Proposed Wood Gasification Facility
Woodham Road, Barry

Air Quality Assessment

Proposed Wood Gasification Facility
Woodham Road, Barry

Air Quality Assessment

Revision	Date	Notes	Author	Checked	Approved
1	05/05/15	E1414	SD	ND	Dr N Davey
2	12/06/15	E1414	SD	ND	Dr N Davey
3	29/04/16	E1414	SD	ND	Dr N Davey
4	27/09/16	E1414	SD	ND	Dr N Davey
5	02/03/17	E1414 Schedule 5 Amendments	SD	ND	Dr N Davey
6	11/07/17	E1414 Further Schedule 5 Amendments	AB	ND	Dr N Davey

Entran Limited
12 Greenway Farm
Bath Road
Wick
Bristol
BS30 5RL

T: 0117 937 4077
www.entranltd.co.uk

-

CONTENTS **PAGE**

1 INTRODUCTION

1.1 Entran Limited was commissioned by Power Consulting Midlands Ltd to undertake an air quality assessment in support of the environmental permit application for a proposed wood gasification facility at Woodham Road, Barry. The Site location and layout are identified in Figures 1 and 2 respectively.

1.2 The proposed plant would consist of a gas boiler utilising synthetic gas (Syngas) generated from the gasification of waste wood. The high-pressure steam generated by the boiler would be directed to a steam turbine and used to generate electricity for supply to the National Grid. The facility is designed to operate 24 hours a day, 365 days per year. Emissions to air would be via a single 43m stack.

1.3 Emissions to air from the facility will be governed by the Industrial Emissions Directive (IED)[1], which requires adherence to emission limits for the following pollutants:

- nitrogen oxides (NOx as NO_2)
- carbon monoxide
- total dust (as PM_{10} and $PM_{2.5}$)
- gaseous and vaporous organic substances, expressed as total organic carbon;
- sulphur dioxide;
- hydrogen chloride;
- hydrogen fluoride;
- twelve trace metals; and
- dioxins and furans.

1.4 The assessment has also considered emissions of Polycyclic aromatic hydrocarbons (PAH, as Benzo[a]pyrene) and polychlorinated biphenyls (PCBs).

1.5 Predicted ground level concentrations of these pollutants are compared with relevant air quality standards and guidelines for the protection of health and sensitive habitat sites.

1.6 In addition to emissions from the main stack, there is also located within the installation boundary a diesel powered start up generator. This generator will only be used when there is absolutely no power available on site such as a total grid failure or transformer failure to bring the

[1] The Industrial Emissions Directive, 2010/75/EU

plant into a safe shutdown scenario. The generator is sized to enable the safe operation of the boiler feed water pumps and combustion fans to allow the plant to 'fail safe'. There is no routine use of the standby generator, and it use is considered to be an extremely unlikely event. Assessment of emissions from this generator has therefore been excluded from the assessment.

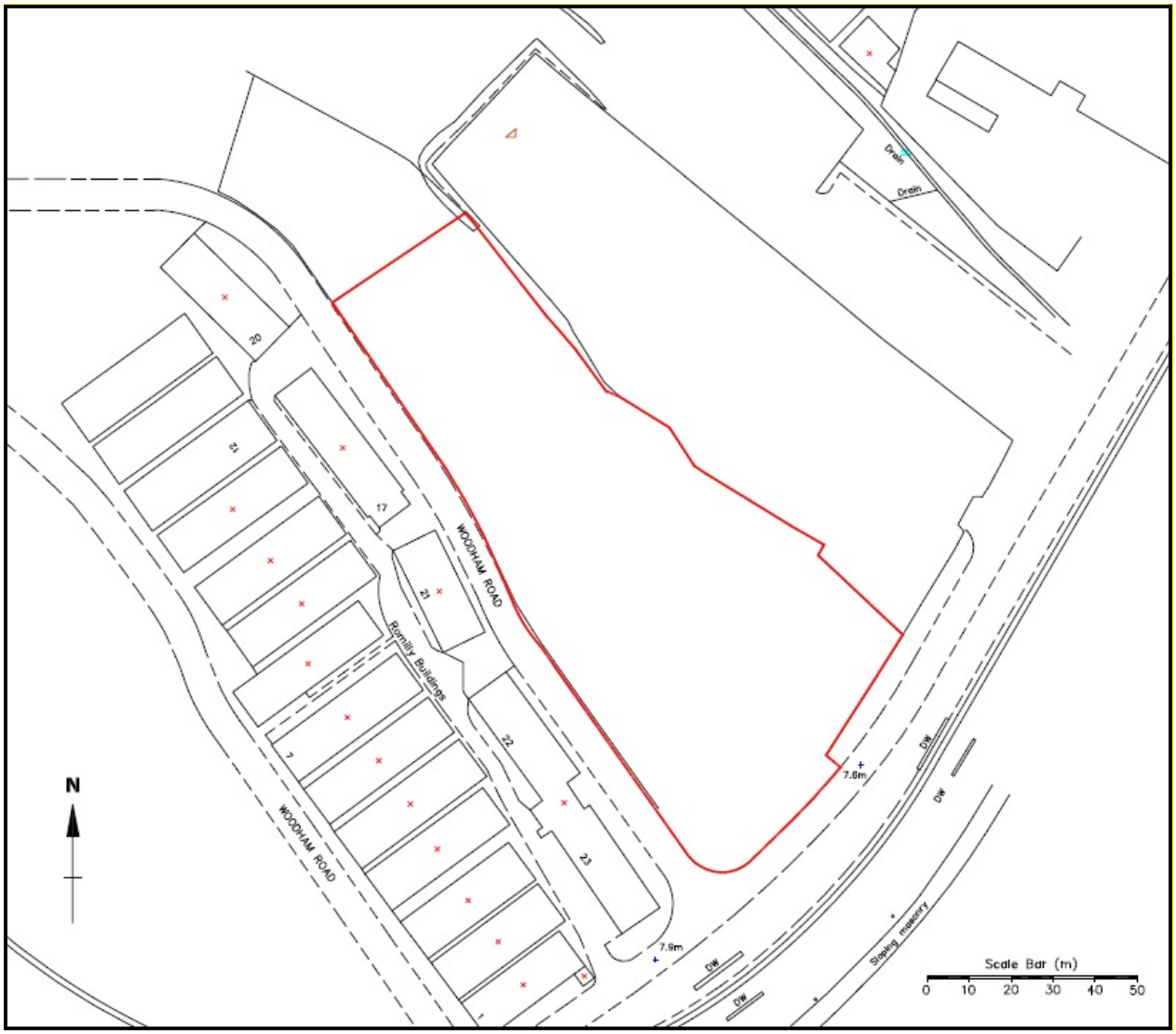
1.7 Also operating within the installation boundary is a single mobile loading shovel which will be operating within the fuel hall and reception shed. Emissions from a single mobile plant are considered to be insignificant and are not considered further within this assessment.

1.8 A glossary of common air quality terminology is provided in **Appendix A.**

Figure 1: Site Location Plan

Contains Ordnance Survey data © Crown copyright and database right 2016

Figure 2: Site Layout



2 LEGISLATION AND POLICY

The European Directive on Ambient Air and Cleaner Air for Europe

2.1 European Directive 2008/50/EC of the European Parliament and of the Council of 21st May 2008, sets legally-binding Europe-wide limit values for the protection of public health and sensitive habitats. The Directive streamlines the European Union's air quality legislation by replacing four of the five existing Air Quality Directives within a single, integrated instrument.

2.2 The pollutants included are sulphur dioxide (SO_2), nitrogen dioxide (NO_2), particulate matter of less than 10 micrometres (μm) in aerodynamic diameter (PM_{10}), particulate matter of less than 2.5 μm in aerodynamic diameter lead ($PM_{2.5}$), lead (Pb), carbon monoxide (CO), benzene (C_6H_6), ozone (O_3), polycyclic aromatic hydrocarbons (PAHs), cadmium (Cd), arsenic (As), nickel (Ni) and mercury (Hg).

Air Quality Strategy for England, Scotland, Wales & Northern Ireland

2.3 The Government's policy on air quality within the UK is set out in the Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland (AQS) published in July 2007[2], pursuant to the requirements of Part IV of the Environment Act 1995. The AQS sets out a framework for reducing hazards to health from air pollution and ensuring that international commitments are met in the UK. The AQS is designed to be an evolving process that is monitored and regularly reviewed.

2.4 The AQS sets standards and objectives for ten main air pollutants to protect health, vegetation and ecosystems.

2.5 The air quality standards are long-term benchmarks for ambient pollutant concentrations which represent negligible or zero risk to health, based on medical and scientific evidence reviewed by the Expert Panel on Air Quality Standards (EPAQS) and the World Health Organisation (WHO). These are general concentration limits, above which sensitive members of the public (e.g. children, the elderly and the unwell) might experience adverse health effects.

2.6 The air quality objectives (AQO) are medium-term policy based targets set by the Government which take into account economic efficiency, practicability, technical feasibility and

[2] Department for Environment, Food and Rural Affairs (2007), The Air Quality Strategy for England, Scotland, Wales and Northern Ireland

timescale. Some objectives are equal to the EPAQS recommended standards or WHO guideline limits, whereas others involve a margin of tolerance, i.e. a limited number of permitted exceedences of the standard over a given period.

2.7 For some pollutants there is both a long-term (annual mean) standard and a short-term standard. In the case of NO_2, the short-term standard is for a 1-hour averaging period, whereas for PM_{10} it is for a 24-hour averaging period. These periods reflect the varying impacts on health of differing exposures to pollutants (e.g. temporary exposure on the pavement adjacent to a busy road, compared with the exposure of residential properties adjacent to a road).

Air Quality (England) Regulations

2.8 Many of the objectives in the AQS were made statutory in England with the *Air Quality (England) Regulations 2000* [3] and the *Air Quality (England) (Amendment) Regulations 2002* (the Regulations)[4] for the purpose of Local Air Quality Management (LAQM).

2.9 The Air Quality Standards Regulations 2010[5] have adopted into UK law the limit values required by EU Directive 2008/50/EC and came into force on the 10th June 2010. These regulations prescribe the 'relevant period' (referred to in Part I2V of the Environment Act 1995) that local authorities must consider in their review of the future quality of air within their area. The regulations also set out the air quality objectives to be achieved by the end of the 'relevant period'.

2.10 Ozone is not included in the Regulations as, due to its trans-boundary nature, mitigation measures must be implemented at a national level rather than at a local authority level.

2.11 The EALs, air quality standards and objectives for the pollutants considered in the assessment are presented in **Appendix B.**

Local Air Quality Management (LAQM)

2.12 Part IV of the Environment Act 1995 also requires local authorities to periodically Review and Assess the quality of air within their administrative area. The Reviews have to consider the present and future air quality and whether any air quality objectives prescribed in Regulations are being achieved or are likely to be achieved in the future.

[3] The Air Quality (England) Regulations 2000 - Statutory Instrument 2000 No.928

[4] The Air Quality (England) (Amendment) Regulations 2002 - Statutory Instrument 2002 No.3043

[5] The Air Quality Standards Regulations 2010 – Statutory Instrument 2010 No. 1001

2.13 Where any of the prescribed air quality objectives are not likely to be achieved the authority concerned must designate that part an Air Quality Management Area (AQMA).

2.14 For each AQMA, the local authority has a duty to draw up an Air Quality Action Plan (AQAP) setting out the measures the authority intends to introduce to deliver improvements in local air quality in pursuit of the air quality objectives. Local authorities are not statutorily obliged to meet the objectives, but they must show that they are working towards them.

2.15 The Department of Environment, Food and Rural Affairs (DEFRA) has published technical guidance for use by local authorities in their Review and Assessment work[6]. This guidance, referred to in this chapter as LAQM.TG(09), has been used where appropriate in the assessment.

Industrial Emissions Directive

2.16 The Industrial Emissions Directive (2010/75/EU) came into force on the 6th January 2011, replacing the seven existing Directives, including the Waste Incineration Directive (WID) and Large Combustion Plant Directive (LDPD), implemented through the Environmental Permitting Regulations (EPR). The aim of the new Directive is to simplify the existing legislation and reduce administrative costs, whilst maintaining a high level of protection for the environment and human health. Permits will still be issued under EPR; however existing and new sites will be required to comply with the requirements of the IED, which places greater emphasis on new plant best available technology (BAT).

2.17 The IED has been transposed into UK law via the Environmental Permitting (England and Wales) (Amendment) Regulations 2013 (SI 2013 No, 390), which came into force on 27 February 2013.

2.18 The design and operation of all new waste incinerations facilities must ensure compliance with emission limit values (ELVs) set out in the IED; these ELVs are summarised in Table 1.

[6] Department for Environment, Food and Rural Affairs (DEFRA), (2009): Part IV The Environment Act 1995 Local Air Quality Management Review and Assessment Technical Guidance LAQM.TG(09).

Table 1: IED Limit Values (mg/Nm^3)

Pollutant	ELV (referenced to 11% O_2)
Daily Average	
Total dust	10
Total organic carbon (TOC)	10
Hydrogen chloride (HCl)	10
Hydrogen fluoride (HF)	1
Sulphur dioxide (SO_2)	50
Oxides of nitrogen (NOx)	200
Carbon monoxide (CO)	50
Half-hourly Average	
Total dust	30
Total organic carbon (TOC)	20
Hydrogen chloride (HCl)	60
Hydrogen fluoride (HF)	4
Sulphur dioxide (SO_2)	200
Oxides of nitrogen (NOx)	400
Carbon monoxide (CO)	100
Average over a sample period between 30 minutes and 8-hours	
Group 1 metals (a)	0.05
Group 2 metals (b)	0.05
Group 3 metals (c)	0.5
Average over a sample period between 6-hours and 8-hours	
Dioxins and furans (d)	1 x 10^{-7}
(a) Cadmium (Cd) and Thallium (Tl) (b) Mercury (Hg) (c) Antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni) and vanadium (V) (d) I-TEQ	

3 METHODOLOGY

Scope of Assessment

3.1 The scope of the assessment has been determined in the following way:

- consultation with the Rebecca Athay Environmental Health Officer at Vale of Glamorgan Council (VGC);
- review of air quality data for the area surrounding the Site, including data from the Defra Air Quality Information Resource (UK-AIR);
- desk study to confirm the location of nearby areas that may be sensitive to changes in local air quality; and
- review of emission parameters for the proposed development and dispersion modelling using the Breeze AERMOD 7 dispersion model) to predict ground-level concentrations of pollutants at sensitive human and habitat receptor locations.

Dispersion Modelling Parameters

Normal Operational Emission Scenario

3.2 IED emission limits have been assumed for the purposes of the modelling assessment and the plant is assumed to be operating at full load, continually throughout the year. Stack emission parameters (flow rate, temperature etc.) have been provided by the technology supplier (Outotech). In the absence of actual emissions data 'worst-case' IED emission limits have been assumed.

3.3 For the Group III trace metal predictions, it has been assumed in accordance with the Environment Agency's (EA) metals guidance[7], that each of the metals is emitted at the maximum IED ELV (0.5 mg/Nm^3) as a worst case. The same approach has also been adopted for the Group I and II metals.

3.4 Where the screening criteria set out in the guidance are not met, an emission concentration equal to half of the ELV for Group I metals and 1/9th of the ELV for Group III metals has been assumed. If the screening criteria are still not met, typical emission concentrations for energy from waste plants have been used, as specified in the guidance.

[7] Guidance to Applicants on Impact Assessment for Group 3 Metals Stack Releases – V.3 September 2012

3.5 It is anticipated that the process will not result in significant emissions of polychlorinated biphenyls (PCBs) or polycyclic aromatic hydrocarbons (PAHs), however emission limits of 0.005 mg/Nm^3 and 0.001 mg/Nm^3 respectively, have been assumed based on measurements at European waste incineration facilities as specified in the IPPC Reference Document on BAT for Waste Incineration[8].

3.6 The input parameters for the boiler exhaust stack are identified in **Appendix C**.

3.7 The proposed stack height of 43m is based on the stack height screening assessment that has been undertaken for the proposed facility[9].

Abnormal Emission Scenarios

3.8 Consideration has been given to the potential impacts in the event of failure of a number of processes associated with the abatement of emissions at the facility as follows:

- Failure of Urea Injection Operation
- Failure of Lime Dosing Operation
- Failure of Activated Carbon Dosing
- Failure of Bag Filter

3.9 A summary of the emission parameters for each abnormal emission scenario is presented in **Appendix C**.

3.10 The maximum allowable period for any one episode of abatement or monitoring equipment failure (separately or together) is 4 hours. In addition, the total allowable period in a year must not exceed 60 hours. On this basis, impacts due to abnormal emissions have been assessed against short-term EALs for the protection of human health only.

