Air Quality Assessment

Uskmouth Power Station

Newport

For Simec Uskmouth Power Limited

www.rpsgroup.com

Quality Management

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1 Introduction

1.1 This report details the air quality assessment undertaken for Uskmouth Power Station, Newport for the Application to vary the existing Environmental Permit from the current coal-firing to be fuelled post conversion by a waste-derived fuel pellet product.

1.2 This air quality assessment covers the operational phase of the proposed converted plant, focusing on the impacts of emissions from the proposed plant on the local area.

1.3 This report begins by setting out the policy and legislative context for the assessment. The methods and criteria used to assess potential air quality effects have then been described. The baseline air quality conditions have been established taking into account Defra estimates, local authority documents and the results of any local monitoring. The results of the assessment of air quality impacts have been presented. A conclusion has been drawn on the significance of the residual operational-phase effects.

2 Policy and Legislative Context

Emission Limits

Industrial Emissions Directive Limits

2.1 The plant would be designed and operated in accordance with the requirements of the Industrial Emissions Directive (2010/75/EU) [1], known hereafter as the IED, which requires adherence to emission limits for a range of pollutants. The emission concentrations used in this assessment are lower than the IED emission limits as shown in Table 3.2.

Environmental Permitting Regulations

2.2 EU Directive 96/61/EC concerning Integrated Pollution Prevention and Control ("the IPPC Directive") [2] applies an integrated environmental approach to the regulation of certain industrial activities. The Environmental Permitting Regulations (EPR) 2016 [3] implement the IPPC Directive relating to installations in England and Wales. The Regulations define activities that require an Environmental Permit from Natural Resources Wales (NRW).

2.3 EPR is a regulatory system that employs an integrated approach to control the environmental impacts of certain listed industrial activities including the generation of energy from waste-derived fuel. The intention of the regulatory system is to ensure that Best Available Techniques (BAT), required by the IPPC Directive, are used to prevent or minimise the effects of an activity on the environment, having regard to the effects of emissions to air, land and water via a single permitting process.

2.4 To gain a permit, Operators have to demonstrate in their applications, in a systematic way, that the techniques they are using or are proposing to use are the BAT for their installation and meet certain other requirements taking account of relevant local factors. The permitting process also places a duty on the regulating body to ensure that the requirements of the IED are included for permitted sites to which these apply.

2.5 The essence of BAT is that the techniques selected to protect the environment should achieve a high degree of protection of people and the environment taken as a whole. Indicative BAT standards are laid out in national guidance and where relevant, should be applied unless a different standard can be justified for a particular installation. NRW is legally obliged to go beyond BAT requirements where EU Air Quality Limit Values may be exceeded by an existing operator.

2.6 Natural Resources Wales uses the Environment Agency's on-line guidance entitled 'Environmental management – guidance, Air emissions risk assessment for your environmental permit' [4] which provides guidelines for air dispersion modelling. The assessment of air quality effects for the proposed conversion is consistent with this guidance.

Waste Framework Directive

2.7 Directive 2008/98/EC [5] of the European Parliament and Council on Waste requires member states to ensure that waste is recovered or disposed of without harm to human health and the environment. It requires member states to impose certain obligations on all those dealing with waste at various stages. Operators of waste disposal and recovery facilities are required to obtain a permit, or register a permit exemption. Retention of the permit requires periodic inspections and documented evidence of the activities in respect of waste.

2.8 The Waste Framework Directive (WFD) requires member states to take appropriate measures to establish an integrated and adequate network of disposal installations. The WFD also promotes environmental protection by optimising the use of resources, promoting the recovery of waste over its disposal (the "waste hierarchy").

2.9 Annex I and II of the WFD provide lists of the operations which are deemed to be "disposal" and "recovery", respectively. The terms are mutually exclusive and an operation cannot be a disposal and recovery operation simultaneously. Where the operation is deemed to be a disposal operation, the permit will contain more extensive conditions than for a recovery operation.

2.10 The principal objective of a recovery operation is to ensure that the waste serves a useful purpose, replacing other substances which would have been used for that purpose. Where the combustion of waste is used to provide a source of energy, the operation is deemed to be a recovery operation.

2.11 The EPR 2016 implements the WFD in the UK. As such, Natural Resources Wales is responsible for implementing the obligations set out in the WFD.

Ambient Air Quality Legislation and National Policy

Ambient Air Quality Criteria

2.12 There are several European Union (EU) Air Quality Directives and UK Air Quality Regulations that will apply to the operation of the proposed SUP facility. These provide a series of statutory air quality limit values, target values and objectives for pollutants, emissions of which are regulated through the IED.

2.13 There are some pollutants regulated by the IED which do not have statutory air quality standards prescribed under current legislation. For these pollutants, a number of non-statutory air quality objectives and guidelines exist which have been applied within this assessment. The Environment Agency website provides further assessment criteria in its online guidance.

The Ambient Air Quality Directive and Air Quality Standards Regulations

2.14 The 2008 Ambient Air Quality Directive (2008/50/EC) [6] aims to protect human health and the environment by avoiding, reducing or preventing harmful concentrations of air pollutants; it sets legally binding concentration-based limit values, as well as target values. There are also information and alert thresholds for reporting purposes. These are to be achieved for the main air pollutants: particulate matter (PM_{10} and $PM_{2.5}$), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), ozone (O_3), carbon monoxide (CO), lead (Pb) and benzene. This Directive replaced most of the previous EU air quality legislation and in Wales was transposed into domestic law by the Air Quality Standards (Wales) Regulations 2010 [7], which in addition incorporates the 4th Air Quality Daughter Directive (2004/107/EC) that sets targets for ambient air concentrations of certain toxic heavy metals (arsenic, cadmium and nickel) and polycyclic aromatic hydrocarbons (PAHs). Member states must comply with the limit values (which are legally binding on the Secretary of State) and the Government and devolved administrations operate various national ambient air quality monitoring networks to measure compliance and develop plans to meet the limit values. The statutory air quality limit values are listed in Table 2.1.

Table 2.1 Summary of Relevant Statutory Air Quality Limit Values and Air Quality Objectives

Pollutant	Averaging Period	Objectives/ Limit Values	Not to be Exceeded More Than	Target Date
Nitrogen Dioxide (NO_2)	1 hour	200 $\mu g.m^{-3}$	18 times per calendar year	-
	Annual	40 $\mu g.m^{-3}$	-	-
Particulate Matter (PM_{10})	24 Hour	50 $\mu g.m^{-3}$	35 times per calendar year	-
	Annual	40 $\mu g.m^{-3}$	-	-
Particulate Matter ($PM_{2.5}$)	Annual	25 $\mu g.m^{-3}$	-	01.01.2020 (a)
				01.01.2015 (b)
Carbon Monoxide	Maximum daily running 8 hour mean	10,000 $\mu g.m^{-3}$	-	-
Sulphur Dioxide (SO_2)	15 minute	266 $\mu g.m^{-3}$	> 35 times per calendar year	-
	1 hour	350 $\mu g.m^{-3}$	> 24 times per calendar year	-
	24 hour	125 $\mu g.m^{-3}$	> 3 times per calendar year	-

Pollutant	Averaging Period	Objectives/ Limit Values	Not to be Exceeded More Than	Target Date
Lead	Annual	0.25 µg.m^{-3}	-	-
Arsenic (As)	Annual (b)	0.006 µg.m^{-3}	-	-
Cadmium (Cd)	Annual (b)	0.005 µg.m^{-3}	-	-
Nickel (Ni)	Annual (b)	0.02 µg.m^{-3}	-	-

(a) Target date set in UK Air Quality Strategy 2007
(b) Target date set in Air Quality Standards Regulations 2010

2.15 On 14 January 2019, Defra published the *'Clean Air Strategy 2019'.* The report sets out actions that the Government intends to take to reduce emissions from transport, in the home, from farming and from industry.

Non-Statutory Air Quality Objectives and Guidelines

2.16 The Environment Act 1995 established the requirement for the Government and the devolved administrations to produce a National Air Quality Strategy (AQS) for improving ambient air quality, the first being published in 1997 and having been revised several times since, with the latest published in 2007 [8]. The Strategy sets UK air quality standards and objectives for the pollutants in the Air Quality Standards Regulations plus 1,3-butadiene and recognises that action at national, regional and local level may be needed, depending on the scale and nature of the air quality problem.

2.17 Non-statutory air quality objectives and guidelines also exist within the World Health Organisation Guidelines [9] and the Expert Panel on Air Quality Standards Guidelines (EPAQS) [10]. The non-statutory objectives and guidelines are presented in Table 2.2.

Table 2.2 Non-Statutory Air Quality Objectives and Guidelines

Pollutant	Averaging Period	Guideline	Target Date
Particulate Matter ($PM_{2.5}$)	Annual	Target of 15% reduction in concentrations at urban background locations	Between 2010 and 2020 (a)
	Annual	25 µg.m^{-3}	2020 (a)
PAHs (as B[a]P equivalent)	Annual (a)	0.00025 µg.m^{-3}	-
Sulphur Dioxide (SO_2)	Annual (b)	50 µg.m^{-3}	-
Hydrogen Chloride	1 hour (c)	750 µg.m^{-3}	-
Hydrogen Fluoride	1 hour (c)	160 µg.m^{-3}	-

Notes:
(a) Target date set in UK Air Quality Strategy 2007
(b) World Health Organisation Guidelines
(c) EPAQS recommended guideline values

Environmental Assessment Levels

2.18 Natural Resources Wales uses the Environment Agency's on-line guidance entitled '*Environmental management – guidance, Air emissions risk assessment for your environmental permit'* [4] provides further assessment criteria in the form of Environmental Assessment Levels (EALs).

2.19 Table 2.3 presents all available EALs for the pollutants relevant to this assessment.

Table 2.3 Environmental Assessment Levels (EALs)

Pollutant	Long-Term EAL (µg.m^{-3})	Short-Term EAL (µg.m^{-3})
Nitrogen Dioxide (NO_2)	40	200
Carbon Monoxide (CO)	-	10,000
Sulphur Dioxide (SO_2)	50	266
Particulates (PM_{10})	40	50
Particulates ($PM_{2.5}$)	25	-
Hydrogen chloride (HCl)	-	750
Hydrogen fluoride (HF)	16 (monthly average)	160
Arsenic (As)	0.003	-
Antimony (Sb)	5	150
Cadmium (Cd)	0.005	-
Chromium (Cr)	5	150
Chromium VI ((oxidation state in the PM_{10} fraction)	0.0002	-
Cobalt (Co)	0.2 (a)	6 (a)
Copper (Cu)	10	200
Lead (Pb)	0.25	-
Manganese (Mn)	0.15	1500
Mercury (Hg)	0.25	7.5
Nickel (Ni)	0.02	-
Thallium (Tl)	1 (a)	30 (a)
Vanadium (V)	5	1
PAHs (as B[a]P equivalent)	0.00025	-
PCBs	0.2	-

Notes: (a) EALs have been obtained from the EA's earlier Horizontal Guidance Note EPR H1 guidance note as no levels are provided in the current guidance.

2.20 Within the assessment, the statutory air quality limit and target values are assumed to take precedence over objectives, guidelines and the EALs, where appropriate. In addition, for those pollutants which do not have any statutory air quality standards, the assessment assumes the lower of either the EAL or the non-statutory air quality objective or guideline where they exist.

2.21 The EALs used in this assessment are summarised in Table 2.4.

Table 2.4 Environmental Assessment Levels (EALs) Used in this Assessment

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)
PM_{10}	24 hour (90.41st percentile)	50
	24 hour (annual mean)	40
$PM_{2.5}$	24 hour (annual mean)	25
HCl	1 hour (maximum)	750
HF	1 hour (maximum)	160
SO_2	15 minute (99.90th percentile)	266
	1 hour (99.73th percentile)	350
	24 hour (99.18th percentile)	125
	1 hour (annual mean)	50
NO_2	1 hour (99.79th percentile)	200
	1 hour (annual mean)	40
CO	8 hour (maximum daily running)	10,000
Cd	1 hour (annual mean)	0.005
Tl	1 hour (maximum)	30
	1 hour (annual mean)	1
Hg	1 hour (maximum)	7.5
	1 hour (annual mean)	0.25
Sb	1 hour (maximum)	150
	1 hour (annual mean)	5
As	1 hour (annual mean)	0.003

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)
Cr	1 hour (maximum)	150
	1 hour (annual mean)	5
Co	1 hour (maximum)	6
	1 hour (annual mean)	0.2
Cu	1 hour (maximum)	200
	1 hour (annual mean)	10
Pb	1 hour (annual mean)	0.25
Mn	1 hour (maximum)	1500
	1 hour (annual mean)	0.15
Ni	1 hour (annual mean)	0.02
V	1 hour (maximum)	5
	1 hour (annual mean)	1
Dioxins & Furans	1 hour (annual mean)	-
PAHs	1 hour (annual mean)	0.00025
PCB	1 hour (annual mean)	0.2

3 Assessment Methodology

3.1 This air quality assessment includes the key elements listed below:

- Establishing the background Ambient Concentration (AC) from consideration of Air Quality Review & Assessment findings and assessment of existing local air quality through a review of available air quality monitoring and Defra background map data in the vicinity of the proposed site.
- Quantitative assessment of the operational effects on local air quality from stack emissions utilising a "new generation" Gaussian dispersion model, ADMS 5. Assessment of Process Contributions (PC) from the facility in isolation, and assessment of resultant Predicted Environmental Concentrations (PEC), taking into account cumulative impacts through incorporation of the AC.

3.2 Air quality guidance advises that the organisation engaged in assessing the overall risks should hold relevant qualifications and/or extensive experience in undertaking air quality assessments. The RPS air quality team members involved at various stages of this assessment have professional affiliations that include Fellow and Member of the Institute of Air Quality Management, Chartered Chemist, Chartered Scientist, Chartered Environmentalist and Member of the Royal Society of Chemistry and have the required academic qualifications for these professional bodies. In addition, the Director responsible for authorising all deliverables has over 15 years' experience.

3.3 The EAs *Guidance for Developments Requiring Planning Permission and Environmental Permits* states *"New development within 250m of an existing incinerator[[1]] might, in some cases, mean people are exposed to odour, dust or noise emissions".* As the nearest sensitive receptors (that are not part of the Power Station itself) are more than 250 m from the site, an assessment of dust and odour has been scoped out.

