Energy from Waste Combined Heat and Power Facility, North Yard, Devonport

Air Quality Dispersion Modelling Report

May 2011

Prepared for

MVV Environment Devonport Ltd

Revision Schedule

Air Quality Dispersion Modelling Report
May 2011

Rev	Date	Details	Prepared by	Reviewed by	Approved by
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Dispersion Modelling Assessment Checklist

Item	√/x	Reasons for Omission
Location map	√	
Site plan	√	
List of pollutants modelled and relevant air quality guidelines	√	
Details of modelled scenarios	√	
Details of relevant ambient concentrations used	√	
Model description and justification	√	
Special model treatments used	√	
Table of emission parameters used	√	
Details of modelled domain and receptors	√	
Details of meteorological data used (including origin) and justification	√	
Details of terrain treatment	√	
Details of building treatment	√	
Sensitivity analysis	√	
Assessment of impacts	√	
Model input files	√	

Dispersion and Deposition Modelling for Ecological Receptors Assessment Checklist

Item	√/x	Reasons for Omission
Location map	√	
Site plan	√	
List of pollutants modelled and relevant air quality guidelines	√	
Details of modelled domain, identifying sensitive ecological receptors (e.g. SSSIs, SACs, and SPAs)	√	
Site-specific critical levels and critical loads, with justification	√	
Details of relevant ambient concentrations, with justification	√	
Details of background deposition fluxes, with justification	√	
Table of emission parameters used	√	
Details of modelled scenarios	√	
Details of meteorological data used (including origin) and justification	√	
Model description, with justification	√	
Choice of meteorological data, with justification	√	
Pollutant-specific deposition velocities and washout / scavenging coefficients, with justification	√	
Table of emission parameters used (including for each source: location, release height, orientation, diameter, emission rate, exit temperature, vertical exit velocity, vertical volumetric flow rate)	√	
Details of terrain treatment	√	
Details of building treatment	√	
Sensitivity analysis	√	
Assessment of impacts	√	
Model input files	√	

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1 Introduction

1.1 Overview

1.1.1 URS / Scott Wilson has been instructed by MVV Environment Devonport Ltd (MVV) to prepare an air quality dispersion modelling report to quantify the impact of the operation of an Energy from Waste (EfW) Combined Heat and Power (CHP) Facility at North Yard, Devonport, Plymouth.

1.1.2 Emissions to air from the facility have the potential to adversely affect human health and sensitive ecosystems. Emissions of odour have the potential to affect amenity of nearby residents living in the vicinity of the operational facility. This report details the results of a dispersion modelling assessment of emissions from the process and associated road traffic.

1.1.3 The magnitude of air quality impacts at sensitive human receptors are quantified for pollutants emitted from the main chimney of the facility. The impact of emissions on sensitive ecological receptors is considered in the context of relevant critical loads or critical levels for designated nature sites. The impact of odour emissions is considered with regard to Environment Agency criteria for predicting the likelihood that odour emissions would lead to complaints from surrounding residents.

1.1.4 The assessment considers emissions from the proposed facility during normal operational conditions. Non routine emissions, such as those which may occur during the four to six month commissioning process or other short-term events typically only occur on an infrequent basis, are detected by the process control system and rectified within a short time period and are tightly regulated by the Environment Agency. For this reason, no detailed consideration of impacts associated with non-routine events is included within this assessment.

1.2 Scope

Combustion Plant Emissions

1.2.1 The assessment considers the impact of process emissions on local air quality, under normal operating conditions, from the main chimney serving the combustion process. The assessment considers impacts in the year in which the facility is due to commence operation, 2014.

1.2.2 The dispersion of emissions is predicted using the dispersion model ADMS 4.2. The results are presented in both tabular format and as contours of predicted ground level process contributions overlaid on mapping of the surrounding area.

1.2.3 Emissions to air from EfW facilities are currently governed by the EU Waste Incineration Directive (2000/76/EC)[1], and are subject to the Environmental Permitting Regulations[2]. By the time the EfW CHP facility becomes operational in 2014, however, Directive 2010/75/EU will have been transposed into UK law[3]. The Industrial Emissions Directive (IED) amends, consolidates and replaces seven Directives on pollution from industrial installations, including those relating to Integrated Pollution Prevention and Control (IPPC) and Waste Incineration.

[1] EC (2000) Directive 2000/76/EC on the Incineration of Waste
[2] H.M. Government (2010) The Environmental Permitting (England and Wales) Regulations 2010 SI 675, OPSI
[3] EC (2010) Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control (Recast)

1.2.4 The pollutants considered within this assessment from the main chimney are:

- Oxides of Nitrogen (NO_X), as Nitrogen Dioxide (NO_2);
- Particulate Matter (as PM_{10} and $PM_{2.5}$);
- Carbon Monoxide (CO);
- Sulphur Dioxide (SO_2);
- Hydrogen Chloride (HCl);
- Hydrogen Fluoride (HF);
- Twelve metals (Cadmium (Cd), Thallium (Tl), Mercury (Hg), Antimony (Sb), Arsenic (As), Lead (Pb), Chromium (Cr), Cobalt (Co), Copper (Cu), Manganese (Mn), Nickel (Ni) and Vanadium (V));
- Polycyclic Aromatic Hydrocarbons (PAH), as benzo[a]pyrene.
- Dioxins and Furans; and
- Volatile organic compounds (VOCs), as benzene

1.2.5 Emissions of ammonia (NH_3) from the facility have been included in the assessment, due to potential effects on sensitive ecosystems, directly through increased atmospheric concentrations, and indirectly as a component of acid and nutrient nitrogen deposition.

1.2.6 A comparison has been made between predicted model output concentrations, and short-term and long-term Environmental Assessment Levels (EALs), set out within Horizontal Guidance Document H1, Annex (f)[4].

1.2.7 The assessment also includes a consideration of visible plume generation.

Road Traffic Emissions

1.2.8 The incomplete combustion of fuel in vehicle engines results in the presence of hydrocarbons (HC) such as benzene and 1,3-butadiene, and carbon monoxide (CO) and PM_{10} in exhaust emissions. In addition, at the high temperatures and pressures found within vehicle engines, some of the nitrogen in the air and the fuel is oxidised to form NO_X, mainly in the form of nitric oxide (NO), which is then converted to NO_2 in the atmosphere. NO_2 is associated with adverse effects on human health. Better emission control technology and fuel specifications are expected to reduce emissions per vehicle over time.

1.2.9 The assessment therefore considers emissions of nitrogen oxides and particulate matter from road traffic, using the dispersion model ADMS-Roads. The magnitude of road traffic emissions for the baseline and with development scenarios are calculated from traffic flow data using the Highways Agency's current emissions factor database tool EFT4.2. The assessment considers the impact of road traffic emissions at receptors adjacent to roads in the vicinity of the proposed facility

1.2.10 Although CO, benzene and 1,3-butadiene are present in motor vehicle exhaust emissions, detailed consideration of the associated impacts on local air quality is not considered relevant in the context of the proposed facility. Road traffic emissions of these substances have been reviewed by Plymouth City Council and nowhere within the administrative area is at risk of

[4] Environment Agency (2010) Horizontal Guidance Note H1 – Annex (f), v2.2, August 2010

exceeding these objectives. The proposed changes to road traffic flows would not be capable of compromising the achievement of the relevant air quality objectives for the protection of human health. Emissions of CO, benzene and 1,3-butadiene from road traffic are therefore not considered within the assessment.

Odour Emissions

1.2.11 Waste odours are contained within the facility building through the use of a ventilation system to maintain negative pressure, thereby virtually eliminating emissions through open doors in all but the most adverse meteorological conditions. Air from the ventilation system is used as feed air to the combustion plant, which ensures destruction of odorous compounds before they are emitted to atmosphere. During normal operations, therefore, odour emissions from the facility building are unlikely to occur.

1.2.12 At times when the combustion line is shut down, waste would continue to be accepted into the facility. At such times, air from the ventilation system would be fed to a filter and emitted to atmosphere via a shutdown exhaust chimney. The dispersion of odour emissions from this source is predicted using the dispersion model ADMS 4.2.

1.2.13 The criteria for assessing odour impact has been developed with reference to Environment Agency draft guidance.

Cumulative Impacts

1.2.14 Cumulative impacts from existing industrial facilities in the area have been accounted for in the adoption of site-specific background pollutant concentrations from archive sources and a programme of project-specific baseline air quality monitoring in close proximity to the facility site. This includes the contribution of emissions from:

- Permitted industrial processes within Devonport (boiler plant, surface treatment process and paint spraying process);
- Weston Mill Crematorium; and
- Langage natural gas fired power station, a major source of combustion emissions located 12 km to the east.

1.2.15 15 km to the east of the proposed facility is the site of the New England Resource Recovery Centre. This process is not yet operational and has not therefore been accounted for in the assessment of background ambient air concentrations. The potential cumulative impact of the New England EfW process and the Devonport EfW CHP facility has been considered separately in Section 6 of this report.

1.3 Site Description

1.3.1 The site is located in the northern section of Her Majesty's Naval Base (HMNB), Devonport, Plymouth. It is in the ownership of the Ministry of Defence (MoD) and will be leased by the MoD to MVV for the EfW CHP facility. The site is in an industrial setting, with the operations of HMNB Devonport and other dockyard activities having been located on this part of the Tamar Estuary for many centuries.

1.3.2 To the north and north-west of the site lies the residential area of Barne Barton. In proximity are properties on Talbot Gardens, Savage Road and Poole Park Road. This area of housing is at a higher elevation than the site. A number of these properties are flats arranged over several storeys.

1.3.3 There are further residential properties to the east, north east and south east of the site at Weston Mill, St. Budeaux, King's Tamerton, Camel's Head, North Prospect and Keyham, as well as further afield in Saltash to the north-west, Wilcove to the west and Torpoint to the south-west.

1.3.4 Weston Mill Community Primary School is located at Camel's Head to the east.

1.3.5 Plymouth City Centre is approximately 5 km to the south east.

1.3.6 The approximate National Grid Reference of the site is SX 447 574. The location of the proposed facility, in relation to the surrounding area and nearby sensitive receptors, is shown in Figure 1.1 of Annex A to this report.

1.4 Sources of Information

1.4.1 The information used within this assessment includes:

- data on emissions to atmosphere from the process, taken from WID limits and data provided by MVV;
- details on the site layout provided by MVV;
- Ordnance Survey mapping;
- Ordnance Survey terrain data;
- baseline air quality data from project specific monitoring, archive sources and Local Authorities; and
- meteorological data supplied by ADM Ltd.

1.5 Assessment Structure

1.5.1 The remainder of this assessment report is set out as follows:

- Section 2: Assessment criteria.
- Section 3: Assessment methodology.
- Section 4: Summary of baseline air quality.
- Section 5: Dispersion modelling results.
- Section 6: Assessment limitations and assumptions
- Section 7: Summary and recommendations

2 Assessment Criteria

2.1 Environmental Assessment Levels (EALs)

EAL Criteria for the Protection of Human Health

2.1.1 The Environmental Assessment Level (EAL) criteria for the protection of human health, against which impacts from the EfW process and road traffic are evaluated, are set out within Table 2.1. The criteria are taken from the Environmental Benchmarks contained within Appendix B of the Environment Agency's Horizontal Guidance Document H1, Annex (f)[5].

2.1.2 The Clean Air for Europe (CAFE) programme revisited the management of Air Quality within the EU and replaced the EU Framework Directive 96/62/EC, its associated Daughter Directives 1999/30/EC, 2000/69/EC, 2002/3/EC, and the Council Decision 97/101/EC with a single legal act, the Ambient Air Quality and Cleaner Air for Europe Directive 2008/50/EC[6].

2.1.3 Directive 2008/50/EC is currently transcribed into UK legislation by the Air Quality Standards Regulations 2010 SI No. 1001[7] which came into force on 11th June 2010. The Limit Values are binding on the UK and have been set with the aim of avoiding, preventing or reducing harmful effects on human health and on the environment as a whole. The Directive also lists a number of Target Values.

2.1.4 For substances not specified in the regulations, EAL criteria are taken from Appendix B of the H1 Annex (f) guidance document.

2.1.5 The EAL concentrations presented within Table 2.1 have been adopted as the assessment criteria for this study.

Table 2.1: Environmental Assessment Levels for Air (for the Protection of Human Health)

Pollutant	Source	Concentration ($\mu g/m^3$)	Measured as	Future Date to be achieved (where applicable)
NO_2	EU Air Quality Limit Values	40	Annual mean	
	EU Air Quality Limit Values	200	1-hour mean, not to be exceeded more than 18 times a year	
PM_{10}	EU Air Quality Limit Values	40	Annual mean	
	EU Air Quality Limit Values	50	24-hour mean, not to be exceeded more than 35 times a year	
$PM_{2.5}$	EU Air Quality Limit Values	25	Annual mean	1 January 2015
SO_2	WHO Guideline	50	Annual mean	

[5] Environment Agency (2010) Horizontal Guidance Note H1 – Annex (f)
[6] EC (2008), Ambient Air Quality and Cleaner Air for Europe, 2008/50/EC, European Parliament and the Council of the European Union
[7] H.M. Government (2010) The Air Quality Standards Regulations. SI 1001, the Stationary Office.

Pollutant	Source	Concentration ($\mu g/m^3$)	Measured as	Future Date to be achieved (where applicable)
	UK Air Quality Strategy Objectives	266	15-min mean, not to be exceeded more than 35 times a year	
	EU Air Quality Limit Values	350	1-hour mean, not to be exceeded more than 24 times a year	
	EU Air Quality Limit Values	125	24-hour mean, not to be exceeded more than 3 times a year	
Benzene	UK Air Quality Strategy Objectives	16.25	Running annual mean	
	EU Air Quality Limit Values	5	Annual mean	
CO	EU Air Quality Limit Values	10,000	Maximum daily running 8-hour mean	
	H1 (f), Table B5	30,000	1-hour maximum	
HCl	H1 (f), Table B5	750	1-hour maximum	
HF	H1 (f), Table B5	16	Monthly mean	
	H1 (f), Table B5	160	1-hour maximum	
PAH, as BaP	EU Air Quality Target Values	0.001	Annual mean	31 December 2012
	UK Air Quality Strategy Objectives	0.00025	Annual mean	31 December 2012
Pb	EU Air Quality Limit Values	0.5	Annual mean	
	UK Air Quality Strategy Objectives	0.25	Annual mean	
Hg	H1 (f), Table B5	0.25	Annual Mean	
	H1 (f), Table B5	7.5	1-hour maximum	
Sb	H1 (f), Table B5	5	Annual Mean	
	H1 (f), Table B5	150	1-hour maximum	
As	EU Air Quality Target Values	0.006	Annual mean	31 December 2012
	H1 (f), Table B5	0.003	Annual mean	
Cd	EU Air Quality Limit Values	0.005	Annual Mean	31 December 2012
Cr, as Cr (II) compounds and Cr (III) compounds	H1 (f), Table B5	5	Annual mean	
	H1 (f), Table B5	150	1-hour maximum	

Pollutant	Source	Concentration ($\mu g/m^3$)	Measured as	Future Date to be achieved (where applicable)
Cr (VI), oxidation state in PM_{10} fraction	H1 (f), Table B5	0.0002	Annual mean	
Cu (dusts and mists)	H1 (f), Table B5	10	Annual mean	
	H1 (f), Table B5	200	1-hour maximum	
Mn	H1 (f), Table B5	0.15	Annual mean	
	H1 (f), Table B5	1500	1-hour maximum	
Ni	EU Air Quality Target Values	0.02	Annual mean	31 December 2012
V	H1 (f), Table B5	5	Annual mean	
	H1 (f), Table B5	1	1-hour maximum	
NH_3	H1 (f), Table B5	180	Annual mean	
	H1 (f), Table B5	2500	1-hour maximum	
PCBs	H1 (f), Table B5	0.2	Annual mean	
	H1 (f), Table B5	6	1-hour maximum	

Assessment Criteria for Sensitive Ecological Receptors

2.1.6 The UK is bound by the terms of the European Birds and Habitats Directives and the Ramsar Convention. The Conservation of Habitats and Species Regulations 2010 (the "2010 Regulations") provides for the protection of European sites created under these polices, i.e. Special Areas of Conservation (SACs) designated pursuant to the Habitats Directive, Special Protection Areas (SPAs) classified under the Birds Directive, and Ramsar Sites designated as wetlands of international importance. The 2010 Regulations apply specific provisions of the European Directives to SACs, SPAs, candidate SACs (cSACs) and proposed SPAs (pSPAs), which require them to be given special consideration and further assessment by any development which is likely to lead to a significant effect upon them.

2.1.7 The legislation concerning the protection and management of designated sites and protected species within England is set out within the provisions of the 2010 Regulations, the Wildlife and Countryside Act 1981 (as amended) and the Countryside and Rights of Way Act 2000 (as amended).

2.1.8 The impact of emissions from the facility on sensitive ecological receptors are quantified within this assessment in two ways:

- as direct impacts arising due to increases in atmospheric pollutant concentrations; and
- indirect impacts arising through deposition of acids and nutrient nitrogen deposition to the ground surface.

2.1.9 The critical levels for the protection of vegetation and ecosystems are set out in Table 2.2, and apply regardless of habitat type. In the case of NH_3 and SO_2, the greater sensitivity of lichens and bryophytes to these pollutants is reflected in the application of stricter EALs at locations where such species are present. These values have been adopted as the assessment criteria for the impact of the process on designated nature sites.

Table 2.2: Critical Level (CLe) Environmental Assessment Levels for Air (for the Protection of Designated Habitat Sites)

Pollutant	Source	Concentration ($\mu g/m^3$)	Measured as	Notes
NH_3	H1 (f), Table B4	1	Annual mean	For sensitive lichen communities & bryophytes and ecosystems where lichens and bryophytes are an important part of the ecosystem's integrity
	H1 (f), Table B4	3	Annual mean	For all higher plants (all other ecosystems)
SO_2	H1 (f), Table B4	10	Annual mean	For sensitive lichen communities & bryophytes and ecosystems where lichens and bryophytes are an important part of the ecosystem's integrity
	H1 (f), Table B4	20	Annual mean	For all higher plants (all other ecosystems)
NO_x (as NO_2)	H1 (f), Table B4	30	Annual mean	-
	H1 (f), Table B4	75	Daily mean	-
HF	H1 (f), Table B4	<5	Daily mean	-
	H1 (f), Table B4	<0.5	Weekly mean	-

2.1.10 Critical load criteria for the deposition of acids and nutrient nitrogen are dependant on the habitat type and species present, and are specific to the sensitive receptors considered within the assessment. The critical loads are set out on the Air Pollution Information System (APIS) website.

2.1.11 The critical load criteria adopted for the sensitive ecological receptors considered by the assessment are presented in the model results section of this report.

Assessment Criteria for Odour Sensitive Receptors

2.1.12 The criteria, at which odour emissions from the auxiliary chimney would cause "no reasonable annoyance", have been set within this assessment at 1.5 OU_E m^{-3}, as a 98th percentile of 1-

hour means. 1.5 OU_E m^{-3} is the benchmark level set within the Draft Horizontal Guidance note H4 for 'highly offensive' odours, and has been adopted in this case[8].

[8] Environment Agency (2009), H4 – Odour Management, Consultation Draft, Version 1.2, June 2009.

3 Assessment Methodology

3.1 Introduction

3.1.1 This section describes the approach taken to the assessment of emissions associated with the operation of the facility. This has been broken down into three sub-sections:

- Modelling of combustion emissions from the EfW CHP facility chimney.
- Modelling of odour emissions from the shutdown exhaust system chimney when the combustion process is offline.
- Modelling of operational phase road traffic emissions on local roads.

3.1.2 The outputs from the modelling of combustion emissions from the EfW CHP process chimney and road traffic have been used to determine the combined change in concentrations of NO_2, PM_{10} and $PM_{2.5}$ at a number of receptors located in close proximity to local roads. The approach taken to the prediction of impacts is determined later within this section of the report.

3.2 Dispersion Model Selection

3.2.1 The assessment of emissions from the EfW CHP facility (emissions of combustion pollutants and odour) has been undertaken using the latest version of ADMS (V4.2), supplied by Cambridge Environmental Research Consultants Limited (CERC). ADMS is a modern dispersion model that has an extensive published validation history for use in the UK[9]. This model has been extensively used throughout the UK to demonstrate regulatory compliance.

3.2.2 The assessment of emissions from road traffic associated with the proposed development has used ADMS-Roads (V2.3) to quantify pollution levels at selected receptors. ADMS-Roads is a modern dispersion model that has an extensive published track record of use in the UK for the assessment of local air quality impacts, including model validation and verification studies[10].

3.3 Modelling of Combustion Emissions from the EfW CHP Facility Chimney

Modelled Scenarios

3.3.1 The dispersion modelling runs undertaken in the assessment of emissions from the main chimney are:

- modelling of maximum ground-level impacts at a range of chimney heights, between 45m and 120m, in order to evaluate the effect of increasing release height on dispersion;
- modelling of impacts on a variable resolution receptor grid and at discrete sensitive human receptors for all pollutants, at a chimney height of 95m; and
- modelling of impacts at selected sensitive ecological receptors, at a chimney height of 95m.

[9] CERC (2007), ADMS 4 Validation Papers.
[10] CERC (2009), ADMS Roads Validation Papers.

3.3.2 The approach taken to the assessment of impacts in each case is outlined further within the remainder of Section 3.3.

Model Inputs

3.3.3 The general model conditions used in the assessment are summarised in Table 3.1. Other more detailed data used to model the dispersion of emissions is considered below.

Table 3.1: General ADMS 4 Model Conditions

Variable	Input
Surface Roughness at source	1.0 m
Receptors	Selected discrete receptors Receptor grid, variable resolution
Receptor location	x,y co-ordinates determined by GIS, z = 1.5 m for residential receptors, z = 0 m for ecological receptors
Source location	x,y co-ordinates determined by GIS
Emissions	Data provided by MVV
Sources	Plant main chimney
Meteorological data	5 years of hourly sequential data, Plymouth Mountbatten (2005 – 2009)
Terrain data	OS Landform Profile DTM tiles: SX45NE, SX45 NW OS Landform Panorama DTM tiles: SX24, SX26, SX44, SX46, SX64, SX66
Buildings that may cause building downwash effects	Turbine Hall, Tipping Hall, Bunker, Silos, Fabric Filter

Emissions Data

3.3.4 The main chimney is the only significant source of combustion emissions from the EfW process itself. The chimney contains a single flue via which the pollutants are emitted to atmosphere.

3.3.5 The physical properties of the combustion emission source, as represented within the model, is presented in Table 3.2. This data has been provided by MVV, and is based on design load operation.

3.3.6 The position of the main chimney within the modelled domain is illustrated in Figure 1.1 of Annex A to this report.

Table 3.2: Physical Properties, EfW Plant Chimney

Parameter	Unit	Value
Chimney position	(NGR) m	244789, 57546
Chimney height	m	95
Effective internal chimney diameter	m	2.3
Flue temperature	°C	120
Flue H_2O content	%	16.92
Flue H_20 mass ratio	kg/kg	0.1191
Flue O_2 content	%	7.5
Chimney gas exit velocity	$m\ s^{-1}$	15.64
Chimney flow at reference conditions (STP, wet)	$Nm^3\ s^{-1}$	45.14

3.3.7 The modelled pollutant emission rates (in $g\ s^{-1}$) are determined by the emissions limits set out within Annex V of the WID. These limits have also been transferred to the IED. The WID emissions limits are shown in Table 3.3.

3.3.8 Pollutant mass emission rates from the EfW process (in $g\ s^{-1}$) have been calculated by multiplying the WID daily average emission limit concentrations by the volumetric flow rate at full load operation (55.85 $m^{-3}\ s^{-1}$, STP, dry basis). The pollutant mass emission rates from the main chimney, as used within the dispersion modelling assessment, are presented in Table 3.4.

3.3.9 Emissions of NH_3 and benzo[a]pyrene are not included in WID. Conservative emission rates for these pollutants has been assumed for this assessment, derived from the IPPC reference document on BAT for Waste Incineration[11].

3.3.10 This assessment assumes that the process would operate at continuous full-load (8,760 hours per year). No time-based variation in emissions has therefore been accounted for within the model.

3.3.11 For the purposes of the assessment of emission of particulate matter (as PM_{10}) and fine particulate matter ($PM_{2.5}$), the total particulate emissions have been assumed to be present in both the PM_{10} and $PM_{2.5}$ size fractions. This approach will result in the over-estimation of impacts on local PM_{10} and $PM_{2.5}$ concentrations.

