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Proposed Wood Gasification Facility
Woodham Road, Barry

Air Quality Assessment

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Air Quality Assessment

Revision	Date	Notes	Author	Checked	Approved
1	05/05/15		SD	ND	Dr N Davey
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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 A glossary of common air quality terminology is provided in **Appendix A.**

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

Figure 1: Site Location Plan

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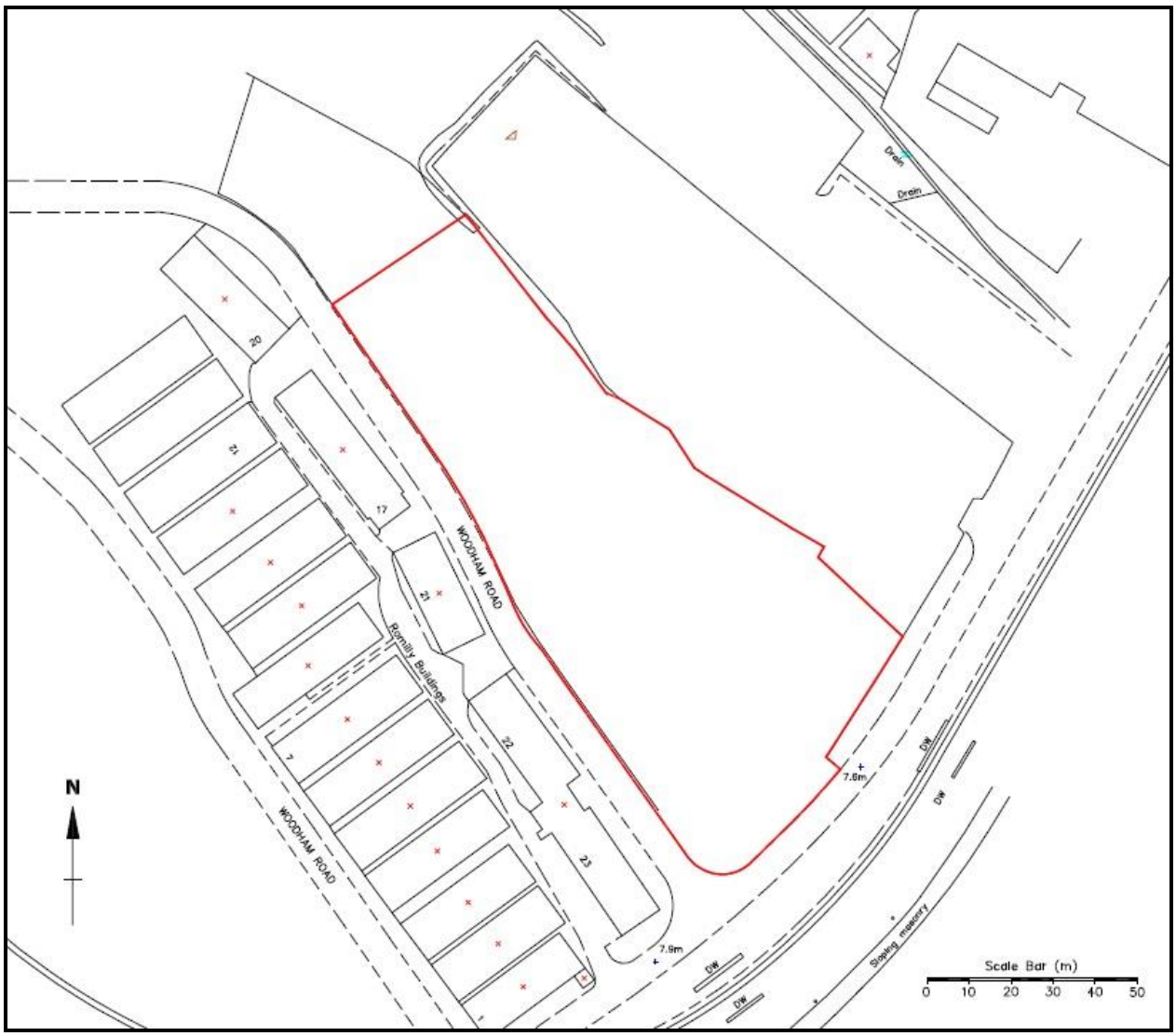
Figure 2: Site Layout



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)	1×10^{-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].

Local Meteorological Data

3.8 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.

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

Topography

3.10 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.

3.11 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

3.12 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

[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.

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.

3.13 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.

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

Nitric Oxide to NO_2 Conversion

3.15 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).

3.16 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

3.17 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.

3.18 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

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

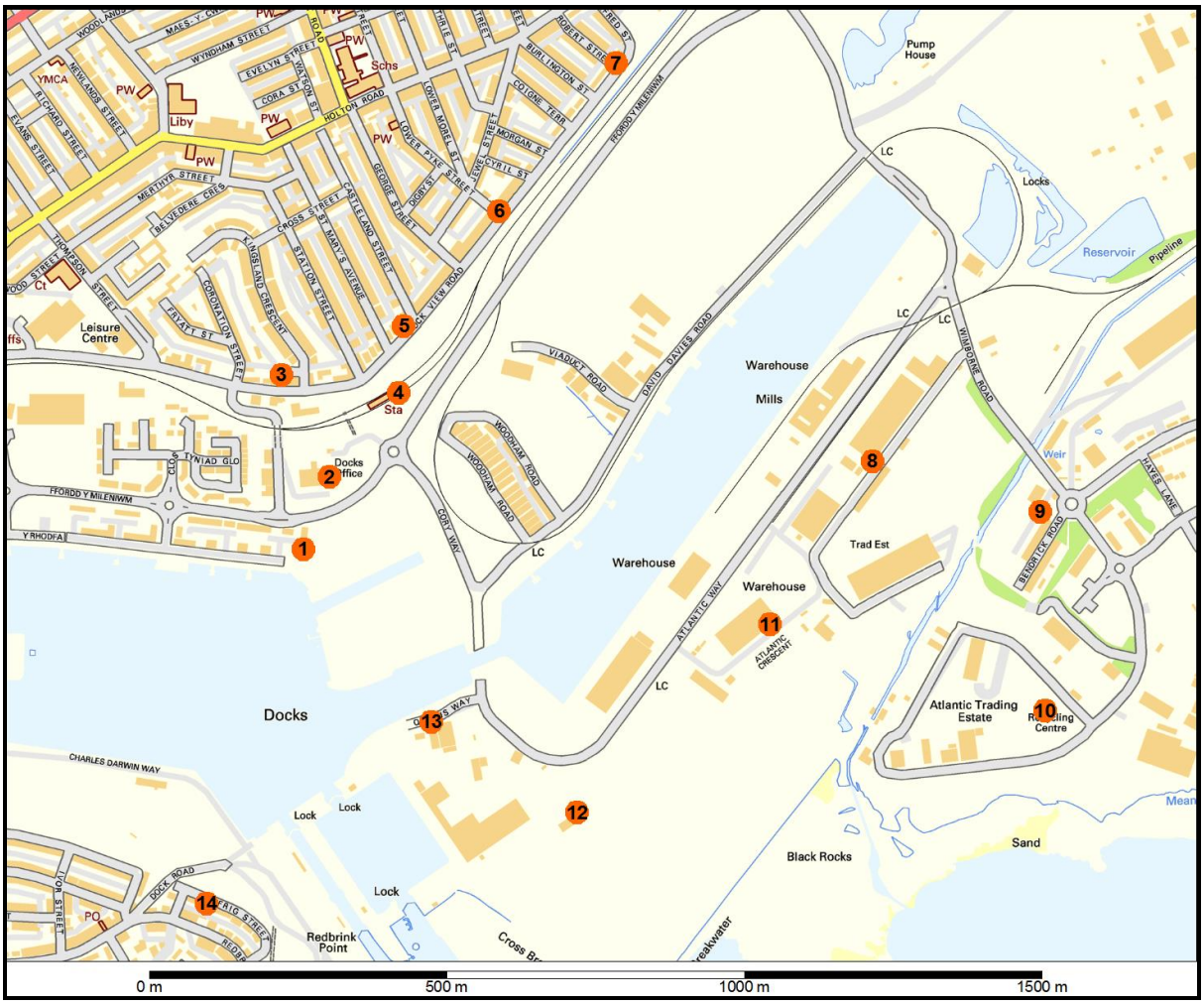
are lower than short-term standards owing to the chronic health effects associated with exposure to low level pollution for longer periods of time.