Modelling Risk Assessment

3.11 In order to determine a higher level of confidence in the modelled results, the modelling was repeated using an alternative model (ADMS 5.2). This model is widely used for

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

[9] Stack Height Assessment for a 10 MWe Wood Gasification Facility at Barry Docks, Barry Island, Stopford Energy and Environment Document Number: R6270-PM-0001, M. Kett and M. Wilkinson, September 2014.

assessments of emissions from stacks and is an EA approved model. It is therefore considered to be an appropriate choice of model.

Local Meteorological Data

3.12 The dispersion modelling has been carried out using five years (2009-2013) of hourly sequential meteorological data in order to take account of inter-annual variability and reduce the effect of any atypical conditions. Data from the meteorological station at Cardiff Airport (approximately 6 km west of the proposed facility) have been used for the assessment, which is the most representative data currently available for the area.

3.13 Wind roses for each year of meteorological data are presented in **Appendix D**.

Topography

3.14 The presence of elevated terrain can significantly affect the dispersion of pollutants by increasing turbulence and reducing the distance between the plume centre line and the ground level.

3.15 Information relating to the topography of the area surrounding the proposed facility has been used in the dispersion modelling to assess the impact of terrain features on the dispersion of emissions.

Building Downwash / Entrainment

3.16 The presence of buildings close to emission sources can significantly affect the dispersion of pollutants by leading to a phenomenon called downwash. This occurs when a building distorts the wind flow, creating zones of increased turbulence. Increased turbulence causes the plume to come to ground earlier than otherwise would be the case and result in higher ground level concentrations closer to the stack.

3.17 Downwash effects are only significant where building heights are greater than 30 to 40% of the emission release height. The downwash structures also need to be sufficiently close for their influence to be significant.

3.18 All potential downwash structures have been included in the model.

Nitric Oxide to NO_2 Conversion

3.19 Oxides of nitrogen (NOx) emitted to atmosphere as a result of combustion will consist largely of nitric oxide (NO), a relatively innocuous substance. Once released into the atmosphere, NO is oxidised to NO_2. The proportion of NO converted to NO_2 depends on a number of factors including wind speed, distance from the source, solar irradiation and the availability of oxidants, such as ozone (O_3).

3.20 A conversion ratio of 70% NOx:NO_2 has been assumed for comparison of predicted concentrations with the long-term objectives for NO_2. A conversion ratio of 35% has been utilised for the assessment of short-term impacts, as recommended by Environment Agency guidance[10].

Sensitive Human Health Receptors

3.21 LAQM.TG(09) describes in detail typical locations where consideration should be given to pollutants defined in the Regulations. Generally, the guidance suggests that all locations 'where members of the public are regularly present' should be considered. At such locations, members of the public will be exposed to pollution over the time that they are present, and the most suitable averaging period of the pollutant needs to be used for assessment purposes.

3.22 For instance, on a footpath, where exposure will be transient (for the duration of passage along that path) comparison with short-term standard (i.e. 15-minute mean or 1-hour mean) may be relevant. In a school, or adjacent to a private dwelling, however; where exposure may be for longer periods, comparison with long-term (such as 24-hour mean or annual mean) standards may be most appropriate. In general terms, concentrations associated with long-term standards are lower than short-term standards owing to the chronic health effects associated with exposure to low level pollution for longer periods of time.

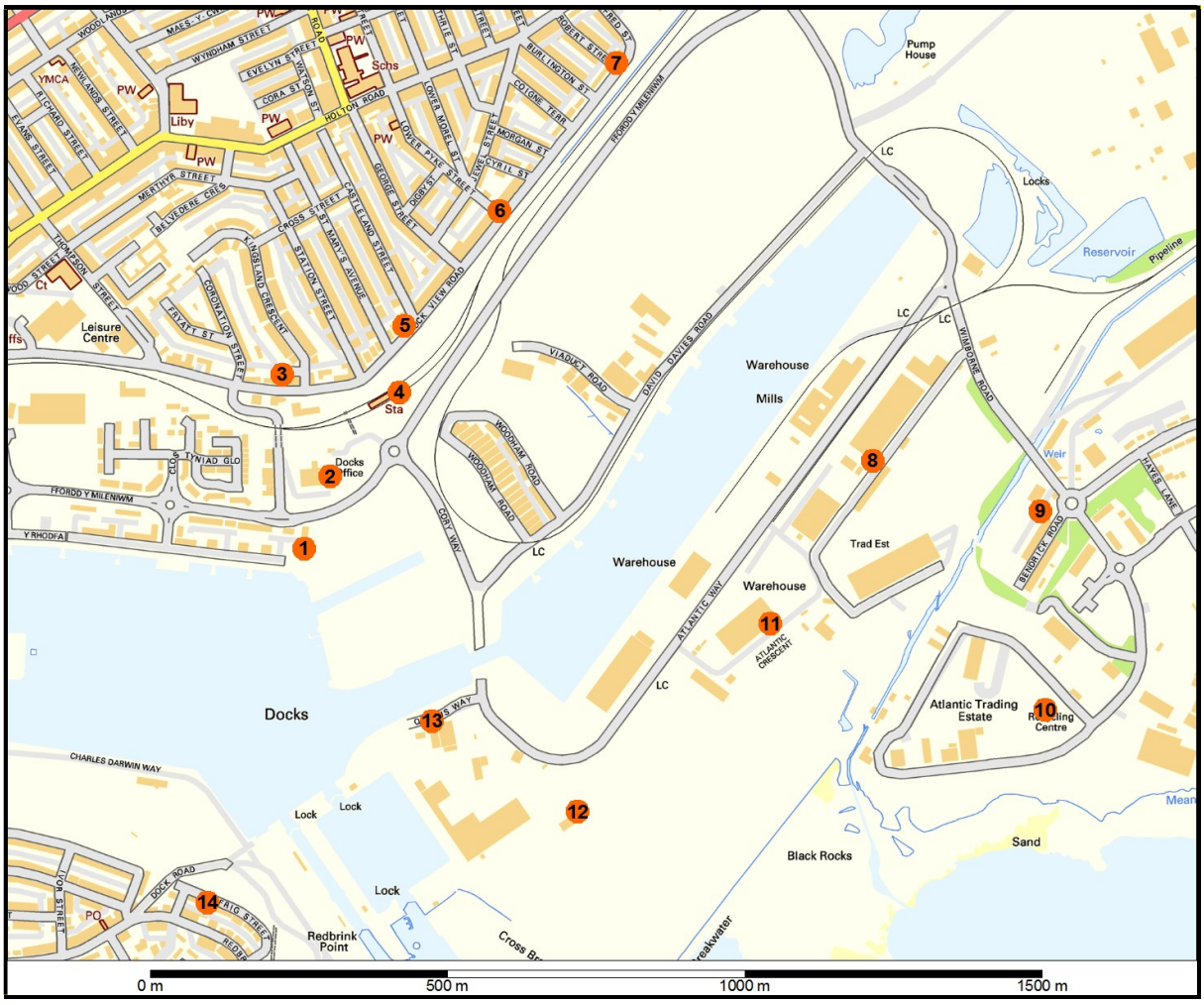
3.23 The location of the discrete sensitive receptors selected for the assessment is presented in Table 3 and Figure 3.

[10] Environment Agency AQMAU, Conversion Rates for NOx and NO_2

Table 3: Location of Sensitive Receptors

ID	Receptor	Type	Easting	Northing
1	Vistamar House	Residential	312199	167543
2	Docks Office	Industrial	312243	167664
3	Phillipa Freeth Court	Residential	312162	167836
4	Barry Dock Station	Station	312359	167806
5	54 Dock View Road	Residential	312368	167918
6	89 Dock View Road	Residential	312528	168111
7	131 Dock View Road	Residential	312724	168359
8	Wimbourne Buildings	Industrial	313155	167691
9	Bendrick Road	Residential	313437	167606
10	Public Recycling Facility	Recycling Facility	313445	167271
11	Atlantic Crescent	Industrial	312983	167416
12	Port Office	Industrial	312659	167100
13	Queens Way	Industrial	312414	167253
14	Dyfrig Street	Residential	312037	166947

Figure 3: Sensitive Receptor Locations



Contains Ordnance Survey data © Crown copyright and database right 2016

3.24 Pollutant concentrations have been predicted at both discrete receptor locations and over a Cartesian grid of 65 m resolution (1.5 times the stack height).

3.25 The maximum predicted ground level concentrations are compared with the relevant air quality standards and guidelines for the protection of health.

Habitat Assessment

3.26 The Environment Agency's risk assessment guidance[11] states that the impact of emissions to air on vegetation and ecosystems should be assessed for the following habitat sites within 10 km of the source:

[11] https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit

- Special Areas of Conservation (SACs) and candidate SACs (cSACs) designated under the EC Habitats Directive[12];
- Special Protection Areas (SPAs) and potential SPAs designated under the EC Birds Directive[13]; and
- Ramsar Sites designated under the Convention on Wetlands of International Importance[14].

3.27 Within 2 km of the source:

- Sites of Special Scientific Interest (SSSI) established by the 1981 Wildlife and Countryside Act;
- National Nature Reserves (NNR);
- Local Nature Reserves (LNR);
- local wildlife sites (LWS), county wildlife sites (CWS) and potential wildlife sites (PWS);
- Sites of Importance for Nature Conservation (SINC) and
- ancient woodland.

3.28 Habitat receptor designations and locations relevant to the assessment are presented in Table 4. There are two SSSI's within 2 km of the proposed facility (Hayes Point to Bendrick Rock SSSI and Barry Island SSSI) however these sites have been designated for geological interest only and have therefore not been included in the assessment.

[12] Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.

[13] Council Directive 79/409/EEC on the conservation of wild birds

[14] Ramsar (1971), The Convention of Wetlands of International Importance especially as Waterfowl Habitat

Table 4: Location of Sensitive Habitat Receptors

ID	Receptor	Approximate Location of Nearest Boundary to Boiler Stack
H1	Cadoxton River SINC	690 m east
H2	Cadoxton Wetlands SINC	780 m northeast
H3	Fields at Merthyr Dyfan SINC	1.9 km northwest
H4	Friars Point SINC	1.98 km southwest
H5	Gladstone Road Pond SINC	1.2 km west-northwest
H6	Nells Point East SINC	1.1 km south-southwest
H7	North of North Road SINC	1.98 km northeast
H8	Cadoxton Ponds Wildlife Trust Reserve	780 m northeast
H9	Severn Estuary Ramsar	3.9 km east
H10	Severn Estuary SPA	3.9 km east
H11	Ancient Woodland (Hayes Lane)	1.1 km east
H12	Severn Estuary SAC	6.0 km east

3.29 The habitat sites have been represented in the model by a discrete receptor at the nearest boundary of the designated area.

3.30 The modelled ground level pollutant concentrations are used to predict deposition rates, using typical deposition velocities. A summary of typical NO_2, SO_2, NH_3 and HCl dry deposition velocities is presented in Table 5.

Table 5: Dry Deposition Velocity (m/s)

Pollutant	Grassland	Woodland
Nitrogen Dioxide (NO_2)	0.0015	0.0030
Sulphur Dioxide (SO_2)	0.012	0.024
Hydrogen Chloride (HCl)	0.025	0.06
Ammonia (NH_3)	0.02	0.03

3.31 The predicted nitrogen deposition rates assume a 100% NOx: NO_2 conversion. This represents a worst-case for the assessment since nitric oxide (NO) has a lower deposition velocity than NO_2 and consequently results in lower deposition rates.

3.32 A wet deposition rate for HCl has been calculated using a dry to wet deposition ratio, as follows:

HCl wet deposition rate = HCl dry deposition rate x wet-to-dry deposition ratio

3.33 Within a few kilometres of the source, the wet deposition rate is comparable to the dry deposition rate and with increasing distance, the wet deposition fraction becomes a smaller fraction of the total HCl deposition. As a worst-case, the wet-to-dry deposition ratio is assumed to be 1 at all the identified habitat sites.

3.34 Predicted ground level concentrations and acidification/ deposition rates are compared with relevant air quality standards, critical levels and critical loads for the protection of sensitive ecosystems and vegetation (see **Appendix E**).

Deposition to Ground

3.35 A screening assessment of deposition rates to soil has been undertaken in accordance with the Environment Agency's Risk Assessment Guidance.

Significance Criteria

3.36 The Environment Agency has developed criteria for assessing the significance of an impact compared with the relevant environmental assessment level (EAL) and background air quality. The criteria are designed to ensure that there is a substantial safety margin to protect public health and the environment. These criteria apply to impacts at human health receptors, SPAs, SACs, Ramsar sites and SSSIs, as well as deposition rates to soil.

Stage 1

3.37 A process contribution (PC) is considered insignificant if:

- The long term PC < 1% of the long-term EAL
- The short term PC < 10% of the short-term EAL

Stage 2

3.38 If the Stage 1 screening criteria are not met, the PC should be considered in combination with relevant ambient background pollutant concentrations. The air quality standards are likely to be met if:

- The long term PC + background concentration < 70% of the EAL
- The short term PC < 20% of the (EAL – short term background concentration)

3.39 For local nature sites, a process contribution (PC) is considered insignificant if:

- The long term PC < 100% of the long-term EAL
- The short term PC < 100% of the short-term EAL

4 BASELINE CONDITIONS

Local Air Quality Management

VGC carries out frequent review and assessments of air quality within the area and produces Updating and Screening Assessments and Progress Reports in accordance with the requirements of DEFRA.

A number of locations have been identified where concentrations of NO_2 are close to the annual mean air quality objective, however to date no AQMAs have been declared.

Nitrogen Dioxide

4.1 There are no automatic air quality monitoring stations measuring NO_2 in the vicinity of the proposed facility, however routine monitoring of NO_2 concentrations is undertaken by passive diffusion tube at a number of locations in Barry. A summary of bias adjusted annual mean NO_2 concentrations measured between 2011 and 2015 is presented in Table 6**.** The locations of the monitoring sites is presented in Figure 4.

Table 6: NO_2 Diffusion Tube Monitoring Data

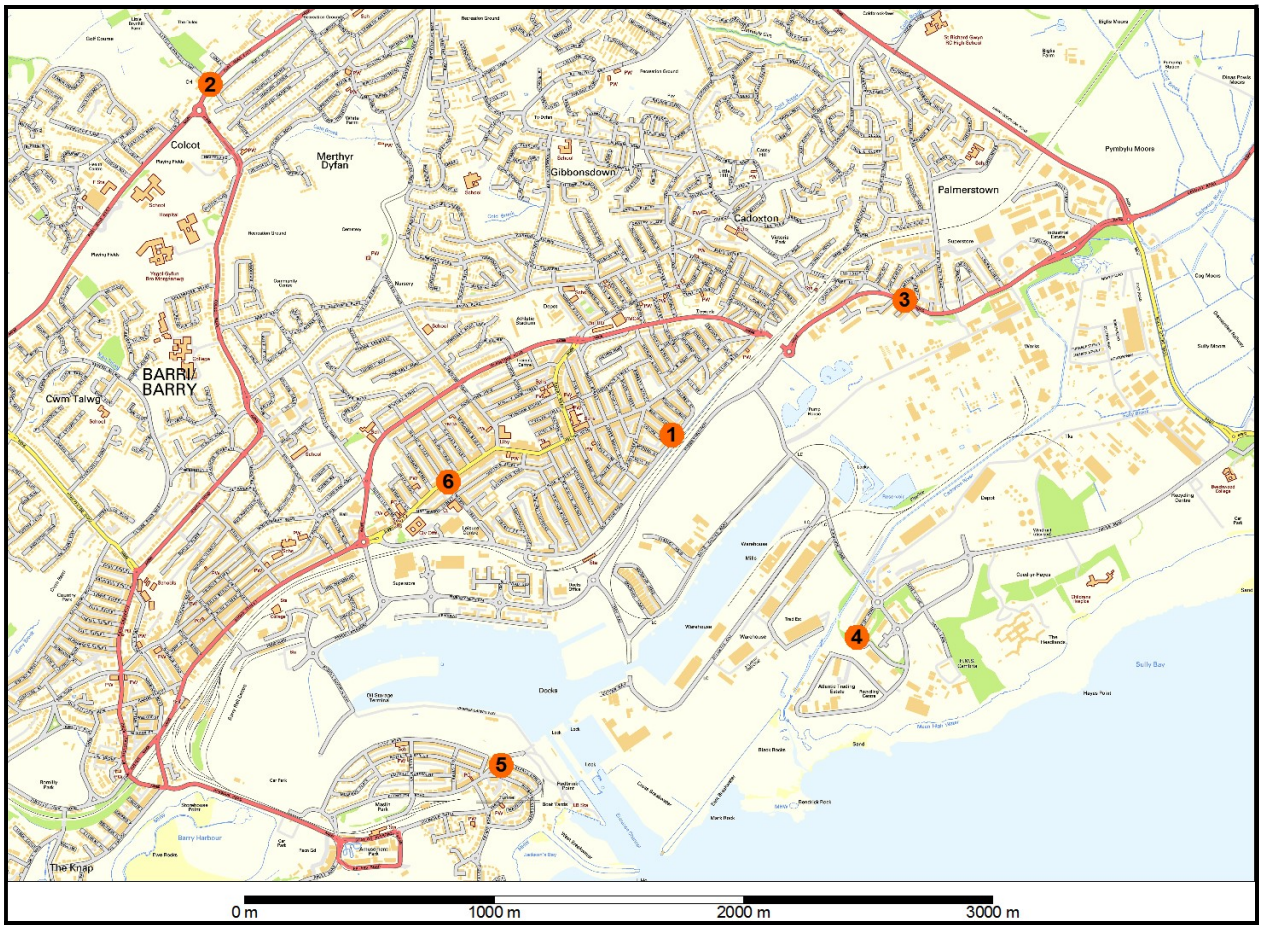
ID	Site Name	Type (a)	OS Grid Reference	2011 (a)	2012 (a)	2013 (c)	2014 (c)	2015 (c)
1	110 Dock View Road	R	312663, 168289	19	20	20.3	17.4	17.1
2	Port Road East	R	310813, 169693	26	27	24.2	25.8	23.1
3	24 Cardiff Road	R	313597, 168829	28	32	28.8	26.9	27.8
4	Bendrick Road	UB	313407, 167477	15	15	22.5	14.0	14.9
5	Thalasa, Dyfrig Street	UB	311980, 166965	14	17	16.7	13.5	14.2
6	Holton Road	R	311768, 168101	31	37	24.9	-	-

(a) B = Background, UB = Urban Background

(b) Data from 2013 LAQM progress Report, bias adjusted

(c) Raw data from Welsh Air Quality Forum, not bias adjusted.