3.3.12 Emissions of Group 1 metals (Cd and Tl) have individually been taken to be emitted at the emission limit value for the whole group. Monitoring data of similar EfW processes shows that actual heavy metal emission rates are normally well below WID limits, and as such this approach can be considered to be conservative

[11] European Commission, 2006, Integrated Pollution Prevention and Control, Reference Document on the Best Available Techniques for Waste Incineration.

Table 3.3: Air Emission Limit Values as Specified in Annex V of the Waste Incineration Directive (2000/76/EC)

Pollutant	Emission limit (mg m^{-3})	
	Half hour average	Daily average
NO_x (as NO_2)	400	200
Total dust (assumed as PM_{10})	30	10
SO_2	200	50
TOC	20	10
CO	100	50
HCl	60	10
HF	4	1
Group 1 metals (Cd + Tl, total)[a]	0.05	
Group 2 metals (Hg)[a]	0.05	
Group 3 metals (Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V, total)[a]	0.5	
Dioxins and Furans[b]	0.0000001	

[a] Sample averaging times for metals are 30 minutes to 8 hours.

[b] Sample averaging times for dioxins are 6 hours to 8 hours, total concentration of dioxins and furans calculated as a toxic equivalent.

3.3.13 As in the case of Group 1 metals, six of the nine Group 3 metals (Sb, Pb, Co, Cu, Mn and V) have been modelled as being emitted at the emission limit value for the whole group. Once again, actual heavy metal emission rates at comparable facilities are normally well below WID limits, and as such the values used are conservative. Emissions of As, Ni, and Cr have been considered separately, in the manner outlined below.

Consideration of Arsenic, Nickel and Chromium (VI)

3.3.14 In April 2010 the EA published revised EALs for arsenic, nickel and chromium(VI) based on Expert Panel on Air Quality Standards Guidelines (see Table 2.1). The new guidelines are much lower than the former EALs. In particular, the use of the conservative assumptions described above for the assessment of Group 3 metal emissions make it very likely that the assessment would identify a theoretical risk that the EAL value could be exceeded in the case of Cr(VI).

3.3.15 For this reason, As, Cr and Ni emissions from EfW process have been evaluated using interim guidance issued by the EA's Air Quality Modelling and Assessment Unit[12]. Data from ten operational Municipal Waste Incinerators (MWI) has been collated and the range of measured

[12] AQMAU (2010) Interim Guidance to Applicants on Metals Impact Assessment for Waste Incineration Plant, Environment Agency, September 2010

metal concentrations reported. For this assessment, the maximum reported concentrations for As, Cr and Ni has been used to calculate the emission rate for the proposed facility.

3.3.16 An analysis of the proportion of Cr(VI) to total Cr in particulate matter from operational MWI plant in the UK has shown that Cr(VI) accounts for between 0.03% and 2.1% of the total Cr emission. For this assessment, Cr(VI) has been assumed to form 2.1% of the total Cr emission from the facility.

Table 3.4: Pollutant Emission Rates, EfW Process Chimney, Maximum Load Operation

Pollutant	Maximum Pollutant Concentration at Source (mg m^{-3})	Emission rate (g s^{-1})	Emission rate (tpa)[d]
NO_x (as NO_2)	200	11.2	352.3
Total dust (assumed to be PM_{10} and $PM_{2.5}$)	10	0.559	17.6
SO_2	50	2.79	88.1
TOC	10	0.559	17.6
CO	50	2.79	88.1
HCl	10	0.559	17.6
HF	1	0.0559	
NH_3[a]	10	0.559	17.6
Group 1 metals[b] (Cd, Tl)	0.05	0.00279	0.09
Group 2 metals (Hg)	0.05	0.00279	0.09
Group 3 metals[b] (Sb, As, Pb, Co, Cu, Mn, Ni, Pb, V)	0.5	0.0279	0.88
As[c]	0.003	0.00017	0.01
Cr (total)[c]	0.033	0.00184	0.06
Cr(VI)[c]	0.00069	0.000039	0.00122
Ni[c]	0.136	0.0076	0.24
Dioxins and Furans	1×10^{-07}	5.01×10^{-09}	1.76×10^{-7}
PAH, as benzo[a]pyrene[a]	0.01	0.000501	0.00176
PCBs	0.005	0.000279	0.01

[a] Not included in WID
[b] Emissions of the listed group 1 and group 3 metals are taken as 100% the respective limit value for each metal group.
[c] Emissions of As, Cr, Cr(VI) and Ni are calculated according to EA interim guidance.
[d] Mass emission rates are calculated at maximum load, WID emission limits and constant operation (8760 hours per year), and as such are likely to be an overestimate of actual annual emissions.

Modelled Domain – Discrete Receptors

Sensitive Human Receptors

3.3.17 Ground-level concentrations of the modelled pollutants relevant to human health have been predicted at 65 discrete air quality sensitive receptors, as listed in Table 3.5. The locations of these receptors are also shown in Figure 1.1 of Appendix A to this report. The receptors have been selected to be representative of residential dwellings in the areas around the proposed facility.

3.3.18 A number of receptors are also in close proximity to traffic routes which would be affected by changes to vehicle flows during the operation of the proposed facility. At these locations, an assessment has been made of the combined effect of emissions from traffic and the main chimney on local concentrations of NO_2, PM_{10} and $PM_{2.5}$. These receptors are listed in Table 3.15.

3.3.19 The flagpole height of the receptors has been set at 1.5 m.

Table 3.5: Modelled Domain, Selected Discrete Human Receptor Locations

Receptor	Description	National Grid Reference
R1	Talbot Gardens	244588, 57389
R2	Furse Park	244257, 57256
R3	Berthon Road	243979, 57523
R4	Kit Hill Crescent	244377, 57846
R5	Poole Park Road	244738, 57868
R6	Cardinal Avenue	244981, 57823
R7	Wolesely Road, adjacent to Camels Head Junction	245250, 57419
R8	York Road	245425, 57752
R9	Junction of Peter's Park Lane / Victoria Road	244807, 58613
R10	Pemros Road	244307, 58257
R11	Saltburn Road	244406, 58554
R12	Vicarage Gardens	243951, 58359
R13	Lowerside	245877, 57895
R14	Wordsworth Crescent	245568, 56978
R15	Wombwell Crescent	245161, 57057
R16	Conway Gardens	246663, 57495
R17	Ford Street	246123, 55992
R18	Westbourne Terrace, Saltash	242938, 59297
R19	Deacon Drive, Saltash	242874, 58242

Receptor	Description	National Grid Reference
R20	Cove Meadow, Torpoint	243206, 56720
R21	Sydney Road, Torpoint	243630, 55443
R22	Weston Mill Primary School at Junction	245286, 57407
R23	Weston Mill Prirmary School at rear	245356, 57366
R24	Wolseley Road nr Camels Head jnc	245235, 57438
R25	Wolseley Road nr Camels Head jnc	245216, 57458
R26	Wolseley Road set back	245257, 57458
R27	Wolseley Road set back	245237, 57483
R28	Weston Mill Drive/Carlton Terrace junction	245297, 57473
R29	Ferndale Road at end of Third Avenue	245465, 57337
R30	Harewood Crescent	246434, 58703
R31	Romney Close	246703, 58423
R32	Cardinal Avenue	244982, 57920
R33	Cardinal Avenue	245103, 58001
R34	Fletemoor Road	244963, 58098
R35	Hamoaze Avenue	244960, 57555
R36	Harbour Avenue	245072, 57475
R37	Wolseley Road/Weston Mill Drive	245274, 57437
R38	Carlton Terrace	245104, 57596
R39	Wolseley Road	244868, 57938
R40	Wolseley Road/Ferndale Avenue	245330, 57316
R41	Ferndale Avenue	245426, 57371
R42	Wolseley Road/Second Avenue	245405, 57220
R43	Wolseley Road/Saltash Road junction	245494, 57120
R44	Bridwell Road	245469, 57937
R45	Riverside Community Primary School (S)	244211, 57569
R46	Riverside Community Primary School (N)	244192, 57669
R47	Savage Road	244663, 57591
R48	Barne Road	244257, 57964
R49	Barne Road	244044, 57849

Receptor	Description	National Grid Reference
R50	Poole Park Road	244409, 57661
R51	Roberts Road	244365, 57692
R52	North Down Crescent	245720, 56866
R53	Wolseley Road	244928, 57664
R54	Duncombe Avenue	246147, 58878
R55	Albert Road, Saltash	243285, 58698
R56	Callington Road, New Road junction, Saltash	241599, 59402
R57	Borough Farm House, Torpoint	242365, 55688
R58	Macey Street, Torpoint	244012, 55200
R59	Charlotte Street	245228, 55634
R60	Northdown Gardens	245896, 56737
R61	St Pancras Avenue	247778, 57967
R62	Shirley Gardens	247145, 58150
R63	St Pancras Avenue	247287, 58034
R64	Sheridan Road	247548, 58130
R65	St Budeaux Foundation Junior School	245422, 58825

Sensitive Ecological Receptors

3.3.20 In accordance with the H1 guidance, the impacts associated with emissions from the combustion process on statutory sensitive ecological sites have been quantified. In addition to considering SSSIs within 2km and European designated sites within 10 km of the proposed facility, as recommended by H1, discussions with Natural England have identified a number of sensitive locations outside of these zones where particularly sensitive species are also known to be present. The most notable of these locations are the European designated SAC South Dartmoor Woods, 10.4 km to the north east (Broad Leaved Woodland with lichens and bryophytes), and the European designated SAC Blackstone Point, approximately 14 km to the south east (Shore Dock). Receptor locations from these locations have also been included in the study, at the request of Natural England.

3.3.21 In addition to the statutory ecological sites, impacts have also been predicted at two County Wildlife Sites (Kinterbury Creek and Ernesettle Complex).

3.3.22 Ground-level concentrations of the modelled pollutants relevant to sensitive ecological receptors have been predicted at 41 locations, as listed in Table 3.6. The locations of these receptors are also shown in Figure 4.2 of Appendix A to this report.

3.3.23 For sensitive ecological receptors, the flagpole height has been set at 0m.

Table 3.6: Modelled Domain, Selected Discrete Ecological Receptor Locations

<table>
<tr><th>Receptor</th><th>Designated Ecological Site</th><th>Description</th><th>Features</th><th>Location Description</th><th>National Grid Reference</th></tr>
<tr><td>E1</td><td rowspan="15">Plymouth Sound and Estuaries SAC</td><td rowspan="15">Marine areas
Sea inlets
Tidal rivers
Estuaries
Mud flats
Sand flats
Lagoons
Salt marshes
Sand dunes
Sand beaches
Shingle
Sea cliffs</td><td rowspan="15">Subtidal sandbanks Estuaries
Intertidal mudflats and sandflats
Shallow Reffs and bays Reefs
Atlantic salt meadows
Allis Shad rivers and streams
Shore Dock</td><td>Next to A38 Bridge East of Tamar</td><td>243689, 58848</td></tr>
<tr><td>E2</td><td>Henn Point south of Saltash West Side of Tamar</td><td>242817, 57742</td></tr>
<tr><td>E3</td><td>Bull Point east side of Tamar</td><td>243356, 57810</td></tr>
<tr><td>E4</td><td>Kinterbury Point east side of Tamar</td><td>243591, 57384</td></tr>
<tr><td>E5</td><td>South point of confluence of Lynher and Tamar</td><td>242824, 57174</td></tr>
<tr><td>E6</td><td>Mudflat on edge of Weston Mill Lake</td><td>244079, 57062</td></tr>
<tr><td>E7</td><td>Looking Glass point next to Wilcove, West side of Tamar</td><td>243642, 56472</td></tr>
<tr><td>E8</td><td>Yonderberry Point West side of Tamar north of Torpoint</td><td>243869, 55959</td></tr>
<tr><td>E9</td><td>Thancakes Lake on the west side of Tamar east of Torpoint</td><td>244094, 55482</td></tr>
<tr><td>E10</td><td>East side of Tamar next to Devonport Dockyard</td><td>244433, 56382</td></tr>
<tr><td>E11</td><td>Western King Point to the north of Plymouth Sound</td><td>246166, 53236</td></tr>
<tr><td>E12</td><td>Mount Batten to the east of the sound</td><td>248454, 53178</td></tr>
<tr><td>E13</td><td>Near Picklecombe point to the west of the sound</td><td>245142, 51423</td></tr>
<tr><td>E14</td><td>Penlee Point to the south west of the sound</td><td>244341, 48698</td></tr>
<tr><td>E15</td><td>Renney Rocks to the south east of the sound</td><td>249076, 48727</td></tr>
</table>

Receptor	Designated Ecological Site	Description	Features	Location Description	National Grid Reference
E16	Plymouth Sound and Estuaries SAC and Tamar Estuaries SPA	Tidal rivers Estuaries Mud flats Sand flats Lagoons Salt marshes Sand dunes Sand Beaches Shingle Sea cliffs	Sub-Saharan Afric breeding fen marsh and swamp Sub-Saharan Afric breeding Littoral sediment Western European/Western Mediterranean breeding – Littoral sediment	River Tamar to the north	242081, 65783
E17				River Tavy at the tidal ford	247446, 65011
E18				River Tavy at Warleigh point to the north	244955, 61117
E19				Skinham point on the west side of the River Tamar near Kingsmill Lake	243105, 60746
E20				East end of Tammerton Lake, a tributary of the Tamar	246625, 60901
E21				Next to Warren point on the east side of the Tamar	243944, 60436
E22				West side of the Tamar just to the north of the A38 bridge	243282, 59134
E23				East side of the Tamar next to the breakwater north of the A38 bridge	243832, 59094
E24				Jupiter point on the south side of the River Lynher	241394, 56802
E25				South side of the Lynher to the west of Maryfield	241030, 55938
E26				Edge of the salt marsh extent on the south side of the Lynher west of Maryfield	240260, 55881
E27				Edge of the salt marsh extent on the north side of the Lynher near blackrock	238983, 55916
E28				Salt marsh on the north side of the Lynher nex to Erth Barton	237770, 56476
E29				Eastern edge of salt marsh in St John's Lake, south of Torpoint	243747, 54348
E30				Salt marsh of St John's Lake next to village of St John	241099, 54005

Receptor	Designated Ecological Site	Description	Features	Location Description	National Grid Reference
E31				Salt Marsh of St John's Lake next to Sango Island	243003, 53610
E32				Eastern edge of salt marsh in Millbrook Lake	244441, 53236
E33	South Dartmoor Woods SAC	Inland water bodies Bogs Marshes Water fringed vegetation and fens	European Dry Heaths Old oak sessile woodlands	Western edge of South Dartmoor Woods	253313, 63623
E34				Central part of South Dartmoor Woods	253809, 63882
E35				Eastern edge of South Dartmoor Woods	254851, 64158
E36	Blackstone Point SAC	Shingle Sea cliffs Improved grasslands	Shore Dock	North Western edge of Blackstone Point	253313, 46530
E37				South Eastern edge of Blackstone Point	253668, 46154
E38	Kinterbury Creek CWS	Mudflats	Mudflats	Western edge of Kinterbury Creek	243939, 58173
E39				Eastern edge of Kinterbury Creek	243547, 58149
E40	Ernesettle Complex CWS	Woodland	Deciduous woodlands	Southern Edge of Ernesettle Complex	244693, 58970
E41				North Eastern edge of Ernesettle Complex	244565, 59728

Modelled Domain – Receptor Grid

3.3.24 Emissions from the main chimney have also been modelled on a receptor grid of variable spacing, in order to determine:

- the location and magnitude of maximum ground level impacts;
- to enable the generation of pollutant contour plots; and
- to predict ground-level pollutant concentrations across the modelled domain, to be used as input data for the assessment of human health effects resulting from exposure to SO_2, NO_2, PM_{10} and $PM_{2.5}$ and the Human Health Risk Assessment.

3.3.25 In accordance with the general guidance set out within H1, the sampling grid extends to encompass the area within a 10 km radius of the chimney location.

3.3.26 Due to the complex nature of the terrain in the immediate vicinity of the site, combined with the need to assess the spatial distribution of the projected impacts in greater detail, a tighter receptor grid has been used in closer proximity to the chimney location.

3.3.27 The receptor grid was centred on the chimney, at grid reference 244789, 57546, details are presented in Table 3.7. As with the discrete human receptor locations, the flagpole height of receptors within the grid has been set at 1.5m.

Table 3.7: Modelled Domain: Variable Resolution Receptor Grid

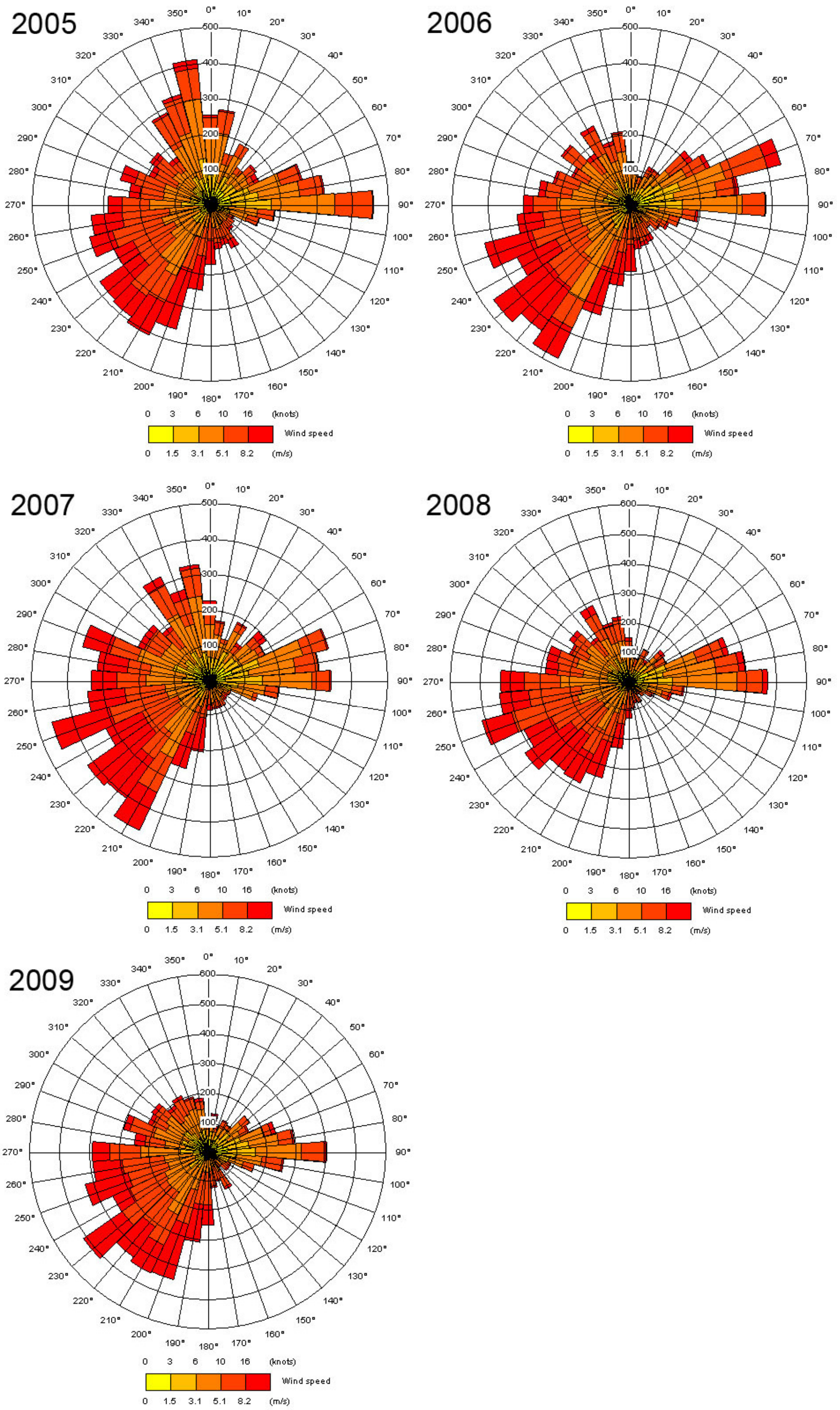
Grid Spacing (m)	Dimensions (m)	No. of Nodes in Each Direction	National Grid Reference of SW Corner
10m	1,000m x 1,000m	101	244289, 57046
25m	2,500m x 2,500m	101	243539, 56296
65m	6,500m x 6,500m	101	241539, 54296
200m	20,000m x 20,000m	101	234789, 47546

Meteorological Data

3.3.28 Hourly sequential data from Plymouth Mountbatten for the years 2005 to 2009 inclusive were used in this study. The station is situated within Plymouth Sound, approximately 5.5.km to the south east and experiences similar meteorological conditions to those at the point of release. The datasets were supplied by ADM Ltd. In order to maximise the number of valid hours in the modelled runs, periods of missing cloud cover in the Mountbatten data have been supplemented with data from Plymouth Airport and Culdrose where possible.

3.3.29 A visual representation of the wind speed and direction data used in the assessment is shown in the wind roses presented in Figure 3.1. The assessment does not use the wind roses to infer the magnitude or frequency of impacts at any receptor. Instead, the set of 41,578 hours of valid sequential observation data for all meteorological parameters are used in the dispersion model to calculate robust estimates of impacts.

Figure 3.1: Wind Roses for Plymouth Mountbatten (2005 – 2009)



Building Downwash Effects

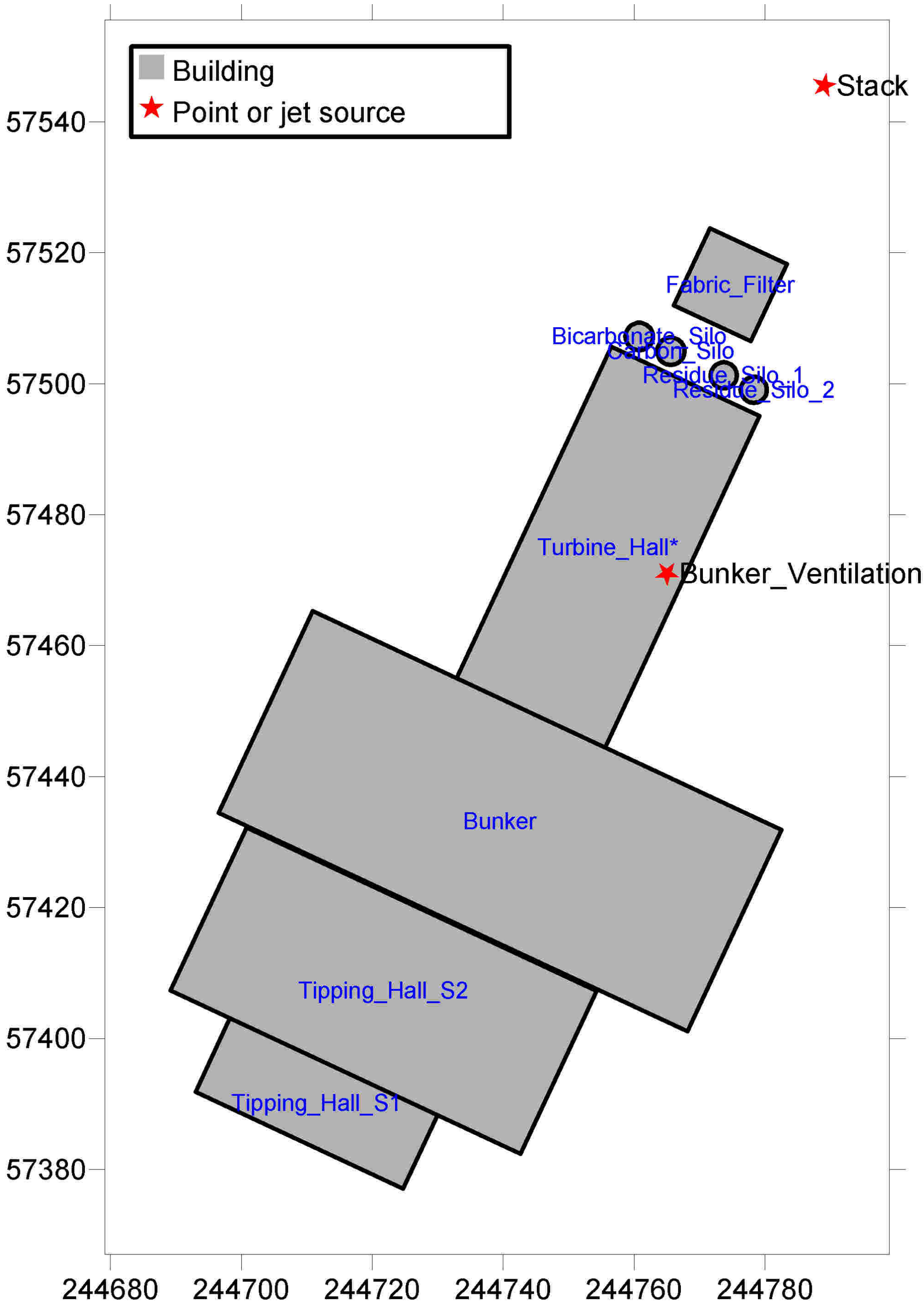
3.3.30 The buildings that make up the facility have the potential to affect the dispersion of emissions from the main chimney. The ADMS buildings effect module has therefore been used to incorporate building downwash effects as part of the modelling procedure. Buildings greater than one third of the range of chimney heights modelled have been included within the modelling assessment.