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

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



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3.20 Pollutant concentrations have been predicted at both discrete receptor locations and over a 3 km by 4 km Cartesian grid of 50 m resolution.

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

Habitat Assessment

3.22 The Environment Agency's H1 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] Environment Agency (August 2010), Horizontal Guidance Note H1, Annex (f) Air Emissions, Version 2.2.

- 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].

3.23 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.

3.24 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	6.2 km east
H11	Ancient Woodland (Hayes Lane)	1.1 km east

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

3.26 The modelled ground level pollutant concentrations are used to predict deposition rates, using typical deposition velocities. A summary of typical NO_2, SO_2 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

3.27 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.

3.28 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

3.29 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.

3.30 A background HCl deposition rate has been calculated for each of the habitat sites using the UK average annual mean concentration of 0.24 µg/m^3.

3.31 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**).

Significance Criteria

3.32 The Environment Agency has developed criteria for assessing the significance of an impact compared with relevant air quality standards and background air quality[11]. A process concentration (PC) is considered potentially significant if:

- The long term PC > 1% of the long-term air quality standard
- The short term PC > 10% of the short-term air quality standard

3.33 At 1% of the long term air quality standard, the impact of a development is unlikely to be significant compared with background air quality. Both the short and long term criteria are also designed to ensure that there is a substantial safety margin to protect public health and the environment.

3.34 If the screening criteria are not met, the process contribution 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 air quality standard
- The short term PC < 20% of the 'headroom' (air quality standard – short term background concentration), where the short term background concentration is assumed to be twice the long term background concentration.

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

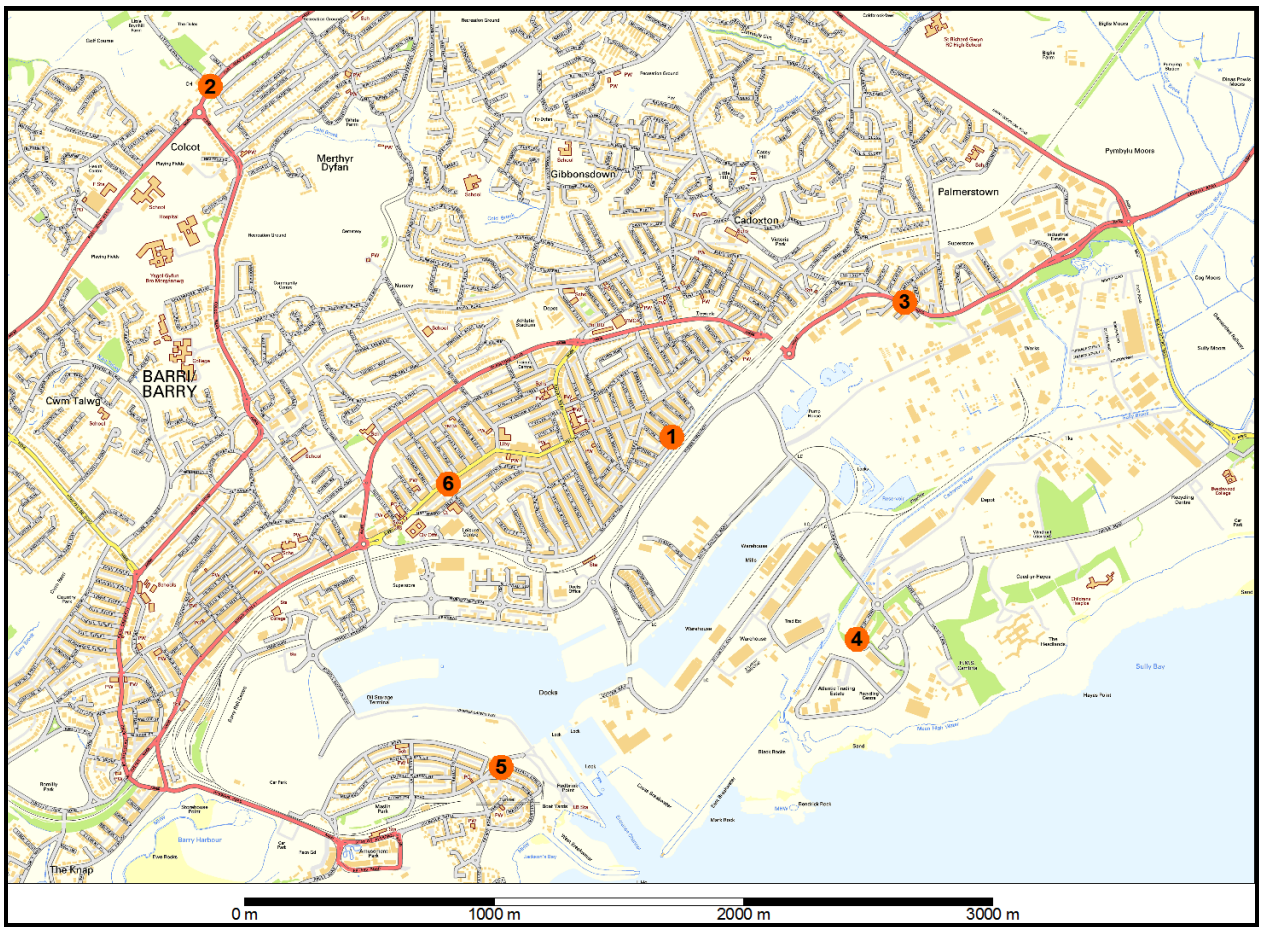
4.1 There are no automatic air quality monitoring stations measuring NO_2 in the vicinity of the proposed facility, however routine monitoring of NO_2 concentrations is undertaken by passive diffusion tube at a number of locations in Barry. A summary of bias adjusted annual mean NO_2 cconcentrations measured between 2009 and 2012 is presented in Table 6**.** The data were extracted from VGCs 2013 Air Quality Progress Report[15]. The locations of the monitoring sites is presented in Figure 4.