Operational Phase - Methodology

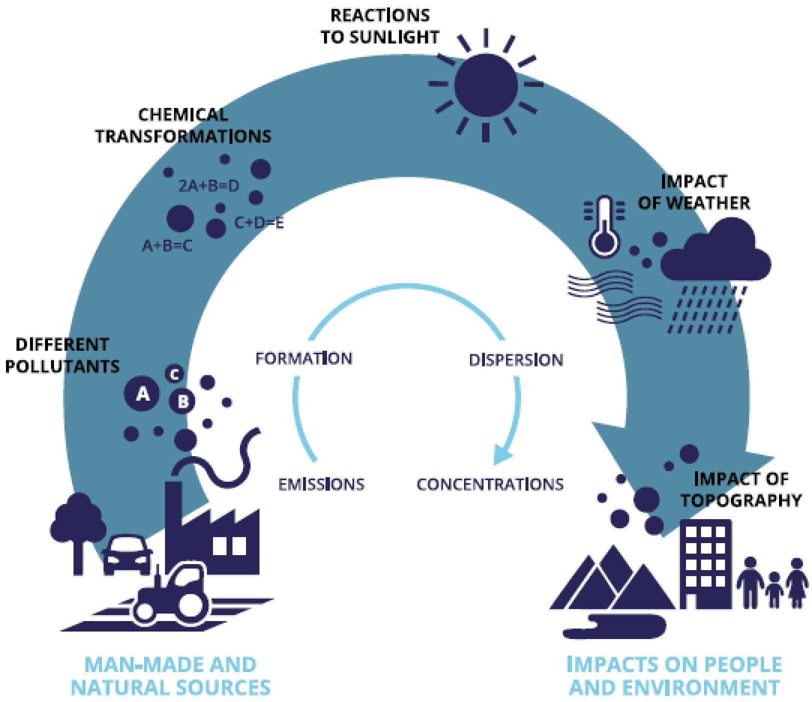
Atmospheric Dispersion Modelling of Pollutant Concentrations

3.4 In urban areas, pollutant concentrations are primarily determined by the balance between pollutant emissions that increase concentrations, and the ability of the atmosphere to reduce and remove pollutants by dispersion, advection, reaction and deposition. An atmospheric dispersion model is used as a practical way to simulate these complex processes; such a model requires a range of input data, which can include emissions rates, meteorological data and local

[1] Whilst the facility is not an incinerator, the 250 m buffer is still relevant as waste is used as a fuel.

topographical information. The model used and the input data relevant to this assessment are described in the following sub-sections.

Figure 3.1 Air Pollution: From Emissions to Exposure



Source: European Environment Agency (2016) Explaining Road Transport Emissions: A Non-technical Guide

3.5 The atmospheric pollutant concentrations in an urban area depend not only on local sources at a street scale, but also on the background pollutant level made up of the local urban-wide background, together with regional pollution and pollution from more remote sources brought in on the incoming air mass. This background contribution needs to be added to the fraction from the modelled sources, and is usually obtained from measurements or estimates of urban background concentrations for the area in locations that are not directly affected by local emissions sources. Where required, background pollution levels are described in detail in Appendix A.

Dispersion Model Selection

3.6 A number of commercially available dispersion models are able to predict ground level concentrations arising from emissions to atmosphere from elevated point sources. Modelling for this study has been undertaken using ADMS 5, a version of the ADMS (Atmospheric Dispersion Modelling System) developed by Cambridge Environmental Research Consultants (CERC) that models a wide range of buoyant and passive releases to atmosphere either individually or in combination. The model calculates the mean concentration over flat terrain and also allows for the effect of plume rise, complex terrain, buildings and deposition. Dispersion models predict atmospheric concentrations within a set level of confidence and there can be variations in results between models under certain conditions; the ADMS 5 model has been formally validated and is widely used in the UK and internationally for regulatory purposes.

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

- An up-to-date dispersion model in which the boundary layer structure is characterised by the height of the boundary layer and the Monin-Obukhov length, a length scale dependent on the friction velocity and the heat flux at the surface. This approach allows the vertical structure of the boundary layer, and hence concentrations, to be calculated more accurately than does the use of Pasquill-Gifford stability categories, which were used in many previous models (e.g. ISCST3). The restriction implied by the Pasquill-Gifford approach that the dispersion parameters are independent of height is avoided. In ADMS the concentration distribution is Gaussian in stable and neutral conditions, but the vertical distribution is non-Gaussian in convective conditions, to take account of the skewed structure of the vertical component of turbulence;
- A number of complex modules including the effects of plume rise, complex terrain, coastlines, concentration fluctuations and buildings;
- A facility to calculate long-term averages of hourly mean concentration, dry and wet deposition fluxes and radioactivity, and percentiles of hourly mean concentrations, from either statistical meteorological data or hourly average data.

Model Input Data

Meteorological Data

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

- Wind direction determines the sector of the compass into which the plume is dispersed;
- Wind speed affects the distance that the plume travels over time and can affect plume dispersion by increasing the initial dilution of pollutants and inhibiting plume rise; and
- Atmospheric stability is a measure of the turbulence of the air, and particularly of its vertical motion. It therefore affects the spread of the plume as it travels away from the source. New generation dispersion models, including ADMS, use a parameter known as the Monin-Obukhov length that, together with the wind speed, describes the stability of the atmosphere.

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

3.10 The year of meteorological data that is used for a modelling assessment can have a significant effect on source contribution concentrations. Dispersion model simulations have been performed using five years of data from Rhoose between 2014 and 2018.

3.11 Wind roses have been produced for each of the years of meteorological data used in this assessment and are presented in Figure 1.

Stack Parameters and Emissions Rates used in the Model

3.12 Flue gases are emitted from an elevated stack to allow dispersion and dilution of the residual combustion emissions. The stack needs to be of sufficient height to ensure that pollutant concentrations are acceptable by the time they reach ground level. The stack also needs to be high enough to ensure that releases are not within the aerodynamic influence of nearby buildings, or else wake effects can quickly bring the undiluted plume down to the ground.

3.13 A stack height determination has been undertaken to establish the height at which there is minimal additional environmental benefit associated with the cost of further increasing the stack. The Environment Agency removed their detailed guidance, Horizontal Guidance Note EPR H1 [13], for undertaking risk assessments on 1 February 2016; however, the approach used here by RPS is consistent with that EA guidance which required the identification of "*an option that gives acceptable environmental performance but balances costs and benefits of implementing it*."

3.14 The stack height determination has focused on identifying the stack height required to overcome the wake effects of nearby buildings. This involved running a series of atmospheric dispersion modelling simulations to predict the ground-level concentrations with the stack at different heights: starting at 110 metres and extending up in 2 metre increments, until a height of 130 metres was reached. The results of the stack height determination are provided in Appendix B. The stack height determination indicated that the existing stack height of 122 m was appropriate.

3.15 Stack emissions characteristics modelled are provided in Table 3.1 and the mass emissions are provided in Table 3.2.

Table 3.1 Stack Characteristics

Parameter	Unit	Value
Stack height	m	122
Internal diameter	m	7.01
Efflux velocity	$m.s^{-1}$	9.9
Efflux temperature	^{o}C	72
Actual volumetric flow (9.7% H_2O, 72°C ,5.3% O_2)	$m^3.s^{-1}$	383

Parameter	Unit	Value
Normalised volumetric flow (Dry, 0°C, 6% O_2)	$m^3.s^{-1}$	286

Table 3.2 Mass Emissions of Released Pollutants

Pollutant	IED Emission Limit at 11% O_2 *(mg.Nm^{-3})	Emission Concentration Used in this Assessment at 11% O_2 (mg.Nm^{-3})	Emission Concentration Used in this Assessment at 6% O_2 (mg.Nm^{-3})	Mass Emission Rate (g.s^{-1})
PM	10	5	7.5	2.14
CO	50	50	75	21.44
SO_2	50	40	60	17.15
HCl	10	8	12	3.43
HF	1	1	1.5	0.43
NOx	200	150	225	64.32
Group 1 Metals Total (a)	0.05	0.02	0.03	8.58E-03
Group 2 Metals (b)	0.05	0.02	0.03	8.58E-03
Group 3 Metals Total (c)	0.5	0.3	0.3	8.58E-02
Dioxins and furans	0.0000001	6.00E-05	9.00E-05	2.57E-05

Notes:
(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)
*emission concentrations all at 0ºC, dry

3.16 Emission limits are provided for total particles. For the purposes of this assessment, all particles are assumed to be less than 10 µm in diameter (i.e. PM_{10}). Furthermore, all particles are also assumed to be less than 2.5 µm in diameter (i.e. $PM_{2.5}$). In reality, the PM_{10} and $PM_{2.5}$ concentrations will be a smaller proportion of the total particulate emissions and the $PM_{2.5}$ concentration will be a smaller proportion of the PM_{10} concentration. Therefore, this can be considered a conservative estimate of the likely particulate emissions in each size fraction.

3.17 Polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) are not specifically regulated under the IED. For the purposes of this assessment, the emission concentrations in Table 3.3 have been used for these pollutants to calculate the mass emission rates..

Table 3.3 Mass Emissions for non-IED-Regulated Pollutants

Pollutant	Emission Limit Used in this Assessment at 6% O_2 (mg.Nm^{-3})	Mass Emission Rate (g.s^{-1})
NH_3	23	6.57
PCBs	0.0001	3.43E-05
PAHs	0.0045	1.29E-03

Notes: All concentrations referenced to temperature 273 K, pressure 101.3 kPa, 6% oxygen, dry gas.
Emission concentrations for PAHs were obtained from the IPPC Reference Document on the Best Available Techniques for Waste Incineration (Final Draft December 2018, Figure 8.118). The maximum of the average PAHs emission concentrations reported was approximately triple the next highest averages and was considered an anomaly. The second, third and fourth highest averages are all approximately 0.003 mg.m^{-3} (at 11% O_2) and have been used in this assessment.

Terrain

3.18 The presence of elevated terrain can significantly affect (usually increase) ground level concentrations of pollutants emitted from elevated sources such as stacks, by reducing the distance between the plume centre line and ground level and by increasing turbulence and, hence, plume mixing. A complex terrain file has been used within the model.

Surface Roughness

3.19 The roughness of the terrain over which a plume passes can have a significant effect on dispersion by altering the velocity profile with height, and the degree of atmospheric turbulence. This is accounted for by a parameter called the surface roughness length.

3.20 A surface roughness length of 0.5 m has been used within the model to represent the average surface characteristics across the study area.

Building Wake Effects

3.21 The movement of air over and around buildings generates areas of flow circulation, which can lead to increased ground level concentrations in the building wakes. Where building heights are greater than about 30 - 40% of the stack height, downwash effects can be significant. The building dimensions are listed in Table 3.4 and shown in Figure 2.

Table 3.4 Dimensions of Buildings Included Within the Dispersion Model

Name	Building Centre (x, y)	Height (m)	Length (m)	Width (m)	Angle (Degrees)
Electrostatic Precipitators	332844, 183804	17.1	77.0	22.0	67
Bunker Bay	332837, 183818	34.2	80.0	10.4	67
Boiler House	332829, 183836	46.1	80.0	30.5	67
Tank Bay	332821, 183856	30.2	80.0	11.6	67
Turbine House part 1	332815, 183870	28.1	80.0	17.2	67

Name	Building Centre (x, y)	Height (m)	Length (m)	Width (m)	Angle (Degrees)
Turbine House part 2	332816, 183889	28.1	100.0	19.0	67
Turbine House part 3	332859, 183894	28.1	19.0	6.5	67
Transformer	332810, 183903	12.8	100.0	13.7	67
West Building	332781, 183826	12.8	15.0	70.0	67
East Building	332873, 183861	12.8	18.8	64.0	67

Receptors

3.22 The air quality assessment predicts the impacts at locations that could be sensitive to any changes. Such sensitive receptors should be selected where the public is regularly present and likely to be exposed over the averaging period of the objective. LAQM.TG16 [11] provides examples of exposure locations and these are summarised in Table 3.5.

Table 3.5: Example of Where Air Quality Objectives Apply

Averaging Period	Objectives should apply at:	Objectives should generally not apply at:
Annual-mean	All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes.	Building façades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the buildings façades), or any other location where public exposure is expected to be short-term.
Daily-mean	All locations where the annual-mean objective would apply, together with hotels. Gardens of residential properties.	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short-term.
Hourly-mean	All locations where the annual and 24 hour mean would apply. Kerbside sites (e.g. pavements of busy shopping streets). Those parts of car parks, bus stations and railway stations etc which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more. Any outdoor locations to which the public might reasonably be expected to spend 1-hour or longer.	Kerbside sites where the public would not be expected to have regular access.

3.23 The effects of the proposed conversion have been assessed at the façades of local existing receptors. All human receptors have been modelled at a height of 1.5 m, representative of typical head height. The locations of these discrete residential receptors are listed in Table 3.6 and illustrated in Figure 2. For the highlighted receptors the annual mean, daily mean and hourly mean objectives apply. For receptors that are not highlighted, only the daily and hourly mean objectives apply.

Table 3.6 Modelled Sensitive Receptors

ID	Description	Distance from Stack	x	y
1	Newport Uskmouth Sailing Club	0.4	332993	184167
2	RSPB Wetlands	0.6	333427	183478
3	Farm along West Nash Road-1	1.0	333880	183542
4	Farm along West Nash Road-2	1.1	333939	183714
5	Residential Property within Nash Village-1	1.4	334246	183695
6	Residential Property within Nash Village-2	1.7	334526	183762
7	Residential Property along Nash Road	1.9	334666	184508
8	Residential Property within Pye Corner Village	1.9	334296	185085
9	Lliswerry High School	2.7	334015	186235
10	Residential Property along Lysaght Avenue	2.7	332761	186503
11	Residential Property near A48 Usk Way - 1	2.8	331461	186208
12	Residential Property near A48 Usk Way - 2	3.4	330101	185735
13	The John Frost School	3.0	330046	184748
14	Residential Property near B4239	2.7	330124	183875
15	West Usk Lighthouse B&B	2.0	331115	182882
16	East Usk Lighthouse (popular walking area)	1.0	333034	182786
17	Commercial Receptor within Alexandra Docks (Closest)-1	0.9	332106	184339
18	Commercial Receptor within Alexandra Docks-2	1.6	331673	184849
19	Welsh Water Office	0.6	333464	183895
20	SUP: Façade of Main Office	0.2	332843	183925
21	SUP: Engineering Offices	0.2	332683	183760
22	SUP: Gatehouse	0.3	333176	183628
23	Severn Power Offices	0.4	332477	183731

3.24 Concentrations have also been modelled across a coarse 30 km by 30 km grid, with a spacing of 100 m, and a fine 4 km by 4 km grid, with a spacing of 10 m. Both grids are at a height of 1.5 m, centred on the proposed conversion.

3.25 There are a number of designated ecological sites within 15 km of the proposed conversion. The air quality impact on ecological receptors is assessed in Appendix C.

Significance Criteria

3.26 The on-line Environment Agency (EA) guidance entitled 'Environmental management – guidance, Air emissions risk assessment for your environmental permit' [4] has been used. This guidance provides details for screening out substances for detailed assessment. In particular, it states that:

"To *screen out a PC for any substance so that you don't need to do any further assessment of it, the PC must meet both of the following criteria:*

- *the short-term PC is less than 10% of the short-term environmental standard*
- *the long-term PC is less than 1% of the long-term environmental standard*

If you meet both of these criteria you don't need to do any further assessment of the substance. If you don't meet them you need to carry out a second stage of screening to determine the impact of the PEC."