3.3.31 The building dimensions, as represented within the model, are presented in Table 3.8, and illustrated in Figure 3.2. As buildings within ADMS must be defined as rectangular or circular structures, the shape of the EfW facility's structure has been simplified. The dimensions used in the modelling were taken from the design drawings for the proposed facili.

Table 4.8: Building Parameters

Building	National Grid Reference of Centre Point	Length (m)	Width (m)	Height (m)	Angle (°)
Turbine Hall	244756, 57475	56	25	45	25
Tipping Hall S1	244712, 57390	12.5	35	14	25
Tipping Hall S2	244722, 57407	27.5	59	15	25
Bunker	244740, 57433	34	79	36	25
Bicarbonate Silo	244761, 57507	4.2	Round	34	Round
Carbon Silo	244766, 57505	4.2	Round	34	Round
Residue Silo 1	244774, 57501	4	Round	34	Round
Residue Silo 2	244778, 57499	4	Round	34	Round
Fabric Filter	244775, 57515	13	13	27	25

Figure 3.2: Layout of Buildings Included Within the Model



Terrain

3.3.32 The terrain in the vicinity of the site, and across Plymouth in general, can be considered to be complex, with steep gradients and pronounced changes in height. For this reason, a consideration of terrain effects has been included within the modelling assessment.

3.3.33 Due to the complex nature of the terrain in the immediate vicinity of the site, three different terrain grids have been used in the assessment, in order to maximise the resolution of the grid where possible and best represent the landscape. The high grid resolution (64x64) option was selected within ADMS in each instance.

3.3.34 The medium and large terrain grids were prepared using OS Landform Panorama terrain data. The small terrain grid was prepared using a higher resolution OS Landform Profile dataset.

3.3.35 Details of the terrain grids are presented in Table 3.9. Three sets of model runs were then undertaken for each year of meteorological data, incorporating the receptor grids and discrete receptors which could be accommodated within that specific model domain.

3.3.36 The chimney height assessment considered the potential maximum impact on ground level concentrations within the modelled domain. This was predicted to occur within 1km of the chimney location. Therefore, the model runs carried out to evaluate the effect of chimney height on predicted process contributions was undertaken with the small terrain grid only.

Table 3.9: Modelled Domain, Terrain Grids

Terrain Grid	Resolution	Dimensions (m)	Receptor Grids Modelled
Small	64 x 64	3,500 x 3,500	10m, 25m
Medium	64 x 64	8,000 x 8,000	65m
Large	64 x 64	30,000 x 30,000	200m

Surface Roughness

3.3.37 A surface roughness of 1.0 m was used within ADMS. This option is considered as representative of city and woodland and fits the description of the landscape within the study area.

NO_x to NO_2 Conversion

3.3.38 Emissions of NO_x from the main chimney will consist mainly of Nitric Oxide (NO) at the point of release, oxidising within the atmosphere to form NO_2 as it moves downwind.

3.3.39 In accordance with EA guidance[13], this assessment has applied a 70% NO_x to NO_2 conversion rate at ground level in the calculation long-term annual mean calculations, and a 35% conversion rate in the calculation of short-term hourly concentrations.

[13] AQMAU (2005) Conversion Ratios for NO_X and NO_2, Environment Agency

Calculation of Deposition at Sensitive Ecological Receptors

3.3.40 The deposition of nutrient nitrogen and acid at sensitive ecological receptors is calculated, using the modelled PC predicted at the receptor points. The deposition rates are determined using conversion rates and factors contained within Environment Agency guidance[14], which account for variations deposition mechanisms in different types of habitat.

3.3.41 The conversion rates and factors used in the assessment are detailed in Tables 3.10 and 3.11.

Table 3.10: Conversion Factors – Calculation of Nutrient Nitrogen Deposition

Pollutant	Deposition Velocity Grasslands ($m\ s^{-1}$)	Deposition Velocity Forests ($m\ s^{-1}$)	Conversion Factor ($\mu g\ m^{-2}\ s^{-1}$ to $kg\ ha^{-1}\ year^{-1}$)
NO_X as NO_2	0.0015	0.003	96
NH_3	0.02	0.03	259.7

Table 3.11: Conversion Factors – Calculation of Acid Deposition

Pollutant	Deposition Velocity Grasslands ($m\ s^{-1}$)	Deposition Velocity Forests ($m\ s^{-1}$)	Conversion Factor ($\mu g\ m^{-2}\ s^{-1}$ to $kg\ ha^{-1}\ year^{-1}$)	Conversion Factor ($kg\ ha^{-1}\ year^{-1}$ to $keq\ ha^{-1}\ year^{-1}$)
SO_2	0.012	0.024	157.7	0.0625
NO_2	0.0015	0.003	96	0.0714
NH_3	0.02	0.03	259.7	0.0714
HCl	0.025	0.06	306.7	0.0282
HF	0.025	0.06	306.7	0.0282

3.3.42 As HCl is readily soluble, it can also wet deposition processes can also significantly contribute to total acid deposition. The assumption has been made in this assessment that the wet deposition will be equal to dry deposition, in effect doubling the process contribution from HCl at the sensitive receptor.

Specialised Model Treatments

3.3.43 Emissions have been modelled such that they are not subject to dry and wet deposition or depleted through chemical reactions. The assumption of continuity of mass is likely to result in an over-estimation of impacts at receptors.

[14] Environment Agency (2004), AQTAG06 – Technical Guidance on Detailed Modelling Approach for an Appropriate Assessment for Emissions to Air

3.4 Modelling of Odour Emissions from the Shutdown Exhaust System Chimney

Modelled Scenarios

3.4.1 Dispersion modelling has been carried out of emissions of odour from the shutdown exhaust chimney. During normal operations, ventilation air from the tipping hall and waste bunker is used as combustion air for the process, during which any odorous compounds are destroyed before being emitted to atmosphere from the main chimney. For this reason, odours are not emitted from the shutdown system for most of the time.

3.4.2 When the combustion line is taken out of service for planned maintenance, however, there is the requirement to continue ventilating the facility building. At such times, building air would be passed through a charcoal filter to remove odorous compounds, prior to being emitted to atmosphere via the shutdown exhaust chimney on the roof of the facility building.

3.4.3 Modelling of residual odour emissions has been undertaken, assuming that a constant emission would occur from the shutdown exhaust system chimney. In practice, the exhaust shutdown system this would not occur as the shutdown exhaust chimney would not be in use when the combustion line is operational, and as such represents an over-estimation of impacts.

3.4.4 The assessment focuses on predicted odour concentrations in the vicinity of the closest residential properties to the site boundary. This has been achieved through the use of a modelled receptor grid.

3.4.5 The use of insufficient ventilation rates can potentially lead to odour emissions occurring from the facility building via open sliding doors. In practice, this often occurs when the ventilation rate is well below 1 building air change per hour. The proposed facility has been designed such that the ventilation rate is 1.3 building air changes per hour and it is therefore very unlikely that odorous emissions would occur from open doors under all but the most adverse meteorological conditions, such as during periods of very high winds, and even then only very minor emissions of odour would occur. For this reason, the modelling assessment has not considered fugitive odour emissions from the facility doors.

3.4.6 The approach taken to the assessment of odour impacts is outlined further within the remainder of Section 4.4.

Model Inputs

3.4.7 The general model conditions used in the odour assessment are summarised in Table 3.12. Other more detailed data used to model the dispersion of emissions is considered below.

Table 3.12: General ADMS 4 Model Conditions

Variable	Input
Surface Roughness at source	1.0 m
Receptors	Receptor grid, variable spacing
Receptor location	x,y co-ordinates determined by GIS, z = 1.5 m
Source location	x,y co-ordinates determined by GIS
Emissions	Data provided by Müller-BBM
Sources	Shutdown exhaust system chimney
Meteorological data	5 years of hourly sequential data, Plymouth Mountbatten (2005 – 2009)
Terrain data	OS Landform Profile DTM tiles: SX45NE, SX45 NW
Buildings that may cause building downwash effects	Turbine Hall, Tipping Hall, Bunker, Silos, Fabric Filter
Outputs	Odour, OU_E m^{-3}, 98^{th} percentile of hourly means

Emissions Data

3.4.8 The shutdown exhaust system chimney is the only source of odour emissions considered by the model. The physical properties of the odour emission source, as represented within the model, is presented in Table 3.13. This data has been provided by Müller-BBM, the technology supplier for the exhaust shutdown ventilation system. The location of the shutdown exhaust chimney is also shown on Figure 3.2.

3.4.9 The assessment assumes constant operation of the shutdown exhaust system. No time-based variation in emissions has therefore been accounted for within the model. Although the system would only be used for less than 1000 hours per year, the assumption of constant operation allows the widest range of meteorological conditions to be considered.

3.4.10 The position of the exhaust shutdown system chimney is illustrated in Figure 3.2.

Table 3.13: Physical Properties, Shutdown Exhaust System Chimney

Parameter	Unit	Value
Chimney position	(NGR) m	244765, 57471
Chimney height	m	55
Effective internal chimney diameter	m	1.5
Flue temperature	°C	ambient
Chimney gas exit velocity	$m\ s^{-1}$	11.0
Chimney flow (actual)	$m^3\ s^{-1}$	19.0
Odour emission concentration	$OU_E\ m^{-3}$	100
Odour emission rate	$OU_E\ s^{-1}$	1944

Modelled Domain – Receptor Grid

3.4.11 Odour emissions from the shutdown exhaust system chimney have been modelled on the same variable spaced receptor grid used to model emissions from the main combustion plant chimney, in order to determine the location and magnitude of maximum ground level impacts. Details of the receptor grid used are presented in Table 3.7.

Meteorological Data

3.4.12 As for the assessment of emissions from the combustion plant chimney, hourly sequential data from Plymouth Mountbatten for the years 2005 to 2009 inclusive were used in the odour assessment.

Building Downwash Effects

3.4.13 The building dimensions within the model are the same as that used for the assessment of main chimney emissions, as shown in Table 3.8.

Terrain

3.4.14 The odour model has used the small terrain gird to model odour emissions in close proximity to the application site. The setup of the grid is shown in Table 3.9.

Surface Roughness

3.4.15 As for the assessment of impacts from the main chimney, the odour model used a surface roughness of 1.0 m. This is considered to be representative the landscape around the proposed facility.

Specialised Model Treatments

3.4.16 No specialised model treatments have been used in the assessment of odour emissions.

3.5 Modelling of Emissions from Road Traffic

Modelled Scenarios

3.5.1 A quantitative assessment of the impact of exhaust emissions from additional road traffic has been undertaken, in order to assess the change in air quality statistics at sensitive receptors in close proximity to the designated access routes to the proposed facility. 'ADMS-Roads' (V2.3) has been used to model the dispersion of road traffic emissions, allowing the quantification of pollution levels at selected receptors.

3.5.2 The approach taken to the assessment of road traffic emissions is outlined further within the remainder of Section 3.5.

Model Inputs

3.5.3 The general model conditions used in the assessment of road traffic emissions are summarised in Table 3.14. Other more detailed data used to model the dispersion of emissions is considered below.

Table 3.14: General ADMS-Roads Model Conditions

Variable	Input
Surface Roughness at source	1.0 m
Minimum Monin-Obukhov length for stable conditions	30 m
Receptors	Selected discrete receptors
Receptor location	x,y co-ordinates determined by GIS, z = 1.5 m for residential receptors, z = 0 m for ecological receptors
Emissions	NO_X, PM_{10}, $PM_{2.5}$
Emissions factors	DfT EFT 4.2 emissions factor toolkit
Meteorological data	1 year of hourly sequential data, Plymouth Mountbatten (2009)
Emissions profiles	Based on actual traffic counts in 2010
Terrain type	Flat terrain
Model output	Long-term annual mean NO_X conc. ($\mu g\ m^{-3}$) Long-term annual mean PM_{10} conc. ($\mu g\ m^{-3}$) Long-term annual mean $PM_{2.5}$ conc. ($\mu g\ m^{-3}$)

Traffic Data

3.5.4 Traffic data was provided by the transport team undertaking the Transport Assessment for the proposed facility. The data was calculated according to the methodology followed within the Transport Assessment. The data is based on traffic counts carried out during late 2010.

3.5.5 The data has been provided for use within the dispersion model for the following scenarios:

- 2009/2010 Observed (based on actual traffic count data);
- 2014 Baseline (2010 Observed, plus traffic growth);
- 2014 Operational (2014 Baseline, plus development traffic);
- 2014 Supplementary Baseline (2014 Baseline, plus a number of "potential, but not yet committed" developments); and
- 2014 Supplementary (2014 Operational, plus a number of "potential, but not yet committed" developments).

3.5.6 The traffic data used in the modelling of road traffic emissions is presented in Annex B to this report.

Emissions Data

3.5.7 The magnitude of road traffic emissions for the baseline and with development scenarios are calculated from traffic flow data using the Highways Agency's current emissions factor database tool EFT4.2. The assessment considers the operational phase impact of road traffic emissions at receptors adjacent to roads in the vicinity of the proposed development

Modelled Domain – Discrete Receptors

3.5.8 The receptors for which the impact of road traffic emissions have been predicted are listed in Table 3.15. At these locations, an assessment has also been made of the combined effect of emissions from the EfW CHP facility main chimney.

3.5.9 A number of discrete receptors are outside the area covered by traffic data collected to support the transport assessment. This includes receptors located in Cornwall (including Torpoint and Saltash) and residential properties situated away from major traffic routes. In these areas, only the impact of emissions from the EfW CHP facility chimney have been calculated.

Table 3.15: Modelled Domain: Selected Discrete Human Receptor Locations, Emissions from Road Traffic

Receptor	Description	National Grid Reference
R1	Talbot Gardens	244588, 57389
R4	Kit Hill Crescent	244377, 57846
R5	Poole Park Road	244738, 57868
R6	Cardinal Avenue	244981, 57823
R7	Wolesely Road, adjacent to Camels Head Junction	245250, 57419
R8	York Road	245425, 57752
R9	Junction of Peter's Park Lane / Victoria Road	244807, 58613
R10	Pemros Road	244307, 58257
R13	Lowerside	245877, 57895

Receptor	Description	National Grid Reference
R14	Wordsworth Crescent	245568, 56978
R15	Wombwell Crescent	245161, 57057
R22	Weston Mill Primary School at Junction	245286, 57407
R23	Weston Mill Prirmary School at rear	245356, 57366
R24	Wolseley Road nr Camels Head jnc	245235, 57438
R25	Wolseley Road nr Camels Head jnc	245216, 57458
R26	Wolseley Road set back	245257, 57458
R27	Wolseley Road set back	245237, 57483
R28	Weston Mill Drive/Carlton Terrace junction	245297, 57473
R29	Ferndale Road at end of Third Avenue	245465, 57337
R30	Harewood Crescent	246434, 58703
R31	Romney Close	246703, 58423
R32	Cardinal Avenue	244982, 57920
R33	Cardinal Avenue	245103, 58001
R34	Fletemoor Road	244963, 58098
R35	Hamoaze Avenue	244960, 57555
R36	Harbour Avenue	245072, 57475
R37	Wolseley Road/Weston Mill Drive	245274, 57437
R38	Carlton Terrace	245104, 57596
R39	Wolseley Road	244868, 57938
R40	Wolseley Road/Ferndale Avenue	245330, 57316
R41	Ferndale Avenue	245426, 57371
R42	Wolseley Road/Second Avenue	245405, 57220
R43	Wolseley Road/Saltash Road junction	245494, 57120
R44	Bridwell Road	245469, 57937
R45	Riverside Community Primary School (S)	244211, 57569
R46	Riverside Community Primary School (N)	244192, 57669
R47	Savage Road	244663, 57591
R48	Barne Road	244257, 57964
R49	Barne Road	244044, 57849

Receptor	Description	National Grid Reference
R50	Poole Park Road	244409, 57661
R51	Roberts Road	244365, 57692
R52	North Down Crescent	245720, 56866
R53	Wolseley Road	244928, 57664
R54	Duncombe Avenue	246147, 58878
R60	Northdown Gardens	245896, 56737
R61	St Pancras Avenue	247778, 57967
R62	Shirley Gardens	247145, 58150
R63	St Pancras Avenue	247287, 58034
R64	Sheridan Road	247548, 58130
R65	St Budeaux Foundation Junior School	245422, 58825

Meteorological Data

3.5.10 As for the model runs carried out for the emissions from the facility, hourly sequential data from Plymouth Mountbatten has been used for 2009, the meteorological data year in which the maximum PC to annual mean pollutant concentrations from the EfW CHP facility was predicted, and is consistent with the year chosen to verify the performance of the model against measured nitrogen dioxide concentrations.

Consideration of Terrain

3.5.11 Emissions from road traffic make the greatest contribution to pollutant concentrations at sensitive receptors adjacent to the source (i.e. at the roadside). For this reason, there is not normally a large variation in height between the emission source and residential properties next to the roads included in the model. Therefore, terrain has not been included in the road traffic modelling assessment.

NO_x to NO_2 Conversion

3.5.12 To accompany the publication of the guidance document LAQM TG(09)[15], a NO_X to NO_2 converter was made available as a tool to calculate the road NO_2 contribution from modelled road NO_X contributions. The tool comes in the form of an MS Excel spreadsheet and uses borough specific data to calculate annual mean concentrations of NO_2 from dispersion model output values of annual mean concentrations of NO_X. This tool was used to calculate the total NO_2 concentrations at receptors from the modelled road NO_X contribution and associated background concentration.

Bias Adjustment of Road Contribution NO_x PM_{10}, and $PM_{2.5}$

3.5.13 The modelled road NO_x contributions from the ADMS-Roads model have been adjusted for bias following the method described in LAQM TG(09). The locations of two of the diffusion

[15] Defra (2009), Local Air Quality Management Technical Guidance LAQM.TG(09)

tubes placed in the survey discussed in Section 4.5 have been modelled, along with the PCC tube 59. These tubes we used in the model verification process as they are located in close proximity to both modelled roads and sensitive receptors. The majority of the locations discussed in Section 4.5 were chosen as urban background sites in order to obtain an understanding of changes in background concentrations and as such were set back from major roads in the traffic model and were therefore not suitable for use as model verification tubes. A direct comparison can be made between concentrations modelled at the diffusion tubes and measured concentrations. Table 13.16 provides a summary of the bias adjustment process.

Table 3.16: Summary of Bias Adjustment Process

Tube	Monitored Road NO_x (µg/m^3)	Modelled Road NO_x (µg/m^3)
T8	24.15	9.35
T9	25.19	13.63
LA59	45.6	11.47

3.5.14 If modelled NO_2 annual mean concentrations are within 10% of the measured value it is not necessary to adjust the modelled NO_x contributions. As the modelled NO_2 concentrations are more than 10% below the measured concentration adjustment of the modelled contribution is required. The modelled road NO_x contributions in Table 3.6 were plotted against measured road NO_x contributions and a trendline plotted. This gives an average bias adjustment factor across the 3 sites of 2.70.

3.5.15 In the absence of suitably located sampled PM_{10} or $PM_{2.5}$ data, the same bias adjustment factor has been applied to the modelled road PM_{10} and $PM_{2.5}$ contributions, as recommended in LAQM TG(09).

Calculation of Combined Impacts on Annual Mean NO_2, PM_{10} and $PM_{2.5}$ Concentrations (EfW CHP Facility and Road traffic Emissions)

3.5.16 The combined impact of EfW CHP facility emissions and road traffic emissions has been determined for a selection of sensitive receptors in close proximity to local roads affected by the development. These receptors are listed in Table 3.13.

3.5.17 In the case of NO_2, the conversion of NO_x to NO_2 is calculated separately for each emission source, using the methods set out above. The combined change in annual mean NO_2 concentrations is calculated by adding together the respective changes predicted from the two assessments.

3.5.18 The combined change in annual mean PM_{10} and $PM_{2.5}$ concentrations is calculated by adding together the changes predicted in the respective process emission and road traffic emission assessments.

Predicting the Number of Days in which the PM_{10} 24-hour Mean Objective is Exceeded

3.5.19 The guidance document LAQM TG(03) set out the method by which the number of days in which the PM_{10} 24-hour objective is exceeded can be obtained based on a relationship with the predicted PM_{10} annual mean concentration. The most recent guidance suggests no change to this method. As such, the formula used within this assessment is:

$$\text{No. of } Exceedances = 0.0014 * C^3 + \frac{206}{C} - 18.5$$

Where C is the annual mean concentration of PM_{10}

Specialised Model Treatments

3.5.20 No specialised model treatments have been used in the assessment of road traffic emissions.

4 Summary of Background Air Quality

4.1.1 This section presents the information used to evaluate the background ambient air quality in the area surrounding the proposed EfW CHP facility. The following steps have been taken in the determination of background values. Where appropriate, the study focuses on data gathered in the vicinity of the site:

- Identification of Air Quality Management Areas;
- Review of Plymouth City Council Ambient Monitoring Data;
- Review of data from the UK National Air Quality Information Archive;
- Review of project specific monitoring undertaken on behalf of MVV in the area around the application site; and
- Review of background data and site relevant critical loads from the APIS website.

4.2 Air Quality Management Areas

Plymouth City Council

4.2.1 At the time of writing, PCC's website[16] states that three Air Quality Management Areas (AQMA) are designated within the City:

- Mutley Plain NO_2 AQMA;
- Exeter Street NO_2 AQMA; and
- Exeter Street Benzene AQMA.

4.2.2 The AQMAs are located close to or within the city centre, around 5 km to the southeast of the Devonport site. There is currently no evidence that local pollutant concentrations, in the immediate vicinity of the Devonport site, are currently exceeding or are at significant risk of exceeding relevant EU Limit Values and UK Air Quality Objectives.

4.2.3 In a pre-application consultation meeting held in February 2011, Officers from PCC's Public Protection Service advised that the situation regarding AQMAs in the city may soon change. The Exeter Street Benzene AQMA may be revoked. Three new NO_2 AQMAs may be designated at Tavistock Road in Crownhill, Stoke village and Royal Parade. There is also the possibility of a city-wide AQMA.

Cornwall Council

4.2.4 Cornwall Council is currently in the process of declaring an AQMA at Tideford, which is located between Liskeard and Saltash on the A38, due to exceedances of the annual mean NO_2 objective. The spatial scale of the AQMA is yet to be decided, but may cover the entire village. Tideford is around 10.5 km to the west of the application site.

[16] http://www.plymouth.gov.uk/homepage/environmentandplanning/pollution/airquality/airqualityareas.htm

4.3 Local Authority Ambient Monitoring Data

Plymouth City Council

4.3.1 Although PCC operates an air quality monitoring network across the city, there is little measurement data, representative of baseline air quality, in the vicinity of the Devonport site itself. The nearest continuous monitoring stations are situated within other parts of the city, around 4 km to the east and south east of the application site. A number of NO_2 diffusion tubes, in close proximity to major roads elsewhere in the city centre, indicate that there is the potential for the NO_2 annual mean objective to be exceeded in some locations.

4.3.2 A summary of the pollutant concentrations obtained from continuous monitoring stations in Plymouth are presented in Table 4.1. The data shows that there is a continued risk of the annual mean NO_2 objective being exceeded at Mutley Plain, due to emissions from road traffic.

4.3.3 Annual mean PM_{10} and $PM_{2.5}$ concentrations are generally well within the objective values, but an annual mean PM_{10} concentration in excess of the objective has been recorded at Exeter Street for 2010. At the current time, PCC suspect that this could be due to ongoing road works, temporary traffic diversions and associated congestion in that part of the city.