Table 6: NO_2 Diffusion Tube Monitoring Data (bias adjusted)

ID	Site Name	Type (a)	OS Grid Reference	2009	2010	2011	2012
1	110 Dock View Road	R	312663, 168289	17	20	19	20
2	Port Road East	R	310813, 169693	23	26	26	27
3	24 Cardiff Road	R	313597, 168829	29	30	28	32
4	Bendrick Road	UB	313407, 167477	14	17	15	15
5	Thalasa, Dyfrig Street	UB	311980, 166965	13	14	14	17
6	Holton Road	R	311768, 168101	26	27	31	37
(a) B = Background, UB = Urban Background							

[15] 2013 Air Quality Progress Report for Vale of Glamorgan, September 2013

Figure 4: Diffusion Tube Monitoring Locations



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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 2009 and 2012 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[16] 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 2014 and are based on 2011 monitoring data. DEFRA guidance issued in conjunction with the new background maps[17] suggests that unusually high particulate concentrations were measured in 2011. A scaling factor of 0.91 is provided to adjust the mapped concentrations to more typical levels.

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[18]. The 2013 SO_2 concentrations are assumed to be 75% of the 2001 estimates, in accordance with the 2003 Local

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

[17] http://laqm.defra.gov.uk/documents/Background-maps-user-guide-v1.0.pdf

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

Air Quality Management Technical Guidance[19]. 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.

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.

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[20] cites a modelling study which suggests that the typical natural

[19] 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).

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.

[20] 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[21].

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

[21] 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.

Summary of Background Concentrations

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

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	n/a
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 (a)
Cobalt (Co)	0.21 ng/m^3	0.42 ng/m^3 (a)
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 (a)
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 (a)
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 (a)

(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 H1 Guidance.

(e) 24-hour mean background concentration estimated by multiplying the 1-hour mean by a factor of 0.59 in accordance with the H1 Guidance.

(f) 8-hour mean background concentration estimated by multiplying the 1-hour mean by a factor of 0.70 in accordance with the H1 Guidance.

(g) 15-minute mean background concentration estimated by multiplying the 1-hour mean by a factor of 1.34 in accordance with the H1 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 H1 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	0.78	2.0%	23.9	11.9%
Vistamar House	0.35	0.88%	6.13	3.1%
Docks Office	0.23	0.57%	6.64	3.3%
Phillipa Freeth Court	0.28	0.71%	7.08	3.5%
Barry Dock Station	0.24	0.60%	7.59	3.8%
54 Dock View Road	0.26	0.65%	8.12	4.1%
89 Dock View Road	0.26	0.65%	7.67	3.8%
131 Dock View Road	0.16	0.40%	5.96	3.0%
Wimbourne Buildings	0.54	1.4%	8.75	4.4%
Bendrick Road	0.49	1.2%	7.43	3.7%
Public Recycling Facility	0.34	0.85%	6.9	3.4%
Atlantic Crescent	0.49	1.2%	10.9	5.4%
Port Office	0.26	0.66%	8.6	4.3%
Queens Way	0.67	1.7%	10.3	5.2%
Dyfrig Street	0.44	1.1%	6.9	3.5%
AQO	**40.0**		**200**	
Background	**20.0**		**40.0**	

5.4 The maximum off-site annual mean process concentration is 0.78 $\mu g/m^3$, which is potentially significant at 2.0% of the AQO. However, the total predicted concentration, PEC (process plus background) is just 52% 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 For the short-term predictions, the maximum off-site PC is 11.4 $\mu g/m^3$, which is potential significant at 11.9% of the AQO, however the PC is <20% of the 'headroom' and therefore the risk of an exceedence of the hourly mean AQO off-site is considered to be negligible. The predicted short-term impacts are of negligible significance (<10% of the AQO) at all of the identified sensitive receptors.

5.6 Predicted annual and 99.8th percentile of hourly mean NO_2 concentrations for 2011 (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 ($\mu g/m^3$)

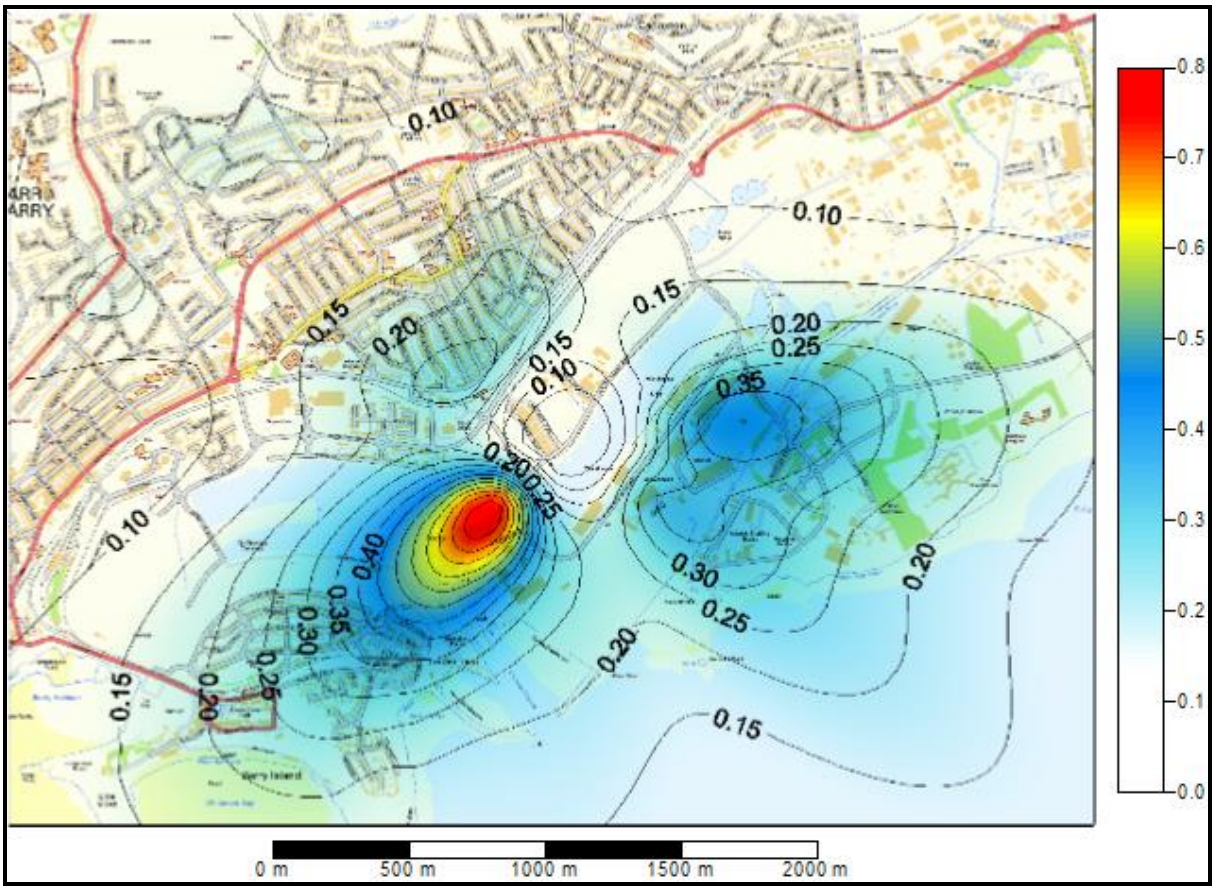
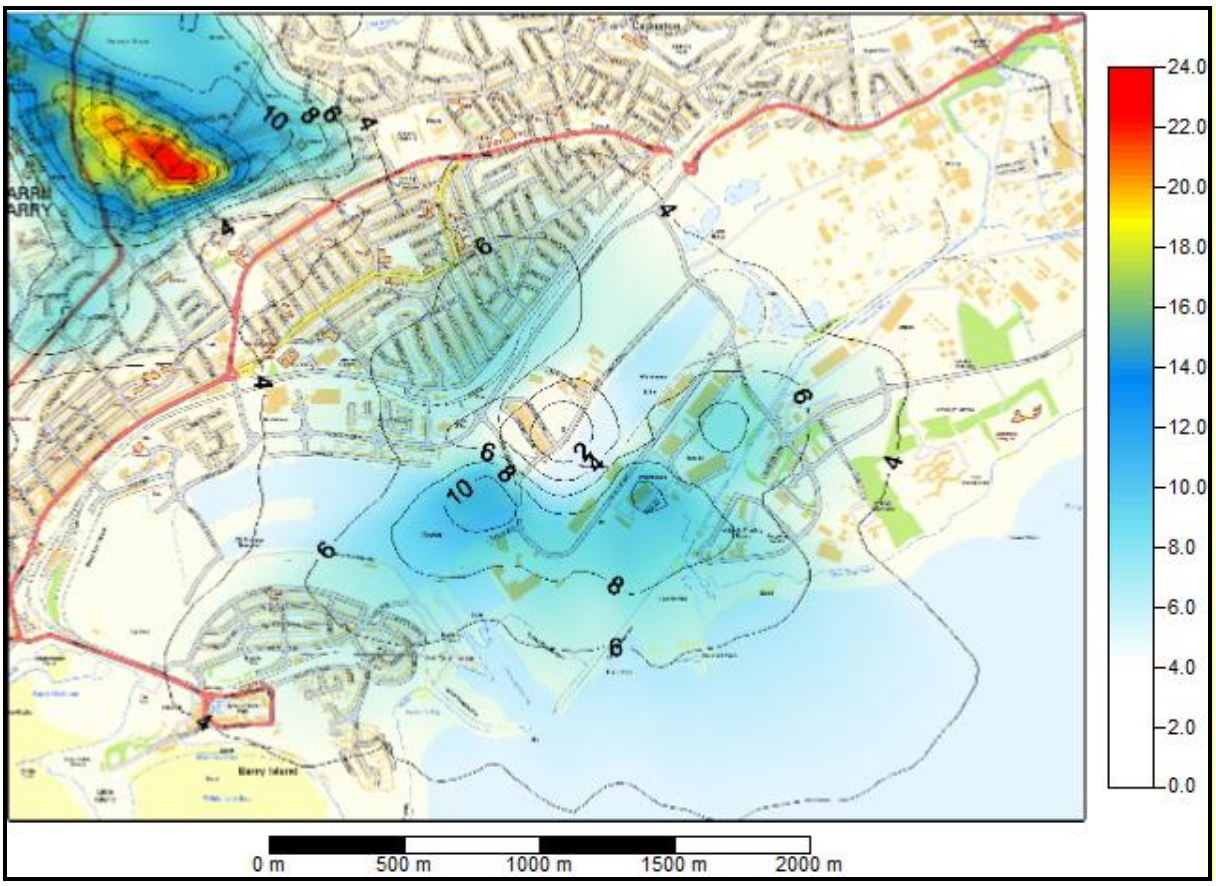