3.27 It continues by stating that:

"You must do detailed modelling for any PECs not screened out as insignificant."

3.28 It then states that further action may be required where:

- *"your PCs could cause a PEC to exceed an environmental standard (unless the PC is very small compared to other contributions – if you think this is the case contact the Environment Agency)*
- *The PEC is already exceeding an environmental standard"*

3.29 On that basis, the results of the detailed modelling presented in this report have been used as follows:

- The effects are not considered significant if the short-term PC is less than 10% of the short-term Air Quality Assessment Level (AQAL) or the PEC is below the AQAL; and
- The effects are not considered significant if the long-term PC is less than 1% of the long-term AQAL or the PEC is below the AQAL.

3.30 The Air Quality Assessment Level refers to the AQS air quality objective and the EU limit value.

Uncertainty

3.31 All air quality assessment tools, whether models or monitoring measurements, have a degree of uncertainty associated with the results. The choices that the practitioner makes in setting-up the model, choosing the input data, and selecting the baseline monitoring data will decide whether the final predicted impact should be considered a central estimate, or an estimate tending towards the upper bounds of the uncertainty range (i.e. tending towards worst-case).

3.32 The atmospheric dispersion model itself contributes some of this uncertainty, due to it being a simplified version of the real situation: it uses a sophisticated set of mathematical equations to approximate the complex physical and chemical atmospheric processes taking place as a pollutant is released and as it travels to a receptor. The predictive ability of even the best model is limited by how well the turbulent nature of the atmosphere can be represented.

3.33 Each of the data inputs for the model, listed earlier, will also have some uncertainty associated with them. Where it has been necessary to make assumptions, these have mainly been made towards the upper end of the range informed by an analysis of relevant, available data.

3.34 The main components of uncertainty in the total predicted concentrations, made up of the background concentration and the modelled fraction, include those summarised in Table 3.7.

Table 3.7 Approaches to Dealing with Uncertainty used Within the Assessment

Concentration	Source of Uncertainty	Approach to Dealing with Uncertainty	Comments
Background Concentration	Characterisation of future baseline air quality (i.e. the air quality conditions in the future assuming that the development does not proceed)	The future background concentration used in the assessment is the same as the current background concentration and no reduction has been assumed. This is a conservative assumption as, in reality, background concentrations are likely to reduce over time as cleaner vehicle technologies form an increasing proportion of the fleet.	The background concentration is the major proportion of the total predicted concentration. The conservative assumptions adopted ensure that the background concentration used within the model contributes towards the results being towards the conservative end of the uncertainty range, rather than a central estimate.
Model Input/ Output Data	Meteorological Data	Uncertainties arise from any differences between the conditions at the met station and the development site, and between the historical met years and the future years. These have been minimised by using meteorological data collated at a representative measuring site. The model has been run for 5 full years of meteorological conditions.	
	Receptors	The model has been run for a grid of receptors. In addition, receptor locations have been identified where concentrations are highest or where the greatest changes are expected.	

3.35 The analysis of the component uncertainties indicates that, overall, the predicted total concentration is likely to be towards the conservative end of the uncertainty range rather than being a central estimate. The actual concentrations that will be found when the development is operational are unlikely to be higher than those presented within this report and are more likely to be lower.

4 Assessment of Operational-Phase Air Quality Impacts

4.1 Table 4.1 summarises the maximum predicted Process Contribution (PC) to ground-level concentrations across the grid. The PC has been compared with the relevant Environmental Assessment Level (EAL) to determine if the impacts are potentially significant. Where the PC is considered potentially significant, the Predicted Environmental Concentration (PEC) has been considered by adding the PC to the background Ambient Concentration (AC). Appendix A provides more detail on the ACs used.

4.2 The results at the selected sensitive receptors are shown in Appendix D. Abnormal Operations are considered in Appendix E.

4.3 In order to assess the human-health related impacts of abnormal operations, NOx concentrations need to be converted to nitrogen dioxide (NO_2). Total conversion (i.e. 100%) of NO to NO_2 is sometimes used for the estimation of the absolute upper limit of the annual mean NO_2. This technique is based on the assumption that all NO emitted is converted to NO_2 before it reaches ground level. However, in reality the conversion is an equilibrium reaction and even at ambient concentrations a proportion of NO_X remains in the form of NO.

4.4 Historically, the Environment Agency has recommended that for a 'worse case scenario', a 70% conversion of NO to NO_2 should be considered for calculation of annual average concentrations. Following the withdrawal of the Environment Agency's H1 guidance document, there is no longer an explicit recommendation; however, a 70% conversion of NO to NO_2 has been assumed for annual average NO_2 concentrations in line with the Environment Agency's historic recommendations and an assumed conversion of 35% follows the Environment Agency's recommendations [12] for the calculation of 'worse case scenario' short-term NO_2 concentrations.

Table 4.1 Predicted Maximum Process Contributions (µg.m^{-3}) – Results Across the Modelled Grid

Pollutant	Averaging Period	EAL (µg.m^{-3})	Max PC (µg.m^{-3})	Max PC as % of EAL	Criteria (%)	Is PC Potentially Significant ?	AC (µg.m^{-3})	PEC (µg.m^{-3})	PEC as % of EAL	Is PEC Potentially Significant ?
PM_{10}	24 hour (90.41st percentile)	50	0.3	1	10	No	-	-	-	-
	24 hour (annual mean)	40	0.1	0	1	No	-	-	-	-
$PM_{2.5}$	24 hour (annual mean)	25	0.2	1	1	No	-	-	-	-
HCl	1 hour (maximum)	750	2.9	0	10	No	-	-	-	-
HF	1 hour (maximum)	160	0.4	0	10	No	-	-	-	-
SO_2	15 minute (99.90th percentile)	266	12.3	5	10	No	-	-	-	-
	1 hour (99.73th percentile)	350	10.3	3	10	No	-	-	-	-
	24 hour (99.18th percentile)	125	4.2	3	10	No	-	-	-	-
	1 hour (annual mean)	50	0.6	1	1	No	-	-	-	-
NO_2	1 hour (99.79th percentile)	200	14.3	7	10	No	-	-	-	-
	1 hour (annual mean)	40	1.7	4	1	Yes	23.1	24.8	62	No
CO	8 hour (maximum daily running)	10,000	11.7	0	10	No	-	-	-	-
Cd	1 hour (annual mean)	0.005	0.0003	6	10	No	-	-	-	-
Tl	1 hour (maximum)	30	0.0072	0	10	No	-	-	-	-
	1 hour (annual mean)	1	0.0003	0	1	No	-	-	-	-
Hg	1 hour (maximum)	7.5	0.0072	0	10	No	-	-	-	-
	1 hour (annual mean)	0.25	0.0003	0	1	No	-	-	-	-
Sb	1 hour (maximum)	150	0.0719	0	10	No	-	-	-	-

Pollutant	Averaging Period	EAL (µg.m^{-3})	Max PC (µg.m^{-3})	Max PC as % of EAL	Criteria (%)	Is PC Potentially Significant ?	AC (µg.m^{-3})	PEC (µg.m^{-3})	PEC as % of EAL	Is PEC Potentially Significant ?
	1 hour (annual mean)	5	0.0032	0	1	No	-	-	-	-
As	1 hour (annual mean)	0.003	0.0032	106	1	Yes	0.00081	0.00400	133	Yes
Cr	1 hour (maximum)	150	0.0719	0	10	No	-	-	-	-
	1 hour (annual mean)	5	0.0032	0	1	No	-	-	-	-
Co	1 hour (maximum)	6	0.0719	1	10	No	-	-	-	-
	1 hour (annual mean)	0.2	0.0032	2	1	Yes	0.00028	0.00347	2	No
Cu	1 hour (maximum)	200	0.0719	0	10	No	-	-	-	-
	1 hour (annual mean)	10	0.0032	0	1	No	-	-	-	-
Pb	1 hour (annual mean)	0.25	0.0032	1	1	No	-	-	-	-
Mn	1 hour (maximum)	1500	0.0719	0	10	No	-	-	-	-
	1 hour (annual mean)	0.15	0.0032	2	1	Yes	0.04594	0.04913	33	No
Ni	1 hour (annual mean)	0.02	0.0032	16	1	Yes	0.00499	0.00818	41	No
V	1 hour (maximum)	5	0.0719	1	10	No	-	-	-	-
	1 hour (annual mean)	1	0.0032	0	1	No	-	-	-	-
Dioxins & Furans	1 hour (annual mean)	-	9.57E-07	-	1	-	-	-	-	-
PAHs	1 hour (annual mean)	0.00025	4.80E-05	19	1	Yes	2.00E-04	2.48E-04	99	No
PCB	1 hour (annual mean)	0.2	1.28E-06	0.0	1	No	-	-	-	-

Cells are shaded grey where impacts cannot be screened out as insignificant.

4.5 The results presented in Table 4.1 show that the predicted PC is below 10% of the relevant short-term EAL and below 1% of the long-term EAL or the PEC is below 100% for all pollutants with the exception of As (arsenic).

4.6 For Arsenic, the predicted PC is more than 1% of the EAL and the PEC is above the EAL. These predictions are based on the assumption that arsenic comprises the total of the group 3 metals emissions. The concentration used in this assessment applies to all nine of the group 3 metals in total. The Environment Agency's '*Releases from waste incinerators – Guidance on assessing group 3 metal stack emissions from incinerators'* version 4 (undated), provides a summary of 34 measured values for each metal recorded at 18 municipal waste and waste wood co-incinerators between 2007 and 2015. For arsenic, the measured concentration varies from 0.04% to 5% of the IED emission concentration limit.

4.7 Table 4.2 shows the predicted PC if the total emission concentration used in the assessment is assumed to apply equally to each of the nine group 3 metals. i.e. the PC for arsenic has been divided by 9. In this case, the predicted PC remains more than 1% above the EAL; however, the PEC for arsenic is below the EAL and the impacts are therefore not considered significant.

Table 4.2 Maximum Predicted Environmental Concentrations (µg.m^{-3}) – Arsenic

Pollutant	Averaging Period	EAL (µg.m^{-3})	Max PC (µg.m^{-3})	Max PC as % of EAL	Criteria (%)	Is PC Potentially Significant ?	AC (µg.m^{-3})	PEC (µg.m^{-3})	PEC as % of EAL	Is PEC Potentially Significant?
As	1 hour (annual mean)	0.003	0.0004	12	1	Yes	0.00081	0.00116	39	No

4.8 For hexavalent chromium (CrVI), the measured concentrations in the Environment Agency '*Releases from waste incinerators – Guidance on assessing group 3 metal stack emissions from incinerators*' version 4 (undated), varies from 0.0005% to 0.03% of the emission concentration used in the assessment. Table 4.3 shows the predicted PC at 0.03% of the IED emission concentration limit.

Table 4.3 Predicted Maximum Cr VI Process Contributions (µg.m^{-3}) at Average Operational Emission Rates

Pollutant	Averaging Period	EAL	Max PC (µg.m^{-3})	Max PC as % of EAL	Is PC Potentially Significant?
Cr VI	1 hour (annual-mean)	0.0002	9.57E-07	0	No

4.9 The PC does not exceed 1% of the EAL and the impacts are therefore screened out as being insignificant.

Significance of Effects

4.10 It is generally considered good practice that, where possible, an assessment should communicate effects both numerically and descriptively. Professional judgement by a competent, suitably qualified professional is required to establish the significance associated with the consequence of the impacts.

4.11 Based on the predicted concentrations, the effects are deemed to be not significant, with no predicted exceedances of any objectives or standards across the modelled grid.

Sensitivity and Uncertainty

4.12 Section 3 provided an analysis of the sources of uncertainty in the results of the assessment. The conclusion of that analysis was that, overall, the predicted total concentration is likely to be towards the top of the uncertainty range and, therefore, tending towards worst case, rather than being a central estimate. The actual concentrations that will be found when the development is operational are unlikely to be higher than those presented within this report and are more likely to be lower.

4.13 The impacts at existing receptors are shown to be not significant even for this conservative scenario. In practice, the impacts at sensitive receptors are likely to be lower than those reported in this conservative assessment.

5 Conclusions

5.1 This assessment has considered the air quality impacts during the operational phase of the Uskmouth Power Station development.

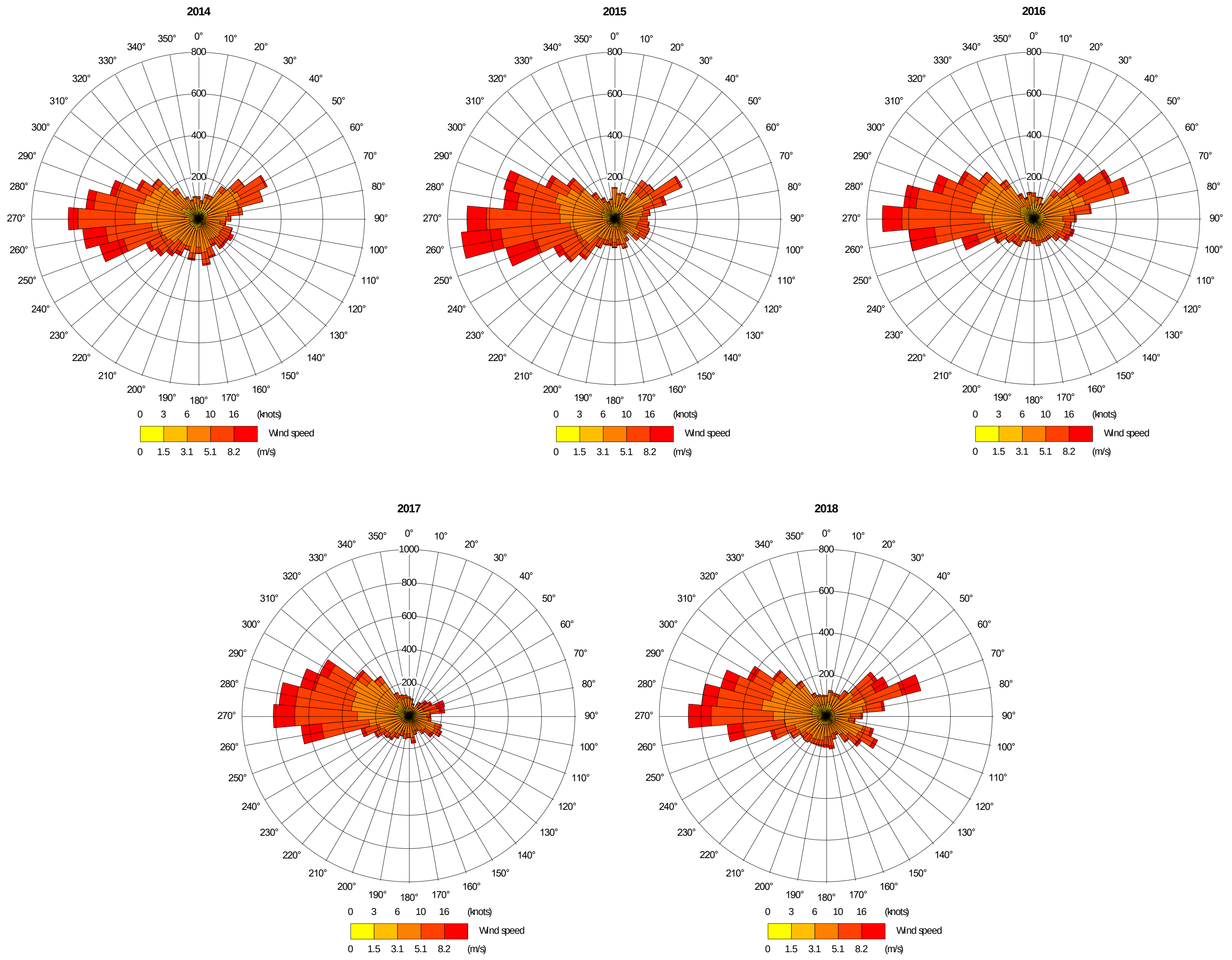
5.2 Emissions from the combustion plant has been assessed through detailed dispersion modelling using best practice approaches. The assessment has been undertaken based on a number of conservative assumptions. This is likely to result in an over-estimate of the contributions that will arise in practice from the facility. The operational impact on receptors in the local area is predicted to be 'negligible' taking into account the changes in pollutant concentrations and the absolute levels. Using the criteria adopted for the assessment, together with professional judgement, the effects are not considered significant.