Table 4.1 Summary of Monitored Annual Mean Concentrations of NO_2, PM_{10} and $PM_{2.5}$ within Plymouth

Location	Within AQMA?	Pollutant	Annual Mean Concentration (µg m^{-3})					
			2005	2006	2007	2008	2009	2010
Plymouth City Centre AURN	N	NO_2	28.0	25.0	23.0 (0)	22.1 (0)	27.0 (0)	36.5 (1)
		PM_{10}	-	-	18.3 (0)	15 (0)	-	14.8 (0)
		$PM_{2.5}$	-	-	**-**	**-**	-	11.0
Mutley Plain	Y	NO_2	-	-	**40.5** (0)	**56.0** (0)	37.9 (2)	**41.6** (0)
Exeter Street	Y	NO_2	-	-	31.3 (0)	32.0 (0)	31.9 (6)	31.2 (2)
		PM_{10}	-	-	26.4 (8)	30.3 (10)	26.0 (35)	**45.4** (15)
Alma Road	N	NO_2	-	-	-	-	-	36.1 (0)
Royal Parade	N	NO_2	-	-	-	-	-	53.5(0)
Tavistock Road	N	NO_2	-	-	-	-	-	37.7(0)

Short-term values provided in parentheses:

NO_2 = No. exceedances of the hourly mean objective (200 µg/m^3)

PM_{10} = No. of exceedances of the daily mean objective (50 µg/m^3).

4.3.4 Of the NO_2 diffusion tubes sites operated by PCC, only site 59 is relevant to the area around the application site. This is located on the façade of a bungalow at 3 Weston Mill Drive, adjacent to the Camel's Head Junction. In 2010, the mean NO_2 concentration was 33.9 µg m^{-3}, which is well within the annual mean EAL of 40 µg m^{-3}.

4.3.5 Overall, there is no existing source of measurement data to suggest that the EAL criteria for the pollutants measured are at risk of exceedence in close proximity to the application site.

Cornwall County Council

4.3.6 Within Cornwall, there is a roadside AURN site in Saltash, which has measured PM_{10}, from July 2008 to the end of August 2010. The site also measured $PM_{2.5}$ between February and August 2010. A summary of the data collected is presented in Table 4.2.

Table 4.2 Summary of Monitored Annual Mean Concentrations of NO_2, PM_{10} and $PM_{2.5}$ at Saltash Roadside

Location	Within AQMA?	Pollutant	Annual Mean Concentration (µg m^{-3})		
			2008	2009	2010
Saltash Roadside	N	PM_{10}	19.2[a]	18.0	17.3[b]
		$PM_{2.5}$	-	-	9.4[c]

[a] From 30/7/2008 only

[b] Up to 31/8/2010 only

[c] From 23/2/2010 to 25/8/2010 only

4.3.7 The available data indicates that baseline PM_{10} and $PM_{2.5}$ concentrations are well within the EAL criteria within Saltash and the surrounding area.

4.4 UK Air Quality Archive Background Data

4.4.1 The National Air Quality Information Archive (NAQIA) provides projections of pollution concentrations across the UK at a resolution of 1 km^2 for pollutants with objectives set out within the Air Quality Strategy (AQS)[17].

4.4.2 Background concentrations for the area around the site have been determined by taking values from the grid square in which the EfW process main chimney is located, centred on national grid reference 244500, 57500. The data is presented in Table 4.3.

Table 4.3: UK Air Quality Archive Background Concentrations

Pollutant	Background Concentration (µg m^{-3})		Source
	Long term	Short term	
NO_X	13.1	26.2	NIAQA background value for 2009.
NO_2	10.3	20.6	NIAQA background value for 2009.
PM_{10}	14.4	28.8	NIAQA background value for 2009.
$PM_{2.5}$	8.6	17.2	NIAQA background value for 2009.
SO_2	2.3	4.6	NIAQA background value for 2001. No adjustment factor available.
Benzene	0.33	0.66	NIAQA background value for 2009.
CO	134	268	NIAQA background value for 2009.

[17] UK Air Quality Archive Projected Background Concentration Maps, Accessed from URL: http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

4.4.3 Background concentrations taken from UK Air Quality Archive sources have been adjusted to the year 2009, the baseline year used for road traffic modelling. Due to the uncertainty currently surrounding projected year-on-year decreases, no further adjustment has been made to the data to project concentrations to the projected opening year of 2014.

4.5 Project Specific Background Air Quality Monitoring

4.5.1 Existing sources of background air quality data have been supplemented with a project specific air quality study, which has consisted of the following monitoring:

- a diffusion tube survey in the vicinity of the application site and the wider area; and
- operation of a continuous monitoring station within Devonport, a short distance to the west of the application site boundary.

Diffusion Tube Monitoring Survey

4.5.2 A diffusion tube monitoring survey for NO_2 and SO_2 has been carried out in the area surrounding the application site, in order to evaluate the variation in modelled concentrations across the modelled domain. Nitrogen dioxide is emitted from road traffic, and therefore concentrations of this pollutant are higher in areas nearer to road traffic emission sources. Monitoring of NO_2 has taken place at nineteen locations, with duplicate tubes also placed next to the Devonport continuous monitoring site. The NO_2 diffusion tubes used in the survey are of the 20% TEA in water type, supplied by Gradko, which is the same type of tube as that used by PCC in their monitoring of local air quality.

4.5.3 A smaller survey for SO_2 at two sites was also undertaken in residential areas near to the Devonport dockyards to evaluate concentrations close to sources of emissions from marine vessels.

4.5.4 The survey commenced on 6th July 2010. This report considers data collected between this date and the 7th March 2011, a period of eight months. Sampling continues and is due to be concluded in May 2011, a total period of ten months.

4.5.5 The diffusion tube monitoring locations are shown on Figure 4.1 of Appendix A to this report.

4.5.6 The survey results for NO_2 and SO_2 are summarised in Tables 4.4 and 4.5 respectively. The complete set of monitoring results is presented in Annex C to this report. For the purposes of verification for the road traffic model, annualised monitoring results are required. The monthly monitoring results have been annualised using data from three continuous monitoring locations; Plymouth, Bournemouth, and Harwell, using the procedure outlined in LAQM.TG(09). The annualised monitoring results for NO_2 are also presented in Table 4.4.

4.5.7 As the survey has taken place over a period in excess of six months and includes both summer and winter months, it could be considered that the average results obtained from the survey are representative of annual mean concentrations and therefore be directly compared with the annual mean EAL values. The annualised data, however, indicates that the period mean is actually higher than the annual mean and as such the period mean represents the part of the year when NO_2 concentrations are higher and likely that the selected monitoring period over-estimates annual mean NO_2 concentrations.

Table 4.4: Summary of Monthly Diffusion Tube Monitoring for NO_2

Location	Description	Period Mean NO_2 concentration ($\mu g\ m^{-3}$)	Annualised NO_2 concentrations for 2009 ($\mu g/m^3$)*	% Capture
1	St Pancras Avenue	27.5	19.1	75
2	Beacon Down Avenue	20.5	14.7	75
3	Harewood Crescent	25.3	14.8	50
4	Beaumont Street	30.9	22.8	88
5	North Down Gardens	21.9	16.6	100
6	St Leo Place	23.5	17.8	100
7	Wombwell Crescent	21.6	16.4	100
8	Wolseley Road (near Weston Mill Drive)	30.6	23.2	100
9	Ferndown Road (near fire station)	31.9	22.7	88
10	York Road (opposite Tucker Close)	21.0	15.9	100
11	Clearbrook Avenue	20.3	15.4	100
12	Harbour Avenue	28.7	21.7	100
13	Furse Park	17.7	13.4	100
14	Admiralty Road	28.5	21.6	100
15	Roman Way (outside school)	27.2	20.6	100
16	Macey Street off Quarry Street, Torpoint	16.9	12.8	100
17	Jetty at Wilcove	11.5	8.2	88
18	Deacon Close, Saltash	11.6	8.8	100
19	Callington Road / Liskeard Road junction, Saltash	25.4	19.2	100
20	2 tubes co-located with Devonport monitoring station	17.2	13.1	100

* These results are also bias adjusted using the national bias adjustment factor obtained from Defra

4.5.8 Long term NO_2 concentrations are higher at locations near to significant road traffic emission sources. The highest concentrations measured at Beaumont Street (close to the A3064 to the south east of the site), Wolseley Road adjacent to the Camel's Head Junction and Ferndown Road near to the Weston Mill fire station. Concentrations are lower in areas away from main roads.

4.5.9 The mean results obtained from the co-location study are slightly higher than that at the continuous monitoring station at Devonport, but can be considered to be comparable with the results generated using the reference method. No adjustment of the diffusion tube results for survey bias is therefore considered necessary.

4.5.10 Overall, the results indicate that long-term NO_2 concentrations are well within the annual mean EAL for this pollutant at all the monitoring sites.

Table 4.5: Summary of Monthly Diffusion Tube Monitoring for SO_2

Location	Description	Average SO_2 concentration ($\mu g\ m^{-3}$)	% Capture
6	St Leo Place	3.6	100
7	Wombwell Crescent	1.6	100
20	Tube co-located with Devonport monitoring station	3.2	100

4.5.11 The results of the SO_2 monitoring show that the long-term average concentration is low in close proximity to the monitoring sites, with no significant local sources of this pollutant. It is likely that the short term EALs for SO_2 would also be met at these locations.

Devonport Air Quality Monitoring

4.5.12 An air quality monitoring station was installed by TRL, on behalf of MVV, within the Devonport site. The station has taken the following measurements:

- continuous monitoring of oxides of nitrogen (NO, NO_X and NO_2);
- continuous monitoring of SO_2;
- continuous monitoring of PM_{10};
- monthly measurement of PAH and PCBs;
- monthly measurement of Dioxins and Furans; and
- monthly measurement of heavy metals.

4.5.13 The survey commenced on the 17th August 2010. This report considers data collected between this date and the 3rd March 2011, a period of six and a half months. Sampling at the site continues and is due to be concluded in mid May 2011, a total period of nine months.

4.5.14 The location of the monitoring station is shown on Figure 4.1 of Annex A to this report.

4.5.15 Data capture rates during the survey period were excellent, with greater than 95% capture for continuous monitoring of NO_X, PM_{10} and SO_2.

4.5.16 As the survey has taken place over a six month period and includes both summer and winter months, it is considered that the average results obtained from the survey are representative of annual mean concentrations and can be directly compared with the annual mean EAL values. It should be noted, however, that the annualisation of NO_2 diffusion tube data in Table 4.4 indicates that the period mean is actually higher for this pollutant than the annual mean and as such the period means reported here may constitute an over-estimate of annual mean concentrations for some pollutants.

4.5.17 A short form summary report, issued by TRL and describing the findings of the survey to date, is included as Annex C to this report. A final report will be issued upon completion of the survey. A data summary of the outcome of the six month survey is shown in Tables 4.6 to 4.8 and discussed in the accompanying paragraphs.

Table 4.6: Summary of Continuous Monitoring for Nitrogen Oxides and Sulphur Dioxide at Devonport (Hourly Average Data)

Statistic	NO	NO_X	NO_2	SO_2
No. exceedances of 1-hr objective	-	-	0	0
Minimum (µg m^{-3})	0.0	0.9	0.2	0.2
Average (µg m^{-3})	**14.7**	**30.1**	**15.3**	**7.1**
Standard deviation (µg m^{-3})	36.7	48.1	14.6	4.2
Median (µg m^{-3})	3.7	15.6	10.9	5.8
Maximum (µg m^{-3})	563.0	664.3	107.2	36.0
% Data capture	97.8	97.8	97.8	95.1

4.5.18 There were no exceedances of the hourly NO_2 objective of 200 µg m^{-3} and the period mean concentration was well within the annual mean EAL for this pollutant. The variation in hourly values at the monitoring site compared well with the AURN network site in Plymouth Urban Centre over the same period.

Table 4.7: Summary of Continuous Monitoring for PM_{10} (24-hour Average Data)

Statistic	Adjusted PM_{10}	VCM Corrected PM_{10}
No. exceedances of 24-hr objective	0	0
Minimum (µg m^{-3})	5.0	3.8
Average (µg m^{-3})	**16.3**	**13.3**
Standard deviation (µg m^{-3})	6.6	6.7
Median (µg m^{-3})	15.2	11.8
Maximum (µg m^{-3})	42.0	33.4
% Data capture	100.0	96.0

4.5.19 There were no exceedances of the 24-hour PM_{10} EAL and the period mean was well below the annual mean EAL. A number of peaks in PM_{10} concentration were also seen at the Plymouth Urban Centre site.

4.5.20 Mean concentrations of PAH, PCBs, Dioxins, Furans and Heavy Metals were found to be generally low, and well within the respective long term EAL values set for these pollutants.

Table 4.8: Summary of Monthly Monitoring for Heavy Metals

Substance	Average (µg m^{-3})	Long-Term EAL (µg m^{-3})
Arsenic	0.00041	0.006
Cadmium	0.00009	0.005
Cobalt	0.00014	-
Chromium (total)	0.00052	5
Copper	0.00299	10
Mercury	0.00001	0.25
Manganese	0.00201	0.15
Nickel	0.00196	0.02
Lead	0.00426	0.5
Antimony	0.00074	5
Thallium	0.00002	-
Vanadium	0.00068	5
Zinc	0.00917	-

Table 4.9: Summary of Monthly Monitoring for PAH

Substance	Average (ng m^{-3})	Long-Term EAL (ng m^{-3})
Acenaphthene	<LOD	-
Acenaphthylene	<LOD	-
Anthracene	<LOD	-
Benzo(a)anthracene	<LOD	-
Benzo(a)pyrene	0.000121	0.25
Benzo(b/k)fluoranthene	<LOD	-
Benzo(ghi)perylene	0.000179	-
Chrysene	0.000259	-
Dibenzo(ah)anthracene	0.000025	-
Fluoranthene	0.001067	-
Fluorene	0.000406	-
Indeno(1,2,3-cd)pyrene	0.000113	-
Naphthalene	0.000137	-
Phenanthrene	0.001403	-
Pyrene	0.000792	-

Table 4.10: Summary of Monthly Monitoring for PCBs

Substance	Average (ng m^{-3})
PCB-77	0.000039
PCB-81	0.000009
PCB-105	0.000404
PCB-114	0.000020
PCB-118	0.000929
PCB-123	0.000055
PCB-126	0.000057
PCB-156	0.000105
PCB-157	0.000020
PCB-167	0.000035
PCB-169	0.000050
PCB-189	0.000001
Total	**0.001724**

Table 4.11: Summary of Monthly Monitoring for Dioxins and Furans (I-TEQ)

Substance	Average (ng m^{-3})
2378-TCDF	4.53×10^{-8}
12378-PCDF	2.59×10^{-8}
23478-PCDF	7.77×10^{-7}
123478-HxCDF	1.66×10^{-7}
123678-HxCDF	7.61×10^{-7}
234678-HxCDF	5.33×10^{-7}
123789-HxCDF	2.67×10^{-7}
1234678-HpCDF	3.92×10^{-7}
1234789-HpCDF	2.41×10^{-7}
OCDF	1.57×10^{-7}
2378-TCDD	1.49×10^{-7}
12378-PCDD	1.28×10^{-7}
123478-HxCDD	5.01×10^{-7}
123678-HxCDD	1.59×10^{-7}
123789-HxCDD	8.7×10^{-7}
1234678-HpCDD	8.93×10^{-7}
OCDD	2.52×10^{-7}
Total	**8.54×10^{-6}**

4.6 Summary of Background Air Quality

4.6.1 The selected background concentrations for each of the pollutants considered within the assessment are listed in Table 4.12. The background concentrations of NO_2, PM_{10} and $PM_{2.5}$ presented in this table do not account for the variation of existing concentrations made by road traffic across the modelled domain. Baseline concentrations (background plus road traffic) of these pollutants are considered further in Tables 4.13 to 4.15.

4.6.2 Background concentrations of NO_x and NO_2 have been taken from the project specific baseline monitoring programme. The monitoring site is situated some distance from major sources of road traffic pollutant emissions and can be considered to be representative of the urban background in the air quality study area.

4.6.3 The background concentration of PM_{10} has been taken from the project specific baseline monitoring programme. The monitoring site is not situated in close proximity to any significant source of particulate matter emissions and is therefore considered to be representative of background concentrations in the air quality study area.

4.6.4 The background concentration of $PM_{2.5}$ has been taken from the UK Air Quality Archive.

4.6.5 The background concentration for benzene has been taken from the UK Air Quality Archive.

4.6.6 The background concentration for NH_3 used is the archive concentration for the 5 km by 5 km grid square containing the application site, obtained from the APIS website.

4.6.7 Background concentrations of HCl and HF have been taken from the EPAQS report on Halogens and Hydrogen Halides in Ambient Air, which includes a consideration of background concentrations of these pollutants in the UK[18].

4.6.8 The metals, PAH, dioxin and furan concentrations obtained from the project specific baseline monitoring programme are considered to represent the best source of available data for the area surrounding the Installation site, and have been used in the calculation of PEC concentrations.

4.6.9 The ratio of total Cr to Cr(VI) in ambient air varies, depending on local emission sources. A review of information by the UK's Expert Panel on Air Quality Standards (EPAQS) indicates that Cr(VI) constitutes between 3% and 33% of airborne Chromium[19], while the US Department of Health suggests the ratio is between 10% and 20%[20]. For this assessment, it is considered that a 20% Cr (VI) to total Cr ratio is a conservative assumption, given the lack of known local sources of this substance.

4.6.10 Where air quality archive data has been used in the assessment, short-term background concentrations have been calculated by multiplying the selected annual mean background concentration by a factor of two[21]. Where project specific monitoring data from a continuous monitor has been adopted, the short-term background concentration used is the mean concentration for the monitoring period, plus standard deviation.

[18] EPAQS (2006) Guidelines for Halogens and Hydrogen Halides in Ambient Air for Protecting Human Health against Acute Irritancy Effects
[19] EPAQS (2009) Metals and Metalloids
[20] US Department of Health and Human Services Public Health Service Agency for Toxic Substances and Disease Registry (2008) Draft Toxicological Profile for Chromium
[21] Defra (2009) Local Air Quality Management Guidance Technical Guidance Note TG(09)

Table 4.12: Background Air Quality Concentrations Selected for Use in the Assessment

Pollutant	Background Concentration (µg/m³)_		Source
	Long-term	Short-term	
NO_x	30.1	78.2	Project specific monitoring at Devonport. Short-term concentration is average plus standard deviation.
NO_2	15.3	29.9	Project specific monitoring at Devonport. Short-term concentration is average plus standard deviation.
PM_{10}	13.3	20.0	VCM corrected PM_{10} from project specific monitoring at Devonport. Short-term concentration is average plus standard deviation.
$PM_{2.5}$	8.6	-	NIAQA background value for 2009.
SO_2	7.1	11.3	Project specific monitoring at Devonport. Short-term concentration is average plus standard deviation.
Benzene	0.33	-	NIAQA background value for 2009.
HCl	0.41	0.82	Long-term background concentrations from EPAQS[20]. Short-term concentration is double long-term concentration.
HF	0.003	0.006	Long-term background concentrations from EPAQS[20]. Short-term concentration is double long-term concentration
CO	134	268	NIAQA background value for 2009. Short-term concentration is double long-term concentration.
BaP	0.000121	-	Project specific monitoring at Devonport.
Pb	0.00426	-	Project specific monitoring at Devonport.
Cd	0.00009	-	Project specific monitoring at Devonport.
Hg	0.00001	0.00005	Project specific monitoring at Devonport.
Sb	0.00074	0.00148	Project specific monitoring at Devonport. Short-term concentration is double long-term concentration.
As	0.00041	-	Project specific monitoring at Devonport.
Cr, as Cr (II) compounds and Cr (III) compounds	0.00052	0.00104	Project specific monitoring at Devonport. Short-term concentration is double long-term concentration
Cr (VI), oxidation state in PM_{10} fraction	0.000104	-	Factored as 20% of total Cr

	Background Concentration (µg/m^3)_		
Cu	0.00299	0.00598	Project specific monitoring at Devonport. Short-term concentration is double long-term concentration
Mn	0.00201	0.00402	Project specific monitoring at Devonport. Short-term concentration is double long-term concentration
Ni	0.00196	-	Project specific monitoring at Devonport.
V	0.00068	0.00136	Project specific monitoring at Devonport. Short-term concentration is double long-term concentration
NH_3	1.0	2.0	APIS website. Short-term concentration is double long-term concentration
PCBs	0.001724	0.003448	Project specific monitoring at Devonport. Short-term concentration is double long-term concentration
Dioxins and furans	8.5 x 10^{-9}	-	Project specific monitoring at Devonport.

Predicted Baseline Pollutant Concentrations of NO_2, PM_{10} and $PM_{2.5}$ at Discrete Sensitive Receptors

4.6.11 The direct contribution of baseline road traffic emissions to annual mean background concentrations of NO_2, PM_{10} and $PM_{2.5}$ have been calculated using the ADMS-Roads model, in order to account for the variations in the concentration of these pollutants over the modelled domain covered by the road traffic assessment. The predicted baseline (background plus road traffic) pollutant concentrations for the scenarios outlined in Section 3.5 are presented in Tables 4.13, 4.14 and 4.15.

4.6.12 The results show that predicted pollutant concentrations are higher in close proximity to the roads carrying the greatest volumes of traffic. This includes those properties close to Camels head junction (R7, R22, R24, R25 R28 and R37) and the A38 (R30, R31, R54, R62, R63 and R64).

4.6.13 At all the selected receptors, annual mean concentrations of NO_2, PM_{10} and $PM_{2.5}$ are well within their respective EAL values.