Figure 5: Predicted 99.8th Percentile of 1-Hour Mean NO_2 Process Concentrations (µg/m^3)



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/m^3)

Receptor	Maximum 8-Hour Mean		Maximum 1-Hour Mean	
	PC	PC (% AQO)	PC	PC (% EAL)
Maximum Off-Site	12.9	0.13%	51.3	0.17%
Vistamar House	3.9	0.039%	5.3	0.018%
Docks Office	3.9	0.039%	5.7	0.019%
Phillipa Freeth Court	4.6	0.046%	6.7	0.022%
Barry Dock Station	4.8	0.048%	6.5	0.022%
54 Dock View Road	4.7	0.047%	6.7	0.022%
89 Dock View Road	4.8	0.048%	6.3	0.021%
131 Dock View Road	3.5	0.035%	4.7	0.016%
Wimbourne Buildings	5.4	0.054%	7.9	0.026%
Bendrick Road	4.1	0.041%	7.9	0.026%
Public Recycling Facility	2.8	0.028%	6.0	0.020%
Atlantic Crescent	5.7	0.057%	8.3	0.028%
Port Office	5.0	0.050%	7.1	0.024%
Queens Way	6.6	0.066%	7.9	0.026%
Dyfrig Street	4.0	0.040%	5.2	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	2.7	2.1%	23.6	6.7%	93.2	35.0%
Vistamar House	0.91	0.73%	8.4	2.4%	12.5	4.7%
Docks Office	0.71	0.57%	9.0	2.6%	13.5	5.1%
Phillipa Freeth Court	1.1	0.89%	9.9	2.8%	14.3	5.4%
Barry Dock Station	0.81	0.65%	10.4	3.0%	15.5	5.8%
54 Dock View Road	0.91	0.73%	11.1	3.2%	16.3	6.1%
89 Dock View Road	0.97	0.78%	10.8	3.1%	15.4	5.8%
131 Dock View Road	0.68	0.54%	8.1	2.3%	11.9	4.5%
Wimbourne Buildings	1.1	0.89%	12.0	3.4%	17.7	6.7%
Bendrick Road	0.92	0.74%	10.4	3.0%	14.9	5.6%
Public Recycling Facility	0.87	0.69%	9.4	2.7%	13.7	5.1%
Atlantic Crescent	1.5	1.2%	15.1	4.3%	21.2	8.0%
Port Office	1.1	0.87%	11.5	3.3%	17.7	6.6%
Queens Way	2.3	1.9%	14.6	4.2%	20.1	7.5%
Dyfrig Street	1.2	0.98%	9.7	2.8%	13.5	5.1%
AQO	**125**		**350**		**266**	
Background	**2.6**		**4.4**		**5.9**	

5.11 The maximum predicted ground level 24-hour and 1-hour mean SO_2 process concentrations are less than 10% of the relevant AQOs and are therefore of *negligible* significance.

5.12 The maximum off-site 15-minite mean concentration is potentially significant, however background SO_2 concentration is low and it is considered unlikely that an exceedence will occur at any location. The maximum 15-minute mean concentrations are of negligible significance at all the identified receptor locations.

Particulate Matter (as PM_{10})

5.13 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	0.056	0.14%	0.20	0.40%
Vistamar House	0.025	0.063%	0.10	0.20%
Docks Office	0.016	0.040%	0.061	0.12%
Phillipa Freeth Court	0.020	0.050%	0.083	0.17%
Barry Dock Station	0.017	0.043%	0.062	0.12%
54 Dock View Road	0.019	0.046%	0.073	0.15%
89 Dock View Road	0.019	0.047%	0.066	0.13%
131 Dock View Road	0.011	0.029%	0.037	0.073%
Wimbourne Buildings	0.039	0.097%	0.11	0.23%
Bendrick Road	0.035	0.088%	0.11	0.22%
Public Recycling Facility	0.024	0.061%	0.077	0.15%
Atlantic Crescent	0.035	0.087%	0.12	0.23%
Port Office	0.019	0.047%	0.068	0.14%
Queens Way	0.048	0.12%	0.18	0.37%
Dyfrig Street	0.031	0.078%	0.12	0.25%
AQO	**40**		**50**	
Background	**13.5**		**15.9**	

5.14 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 $PM_{2.5}$)