Figure 4: Diffusion Tube Monitoring Locations



Contains Ordnance Survey data © Crown copyright and database right 2017

4.2 The diffusion tube monitoring data indicate that urban background concentrations of NO_2 in Barry are less than 50% of the air quality objective of 40 µg/m^3.

4.3 The nearest monitoring site to the proposed facility is at 110 Dock View Road, where the maximum concentration measured between 2011 and 2015 was 20 µg/m^3. This concentration is assumed to provide a reasonable estimate of the baseline concentration at the Site and the sensitive receptors on Dock View Road and a worst-case baseline for receptors to the south of the proposed facility (where the urban background monitoring sites indicate that the annual mean concentrations are somewhat lower).

Carbon Monoxide, Particulate Matter, Sulphur Dioxide and Total Organic Carbon (as Benzene)

4.4 Continuous monitoring of PM_{10} concentrations has been undertaken at a roadside site on Cardiff Road in Barry since 2010. Unfortunately data capture at this location has been relatively poor; therefore the data has not been used to inform the baseline for the assessment.

4.5 In the absence of local monitoring data background concentrations of CO, PM_{10}, $PM_{2.5}$, SO_2 and benzene have been obtained from the DEFRA UK Background Air Pollution maps[15] for use in the assessment. These 1 km grid resolution maps are derived from a complex modelling exercise that takes into account emissions inventories and measurements of ambient air pollution from both automated and non-automated sites.

4.6 The latest background maps for NO_{10} and $PM_{2.5}$ were issued in June 2016 and are based on 2013 monitoring data.

4.7 The CO, SO_2 and benzene mapped concentrations are based on 2001 monitoring data. For CO, factors are available to project the concentrations to future years[16]. The 2013 SO_2 concentrations are assumed to be 75% of the 2001 estimates, in accordance with the 2003 Local Air Quality Management Technical Guidance[17]. The 2001 mapping includes projected benzene concentrations for 2010 and these are assumed to be representative of the existing concentrations for the purposes of the assessment.

[15] http://uk-air.defra.gov.uk/data/laqm-background-home

[16] http://laqm.defra.gov.uk/tools-monitoring-data/year-adjustment.html

4.8 A summary of the mapped annual mean background concentrations assumed for the assessment is presented in Table 7. The concentrations were derived from contour plots of the mapped data to determine the maximum at sensitive receptor locations. These concentrations are assumed to provide a reasonable representation of the existing and future air quality in the vicinity of the proposed facility.

Table 7: Mapped Annual Mean Background Concentrations for PM_{10}, $PM_{2.5}$, CO, SO_2 and Benzene (µg/m^3)

Pollutant	Annual Mean	AQO/EAL
Particles (PM_{10})	13.5	40
Particles ($PM_{2.5}$)	9.4	25
Sulphur Dioxide (SO_2)	2.2	n/a
Carbon Monoxide (CO)	140	n/a
Benzene (C_8)	0.35	5

Hydrogen Chloride

4.9 Ambient monitoring of Hydrogen Chloride is carried out as part of the Defra Acid Gases and Aerosols Network (AGANET) at a number of locations around the UK.

4.10 The closest monitoring sites to the proposed facility are at at Narbeth in Pembrokeshire and Rosemaund in Herefordshire. Over the period 2010 to 2012, the average annual mean HCl concentration at these sites was the same as the UK average at 0.24 µg/m^3. This concentration is assumed to provide a reasonable estimate of the background concentration of HCl at the Site.

[17] Department for Environment, Food and Rural Affairs (2003): Part IV The Environment Act 1995 Local Air Quality Management Review and Assessment Technical Guidance, LAQM.TG(03).

Hydrogen Fluoride

4.11 Monitoring of ambient levels of hydrogen fluoride is not currently carried out in the UK, however the Expert Panel on Air Quality Standards (EPAQS) report on halogen and hydrogen halides in ambient air[18] cites a modelling study which suggests that the typical natural background HF concentration is 0.5 µg/m^3, with an elevated background of 3 µg/m^3 where there are local anthropogenic emission sources.

4.12 The natural background HF concentration of 0.5 µg/m^3 is assumed to be applicable at sensitive human health and habitat receptors in the vicinity of the Site.

Trace Metals

4.13 DEFRA has undertaken monitoring of trace elements at a number of locations in the UK since 1976 as part of the UK Urban and Rural Heavy Metals Monitoring Networks.

4.14 To provide an indication of the range of trace metal concentrations that occur in the UK the average concentrations measured at rural and urban sites between 2008 and 2011 are summarised in Table 8.

4.15 With the exception of Cr(VI), all the measured concentrations are well below their respective EAL's. Guidance issued by the Environment Agency[7] for the assessment of Group 3 metals, states that for screening purposes it should be assumed that Cr(VI) comprises 20% of the total background chromium). On this basis the urban average Cr(VI) concentration substantially exceeds the EAL.

4.16 For the purposes of the assessment, the UK average urban concentrations are assumed to be reasonably representative of the baseline trace metal concentrations at the Site.

[18] EPAQS (February 2006), Guidelines for Halogen and Hydrogen Halides in Ambient Air for Protecting Human Health Against Acute Irritancy Effects.

Table 8: Average UK Trace Metal Concentrations (ng/m^3)

Metal	Rural	Urban	EAL
Antimony (Sb)	Not measured	Not measured	5,000
Arsenic (As)	0.47	0.68	3
Cadmium (Cd)	0.10	0.30	5
Chromium (Cr)	0.76	4.2	n/a
Trivalent Chromium (Cr(III))	0.61 (a)	3.4 (a)	5,000
Hexavalent Chromium (Cr(VI))	0.15 (b)	0.85 (b)	0.2
Cobalt (Co)	0.047	0.21	1,000
Copper (Cu)	2.8	16.8	10,000
Lead (Pb)	4.4	13.9	250 – 500
Manganese (Mn)	2.2	13.2	150
Mercury (Hg) (c)	1.2	2.0	250
Nickel (Ni)	0.83	3.8	20
Thallium (Tl)	Not measured	Not measured	1,000
Vanadium (V)	1.1	1.7	5,000

(a) 80% of total chromium
(b) 20% of total chromium
(c) Total particulate and vapour

Dioxins and Furans

4.17 Monitoring of PCDD/Fs is currently carried out by Defra at six locations in the UK (Hazelrigg, High Muffles, London, Manchester, Auchencorth Moss and Weybourne) as part of the Toxic Organic Micropollutants (TOMPs) Network.

4.18 To provide an indication of the range of PCDD/F concentrations that occur in the UK, a summary of the annual mean concentrations measured between 2008 and 2010 is presented in Table 9.

Table 9: UK PCDD/Fs Concentrations (fg TEQ/m^3)

Metal	Type	2008	2009	2010
London	Urban background	10.9	41.4	38.6
Manchester	Urban background	19.0	14.2	48.7
Auchencorth Moss	Rural background	6.4	0.56	5.0
High Muffles	Rural background	1.7	9.38	2.8
Hazelrigg	Rural background	3.7	13.5	8.0
Weybourne	Rural background	-	22.82	2.5

4.19 In general, the concentration of dioxins and furans at rural locations is considerably lower than at urban locations.

4.20 The average concentration measured at the two urban background monitoring sites from 2008 to 2010 is 28.8 fg/m^3 and is assumed to be reasonably representative of the baseline dioxin and furan concentration at the proposed facility and nearby sensitive receptors.

Polycyclic Aromatic Hydrocarbons (as benzo[a]pyrene)

4.21 Monitoring of benzo(a)pyrene (B[a]P) is currently carried out by DEFRA at a number of locations in the UK as part of the TOMPS and PAH monitoring and analysis network. A summary of concentrations measured in the UK is issued by the National Physical Laboratory (NPL) on behalf of Defra on an annual basis. The most recent report was published in January 2014 and provides annual mean B[a]P concentrations measured by the network in 2012[19].

4.22 The average urban and rural background concentrations measured in the UK between 2010 and 2012 were 0.33 ng/m^3 and 0.062 respectively.

4.23 The average urban background concentration is assumed to provide a reasonable estimate of the background concentration in the vicinity of the Site.

Polychlorinated Biphenyls

4.24 Monitoring of PCBs is currently carried out by DEFRA at six locations in the UK as part of the TOMPs Network. The average PCB concentration measured at the urban background monitoring sites (London and Manchester) from 2008 to 2010 is 0.00044 µg/m3 and is assumed

[19] Annual Report for 2012 on the UK PAH Monitoring and Analysis Network, NPL Report AS 84, January 2014.

to be reasonably representative of the baseline PCB concentration at the Site and nearby sensitive receptors.

Ammonia

4.25 Ambient monitoring of ammonia (NH_3) concentrations is carried out as part of the National Ammonia Monitoring Network (NAMN) at 95 locations around the UK. The Air Pollution Information Service, APIS[20] uses the measured concentration to calibrate the FRAME dispersion model, which estimates concentrations at a 5km grid resolution. The three year average (2012–2014) NH_3 concentration for the grid square containing the Site is 0.99 µg/m^3.

Summary of Background Concentrations

4.26 A summary of the annual mean and short-term background concentrations assumed for the assessment is presented in Table 10.

[20] http://www.apis.ac.uk/

Table 10: Summary of Assessment Background Concentrations (a)

Pollutant	Annual Mean	Short-term
Particles (PM_{10})	13.5 µg/m^3	15.9 µg/m^3 (d)(e)
Particles ($PM_{2.5}$)	9.4 µg/m^3	n/a
Nitrogen Dioxide (NO_2)	20.0 µg/m^3	40.0 µg/m^3 (d)
Sulphur Dioxide (SO_2)	2.2 µg/m^3	2.6 µg/m^3 (d)(e) 4.4 µg/m^3 (d) 5.9 µg/m^3 (d)(g)
Carbon Monoxide (CO)	140 µg/m^3	196 µg/m^3 (d)(f) 280 µg/m^3 (d)
Hydrogen Fluoride (HF)	0.50 µg/m^3	1.0 µg/m^3 (d)
Hydrogen Chloride (HCl)	0.24 µg/m^3	0.48 µg/m^3 (d)
Benzene (C_8)	0.35 µg/m^3	0.70 µg/m^3 (d)
Dioxins and Furans (PCDD/Fs)	28.8 fg/m^3 (b)	n/a
Antimony (Sb)	No data available	n/a
Arsenic (As)	0.68 ng/m^3	n/a
Cadmium (Cd)	0.30 ng/m^3	n/a
Total Cr	4.2 ng/m^3	8.4 ng/m^3 (d)
Cobalt (Co)	0.21 ng/m^3	0.42 ng/m^3 (d)
Copper (Cu)	16.8 ng/m^3	33.6 ng/m^3
Lead (Pb)	13.9 ng/m^3	n/a
Manganese (Mn)	13.2 ng/m^3	26.4 ng/m^3 (d)
Mercury (Hg)	2.0 ng/m^3	4.0 ng/m^3
Nickel (Ni)	3.8 ng/m^3	n/a
Thallium (Tl)	No data available	n/a
Vanadium (V)	1.7 ng/m^3	3.4 ng/m^3 (d)(e)
Polycyclic Aromatic Hydrocarbons (PAH, as BaP)	0.33 ng/m^3	n/a
Polychlorinated biphenyls (PCBs)	0.00044 µg/m^3	0.00088 µg/m^3 (d)
Ammonia (NH_3)	0.99 µg/m^3	2.0 µg/m^3 (d)

(a) Where background concentrations are expressed as range (e.g. trace metals) the average concentration has been used.

(b) Units are fg/m^3 (femtogram per cubic metre) equivalent to 1 x 10^{-15} grams per cubic metre

(c) Units are ng/m^3 (nanogram per cubic metre) equivalent to 1 x 10^{-9} grams per cubic metre

(d) 1-hour mean background concentration estimated by multiplying the annual mean by a factor of 2 in accordance with the EA Guidance.

(e) 24-hour mean background concentration estimated by multiplying the 1-hour mean by a factor of 0.59 in accordance with the EA Guidance.

(f) 8-hour mean background concentration estimated by multiplying the 1-hour mean by a factor of 0.70 in accordance with the EA Guidance.

(g) 15-minute mean background concentration estimated by multiplying the 1-hour mean by a factor of 1.34 in accordance with the EA Guidance.

5 ASSESSMENT OF IMPACT

Human Health Impacts

Introduction

5.1 Predicted process concentrations (PC) for the five years of meteorological data are presented as the maximum arising off-site and at each of the discrete receptors identified in Table 3.

5.2 The maximum PC is compared with the relevant air quality standard to determine the significance of the impact, in accordance with the EA risk assessment guidance. Where a potentially significant impact is identified, the total; predicted environmental concentration (process + background) is compared with the air quality standard to assess the likelihood of an exceedence.

Nitrogen Dioxide

5.3 The predicted annual mean and 99.8th percentile of 1-hour mean ground level NO_2 process concentrations are presented in Table 11.

Table 11: Predicted NO_2 Concentrations ($\mu g/m^3$)

Receptor	Annual Mean		99.8th Percentile of 1-Hour Means	
	PC	PC (% AQO)	PC	PC (% AQO)
Maximum Off-Site	1.8	4.5%	10.6	5.3%
Vistamar House	0.95	2.4%	10.3	5.1%
Docks Office	0.66	1.6%	10.0	5.0%
Phillipa Freeth Court	0.51	1.3%	9.3	4.6%
Barry Dock Station	0.51	1.3%	9.4	4.7%
54 Dock View Road	0.49	1.2%	10.0	5.0%
89 Dock View Road	0.44	1.1%	9.5	4.8%
131 Dock View Road	0.29	0.73%	7.8	3.9%
Wimbourne Buildings	1.6	3.9%	9.7	4.9%
Bendrick Road	1.0	2.5%	7.4	3.7%
Public Recycling Facility	0.68	1.7%	6.9	3.5%
Atlantic Crescent	0.88	2.2%	8.9	4.4%
Port Office	0.27	0.67%	6.5	3.3%
Queens Way	0.65	1.6%	10.0	5.0%
Dyfrig Street	0.45	1.1%	6.8	3.4%
AQO	**40.0**		**200**	
Background	**20.0**		**40.0**	

5.4 The maximum off-site annual mean process concentration is 1.8 $\mu g/m^3$, which is potentially significant at 4.5% of the AQO. However, the total predicted concentration, PEC (process plus background) is just 54.5% of the AQO, therefore the risk of an exceedence of the annual mean air quality objective is considered to be negligible at any off-site location.