Table 4.13: Predicted Annual Mean NO_2 Concentrations at Discrete Receptors, Baseline Scenarios

Receptor	Annual Mean Concentration (µg m^{-3})			
	Background Contribution*	2009/2010	2014	2014 Supplementary
R1	10.28	11.17	10.86	10.89
R2	10.28	10.28	10.28	10.28
R3	10.28	10.28	10.28	10.28

Receptor	Annual Mean Concentration ($\mu g\ m^{-3}$)			
	Background Contribution*	2009/2010	2014	2014 Supplementary
R4	10.28	11.29	10.93	11.00
R5	10.28	14.58	13.10	13.20
R6	10.28	12.04	11.42	11.55
R7	11.71	25.44	21.57	22.33
R8	11.71	13.22	12.70	12.77
R9	12.86	13.59	13.33	14.31
R10	12.86	14.16	13.71	15.20
R11	12.86	12.86	12.86	12.86
R12	12.44	12.44	12.44	12.44
R13	11.71	13.06	12.58	12.62
R14	13.66	16.89	15.77	15.89
R15	11.71	12.94	12.51	12.55
R16	13.40	13.40	13.40	13.40
R17	15.45	15.45	15.45	15.45
R18	12.08	12.08	12.08	12.08
R19	10.20	10.20	10.20	10.20
R20	7.89	7.89	7.89	7.89
R21	8.88	8.88	8.88	8.88
R22	11.71	29.37	24.61	25.65
R23	11.71	15.75	14.45	14.69
R24	11.71	20.70	18.02	18.54
R25	11.71	20.06	17.56	18.05
R26	11.71	18.90	16.71	17.13
R27	11.71	16.63	15.08	15.37
R28	11.71	25.85	21.90	22.73
R29	11.71	14.74	13.72	14.30
R30	17.06	21.35	19.83	19.86
R31	17.06	24.58	21.95	21.99
R32	10.28	11.76	11.24	11.36

Receptor	Annual Mean Concentration ($\mu g\ m^{-3}$)			
	Background Contribution*	2009/2010	2014	2014 Supplementary
R33	12.45	13.76	13.30	13.42
R34	12.86	14.33	13.82	13.99
R35	10.28	15.24	13.54	13.82
R36	11.71	13.70	13.02	13.14
R37	11.71	27.26	22.98	23.85
R38	11.71	14.35	13.44	13.63
R39	10.28	13.88	12.62	12.86
R40	11.71	19.38	16.95	17.17
R41	11.71	15.10	13.98	14.56
R42	11.71	17.94	15.83	15.98
R43	11.71	17.21	15.41	15.55
R44	11.71	13.42	12.92	12.95
R45	10.28	11.19	10.87	10.90
R46	10.28	13.21	12.20	12.23
R47	10.28	13.73	12.54	12.59
R48	10.28	13.72	12.54	12.62
R49	10.28	14.03	12.74	12.79
R50	10.28	14.13	12.80	12.84
R51	10.28	14.00	12.72	12.76
R52	13.66	17.19	15.97	16.10
R53	10.28	15.75	13.86	14.17
R54	17.06	21.21	19.72	19.75
R55	12.44	12.44	12.44	12.44
R56	11.71	11.71	11.71	11.71
R57	7.82	7.82	7.82	7.82
R58	9.30	9.30	9.30	9.30
R59	13.92	13.92	13.92	13.92
R60	13.66	15.25	14.69	14.75
R61	10.28	16.68	14.39	14.42

Receptor	Annual Mean Concentration ($\mu g\ m^{-3}$)			
	Background Contribution*	2009/2010	2014	2014 Supplementary
R62	15.54	26.45	22.71	22.75
R63	15.54	21.53	19.41	19.44
R64	15.54	23.67	20.81	20.84
R65	12.45	13.10	12.87	12.96

*Projected background concentration from the UK Air Quality Archive

Table 4.14: Predicted Annual Mean PM_{10} Concentrations at Discrete Receptors, Baseline Scenarios

Receptor	Annual Mean Concentration ($\mu g\ m^{-3}$)			
	Background*	2009/2010	2014	2014 Supplementary
R1	14.37	14.56	14.53	14.54
R2	14.37	14.37	14.37	14.37
R3	14.37	14.37	14.37	14.37
R4	14.37	14.59	14.56	14.58
R5	14.37	15.36	15.22	15.25
R6	14.37	14.75	14.69	14.74
R7	14.77	16.87	16.37	16.54
R8	14.77	15.04	15.00	15.02
R9	15.04	15.18	15.17	15.47
R10	15.04	15.32	15.29	15.75
R11	15.04	15.04	15.04	15.04
R12	14.89	14.89	14.89	14.89
R13	14.77	15.02	14.97	14.99
R14	14.95	15.66	16.87	15.61
R15	14.77	15.00	15.30	14.98
R16	14.81	14.81	14.81	14.81
R17	15.66	15.66	15.66	15.66
R18	14.96	14.96	14.96	14.96
R19	14.26	14.26	14.26	14.26
R20	13.77	13.77	13.77	13.77
R21	13.94	13.94	13.94	13.94
R22	14.77	17.54	16.87	17.10
R23	14.77	15.43	15.30	15.36
R24	14.77	16.14	15.92	15.94
R25	14.77	16.10	15.80	15.91
R26	14.77	15.85	15.60	15.69
R27	14.77	15.54	15.38	15.45

Receptor	Annual Mean Concentration ($\mu g\ m^{-3}$)			
	Background*	2009/2010	2014	2014 Supplementary
R28	14.77	16.88	16.38	16.56
R29	14.77	15.34	15.25	15.45
R30	16.47	17.18	17.06	17.01
R31	16.47	17.70	17.48	17.49
R32	14.37	14.69	14.64	14.68
R33	14.73	15.00	14.96	15.00
R34	15.04	15.35	15.31	15.38
R35	14.37	15.50	15.35	15.42
R36	14.77	15.15	15.08	15.11
R37	14.77	17.13	16.56	16.75
R38	14.77	15.32	15.24	15.31
R39	14.37	15.19	15.08	15.17
R40	14.77	16.20	15.94	16.00
R41	14.77	15.38	15.28	15.47
R42	14.77	16.13	15.93	15.97
R43	14.77	15.79	15.61	15.65
R44	14.77	15.11	15.06	15.11
R45	14.37	14.57	14.54	14.55
R46	14.37	15.04	14.95	14.96
R47	14.37	15.15	15.04	15.06
R48	14.37	15.16	15.05	15.08
R49	14.37	15.23	15.12	15.13
R50	14.37	15.25	15.13	15.14
R51	14.37	15.22	15.11	15.12
R52	14.95	15276	15.64	15.70
R53	14.37	15.64	15.46	15.54
R54	16.47	17.14	17.02	17.03
R55	14.89	14.89	14.89	14.89
R56	14.67	14.67	14.67	14.67

Receptor	Annual Mean Concentration ($\mu g\ m^{-3}$)			
	Background*	2009/2010	2014	2014 Supplementary
R57	14.52	14.52	14.52	14.52
R58	14.08	14.08	14.08	14.08
R59	15.11	15.11	15.11	15.11
R60	14.95	15.30	15.25	15.28
R61	14.37	15.36	15.18	15.19
R62	15.91	17.71	17.38	17.39
R63	15.91	16.86	16.69	16.70
R64	15.91	17.22	16.98	16.98
R65	14.73	14.84	14.82	14.85

*Projected background concentration from the UK Air Quality Archive

Table 4.15: Predicted Annual Mean $PM_{2.5}$ Concentrations at Discrete Receptors, Baseline Scenarios

Receptor	Annual Mean Concentration (µg m^{-3})			
	Background*	2009/2010	2014	2014 Supplementary
R1	8.60	8.73	8.70	8.71
R2	8.60	8.60	8.60	8.60
R3	8.60	8.60	8.60	8.60
R4	8.60	8.75	8.72	8.73
R5	8.60	9.27	9.13	9.15
R6	8.60	8.87	8.81	8.83
R7	9.07	10.67	10.20	10.32
R8	9.07	9.26	9.22	9.23
R9	9.23	9.33	9.31	9.50
R10	9.23	9.42	9.39	9.67
R11	9.23	9.23	9.23	9.23
R12	9.02	9.02	9.02	9.02
R13	9.07	9.24	9.20	9.21
R14	9.23	9.74	9.63	9.66
R15	9.07	9.23	9.20	9.20
R16	9.20	9.20	9.20	9.20
R17	9.77	9.77	9.77	9.77
R18	9.03	9.03	9.03	9.03
R19	8.53	8.53	8.53	8.53
R20	8.18	8.18	8.18	8.18
R21	8.38	8.38	8.38	8.38
R22	9.07	11.20	10.57	10.72
R23	9.07	9.55	9.43	9.47
R24	9.07	10.11	9.81	9.89
R25	9.07	10.08	9.79	9.86
R26	9.07	9.89	9.65	9.71
R27	9.07	9.65	9.49	9.53

Receptor	Annual Mean Concentration ($\mu g\ m^{-3}$)			
	Background*	2009/2010	2014	2014 Supplementary
R28	9.07	10.70	10.21	10.34
R29	9.07	9.47	9.38	9.50
R30	10.33	10.83	10.71	10.71
R31	10.33	11.20	10.98	10.99
R32	8.60	8.83	8.78	8.80
R33	9.12	9.32	9.27	9.29
R34	9.23	9.44	9.41	9.44
R35	8.60	9.38	9.22	9.26
R36	9.07	9.33	9.27	9.29
R37	9.07	10.89	10.35	10.48
R38	9.07	9.45	9.38	9.42
R39	8.60	9.16	9.05	9.10
R40	9.07	10.09	9.84	9.88
R41	9.07	9.50	9.41	9.52
R42	9.07	10.00	9.80	9.83
R43	9.07	9.79	9.62	9.64
R44	9.07	9.31	9.26	9.29
R45	8.60	8.74	8.71	8.71
R46	8.60	9.05	8.96	8.97
R47	8.60	9.13	9.02	9.03
R48	8.60	9.13	9.03	9.04
R49	8.60	9.18	9.07	9.08
R50	8.60	9.20	9.08	9.08
R51	8.60	9.18	9.06	9.07
R52	9.25	9.80	9.68	9.71
R53	8.60	9.47	9.29	9.34
R54	10.33	10.80	10.68	10.69
R55	9.02	9.02	9.02	9.02
R56	8.97	8.97	8.97	8.97

Receptor	Annual Mean Concentration ($\mu g\ m^{-3}$)			
	Background*	2009/2010	2014	2014 Supplementary
R57	8.32	8.32	8.32	8.32
R58	8.47	8.47	8.47	8.47
R59	9.36	9.36	9.36	9.36
R60	9.25	9.49	9.44	9.45
R61	8.60	9.30	9.13	9.13
R62	9.96	11.24	10.91	10.92
R63	9.96	10.64	10.46	10.47
R64	9.96	10.89	10.65	10.66
R65	9.12	9.20	9.18	9.20

*Projected background concentration from the UK Air Quality Archive

5 Dispersion Model Results

5.1.1 This section reports the results of the modelling runs for the with-development scenarios described in Section 3.

5.1.2 For the pollutants considered within this assessment, impacts on local air quality will arise due to emissions from the EfW CHP process, via the main chimney, and from operational road traffic movements on local roads.

5.1.3 The tables within this section report the results of the model runs detailed in Section 3. The predicted process contributions (PC) to ground-level concentrations of the modelled pollutants are reported for the location where the maximum off-site PC within the modelled domain occurs.

5.1.4 The impact on local concentrations of NO_2 and PM_{10} are considered separately. These substances are the most significant local air pollutants in terms of existing baseline concentrations, and concentrations can be expected to vary widely across the modelled domain due to the combined impact of emissions from road traffic.

5.1.5 An investigation of model sensitivity to meteorological data is also included within this section.

5.2 Evaluation of Chimney Height

5.2.1 This section reports the results of an evaluation of the height of the main chimney serving the EfW CHP facility, using the ADMS dispersion model. The selection of an appropriate chimney height requires a number of factors to be taken into account, the most important of which is the need to balance a chimney height sufficient to achieve adequate dispersion of pollutants against other constraints such as visual impact.

5.2.2 Emissions from the main chimney have been modelled at chimney heights between 45 m and 120 m, at 5 m increments. A graph, showing the PC to annual mean and 99.79th percentile NO_x concentrations is presented in Figure 5.1, below. The purpose of the graph is to evaluate the optimum chimney height in terms of the dispersion of pollutants would occur, against the visual constraints of further increases in release height.

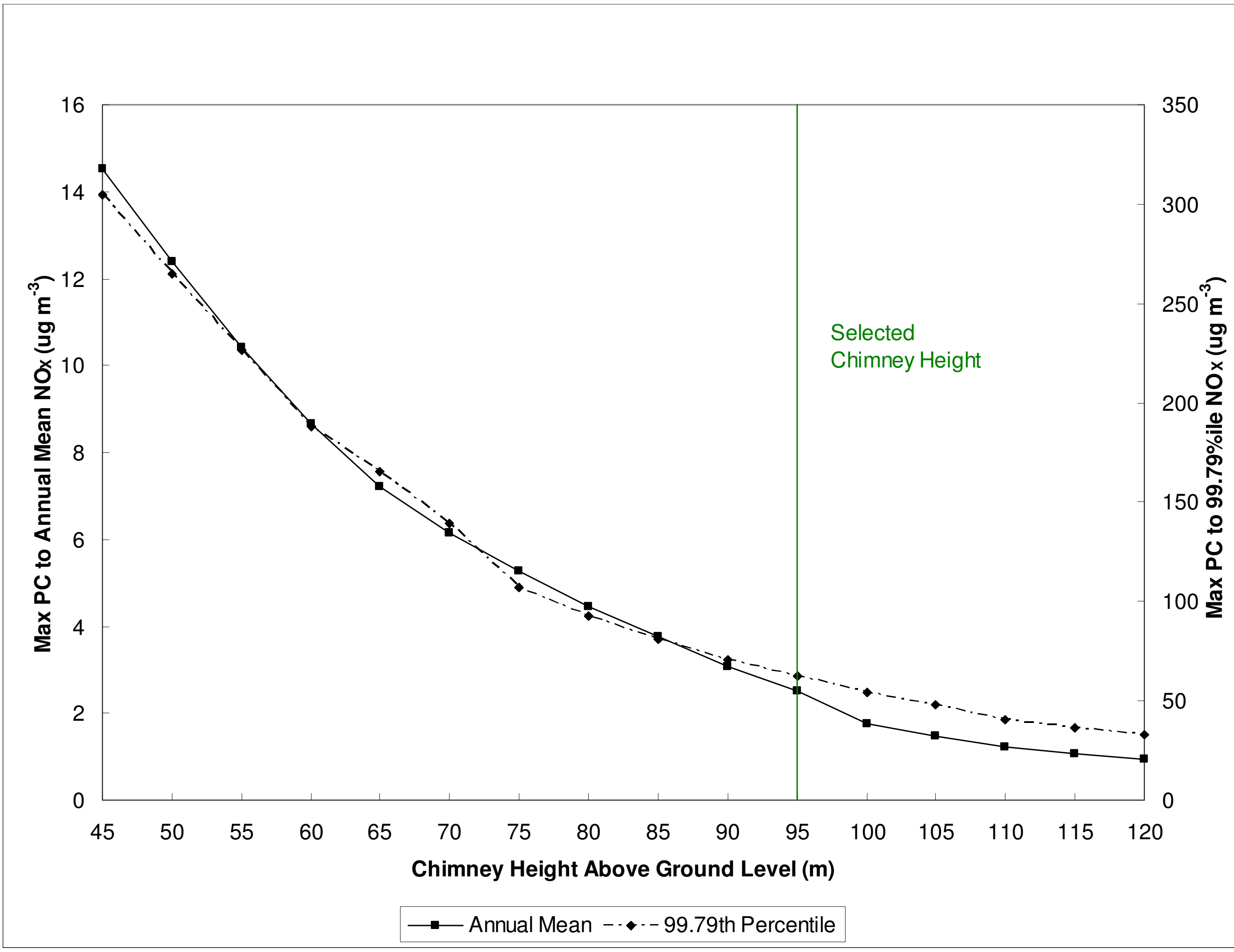
5.2.3 Analysis of the annual mean curve shows that the benefit of incremental increases in chimney height up to 70 m is pronounced. At heights above 80 m, the air quality benefit of increasing chimney height further is reduced.

5.2.4 The rate of improvement in 99.79th percentile impacts is similar to the decrease seen for the annual mean curve.

5.2.5 The use of a 95m chimney would be capable of mitigating both the short-term and long-term impacts of the modelled emissions of all pollutants, such that no significant adverse effects would occur at any receptor.

5.2.6 The incremental benefit of further increases in the chimney height become less effective in reducing the PC to ground-level concentrations. It is therefore considered that 95m represents a height at which the visual impacts of an increase in chimney height begin to outweigh the benefits to air quality, in terms of human health.

Figure 5.1: Predicted Process Contribution to Maximum Ground-Level NO_X Concentration at Chimney Heights between 45 m and 120 m



5.3 Sensitivity of Results to Meteorological Data

Meteorological Data Year

5.3.1 The dispersion modelling assessment has been undertaken using meteorological data from Plymouth Mountbatten, for the years 2005 to 2009 inclusive. Table 5.1, below, presents the maximum predicted ground-level impact, for a number of the averaging periods evaluated throughout the assessment, for each year of meteorological data within the dataset. The comparison is based on a unit emission rate of 1 g s^{-1} from the main chimney at a release height of 95m, and the figure highlighted in bold is the highest value obtained from the five years of meteorological data modelled.

Table 5.1: Maximum Modelled Impact on Ground-Level Concentrations, 1 g s^{-1} Emission Rate

Met Year	Averaging Period and Statistic							
	Annual Average	1 hr Max	1 hour 99.79^{th} %ile	1 hour 99.73^{rd} %ile	24 hour 99.18^{th} %ile	24 hour 90.41^{st} %ile	15 min 99.9^{th} %ile	Max 8hr running mean
2005	0.29	4.14	**3.63**	**3.57**	1.57	0.94	**3.97**	3.32
2006	0.32	4.02	3.55	3.46	**1.86**	0.94	3.87	**3.60**
2007	0.30	**6.63**	3.55	3.49	1.83	**0.98**	3.88	3.31
2008	0.28	4.44	3.51	3.43	1.65	0.97	3.84	3.02
2009	**0.34**	4.27	3.49	3.41	1.68	0.95	3.81	3.06

5.3.2 The results presented in Table 5.1 demonstrate that there is a variation in the meteorological dataset for which the maximum modelled impact is reported for each averaging period. For this reason, the values reported in the table are the maximum value obtained from modelling each of the five years meteorological data within the assessment. The reported values can therefore be considered to represent a worst-case assessment of impacts that would be experienced during typical meteorological conditions.

Consideration of Local Meteorological Conditions

5.3.3 Within the lower reaches of the Tamar and Lynher valley system, meteorological conditions can occur where air in the upper reaches of the valley is mixed with the air above. This can cause the formation of a ground-based inversion layer air in the lower reaches of the valley. There are other occasions when sea fogs affect the whole area equally and under these conditions there is no ground-based inversion within the valley system.

5.3.4 The point of release from the main chimney is 104m AOD, which is above the height of the immediate surrounding hills (the ground at Kings Tamerton rises to 96m AOD). Therefore, emissions from the main chimney are never released directly into the lower valley and would not be subject to the local meteorological conditions there.

5.3.5 A meteorological station has been selected that is representative of conditions at the height of release. This approach does not recognise the fact that the presence of an inversion layer within the valley would inhibit the dispersion of emissions to receptors located in the lower valley during inversion episodes. As such, the reported impacts are slightly over-estimated at these receptors.

5.4 Modelling Results

5.4.1 This section presents the modelling results for the proposed EfW CHP facility, operating with a 95m chimney. The impact of odour emissions from the shutdown exhaust system chimney is also considered.

5.4.2 In the tables within this section, any small discrepancies in 'total' reported process contributions from both facility emissions and road traffic are due to rounding.

Modelling Results for Nitrogen Dioxide

5.4.3 Oxides of nitrogen are emitted in the largest quantity (in terms of mass) from the EfW process chimney. In view of existing baseline pollutant concentrations and the proximity of major traffic routes near to the site (the main source of NO_2 in urban areas), emissions of this pollutant would also potentially have the greatest impact on local air quality. This section focuses on the change in local annual mean NO_x and NO_2 concentrations that would occur as a result of the operation of the EfW process and associated road traffic.

Emissions from the EfW CHP Facility Chimney

5.4.4 A contour plot, showing the modelled PC to annual mean NO_2 concentrations due to emissions from the EfW CHP facility main chimney only, is presented as Figure 5.2 of Annex A to this report. A contour plot showing the PC to 99.79th percentile of 1-hr NO_2 concentrations is presented in Figure 5.3 of Annex A to this report.

5.4.5 The annual mean contour plot indicates that, with a 95m chimney, the maximum PC to ground level NO_2 concentrations would occur approximately 400 m to the north east of the location of the main chimney in the area around the junction of Cardinal Avenue and Boringdon Avenue. At this location, the predicted annual mean NO_2 PC is 1.8 µg m^{-3}.

5.4.6 The area where there is a predicted impact on annual mean NO_2 concentrations of 0.4 µg m^{-3} or more is restricted to an area to the north east of the proposed facility, within a maximum distance of approximately 1.8 km from the chimney location. 0.4 µg m^{-3} represents 1% of the annual mean EAL for NO_2. Beyond this distance, the effect of emissions from the EfW CHP facility chimney on annual mean NO_2 concentrations can be considered to be insignificant.

5.4.7 An area covering parts of St. Budeaux, Kings Tamerton, parts of Weston Mill and Ham, and a small area in Barne Barton is within the 0.4 µg m^{-3} contour for annual mean NO_2. Baseline monitoring of NO_2 within this area has shown that the annual mean EAL is not at risk of being exceeded, and the process contribution from the proposed EfW CHP facility would not change this situation.

5.4.8 Plymouth's three existing AQMAs are situated more than 5 km to the south east of the site. Emissions from the EfW CHP facility chimney would not therefore subject these areas to a measurable change in annual mean NO_2 concentrations, due to the operation of the EfW CHP facility.

5.4.9 The largest predicted increase in 99.79th percentile of hourly means NO_2 concentrations occur in close proximity to the EfW CHP facility. The maximum predicted PC to short term NO_2 concentrations is 22.1 µg m^{-3}. Such an impact is not likely to result in a risk that the 99.79th percentile 1-hour EAL for NO_2 of 200 µg m^{-3} would be exceeded.

Change in Annual Mean Nitrogen Dioxide Concentrations at Discrete Receptors

5.4.10 The predicted change in annual mean NO_2 concentrations, that would occur during the operation of the EfW CHP facility, at the selected sensitive receptors, is presented in Table 5.2. Some of these receptors would also be subject to an increase in annual mean NO_2 concentrations from operational road traffic emissions, in addition to those from the EfW CHP facility chimney. The results reported in this section are the combined predicted change at receptors that would occur due to emissions from both sources.

5.4.11 The maximum predicted change in annual mean NO_2 concentrations at selected receptors within the whole modelled domain is +1.76 µg m^{-3} (+1.77 µg/m^3 in the supplementary scenario), in the vicinity of Cardinal Avenue. The reported change in concentration at this location is predominantly due to the impact of emissions of emissions from the EfW CHP facility chimney.

5.4.12 The maximum predicted change in annual mean NO_2 concentrations at selected receptors in close proximity to the Camel's Head junction is around R28 with +1.27 µg m^{-3} (+1.30 µg/m^3 in the supplementary scenario). The reported change in concentration at this location is as a result of the combined impact of emissions from road traffic and emissions from the EfW CHP facility chimney, although the majority contribution is as a result of operational road traffic.

5.4.13 Based on the results of the modelling, there is no predicted risk of exceedence of the annual mean NO_2 limit value within the modelled domain. At receptors exposed to annual mean concentrations of NO_2 of less than 40 µg m^{-3}, it is also highly unlikely that the hourly mean limit value would be exceeded.