5.3 Overall the effects of the proposed conversion are not considered to be significant.

Glossary

ADMS	Atmospheric Dispersion Modelling System
AQMA	Air Quality Management Area
AQS	Air Quality Strategy
Effect	The consequences of an impact, experienced by a receptor
EPUK	Environmental Protection UK
IAQM	Institute of Air Quality Management
Impact	The change in atmospheric pollutant concentration and/or dust deposition. A scheme can have an ‘impact’ on atmospheric pollutant concentration but no effect, for instance if there are no receptors to experience the impact
R&A	Review and Assessment
Receptor	A person, their land or property and ecologically sensitive sites that may be affected by air quality

Figures



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Job Ref: JAR10554	
Date: 08/10/19	Rev: 0
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Figure 1: Wind Roses – Rhoose, 2014 - 2018

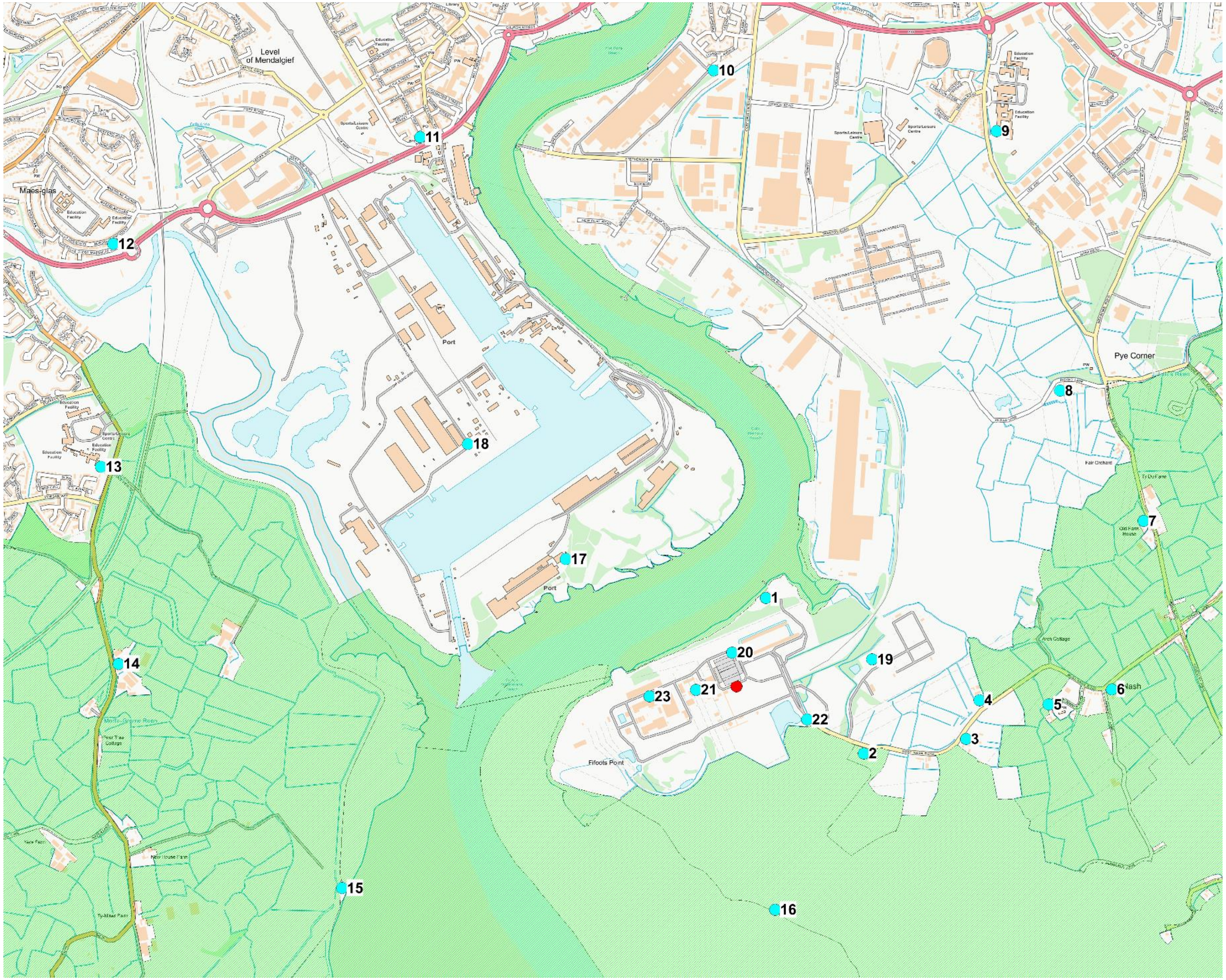

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Figure 2: Site Layout and Receptors

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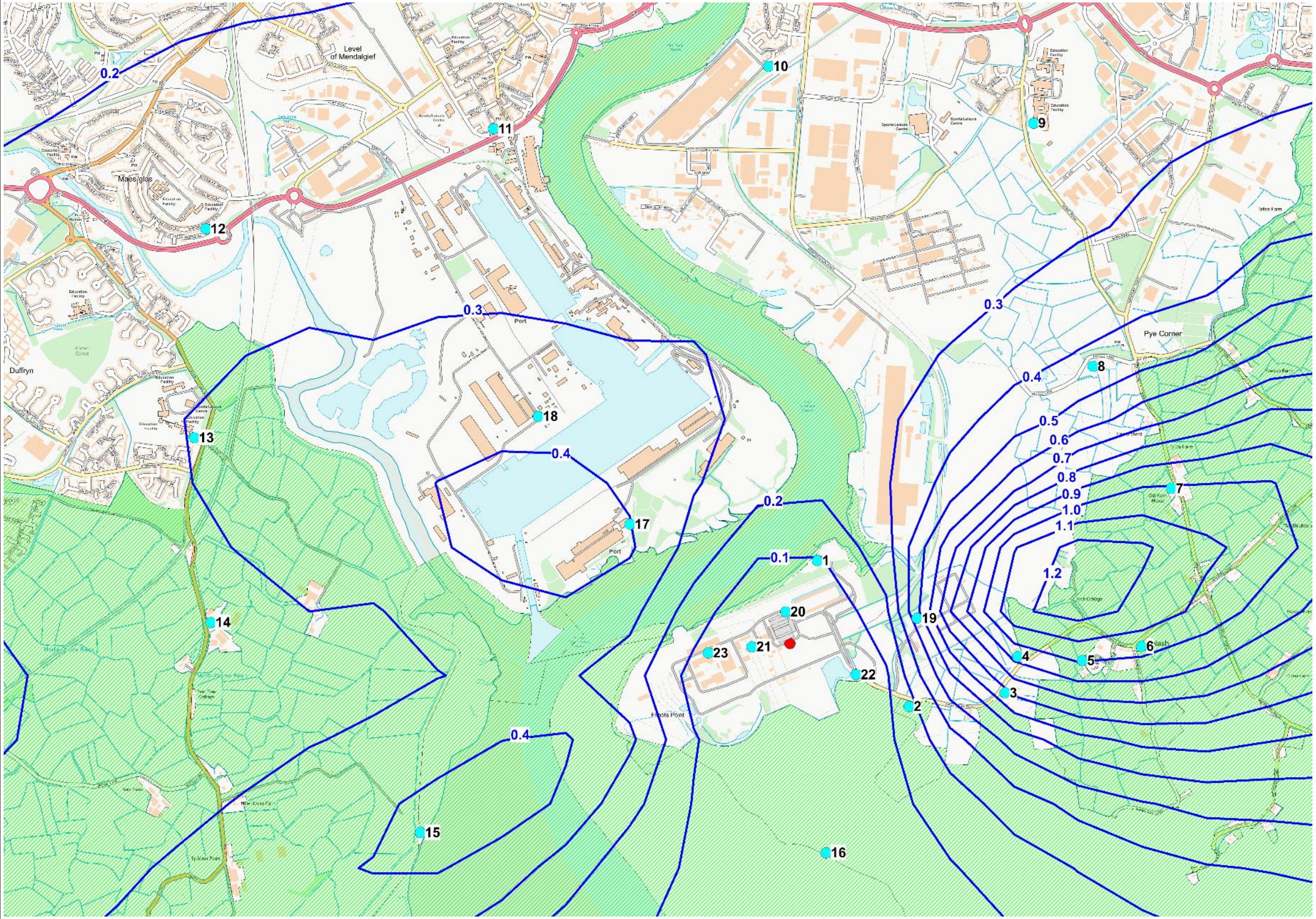

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Figure 3: Annual-Mean NO_2 Process Contributions ($\mu g.m^{-3}$)

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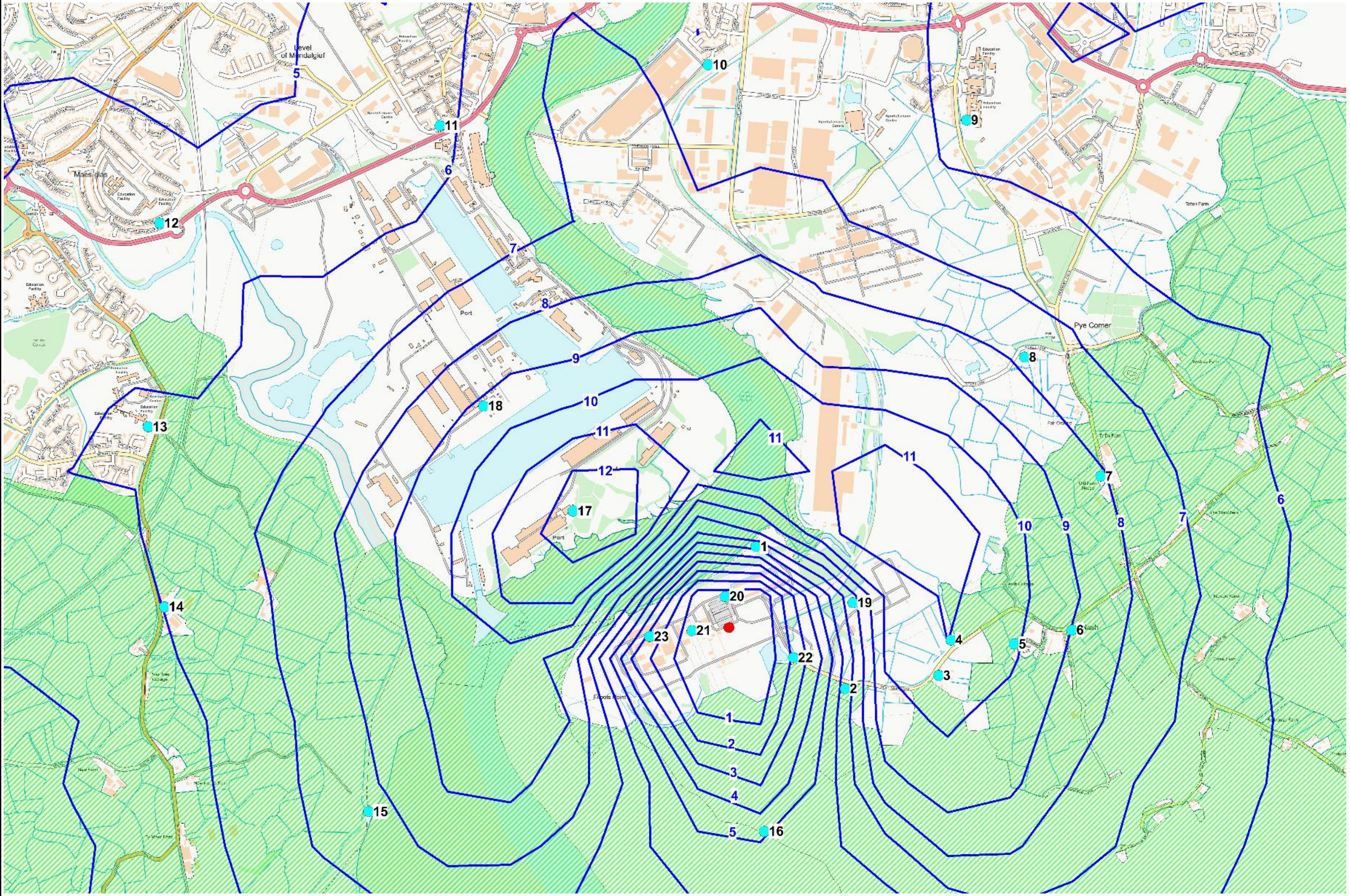

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Figure 4: Short-Term NO_2 Process Contributions ($\mu g.m^{-3}$)

Appendices

Appendix A: Baseline Conditions

Nitrogen Dioxide

Local Monitoring Data

A.1 There is one local monitoring station where urban background concentrations are measured using a continuous automatic instrument. NCC monitors NO_2 at the St Julian's urban background location. The most recently measured annual-mean concentrations are presented in in Table A.1.

Table A.1 Automatically Monitored Annual-Mean Background Concentration (µg.m^{-3})

Monitor	Approx. Distance from Application Site (km)	Pollutant	Concentration (µg.m^{-3})					
			2013	2014	2015	2016	2017	Average
St Julian's	5.9	NO_2	23.1	22.4	21.0	22.0	21.0	21.9

Defra Mapped Concentration Background Estimates

A.2 Defra's total annual-mean NO_2 concentration estimates have been collected for the 1 km grid squares of the monitoring site and the Application Site are summarised in Table A.2.