5.15 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	0.056	0.22%
Vistamar House	0.025	0.10%
Docks Office	0.016	0.065%
Phillipa Freeth Court	0.020	0.081%
Barry Dock Station	0.017	0.069%
54 Dock View Road	0.019	0.074%
89 Dock View Road	0.019	0.074%
131 Dock View Road	0.011	0.046%
Wimbourne Buildings	0.039	0.15%
Bendrick Road	0.035	0.14%
Public Recycling Facility	0.024	0.10%
Atlantic Crescent	0.035	0.14%
Port Office	0.019	0.076%
Queens Way	0.048	0.19%
Dyfrig Street	0.031	0.12%
Limit Value	**25**	
Background	**9.5**	

5.16 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)

5.17 Predicted annual mean ground-level benzene process concentrations are presented in Table 16.

Table 16: Predicted Benzene Concentrations (μg/m^3)

Receptor	Annual Mean	
	PC	PC (% AQO)
Maximum Off-Site	0.056	1.1%
Vistamar House	0.025	0.50%
Docks Office	0.016	0.32%
Phillipa Freeth Court	0.020	0.40%
Barry Dock Station	0.017	0.34%
54 Dock View Road	0.019	0.37%
89 Dock View Road	0.019	0.37%
131 Dock View Road	0.011	0.23%
Wimbourne Buildings	0.039	0.77%
Bendrick Road	0.035	0.71%
Public Recycling Facility	0.024	0.49%
Atlantic Crescent	0.035	0.69%
Port Office	0.019	0.38%
Queens Way	0.048	0.96%
Dyfrig Street	0.031	0.62%
AQO	**5**	
Background	**0.35**	

5.18 The predicted impact on annual mean benzene concentration is of negligible significance at all of the identified sensitive receptors,

5.19 The maximum off-site annual mean process concentration is 0.056 μg/m^3, which is potentially significant at 1.1% of the AQO. However, the total predicted concentration, PEC (process plus background) is just 8.1% of the AQO, therefore the facility is unlikely to result an exceedence of the annual mean air quality objective at any off-site location.

Hydrogen Chloride (HCl)

5.20 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	30.8	4.1%
Vistamar House	3.2	0.42%
Docks Office	3.4	0.45%
Phillipa Freeth Court	4.0	0.54%
Barry Dock Station	3.9	0.52%
54 Dock View Road	4.0	0.53%
89 Dock View Road	3.8	0.51%
131 Dock View Road	2.8	0.37%
Wimbourne Buildings	4.8	0.63%
Bendrick Road	4.7	0.63%
Public Recycling Facility	3.6	0.48%
Atlantic Crescent	5.0	0.67%
Port Office	4.3	0.57%
Queens Way	4.7	0.63%
Dyfrig Street	3.1	0.42%
Guideline Value	**750**	
Background	**0.24**	

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

5.22 The maximum off-site 1-hour mean process concentration is 30.8 μg/m^3, which is potentially significant at 4.1% of the AQO. However, the total predicted concentration, PEC (process plus background) is just 4.1% of the AQO, therefore the facility is unlikely to result an exceedence of the 1-hour mean air quality objective at any off-site location.

Hydrogen Fluoride (HF)

5.23 The predicted annual and maximum 1-hour mean ground-level HF process concentrations are presented in Table 18.

Table 18: Predicted HF Concentrations (μg/m^3)

Receptor	Annual Mean		1-Hour Mean	
	PC	PC (% GV)	PC	PC (% GV)
Maximum Off-Site	0.0056	0.035%	0.21	1.3%
Vistamar House	0.0025	0.016%	0.23	0.13%
Docks Office	0.0016	0.010%	0.27	0.14%
Phillipa Freeth Court	0.0020	0.013%	0.26	0.17%
Barry Dock Station	0.0017	0.011%	0.27	0.16%
54 Dock View Road	0.0019	0.012%	0.25	0.17%
89 Dock View Road	0.0019	0.012%	0.19	0.16%
131 Dock View Road	0.0011	0.0072%	0.32	0.12%
Wimbourne Buildings	0.0039	0.024%	0.32	0.20%
Bendrick Road	0.0035	0.022%	0.24	0.20%
Public Recycling Facility	0.0024	0.015%	0.33	0.15%
Atlantic Crescent	0.0035	0.022%	0.29	0.21%
Port Office	0.0019	0.012%	0.31	0.18%
Queens Way	0.0048	0.030%	0.21	0.20%
Dyfrig Street	0.0031	0.019%	0.21	0.13%
Guideline Value	**16**		**160**	
Background	**0.5**		**1.0**	

5.24 Maximum predicted ground level annual mean and 1-hour mean hydrogen fluoride 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

5.25 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/m^3).

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

Receptor	Annual Mean
	PC
Maximum Off-Site	0.56
Vistamar House	0.25
Docks Office	0.16
Phillipa Freeth Court	0.20
Barry Dock Station	0.17
54 Dock View Road	0.19
89 Dock View Road	0.19
131 Dock View Road	0.11
Wimbourne Buildings	0.39
Bendrick Road	0.35
Public Recycling Facility	0.24
Atlantic Crescent	0.35
Port Office	0.19
Queens Way	0.48
Dyfrig Street	0.31
Background	**28.8**

5.26 There are no assessment criteria for dioxins and furans. The predicted maximum contribution from the proposed development is 1.9% of the average background concentration measured at urban monitoring sites in the UK.

PAH (as Benzo[a]pyrene)

5.27 The maximum predicted 1-hour 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	0.0056	0.56%
Vistamar House	0.0025	0.25%
Docks Office	0.0016	0.16%
Phillipa Freeth Court	0.0020	0.20%
Barry Dock Station	0.0017	0.17%
54 Dock View Road	0.0019	0.19%
89 Dock View Road	0.0019	0.19%
131 Dock View Road	0.0011	0.11%
Wimbourne Buildings	0.0039	0.39%
Bendrick Road	0.0035	0.35%
Public Recycling Facility	0.0024	0.24%
Atlantic Crescent	0.0035	0.35%
Port Office	0.0019	0.19%
Queens Way	0.0048	0.48%
Dyfrig Street	0.0031	0.31%
EU Limit Value	**1.0**	
Background	**0.33**	

5.28 The maximum predicted off-site annual mean ground level B[a]P concentration is less than 1% of the EU limit value, therefore the impact of the proposed facility is of *negligible* significance.

Polychlorinated Biphenyls (PCBs)

5.29 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	0.028	0.014%	2.6	0.043%
Vistamar House	0.013	0.0063%	0.27	0.0044%
Docks Office	0.0081	0.0040%	0.28	0.0047%
Phillipa Freeth Court	0.010	0.0050%	0.33	0.0056%
Barry Dock Station	0.0086	0.0043%	0.32	0.0054%
54 Dock View Road	0.0093	0.0046%	0.33	0.0056%
89 Dock View Road	0.0093	0.0047%	0.32	0.0053%
131 Dock View Road	0.0057	0.0029%	0.23	0.0039%
Wimbourne Buildings	0.019	0.0097%	0.40	0.0066%
Bendrick Road	0.018	0.0088%	0.40	0.0066%
Public Recycling Facility	0.012	0.0061%	0.30	0.0050%
Atlantic Crescent	0.017	0.0087%	0.42	0.0069%
Port Office	0.0095	0.0047%	0.36	0.0060%
Queens Way	0.024	0.012%	0.39	0.0066%
Dyfrig Street	0.016	0.0078%	0.26	0.0044%
EAL	**200**		**6000**	
Background	**0.44**		**0.88**	