5.5 The predicted short-term impacts are of negligible significance (<10% of the AQO) at all off-site locations.

5.6 Predicted annual and 99.8th percentile of hourly mean NO_2 concentrations for 2012 (the year in which the highest off-site annual mean concentrations are predicted) are presented as contour plots in Figures 5 and 6 respectively.

5.7 The influence of locally elevated terrain is clearly seen in the short-term concentrations, with the maximum impact occurring approximately 1.5 km northwest of the proposed facility.

Figure 5: Predicted Annual Mean NO_2 Process Concentration ($\mu g/m^3$)

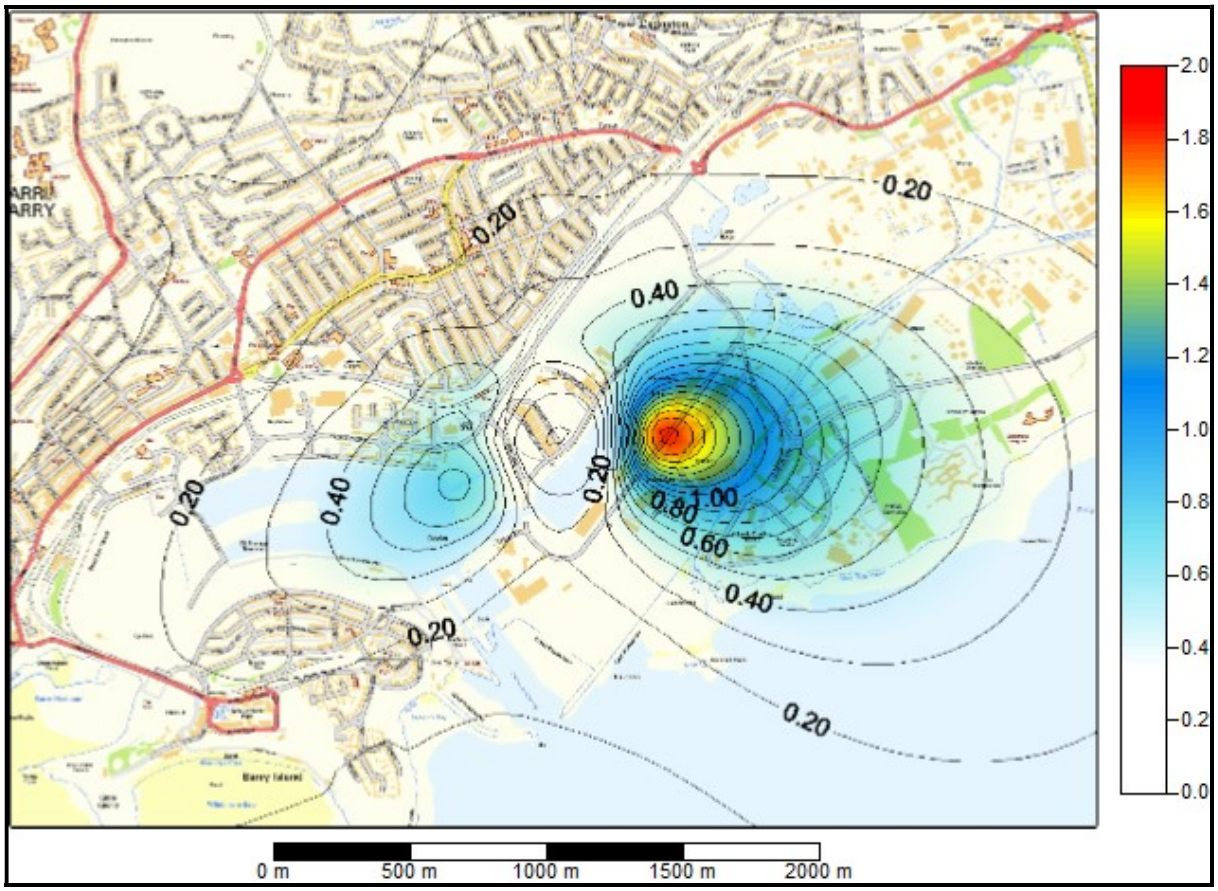
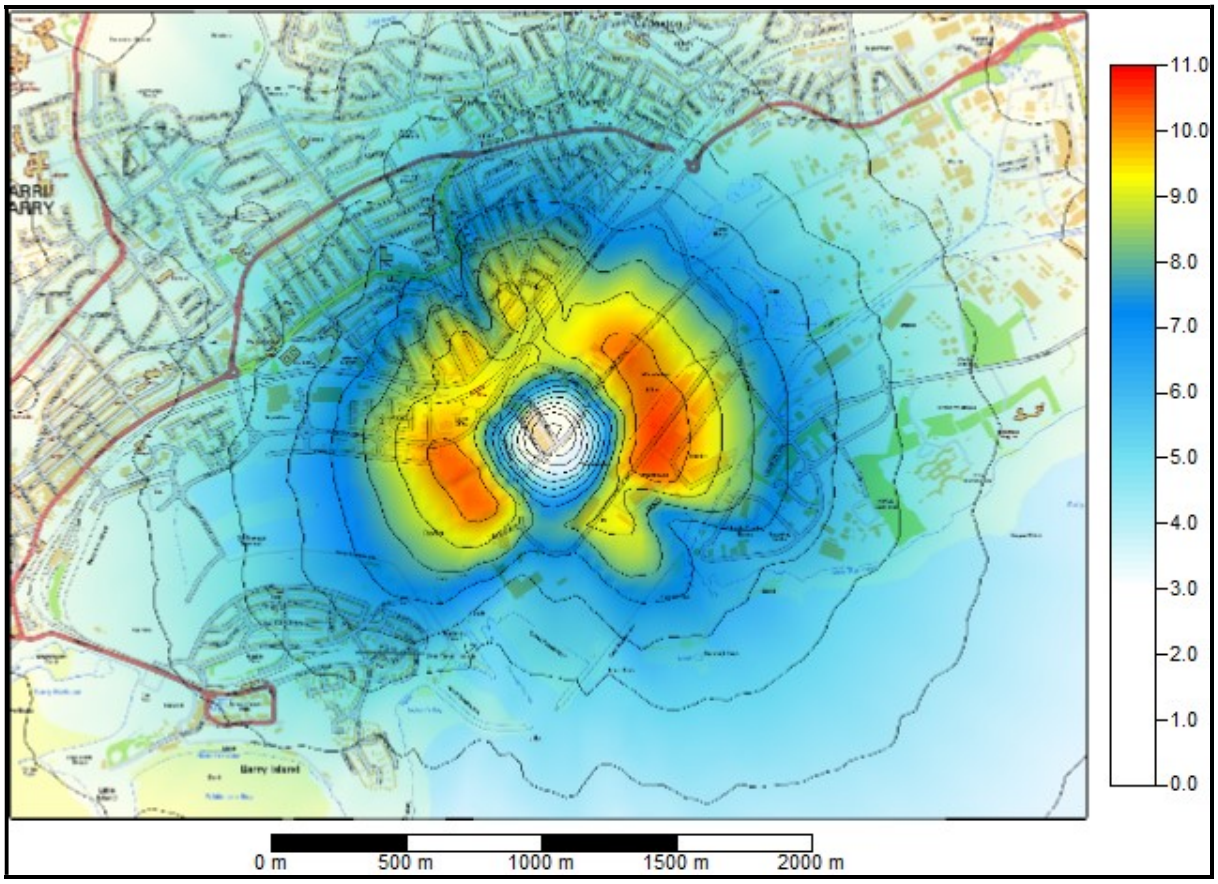


Figure 5: Predicted 99.8th Percentile of 1-Hour Mean NO_2 Process Concentrations (µg/m³)



Carbon Monoxide (CO)

5.8 The predicted maximum 1-hour and 8-hour mean ground level CO process concentrations are presented in Table 12.

Table 12: Predicted CO Concentrations (μg/m³)

Receptor	Maximum 8-Hour Mean		Maximum 1-Hour Mean	
	PC	PC (% AQO)	PC	PC (% EAL)
Maximum Off-Site	7.5	0.075%	25.1	0.084%
Vistamar House	6.8	0.068%	8.0	0.027%
Docks Office	6.4	0.064%	7.6	0.025%
Phillipa Freeth Court	6.0	0.060%	7.4	0.025%
Barry Dock Station	5.6	0.056%	7.4	0.025%
54 Dock View Road	6.1	0.061%	7.7	0.026%
89 Dock View Road	5.7	0.057%	7.3	0.024%
131 Dock View Road	3.8	0.038%	6.0	0.020%
Wimbourne Buildings	6.1	0.061%	7.3	0.024%
Bendrick Road	4.6	0.046%	5.5	0.018%
Public Recycling Facility	3.6	0.036%	5.1	0.017%
Atlantic Crescent	5.7	0.057%	6.9	0.023%
Port Office	4.0	0.040%	5.2	0.017%
Queens Way	6.3	0.063%	7.6	0.025%
Dyfrig Street	4.0	0.040%	5.1	0.017%
AQO/ EAL	**10,000**		**30,000**	
Background	**196**		**280**	

5.9 The maximum predicted 8-hour and 1-hour PCs are less than 10% of the relevant air quality objectives, therefore according to the Environment Agency's criteria the significance of the impact is *negligible*.

Sulphur Dioxide (SO_2)

5.10 Predicted SO_2 process concentrations are presented in Table 13.

Table 13: Predicted SO_2 Concentrations ($\mu g/m^3$)

Receptor	99.2nd Percentile of 24-Hour Means		99.7th Percentile of 1-Hour Means		99.9th Percentile of 15-Minute Means	
	PC	PC (% AQO)	PC	PC (% AQO)	PC	PC (% AQO)
Maximum Off-Site	2.9	2.3%	15.1	4.3%	20.5	7.7%
Vistamar House	2.4	1.9%	14.6	4.2%	20.0	7.5%
Docks Office	1.9	1.5%	14.0	4.0%	19.5	7.3%
Phillipa Freeth Court	2.1	1.6%	13.1	3.7%	18.2	6.8%
Barry Dock Station	1.3	1.0%	13.1	3.7%	18.5	7.0%
54 Dock View Road	1.3	1.1%	13.5	3.9%	19.6	7.4%
89 Dock View Road	1.4	1.1%	13.1	3.7%	18.8	7.1%
131 Dock View Road	0.90	0.7%	10.6	3.0%	15.5	5.8%
Wimbourne Buildings	2.6	2.1%	13.7	3.9%	18.8	7.1%
Bendrick Road	1.5	1.2%	10.5	3.0%	14.4	5.4%
Public Recycling Facility	1.2	1.0%	9.8	2.8%	13.5	5.1%
Atlantic Crescent	1.7	1.4%	12.3	3.5%	17.6	6.6%
Port Office	0.90	0.72%	9.1	2.6%	12.8	4.8%
Queens Way	2.2	1.7%	14.2	4.1%	19.5	7.3%
Dyfrig Street	1.3	1.0%	9.6	2.7%	13.2	4.9%
AQO	**125**		**350**		**266**	
Background	**2.6**		**4.4**		**5.9**	

5.11 The maximum predicted ground level SO_2 process concentrations are less than 10% of the relevant AQOs and are therefore of *negligible* significance.

Particulate Matter (as PM_{10})

5.12 Predicted annual mean and 90.4th percentile of 24-hour mean ground level PM_{10} process concentrations are presented in Table 14. The predictions assume that 100% of the particulate matter is emitted from the stack is PM_{10}.

Table 14: Predicted PM_{10} Concentrations ($\mu g/m^3$)

Receptor	Annual Mean		90.4th Percentile of 24-Hour Means	
	PC	PC (% AQO)	PC	PC (% AQO)
Maximum Off-Site	0.13	0.33%	0.36	0.71%
Vistamar House	0.068	0.17%	0.28	0.55%
Docks Office	0.047	0.12%	0.14	0.28%
Phillipa Freeth Court	0.037	0.091%	0.13	0.25%
Barry Dock Station	0.037	0.091%	0.13	0.26%
54 Dock View Road	0.035	0.087%	0.11	0.22%
89 Dock View Road	0.032	0.079%	0.093	0.19%
131 Dock View Road	0.021	0.052%	0.064	0.13%
Wimbourne Buildings	0.11	0.28%	0.29	0.58%
Bendrick Road	0.072	0.18%	0.18	0.36%
Public Recycling Facility	0.049	0.12%	0.13	0.26%
Atlantic Crescent	0.063	0.16%	0.17	0.34%
Port Office	0.019	0.048%	0.056	0.11%
Queens Way	0.046	0.12%	0.15	0.31%
Dyfrig Street	0.032	0.080%	0.12	0.24%
AQO	**40**		**50**	
Background	**13.5**		**15.9**	

5.13 The predicted maximum ground level PM_{10} concentrations are less than 1% and 10% of the long and short-term AQOs respectively and are therefore of *negligible* significance.

Particulate Matter (as $PM_{2.5}$)

5.14 Predicted annual mean ground-level $PM_{2.5}$ process concentrations are presented in Table 15. The predictions assume that 100% of the particulate matter emitted from the stack is $PM_{2.5}$.

Table 15: Predicted $PM_{2.5}$ Concentrations ($\mu g/m^3$)

Receptor	Annual Mean	
	PC	PC (% LV)
Maximum Off-Site	0.13	0.53%
Vistamar House	0.068	0.27%
Docks Office	0.047	0.19%
Phillipa Freeth Court	0.037	0.15%
Barry Dock Station	0.037	0.15%
54 Dock View Road	0.035	0.14%
89 Dock View Road	0.032	0.13%
131 Dock View Road	0.021	0.083%
Wimbourne Buildings	0.11	0.44%
Bendrick Road	0.072	0.29%
Public Recycling Facility	0.049	0.20%
Atlantic Crescent	0.063	0.25%
Port Office	0.019	0.08%
Queens Way	0.046	0.18%
Dyfrig Street	0.032	0.13%
Limit Value	**25**	
Background	**9.5**	

5.15 Maximum predicted annual mean $PM_{2.5}$ concentrations are less than 1% of the EU limit value are therefore of *negligible* significance.

Total Organic Carbon (as Benzene)

5.16 Predicted annual mean ground-level C_6H_6 concentrations are presented in Table 16.

Table 16: Predicted Benzene Concentrations (μg/m³)

Receptor	Annual Mean		1-Hour Mean	
	PC	PC (% AQS)	PC	PC (% AQS)
Maximum Off-Site	0.13	2.7%	4.9	2.5%
Vistamar House	0.068	1.4%	1.6	0.21%
Docks Office	0.047	0.94%	1.5	0.20%
Phillipa Freeth Court	0.037	0.73%	1.5	0.20%
Barry Dock Station	0.037	0.73%	1.5	0.20%
54 Dock View Road	0.035	0.69%	1.5	0.21%
89 Dock View Road	0.032	0.63%	1.5	0.20%
131 Dock View Road	0.021	0.42%	1.2	0.16%
Wimbourne Buildings	0.11	2.2%	1.5	0.19%
Bendrick Road	0.072	1.4%	1.1	0.15%
Public Recycling Facility	0.049	0.98%	1.0	0.14%
Atlantic Crescent	0.063	1.3%	1.4	0.18%
Port Office	0.019	0.38%	1.0	0.14%
Queens Way	0.046	0.92%	1.5	0.20%
Dyfrig Street	0.032	0.64%	1.0	0.14%
AQS	**5**		**195**	
Background	**0.35**		**0.70**	

5.17 The predicted maximum ground level C_6H_6 PC is potentially significant at 2.7% of the air quality objective, however the predicted PEC is just 9.7% of the objective and the impact is therefore of *negligible* significance.