Table A.2 Defra Mapped Annual-Mean Background NO_2 Concentration Estimates (µg.m^{-3})

Site	Approx. Distance from Application Site (km)	Concentration (µg.m^{-3})	
		Range of Monitored	Estimated Defra Mapped (2017)
Application Site	-	-	9.9
St Julian's	5.9	21.0 - 23.1	22.7

A.3 For NO_2, the Defra mapped concentration estimate of 22.7 µg.m^{-3} at St Julian's is within the range of measured concentrations and above the average measured concentration of 21.9 µg.m^{-3}. This indicates that the Defra mapped concentration may be representative of the area. However, the Defra mapped concentration at the Application Site, 9.9 µg.m^{-3}, is well below the measured concentrations. To ensure the assessment is conservative, the background annual-mean NO_2 concentration has been derived from the highest concentration of 23.1 µg.m^{-3}, measured in 2013.

Heavy Metals

A.4 The Heavy Metals Network monitors the concentrations in air, and the deposition rates of a range of metallic elements at urban, industrial and rural sites.

A.5 The nearest monitoring site to the Application Site is the Port Talbot, Margam urban industrial site. Monitored concentrations up to 2018 are provided in Table A.3.

Table A.3 Measured Metals Concentrations (ng.m^{-3})

Metal	2013	2014	2015	2016	2017	2018	Maximum
As	0.61	0.66	0.66	0.72	0.74	0.81	0.81
Co	0.16	0.20	0.28	0.20	0.22	0.22	0.28
Mn	45.93	45.94	38.07	29.58	34.14	33.36	45.94
Ni	1.70	1.78	4.99	3.63	1.34	1.59	4.99

A.6 The maximum concentration of each heavy metal from the monitoring period has been used in this assessment.

Polycyclic Aromatic Hydrocarbons

A.7 The polycyclic aromatic hydrocarbon (PAH) network monitors ambient concentrations of PAHs at 31 sites in the UK. At the most sites, only solid PAHs are monitored; both gaseous and solid PAHs are only monitored at two locations.

A.8 The nearest sites monitoring solid PAHs are Newport St Julian's and Cardiff Lakeside. The nearest sites monitoring both gaseous and solid PAHs are Auchencorth Moss and Harwell.

A.9 Measurements at all five monitoring sites are compared in Table A.4.

Table A.4 Annual-mean PAHs Concentrations (ng.m^{-3})

Site Name	2014	2015	2016	2017	2018	Average
Newport St Julian's	0.2	0.19	0.25	0.19	0.16	0.20
Cardiff Lakeside	0.2	0.18	0.2	0.2	0.2	0.20
Auchencorth Moss (solid and vapour)	0.03	-	-	-	-	0.03
Harwell (solid and vapour)	0.04	-	-	-	-	0.04

A.10 Although only PAHs in the solid phase are measured at the two closest sites (Newport St Julian's and Cardiff Lakeside), the measurements are typically higher than the measurements at Harwell and Auchencorth Moss which include the gaseous phase. The average monitored concentration of 0.20 ng.m^{-3} at Newport St Julian's and Cardiff Lakeside has therefore been used within the assessment.

Appendix B: Stack Height Determination

Overview

B.1 A stack height determination has been undertaken to establish the height at which there is minimal additional environmental benefit associated with the cost of further increasing the height of the stack. The Environment Agency removed their detailed guidance, Horizontal Guidance Note EPR H1 [13], for undertaking risk assessments on 1 February 2016; however, the approach used here is consistent with that EA guidance which required the identification of "*an option that gives acceptable environmental performance but balances costs and benefits of implementing it*."

Methodology

B.2 Model simulations have been run using ADMS 5 to determine what stack height is required to provide adequate dispersion/dilution and to overcome local building wake effects.

B.3 The stack height determination considers ground level concentrations over the averaging periods relevant to the air quality assessment, together with the full range of all likely meteorological conditions through the use of five years (2014 to 2018) of hourly sequential meteorological data from Rhoose. A complex terrain file was also used within the model. The model was run for a range of stack heights between 110 m and 130 m, in 2 m increments.

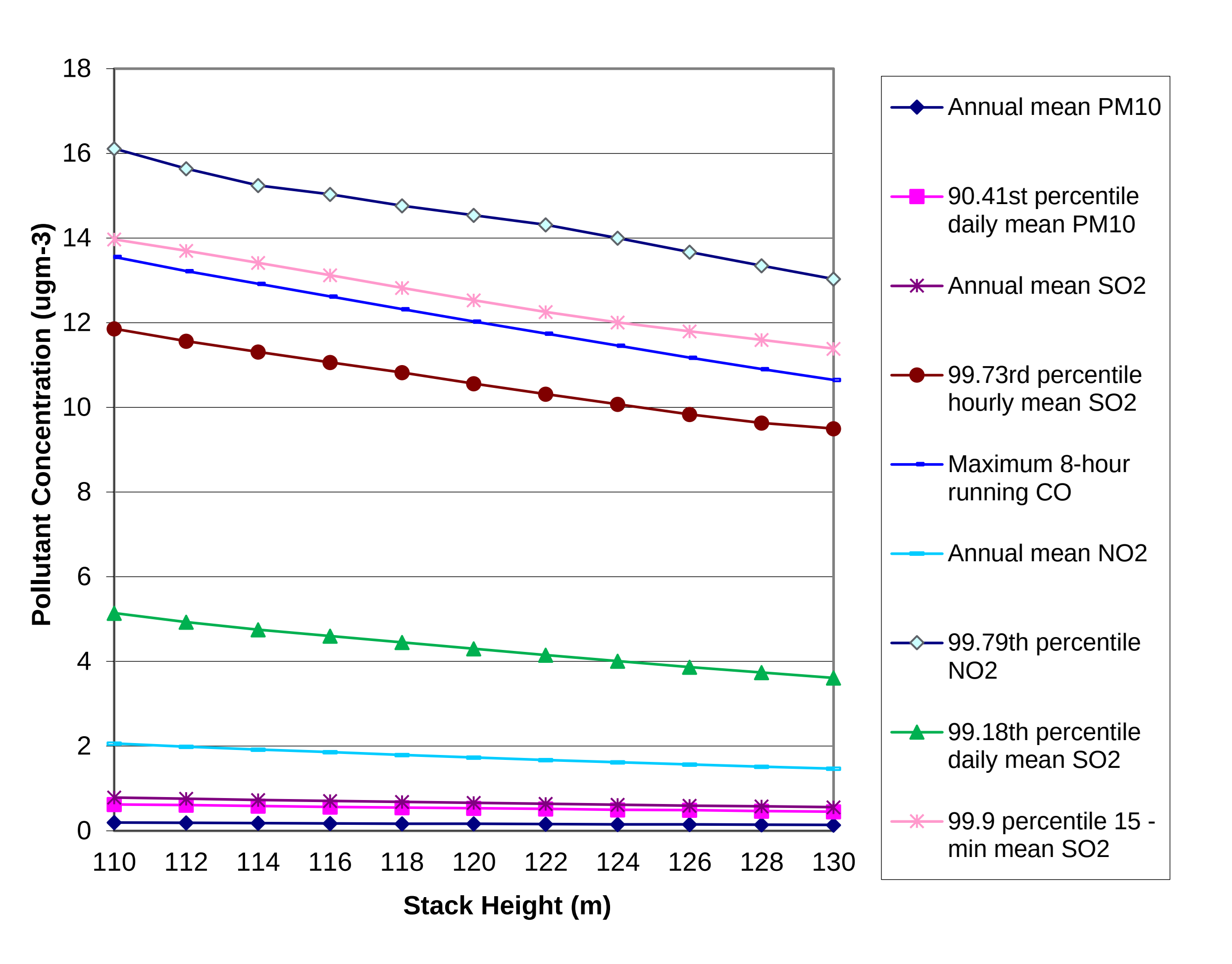
B.4 Concentrations have also been modelled across a coarse 20 km by 20 km grid, with a spacing of 100 m. Results have been reported for the location where the highest concentration is predicted and for the worst-case meteorological conditions.

Stack Height Determination Results

B.5 The stack height modelling results have been analysed in two stages as discussed below.

B.6 **Stage 1 -** The maximum predicted Process Contributions (PCs) have been plotted against height to determine if there is a height at which no benefit is gained from increases in stack heights.

Graph B.1 Maximum Predicted Process Contributions vs Stack Height



B.7 The graphs do not show the ground-level Process Contribution levelling off within the range of heights considered. The graphs indicate that the point at which there are no further potential benefits in increasing the stack height has not been reached by 130 m.

B.8 **Stage 2 –** The on-line EA guidance entitled '*Environmental management – guidance, Air emissions risk assessment for your environmental permit*' [14]] is for risk assessments and provides details for screening out substances for detailed assessment. In particular, it states that:

"To screen out a PC for any substance so that you don't need to do any further assessment of it, the PC must meet both of the following criteria:

- the short-term PC is less than 10% of the short-term environmental standard
- the long-term PC is less than 1% of the long-term environmental standard

If you meet both of these criteria you don't need to do any further assessment of the substance.

If you don't meet them you need to carry out a second stage of screening to determine the impact of the PEC."

The PEC refers to the Predicted Environmental Concentration calculated as the PC added to the Ambient Concentration (AC).

B.9 The on-line EA guidance continues by stating that:

"You must do detailed modelling for any PECs not screened out as insignificant."

B.10 It then states that further action may be required where:

"your PCs could cause a PEC to exceed an environmental standard (unless the PC is very small compared to other contributors – if you think this is the case contact the Environment Agency)

the PEC is already exceeding an environmental standard"

B.11 On that basis, the stack height has been determined as the height at which the effects are not considered significant, i.e. the height at which:

- the short-term PC is less than 10 % of the short-term Environmental Assessment Level (EAL) or the PEC is below the EAL; and
- the long-term PC is less than 1 % of the long-term EAL or the PEC is below the EAL.

B.12 Table B.1 provides the maximum predicted PC and Table B.2 provides the maximum predicted PC as a percentage of the EAL.

Table B.5 Maximum Predicted Process Contributions (µg.m^{-3}) at each Stack Height Modelled

Height (m)	Concentration (µg.m^{-3})									
	Annual-mean PM_{10}	90.41st percentile daily mean PM_{10}	Maximum hourly HCl	Annual mean SO_2	99.73rd percentile hourly mean SO_2	Maximum 8-hour running CO	Annual-mean NO_2	99.79th percentile NO_2	99.18th percentile daily mean SO_2	99.9th percentile 15-minute mean SO_2
110	0.10	0.31	3.21	0.79	11.86	13.55	2.06	16.11	5.14	13.97
112	0.09	0.30	3.14	0.76	11.57	13.22	1.99	15.64	4.93	13.70
114	0.09	0.29	3.08	0.73	11.31	12.92	1.92	15.24	4.75	13.42
116	0.09	0.28	3.03	0.71	11.06	12.62	1.86	15.03	4.60	13.12
118	0.09	0.27	2.96	0.68	10.83	12.32	1.79	14.76	4.45	12.83
120	0.08	0.27	2.92	0.66	10.56	12.03	1.73	14.54	4.30	12.53
122	0.08	0.26	2.88	0.64	10.32	11.74	1.68	14.31	4.15	12.25
124	0.08	0.25	2.83	0.62	10.08	11.46	1.62	14.00	4.01	12.01
126	0.07	0.24	2.79	0.60	9.84	11.18	1.57	13.67	3.87	11.80
128	0.07	0.24	2.75	0.58	9.63	10.90	1.52	13.35	3.74	11.59
130	0.07	0.23	2.72	0.56	9.50	10.65	1.47	13.03	3.61	11.39

Table B.6 Maximum Predicted Process Contributions as a Percentage of the Relevant EAL at each Stack Height Modelled

	Percentage of Environmental Assessment Level (%)									
Environmental Assessment Level (µg.m^{-3})	40	50	750	50	350	10000	40	200	125	266
Height (m)	Annual-mean PM_{10}	90.41st percentile daily mean PM_{10}	Maximum hourly HCl	Annual mean SO_2	99.73rd percentile hourly mean SO_2	Maximum 8-hour running CO	Annual mean NO_2	99.79th percentile NO_2	99.18th percentile daily mean SO_2	99.9th percentile 15-minute mean SO_2
110	0	1	0	2	3	0	5	8	4	5
112	0	1	0	2	3	0	5	8	4	5
114	0	1	0	1	3	0	5	8	4	5
116	0	1	0	1	3	0	5	8	4	5
118	0	1	0	1	3	0	4	7	4	5
120	0	1	0	1	3	0	4	7	3	5
122	0	1	0	1	3	0	4	7	3	5
124	0	0	0	1	3	0	4	7	3	5
126	0	0	0	1	3	0	4	7	3	4
128	0	0	0	1	3	0	4	7	3	4
130	0	0	0	1	3	0	4	7	3	4

Cells are shaded grey where the predicted process contribution is above 1% (for long-term concentrations) or 10% (for short-term concentrations) of the EAL.

Discussion

B.13 The results in Table B.2 indicate that there are no heights below 130 m at which the impacts can be screened-out as insignificant based on the PC alone for all pollutants.

B.14 In particular, the maximum predicted PC for annual-mean NO_2 is above 1% at all heights. If the maximum predicted PC for NO_2 are ignored, the maximum PCs do not exceed 1% and 10% for long- and short-term impacts respectively at heights of 112 m and above.

B.15 The proposal is to use the existing 122 m stack at Uskmouth Power Station The results in Section 4 are based on this stack height of 122 m. For annual-mean NO_2, the PEC for a 122 m stack is 24.8 $\mu g.m^{-3}$ (see Table 4.1) which is well below the EAL. On that basis, the existing stack height of 122 m is considered to be acceptable.

Appendix C: Impacts on Designated Habitat Sites

C.1 The air quality impacts at thirty habitat sites within 15 km of the stack have been assessed and the results presented in this appendix.

C.2 Air quality impacts were assessed at:

- Coed-Y-Darren SSSI

- Dan Y Graig SSSI
- Gwent Levels – Magor and Undy SSSI
- Gwent Levels – Nash and Goldcliff SSSI
- Gwent Levels – Redwick and Llandevenny SSSI
- Gwent Levels – Rumney and Peterstone SSSI
- Gwent levels - St Brides SSSI
- Gwent levels – Whitson SSSI
- Gwlyptiroedd casnewdd/ Newport Wetlands SSSI
- Henllys Bog SSSI
- Langstone-Llanmartin Meadows SSSI
- Llandegfedd Reservoir SSSI
- Magor Marsh SSSI
- Parc Seymour Woods SSSI
- Penhow Woodlands SSSI
- Plas Machan Wood SSSI
- Rectory Meadow – Rogiet SSSI
- River Usk SSSI
- River Usk Special Area of Conservation (SAC)
- Ruperra Castle and Woodlands SSSI
- Severn Estuary (England) SAC
- Severn Estuary (Wales) SAC
- Severn Estuary SSSI
- Severn Estuary Special Protection Area (SPA)

C.3 The following sites within 15 km of the stack are not sensitive to air quality and have not been considered further.