5.30 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.*

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 22 and 23 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 22: 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	0.00024	0.00030	4.8%	10.8%	No
Tl	1	0.00024	n/a	0.024%	0.024%	No
Hg	0.25	0.00024	0.0020	0.096%	0.90%	No
Sb	5	0.0024	n/a	0.048%	0.048%	No
As	**0.003**	**0.0024**	**0.00068**	**79.9%**	**103%**	**Yes**
Cr (III)	5	0.0019	0.0034	0.038%	0.106%	No
Cr (VI)	**0.0002**	**0.00048**	**0.00085**	**240%**	**665%**	**Yes**
Co	1	0.0024	0.00021	0.24%	0.26%	No
Cu	10	0.0024	0.017	0.024%	0.19%	No
Pb	0.25	0.0024	0.014	0.96%	6.5%	No
Mn	0.15	0.0024	0.013	1.6%	10.4%	No
Ni	0.02	0.0024	0.0038	12.0%	31.0%	No
V	5	0.0024	0.0017	0.048%	0.082%	No

Table 23: 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	0.0042	n/a	0.014%	No
Hg	7.5	0.0042	0.0040	0.055%	No
Sb	150	0.042	n/a	0.028%	No
Cr (III)	150	0.033	0.0068	0.022%	No
Cr (VI)	3	0.0083	0.0017	0.28%	No
Co	30	0.042	0.00042	0.14%	No
Cu	200	0.042	0.034	0.021%	No
Mn	150	0.042	0.026	0.028%	No
V	1	0.028	0.0034	2.8%	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 24 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 24: 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	0.00027	0.00068	31.5%	No
Cr (VI)	**0.0002**	**0.00027**	**0.0042**	**133%**	**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 25.

Table 25: Predicted Annual Mean Chromium (VI) Concentration (ng/m^3)

Receptor	Annual Mean	
	Maximum	Average
Maximum Off-Site	0.00073	0.36%
Vistamar House	0.00033	0.16%
Docks Office	0.00021	0.11%
Phillipa Freeth Court	0.00026	0.13%
Barry Dock Station	0.00022	0.11%
54 Dock View Road	0.00024	0.12%
89 Dock View Road	0.00024	0.12%
131 Dock View Road	0.00015	0.07%
Wimbourne Buildings	0.00050	0.25%
Bendrick Road	0.00046	0.23%
Public Recycling Facility	0.00032	0.16%
Atlantic Crescent	0.00045	0.23%
Port Office	0.00025	0.12%
Queens Way	0.00062	0.31%
Dyfrig Street	0.00040	0.36%
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 26.

Table 26: 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
PAHs (as B[a]P)	Negligible
PCBs	Negligible

Habitat Impacts

Airborne Concentrations of NOx, SO_2 and HF

5.40 Predicted maximum ground level concentrations of NOx, SO_2 and HF at the sensitive habitat sites are compared with the relevant critical level (CL) and background concentrations obtained from APIS in Tables 27 to 29.

Table 27: Predicted Airborne NOx, Concentrations as a Percentage of the Critical Level ($\mu g/m^3$)

Habitat Site	Annual Mean		Daily Mean	
	PC	PEC (a)	PC	PEC (b)
Cadoxton River SINC	2.6%	48.1%	7.0%	29.6%
Cadoxton Wetlands SINC	0.65%	48.0%	2.2%	24.9%
Fields at Merthyr Dyfan SINC	0.57%	48.0%	4.7%	27.3%
Friars Point SINC	0.79%	48.0%	2.9%	25.5%
Gladstone Road Pond SINC	0.62%	48.0%	3.8%	26.4%
Nells Point East SINC	1.5%	48.0%	6.9%	29.5%
North of North Road SINC	0.24%	48.0%	0.89%	23.5%
Cadoxton Ponds Wildlife Trust Reserve	0.65%	48.0%	2.2%	24.9%
Severn Estuary Ramsar	0.27%	39.7%	0.71%	19.5%
Severn Estuary SPA	0.19%	39.7%	0.89%	19.6%
Ancient Woodland (Hayes Lane)	1.8%	48.0%	3.9%	26.6%
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 H1 guidance).

Table 28: Predicted Annual Mean SO_2 Concentrations as a Percentage of the Critical Level ($\mu g/m^3$)

Habitat Site	PC	PEC
Cadoxton River SINC	0.96%	12.0%
Cadoxton Wetlands SINC	0.24%	11.3%
Fields at Merthyr Dyfan SINC	0.22%	11.3%
Friars Point SINC	0.30%	11.3%
Gladstone Road Pond SINC	0.23%	11.3%
Nells Point East SINC	0.55%	11.6%
North of North Road SINC	0.091%	11.1%
Cadoxton Ponds Wildlife Trust Reserve	0.24%	11.3%
Severn Estuary Ramsar	0.10%	9.6%
Severn Estuary SPA	0.071%	9.5%
Ancient Woodland (Hayes Lane)	0.66%	11.7%
Critical Level	**20**	

Table 29: Predicted HF Concentrations as a Percentage of the Critical Level (μg/m^3)

Habitat Site	Daily Mean		Weekly Mean	
	PC	PEC (a)	PC (b)	PEC (c)
Cadoxton River SINC	0.52%	12.3%	0.77%	n/a
Cadoxton Wetlands SINC	0.20%	12.0%	0.19%	n/a
Fields at Merthyr Dyfan SINC	0.47%	12.3%	0.17%	n/a
Friars Point SINC	0.26%	12.1%	0.24%	n/a
Gladstone Road Pond SINC	0.34%	12.1%	0.19%	n/a
Nells Point East SINC	0.52%	12.3%	0.44%	n/a
North of North Road SINC	0.10%	11.9%	0.073%	n/a
Cadoxton Ponds Wildlife Trust Reserve	0.20%	12.0%	0.19%	n/a
Severn Estuary Ramsar	0.068%	11.9%	0.082%	n/a
Severn Estuary SPA	0.078%	11.9%	0.057%	n/a
Ancient Woodland (Hayes Lane)	0.31%	12.1%	0.53%	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 H1 guidance).
(b) It is not possible to predict weekly concentrations using the dispersion model, therefore the annual mean concentrations have been compared with the CL.
(c) There is no current guidance available with regard to calculating a weekly mean background concentration from the annual mean.

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 Potentially significant long-term impacts (>1% of the critical level) occur at Nells Point East SINC and the ancient woodland at Hayes Lane, however the PECs (process + background) are less than 70% of the critical load, therefore the risk of an exceedence is considered to be *negligible*.

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

Eutrophication

5.44 Predicted maximum nutrient nitrogen deposition rates are compared with the critical load for eutrophication in Table 30.

Table 30: 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	0.74%	81.0%
Cadoxton Wetlands SINC	15	0.19%	80.5%
Fields at Merthyr Dyfan SINC	20	0.12%	60.3%
Friars Point SINC	20	0.17%	60.4%
Gladstone Road Pond SINC	n/a	n/a	n/a
Nells Point East SINC	20	0.32%	60.5%
North of North Road SINC	15	0.070%	80.3%
Cadoxton Ponds Wildlife Trust Reserve	15	0.19%	80.5%
Severn Estuary Ramsar	10	0.12%	104%
Severn Estuary SPA	10	0.082%	104%
Ancient Woodland (Hayes Lane)	10	1.5%	216%

5.45 With the exception of the ancient woodland at Hayes Lane, the maximum predicted nutrient nitrogen deposition rates are <1% of the lower critical load and are therefore of *negligible* significance.