Table 5.2: Predicted Change in Annual Mean NO_2 Concentrations in 2014 (µg m^{-3}), with Comparison Against Environmental Assessment Level Criteria

Receptor	Baseline	Change due to road traffic	PC	Total Change	% EAL	PEC	PEC%EAL
R1	10.86	0.06	0.01	0.07	0.2	10.93	27.3
R2	10.28	-	0.19	0.19	0.5	10.47	26.2
R3	10.28	-	0.41	0.41	1.0	10.69	26.7
R4	10.93	0.01	0.17	0.18	0.4	1.12	27.8
R5	13.10	0.01	0.33	0.34	0.9	13.45	33.6
R6	11.42	0.04	1.57	1.61	4.0	13.03	32.6
R7	21.57	0.80	0.19	0.99	2.5	22.57	56.4
R8	12.70	0.08	0.62	0.70	1.8	13.40	33.5
R9	13.33	0.01	0.44	0.45	1.1	13.78	34.4
R10	13.71	0.02	0.17	0.19	0.5	13.89	34.7
R11	12.86	-	0.20	0.20	0.5	13.07	32.7
R12	12.44	-	0.13	0.13	0.3	12.56	31.4
R13	12.58	0.03	0.55	0.62	1.6	13.20	33.0

Receptor	Baseline	Change due to road traffic	PC	Total Change	% EAL	PEC	PEC%EAL
R14	15.77	0.11	0.26	0.37	0.9	16.14	40.4
R15	12.51	0.05	0.24	0.29	0.7	12.80	32.0
R16	13.40	-	0.26	0.26	0.7	13.67	34.2
R17	15.45	-	0.13	0.13	0.3	54.58	38.9
R18	12.08	-	0.05	0.05	0.1	12.13	30.3
R19	10.20	-	0.12	0.12	0.3	10.32	25.8
R20	7.89	-	0.11	0.11	0.3	8.00	20.0
R21	8.88	-	0.05	0.05	0.1	8.92	22.3
R22	24.61	1.01	0.22	1.23	3.1	25.84	64.6
R23	14.45	0.21	0.27	0.48	1.2	14.93	37.3
R24	18.02	0.46	0.18	0.64	1.6	18.66	46.7
R25	17.56	0.33	0.17	0.50	1.2	18.06	45.1
R26	16.71	0.48	0.21	0.69	1.7	17.40	43.5
R27	15.08	0.30	0.20	0.50	1.2	15.58	38.9
R28	21.90	1.01	0.25	1.27	3.1	23.16	57.9
R29	13.72	0.09	0.34	0.43	1.1	14.15	35.4
R30	19.83	0.10	0.33	0.43	1.1	20.25	50.6
R31	21.95	0.14	0.28	0.42	1.1	22.37	55.9
R32	11.24	0.03	1.73	1.76	4.4	13.00	32.5
R33	13.30	0.04	1.53	1.57	3.9	14.87	37.2
R34	13.82	0.04	1.33	1.37	3.4	15.18	37.9
R35	13.54	0.11	0.01	0.12	0.3	13.66	34.1
R36	13.02	0.23	0.04	0.27	0.7	13.29	33.2
R37	22.98	1.13	0.22	1.35	3.4	24.33	60.8
R38	13.44	0.11	0.12	0.23	0.6	13.67	34.2
R39	12.62	0.03	1.27	1.30	3.2	13.91	34.8
R40	16.95	0.26	0.25	0.51	1.3	17.47	43.7
R41	13.98	0.12	0.32	0.44	1.1	14.42	36.1
R42	15.83	0.16	0.28	0.44	1.1	16.26	40.6

Receptor	Baseline	Change due to road traffic	PC	Total Change	% EAL	PEC	PEC%EAL
R43	15.41	0.14	0.29	0.43	1.1	15.84	39.6
R44	12.92	0.07	0.87	0.94	2.3	13.76	34.4
R45	10.87	0.02	0.44	0.46	1.1	11.33	28.3
R46	12.20	0.01	0.38	0.39	1.0	12.59	31.5
R47	12.54	0.03	0.00	0.03	0.1	12.57	31.4
R48	12.54	0.01	0.15	0.16	0.4	12.69	31.7
R49	12.74	0.01	0.26	0.27	0.7	13.01	32.5
R50	12.80	0.02	0.23	0.25	0.6	13.05	32.6
R51	12.72	0.01	0.26	0.27	0.7	12.99	32.5
R52	15.97	0.13	0.23	0.36	0.9	16.323	40.8
R53	13.86	0.05	0.02	0.07	0.2	13.94	34.9
R54	19.72	0.05	0.38	0.43	1.1	20.14	50.3
R55	12.44	-	0.07	0.07	0.02	12.51	31.3
R56	11.71	-	0.04	0.04	0.1	11.76	29.4
R57	7.82	-	0.05	0.05	0.1	7.88	19.7
R58	9.30	-	0.04	0.04	0.1	9.34	23.4
R59	13.92	-	0.11	0.11	0.3	14.03	35.1
R60	14.69	0.06	0.21	0.27	0.7	14.96	37.4
R61	14.39	0.11	0.18	0.29	0.7	14.69	36.7
R62	22.71	0.18	0.26	0.44	1.1	23.15	57.9
R63	19.41	0.11	0.22	0.33	0.8	19.74	49.3
R64	20.81	0.13	0.19	0.32	0.8	21.13	52.8
R65	12.87	0.01	0.55	0.56	1.4	13.43	33.6

Table 5.3: Predicted Change in Annual Mean NO_2 Concentrations in 2014 for the Supplementary Scenario (µg m^{-3}), with Comparison Against Environmental Assessment Level Criteria

Receptor	Baseline	Change due to road traffic	PC	Total Change	% EAL	PEC	PEC%EAL
R1	10.89	0.06	0.01	0.07	0.2	10.97	27.4

Receptor	Baseline	Change due to road traffic	PC	Total Change	% EAL	PEC	PEC%EAL
R2	10.28	-	0.19	0.19	0.5	10.47	26.2
R3	10.28	-	0.41	0.41	1.0	10.69	26.7
R4	11.00	0.01	0.17	0.18	0.4	11.18	27.9
R5	13.20	0.03	0.33	0.36	0.9	13.55	33.9
R6	11.55	0.04	1.57	1.61	4.0	13.17	32.9
R7	22.33	0.84	0.19	1.03	2.6	23.36	58.4
R8	12.77	0.09	0.62	0.71	1.8	13.48	33.7
R9	14.31	0.02	0.44	0.46	1.1	14.77	36.9
R10	15.20	0.02	0.17	0.19	0.5	15.39	38.5
R11	12.86	-	0.20	0.20	0.5	13.07	32.7
R12	12.44	-	0.13	0.13	0.3	12.56	31.4
R13	12.62	0.07	0.55	0.62	1.6	13.24	33.1
R14	15.89	0.13	0.26	0.39	1.0	16.28	40.7
R15	12.55	0.05	0.24	0.29	0.7	12.84	32.1
R16	13.40	-	0.26	0.26	0.7	13.67	34.2
R17	15.45	-	0.13	0.13	0.3	15.58	38.9
R18	12.08	-	0.05	0.05	0.1	12.13	30.3
R19	10.20	-	0.12	0.12	0.3	10.32	25.8
R20	7.89	-	0.11	0.11	0.3	8.00	20.0
R21	8.88	-	0.05	0.05	0.1	8.92	22.3
R22	25.65	1.01	0.22	1.23	3.1	26.88	67.2
R23	14.69	0.23	0.27	0.50	1.3	15.19	38.0
R24	18.54	0.50	0.18	0.68	1.7	19.23	48.1
R25	18.05	0.38	0.17	0.55	1.4	18.60	46.5
R26	17.13	0.51	0.21	0.72	1.8	17.85	44.6
R27	15.37	0.33	0.20	0.53	1.3	15.90	39.7
R28	22.73	1.05	0.25	1.30	3.2	24.03	60.1
R29	14.30	0.10	0.34	0.44	1.1	14.74	36.8
R30	19.86	0.10	0.33	0.43	1.1	20.29	50.7

Receptor	Baseline	Change due to road traffic	PC	Total Change	% EAL	PEC	PEC%EAL
R31	21.99	0.13	0.28	0.41	1.0	22.40	56.0
R32	11.36	0.04	1.73	1.77	4.4	13.13	32.8
R33	13.42	0.03	1.53	1.56	3.9	14.99	37.5
R34	13.99	0.03	1.33	1.36	3.4	15.36	38.4
R35	13.82	0.15	0.01	0.16	0.4	13.94	34.9
R36	13.14	0.24	0.04	0.28	0.7	13.42	33.6
R37	23.85	1.16	0.22	1.68	3.4	25.23	63.1
R38	13.63	0.13	0.12	0.25	0.6	13.88	34.7
R39	12.86	0.05	1.27	1.32	3.3	14.19	35.5
R40	17.17	0.32	0.25	0.57	1.4	17.74	44.4
R41	14.56	0.13	0.32	0.45	1.1	15.01	37.5
R42	15.98	0.21	0.28	0.49	1.2	16.47	41.2
R43	15.55	0.18	0.29	0.47	1.2	16.02	40.0
R44	12.95	0.06	0.87	0.93	2.3	13.88	34.7
R45	10.90	0.02	0.44	0.46	1.1	11.36	28.4
R46	12.23	0.01	0.38	0.39	1.0	12.63	31.6
R47	12.59	0.04	0.00	0.04	0.1	12.62	31.6
R48	12.62	0.01	0.15	0.16	0.4	12.78	32.0
R49	12.79	0.01	0.26	0.27	0.7	13.05	32.6
R50	12.84	0.02	0.23	0.25	0.6	13.09	32.7
R51	12.76	0.01	0.26	0.27	0.7	13.04	32.6
R52	16.10	0.14	0.23	0.37	0.9	16.48	41.2
R53	14.17	0.11	0.02	0.13	0.3	14.30	35.8
R54	19.75	0.05	0.38	0.43	1.1	20.18	50.4
R55	12.44	-	0.07	0.07	0.2	12.51	31.3
R56	11.71	-	0.04	0.04	0.1	11.76	29.4
R57	7.82	-	0.05	0.05	0.1	7.88	19.7
R58	9.30	-	0.04	0.04	0..1	9.34	23.4
R59	13.92	-	0.11	0.11	0.3	14.03	35.1

Receptor	Baseline	Change due to road traffic	PC	Total Change	% EAL	PEC	PEC%EAL
R60	14.75	0.07	0.21	0.28	0.7	15.03	37.6
R61	14.42	0.10	0.18	0.28	0.7	14.71	36.8
R62	22.75	0.18	0.26	0.44	1.1	23.19	58.0
R63	19.44	0.10	0.22	0.32	0.8	19.76	49.4
R64	20.84	0.13	0.19	0.32	0.8	21.16	52.9
R65	12.96	0.01	0.55	0.56	1.4	13.52	33.8

Modelling Results for PM_{10} and $PM_{2.5}$

Emissions from the EfW CHP Facility Chimney

5.4.14 A contour plot, showing the predicted PC to annual mean PM_{10} and $PM_{2.5}$ concentrations arising due to emissions from the EfW CHP facility main chimney, is presented as Figure 5.4 of Appendix A to this report. A contour plot showing the PC to 90.41st percentile of 24-hr concentrations is presented in Figure 5.5 of Appendix A to this report.

5.4.15 The annual mean contour plot shows that the predicted PC to ground level concentrations of PM_{10} and $PM_{2.5}$ are very small. The maximum impact within the modelled domain is 0.1 µg m^{-3}, which is restricted to a very small area. At all other locations, the change in annual mean concentrations would be less than 0.1 µg m^{-3}.

5.4.16 The predicted change in 24-hour mean concentrations of PM_{10} is also very small, and is very unlikely to contribute to any risk of an exceedence of the 24-hour EAL.

Change in Annual Mean PM_{10} and $PM_{2.5}$ Concentrations at Discrete Receptors

5.4.17 The predicted change in annual mean pollutant concentrations that would occur from EfW CHP facility operations and associated road traffic, at the selected sensitive receptors, is presented in Tables 5.4 and 5.5.

5.4.18 The maximum predicted change in annual mean PM_{10} concentrations at the selected receptors in the whole modelled domain is 0.1 µg m^{-3}. The change area most affected by road traffic around Camels Head junction is similar, slightly less than 0.1 µg m^{-3}. This change in annual mean PM_{10} concentrations would not result in any additional days in which the PM_{10} 24-hour objective is exceeded.

5.4.19 The modelling results show that predicted annual mean concentrations are well below the respective EAL values for PM_{10} and $PM_{2.5}$.

Table 5.4: Predicted Change in Annual Mean PM_{10} Concentrations in 2014 (µg m^{-3}), with Comparison Against Environmental Assessment Level Criteria

Receptor	Baseline	Change due to road traffic	PC	Total Change	% EAL	PEC	PEC%EAL

Receptor	Baseline	Change due to road traffic	PC	Total Change	% EAL	PEC	PEC%EAL
R1	14.53	0.01	<0.01	0.01	<0.1	14.53	36.3
R2	14.37	-	0.01	0.01	<0.1	14.38	36.0
R3	14.37	-	0.02	0.02	0.1	14.40	36.0
R4	14.56	<0.01	0.01	0.01	<0.1	14.57	36.4
R5	15.22	<0.01	0.02	0.02	<0.1	15.24	38.1
R6	14.69	0.02	0.08	0.10	0.2	14.79	37.0
R7	16.37	0.06	0.01	0.07	0.2	16.44	41.1
R8	15.00	0.01	0.03	0.04	0.1	15.03	37.6
R9	15.17	<0.01	0.02	0.02	0.1	15.19	38.0
R10	15.29	<0.01	0.01	0.01	<0.1	15.30	38.2
R11	15.04	-	0.01	0.01	<0.1	15.05	37.6
R12	14.89	-	0.01	0.01	<0.1	14.90	37.3
R13	14.97	0.01	0.03	0.03	0.1	15.01	37.5
R14	16.87	0.01	0.01	0.03	0.1	15.58	39.0
R15	15.30	<0.01	0.01	0.02	<0.1	14.98	37.5
R16	14.81	-	0.01	0.01	<0.1	14.92	37.0
R17	15.66	-	0.01	0.01	<0.1	15.66	39.2
R18	14.96	-	<0.01	<0.01	<0.1	14.96	37.4
R19	14.26	-	0.01	0.01	<0.1	14.26	35.7
R20	13.77	-	0.01	0.01	<0.1	13.74	34.4
R21	13.94	-	<0.01	<0.01	<0.1	13.94	34.9
R22	16.87	0.09	0.01	0.10	0.2	16.97	42.4
R23	15.30	0.01	0.01	0.03	0.1	15.33	38.3
R24	15.92	0.03	0.01	0.04	0.1	15.87	39.7
R25	15.80	0.03	0.01	0.04	0.1	15.84	39.6
R26	15.60	0.04	0.01	0.05	0.1	15.65	39.1
R27	15.38	0.02	0.01	0.03	0.1	15.41	38.5
R28	16.38	0.08	0.01	0.09	0.2	16.47	41.2
R29	15.25	<0.01	0.02	0.02	0.1	15.27	38.2

Receptor	Baseline	Change due to road traffic	PC	Total Change	% EAL	PEC	PEC%EAL
R30	17.06	0.01	0.02	0.02	0.1	17.09	42.7
R31	17.48	0.01	0.01	0.03	0.1	17.50	43.8
R32	14.64	0.02	0.09	0.10	0.3	14.74	36.9
R33	14.96	0.02	0.08	0.10	0.2	15.06	37.6
R34	15.31	<0.01	0.07	0.07	0.2	15.38	38.5
R35	15.35	0.02	<0.01	0.02	<0.1	15.37	38.4
R36	15.08	0.02	<0.01	0.02	<0.1	15.10	37.8
R37	16.56	0.09	0.01	0.10	0.2	16.66	41.7
R38	15.24	0.01	0.01	0.01	<0.1	15.26	38.1
R39	15.08	0.01	0.06	0.07	0.2	15.15	37.9
R40	15.94	0.01	0.01	0.02	<0.1	15.96	39.9
R41	15.28	0.01	0.02	0.02	0.1	15.30	38.3
R42	15.93	<0.01	0.01	0.01	<0.1	15.94	39.9
R43	15.61	<0.01	0.01	0.03	0.1	15.63	39.1
R44	15.06	<0.01	0.04	0.05	0.1	15.11	37.8
R45	14.54	<0.01	0.02	0.02	0.1	14.57	36.4
R46	14.95	<0.01	0.02	0.02	0.1	14.97	37.4
R47	15.04	<0.01	<0.01	<0.01	<0.1	15.05	37.6
R48	15.05	<0.01	0.01	0.01	<0.1	15.06	37.6
R49	15.12	<0.01	0.01	0.01	<0.1	15.13	37.8
R50	15.13	<0.01	0.01	0.01	<0.1	15.14	37.9
R51	15.11	<0.01	0.01	0.01	<0.1	15.12	37.8
R52	15.64	0.01	0.01	0.02	<0.1	15.66	39.2
R53	15.46	0.02	<0.01	0.02	<0.1	15.48	38.7
R54	17.02	<0.01	0.02	0.02	0.1	17.04	42.6
R55	14.89	-	<0.01	<0.01	<0.1	14.90	37.2
R56	14.67	-	<0.01	<0.01	<0.1	14.67	36.7
R57	14.52	-	<0.01	<0.01	<0.1	14.52	36.3
R58	14.08	-	<0.01	<0.01	<0.1	14.08	35.2

Receptor	Baseline	Change due to road traffic	PC	Total Change	% EAL	PEC	PEC%EAL
R59	15.11	-	0.01	0.01	<0.1	15.11	37.8
R60	15.25	<0.01	0.01	0.02	<0.1	15.27	38.2
R61	15.18	0.01	0.01	0.02	<0.1	15.20	38.0
R62	17.38	0.02	0.01	0.03	0.1	17.41	43.5
R63	16.69	0.01	0.01	0.02	0.1	16.71	41.8
R64	16.98	0.01	0.01	0.02	0.1	17.00	42.5
R65	14.82	<0.01	0.03	0.03	0.1	14.85	37.1

Table 5.5: Predicted Change in Annual Mean PM_{10} Concentrations in 2014 in the Supplementary Scenario (μg m^{-3}), with Comparison Against Environmental Assessment Level Criteria

Receptor	Baseline	Change due to road traffic	PC	Total Change	% EAL	PEC	PEC%EAL
R1	14.54	0.01	<0.01	0.01	<0.1	14.54	36.4
R2	14.37	-	0.01	0.01	<0.1	14.38	36.0
R3	14.37	-	0.02	0.02	0.1	14.40	36.0
R4	14.58	<0.01	0.01	0.01	<0.1	14.59	36.5
R5	15.25	<0.01	0.02	0.02	<0.1	15.27	38.2
R6	14.74	0.01	0.08	0.08	0.2	14.82	37.1
R7	16.54	0.07	0.01	0.08	0.2	16.62	41.6
R8	15.02	0.01	0.03	0.04	0.1	15.06	37.6
R9	15.47	<0.01	0.02	0.02	0.1	15.49	38.7
R10	15.75	<0.01	0.01	0.01	<0.1	15.76	38.4
R11	15.04	-	0.01	0.01	<0.1	15.05	37.6
R12	14.89	-	0.01	0.01	<0.1	14.90	37.3
R13	14.99	0.01	0.03	0.03	0.1	15.02	37.6
R14	15.61	<0.01	0.01	0.02	<0.1	15.62	39.1
R15	14.98	<0.01	0.01	0.02	<0.1	14.99	37.5
R16	14.81	-	0.01	0.0.1	<0.1	14.82	37.0
R17	15.66	-	0.01	0.01	<0.1	15.66	39.2
R18	14.96	-	<0.01	<0.01	<0.1	14.96	37.4
R19	14.26	-	0.01	0.01	<0.1	14.26	35.7
R20	13.77	-	0.01	0.01	<0.1	13.78	34.4
R21	13.94	-	<0.01	<0.01	<0.1	13.94	34.9
R22	17.10	0.09	0.01	0.10	0.2	17.19	43.0
R23	15.36	0.02	0.01	0.03	0.1	15.40	38.5
R24	15.94	0.05	0.01	0.05	0.1	15.99	40.0
R25	15.91	0.04	0.01	0.05	0.1	15.96	39.9
R26	15.69	0.04	0.01	0.05	0.1	15.74	39.4
R27	15.45	0.03	0.01	0.04	0.1	15.49	38.7

Receptor	Baseline	Change due to road traffic	PC	Total Change	% EAL	PEC	PEC%EAL
R28	16.56	0.07	0.01	0.09	0.2	16.64	41.6
R29	15.45	0.01	0.02	0.03	0.1	15.47	38.7
R30	17.01	0.01	0.02	0.02	0.1	17.10	42.7
R31	17.49	0.02	0.01	0.03	0.1	17.52	43.8
R32	14.68	<0.01	0.09	0.09	0.2	14.77	36.9
R33	15.00	<0.01	0.08	0.08	0.2	15.08	37.7
R34	15.38	<0.01	0.07	0.07	0.2	15.44	38.6
R35	15.42	0.05	<0.01	0.05	0.1	15.47	38.7
R36	15.11	0.02	<0.01	0.03	0.1	15.14	37.8
R37	16.75	0.09	0.01	0.10	0.3	16.85	42.1
R38	15.31	0.01	0.01	0.02	0.1	15.33	34.3
R39	15.17	0.01	0.06	0.07	0.2	15.24	38.1
R40	16.00	0.03	0.01	0.05	0.1	16.04	40.1
R41	15.47	0.01	0.02	0.03	0.1	15.50	38.7
R42	15.97	0.03	0.01	0.04	0.1	16.01	40.0
R43	15.65	0.01	0.01	0.03	0.1	15.68	39.2
R44	15.11	<0.01	0.04	0.05	0.1	15.16	37.9
R45	14.55	<0.01	0.02	0.02	0.1	14.57	36.4
R46	14.96	<0.01	0.02	0.02	0.1	14.98	37.4
R47	15.06	<0.01	<0.01	<0.01	<0.1	15.06	37.7
R48	15.08	<0.01	0.01	0.01	<0.1	15.09	37.7
R49	15.13	<0.01	0.01	0.01	<0.1	15.14	37.9
R50	15.14	<0.01	0.01	0.01	<0.1	15.16	37.9
R51	15.12	<0.01	0.01	0.01	<0.1	15.13	37.8
R52	15.70	<0.01	0.01	0.01	<0.1	15.71	39.3
R53	15.54	0.05	<0.01	0.05	0.1	15.59	39.0
R54	17.03	0.01	0.02	0.02	0.1	17.05	42.6
R55	14.89	-	<0.01	<0.01	<0.1	14.90	37.2
R56	14.67	-	<0.01	<0.01	<0.1	14.7	36.7

Receptor	Baseline	Change due to road traffic	PC	Total Change	% EAL	PEC	PEC%EAL
R57	14.52	-	<0.01	<0.01	<0.1	14.52	36.3
R58	14.08	-	<0.01	<0.01	<0.1	14.08	35.2
R59	15.11	-	0.01	0.01	<0.1	15.11	37.8
R60	15.28	<0.01	0.01	0.01	<0.1	15.29	38.2
R61	15.19	0.01	0.01	0.02	0.1	15.21	38.0
R62	17.39	0.03	0.01	0.04	0.1	17.42	43.6
R63	16.70	0.01	0.01	0.02	0.1	16.72	41.8
R64	16.98	0.02	0.01	0.03	0.1	17.01	42.5
R65	14.85	<0.01	0.03	0.03	0.1	14.88	37.2

Table 5.6: Predicted Change in Annual Mean $PM_{2.5}$ Concentrations in 2014 (µg m^{-3}), with Comparison Against Environmental Assessment Level Criteria

Receptor	Baseline	Change due to road traffic	PC	Total Change	% EAL	PEC	PEC%EAL
R1	8.70	<0.01	<0.01	<0.01	<0.1	8.71	34.8
R2	8.60	-	0.01	0.01	<0.1	8.61	34.5
R3	8.60	-	0.02	0.02	0.1	8.62	34.5
R4	8.72	<0.01	0.01	0.01	<0.1	8.73	34.9
R5	9.13	<0.01	0.02	0.02	0.1	9.15	36.6
R6	8.81	<0.01	0.08	0.08	0.3	8.89	35.6
R7	10.20	0.03	0.01	0.04	0.2	10.24	41.0
R8	9.22	<0.01	0.03	0.03	0.1	9.25	37.0
R9	9.31	<0.01	0.02	0.02	0.1	9.33	37.0
R10	9.39	<0.01	0.01	0.01	<0.1	9.40	37.6
R11	9.23	-	0.01	0.01	<0.1	9.24	36.9
R12	9.02	-	0.01	0.01	<0.1	9.03	36.1
R13	9.20	<0.01	0.03	0.03	0.1	9.23	36.9
R14	9.63	<0.01	0.01	0.01	0.1	9.65	38.6
R15	9.20	<0.01	0.01	0.01	0.1	9.21	36.8

Receptor	Baseline	Change due to road traffic	PC	Total Change	% EAL	PEC	PEC%EAL
R16	9.20	-	0.01	0.01	0.1	9.21	36.8
R17	9.77	-	0.01	0.01	<0.1	9.77	39.1
R18	9.03	-	<0.01	<0.01	<0.1	9.03	36.1
R19	8.53	-	0.01	0.01	<0.1	8.54	34.2
R20	8.18	-	0.01	0.01	<0.1	8.19	32.7
R21	8.38	-	<0.01	<0.01	<0.1	8.38	33.5
R22	10.57	0.04	0.01	0.05	0.2	10.62	42.5
R23	9.43	0.01	0.01	0.02	0.1	9.45	37.8
R24	9.81	0.02	0.01	0.03	0.1	9.84	39.4
R25	9.79	0.01	0.01	0.02	0.1	9.81	39.2
R26	9.65	0.02	0.01	0.03	0.1	9.68	38.7
R27	9.49	0.01	0.01	0.02	0.1	9.51	38.0
R28	10.21	0.05	0.01	0.06	0.2	1.27	41.1
R29	9.38	<0.01	0.02	0.02	0.1	9.40	37.6
R30	10.71	<0.01	0.02	0.02	0.1	10.73	42.9
R31	10.98	0.01	0.01	0.03	0.1	11.01	44.0
R32	8.78	<0.01	0.09	0.09	0.3	8.86	35.5
R33	9.27	<0.01	0.08	0.08	0.3	9.35	37.4
R34	9.41	<0.01	0.07	0.07	0.3	9.47	37.9
R35	9.22	<0.01	<0.01	<0.01	<0.1	9.22	36.9
R36	9.27	0.01	<0.01	0.01	<0.1	9.28	37.1
R37	10.35	0.05	0.01	0.06	0.3	10.41	41.6
R38	9.38	<0.01	0.01	0.01	<0.1	9.39	37.6
R39	9.05	<0.01	0.06	0.06	0.2	9.11	36.4
R40	9.84	<0.01	0.01	0.02	0.1	9.86	39.4
R41	9.41	<0.01	0.02	0.02	0.1	9.43	37.7
R42	9.80	<0.01	0.01	0.01	<0.1	9.81	39.3
R43	9.62	<0.01	0.01	0.02	0.1	9.63	38.5
R44	9.26	<0.01	0.04	0.04	0.2	9.31	37.2