- Brook Cottage, Llangybi Site of Special Scientific Interest (SSSI)

- Cilwrgi Quarry SSSI
- Lisvane Reservoir SSSI
- Penylan Quarry SSSI

- Rhymney River Section SSSI
- Rumney Quarry SSSI

C.4 Modelling was undertaken across the same grid as described in Section 3 and the maximum modelled concentration within each habitat site are presented in this appendix.

Critical Levels

C.5 Critical levels are maximum atmospheric concentrations of pollutants for the protection of vegetation and ecosystems and are specified within relevant European air quality directives and corresponding UK air quality regulations. Process Contributions (PCs) and Predicted Environmental Concentrations (PECs) of NOx, SO_2 and NH_3 have been calculated for comparison with the relevant annual-mean critical level. Background concentrations of NO_x, SO_2 and NH_3 at each designated site have been derived from the UK Air Pollution Information System (APIS) database [15].

Critical Loads

C.6 Critical loads refer to the quantity of pollutant deposited, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge.

Critical Loads – Nutrient Nitrogen Deposition

C.7 Percentage contributions to nutrient nitrogen deposition have been derived from the results of the ADMS dispersion modelling. Deposition rates have been calculated using empirical methods recommended by the EA, as follows:

C.8 The deposition flux ($\mu g.m^{-2}.s^{-1}$) has been calculated by multiplying the ground level NO_2 and NH_3 concentrations ($\mu g.m^{-3}$) by the deposition velocity. The EA guidance provides deposition velocities of 0.0015 $m.s^{-1}$ for short habitats and 0.003 $m.s^{-1}$ for forests for NO_2 and 0.02 $m.s^{-1}$ for short habitats and 0.03 $m.s^{-1}$ for forests for NH_3.

C.9 Units of $\mu g.m^{-2}.s^{-1}$ have been converted to units of $kg.ha^{-1}.year^{-1}$ by multiplying the dry deposition flux by the standard conversion factor of 96 for NOx and the wet deposition flux by 259.7 for NH_3.

C.10 Predicted contributions to nitrogen deposition have been calculated and compared with the relevant critical load range for the habitat types associated with the designated site. These have been derived from the APIS database. Where no 'site relevant critical loads' are available in the APIS database, site specific data has been sourced from the APIS database for the location instead. Data sourced from the location are shown with an asterisk in the tables in this appendix.

Critical Loads – Acidification

C.11 The acid deposition rate, in equivalents $keq.ha^{-1}.year^{-1}$, has been calculated by multiplying the dry deposition flux ($kg.ha^{-1}.year^{-1}$) by a conversion factor of 0.071428 for N and adding the deposition rate for S. The acid deposition rate for S has been calculated by multiplying the ground level SO_2 concentration by the deposition velocity to derive the deposition flux $\mu g.m^{-2}.s$. For short habitats this is 0.012 $m.s^{-1}$ and for forests it is 0.024 $m.s^{-1}$. This has then been multiplied by a conversion factor of 157.7 and 0.0625 (i.e. 9.86) to determine the acid deposition arising from S ($keq.ha^{-1}.year^{-1}$). This takes into account the degree to which a chemical species is acidifying, calculated as the proportion of N within the molecule.

C.12 Wet deposition in the near field is not significant compared with dry deposition for N [16] and therefore for the purposes of this assessment, wet deposition has not been considered.

C.13 Predicted contributions to acid deposition have been calculated and compared with the minimum critical load function for the habitat types associated with each designated site as derived from the APIS database.

Significance Criteria

C.14 The PCs and PECs have been compared against the relevant critical level/load for the relevant habitat type/interest feature. Based on current Environment Agency guidelines [17] and the Institute of Air Quality Management *A guide to the assessment of air quality impacts on designated nature conservation sites* [18] the following criteria have been used to determine if the impacts are significant:

- If the PC does not exceed 1% of relevant critical level/load the emission is considered not significant; and
- If the PC exceeds 1% but the resulting PEC is below 100% of the relevant critical level/load, the emission is not considered significant.

Results

C.15 The predicted annual-mean concentrations for NOx, SO_2 and NH_3 are compared with the relevant critical levels in Table C.1, Table C.2 and Table C.3. The predicted nutrient N deposition rate is compared with the critical load in Table C.4 and the predicted acid deposition rate is compared with the critical load in Table C.5. The predicted daily-mean concentrations for NOx are compared with the relevant critical levels in Table C.6.

Table C.1 Predicted Annual-Mean NOx Concentrations at Designated Habitat Sites

Habitat Site	Critical Level (µg.m-3)	PC (µg.m-3)	PC/Critical Level (%)	Ambient Concentration (µg.m-3)	PEC (µg.m-3)	PEC/ Critical Level (%)
Coed-Y-Darren SSSI	30	0.18	1	-	-	-
Dan Y Graig SSSI		0.11	0	-	-	-
Gwent Levels – Magor and Undy SSSI		0.47	2	11.34*	11.81	39
Gwent Levels – Nash and Goldcliff SSSI		2.39	8	15.28*	17.67	59
Gwent Levels – Redwick and Llandevenny SSSI		0.68	2	12.09*	12.77	43
Gwent Levels – Rumney and Peterstone SSSI		0.40	1	-	-	-
Gwent levels - St Brides SSSI		0.94	3	15.63*	16.57	55
Gwent levels – Whitson SSSI		1.05	3	12.15*	13.20	44
Gwlyptiroedd casnewdd/ Newport Wetlands SSSI		1.56	5	13.72*	15.28	51
Henllys Bog SSSI		0.08	0	-	-	-
Langstone-Llanmartin Meadows SSSI		0.23	1	-	-	-
Llandegfedd Reservoir SSSI		0.09	0	-	-	-
Magor Marsh SSSI		0.44	1	-	-	-
Parc Seymour Woods SSSI		0.16	1	-	-	-
Penhow Woodlands SSSI		0.23	1	-	-	-
Plas Machan Wood SSSI		0.18	1	-	-	-
Rectory Meadow – Rogiet SSSI		0.28	1	-	-	-
River Usk SSSI		0.70	2	19.22*	19.92	66
River Usk SAC		0.70	2	12.39	13.09	44
Ruperra Castle and Woodlands SSSI		0.16	1	-	-	-
Severn Estuary (England) SAC		0.31	1	-	-	-
Severn Estuary (Wales) SAC		1.02	3	12.83*	13.85	46
Severn Estuary SSSI		1.02	3	12.83	13.85	46
Severn Estuary SPA		0.31	1	-	-	-

*Data derived from 'search by location' tab on APIS.

Table C.2 Predicted Annual-Mean SO_2 Concentrations at Designated Habitat Sites

Habitat Site	Critical Level (µg.m-3)	PC (µg.m-3)	PC/Critical Level (%)	Ambient Concentration (µg.m-3)	PEC (µg.m-3)	PEC/ Critical Level (%)
Coed-Y-Darren SSSI	20	0.05	0	-	-	-
Dan Y Graig SSSI		0.03	0	-	-	-

Gwent Levels – Magor and Undy SSSI		0.12	1	-	-	-
Gwent Levels – Nash and Goldcliff SSSI		0.64	3	1.87*	2.51	13
Gwent Levels – Redwick and Llandevenny SSSI		0.18	1	-	-	-
Gwent Levels – Rumney and Peterstone SSSI		0.11	1	-	-	-
Gwent levels - St Brides SSSI		0.25	1	-	-	-
Gwent levels – Whitson SSSI		0.28	1	-	-	-
Gwlyptiroedd casnewdd/ Newport Wetlands SSSI		0.42	2	1.87*	2.29	11
Henllys Bog SSSI		0.02	0	-	-	-
Langstone-Llanmartin Meadows SSSI		0.06	0	-	-	-
Llandegfedd Reservoir SSSI		0.02	0	-	-	-
Magor Marsh SSSI		0.12	1	-	-	-
Parc Seymour Woods SSSI		0.04	0	-	-	-
Penhow Woodlands SSSI		0.06	0	-	-	-
Plas Machan Wood SSSI		0.05	0	-	-	-
Rectory Meadow – Rogiet SSSI		0.08	0	-	-	-
River Usk SSSI		0.19	1	-	-	-
River Usk SAC		0.19	1	-	-	-
Ruperra Castle and Woodlands SSSI		0.04	0	-	-	-
Severn Estuary (England) SAC		0.08	0	-	-	-
Severn Estuary (Wales) SAC		0.27	1	-	-	-
Severn Estuary SSSI		0.27	1	-	-	-
Severn Estuary SPA		0.08	0	-	-	-

*Data derived from ‘search by location’ tab on APIS.

Table C.3 Predicted Annual-Mean NH_3 Concentrations at Designated Habitat Sites

Habitat Site	Critical Level ($\mu g.m^{-3}$)	PC ($\mu g.m^{-3}$)	PC/Critical Level (%)	Ambient Concentration ($\mu g.m^{-3}$)	PEC ($\mu g.m^{-3}$)	PEC/ Critical Level (%)
Coed-Y-Darren SSSI	3	0.04	1	-	-	-
Dan Y Graig SSSI		0.03	1	-	-	-
Gwent Levels – Magor and Undy SSSI		0.11	4	0.88*	0.99	33
Gwent Levels – Nash and Goldcliff SSSI		0.55	18	1.15*	1.70	57
Gwent Levels – Redwick and Llandevenny SSSI		0.16	5	1.72*	1.88	63
Gwent Levels – Rumney and Peterstone SSSI		0.09	3	1.61*	1.70	57
Gwent levels - St Brides SSSI		0.22	7	1.15*	1.37	46
Gwent levels – Whitson SSSI		0.24	8	1.11*	1.35	45
Gwlyptiroedd casnewdd/ Newport Wetlands SSSI		0.36	12	1.15*	1.51	50
Henllys Bog SSSI		0.02	1	-	-	-
Langstone-Llanmartin Meadows SSSI		0.05	2	1.72*	1.77	59

Llandegfedd Reservoir SSSI		0.02	1	-	-	-
Magor Marsh SSSI		0.10	3	1.68*	1.78	59
Parc Seymour Woods SSSI		0.04	1	-	-	-
Penhow Woodlands SSSI		0.05	2	1.68*	1.73	58
Plas Machan Wood SSSI		0.04	1	-	-	-
Rectory Meadow – Rogiet SSSI		0.06	2	1.2*	1.26	42
River Usk SSSI		0.16	5	1.15*	1.31	44
River Usk SAC		0.16	5	1.42	1.58	53
Ruperra Castle and Woodlands SSSI		0.04	1	-	-	-
Severn Estuary (England) SAC		0.07	2	1.29	1.36	45
Severn Estuary (Wales) SAC		0.24	8	1.15*	1.39	46
Severn Estuary SSSI		0.24	8	1.35	1.59	53
Severn Estuary SPA		0.07	2	1.35	1.42	47

*Data derived from 'search by location' tab on APIS.

Table C.4 Predicted Nutrient N Deposition at Designated Habitat Sites

Habitat Site	Critical Load ($kgN.ha^{-1}.yr^{-1}$)	PC ($kgN.ha^{-1}.yr^{-1}$)	PC/Critical Load (%)	Ambient Concentration ($kgN.ha^{-1}.yr^{-1}$)	PEC ($kgN.ha^{-1}.yr^{-1}$)	PEC/ Critical Level (%)
Coed-Y-Darren SSSI	no data	0.18	-	no data	-	-
Dan Y Graig SSSI	20*	0.11	1	-	-	-
Gwent Levels – Magor and Undy SSSI	30*	0.47	2	9.8*	10.27	34
Gwent Levels – Nash and Goldcliff SSSI	30*	2.38	8	12.32*	14.70	49
Gwent Levels – Redwick and Llandevenny SSSI	30*	0.68	2	15.54*	16.22	54
Gwent Levels – Rumney and Peterstone SSSI	30*	0.40	1			
Gwent levels - St Brides SSSI	30*	0.94	3	12.32*	13.26	44
Gwent levels – Whitson SSSI	30*	1.05	3	11.2*	12.25	41
Gwlyptiroedd casnewdd/ Newport Wetlands SSSI	20*	1.55	8	12.32*	13.87	69
Henllys Bog SSSI	no data	0.08	-	-	-	-
Langstone-Llanmartin Meadows SSSI	30*	0.23	1	-	-	-
Llandegfedd Reservoir SSSI	no data	0.09	-	-	-	-
Magor Marsh SSSI	30*	0.44	1	-	-	-
Parc Seymour Woods SSSI	20*	0.16	1	-	-	-
Penhow Woodlands SSSI	20*	0.23	1	-	-	-
Plas Machan Wood SSSI	20*	0.18	1	-	-	-
Rectory Meadow – Rogiet SSSI	25*	0.28	1	-	-	-
River Usk SSSI	not sensitive					
River Usk SAC	not sensitive					
Ruperra Castle and Woodlands SSSI	20*	0.16	1	-	-	-

Severn Estuary (England) SAC	30*	0.31	1	-	-	-
Severn Estuary (Wales) SAC	30*	1.02	3	12.32*	13.34	44
Severn Estuary SSSI	30*	1.02	3	12.6	13.62	45
Severn Estuary SPA	30*	0.31	1	-	-	-

*Data derived from 'search by location' tab on APIS.