Acidification

5.46 Predicted nitrogen and sulphur acidification rates are compared with the relevant critical loads and background acidification rates in Table 31.

Table 31: 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	0.19%	22.5%
Friars Point SINC	0.26%	22.6%
Nells Point East SINC	0.48%	22.8%
Ancient Woodland (Hayes Lane)	1.8%	60.3%

5.47 With the exception of the ancient woodland at Hayes Lane, maximum predicted acidification rates (PC) are less than 1% of the CLFs and therefore of *negligible* significance.

5.48 At the ancient woodland the process impacts are potentially significant, however the total predicted acidification rates (including the background) are less than 70% of the CLF, therefore the risk of an exceedence is considered to be *negligible*.

6 CONCLUSIONS

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

6.2 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.

6.3 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 H1 guidance.

6.4 The predicted process contributions are also negligible compared with the critical levels and critical loads for nutrient nitrogen deposition and acidification at nearby statutory sensitive habitat sites. However, a potentially significant impact occurs at ancient woodland adjacent at Hayes Lane.

6.5 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
	1-hour	200	UK AQO, 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, 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, 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	AQO
	1-hour	30,000	EAL, H1
Particulate Matter (as PM_{10})	annual	40	AQO
	24-hour	50	UK AQO, 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	EU Limit Value
Benzene (C_8)	annual	5	AQO (England and Wales)
Hydrogen Chloride (HCl)	1-hour	750	EPAQS Guideline Value
Hydrogen Fluoride (HF)	1-hour	160	EPAQS Guideline Values
	annual	16	
Antimony (Sb)	annual	5	EAL derived from long-term occupational exposure limits
	1-hour	150	EAL derived from long-term occupational exposure limits as no short-term limit exists
Arsenic (As)	annual	0.003	EPAQS Guideline Value
Cadmium (Cd)	annual	0.005	WHO Guideline Value
Chromium III (CrIII)	annual	5	EAL derived from long-term occupational exposure limits
	1-hour	150	EAL derived from long-term occupational exposure limits as no short-term limit

			exists
Chromium VI (CrVI)	annual	0.0002	EPAQS Guideline Value
	1-hour	3	EAL derived from long-term occupational exposure limits
Cobalt (Co)	annual	1	EAL derived from long-term occupational exposure limits
	1-hour	30	EAL derived from long-term occupational exposure limits as no short-term limit exists
Copper (Cu)	Annual	10	Copper as dusts and mists. EAL derived from long-term occupational exposure limits
	1-hour	200	EAL derived from short-term occupational exposure limits
Manganese (Mn)	annual	0.15	WHO Guideline Value
	1-hour	150	EAL derived from long-term occupational exposure limits as no short-term limit exists
Lead (Pb)	annual	0.25	UK AQO
Mercury (Hg)	annual	0.25	EAL derived from long-term occupational exposure limits
	1-hour	7.5	EAL derived from long-term occupational exposure limits as no short-term limit exists
Nickel (Ni)	annual	0.02	EPAQS Guideline Value
Thallium (Tl)	annual	1	EAL derived from long-term occupational exposure limits
	1-hour	30	EAL derived from long-term occupational exposure limits as no short-term limit exists
Vanadium (V)	annual	5	EAL derived from long-term occupational exposure limits
	24-hour	1	WHO Guideline Value
Polycyclic Aromatic Hydrocarbons (PAH) as Benzo(a)Pyrene	annual	0.00025	UK AQO
	annual	0.001	EU Limit Value
Polychlorinated Biphenyls (PCBs)	annual	0.2	EAL derived from long-term occupational exposure limits
	1-hour	6	EAL derived from long-term occupational exposure limits as no short-term limit exists

APPENDIX C – BOILER EMISSION PARAMETERS

Table C1: Emission Parameters

Source ID	**ATT Stack**	
Stack Height (m)	43.0	
Stack diameter (m)	1.23	
Temperature of release (K)	411	
Actual flow rate (Am^3/s)	35.2 (a)	
Emission velocity at stack exit (m/s)	29.6	
Normalised flow rate (Nm^3/s)	22.5 (b)	
Emission Concentration (mg/Nm^3)	**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 B[a]P)	0.001	
PCBs	0.005	
Emission Rate (g/s)	**Long-Term**	**Short-Term**
PM_{10}	0.22	0.67
TOC	0.22	0.45
HCl	0.22	1.3
HF	0.02	0.090
CO	1.1	2.2
SO_2	1.1	4.5
NOx	4.5	9.0
Group I (Cd, Tl)	0.0011	
Group II (Hg)	0.011	
Group III (Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V)	2.2×10^{-9}	
Dioxins and Furans	2.2×10^{-5}	
PAHs (as B[a]P)	1.1×10^{-4}	
PCBs	2.9×10^{-6}	
(a) Actual flow rate at 411 K and 9.7% O_2, 101.3 kPa, 15% H_2O (b) Reference conditions: 273 K and 11% O_2, 101.3 kPa, dry gas		