5.18 The short-term PCs are less than 10% of the EAL and are therefore also of *negligible* significance.

Hydrogen Chloride (HCl)

5.19 The maximum predicted 1-hour mean ground-level HCl process concentrations are presented in Table 17.

Table 17: Predicted HCl Concentrations (μg/m^3)

Receptor	1-Hour Mean	
	PC	PC (% GV)
Maximum Off-Site	14.8	2.0%
Vistamar House	4.8	0.64%
Docks Office	4.6	0.61%
Phillipa Freeth Court	4.4	0.59%
Barry Dock Station	4.5	0.59%
54 Dock View Road	4.6	0.62%
89 Dock View Road	4.4	0.59%
131 Dock View Road	3.6	0.48%
Wimbourne Buildings	4.4	0.58%
Bendrick Road	3.3	0.44%
Public Recycling Facility	3.1	0.41%
Atlantic Crescent	4.1	0.55%
Port Office	3.1	0.42%
Queens Way	4.6	0.61%
Dyfrig Street	3.1	0.41%
Guideline Value	**750**	
Background	**0.24**	

5.20 Predicted maximum 1-hour mean off-site ground level HCl concentrations are less than 10% of the EPAQS guideline value for protection from irritant and respiratory effects at all of the identified receptor locations, therefore the significance of the impact is *negligible.*

Hydrogen Fluoride (HF)

5.21 The predicted monthly mean and 1-hour mean ground-level HF process concentrations are presented in Table 18.

Table 18: Predicted HF Concentrations (μg/m³)

Receptor	Monthly Mean		1-Hour Mean	
	PC	PC (% GV)	PC	PC (% GV)
Maximum Off-Site	0.024	0.15%	0.98	0.61%
Vistamar House	0.022	0.14%	0.32	0.20%
Docks Office	0.013	0.081%	0.31	0.19%
Phillipa Freeth Court	0.0087	0.054%	0.30	0.18%
Barry Dock Station	0.0079	0.049%	0.30	0.19%
54 Dock View Road	0.0074	0.046%	0.31	0.19%
89 Dock View Road	0.0076	0.048%	0.29	0.18%
131 Dock View Road	0.0043	0.027%	0.24	0.15%
Wimbourne Buildings	0.021	0.13%	0.29	0.18%
Bendrick Road	0.013	0.080%	0.22	0.14%
Public Recycling Facility	0.010	0.065%	0.20	0.13%
Atlantic Crescent	0.013	0.081%	0.27	0.17%
Port Office	0.0031	0.019%	0.21	0.13%
Queens Way	0.0072	0.045%	0.30	0.19%
Dyfrig Street	0.0052	0.033%	0.20	0.13%
Guideline Value	**16**		**160**	
Background	**0.5**		**1.0**	

5.22 The maximum predicted ground level monthly mean and 1-hour mean HF concentrations are less than 1% and 10% of the long and short-term EPAQS guideline values, therefore the significance of the impact is *negligible.*

Dioxins and Furans

5.23 The predicted annual mean ground-level dioxin and furan process concentrations at identified sensitive receptor locations are presented in Table 19. The results are presented in femtograms (fg) per cubic metre (10^{-15} g/m³).

Table 19: Predicted Dioxin and Furan Concentrations (fg/m^3)

Receptor	Annual Mean
	PC
Maximum Off-Site	1.3
Vistamar House	0.68
Docks Office	0.47
Phillipa Freeth Court	0.37
Barry Dock Station	0.37
54 Dock View Road	0.35
89 Dock View Road	0.32
131 Dock View Road	0.21
Wimbourne Buildings	1.1
Bendrick Road	0.72
Public Recycling Facility	0.49
Atlantic Crescent	0.63
Port Office	0.19
Queens Way	0.46
Dyfrig Street	0.32
Background	**28.8**

5.24 There are no assessment criteria for dioxins and furans. The predicted maximum contribution from the proposed development is 4.6% of the average background concentration measured at urban monitoring sites in the UK.

PAH (as Benzo[a]pyrene)

5.25 The maximum predicted annual mean ground-level B[a]P process concentrations are presented in Table 20. The results are presented in nanograms (ng) per cubic metre (10^{-9} g/m^3).

Table 20: Predicted B[a]P Concentrations (ng/m^3)

Receptor	Annual Mean	
	PC	PC (% LV)
Maximum Off-Site	0.13	13.3%
Vistamar House	0.068	6.8%
Docks Office	0.047	4.7%
Phillipa Freeth Court	0.037	3.7%
Barry Dock Station	0.037	3.7%
54 Dock View Road	0.035	3.5%
89 Dock View Road	0.032	3.2%
131 Dock View Road	0.021	2.1%
Wimbourne Buildings	0.11	11.1%
Bendrick Road	0.072	7.2%
Public Recycling Facility	0.049	4.9%
Atlantic Crescent	0.063	6.3%
Port Office	0.019	1.9%
Queens Way	0.046	4.6%
Dyfrig Street	0.032	3.2%
EU Limit Value	**1.0**	
Background	**0.33**	

5.26 The maximum predicted off-site annual mean ground level B[a]P concentration is 13.3% of the EU limit value, however the PEC is less than 70% of the limit value and the impact of the proposed facility is therefore of *negligible* significance.

Polychlorinated Biphenyls (PCBs)

5.27 The predicted annual and maximum 1-hour mean ground-level PCB process concentrations are presented in Table 21. The results are presented in nanograms (ng) per cubic metre (10^{-9} g/m^3).

Table 21: Predicted PCB Concentrations (ng/m^3)

Receptor	Annual Mean		1-Hour Mean	
	PC	PC (% EAL)	PC	PC (% EAL)
Maximum Off-Site	0.066	0.033%	1.2	0.021%
Vistamar House	0.034	0.017%	0.40	0.0066%
Docks Office	0.023	0.012%	0.38	0.0064%
Phillipa Freeth Court	0.018	0.0091%	0.37	0.0062%
Barry Dock Station	0.018	0.0091%	0.37	0.0062%
54 Dock View Road	0.017	0.0087%	0.39	0.0064%
89 Dock View Road	0.016	0.0079%	0.37	0.0061%
131 Dock View Road	0.010	0.0052%	0.30	0.0050%
Wimbourne Buildings	0.056	0.028%	0.36	0.0061%
Bendrick Road	0.036	0.018%	0.28	0.0046%
Public Recycling Facility	0.024	0.012%	0.26	0.0043%
Atlantic Crescent	0.031	0.016%	0.34	0.0057%
Port Office	0.0096	0.0048%	0.26	0.0043%
Queens Way	0.023	0.012%	0.38	0.0063%
Dyfrig Street	0.016	0.0080%	0.25	0.0042%
EAL	**200**		**6000**	
Background	**0.44**		**0.88**	

5.28 Maximum predicted ground level annual mean and 1-hour mean PCB concentrations are less than 1% and 10% of the long and short-term EALs, therefore the significance of the impact is *negligible.*

Ammonia (NH_3)

5.29 The predicted annual and maximum 1-hour mean ground-level NH_3 process concentrations are presented in Table 22.

Table 22: Predicted NH_3 Concentrations (ng/m^3)

Receptor	Annual Mean		1-Hour Mean	
	PC	PC (% EAL)	PC	PC (% EAL)
Maximum Off-Site	0.066	0.037%	1.26	0.050%
Vistamar House	0.034	0.019%	0.40	0.016%
Docks Office	0.023	0.013%	0.38	0.015%
Phillipa Freeth Court	0.018	0.010%	0.37	0.015%
Barry Dock Station	0.018	0.010%	0.37	0.015%
54 Dock View Road	0.017	0.0096%	0.39	0.015%
89 Dock View Road	0.016	0.0088%	0.37	0.015%
131 Dock View Road	0.010	0.0058%	0.30	0.012%
Wimbourne Buildings	0.056	0.031%	0.36	0.015%
Bendrick Road	0.036	0.020%	0.28	0.011%
Public Recycling Facility	0.024	0.014%	0.26	0.010%
Atlantic Crescent	0.031	0.017%	0.34	0.014%
Port Office	0.010	0.0053%	0.26	0.010%
Queens Way	0.023	0.013%	0.38	0.015%
Dyfrig Street	0.016	0.0089%	0.25	0.010%
EAL	**180**		**2500**	
Background	**0.99**		**2.0**	

5.30 Maximum predicted ground level annual mean and 1-hour mean NH_3 concentrations are less than 1% and 10% of the long and short-term EALs, therefore the significance of the impact is *negligible.*

Trace Metals

Step 1: Screening

5.31 The predicted maximum long and short-term trace metal impacts at sensitive receptors for emissions at maximum IED limits are presented in Tables 23 and 24 respectively.

5.32 For the group 3 metals (Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V), if both the long and short term PCs are within the relevant EALs, then the impact is considered insignificant, in accordance with the Environment Agency's metals guidance[7].

5.33 The Step 1 screening has assumed that the background concentration is equal to the average measured at urban sites for each pollutant. The predicted and background concentrations are apportioned 80% Cr (III): 20% Cr(VI).

Table 23: Long-Term Trace Metal Predictions - Step 1

Pollutant	EAL ($\mu g/m^3$)	Max. PC ($\mu g/m^3$)	Background ($\mu g/m^3$)	PC (% EAL)	PEC (% of EAL)	Further Assessment Required?
Cd	0.005	0.00056	0.00030	11.1%	17.1%	No
Tl	1	0.00056	n/a	0.056%	0.056%	No
Hg	0.25	0.00056	0.0020	0.22%	1.0%	No
Sb	5	0.0056	n/a	0.11%	0.11%	No
As	**0.003**	**0.0056**	**0.00068**	**185%**	**208%**	**Yes**
Cr (III)	5	0.0044	0.0034	0.089%	0.16%	No
Cr (VI)	**0.0002**	**0.0011**	**0.00085**	**556%**	**981%**	**Yes**
Co	1	0.0056	0.00021	0.56%	0.58%	No
Cu	10	0.0056	0.017	0.056%	0.22%	No
Pb	0.25	0.0056	0.014	2.2%	7.8%	No
Mn	0.15	0.0056	0.013	3.7%	12.5%	No
Ni	0.02	0.0056	0.0038	27.8%	46.8%	No
V	5	0.0056	0.0017	0.11%	0.15%	No

Table 24: Short-Term Trace Metal Predictions - Step 1

Pollutant	EAL ($\mu g/m^3$)	Max. PC ($\mu g/m^3$)	Background ($\mu g/m^3$)	Max PC (% EAL)	Further Assessment Required?
Tl	30	0.0040	n/a	0.013%	No
Hg	7.5	0.0040	0.0040	0.053%	No
Sb	150	0.040	n/a	0.027%	No
Cr (III)	150	0.032	0.0068	0.021%	No
Cr (VI)	3	0.0080	0.0017	0.27%	No
Co	30	0.040	0.00042	0.13%	No
Cu	200	0.040	0.034	0.020%	No
Mn	150	0.040	0.026	0.027%	No
V	1	0.029	0.0034	2.9%	No

5.34 On the basis of the Step 1 screening, further assessment is required for long-term arsenic and chromium (VI) only. The maximum predicted short-term impacts are *negligible* for all trace metals.

Step 2: Emissions at 11% of IED Limits

5.35 Maximum predicted concentrations of arsenic and chromium (VI) are presented in Table 25 for emissions at 11% of the maximum IED limits (1/9th of ELV). No Cr(III):Cr(VI) apportionment has been applied to either the emissions or background concentration. The results show that the EAL for Cr(VI) continues to be substantially exceeded and further assessment is required.

Table 25: Long-Term As and Cr(VI) Predictions - Step 2

Pollutant	EAL ($\mu g/m^3$)	Max. PC ($\mu g/m^3$)	Background ($\mu g/m^3$)	PC (%EAL)	Further Assessment Required?
As	0.003	0.00062	0.00068	20.6%	No
Cr (VI)	**0.0002**	**0.00062**	**0.0042**	**126%**	**Yes**

Step 3: Typical Operational Emissions

5.36 The EA metals guidance provides a range of emission concentrations (corresponding fractions of the total Group III emission) measured at twenty municipal waste incineration (MWI) facilities in the UK. These data suggest that, on average, chromium comprises 2.2% of the total Group III emission. The guidance also provides a maximum chromium Cr(VI) emission based on the analysis of total chromium residues at the plant of 1.3×10^{-4} mg/Nm^3.

5.37 Predicted annual mean Cr(VI) concentrations at this maximum operational emission rate are presented as a percentage of the EAL in Table 26.

Table 26: Predicted Annual Mean Chromium (VI) Concentration (ng/m^3)

Receptor	Annual Mean	
	Maximum	Average
Maximum Off-Site	0.0017	0.85%
Vistamar House	0.00088	0.44%
Docks Office	0.00061	0.30%
Phillipa Freeth Court	0.00048	0.24%
Barry Dock Station	0.00047	0.24%
54 Dock View Road	0.00045	0.23%
89 Dock View Road	0.00041	0.21%
131 Dock View Road	0.00027	0.14%
Wimbourne Buildings	0.0014	0.72%
Bendrick Road	0.00093	0.47%
Public Recycling Facility	0.00063	0.32%
Atlantic Crescent	0.00082	0.41%
Port Office	0.00025	0.12%
Queens Way	0.00060	0.30%
Dyfrig Street	0.00042	0.21%
EAL	**0.2**	
Background	**4.2**	

5.38 For maximum typical operational emissions, the maximum predicted annual mean Cr(VI) concentrations off-site and at the identified receptors are *negligible* (<1%) compared with the EAL.

Summary of Stack Emissions Impact

5.39 A summary of the significance of the predicted significance of the impact on pollutant concentrations at receptor locations is presented in Table 27.

Table 27: Summary of Impact Significance for Maximum Off-Site Concentrations

Pollutant	Significance
Particles (PM_{10})	Negligible
Particles ($PM_{2.5}$)	Negligible
Nitrogen Dioxide (NO_2)	Negligible
Sulphur Dioxide (SO_2)	Negligible
Carbon Monoxide (CO)	Negligible
Hydrogen Fluoride (HF)	Negligible
Hydrogen Chloride (HCl)	Negligible
Benzene (C_8)	Negligible
Dioxins and Furans (PCDD/Fs)	Negligible
Cadmium (Cd)	Negligible
Thallium (Tl)	Negligible
Mercury (Hg)	Negligible
Arsenic (As)	Negligible
Chromium (CrIII)	Negligible
Chromium (CrIV)	Negligible
Cobalt (Co)	Negligible
Copper (Cu)	Negligible
Lead (Pb)	Negligible
Manganese (Mn)	Negligible
Nickel (Ni)	Negligible
Antimony (Sb)	Negligible
Vanadium (V)	Negligible
Polycyclic Aromatic Hydrocarbons, PAH (as B[a]P)	Negligible
Polychlorinated Biphenyls (PCBs)	Negligible
Ammonia (NH_3)	Negligible

Habitat Impacts

Airborne Concentrations of NOx, SO_2 and HF

5.40 Predicted maximum ground level concentrations of NOx, SO_2, HF and NH_3 at the sensitive habitat sites are compared with the relevant critical level (CL) and background concentrations obtained from APIS in Tables 28 to 31.

Table 28: Predicted Airborne NOx, Concentrations as a Percentage of the Critical Level (μg/m³)

Habitat Site	Annual Mean		Daily Mean	
	PC	PEC (a)	PC	PEC (b)
Cadoxton River SINC	5.6%	48.2%	9.7%	32.3%
Cadoxton Wetlands SINC	1.8%	48.0%	8.5%	31.1%
Fields at Merthyr Dyfan SINC	0.42%	48.0%	1.7%	24.3%
Friars Point SINC	0.89%	48.0%	3.0%	25.6%
Gladstone Road Pond SINC	1.0%	48.0%	6.1%	28.8%
Nells Point East SINC	1.5%	48.0%	6.7%	29.3%
North of North Road SINC	0.64%	48.0%	2.4%	25.1%
Cadoxton Ponds Wildlife Trust Reserve	1.8%	48.0%	8.5%	31.1%
Severn Estuary Ramsar	0.51%	48.7%	1.2%	24.1%
Severn Estuary SPA	0.22%	48.7%	0.60%	23.6%
Ancient Woodland (Hayes Lane)	3.2%	48.1%	6.1%	28.7%
Severn Estuary SAC	0.22%	48.7%	0.60%	23.6%
Critical Level	**30**		**75**	

(a) Includes annual mean NOx backgrounds obtained from APIS
(b) Includes 24-hour mean NOx background concentration (annual mean x 2 x 0.59, in accordance with the EA guidance).