Table C.5 Predicted Acid Deposition at Designated Habitat Sites

Habitat Site	Critical Loads ($keq.ha^{-1}.yr^{-1}$)			PC ($keq.ha^{-1}.yr^{-1}$)		PC/CLF (%)	Ambient Concentration ($keq.ha^{-1}.yr^{-1}$)		PEC ($keq.ha^{-1}.yr^{-1}$)		PEC/CLF (%)
	Min N	Max S	Max N	N	S		N	S	N	S	
Coed-Y-Darren SSSI	no data	no data	no data	0.01	0.01	-	no data	no data	-	-	-
Dan Y Graig SSSI	0.142	11.47	11.612	0.01	0.01	0	1.31	0.52	1.32	0.53	16
Gwent Levels – Magor and Undy SSSI	no data	no data	no data	0.03	0.03	-	no data	no data	-	-	-
Gwent Levels – Nash and Goldcliff SSSI	no data	no data	no data	0.17	0.15	-	0.88	0.34	1.05	0.49	-
Gwent Levels – Redwick and Llandevenny SSSI	no data	no data	no data	0.05	0.04	-	1.37	0.34	1.42	0.38	-
Gwent Levels – Rumney and Peterstone SSSI	no data	no data	no data	0.03	0.03	-	1.13	0.38	1.16	0.41	-
Gwent levels - St Brides SSSI	no data	no data	no data	0.07	0.06	-	0.88	0.33	0.95	0.39	-
Gwent levels – Whitson SSSI	no data	no data	no data	0.07	0.07	-	0.8	0.28	0.87	0.35	-
Gwlyptiroedd casnewdd/ Newport Wetlands SSSI	no data	no data	no data	0.11	0.10	-	0.88	0.34	0.99	0.44	-
Henllys Bog SSSI	no data	no data	no data	0.01	0.01	-	no data	no data	-	-	-
Langstone-Llanmartin Meadows SSSI	no data	no data	no data	0.02	0.01	-	1.11	0.34	1.13	0.35	-
Llandegfedd Reservoir SSSI	0.856	4	4.856	0.01	0.01	0	1.33	0.46	1.34	0.47	37
Magor Marsh SSSI	No data	No data	No data	0.03	0.03	-	1.07	0.3	1.10	0.33	-
Parc Seymour Woods SSSI	0.142	1.691	1.833	0.01	0.01	1	1.73	0.36	1.74	0.37	115
Penhow Woodlands SSSI	0.142	5.93	6.072	0.02	0.01	1	1.81	0.33	1.83	0.34	36
Plas Machan Wood SSSI	0.142	1.906	2.048	0.01	0.01	1	1.79	0.49	1.80	0.50	113
Rectory Meadow – Rogiet SSSI	1.071	4	5.071	0.02	0.02	0	0.98	0.45	1.00	0.47	12
River Usk SSSI	Not sensitive										
River Usk SAC	Not sensitive										

Habitat Site	Critical Loads (keq.ha-1.yr-1)			PC (keq.ha-1.yr-1)		PC/CLF (%)	Ambient Concentration (keq.ha-1.yr-1)		PEC (keq.ha-1.yr-1)		PEC/CLF (%)
	Min N	Max S	Max N	N	S		N	S	N	S	
Ruperra Castle and Woodlands SSSI	0.142	1.908	2.05	0.01	0.01	1	1.79	0.49	1.80	0.50	112
Severn Estuary (England) SAC	No data	No data	No data	0.02	0.02	-	0.8	0.3	0.82	0.32	-
Severn Estuary (Wales) SAC	No data	No data	No data	0.07	0.06	-	0.88	0.34	0.95	0.40	-
Severn Estuary SSSI	No data	No data	No data	0.07	0.06	-	0.9	0.3	0.97	0.36	-
Severn Estuary SPA	No data	No data	No data	0.02	0.02	-	0.8	0.3	0.82	0.32	--

*Data derived from 'search by location' tab on APIS.

Table C.6 Predicted Daily-Mean NOx Concentrations at Designated Habitat Sites

Habitat Site	Critical Level ($\mu g.m^{-3}$)	PC ($\mu g.m^{-3}$)	PC/Critical Level (%)	Ambient Concentration ($\mu g.m^{-3}$)	PEC ($\mu g.m^{-3}$)	PEC/ Critical Level (%)
Coed-Y-Darren SSSI	75	2.87	4	-	-	-
Dan Y Graig SSSI		1.67	2	-	-	-
Gwent Levels – Magor and Undy SSSI		3.47	5	-	-	-
Gwent Levels – Nash and Goldcliff SSSI		19.07	25	30.56*	49.63	66
Gwent Levels – Redwick and Llandevenny SSSI		5.03	7	-	-	-
Gwent Levels – Rumney and Peterstone SSSI		6.08	8	-	-	-
Gwent levels - St Brides SSSI		15.29	20	31.26*	46.55	62
Gwent levels – Whitson SSSI		8.16	11	24.3*	32.46	43
Gwlyptiroedd casnewdd/ Newport Wetlands SSSI		14.44	19	27.44*	41.88	56
Henllys Bog SSSI		2.13	3	-	-	-
Langstone-Llanmartin Meadows SSSI		3.30	4	-	-	-
Llandegfedd Reservoir SSSI		4.82	6	-	-	-
Magor Marsh SSSI		3.23	4	-	-	-
Parc Seymour Woods SSSI		2.00	3	-	-	-
Penhow Woodlands SSSI		2.43	3	-	-	-
Plas Machan Wood SSSI		2.87	4	-	-	-
Rectory Meadow – Rogiet SSSI		2.19	3	-	-	-
River Usk SSSI		14.32	19	38.44*	52.76	70
River Usk SAC		14.32	19	24.78	39.10	52
Ruperra Castle and Woodlands SSSI		2.28	3	-	-	-
Severn Estuary (England) SAC		2.37	3	-	-	-

Habitat Site	Critical Level (µg.m^{-3})	PC (µg.m^{-3})	PC/Critical Level (%)	Ambient Concentration (µg.m^{-3})	PEC (µg.m^{-3})	PEC/ Critical Level (%)
Severn Estuary (Wales) SAC		17.74	24	25.66*	43.40	58
Severn Estuary SSSI		17.74	24	25.66	43.40	58
Severn Estuary SPA		3.30	4	-	-	-

*Data derived from 'search by location' tab on APIS.

Interpretation of Results

Annual-mean NOx

C.16 The maximum annual-mean NO_X PCs do not exceed 1% of the critical level or the PEC is below the critical level for all habitat sites. On that basis, the impacts can be screened out as insignificant.

Annual-mean SO_2

C.17 The maximum annual-mean SO_2 PCs do not exceed 1% of the critical level or the PEC is below the critical level for all habitat sites. On that basis, the impacts can be screened out as insignificant.

Annual-mean NH_3

C.18 The maximum annual-mean NH_3 PCs do not exceed 1% of the critical level or the PEC is below the critical level for all habitat sites. On that basis, the impacts can be screened out as insignificant.

Nutrient N Deposition

C.19 The maximum nitrogen deposition PCs do not exceed 1% of the critical load or the PEC is below the critical load for all habitat sites. On that basis, the impacts can be screened out as insignificant.

Acid Deposition

C.20 The maximum acid deposition PCs do not exceed 1% of the critical load or the PEC is below the critical load for all habitat sites. On that basis, the impacts can be screened out as insignificant.

Daily-mean NOx

C.21 The maximum daily-mean NO_X PCs do not exceed 10% of the critical level or the PEC is below the critical level for all habitat sites. On that basis, the impacts can be screened out as insignificant.

Appendix D: Results at Discrete Receptors

D.1 Table D.1 and Table D.2 show the PCs and the PCs as a percentage of the EAL at the modelled sensitive receptors.

Table D.1 Predicted Maximum Process Contributions ($\mu g.m^{-3}$) – Results at Sensitive Receptors

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)	Receptor ID 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
PM_{10}	24 hour (90.41st percentile)	50	0.01	0.03	0.13	0.20	0.22	0.21	0.16	0.08	0.04	0.04	0.04	0.05	0.06	0.04	0.12	0.00	0.09	0.07	0.08	0.00	0.00	0.00	0.00
	24 hour (annual mean)	40	0.00	0.01	0.04	0.06	0.06	0.07	0.06	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.00	0.02	0.02	0.02	0.00	0.00	0.00	0.00
$PM_{2.5}$	24 hour (annual mean)	25	0.00	0.01	0.04	0.06	0.06	0.07	0.06	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.00	0.02	0.02	0.02	0.00	0.00	0.00	0.00
HCl	1 hour (maximum)	750	1.77	0.20	0.46	0.60	0.66	0.63	0.67	0.34	0.17	0.22	0.19	0.23	0.25	0.24	0.69	0.15	0.48	0.34	0.25	0.01	0.00	0.03	0.07
HF	1 hour (maximum)	160	0.22	0.02	0.06	0.07	0.08	0.08	0.08	0.04	0.02	0.03	0.02	0.03	0.03	0.03	0.09	0.02	0.06	0.04	0.03	0.00	0.00	0.00	0.01
SO_2	15 minute (99.90th percentile)	266	6.26	7.46	9.93	9.76	8.74	7.82	7.04	6.97	5.51	5.48	6.81	6.42	6.06	5.24	6.78	7.63	10.81	7.92	7.48	0.19	0.03	1.22	2.13
	1 hour (99.73th percentile)	350	3.54	4.96	8.20	8.33	7.73	6.86	6.03	5.94	4.11	4.25	4.27	3.99	4.44	4.39	5.81	3.35	9.20	6.89	5.64	0.10	0.00	0.47	1.05
	24 hour (99.18th percentile)	125	0.74	1.00	2.32	2.99	3.29	3.13	3.33	1.68	0.86	1.08	0.97	1.16	1.26	1.22	3.44	0.75	2.38	1.71	1.27	0.03	0.00	0.15	0.35

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)	Receptor ID																						
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	1 hour (annual mean)	50	0.03	0.06	0.34	0.46	0.52	0.54	0.45	0.17	0.08	0.09	0.09	0.11	0.12	0.09	0.25	0.03	0.16	0.14	0.19	0.00	0.00	0.01	0.01
NO_2	1 hour (99.79th percentile)	200	5.63	7.19	11.33	11.03	10.23	9.08	8.10	7.85	5.53	5.70	5.96	5.58	6.08	5.82	7.78	5.53	12.35	9.15	7.70	0.15	0.00	0.84	1.78
	1 hour (annual mean)	40	0.08	0.16	0.90	1.21	1.37	1.41	1.17	0.44	0.22	0.23	0.22	0.29	0.31	0.23	0.64	0.07	0.41	0.37	0.50	0.00	0.00	0.01	0.03
CO	8 hour (maximum daily running)	10,000	3.98	3.88	7.89	8.15	7.62	7.04	7.71	6.40	4.22	4.94	5.21	4.79	7.79	5.07	6.32	7.56	10.37	7.84	5.19	0.24	0.16	1.37	2.11
Cd	1 hour (annual mean)	5.00E-03	1.6E-05	3.1E-05	1.7E-04	2.3E-04	2.6E-04	2.7E-04	2.2E-04	8.5E-05	4.2E-05	4.3E-05	4.3E-05	5.5E-05	6.0E-05	4.3E-05	1.2E-04	1.3E-05	7.8E-05	7.1E-05	9.5E-05	4.3E-07	1.2E-07	2.5E-06	6.2E-06
Tl	1 hour (maximum)	3.00E+01	4.4E-03	4.7E-03	5.1E-03	5.8E-03	6.0E-03	5.7E-03	4.8E-03	5.3E-03	4.1E-03	3.8E-03	4.4E-03	4.4E-03	5.2E-03	3.9E-03	3.9E-03	5.1E-03	5.6E-03	4.5E-03	5.8E-03	4.7E-04	5.2E-04	3.9E-03	4.9E-03
	1 hour (annual mean)	1.00E+00	1.6E-05	3.1E-05	1.7E-04	2.3E-04	2.6E-04	2.7E-04	2.2E-04	8.5E-05	4.2E-05	4.3E-05	4.3E-05	5.5E-05	6.0E-05	4.3E-05	1.2E-04	1.3E-05	7.8E-05	7.1E-05	9.5E-05	4.3E-07	1.2E-07	2.5E-06	6.2E-06
Hg	1 hour (maximum)	7.50E+00	4.4E-03	4.7E-03	5.1E-03	5.8E-03	6.0E-03	5.7E-03	4.8E-03	5.3E-03	4.1E-03	3.8E-03	4.4E-03	4.4E-03	5.2E-03	3.9E-03	3.9E-03	5.1E-03	5.6E-03	4.5E-03	5.8E-03	4.7E-04	5.2E-04	3.9E-03	4.9E-03
	1 hour (annual mean)	2.50E-01	1.6E-05	3.1E-05	1.7E-04	2.3E-04	2.6E-04	2.7E-04	2.2E-04	8.5E-05	4.2E-05	4.3E-05	4.3E-05	5.5E-05	6.0E-05	4.3E-05	1.2E-04	1.3E-05	7.8E-05	7.1E-05	9.5E-05	4.3E-07	1.2E-07	2.5E-06	6.2E-06

Pollutant	Averaging Period	EAL (µg.m^{-3})	Receptor ID 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Sb	1 hour (maximum)	1.50E+02	4.4E-02	4.7E-02	5.1E-02	5.8E-02	6.0E-02	5.7E-02	4.8E-02	5.3E-02	4.1E-02	3.8E-02	4.4E-02	4.4E-02	5.2E-02	3.9E-02	3.9E-02	5.1E-02	5.6E-02	4.5E-02	5.8E-02	4.7E-03	5.2E-03	3.9E-02	4.9E-02
	1 hour (annual mean)	5.00E+00	1.6E-04	3.1E-04	1.7E-03	2.3E-03	2.6E-03	2.7E-03	2.2E-03	8.5E-04	4.2E-04	4.3E-04	4.3E-04	5.5E-04	6.0E-04	4.3E-04	1.2E-03	1.3E-04	7.8E-04	7.1E-04	9.5E-04	4.3E-06	1.2E-06	2.5E-05	6.2E-05
As	1 hour (annual mean)	3.00E-03	1.6E-04	3.1E-04	1.7E-03	2.3E-03	2.6E-03	2.7E-03	2.2E-03	8.5E-04	4.2E-04	4.3E-04	4.3E-04	5.5E-04	6.0E-04	4.3E-04	1.2E-03	1.3E-04	7.8E-04	7.1E-04	9.5E-04	4.3E-06	1.2E-06	2.5E-05	6.2E-05
Cr	1 hour (maximum)	1.50E+02	4.4E-02	4.7E-02	5.1E-02	5.8E-02	6.0E-02	5.7E-02	4.8E-02	5.3E-02	4.1E-02	3.8E-02	4.4E-02	4.4E-02	5.2E-02	3.9E-02	3.9E-02	5.1E-02	5.6E-02	4.5E-02	5.8E-02	4.7E-03	5.2E-03	3.9E-02	4.9E-02
	1 hour (annual mean)	5.00E+00	1.6E-04	3.1E-04	1.7E-03	2.3E-03	2.6E-03	2.7E-03	2.2E-03	8.5E-04	4.2E-04	4.3E-04	4.3E-04	5.5E-04	6.0E-04	4.3E-04	1.2E-03	1.3E-04	7.8E-04	7.1E-04	9.5E-04	4.3E-06	1.2E-06	2.5E-05	6.2E-05
Co	1 hour (maximum)	6.00E+00	4.4E-02	4.7E-02	5.1E-02	5.8E-02	6.0E-02	5.7E-02	4.8E-02	5.3E-02	4.1E-02	3.8E-02	4.4E-02	4.4E-02	5.2E-02	3.9E-02	3.9E-02	5.1E-02	5.6E-02	4.5E-02	5.8E-02	4.7E-03	5.2E-03	3.9E-02	4.9E-02
	1 hour (annual mean)	2.00E-01	1.6E-04	3.1E-04	1.7E-03	2.3E-03	2.6E-03	2.7E-03	2.2E-03	8.5E-04	4.2E-04	4.3E-04	4.3E-04	5.5E-04	6.0E-04	4.3E-04	1.2E-03	1.3E-04	7.8E-04	7.1E-04	9.5E-04	4.3E-06	1.2E-06	2.5E-05	6.2E-05
Cu	1 hour (maximum)	2.00E+02	4.4E-02	4.7E-02	5.1E-02	5.8E-02	6.0E-02	5.7E-02	4.8E-02	5.3E-02	4.1E-02	3.8E-02	4.4E-02	4.4E-02	5.2E-02	3.9E-02	3.9E-02	5.1E-02	5.6E-02	4.5E-02	5.8E-02	4.7E-03	5.2E-03	3.9E-02	4.9E-02
	1 hour (annual mean)	1.00E+01	1.6E-04	3.1E-04	1.7E-03	2.3E-03	2.6E-03	2.7E-03	2.2E-03	8.5E-04	4.2E-04	4.3E-04	4.3E-04	5.5E-04	6.0E-04	4.3E-04	1.2E-03	1.3E-04	7.8E-04	7.1E-04	9.5E-04	4.3E-06	1.2E-06	2.5E-05	6.2E-05

