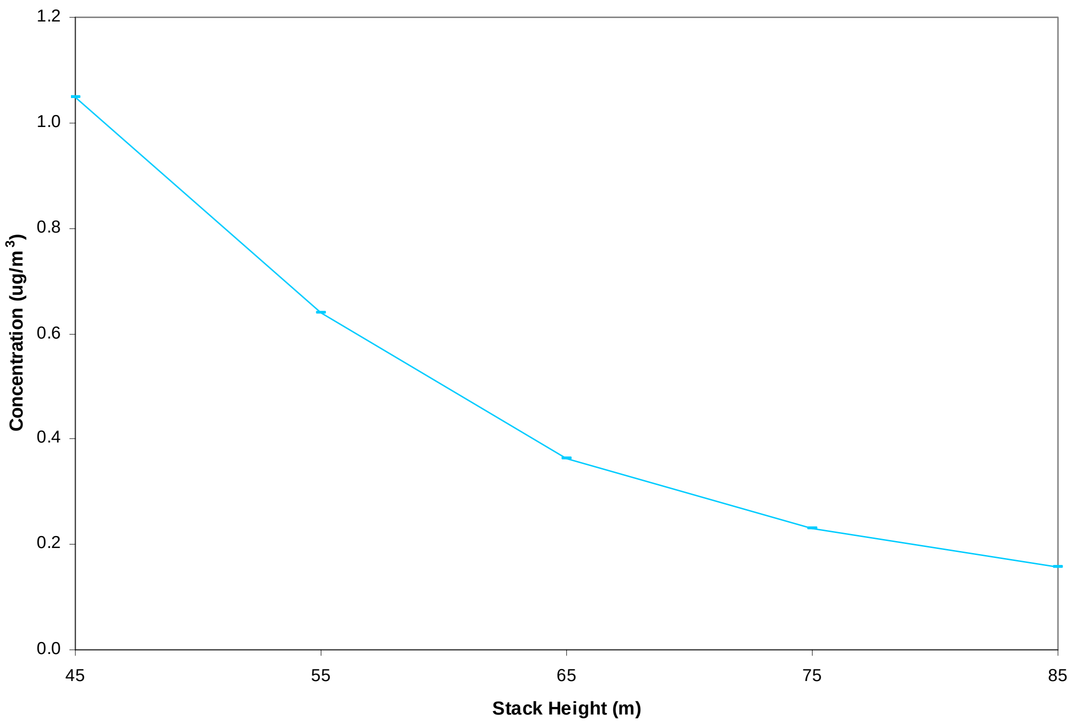
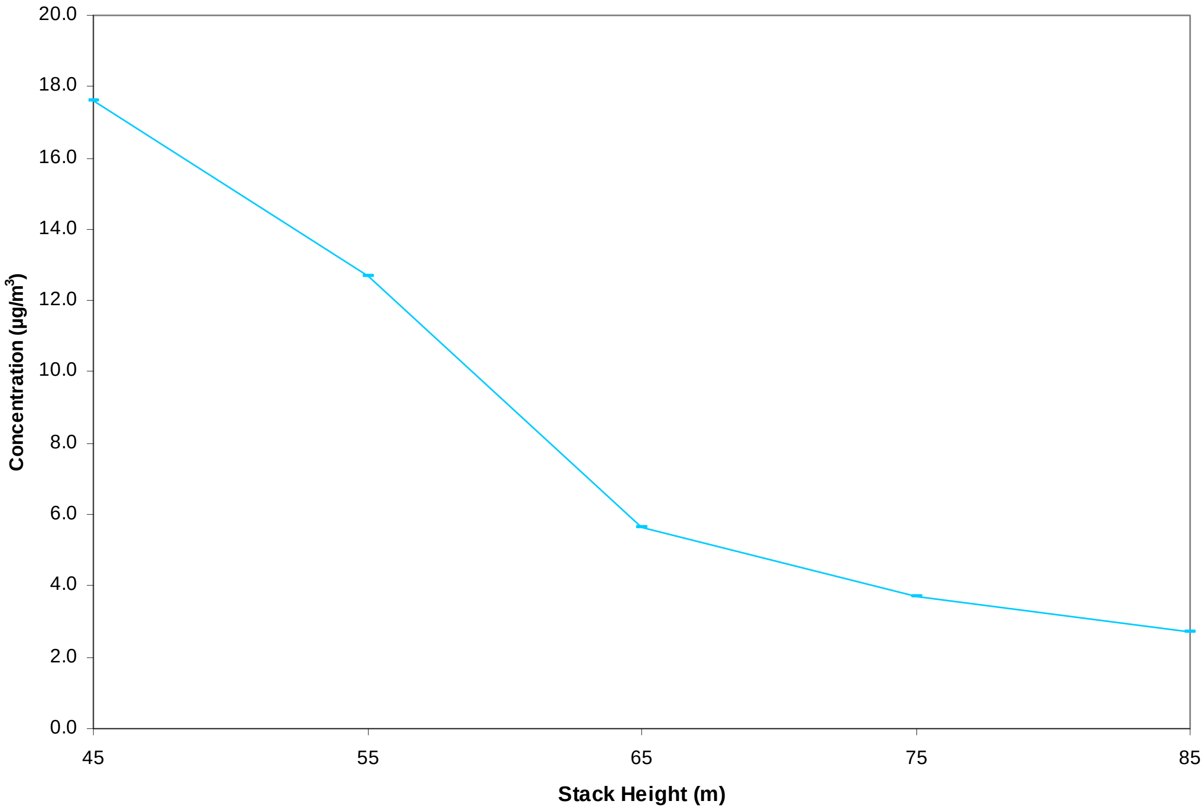


Figure C-2: Predicted Contributions for Different Stack Heights (99.79th Percentile Hourly Mean)



The analysis illustrates that for stack heights below 65m, the building wake effects associated with the EfW facility main building are predicted to affect dispersion of exhaust gases from the CHP plant stack. For stack heights above this height, ground level contributions do not reduce materially with increasing stack height.

Project Recommendations

An increase in CHP stack height to reduce air quality effects resulting from the proposed EfW facility development is not considered essential as resultant concentrations of NO_2 are predicted to achieve relevant air quality objectives and limit values taking into account combined effects with the EfW facility itself and background concentrations.