Table 29: Predicted Annual Mean SO_2 Concentrations as a Percentage of the Critical Level ($\mu g/m^3$)

Habitat Site	PC	PEC
Cadoxton River SINC	2.1%	13.2%
Cadoxton Wetlands SINC	0.68%	11.7%
Fields at Merthyr Dyfan SINC	0.16%	11.2%
Friars Point SINC	0.33%	11.4%
Gladstone Road Pond SINC	0.39%	11.4%
Nells Point East SINC	0.55%	11.6%
North of North Road SINC	0.24%	11.3%
Cadoxton Ponds Wildlife Trust Reserve	0.68%	11.7%
Severn Estuary Ramsar	0.19%	8.7%
Severn Estuary SPA	0.081%	8.6%
Ancient Woodland (Hayes Lane)	1.2%	12.2%
Severn Estuary SAC	0.081%	8.6%
Critical Level	**20**	

Table 30: Predicted HF Concentrations as a Percentage of the Critical Level (μg/m³)

Habitat Site	Daily Mean		Weekly Mean	
	PC	PEC (a)	PC (b)	PEC (c)
Cadoxton River SINC	0.85%	12.7%	3.0%	n/a
Cadoxton Wetlands SINC	0.64%	12.4%	1.3%	n/a
Fields at Merthyr Dyfan SINC	0.23%	12.0%	0.25%	n/a
Friars Point SINC	0.28%	12.1%	0.69%	n/a
Gladstone Road Pond SINC	0.47%	12.3%	0.73%	n/a
Nells Point East SINC	0.50%	12.3%	0.74%	n/a
North of North Road SINC	0.20%	12.0%	0.39%	n/a
Cadoxton Ponds Wildlife Trust Reserve	0.64%	12.4%	1.3%	n/a
Severn Estuary Ramsar	0.092%	11.9%	0.30%	n/a
Severn Estuary SPA	0.047%	11.8%	0.10%	n/a
Ancient Woodland (Hayes Lane)	0.48%	12.3%	1.7%	n/a
Severn Estuary SAC	0.047%	11.8%	0.10%	n/a
Critical Level	**5**		**0.5**	

(a) Includes 24-hour mean HF background concentration (annual mean x 2 x 0.59, in accordance with the EA guidance).
(b) It is not possible to predict weekly concentrations using the dispersion model, therefore the monthly mean concentrations have been compared with the CL.
(c) There is no current guidance available with regard to calculating a monthly mean background concentration from the annual mean.

Table 31: Predicted Annual Mean NH_3 Concentrations as a Percentage of the Critical Level ($\mu g/m^3$)

Habitat Site	PC	PEC
Cadoxton River SINC	1.4%	33.0%
Cadoxton Wetlands SINC	0.45%	33.0%
Fields at Merthyr Dyfan SINC	0.11%	33.0%
Friars Point SINC	0.22%	33.0%
Gladstone Road Pond SINC	0.26%	33.0%
Nells Point East SINC	0.36%	33.0%
North of North Road SINC	0.16%	33.0%
Cadoxton Ponds Wildlife Trust Reserve	0.45%	33.0%
Severn Estuary Ramsar	0.13%	22.0%
Severn Estuary SPA	0.054%	22.0%
Ancient Woodland (Hayes Lane)	0.79%	33.0%
Severn Estuary SAC	0.054%	22.0%
Critical Level	**3**	

5.41 There are no predicted exceedences of the critical levels for NOx, SO_2 or HF any of the identified sensitive habitat sites. At the statutory habitat sites, the process impacts are less than 1% of the critical level and therefore of *negligible* significance.

5.42 The short-term NOx process concentrations are of *negligible* significance at all of the identified habitat sites.

Eutrophication

5.43 Predicted maximum nutrient nitrogen deposition rates are compared with the critical load for eutrophication in Table 32.

Table 32: Predicted Eutrophication Rates (kg N/ha/yr)

Habitat Site	Critical Load (CL)	PC (as a %age of CL)	PEC (as a %age of CL)
Cadoxton River SINC	15	3.1%	83.4%
Cadoxton Wetlands SINC	15	0.99%	81.3%
Fields at Merthyr Dyfan SINC	20	0.17%	60.4%
Friars Point SINC	20	0.36%	60.6%
Gladstone Road Pond SINC	n/a	n/a	n/a
Nells Point East SINC	20	0.60%	60.8%
North of North Road SINC	15	0.35%	80.6%
Cadoxton Ponds Wildlife Trust Reserve	15	0.99%	81.3%
Severn Estuary Ramsar	20	0.21%	50.7%
Severn Estuary SPA	20	0.089%	50.6%
Ancient Woodland (Hayes Lane)	10	4.6%	219%
Severn Estuary SAC	20	0.089%	50.6%

5.44 The predicted PC's are less than 1% and 100% of the relevant critical loads at the statutory and locally designated sites respectively. On this basis the significance of the proposed development impact is *negligible*.

Acidification

5.45 Predicted nitrogen and sulphur acidification rates are compared with the relevant critical loads and background acidification rates in Table 33.

Table 33: Predicted Acidification Rates (keq/ha/yr)

Habitat Site	PC (as a %age of the CLF)	PEC (as a %age of the CLF)
Fields at Merthyr Dyfan SINC	0.16%	22.3%
Friars Point SINC	0.34%	22.6%
Nells Point East SINC	0.56%	22.9%
Ancient Woodland (Hayes Lane)	3.6%	60.5%

5.46 The maximum predicted acidification rates (PC) are less than 100% of the CLFs and are therefore of *negligible* significance.

Deposition to Ground

5.47 A summary of the screening assessment for deposition of pollutants to ground is presented in Table 34. It has been assumed that each of the Group I and Group III metals are emitted at ½ and 1/9th of the maximum IED ELVs of 0.05 and 0.5 mg/Nm^3, respectively.

5.48 The maximum off-site deposition rates are *negligible* compared with the Limit Values specified by the Environment Agency.

Table 34: Predicted Deposition Rates to Ground (µg/m^2/day)

Pollutant	Limit	PC	PC (% Limit)
As	0.02	2.5×10^{-7}	<0.001%
Cd	0.009	1.1×10^{-9}	<0.001%
Cr	1.5	2.5×10^{-7}	<0.001%
Cu	0.25	2.5×10^{-7}	<0.001%
F	2.1	1.8×10^{-5}	<0.001%
Pb	1.1	2.5×10^{-7}	<0.001%
Hg	0.004	2.2×10^{-9}	<0.001%
Ni	0.11	2.5×10^{-7}	<0.001%

6 ASSESSMENT OF IMPACTS – ABNORMAL EMISSIONS

Failure of Urea Injection and Lime Dosing Operation

6.1 The plant control systems continuously monitor the urea and lime injection systems and the values stored within the bulk storage containers. The control systems will not allow the plant to continue operating without there being adequate supplies of urea or lime reagent available. Once the critical 'low level' reagent alarm is activated, the plant will automatically shut down without any loss of performance. It is therefore considered that emissions would not occur in the event of failure of the Urea Injection System or Lime Dosing Operation.

6.2 The reagent injection systems operate across many zones of the combustion plant, all of which have been designed with duty and standby pumps. Similarly, all reagent and abatement systems are fitted with duty and standby systems which have been subject to HAZOP assessment to ensure that the plant fails safe in all instances.

Failure of Activated Carbon Dosing

Trace Metals

Step 1: Screening

6.3 The predicted maximum short-term Group III trace metal impacts at sensitive receptors for emissions at 5 mg/Nm^3 are presented in Table 37.

6.4 The Step 1 screening has assumed that the background concentration is equal to the average measured at urban sites for each pollutant. The predicted and background concentrations are apportioned 80% Cr (III): 20% Cr(VI).

Table 37: Short-Term Group III Trace Metal Predictions - Step 1

Pollutant	EAL (µg/m^3)	Max. PC (µg/m^3)	Background (µg/m^3)	Max PC (% EAL)	Further Assessment Required?
Sb	150	0.40	n/a	0.27%	No
Cr (III)	150	0.32	0.0068	0.21%	No
Cr (VI)	3	0.080	0.0017	2.7%	No
Co	30	0.40	0.00042	1.3%	No

Cu	200	0.40	0.034	0.20%	No
Mn	150	0.40	0.026	0.27%	No
V	**1**	**0.29**	**0.0034**	**28.9%**	**Yes**

6.5 On the basis of the Step 1 screening, further assessment is required for vanadium only.

Step 2: Emissions at 11% of Group III Limit

6.6 Maximum predicted 24-hour mean concentrations of vanadium are presented in Table 38 for emissions at 11% of the 'abnormal emissions' Group III limit of 5 mg/Nm^3.

Table 38: Maximum Off-Site 24-Hour Mean Vanadium Concentration - Step 2

Pollutant	EAL (µg/m^3)	Max. PC (µg/m^3)	Background (µg/m^3)	PC (%EAL)	Further Assessment Required?
V	1	0.032	0.0034	3.2%	No

6.7 The maximum predicted short-term vanadium concentration is less than 10% of the EAL, therefore the significance of the impact is considered to be *negligible*.

Failure of Bag Filter

Particulate Matter (as PM_{10})

6.8 Predicted 90.4th percentile of 24-hour mean ground level PM_{10} process concentrations are presented in Table 39. The predictions assume that 100% of the particulate matter is emitted from the stack is PM_{10}.

Table 39: Predicted PM_{10} Concentrations ($\mu g/m^3$)

Receptor	90.4th Percentile of 24-Hour Means	
	PC	PC (% AQS)
Maximum Off-Site	5.2	10.5%
Vistamar House	4.1	8.3%
Docks Office	2.1	4.3%
Phillipa Freeth Court	1.9	3.8%
Barry Dock Station	2.0	3.9%
54 Dock View Road	1.7	3.3%
89 Dock View Road	1.4	2.8%
131 Dock View Road	0.96	1.9%
Wimbourne Buildings	4.4	8.7%
Bendrick Road	2.7	5.4%
Public Recycling Facility	2.0	3.9%
Atlantic Crescent	2.6	5.2%
Port Office	0.84	1.7%
Queens Way	2.3	4.6%
Dyfrig Street	1.8	3.7%
AQS	**50**	
Background	**15.9**	
Maximum PEC	**21.1**	
Maximum PEC (% AQS)	**42.2%**	

6.9 The predicted maximum off-site 90.4th percentile of 24-hour mean PC is less than 20% of the objective minus the short-term background concentration therefore the risk of any exceedance is considered to be *negligible*.

6.10 The predicted concentrations at sensitive receptor locations are less than 10% of the AQS and therefore of *negligible* significance.

7 MODELLING RISK ASSESSMENT

7.1 A summary of the maximum PC's at a sensitive receptor from both models are presented in Table 40 below along with the significance for each pollutant determined from both sets of modelling. A full comparison of the results are presented in Appendix F.

Table 40: Comparison of Model Results

Pollutant	Averaging Period	Aermod Results			ADMS Results		
		PC	PC as % of EAL	Significance	PC	PC as % of EAL	Significance
NO_2	Annual Mean	1.6	3.9	Negligible	1.6	4.0	Negligible
	Hourly Mean	10.3	5.1	Negligible	16.2	8.1	Negligible
CO	8 Hour Mean	6.8	0.068	Negligible	10.1	0.10	Negligible
	Hourly Mean	8.0	0.027	Negligible	13.2	0.04	Negligible
SO_2	24 Hour Mean	2.6	2.1	Negligible	3.1	2.5	Negligible
	Hourly Mean	14.6	4.2	Negligible	22.3	6.4	Negligible
	15 Minute Mean	20.0	7.5	Negligible	25.1	9.5	Negligible
PM_{10}	Annual Mean	0.11	0.28	Negligible	0.12	0.29	Negligible
	24 Hour Mean	0.29	0.58	Negligible	0.34	0.7	Negligible
$PM_{2.5}$	Annual Mean	0.11	0.44	Negligible	0.12	0.5	Negligible
TOC	Annual Mean	0.11	2.2	Negligible	0.12	2.3	Negligible
	Hourly Mean	1.6	0.21	Negligible	2.6	1.3	Negligible
HCl	Hourly Mean	4.8	0.64	Negligible	7.8	1.0	Negligible
HF	Hourly Mean	0.32	0.2	Negligible	0.52	0.3	Negligible
Dioxins[(a)]	Annual Mean	1.1	4.5[(b)]	Negligible	1.2	4.0	Negligible
PAH[(c)]	Annual Mean	0.11	11.1	Negligible	0.12	11.6	Negligible
PCB[(c)]	Annual Mean	0.056	0.028	Negligible	0.058	0.03	Negligible
	Hourly Mean	0.40	0.0066	Negligible	0.66	0.01	Negligible
NH_3	Annual Mean	0.056	0.031	Negligible	0.058	0.03	Negligible
	Hourly Mean	0.40	0.016	Negligible	0.66	0.03	Negligible

(a) Presented as fg/m^3
(b) As % of UK background concentration
(c) Presented as ng/m^3

7.2 As illustrated in Table 40 above, the maximum concentration predicted at a sensitive human receptor for each of the pollutants is very similar using either model. Further analysis of the full results as presented in Appendix F, has indicated that for the long term (annual mean) predicted concentrations the results predicted by AERMOD 7 model are generally marginally higher than the concentrations predicted by the alternative model ADMS 5.2. For short term predicted concentrations the results predicted by AERMOD 7 are generally marginally lower than the concentrations predicted by the alternative model ADMS 5.2.

7.3 The results of the modelling of trace metals within the stack emissions also show the same similarity between the two models. The key metal of concern was determined to be Cr VI in the assessment above. The results of the Step 3 assessment using the result from both models are provided in Table 41 below.

Table 41: Comparison of Model Results for Cr VI Step 3 Assessment (ng/m^3)

Pollutant	Averaging Period	Aermod Results			ADMS Results		
		PC	PC as % of EAL	Significance	PC	PC as % of EAL	Significance
Cr VI	Annual Mean	0.014	0.72	Negligible	0.0015	0.74	Negligible

7.4 For all of the pollutants and scenarios modelled, the significance of the impact is not changed by using a different model. Therefore, it is concluded that the choice of model does not have a significant impact on the predicted results or the conclusions drawn from the modelling.

8 CONCLUSIONS

8.1 An assessment has been carried out to determine the local air quality impacts associated with the operation of the proposed wood gasification facility.

8.2 Detailed air quality modelling using the AERMOD 7 dispersion model has been undertaken to predict the impacts associated with stack emissions from the Site. As a worst-case, emissions from the site have been assumed to occur at the IED limits. Actual emissions from the site are anticipated to be significantly lower.

8.3 For a proposed stack height of 43m, predicted maximum off-site process concentrations are well within the relevant air quality standards for all pollutants considered. The significance of the impacts has been assessed as negligible, in accordance with the Environment Agency's risk assessment guidance.

8.4 The predicted process contributions are also negligible compared with the critical levels and critical loads for nutrient nitrogen deposition and acidification at nearby statutory and locally designated sensitive habitat sites.

8.5 Maximum impacts both off-site and at sensitive receptors have also been determined for a number of potential abnormal emissions scenarios for the facility, including failure of the Urea injection operation. Predicted short-term concentrations of all affected pollutants are of negligible significance compared with the relevant air quality standards.

8.6 Based on the above information, it is considered that air quality does not pose a constraint to development of the site as proposed.

APPENDIX A - AIR QUALITY TERMINOLOGY

Term	Definition
Accuracy	A measure of how well a set of data fits the true value.
Air quality objective	Policy target generally expressed as a maximum ambient concentration to be achieved, either without exception or with a permitted number of exceedences within a specific timescale (see also air quality standard).
Air quality standard	The concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. The standards are based on the assessment of the effects of each pollutant on human health including the effects on sensitive sub groups (see also air quality objective).
Ambient air	Outdoor air in the troposphere, excluding workplace air.
Annual mean	The average (mean) of the concentrations measured for each pollutant for one year. Usually this is for a calendar year, but some species are reported for the period April to March, known as a pollution year. This period avoids splitting winter season between 2 years, which is useful for pollutants that have higher concentrations during the winter months.
AQMA	Air Quality Management Area.
DEFRA	Department for Environment, Food and Rural Affairs.
Exceedence	A period of time where the concentrations of a pollutant is greater than, or equal to, the appropriate air quality standard.
Fugitive emissions	Emissions arising from the passage of vehicles that do not arise from the exhaust system.
LAQM	Local Air Quality Management.
NO	Nitrogen monoxide, a.k.a. nitric oxide.
NO_2	Nitrogen dioxide.
NO_x	Nitrogen oxides.
O_3	Ozone.
Percentile	The percentage of results below a given value.
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10 micrometres.
ppb parts per billion	The concentration of a pollutant in the air in terms of volume ratio. A concentration of 1 ppb means that for every billion (10^9) units of air, there is one unit of pollutant present.
ppm parts per million	The concentration of a pollutant in the air in terms of volume ratio. A concentration of 1 ppm means that for every billion (10^6) units of air, there is one unit of pollutant present.
Ratification (Monitoring)	Involves a critical review of all information relating to a data set, in order to amend or reject the data. When the data have been ratified they represent the final data to be used (see also validation).
µg/m^3 micrograms per cubic metre	A measure of concentration in terms of mass per unit volume. A concentration of 1µg/m^3 means that one cubic metre of air contains one microgram (millionth of a gram) of pollutant.
UKAS	United Kingdom Accreditation Service.
Uncertainty	A measure, associated with the result of a measurement, which characterizes the range of values within which the true value is expected to lie. Uncertainty is usually expressed as the range within which the true value is expected to lie with a 95% probability, where standard statistical and other procedures have been used to evaluate this figure. Uncertainty is more clearly defined than the closely related parameter 'accuracy', and has replaced it on recent European legislation.
USA	Updating and Screening Assessment.
Validation (modelling)	Refers to the general comparison of modelled results against

Term	Definition
	monitoring data carried out by model developers.
Validation (monitoring)	Screening monitoring data by visual examination to check for spurious and unusual measurements (see also ratification).
Verification (modelling)	Comparison of modelled results versus any local monitoring data at relevant locations.