Receptor	Baseline	Change due to road traffic	PC	Total Change	% EAL	PEC	PEC%EAL
R45	8.71	<0.01	0.02	0.02	0.1	8.73	34.9
R46	8.96	<0.01	0.02	0.02	0.1	8.98	35.9
R47	9.02	<0.01	<0.01	<0.01	<0.1	9.02	36.1
R48	9.03	<0.01	0.01	0.01	<0.1	9.04	36.1
R49	9.07	<0.01	0.01	0.01	0.1	9.08	36.3
R50	9.08	<0.01	0.01	0.01	<0.1	9.09	36.4
R51	9.06	<0.01	0.01	0.01	0.1	9.08	36.3
R52	9.68	<0.01	0.01	0.01	<0.1	9.69	38.8
R53	9.29	<0.01	<0.01	<0.01	<0.1	9.29	37.1
R54	10.68	<0.01	0.02	0.02	0.1	10.71	42.8
R55	9.02	-	<0.01	<0.01	<0.1	9.02	36.1
R56	8.97	-	<0.01	<0.01	<0.1	8.91	35.6
R57	8.32	-	<0.01	<0.01	<0.1	8.33	33.3
R58	8.47	-	<0.01	<0.01	<0.1	8.47	33.9
R59	9.36	-	0.01	0.01	<0.1	9.36	37.5
R60	9.44	<0.01	0.01	0.01	<0.1	9.45	37.8
R61	9.13	0.01	0.01	0.02	0.1	9.15	36.6
R62	10.91	0.02	0.01	0.03	0.1	10.94	43.8
R63	10.46	0.01	0.01	0.02	0.1	10.48	41.9
R64	10.65	0.01	0.01	0.02	0.1	10.67	42.7
R65	9.18	<0.01	0.03	0.03	0.1	9.21	36.8

Table 5.7: Predicted Change in Annual Mean $PM_{2.5}$ Concentrations in 2014 in the Supplementary Scenario (µg m^{-3}), with Comparison Against Environmental Assessment Level Criteria

Receptor	Baseline	Change due to road traffic	PC	Total Change	% EAL	PEC	PEC%EAL
R1	8.71	<0.01	<0.01	<0.01	<0.1	8.71	34.8
R2	8.60	-	0.01	0.01	<0.1	8.61	34.5
R3	8.60	-	0.02	0.02	0.01	8.62	34.5
R4	8.73	<0.01	0.01	0.01	<0.1	8.74	35.0
R5	9.15	<0.01	0.02	0.02	<0.1	9.17	36.7
R6	8.83	<0.01	0.08	0.08	0.2	8.91	35.6
R7	10.32	0.05	0.01	0.06	0.1	10.38	41.5
R8	9.23	<0.01	0.03	0.03	0.1	9.26	37.1
R9	9.50	<0.01	0.02	0.02	0.1	9.52	38.1
R10	9.67	<0.01	0.01	0.01	<0.1	9.68	38.7
R11	9.23	-	0.01	0.01	<0.1	9.24	36.9
R12	9.02	-	0.01	0.01	<0.1	9.03	36.1
R13	9.21	<0.01	0.03	0.03	0.1	9.24	37.0
R14	9.66	0.01	0.01	0.03	0.1	9.68	38.7
R15	9.20	<0.01	0.01	0.01	<0.1	9.22	36.9
R16	9.20	-	0.01	0.01	<0.1	9.21	36.8
R17	9.77	-	0.01	0.01	<0.1	9.77	39.1
R18	9.03	-	<0.01	<0.01	<0.1	9.03	36.1
R19	8.53	-	0.01	0.01	<0.1	8.54	34.2
R20	8.18	-	0.01	0.01	<0.1	8.19	32.7
R21	8.38	-	<0.01	<0.01	<0.1	8.38	33.5
R22	10.72	0.05	0.01	0.06	0.2	10.78	43.1
R23	9.47	0.01	0.01	0.02	0.1	9.49	38.0
R24	9.89	0.03	0.01	0.04	0.1	9.93	39.7
R25	9.86	0.02	0.01	0.03	0.1	9..90	39.6
R26	9.71	0.03	0.01	0.04	0.1	9.75	39.0
R27	9.53	0.02	0.01	0.03	0.1	9.56	38.3

Receptor	Baseline	Change due to road traffic	PC	Total Change	% EAL	PEC	PEC%EAL
R28	10.34	0.05	0.01	0.07	0.2	10.41	41.6
R29	9.50	<0.01	0.02	0.02	0.1	9.52	38.1
R30	10.71	0.01	0.02	0.02	0.1	10.74	42.9
R31	10.99	0.01	0.01	0.02	0.1	11.01	44.0
R32	8.80	<0.01	0.09	0.09	0.2	8.88	35.5
R33	9.29	<0.01	0.08	0.08	0.2	9.37	37.5
R34	9.44	<0.01	0.07	0.07	0.2	9.51	38.0
R35	9.26	0.03	<0.01	0.03	0.1	9.29	37.2
R36	9.29	0.02	<0.01	0.02	<0.1	9.31	37.2
R37	10.48	0.06	0.01	0.07	0.2	10.55	42.2
R38	9.42	0.01	0.01	0.01	<0.1	9.43	37.7
R39	9.10	<0.01	0.06	0.07	0.2	9.17	36.7
R40	9.88	0.01	0.01	0.02	0.1	9.90	39.6
R41	9.52	0.01	0.02	0.02	0.1	9.54	38.2
R42	9.83	0.01	0.01	0.02	<0.1	9.85	39.4
R43	9.64	0.01	0.01	0.03	0.1	9.67	38.7
R44	9.29	<0.01	0.04	0.05	0.1	9.33	37.3
R45	8.71	<0.01	0.02	0.02	0.1	8.74	34.9
R46	8.97	<0.01	0.02	0.02	<0.1	8.99	36.0
R47	9.03	<0.01	<0.01	<0.01	<0.1	9.03	36.1
R48	9.04	<0.01	0.01	0.01	<0.1	9.05	36.2
R49	9.08	<0.01	0.01	0.01	<0.1	9.09	36.4
R50	9.08	<0.01	0.01	0.01	<0.1	9.10	36.4
R51	9.07	<0.01	0.01	0.01	<0.1	9.08	36.3
R52	9.71	0.01	0.01	0.02	0.1	9.73	38.9
R53	9.34	0.03	<0.01	0.03	0.1	9.37	37.5
R54	10.69	<0.01	0.02	0.02	0.1	10.71	42.8
R55	9.02	-	<0.01	<0.01	<0.1	9.02	36.1
R56	8.97	-	<0.01	<0.01	<0.1	8.91	35.6

Receptor	Baseline	Change due to road traffic	PC	Total Change	% EAL	PEC	PEC%EAL
R57	8.32	-	<0.01	<0.01	<0.1	8.33	33.3
R58	8.47	-	<0.01	<0.01	<0.1	8.47	33.9
R59	9.36	-	<0.01	0.01	<0.1	9.36	37.5
R60	9.45	<0.01	0.01	0.02	<0.1	9.47	37.9
R61	9.13	<0.01	0.01	0.01	<0.1	9.15	36.6
R62	10.92	0.01	0.01	0.02	0.1	10.94	43.8
R63	10.47	<0.01	0.01	0.02	<0.1	10.48	41.9
R64	10.66	0.01	0.01	0.02	<0.1	10.67	42.7
R65	9.20	<0.01	0.03	0.03	0.1	9.22	36.9

Modelling Results for All Pollutants (for the Protection of Human Health)

5.4.20 The maximum Process Contribution (PC) and Predicted Environmental Concentration (PEC) within the modelled domain, for each pollutant and averaging period, are summarised in Table 5.8. The results are based on emissions from the proposed facility as presented in Table 3.4, with a 95m chimney. The modelling result in respect of each pollutant and averaging period, at the selected discrete sensitive receptors, is presented separately in Annex D to this report.

5.4.21 The PC listed, in respect of each pollutant and averaging period assessed, is the maximum impact reported from the modelling of five years of meteorological data. The background values used in the calculation of PEC concentrations are taken from Table 4.12.

5.4.22 The PECs for NO_2, PM_{10} and $PM_{2.5}$ are calculated using the background concentrations for the modelled domain. Predicted concentrations at discrete receptors, incorporating contributions from road traffic, are detailed in Tables 5.2 to 5.7, above.

5.4.23 The results show that the maximum PC/PEC values for each of the modelled pollutants are well within their respective EAL criteria for the protection of human health.

Table 5.8: 95m Chimney. Maximum Process Contribution and Predicted Environmental Concentration, all Modelled Pollutants, for the Worst-Case Meteorological Data Year

Pollutant	Averaging Period	EAL	PC	PC	PEC	PEC
		($\mu g\ m^{-3}$)	($\mu g\ m^{-3}$)	(% EAL)	($\mu g\ m^{-3}$)	(% EAL)
NO_2	Annual Mean	40	1.8	4.5%	17.1	43%
	99.79^{th} %ile of 1-hour means	200	11.1	5.6%	41.0	21%
PM_{10}	Annual Mean	40	0.1	0.25%	13.4	34%
	90.41^{st} %ile of 24-hour means	50	0.4	0.8%	20.4	41%
$PM_{2.5}$	Annual Mean	25	0.1	0.4%	8.7	35%

Pollutant	Averaging Period	EAL ($\mu g\ m^{-3}$)	PC ($\mu g\ m^{-3}$)	PC (% EAL)	PEC ($\mu g\ m^{-3}$)	PEC (% EAL)
SO_2	Annual Mean	50	0.6	1.2%	7.7	15%
	99.9th %ile of 15-min means	266	8.8	3.3%	20.1	8%
	99.73rd %ile of 1-hour means	350	7.7	2.2%	19.0	5%
	99.18th %ile of 24-hour means	125	3.6	2.9%	14.9	12%
VOC, as benzene	Annual Mean	5	0.13	2.6%	0.46	9%
CO	Max daily 8-hour running mean	10,000	8.0	<0.1%	276	3%
	Max 1-hour mean	30,000	14.2	<0.1%	282	1%
HCl	Max 1-hour mean	750	2.8	0.4%	3.2	<1%
HF	Monthly mean*	16	-	-	-	-
	Max 1-hour mean	160	0.3	0.2%	0.3	<1%
PAH (as benzo[a] pyrene)	Annual Mean	0.00025	0.000013	5.2%	0.000134	54%
Pb	Annual Mean	0.25	0.006	2.4%	0.01026	4%
Cd	Annual Mean	0.005	0.00063	12.6%	0.00072	14%
Hg	Annual Mean	0.25	0.001	0.4%	0.00101	<1%
	Max 1-hour mean	7.5	0.014	0.2%	0.01405	<1%
Sb	Annual Mean	5	0.01	0.2%	0.01074	<1%
	Max 1-hour mean	150	0.14	0.1%	0.14148	<1%
As	Annual Mean	0.003	0.00004	1.3%	0.00045	15%
Total Cr	Annual Mean	5	0.00042	<0.1%	0.00094	<1%
	Max 1-hour mean	150	0.0093	<0.1%	0.01034	<1%
Cr, (VI) oxidation state in PM_{10} fraction	Annual Mean	0.0002	0.0000088	4.4%	0.00011	56%
Cu (dusts and mists)	Annual Mean	10	0.01	0.1%	0.01299	<1%
	Max 1-hour mean	200	0.14	0.1%	0.14598	<1%
Mn	Annual Mean	0.15	0.006	4.0%	0.00801	5%
	Max 1-hour mean	1500	0.142	<0.1%	0.14602	<1%
Ni	Annual Mean	0.02	0.0017	8.5%	0.00366	18%

Pollutant	Averaging Period	EAL	PC	PC	PEC	PEC
		($\mu g\ m^{-3}$)	($\mu g\ m^{-3}$)	(% EAL)	($\mu g\ m^{-3}$)	(% EAL)
V	Annual Mean	5	0.01	0.2%	0.01068	<1%
	Max 1-hour mean	1	0.14	14.0%	0.14136	14%
NH_3	Annual Mean	180	0.1	<0.1%	1.1	<1%
	Max 1-hour mean	2500	3	0.1%	5.0	<1%
PCBs	Annual Mean	0.2	0.00005	<0.1%	0.001774	1%
	Max 1-hour mean	6	0.001	<0.1%	0.004448	<1%
Dioxins and Furans	Annual Mean	n/a	1.26×10^{-9}	-	9.76×10^{-9}	-

* The dispersion model does not give a monthly mean for HF, but the maximum predicted hourly concentration demonstrates that this EAL would not be exceeded

Modelling Results: Impact on Designated Nature Sites

5.4.24 The results of the dispersion modelling of predicted impacts on sensitive ecological receptors are presented in Tables 5.9 to 5.15. The tables set out the predicted PC to atmospheric concentrations of NO_X, SO_2, NH_3 and HF, and also acid deposition and nutrient nitrogen deposition.

5.4.25 Specific significance criteria relating to impacts on sensitive designated ecological receptors are set out within the H1 guidance. The impact of chimney emissions can be disregarded as insignificant if:

- The long term critical load or critical level is less than 1%; or if greater than 1% then
- The PEC is less than 70% of the critical load or critical level.

5.4.26 The assessment results show that the predicted impacts are within the criteria for insignificance at most of the selected receptors. PCs of slightly more than 1% of the long term Critical Load or Critical Level have been predicted to occur at:

- some locations within the Plymouth Sound Estuaries SAC in respect of annual mean NO_X; and
- at Ernesettle County Wildlife Site in respect of annual mean NO_X, nutrient nitrogen deposition and total acid deposition.

5.4.27 Within the Plymouth Sound Estuaries SAC, the PC to annual mean NO_X is slightly above 1% at the selected receptors. The PEC, however, remains well within 70% of the critical level at all locations within the modelled domain. Using the H1 criteria, these impacts can therefore be considered to be insignificant.

5.4.28 At Ernsettle CWS, the PC to total acid deposition is predicted to be just above 3% of the critical load, with the PC to nutrient nitrogen deposition predicted to be 2.5% of the lower bound critical load. In both cases, baseline deposition rates are already in excess of the critical load without the contribution of the facility (100% for acid deposition and 260% for nutrient nitrogen). The small additional contribution to these existing levels predicted by the assessment is unlikely to significantly affect the overall condition of this locally designated wildlife site. Furthermore, it should be noted that the assessment has been undertaken based on the modelling of emissions at WID limits for the pollutants considered in the prediction of impacts on ecological sites, in reality long term emissions from facilities such as this one are often well below WID limits for many pollutants. For this reason, it is likely that the actual impacts will be lower than those presented here.

Table 5.9: Dispersion Modelling Results for Sensitive Ecological Receptors – NO_X

Ecological Receptor Number	Site Name	Habitat Type	Background	Annual Mean (µg m^{-3})					24 Hour Mean (µg m^{-3})				
				Critical Level	PC	PC/CL	PEC	PEC/CL	Critical Level	PC	PC/CL	PEC	PEC/CL
E1	Plymouth Sound and Estuaries SAC	Mudflats	11.60	30	0.134	0.45%	11.73	39.1%	75	0.137	4.63%	26.68	35.6%
E2			11.60	30	0.280	0.93%	11.88	39.6%	75	0.279	4.64%	26.68	35.6%
E3			11.60	30	0.327	1.09%	11.93	39.8%	75	0.332	5.64%	27.43	36.6%
E4			11.60	30	0.583	1.94%	12.18	40.6%	75	0.592	8.71%	29.74	39.6%
E5			11.60	30	0.345	1.15%	11.94	39.8%	75	0.348	5.57%	27.37	36.5%
E6			11.60	30	0.385	1.28%	11.99	40.0%	75	0.384	8.83%	29.82	39.8%
E7			11.60	30	0.188	0.63%	11.79	39.3%	75	0.189	5.54%	27.36	36.5%
E8			11.60	30	0.154	0.51%	11.75	39.2%	75	0.157	4.36%	26.47	35.3%
E9			11.60	30	0.160	0.53%	11.76	39.2%	75	0.163	3.48%	25.81	34.4%
E10			11.60	30	0.345	1.15%	11.95	39.8%	75	0.350	7.63%	28.92	38.6%
E11			16.50	30	0.139	0.46%	16.64	55.5%	75	0.142	1.74%	34.30	45.7%
E12			16.50	30	0.065	0.22%	16.56	55.2%	75	0.065	0.89%	33.67	44.9%
E13			16.50	30	0.097	0.32%	16.60	55.3%	75	0.098	1.19%	33.89	45.2%
E14			6.90	30	0.052	0.17%	6.95	23.2%	75	0.053	0.79%	14.39	19.2%
E15			7.70	30	0.048	0.16%	7.75	25.8%	75	0.049	0.65%	15.89	21.2%
E16	Plymouth Sound and Estuaries SAC, Tamar Estuaries SPA and Tamar Tavy SSSI	Mudflats	7.90	30	0.020	0.07%	7.92	26.4%	75	0.021	0.77%	16.38	21.8%
E17			7.90	30	0.055	0.18%	7.95	26.5%	75	0.052	0.71%	16.33	21.8%
E18			9.40	30	0.120	0.40%	9.52	31.7%	75	0.119	1.80%	20.15	26.9%
E19			9.40	30	0.062	0.21%	9.46	31.5%	75	0.064	1.78%	20.13	26.8%
E20			12.30	30	0.200	0.67%	12.50	41.7%	75	0.197	2.05%	26.14	34.9%

Ecological Receptor Number	Site Name	Habitat Type	Background	Annual Mean (µg m^{-3})					24 Hour Mean (µg m^{-3})				
				Critical Level	PC	PC/CL	PEC	PEC/CL	Critical Level	PC	PC/CL	PEC	PEC/CL
E21			9.40	30	0.084	0.28%	9.48	31.6%	75	0.085	2.55%	20.72	27.6%
E22			11.60	30	0.100	0.33%	11.70	39.0%	75	0.102	3.77%	26.03	34.7%
E23			11.60	30	0.142	0.47%	11.74	39.1%	75	0.146	4.18%	26.33	35.1%
E24	Plymouth Sound and Estuaries SAC and Tamar Estuaries SPA	Mudflats	11.60	30	0.172	0.57%	11.77	39.2%	75	0.173	2.65%	25.19	33.6%
E25			11.60	30	0.114	0.38%	11.71	39.0%	75	0.112	1.68%	24.46	32.6%
E26			11.60	30	0.103	0.34%	11.70	39.0%	75	0.101	1.55%	24.36	32.5%
E27			8.30	30	0.086	0.29%	8.39	28.0%	75	0.087	1.24%	17.53	23.4%
E28			8.30	30	0.088	0.29%	8.39	28.0%	75	0.089	1.25%	17.54	23.4%
E29			8.00	30	0.098	0.33%	8.10	27.0%	75	0.100	2.05%	17.54	23.4%
E30			8.00	30	0.049	0.16%	8.05	26.8%	75	0.050	1.21%	16.91	22.5%
E31			8.00	30	0.070	0.23%	8.07	26.9%	75	0.071	1.42%	17.07	22.8%
E32			8.00	30	0.103	0.34%	8.10	27.0%	75	0.105	1.91%	17.43	23.2%
E33	South Dartmoor Woods SAC	Old sessile oak woods	13.5	30	0.048	0.16%	13.55	45.2%	75	0.047	0.58%	27.44	36.6%
E34			13.5	30	0.043	0.14%	13.54	45.1%	75	0.042	0.57%	27.43	36.6%
E35			13.5	30	0.036	0.12%	13.54	45.1%	75	0.034	0.53%	27.40	36.5%
E36	Blackstone Point SAC	Shoredock	7.4	30	0.027	0.09%	7.43	24.8%	75	0.027	0.38%	15.08	20.1%
E37			7.4	30	0.026	0.09%	7.43	24.8%	75	0.026	0.36%	15.07	20.1%
E38	Kinterbury Creek CWS	Mudflats	11.6	30	0.216	0.72%	11.82	39.4%	75	0.215	6.91%	28.38	37.8%
E39			11.6	30	0.200	0.67%	11.80	39.3%	75	0.199	4.73%	26.75	35.7%
E40	Ernesettle Complex CWS	Deciduous woodland	11.60	30	0.363	1.21%	11.96	39.9%	75	0.364	6.39%	27.99	37.3%
E41			11.6	30	0.182	0.61%	11.78	39.3%	75	0.184	3.32%	25.69	34.3%

Table 5.10: Dispersion Modelling Results for Sensitive Ecological Receptors – SO_2

Ecological Receptor Number	Site Name	Habitat Type	Background	Annual Mean (µg m^{-3})				
				Critical Level	PC	PC/CL	PEC	PEC/CL
E1	Plymouth Sound and Estuaries SAC	Mudflats	0.7	20	0.033	0.17%	0.73	3.67%
E2			0.7	20	0.070	0.35%	0.77	3.85%
E3			0.7	20	0.082	0.41%	0.78	3.91%
E4			0.7	20	0.146	0.73%	0.85	4.23%
E5			0.7	20	0.086	0.43%	0.79	3.93%
E6			0.7	20	0.096	0.48%	0.80	3.98%
E7			0.7	20	0.047	0.24%	0.75	3.74%
E8			0.7	20	0.039	0.19%	0.74	3.69%
E9			0.7	20	0.040	0.20%	0.74	3.70%
E10			0.7	20	0.086	0.43%	0.79	3.93%
E11			0.7	20	0.035	0.17%	0.73	3.67%
E12			0.7	20	0.016	0.08%	0.72	3.58%
E13			0.7	20	0.024	0.12%	0.72	3.62%
E14			0.7	20	0.013	0.06%	0.71	3.56%
E15			0.7	20	0.012	0.06%	0.71	3.56%
E16	Plymouth Sound and Estuaries SAC, Tamar Estuaries SPA and Tamar Tavy SSSI	Mudflats	0.7	20	0.005	0.03%	0.71	3.53%
E17			0.7	20	0.014	0.07%	0.71	3.57%
E18			0.7	20	0.030	0.15%	0.73	3.65%
E19			0.7	20	0.016	0.08%	0.72	3.58%
E20			0.7	20	0.050	0.25%	0.75	3.75%

Ecological Receptor Number	Site Name	Habitat Type	Background	Annual Mean (µg m^{-3})				
				Critical Level	PC	PC/CL	PEC	PEC/CL
E21			0.7	20	0.021	0.11%	0.72	3.61%
E22			0.7	20	0.025	0.13%	0.73	3.63%
E23			0.7	20	0.035	0.18%	0.74	3.68%
E24	Plymouth Sound and Estuaries SAC and Tamar Estuaries SPA	Mudflats	0.7	20	0.043	0.21%	0.74	3.71%
E25			0.7	20	0.029	0.14%	0.73	3.64%
E26			0.7	20	0.026	0.13%	0.73	3.63%
E27			0.7	20	0.022	0.11%	0.72	3.61%
E28			0.7	20	0.022	0.11%	0.72	3.61%
E29			0.7	20	0.025	0.12%	0.72	3.62%
E30			0.7	20	0.012	0.06%	0.71	3.56%
E31			0.7	20	0.017	0.09%	0.72	3.59%
E32			0.7	20	0.026	0.13%	0.73	3.63%
E33	South Dartmoor Woods SAC	Old sessile oak woods	0.7	10	0.012	0.12%	0.71	7.12%
E34			0.7	10	0.011	0.11%	0.71	7.11%
E35			0.7	10	0.009	0.09%	0.71	7.09%
E36	Blackstone Point SAC	Shoredock	0.7	20	0.007	0.03%	0.71	3.53%
E37			0.7	20	0.006	0.03%	0.71	3.53%
E38	Kinterbury Creek CWS	Mudflats	0.7	20	0.054	0.27%	0.75	3.77%
E39			0.7	20	0.050	0.25%	0.75	3.75%
E40	Ernesettle Complex CWS	Deciduous woodland	0.7	20	0.091	0.45%	0.79	3.95%
E41			0.7	20	0.046	0.23%	0.75	3.73%

Table 5.11: Dispersion Modelling Results for Sensitive Ecological Receptors – NH_3

Ecological Receptor Number	Site Name	Habitat Type	Background	Annual Mean (µg m^{-3})				
				Critical Level	PC	PC/CL	PEC	PEC/CL
E1	Plymouth Sound and Estuaries SAC	Mudflats	1.00	3	0.007	0.22%	1.01	34%
E2			1.00	3	0.014	0.47%	1.01	34%
E3			1.00	3	0.016	0.55%	1.02	34%
E4			1.00	3	0.029	0.97%	1.03	34%
E5			1.00	3	0.017	0.57%	1.02	34%
E6			1.00	3	0.019	0.64%	1.02	34%
E7			1.00	3	0.009	0.31%	1.01	34%
E8			1.00	3	0.008	0.26%	1.01	34%
E9			1.00	3	0.008	0.27%	1.01	34%
E10			1.00	3	0.017	0.58%	1.02	34%
E11			0.80	3	0.007	0.23%	0.81	27%
E12			0.80	3	0.003	0.11%	0.80	27%
E13			0.80	3	0.005	0.16%	0.80	27%
E14			0.40	3	0.003	0.09%	0.40	13%
E15			0.40	3	0.002	0.08%	0.40	13%
E16	Plymouth Sound and Estuaries SAC, Tamar Estuaries SPA and Tamar Tavy SSSI	Mudflats	1.70	3	0.001	0.03%	1.70	57%
E17			1.40	3	0.003	0.09%	1.40	47%
E18			1.40	3	0.006	0.20%	1.41	47%
E19			1.40	3	0.003	0.10%	1.40	47%
E20			1.50	3	0.010	0.33%	1.51	50%