APPENDIX D – WIND ROSES

Figure D1: 2009

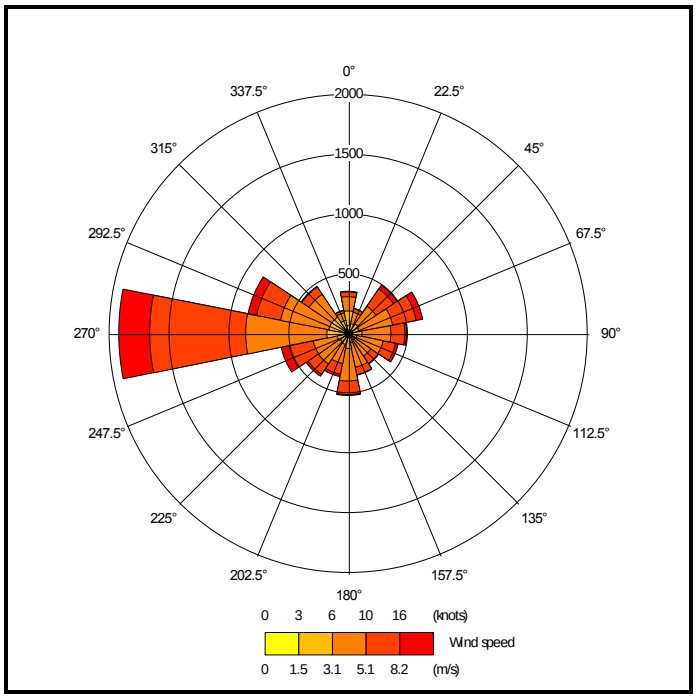


Figure D2: 2010

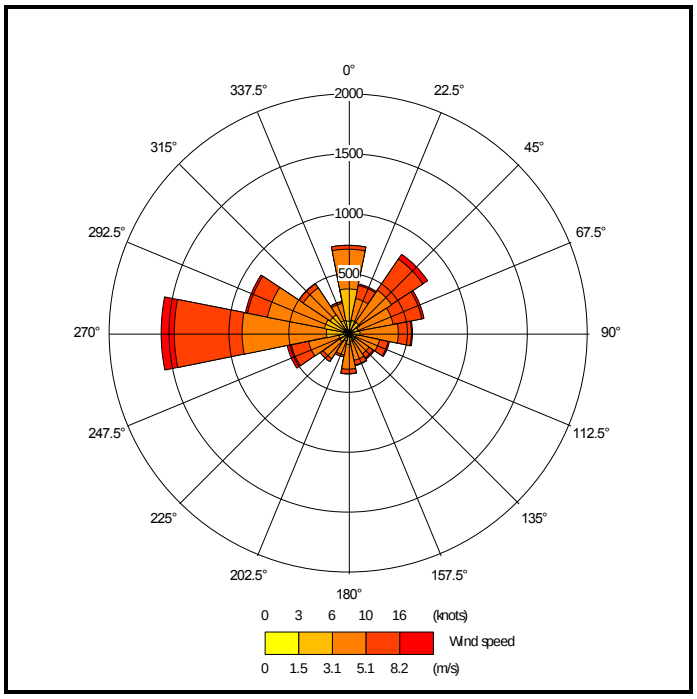


Figure D3: 2011

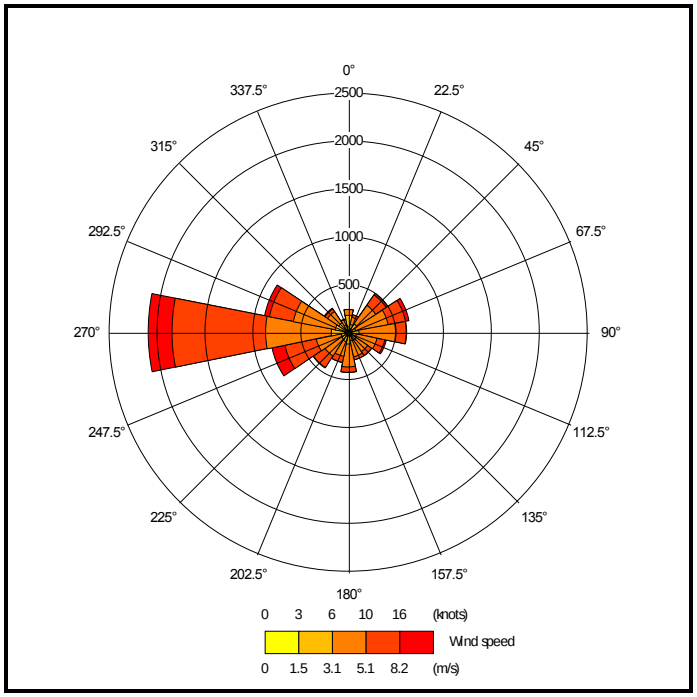


Figure D4: 2012

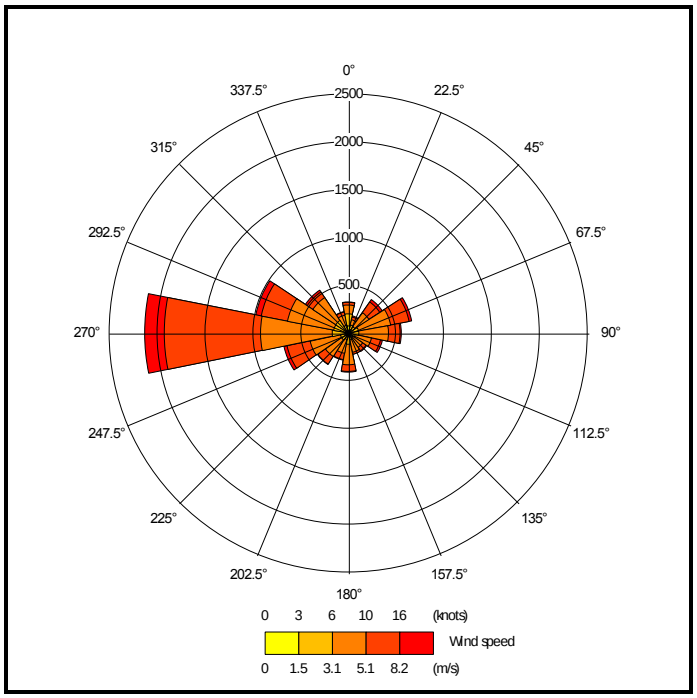
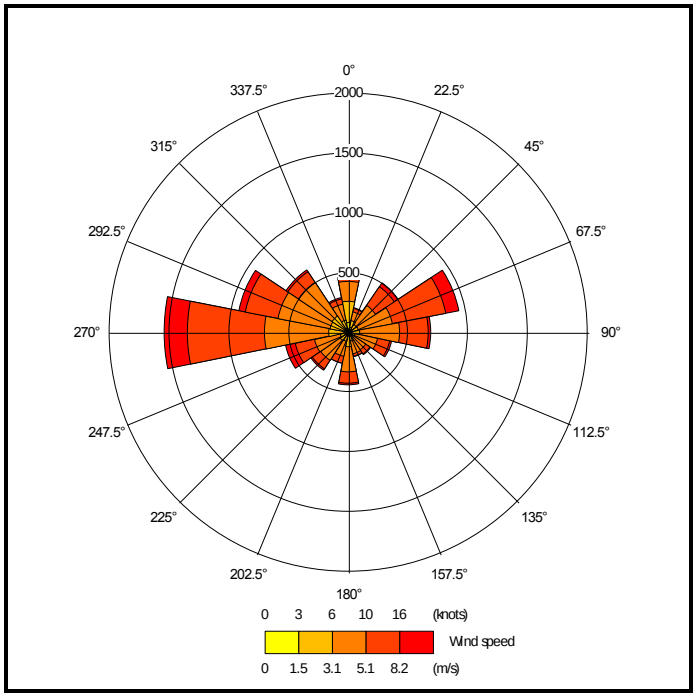


Figure D5: 2013



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

The critical levels are based on monitoring criteria and only apply in the following areas:

- more than 20 km from agglomerations; and
- more than 5 km away from other built up areas, industrial installations motorways and major roads with a traffic count of more than 50,000 vehicles per day.

Nationally, around 37% of designated sites currently do not fall within the above criteria and are therefore excluded from the objectives. None of the habitat sites within 10 km of the proposed development are sufficiently rural for the objectives to apply; however, the Environment Agency's H1 guidance states that

"the critical levels should be applied at all locations as a matter of policy, as they represent a standard against which to judge ecological harm".

Background NOx and SO_2 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 and SO_2 Concentrations (µg/m^3)

Habitat Site	NOx	SO_2
Cadoxton River SINC	14.4	2.2
Cadoxton Wetlands SINC	14.4	2.2
Fields at Merthyr Dyfan SINC	14.4	2.2
Friars Point SINC	14.4	2.2
Gladstone Road Pond SINC	14.4	2.2
Nells Point East SINC	14.4	2.2
North of North Road SINC	14.4	2.2
Cadoxton Ponds Wildlife Trust Reserve	14.4	2.2
Severn Estuary Ramsar	11.9	1.9
Severn Estuary SPA	11.9	1.9
Ancient Woodland (Hayes Lane)	14.4	2.2

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	Improved grassland	10	10.4
Severn Estuary SPA	Improved grassland	10	10.4
Ancient Woodland (Hayes Lane)	Broadleaved Woodland	10	21.4

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	0.74	0.14	0.053	n/a
Severn Estuary SPA	n/a	n/a	n/a	0.74	0.14	0.053	n/a
Ancient Woodland (Hayes Lane)	2.8	0.36	3.1	1.5	0.17	0.13	58.5%
(a) Based on 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.