APPENDIX B - AIR QUALITY STANDARDS AND OBJECTIVES

Table B1: Air Quality Standards and Environmental Assessment Levels

Pollutant	Averaging Period	EAL / AQS ($\mu g/m^3$)	Comments
Nitrogen Dioxide (NO_2)	annual	40	UK AQO and EU Limit Value
	1-hour	200	UK AQO and EU Limit Value, not to be exceeded more than 18 times per annum, equivalent to the 99.8th percentile of 1-hour means
Sulphur Dioxide (SO_2)	24-hour	125	UK AQO and EU Limit Value, not to be exceeded more than 3 times per annum, equivalent to the 99.2nd percentile of 24-hour means
	1-hour	350	UK AQO and EU Limit Value, not to be exceeded more than 24 times per annum, equivalent to the 99.7th percentile of 1-hour means
	15-minute	266	UK AQO, not to be exceeded more than 35 times per annum, equivalent to the 99.9th percentile of 15-minute means
Carbon Monoxide (CO)	8-hour	10,000	UK AQO and EU Limit Value
	1-hour	30,000	EAL
Particulate Matter (as PM_{10})	annual	40	UK AQO and EU Limit Value
	24-hour	50	UK AQO and EU Limit Value, not to be exceeded more than 35 times per annum, equivalent to the 90.4th percentile of 24-hour means
Particulate Matter (as $PM_{2.5}$)	annual	25 (a)	EU Limit Value
Benzene (C_8)	annual	5	AQO (England and Wales) and EU Limit Value
	1-hour	195	EAL
Hydrogen Chloride (HCl)	1-hour	750	EAL
Hydrogen Fluoride (HF)	1-hour	160	EAL
	monthly	16	EAL
Antimony (Sb)	annual	5	EAL
	1-hour	150	EAL
Arsenic (As)	annual	0.006	EU Target Value
	annual	0.003	EAL
Cadmium (Cd)	annual	0.005	EU Target Value

Chromium III and II Compounds (as Cr)	annual	5	EAL
	1-hour	150	EAL
Chromium VI (CrVI)	annual	0.0002	EAL
Cobalt (Co)	annual	1	EAL
	1-hour	30	EAL
Copper (Cu) as dusts and mists	Annual	10	EAL
	1-hour	200	EAL
Manganese (Mn)	annual	0.15	EAL
	1-hour	1,500	EAL
Lead (Pb)	annual	0.25	UK AQO
	annual	0.50	EU Limit Value
Mercury (Hg)	annual	0.25	EAL
	1-hour	7.5	EAL
Nickel (Ni)	annual	0.02	EU Target Value
Thallium (Tl)	annual	1	EAL
	1-hour	30	EAL
Vanadium (V)	annual	5	EAL
	24-hour	1	EAL
Polycyclic Aromatic Hydrocarbons (PAH) as Benzo(a)Pyrene	annual	0.00025	UK AQO
	annual	0.001	EU Target Value
Polychlorinated Biphenyls (PCBs)	annual	0.2	EAL
	1-hour	6	EAL
Ammonia (NH_3)	annual	180	EAL
	1-Hour	2500	EAL
(a) Reducing to 20 µg/m^3 in 2020			

APPENDIX C – BOILER EMISSION PARAMETERS

Table C1: Emission Parameters

Source ID	**Main Stack**	
Stack Height (m)	43.0	
Stack diameter (m)	1.6	
Temperature of release (K)	419	
Actual flow rate (Am^3/s)	35.7 (a)	
Emission velocity at stack exit (m/s)	17.8	
Normalised flow rate (Nm^3/s)	21.6 (b)	
Emission Concentration (mg/Nm^3) (b)	**Long-Term**	**Short-Term**
PM_{10}	10	30
TOC	10	20
HCl	10	60
HF	1	4
CO	50	100
SO_2	50	200
NOx	200	400
Group I (Cd, Tl)	0.05	
Group II (Hg)	0.05	
Group III (Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V)	0.50	
Dioxins and Furans	1.0×10^{-7}	
PAHs (as BaP)	0.01	
PCBs	0.005	
NH_3	5	
Emission Rate (g/s)	**Long-Term**	**Short-Term**
PM_{10}	0.22	0.65
TOC	0.22	0.43
HCl	0.22	1.3
HF	0.022	0.086
CO	1.1	2.2
SO_2	1.1	4.3
NOx	4.3	8.6
Group I (Cd, Tl)	0.0011	
Group II (Hg)	0.0011	
Group III (Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V)	0.011	
Dioxins and Furans	2.2×10^{-9}	
PAHs (as BaP)	2.2×10^{-4}	
PCBs	1.1×10^{-4}	
NH_3	0.11	

(a) Actual flow rate at 419 K and 10.1% O_2, 101.3 kPa, 15% H_2O
(b) Reference conditions: 273 K and 11% O_2, 101.3 kPa, dry gas

Table C1: Emission Parameters – Failure of Activated Carbon Dosing

Source ID	Main Stack
Emission Concentration (mg/Nm^3)	
Group I (Cd, Tl)	0.03
Group II (Hg)	0.03
Group III Metals (Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V)	5
Dioxins and Furans	1×10^{-7}
PCB	3.0×10^{-11}
Emission Rate (g/s)	
Group I (Cd, Tl)	0.00065
Group II (Hg)	0.00065
Group III Metals (Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V)	0.11
Dioxins and Furans	6.5×10^{-9}
PCB	6.5×10^{-13}
Note: The emissions of Group I and II metals and PCB's are anticipated to be lower than the short-term limits modelled for normal operation (see Table C1) and have therefore not been considered. There is no short-term air quality standard for dioxins and furans, therefore assessment of this pollutant has not been possible.	

Table C2: Emission Parameters – Failure of Bag Filter

Source ID	Main Stack
Emission Concentration (mg/Nm^3)	
PM_{10}	150
Emission Rate (g/s)	
PM_{10}	3.2

APPENDIX D – WIND ROSES

Figure D1: 2009

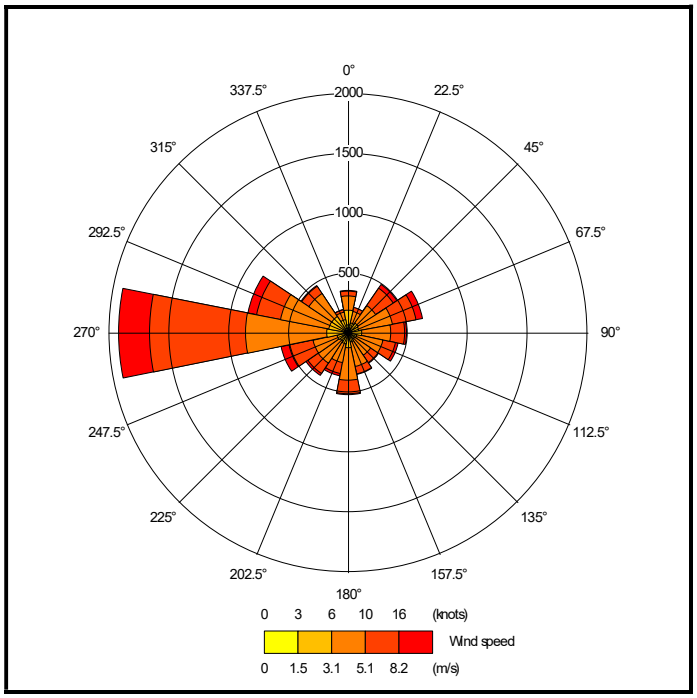


Figure D2: 2010

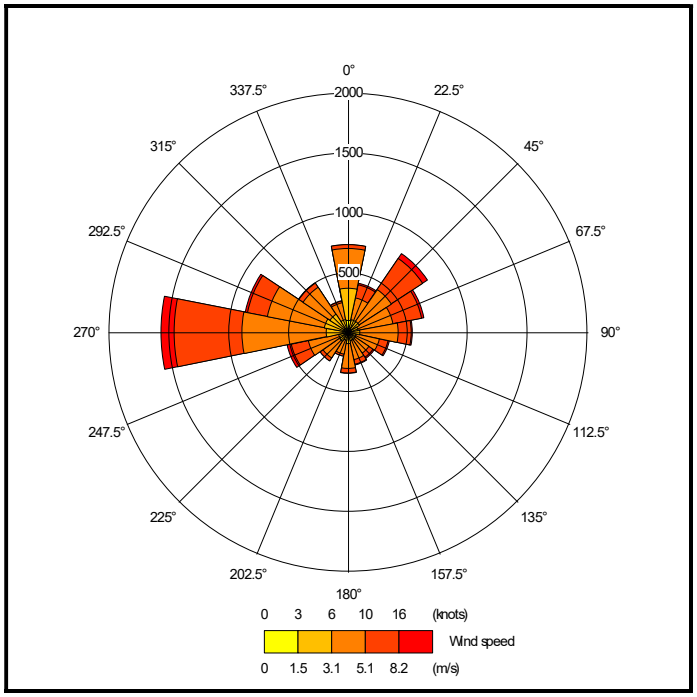


Figure D3: 2011

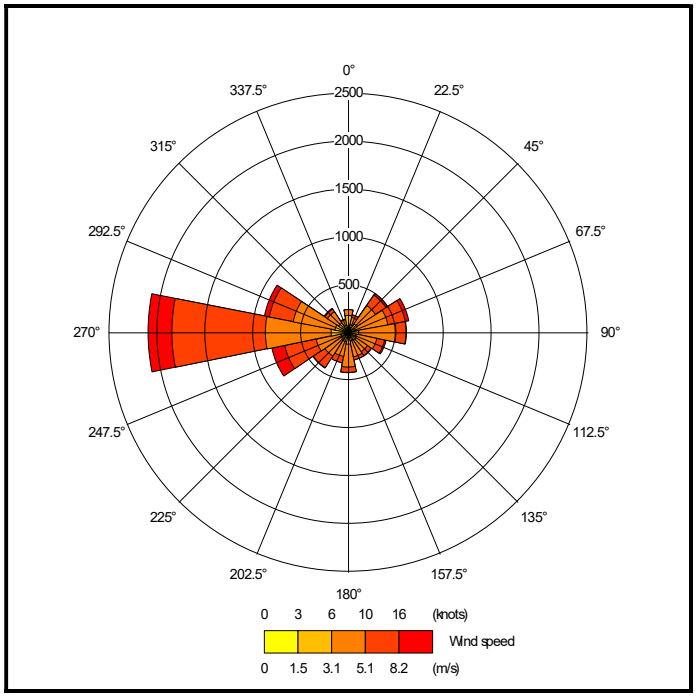


Figure D4: 2012

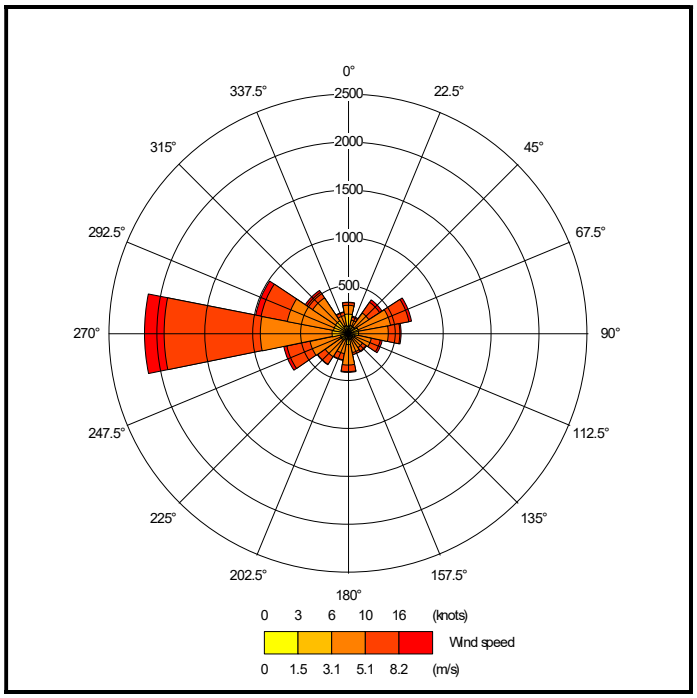
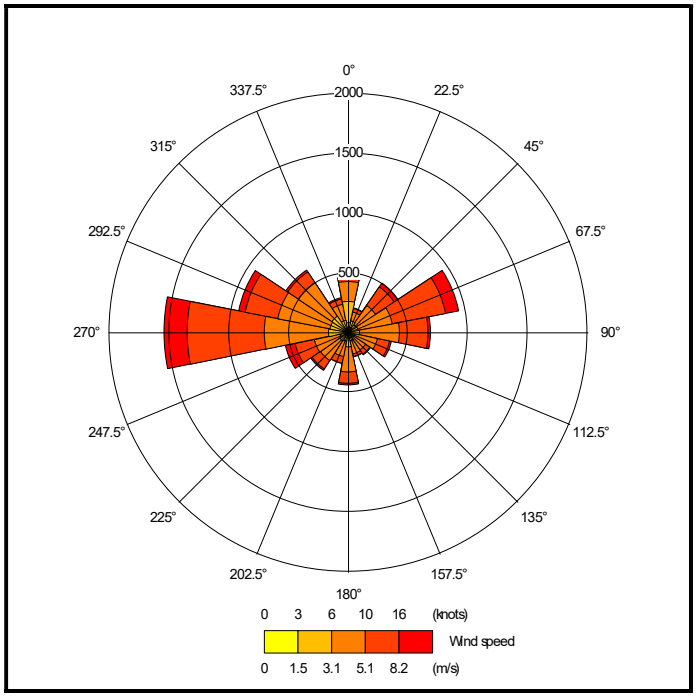


Figure D5: 2013



APPENDIX E - ENVIRONMENTAL ASSESSMENT LEVELS FOR THE PROTECTION OF VEGETATION AND ECOSYSTEMS

Critical Levels

Critical levels are thresholds of airborne pollutant concentrations above which damage may be sustained to sensitive plants and animals.

The critical levels for the protection of vegetation and ecosystems as defined by the EU Directive 2008/50/EC and the 2010 UK Air Quality Standards Regulations are summarised in Table E1.

Table E1: Critical Levels for the Protection of Vegetation and Ecosystems

Pollutant	Averaging Period	Concentration (µg/m^3)
Oxides of Nitrogen (NOx)	Annual Mean	30
	Daily Mean	75
Sulphur Dioxide (SO_2)	Annual Mean	10 (sensitive habitats with lichen and bryophytes)
		20 (all other habitats)
Hydrogen Fluoride (HF)	Weekly Mean	0.5
	Daily Mean	5
NH_3	Annual Mean	1 (sensitive habitats with lichen and bryophytes)
		3 (all other habitats)

Background NOx, SO_2 and NH_3 concentrations for the identified habitat sites have been obtained from Air Pollution Information System (APIS) and are summarised in Table E2. In the absence of site specific data, the rural background HF concentration of 0.5 µg/m^3 is assumed to provide a reasonable estimate of the background concentration at the designated sites.

Table E2: Annual Mean Background NOx, SO_2 and NH_3 Concentrations (µg/m^3)

Habitat Site	NOx	SO_2	NH_3
Cadoxton River SINC	14.4	2.2	0.99
Cadoxton Wetlands SINC	14.4	2.2	0.99
Fields at Merthyr Dyfan SINC	14.4	2.2	0.99
Friars Point SINC	14.4	2.2	0.99
Gladstone Road Pond SINC	14.4	2.2	0.99
Nells Point East SINC	14.4	2.2	0.99
North of North Road SINC	14.4	2.2	0.99
Cadoxton Ponds Wildlife Trust Reserve	14.4	2.2	0.99
Severn Estuary Ramsar	14.6	1.7	0.66
Severn Estuary SPA	14.6	1.7	0.66
Ancient Woodland (Hayes Lane)	14.4	2.2	0.99
Severn Estuary SAC	14.6	1.7	0.66

Critical Loads

Critical loads refer to the threshold beyond which deposition of pollutants to water or land results in measurable damage to vegetation and habitats. This takes the form of either gravitational settling of particulate matter (dry deposition) or wet deposition, where atmospheric pollutants dissolve in water vapour and then precipitate to the ground (e.g. as rain, snow, fog etc.).

Critical loads for eutrophication (nutrient nitrogen deposition) and background nutrient nitrogen deposition rates have been obtained from APIS and are summarised in Table E3 for the identified habitat sites.