Ecological Receptor Number	Site Name	Habitat Type	Background	Annual Mean ($\mu g\ m^{-3}$)				
				Critical Level	PC	PC/CL	PEC	PEC/CL
E21			1.40	3	0.004	0.14%	1.40	47%
E22			1.00	3	0.005	0.17%	1.01	34%
E23			1.00	3	0.007	0.24%	1.01	34%
E24	Plymouth Sound and Estuaries SAC and Tamar Estuaries SPA	Mudflats	1.00	3	0.009	0.29%	1.01	34%
E25			1.00	3	0.006	0.19%	1.01	34%
E26			1.00	3	0.005	0.17%	1.01	34%
E27			1.20	3	0.004	0.14%	1.20	40%
E28			1.20	3	0.004	0.15%	1.20	40%
E29			0.90	3	0.005	0.16%	0.90	30%
E30			0.90	3	0.002	0.08%	0.90	30%
E31			0.90	3	0.003	0.12%	0.90	30%
E32			0.90	3	0.005	0.17%	0.91	30%
E33	South Dartmoor Woods SAC	Old sessile oak woods	1.40	1	0.002	0.24%	1.40	140%
E34			1.40	1	0.002	0.22%	1.40	140%
E35			1.40	1	0.002	0.18%	1.40	140%
E36	Blackstone Point SAC	Shoredock	0.80	3	0.001	0.04%	0.80	27%
E37			0.80	3	0.001	0.04%	0.80	27%
E38	Kinterbury Creek CWS	Mudflats	1.00	3	0.011	0.36%	1.01	34%
E39			1.00	3	0.010	0.33%	1.01	34%
E40	Ernesettle Complex CWS	Deciduous woodland	1.00	3	0.018	0.60%	1.02	34%
E41			1.00	3	0.009	0.30%	1.01	34%

Table 5.12: Dispersion Modelling Results for Sensitive Ecological Receptors – HF

Ecological Receptor Number	Site Name	Habitat Type	Annual Mean (μgm^{-3})			Weekly Mean (μgm^{-3})		
			Critical Level	PC	PC/CL	Critical Level	PC	PC/CL
E1	Plymouth Sound and Estuaries SAC	Mudflats	5	0.0007	0.35%	0.5	0.0007	0.14%
E2			5	0.0014	0.35%	0.5	0.0014	0.28%
E3			5	0.0017	0.42%	0.5	0.0016	0.33%
E4			5	0.0030	0.65%	0.5	0.0029	0.57%
E5			5	0.0017	0.42%	0.5	0.0017	0.34%
E6			5	0.0019	0.66%	0.5	0.0021	0.43%
E7			5	0.0009	0.42%	0.5	0.0011	0.21%
E8			5	0.0008	0.33%	0.5	0.0008	0.16%
E9			5	0.0008	0.26%	0.5	0.0008	0.17%
E10			5	0.0017	0.57%	0.5	0.0018	0.37%
E11			5	0.0007	0.13%	0.5	0.0007	0.14%
E12			5	0.0003	0.07%	0.5	0.0003	0.06%
E13			5	0.0005	0.09%	0.5	0.0005	0.10%
E14			5	0.0003	0.06%	0.5	0.0003	0.05%
E15			5	0.0002	0.05%	0.5	0.0002	0.05%
E16	Plymouth Sound and Estuaries SAC, Tamar Estuaries SPA and Tamar Tavy SSSI	Mudflats	5	0.0001	0.06%	0.5	0.0001	0.02%
E17			5	0.0003	0.05%	0.5	0.0003	0.05%
E18			5	0.0006	0.13%	0.5	0.0006	0.12%
E19			5	0.0003	0.13%	0.5	0.0003	0.07%

Ecological Receptor Number	Site Name	Habitat Type	Annual Mean (μgm^{-3})			Weekly Mean (μgm^{-3})		
			Critical Level	PC	PC/CL	Critical Level	PC	PC/CL
E20	Plymouth Sound and Estuaries SAC and Tamar Estuaries SPA	Mudflats	5	0.0010	0.15%	0.5	0.0010	0.20%
E21			5	0.0004	0.19%	0.5	0.0005	0.09%
E22			5	0.0005	0.28%	0.5	0.0005	0.10%
E23			5	0.0007	0.31%	0.5	0.0008	0.15%
E24			5	0.0009	0.20%	0.5	0.0009	0.17%
E25			5	0.0006	0.13%	0.5	0.0006	0.12%
E26			5	0.0005	0.12%	0.5	0.0006	0.11%
E27			5	0.0004	0.09%	0.5	0.0005	0.09%
E28			5	0.0004	0.09%	0.5	0.0004	0.09%
E29			5	0.0005	0.15%	0.5	0.0005	0.10%
E30			5	0.0002	0.09%	0.5	0.0003	0.05%
E31			5	0.0004	0.11%	0.5	0.0004	0.07%
E32			5	0.0005	0.14%	0.5	0.0005	0.11%
E33	South Dartmoor Woods SAC	Old sessile oak woods	5	0.0002	0.04%	0.5	0.0002	0.05%
E34			5	0.0002	0.04%	0.5	0.0002	0.04%
E35			5	0.0002	0.04%	0.5	0.0002	0.04%
E36	Blackstone Point SAC	Shoredock	5	0.0001	0.03%	0.5	0.0001	0.03%
E37			5	0.0001	0.03%	0.5	0.0001	0.03%
E38	Kinterbury Creek CWS	Mudflats	5	0.0011	0.52%	0.5	0.0011	0.22%
E39			5	0.0010	0.35%	0.5	0.0010	0.20%
E40	Ernesettle Complex CWS	Deciduous woodland	5	0.0018	0.48%	0.5	0.0017	0.34%
E41			5	0.0009	0.25%	0.5	0.0009	0.17%

Table 5.13: Dispersion Modelling Results for Sensitive Ecological Receptors – Nutrient Nitrogen (ka ha^{-1} year^{-1})

Ecological Receptor Number	Site Name	Habitat Type	Background	PC	Critical Load				PEC	PEC/CL	
					Lower	Upper	%Lower	%Upper		Lower	Upper
E1	Plymouth Sound and Estuaries SAC	Mudflats	10.8	0.05	30	40	0.18	0.13	10.85	36%	27%
E2			10.8	0.11	30	40	0.38	0.28	10.91	36%	27%
E3			10.8	0.13	30	40	0.44	0.33	10.93	36%	27%
E4			10.8	0.24	30	40	0.78	0.59	11.04	37%	27%
E5			10.8	0.14	30	40	0.46	0.35	10.94	36%	27%
E6			10.8	0.16	30	40	0.52	0.39	10.96	37%	27%
E7			10.8	0.08	30	40	0.25	0.19	10.88	36%	27%
E8			10.8	0.06	30	40	0.21	0.16	10.86	36%	27%
E9			10.8	0.06	30	40	0.22	0.16	10.86	36%	27%
E10			10.8	0.14	30	40	0.46	0.35	10.94	36%	27%
E11			9.8	0.06	30	40	0.19	0.14	9.86	33%	25%
E12			9.8	0.03	30	40	0.09	0.07	9.83	33%	25%
E13			9.8	0.04	30	40	0.13	0.10	9.84	33%	25%
E14			6.4	0.02	30	40	0.07	0.05	6.42	21%	16%
E15			7.3	0.02	30	40	0.06	0.05	7.32	24%	18%
E16	Plymouth Sound and Estuaries SAC, Tamar Estuaries SPA and Tamar Tavy SSSI	Mudflats	14.0	0.01	30	40	0.03	0.02	14.01	47%	35%
E17			15.0	0.02	30	40	0.07	0.06	15.02	50%	38%
E18			13.7	0.05	30	40	0.16	0.12	13.75	46%	34%
E19			13.7	0.03	30	40	0.08	0.06	13.73	46%	34%
E20			11.8	0.08	30	40	0.27	0.20	11.88	40%	30%

Ecological Receptor Number	Site Name	Habitat Type	Background	PC	Critical Load				PEC	PEC/CL	
					Lower	Upper	%Lower	%Upper		Lower	Upper
E21	Plymouth Sound and Estuaries SAC and Tamar Estuaries SPA	Mudflats	13.7	0.03	30	40	0.11	0.09	13.73	46%	34%
E22			10.8	0.04	30	40	0.13	0.10	10.84	36%	27%
E23			10.8	0.06	30	40	0.19	0.14	10.86	36%	27%
E24			10.8	0.07	30	40	0.23	0.17	10.87	36%	27%
E25			10.8	0.05	30	40	0.15	0.12	10.85	36%	27%
E26			10.8	0.04	30	40	0.14	0.10	10.84	36%	27%
E27			11.1	0.03	30	40	0.12	0.09	11.13	37%	28%
E28			11.1	0.04	30	40	0.12	0.09	11.14	37%	28%
E29			9.9	0.04	30	40	0.13	0.10	9.94	33%	25%
E30			9.9	0.02	30	40	0.07	0.05	9.92	33%	25%
E31			9.9	0.03	30	40	0.09	0.07	9.93	33%	25%
E32			9.9	0.04	30	40	0.14	0.10	9.94	33%	25%
E33	South Dartmoor Woods SAC	Old sessile oak woods	22.8	0.03	10	15	0.33	0.22	22.83	228%	152%
E34			13.6	0.03	10	15	0.29	0.19	13.63	136%	91%
E35			23.2	0.02	10	15	0.24	0.16	23.22	232%	155%
E36	Blackstone Point SAC	Shoredock	9.0	0.01	10	25	0.11	0.04	9.01	90%	36%
E37			9.0	0.01	10	25	0.10	0.04	9.01	90%	36%
E38	Kinterbury Creek CWS	Mudflats	15.0	0.15	30	40	0.49	0.37	15.15	50%	38%
E39			15.0	0.08	30	40	0.27	0.20	15.08	50%	38%
E40	Ernesettle Complex CWS	Deciduous woodland	26.2	0.25	10	15	2.46	1.64	26.45	264%	175%
E41			26.2	0.07	10	15	0.74	0.49	26.27	263%	175%

Table 5.14: Dispersion Modelling Results for Sensitive Ecological Receptors – Total Acid Deposition N + S (keq ha^{-1} year^{-1})

Ecological Receptor Number	Site Name	Habitat Type	Background	Annual Mean (µgm^{-3})				
				Critical Load	PC	PC/CL	PEC	PEC/CL
E1	Plymouth Sound and Estuaries SAC	Mudflats	Not sensitive to acid deposition					
E2								
E3								
E4								
E5								
E6								
E7								
E8								
E9								
E10								
E11								
E12								
E13								
E14								
E15								
E16	Plymouth Sound and Estuaries SAC, Tamar Estuaries SPA and Tamar Tavy SSSI	Mudflats						
E17								
E18								
E19								

Ecological Receptor Number	Site Name	Habitat Type	Background	Annual Mean (µgm^{-3})				
				Critical Load	PC	PC/CL	PEC	PEC/CL
E20								
E21								
E22								
E23								
E24	Plymouth Sound and Estuaries SAC and Tamar Estuaries SPA	Mudflats						
E25								
E26								
E27								
E28								
E29								
E30								
E31								
E32								
E33	South Dartmoor Woods SAC	Old sessile oak woods	1.63	1.55	0.0067	0.51%	1.64	105.7%
E34			0.97	1.86	0.0059	0.38%	0.98	52.5%
E35			1.66	1.55	0.0049	0.38%	1.67	107.5%
E36	Blackstone Point SAC	Shoredock	Not sensitive to acid deposition					
E37								
E38	Kinterbury Creek CWS	Mudflats						
E39								
E40	Ernesettle Complex CWS	Deciduous woodland	1.87	1.87	0.0501	3.18%	1.93	103.2%
E41			1.87	1.88	0.0130	0.79%	1.88	100.3%

Table 5.15 Impact on Sensitive Ecological Receptors – Summary

Ecological Receptor Number	Site Name	Habitat Type	Total Acid Deposition	Nutrient Nitrogen Deposition	NO_x Annual Mean	NO_x 24hr Mean	SO_2 Annual Mean	NH_3 Annual Mean	HF 24hr Mean	HF Weekly Mean
E1	Plymouth Sound and Estuaries SAC	Mudflats	N/A							
E2			N/A							
E3			N/A							
E4			N/A							
E5			N/A							
E6			N/A							
E7			N/A							
E8			N/A							
E9			N/A							
E10			N/A							
E11			N/A							
E12			N/A							
E13			N/A							
E14			N/A							
E15			N/A							
E16	Plymouth Sound and Estuaries SAC, Tamar Estuaries SPA and Tamar Tavy SSSI	Mudflats	N/A							
E17			N/A							
E18			N/A							
E19			N/A							
E20			N/A							
E21			N/A							
E22			N/A							
E23			N/A							
E24	Plymouth Sound and Estuaries SAC and Tamar Estuaries SPA	Mudflats	N/A							
E25			N/A							
E26			N/A							
E27			N/A							
E28			N/A							
E29			N/A							
E30			N/A							
E31			N/A							
E32			N/A							
E33	South Dartmoor Woods SAC	Old sessile oak woods								
E34										

Ecological Receptor Number	Site Name	Habitat Type	Total Acid Deposition	Nutrient Nitrogen Deposition	NO_x Annual Mean	NO_x 24hr Mean	SO_2 Annual Mean	NH_3 Annual Mean	HF 24hr Mean	HF Weekly Mean
E35										
E36	Blackstone Point SAC	Shoredock	N/A							
E37			N/A							
E38	Kinterbury Creek CWS	Mudflats	N/A							
E39			N/A							
E40	Ernesettle Complex CWS	Deciduous woodland								
E41										

Key

PC>1%; PEC>70%
PC>1%; PEC<70%
PC<1%

Modelling Results: Odour Emissions from the Shutdown Exhaust System Chimney

5.4.29 The results of the modelling of odour from the shutdown exhaust system chimney are summarised in Table 5.16, for each of the 5 meteorological data years used in the study. The 98th percentile of hourly means concentration reported in the table is the maximum predicted concentration within the modelled domain.

Table 5.16: Maximum Predicted Odour Concentrations in Modelled Domain, Shutdown Exhaust System Chimney

Met Year	Grid Reference of Maximum Impact	Predicted 98th Percentile Odour Concentration (OU_E m^{-3})
2005	244759, 57446	0.04
2006	244759, 57446	0.04
2007	244759, 57446	0.04
2008	244759, 57446	0.04
2009	244759, 57446	0.04

5.4.30 The model results show that ground level odour concentrations are predicted to be very small, well within the selected 1.5 OU_E m^{-3} benchmark level set within the Draft Horizontal Guidance note H4 for 'highly offensive' odours. Such odour concentrations are unlikely to be detectable.

5.4.31 The location of the maximum predicted odour concentrations is the same for all the meteorological data years used in the assessment, which is a point within the application site boundary, close to the eastern edge of the EfW CHP facility main building. Odour concentrations at locations outside the site boundary would be even lower.

Modelling Results: Plume Visibility

5.4.32 A chimney plume is visible when condensed water is present in the plume. The visibility of the plume from the main chimney of the proposed EfW CHP facility has been predicted using ADMS 4.2. Although the latest version of H1 does not include the requirement to undertake an assessment of plume visibility, an assessment has been undertaken so that the outputs can be reported in the Landscape and Visual Impact Assessment. The procedure used in this assessment is based on that outlined in the 2003 version of H1 (now superseded)[22].

5.4.33 The model setup is identical to that used for the main assessment, except for the selection of plume visibility and the input of initial water content in the plume. The initial water vapour mixing ratio of the plume is 0.1191 kg/kg (mass of water vapour per unit mass of dry release at the chimney). ADMS 4.2 defines the plume to be 'visible' at a particular downwind distance if the condensed water content of the plume at the plume centreline exceeds 10-5 kg/kg and the ambient relative humidity is below 100%.

[22] Environment Agency (2003) Horizontal Guidance Note H1: IPPC – Environmental Assessment and Appraisal of BAT.

5.4.34 The results from the model runs have been summarised in Table 5.17. This shows that for less than 2% of the time there is a visible plume longer than 95 metres (the height of the main chimney). Although the calculation has included both daytime and night time hours, it is unlikely that this would increase to more than 5% if this all occurred during daytime hours only.

Table 5.17: Plume Visibility Assessment Results

Met Data Year	Percentage time plume is visible	Longest visible plume length (m)	Average visible plume length (m)	Percentage of time there is a visible plume over 95m
2005	16.3%	177.6	50.8	1.3%
2006	12.7%	168.3	53.7	1.5%
2007	13.1%	163.4	45.8	1.0%
2008	13.7%	158.2	50.2	1.3%
2009	14.6%	172.9	49.5	1.6%

6 Assessment of Cumulative Effects

6.1 Langage Power Station

6.1.1 Langage Power Station is a new 885 MW natural gas fired power station which commenced full operation in early 2010. It is sited approximately 12 km to east of the application site. Due to the nature of the fuel used, oxides of nitrogen are the main emission to atmosphere from the plant chimney, with very low concentrations of other pollutants.

6.1.2 As the plant was operational at the time of the project specific baseline monitoring survey, the cumulative impact of the station on local NO_2 concentrations in the vicinity of the EfW CHP facility site have been accounted for in the adoption of site-specific background pollutant concentrations. As reported in Section 5, the predicted impact of the proposed EfW CHP facility on NO_2 concentrations is restricted to an area within 2 km of the application site where there a change of greater 1% of the EAL. For this reason, given the distance to the Langage power station site, there is a very low likelihood of significant combined impacts on human health due to emissions of oxides of nitrogen from both facilities.

6.1.3 The predicted impact of emissions from the proposed EfW CHP facility on designated sensitive ecological areas to the east of Plymouth, such as Blackstone Point and South Dartmoor Woods are well below the EA criteria for significance (<1% of the respective EAL values). Significant cumulative impacts are therefore unlikely.

6.2 New England Quarry Resource Recovery Centre

6.2.1 15 km to the east of the proposed EfW CHP facility is the site of the proposed New England Quarry Resource Recovery Centre, for which a planning application has been made by Viridor. As such, impacts from this facility have not been captured within the project specific baseline monitoring study. The site is situated around 15 km to the east of Devonport.

6.2.2 As in the previous example, the distance between the Resource Recovery Centre and EfW CHP facility sites is such that the maximum ground level impacts of the two plants would not co-incide. The risk of cumulative impacts is therefore not significant.

6.3 Weston Mill Crematorium

6.3.1 The crematorium is situated around 1 km to the east of the application site and was operational throughout the project specific monitoring survey. Emissions from the process have therefore been accounted for in the use of project specific air quality monitoring data within the assessment. Existing background levels of all pollutants in the survey, including those associated with crematoria, such as mercury and dioxins / furans, have been shown to be well within air quality standards or guideline criteria. Given the small predicted contribution made by the proposed EfW CHP facility to ground level concentrations of such pollutants, and that the areas most affected by emissions from each respective facility are unlikely to coincide, there would be a low risk of significant effects from the cumulative operation of both processes.

6.4 Devonport Boiler Plant

6.4.1 HMNB Devonport currently operate a natural gas fired boiler plant for the purposes of raising steam, at the current time this emits pollutants to atmosphere (predominantly NO_X) into the local area around the application site. This contribution has been captured by the baseline air quality monitoring programme.

6.4.2 The steam raised within the proposed EfW CHP facility would be transferred to the Devonport steam system, which would remove the need to operate the steam raising plant during normal operations. For this reason, the contribution to local NO_2 concentrations made by the EfW CHP facility are likely to be partially offset by the reduction in emissions from the existing boiler plant.

6.4.3 At times when the EfW CHP plant is offline, there would still be a requirement to have steam available at Devonport. The existing boilers would therefore be kept for this purpose and would not be decommissioned.

7 Assessment Limitations and Assumptions

7.1.1 This section outlines the potential limitations associated with the dispersion modelling assessment. Where assumptions have been made, this is also detailed here.

7.1.2 The greatest uncertainty associated with any dispersion modelling assessment arises through the inherent uncertainty of the dispersion modelling process itself. Despite this, the use of dispersion modelling is a widely applied and accepted approach for the prediction of impacts from an EfW CHP facility such as this one.

7.1.3 In order to minimise the likelihood of under-estimating the PC to ground level concentrations from the main chimney, the following assumptions have been made within the assessment:

- the EfW CHP process has been assumed to operate on a continuous basis i.e. for 8,760 hour per year;
- the modelling predictions are based on the use of five full years of meteorological data from Plymouth Mountbatten, for the years 2005 to 2009 inclusive. The use of five years data can be considered to represent the majority of adverse meteorological conditions that would be experienced during the future operation of the facility; and
- emission concentrations for the EfW process are calculated based on the use of WID limits or maximum measured emission rates at comparable facilities.

7.1.4 The following assumptions have been made in the preparation of the assessment:

- a 70% NO_x to NO_2 conversion rate has been assumed in predicting the long-term PC, and 35% for the short-term PC;
- in the assessment of emissions of $PM_{2.5}$, the total particulate emissions have been assumed to be $PM_{2.5}$; and
- with the exception of As, Ni and Cr, the emission concentrations for individual metals have been modelled as being emitted at the emission limit value for the whole group. Actual heavy metal emission rates at comparable facilities are normally well below WID limits, and as such the values used are conservative.
- Emissions of As, Ni, and Cr have been considered separately, and have been evaluated using interim guidance issued by the EA's Air Quality Modelling and Assessment Unit. The maximum reported measured concentrations for As, Cr and Ni at operational MWI facilities in the UK has been used to calculate the emission rate for the proposed facility.

7.1.5 In particular, the use of WID emission limits for most of the pollutants in the study is likely to result in an over-prediction of impacts from the EfW CHP process. Emissions tests on other MWI facilities of comparable design within the UK have shown that actual emissions associated with this facility actually represent only a fraction of their respective WID limits for most pollutants.

8 Summary

8.1 Summary

8.1.1 This report has assessed the impact on local air quality of the operation of an EfW CHP facility at the Devonport Site, Plymouth. The facility would be operated by MVV Environment Devonport Ltd under the South West Devon Waste Partnership (SWDWP) residual waste treatment PFI contract. The assessment has used the dispersion models ADMS and ADMS Roads.

8.1.2 The assessment of emissions from the main chimney has focused on the impact on ground-level concentrations of the pollutants specified in the WID. Particular attention has been given to the impact on concentrations of NO_2 and particulate matter in the vicinity of residential properties in close proximity to the application site and near to major traffic routes.

8.1.3 An evaluation of chimney heights has shown that a release height of 95 metres above local ground level is capable of mitigating the short-term and long-term impacts of emissions to an acceptable level, with regard to existing air quality and ambient air quality standards.

8.1.4 Emissions from the main chimney and road traffic would result in small increases in ground-level concentrations of the modelled pollutants. Taking into account available information on background concentrations within the modelled domain, predicted operational concentrations of the modelled pollutants would be within current EAL criteria for the protection of human health.

8.1.5 The results from modelling of emissions from the chimney predicted an impact on annual mean NO_2 concentrations of 0.4 µg m^{-3} or more is restricted to an area within a maximum distance of 2 km. Plymouth's three existing AQMAs are situated more than 5 km to the south east of the site and would not therefore be subject to a measurable change in annual mean NO_2 concentrations due to the operation of the EfW CHP process.

8.1.6 The modelling of impacts at designated ecological sites (SACs, SPAs and SSSIs) has predicted that there would be no significant impacts with regard to increases in atmospheric concentrations of NO_X, SO_2, NH_3 and HF, or through deposition of nutrient nitrogen and acid.

8.1.7 The use of emission concentrations at the WID emission limit values is likely to have resulted in an over-prediction of impacts from the EfW CHP facility.

Annex A: Figures

Annex B: Traffic Data

Annex C: Project Specific Monitoring Data

Annex D: Dispersion Modelling Results for Discrete Sensitive Human Receptors