Table E3: Critical Loads (Eutrophication) and Background Nutrient Nitrogen Deposition

Habitat Site	Primary Sensitive Habitat	Critical Load (kg N/ha/a)	Background N Deposition (kg N/ha/a)
Cadoxton River SINC	Reedbeds	15	12.0
Cadoxton Wetlands SINC	Reedbeds	15	12.0
Fields at Merthyr Dyfan SINC	Lowland meadow	20	12.0
Friars Point SINC	Lowland meadow	20	12.0
Gladstone Road Pond SINC	Pond	n/a	12.0
Nells Point East SINC	Lowland meadow	20	12.0
North of North Road SINC	Reedbeds	15	12.0
Cadoxton Ponds Wildlife Trust Reserve	Reedbeds	15	12.0
Severn Estuary Ramsar	Saltmarsh	20	10.1
Severn Estuary SPA	Saltmarsh	20	10.1
Ancient Woodland (Hayes Lane)	Broadleaved Woodland	10	21.4
Severn Estuary SPA	Saltmarsh	20	10.1

The background nutrient nitrogen deposition rates are within the critical loads at the majority of the identified habitat sites.

For acidic deposition, the critical load of a habitat site is largely determined by the underlying geology and soils. The critical load of acidification is defined by a critical load function (CLF), which describes the relationship between the relative contributions of sulphur (S) and nitrogen (N) to the total acidification.

The critical load function is defined by the following parameters:

- CLmaxS, the maximum critical load of acidity for S, assuming there is no N deposition;
- CLminN, is the critical load of acidity due to nitrogen removal processes in the soil only (i.e. independent of deposition); and
- CLmaxN, is the maximum critical load of acidity for N, assuming there is no S deposition.

Where available from APIS, the critical loads for acidification for the identified habitat sites are presented in Table E4. For comparison with the critical load function (CLF), the HCl acidification rate is combined with the S acidification rate.

Table E4: Critical Loads (Acidification) and Background Nitrogen and Sulphur Acidification Rates

Habitat Site	Critical Load (keq/ha/a)			Background Acidification (keq/ha/a)			Background (as a %age of CLF)
	Max S	Min N	Max N	N	S	HCl (a)	
Cadoxton River SINC	n/a	n/a	n/a	0.86	0.14	0.053	n/a
Cadoxton Wetlands SINC	n/a	n/a	n/a	0.86	0.14	0.053	n/a
Fields at Merthyr Dyfan SINC	3.9	0.85	4.7	0.86	0.14	0.053	22.3%
Friars Point SINC	3.9	0.85	4.7	0.86	0.14	0.053	22.3%
Gladstone Road Pond SINC	n/a	n/a	n/a	0.86	0.14	0.053	n/a
Nells Point East SINC	3.9	0.85	4.7	0.86	0.14	0.053	22.3%
North of North Road SINC	n/a	n/a	n/a	0.86	0.14	0.053	n/a
Cadoxton Ponds Wildlife Trust Reserve	n/a	n/a	n/a	0.86	0.14	0.053	n/a
Severn Estuary Ramsar	n/a	n/a	n/a	0.72	0.23	0.053	n/a
Severn Estuary SPA	n/a	n/a	n/a	0.72	0.23	0.053	n/a
Ancient Woodland (Hayes Lane)	2.8	0.36	3.1	1.5	0.17	0.13	58.5%
Severn Estuary SAC	n/a	n/a	n/a	0.72	0.23	0.053	n/a
(a) Based on UK average background HCl concentration of 0.24µg/m^3							

The majority of the habitat sites are insensitive to acidification according to APIS, however where CLFs exist the background acidification rates are well within the relevant levels.

APPENDIX F – COMPARISON ON RESULTS FROM AERMOD 7 AND ADMS 5.2 MODELS

Table F1: Predicted NO_2 Concentrations ($\mu g/m^3$)

Receptor	Annual Mean		99.8th Percentile of 1-Hour Means	
	AERMOD	ADMS	AERMOD	ADMS
Vistamar House	0.95	0.76	10.3	12.8
Docks Office	0.66	0.52	10.0	13.9
Phillipa Freeth Court	0.51	0.50	9.3	11.7
Barry Dock Station	0.51	0.49	9.4	16.2
54 Dock View Road	0.49	0.51	10.0	15.0
89 Dock View Road	0.44	0.59	9.5	15.1
131 Dock View Road	0.29	0.29	7.8	8.6
Wimbourne Buildings	1.6	1.59	9.7	10.8
Bendrick Road	1.0	1.01	7.4	7.4
Public Recycling Facility	0.68	0.50	6.9	6.9
Atlantic Crescent	0.88	0.56	8.9	12.1
Port Office	0.27	0.22	6.5	13.5
Queens Way	0.65	0.46	10.0	10.9
Dyfrig Street	0.45	0.46	6.8	6.6
AQO	**40.0**		**200**	
Background	**20.0**		**40.0**	

Table F2: Predicted CO Concentrations ($\mu g/m^3$)

Receptor	Maximum 8-Hour Mean		Maximum 1-Hour Mean	
	AERMOD	ADMS	AERMOD	ADMS
Vistamar House	6.8	8.5	8.0	11.0
Docks Office	6.4	8.5	7.6	11.4
Phillipa Freeth Court	6.0	7.2	7.4	9.5
Barry Dock Station	5.6	10.1	7.4	13.1
54 Dock View Road	6.1	9.7	7.7	13.2
89 Dock View Road	5.7	9.4	7.3	12.5
131 Dock View Road	3.8	5.5	6.0	10.7
Wimbourne Buildings	6.1	7.3	7.3	8.6
Bendrick Road	4.6	4.6	5.5	9.9
Public Recycling Facility	3.6	4.0	5.1	8.7
Atlantic Crescent	5.7	7.1	6.9	9.9
Port Office	4.0	7.2	5.2	11.7

Queens Way	6.3	6.7	7.6	10.0
Dyfrig Street	4.0	4.3	5.1	6.6
AQO/ EAL	**10,000**		**30,000**	
Background	**196**		**280**	

Table F3: Predicted SO_2 Concentrations ($\mu g/m^3$)

Receptor	99.2nd Percentile of 24-Hour Means		99.7th Percentile of 1-Hour Means		99.9th Percentile of 15-Minute Means	
	AERMOD	ADMS	AERMOD	ADMS	AERMOD	ADMS
Vistamar House	2.4	2.6	14.6	19.6	20.0	19.8
Docks Office	1.9	2.1	14.0	19.6	19.5	21.7
Phillipa Freeth Court	2.1	1.8	13.1	22.3	18.2	18.4
Barry Dock Station	1.3	1.8	13.1	22.3	18.5	25.1
54 Dock View Road	1.3	1.7	13.5	21.8	19.6	23.5
89 Dock View Road	1.4	2.4	13.1	21.8	18.8	24.9
131 Dock View Road	0.90	1.2	10.6	15.3	15.5	15.3
Wimbourne Buildings	2.6	3.1	13.7	15.3	18.8	17.2
Bendrick Road	1.5	1.7	10.5	10.5	14.4	12.2
Public Recycling Facility	1.2	1.3	9.8	17.0	13.5	11.6
Atlantic Crescent	1.7	1.9	12.3	18.4	17.6	19.5
Port Office	0.90	1.4	9.1	18.4	12.8	24.3
Queens Way	2.2	2.1	14.2	15.1	19.5	18.4
Dyfrig Street	1.3	1.6	9.6	9.3	13.2	11.4
AQO	**125**		**350**		**266**	
Background	**2.6**		**4.4**		**5.9**	

Table F4: Predicted PM_{10} Concentrations ($\mu g/m^3$)

Receptor	Annual Mean		90.4th Percentile of 24-Hour Means	
	AERMOD	ADMS	AERMOD	ADMS
Vistamar House	0.068	0.055	0.28	0.23
Docks Office	0.047	0.038	0.14	0.16
Phillipa Freeth Court	0.037	0.037	0.13	0.14
Barry Dock Station	0.037	0.036	0.13	0.15
54 Dock View Road	0.035	0.037	0.11	0.14
89 Dock View Road	0.032	0.043	0.093	0.15
131 Dock View Road	0.021	0.022	0.064	0.08
Wimbourne Buildings	0.11	0.116	0.29	0.34
Bendrick Road	0.072	0.074	0.18	0.21
Public Recycling Facility	0.049	0.036	0.13	0.11
Atlantic Crescent	0.063	0.041	0.17	0.15
Port Office	0.019	0.016	0.056	0.05
Queens Way	0.046	0.034	0.15	0.12
Dyfrig Street	0.032	0.033	0.12	0.12
AQO	**40**		**50**	
Background	**13.5**		**15.9**	

Table F5: Predicted $PM_{2.5}$ Concentrations ($\mu g/m^3$)

Receptor	Annual Mean	
	AERMOD	ADMS
Vistamar House	0.068	0.055
Docks Office	0.047	0.038
Phillipa Freeth Court	0.037	0.037
Barry Dock Station	0.037	0.036
54 Dock View Road	0.035	0.037
89 Dock View Road	0.032	0.043
131 Dock View Road	0.021	0.022
Wimbourne Buildings	0.11	0.116
Bendrick Road	0.072	0.074
Public Recycling Facility	0.049	0.036
Atlantic Crescent	0.063	0.041
Port Office	0.019	0.016
Queens Way	0.046	0.034
Dyfrig Street	0.032	0.033
Limit Value	**25**	
Background	**9.5**	

Table F6: Predicted Benzene Concentrations (μg/m^3)

Receptor	Annual Mean		1-Hour Mean	
	AERMOD	ADMS	AERMOD	ADMS
Vistamar House	0.068	0.055	1.6	2.1
Docks Office	0.047	0.038	1.5	2.2
Phillipa Freeth Court	0.037	0.037	1.5	1.9
Barry Dock Station	0.037	0.036	1.5	2.6
54 Dock View Road	0.035	0.037	1.5	2.6
89 Dock View Road	0.032	0.043	1.5	2.4
131 Dock View Road	0.021	0.022	1.2	2.1
Wimbourne Buildings	0.11	0.116	1.5	1.7
Bendrick Road	0.072	0.074	1.1	1.9
Public Recycling Facility	0.049	0.036	1.0	1.7
Atlantic Crescent	0.063	0.041	1.4	1.9
Port Office	0.019	0.016	1.0	2.3
Queens Way	0.046	0.034	1.5	2.0
Dyfrig Street	0.032	0.033	1.0	1.3
AQS	**5**		**195**	
Background	**0.35**		**0.70**	

Table F7: Predicted HCl Concentrations (μg/m^3)

Receptor	1-Hour Mean	
	AERMOD	ADMS
Vistamar House	4.8	6.5
Docks Office	4.6	6.7
Phillipa Freeth Court	4.4	5.6
Barry Dock Station	4.5	7.7
54 Dock View Road	4.6	7.8
89 Dock View Road	4.4	7.4
131 Dock View Road	3.6	6.3
Wimbourne Buildings	4.4	5.1
Bendrick Road	3.3	5.8
Public Recycling Facility	3.1	5.2
Atlantic Crescent	4.1	5.8
Port Office	3.1	6.9
Queens Way	4.6	5.9
Dyfrig Street	3.1	3.9
Guideline Value	**750**	
Background	**0.24**	

Table F8: Predicted HF Concentrations (μg/m^3)

Receptor	1-Hour Mean	
	AERMOD	ADMS
Vistamar House	0.32	0.43
Docks Office	0.31	0.44
Phillipa Freeth Court	0.30	0.37
Barry Dock Station	0.30	0.51
54 Dock View Road	0.31	0.52
89 Dock View Road	0.29	0.49
131 Dock View Road	0.24	0.42
Wimbourne Buildings	0.29	0.34
Bendrick Road	0.22	0.39
Public Recycling Facility	0.20	0.34
Atlantic Crescent	0.27	0.39
Port Office	0.21	0.46
Queens Way	0.30	0.39
Dyfrig Street	0.20	0.26
Guideline Value	**160**	
Background	**1.0**	

Table F9: Predicted Dioxin and Furan Concentrations (fg/m^3)

Receptor	Annual Mean	
	AERMOD	ADMS
Vistamar House	0.68	0.43
Docks Office	0.47	0.44
Phillipa Freeth Court	0.37	0.37
Barry Dock Station	0.37	0.51
54 Dock View Road	0.35	0.52
89 Dock View Road	0.32	0.49
131 Dock View Road	0.21	0.42
Wimbourne Buildings	1.1	0.34
Bendrick Road	0.72	0.39
Public Recycling Facility	0.49	0.34
Atlantic Crescent	0.63	0.39
Port Office	0.19	0.46
Queens Way	0.46	0.39
Dyfrig Street	0.32	0.26
Background	**28.8**	

Table F10: Predicted B[a]P Concentrations (ng/m^3)

Receptor	Annual Mean	
	AERMOD	ADMS
Vistamar House	0.068	0.055
Docks Office	0.047	0.038
Phillipa Freeth Court	0.037	0.037
Barry Dock Station	0.037	0.036
54 Dock View Road	0.035	0.037
89 Dock View Road	0.032	0.043
131 Dock View Road	0.021	0.022
Wimbourne Buildings	0.11	0.116
Bendrick Road	0.072	0.074
Public Recycling Facility	0.049	0.036
Atlantic Crescent	0.063	0.041
Port Office	0.019	0.016
Queens Way	0.046	0.034
Dyfrig Street	0.032	0.033
EU Limit Value	**1.0**	
Background	**0.33**	

Table F11: Predicted PCB Concentrations (ng/m^3)

Receptor	Annual Mean		1-Hour Mean	
	AERMOD	ADMS	AERMOD	ADMS
Vistamar House	0.034	0.028	0.40	0.55
Docks Office	0.023	0.019	0.38	0.57
Phillipa Freeth Court	0.018	0.018	0.37	0.48
Barry Dock Station	0.018	0.018	0.37	0.66
54 Dock View Road	0.017	0.019	0.39	0.66
89 Dock View Road	0.016	0.022	0.37	0.62
131 Dock View Road	0.010	0.011	0.30	0.53
Wimbourne Buildings	0.056	0.058	0.36	0.43
Bendrick Road	0.036	0.037	0.28	0.49
Public Recycling Facility	0.024	0.018	0.26	0.44
Atlantic Crescent	0.031	0.021	0.34	0.49
Port Office	0.0096	0.008	0.26	0.58
Queens Way	0.023	0.017	0.38	0.50
Dyfrig Street	0.016	0.017	0.25	0.33
EAL	**200**		**6000**	
Background	**0.44**		**0.88**	

Table F12: Predicted NH_3 Concentrations (ng/m^3)

Receptor	Annual Mean		1-Hour Mean	
	AERMOD	ADMS	AERMOD	ADMS
Vistamar House	0.034	0.028	0.40	0.55
Docks Office	0.023	0.019	0.38	0.57
Phillipa Freeth Court	0.018	0.018	0.37	0.48
Barry Dock Station	0.018	0.018	0.37	0.66
54 Dock View Road	0.017	0.019	0.39	0.66
89 Dock View Road	0.016	0.022	0.37	0.62
131 Dock View Road	0.010	0.011	0.30	0.53
Wimbourne Buildings	0.056	0.058	0.36	0.43
Bendrick Road	0.036	0.037	0.28	0.49
Public Recycling Facility	0.024	0.018	0.26	0.44
Atlantic Crescent	0.031	0.021	0.34	0.49
Port Office	0.010	0.008	0.26	0.58
Queens Way	0.023	0.017	0.38	0.50
Dyfrig Street	0.016	0.017	0.25	0.33
EAL	**180**		**2500**	
Background	**0.99**		**2.0**	

Table F13: Trace Metal Predictions – (Step 1 Results)

Pollutant	Averaging Period	AERMOD	ADMS
Cd	Annual	0.00056	0.00058
Tl	Annual	0.00056	0.00058
	Hourly	0.0040	0.0066
Hg	Annual	0.00056	0.00058
	Hourly	0.0040	0.0066
Sb	Annual	0.0056	0.0058
	Hourly	0.040	0.066
As	Annual	**0.0056**	0.0058
Cr (III)	Annual	0.0044	0.0047
	Hourly	0.032	0.053
Cr (VI)	Annual	**0.0011**	0.0012
Co	Annual	0.0056	0.0058
	Hourly	0.040	0.066
Cu	Annual	0.0056	0.0058
	Hourly	0.040	0.066
Pb	Annual	0.0056	0.0058
Mn	Annual	0.0056	0.0058
	Hourly	0.040	0.066
Ni	Annual	0.0056	0.0058
V	Annual	0.0056	0.0058
	24 hour	0.029	0.033