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Pollutant	Averaging Period	EAL (μg.m^{-3})	Receptor ID																						
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Pb	1 hour (annual mean)	2.50E-01	1.6E-04	3.1E-04	1.7E-03	2.3E-03	2.6E-03	2.7E-03	2.2E-03	8.5E-04	4.2E-04	4.3E-04	4.3E-04	5.5E-04	6.0E-04	4.3E-04	1.2E-03	1.3E-04	7.8E-04	7.1E-04	9.5E-04	4.3E-06	1.2E-06	2.5E-05	6.2E-05
Mn	1 hour (maximum)	1.50E+03	4.4E-02	4.7E-02	5.1E-02	5.8E-02	6.0E-02	5.7E-02	4.8E-02	5.3E-02	4.1E-02	3.8E-02	4.4E-02	4.4E-02	5.2E-02	3.9E-02	3.9E-02	5.1E-02	5.6E-02	4.5E-02	5.8E-02	4.7E-03	5.2E-03	3.9E-02	4.9E-02
	1 hour (annual mean)	1.50E-01	1.6E-04	3.1E-04	1.7E-03	2.3E-03	2.6E-03	2.7E-03	2.2E-03	8.5E-04	4.2E-04	4.3E-04	4.3E-04	5.5E-04	6.0E-04	4.3E-04	1.2E-03	1.3E-04	7.8E-04	7.1E-04	9.5E-04	4.3E-06	1.2E-06	2.5E-05	6.2E-05
Ni	1 hour (annual mean)	2.00E-02	1.6E-04	3.1E-04	1.7E-03	2.3E-03	2.6E-03	2.7E-03	2.2E-03	8.5E-04	4.2E-04	4.3E-04	4.3E-04	5.5E-04	6.0E-04	4.3E-04	1.2E-03	1.3E-04	7.8E-04	7.1E-04	9.5E-04	4.3E-06	1.2E-06	2.5E-05	6.2E-05
V	1 hour (maximum)	5.00E+00	4.4E-02	4.7E-02	5.1E-02	5.8E-02	6.0E-02	5.7E-02	4.8E-02	5.3E-02	4.1E-02	3.8E-02	4.4E-02	4.4E-02	5.2E-02	3.9E-02	3.9E-02	5.1E-02	5.6E-02	4.5E-02	5.8E-02	4.7E-03	5.2E-03	3.9E-02	4.9E-02
	1 hour (annual mean)	1.00E+00	1.6E-04	3.1E-04	1.7E-03	2.3E-03	2.6E-03	2.7E-03	2.2E-03	8.5E-04	4.2E-04	4.3E-04	4.3E-04	5.5E-04	6.0E-04	4.3E-04	1.2E-03	1.3E-04	7.8E-04	7.1E-04	9.5E-04	4.3E-06	1.2E-06	2.5E-05	6.2E-05
Dioxins & Furans	1 hour (annual mean)	-	4.7E-08	9.3E-08	5.1E-07	6.9E-07	7.8E-07	8.0E-07	6.7E-07	2.5E-07	1.3E-07	1.3E-07	1.3E-07	1.7E-07	1.8E-07	1.3E-07	3.7E-07	3.8E-08	2.3E-07	2.1E-07	2.9E-07	1.3E-09	3.5E-10	7.5E-09	1.9E-08
PAHs	1 hour (annual mean)	2.50E-04	2.3E-06	4.7E-06	2.6E-05	3.5E-05	3.9E-05	4.0E-05	3.4E-05	1.3E-05	6.3E-06	6.5E-06	6.4E-06	8.3E-06	9.0E-06	6.5E-06	1.8E-05	1.9E-06	1.2E-05	1.1E-05	1.4E-05	6.5E-08	1.8E-08	3.8E-07	9.3E-07
PCB	1 hour (annual mean)	2.00E-01	6.2E-08	1.2E-07	6.8E-07	9.2E-07	1.0E-06	1.1E-06	8.9E-07	3.4E-07	1.7E-07	1.7E-07	1.7E-07	2.2E-07	2.4E-07	1.7E-07	4.9E-07	5.1E-08	3.1E-07	2.8E-07	3.8E-07	1.7E-09	4.7E-10	1.0E-08	2.5E-08

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Table D.2 Maximum Process Contributions as a Percentage of the EAL at Long-Term Emission Limit Values – Results at Sensitive Receptors

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)	Criteria	Receptor ID																						
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
PM_{10}	24 hour (90.41st percentile)	50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	24 hour (annual mean)	40	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$PM_{2.5}$	24 hour (annual mean)	25	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HCl	1 hour (maximum)	750	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HF	1 hour (maximum)	160	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SO_2	15 minute (99.90th percentile)	266	10	2	3	4	4	3	3	3	3	2	2	3	2	2	2	3	3	4	3	3	0	0	0	1
	1 hour (99.73th percentile)	350	10	1	1	2	2	2	2	2	2	1	1	1	1	1	1	2	1	3	2	2	0	0	0	0

Pollutant	Averaging Period	EAL (µg.m-3)	Criteria	Receptor ID																						
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	24 hour (99.18th percentile)	125	10	1	1	2	2	3	3	3	1	1	1	1	1	1	1	3	1	2	1	1	0	0	0	0
	1 hour (annual mean)	50	1	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NO_2	1 hour (99.79th percentile)	200	10	3	4	6	6	5	5	4	4	3	3	3	3	3	3	4	3	6	5	4	0	0	0	1
	1 hour (annual mean)	40	1	0	0	2	3	3	4	3	1	1	1	1	1	1	1	2	0	1	1	1	0	0	0	0
CO	8 hour (maximum daily running)	10,000	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cd	1 hour (annual mean)	0.005	10	0	1	3	5	5	5	4	2	1	1	1	1	1	1	2	0	2	1	2	0	0	0	0
Tl	1 hour (maximum)	30	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1 hour (annual mean)	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Pollutant	Averaging Period	EAL (µg.m-3)	Criteria	Receptor ID 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Hg	1 hour (maximum)	7.5	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1 hour (annual mean)	0.25	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sb	1 hour (maximum)	150	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1 hour (annual mean)	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
As	1 hour (annual mean)	0.003	1	5	10	57	77	87	89	74	28	14	14	14	18	20	14	41	4	26	24	32	0	0	1	2

Pollutant	Averaging Period	EAL (µg.m-3)	Criteria	Receptor ID																						
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Cr	1 hour (maximum)	150	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1 hour (annual mean)	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Co	1 hour (maximum)	6	10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1
	1 hour (annual mean)	0.2	1	0	0	1	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Cu	1 hour (maximum)	200	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1 hour (annual mean)	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pb	1 hour (annual mean)	0.25	1	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mn	1 hour (maximum)	1500	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Pollutant	Averaging Period	EAL (µg.m-3)	Criteria	Receptor ID 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	1 hour (annual mean)	0.15	1	0	0	1	2	2	2	1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0
Ni	1 hour (annual mean)	0.02	1	1	2	9	11	13	13	11	4	2	2	2	3	3	2	6	1	4	4	5	0	0	0	0
V	1 hour (maximum)	5	10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1
	1 hour (annual mean)	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dioxins & Furans	1 hour (annual mean)	-	1	-																						
PAHs	1 hour (annual mean)	0.00025	1	1	2	10	14	16	16	13	5	3	3	3	3	4	3	7	1	5	4	6	0	0	0	0
PCB	1 hour (annual mean)	0.2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Highlighted cells indicate where the PC as a % of the EAL exceeds 1% for long-term and 10% for short term averaging periods and the impacts cannot be screened out as insignificant based on the PC alone.

D.2 For receptors where the PC as a percentage of the EAL is less than 1% for long-term and 10% for short-term averaging periods, the impacts can be screened out as insignificant. For the pollutants where the impacts can't be screened out as insignificant based on the PC alone, the PEC is considered in Table D.3.

Table D.3 Predicted Environmental Concentrations at Long-Term Emission Limit Values – Results at Sensitive Receptors

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)	AC ($\mu g.m^{-3}$)	Receptor ID																						
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NO_2	1 hour (annual mean)	40	23.1	23.2	23.3	24.0	24.3	24.5	24.5	24.3	23.5	23.3	23.3	23.3	23.4	23.4	23.3	23.7	23.2	23.5	23.5	23.6	23.1	23.1	23.1	23.1
As	1 hour (annual mean)	3.00E-03	8.1E-04	9.7E-04	1.1E-03	2.5E-03	3.1E-03	3.4E-03	3.5E-03	3.0E-03	1.7E-03	1.2E-03	1.2E-03	1.2E-03	1.4E-03	1.4E-03	1.2E-03	2.0E-03	9.4E-04	1.6E-03	1.5E-03	1.8E-03	8.1E-04	8.1E-04	8.4E-04	8.7E-04
Mn	1 hour (annual mean)	1.50E-01	4.6E-02	4.6E-02	4.6E-02	4.8E-02	4.8E-02	4.9E-02	4.9E-02	4.8E-02	4.7E-02	4.6E-02	4.6E-02	4.6E-02	4.6E-02	4.7E-02	4.6E-02	4.7E-02	4.6E-02	4.7E-02	4.7E-02	4.7E-02	4.6E-02	4.6E-02	4.6E-02	4.6E-02
Ni	1 hour (annual mean)	2.00E-02	5.0E-03	5.1E-03	5.3E-03	6.7E-03	7.3E-03	7.6E-03	7.7E-03	7.2E-03	5.8E-03	5.4E-03	5.4E-03	5.4E-03	5.5E-03	5.6E-03	5.4E-03	6.2E-03	5.1E-03	5.8E-03	5.7E-03	5.9E-03	5.0E-03	5.0E-03	5.0E-03	5.1E-03
PAHs	1 hour (annual mean)	2.50E-04	2.0E-04	2.0E-04	2.0E-04	2.3E-04	2.3E-04	2.4E-04	2.4E-04	2.3E-04	2.1E-04	2.1E-04	2.1E-04	2.1E-04	2.1E-04	2.1E-04	2.1E-04	2.2E-04	2.0E-04	2.1E-04	2.1E-04	2.1E-04	2.0E-04	2.0E-04	2.0E-04	2.0E-04

Highlighted cells indicate where the PEC exceeds the EAL and the impacts cannot be screened out as insignificant based on the PEC.

D.3 For all pollutants except arsenic, the PECs are below the EAL and the impacts can be screened out as not significant.

D.4 For As, the predicted PC is more than 1% of the EAL and the PEC is above the EAL. These predictions are based on the assumption that arsenic comprises the total of the group 3 metals emissions. The concentration used in the assessment applies to all nine of the group 3 metals in total. The Environment Agency's '*Releases from waste incinerators – Guidance on assessing group 3 metal stack emissions from incinerators'* version 4 (undated), provides a summary of 34 measured values for each metal recorded at 18 municipal waste and waste wood co-incinerators between 2007 and 2015. For As, the measured concentration varies from 0.04% to 5% of the IED emission concentration limit.

D.5 Table D.4 shows the predicted PC if the total emission concentration used in the assessment is assumed to apply equally to each of the nine group 3 metals. i.e. the PC for As has been divided by 9. In this case the PECs at all receptors are below the EAL and the impacts are therefore not considered significant.

Table D.4 Maximum Predicted Environmental Concentrations (µg.m^{-3}) – Arsenic

Pollutant	Averaging Period	EAL (µg.m^{-3})	AC (µg.m^{-3})	Receptor ID																						
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
As	1 hour (annual mean)	0.003	8.1E-04	8.27 E-04	8.44 E-04	9.98 E-04	1.06 E-03	1.10 E-03	1.10 E-03	1.06 E-03	9.03 E-04	8.56 E-04	8.58 E-04	8.57 E-04	8.71 E-04	8.76 E-04	8.57 E-04	9.45 E-04	8.24 E-04	8.95 E-04	8.88 E-04	9.15 E-04	8.10 E-04	8.10 E-04	8.13 E-04	8.17 E-04

Appendix E: Abnormal Operations

E.1 This appendix provides the results of an assessment of the potential long and short-term air quality impacts during abnormal operations.

Background

E.2 Article 46 of the Industrial Emissions Directive (IED) [1] provides operators with some operational flexibility to resolve plant problems without initiating a complete shutdown of the energy recovery facility. These scenarios are termed 'abnormal operations' and include incidents such as technically unavoidable stoppages, disturbances, or failures of the air pollution control equipment or monitoring equipment.

E.3 The IED requires that such abnormal operations must not exceed a maximum of four hours at any one time and the cumulative duration of these periods must not exceed 60 hours in a year. If the failure cannot be rectified after four hours, then the facility must shutdown.

E.4 The modelling results presented in Section 4 of this report were prepared on the basis of continuous operations, with emissions to air for each pollutant considered being at the emission limits for the entire time. In practice, for the majority of plant operating conditions, emissions would be well below the limits.

E.5 The potential long-term and short-term air quality impacts during abnormal operations are summarised below.

Failure of the Selective Non-Catalytic Reduction (SNCR) System

E.6 The SNCR air pollution control system is expected to abate nitrogen oxides (NOx) down to levels well below the emission concentration used in this assessment of 225 $mg.m^{-3}$. Unabated concentrations of NOx are anticipated to be 421 $mg.m^{-3}$, i.e. 1.87 times the daily-mean emissions limit value.

E.7 The ground-level concentrations under abnormal operations are then compared to the relevant Environmental Assessment Levels (EALs) for ambient NO_2 concentrations set out in Section 4 but repeated, as appropriate, throughout this report for ease of reference.

Short-term Impacts

E.8 Under abnormal operations, the maximum short-term emission rate has been considered to be 1.87 times the normal emission rate and this will have the effect of increasing the modelled Process Contribution (PC) by a factor of 1.87. The predicted short-term contributions from the energy recovery facility under normal and abnormal operations are set out in Table E.5.

Table E.5 Predicted Short-term NO_2 Concentrations (µg.m^{-3}) During Normal and Abnormal Operations

Pollutant	Averaging Period	EAL	Ambient Concentration (AC)	Normal	Abnormal					
				Max PC	Max PC	Max PC as % of EAL	PC <10% EAL?	Screen Out	PEC	PEC as % of EAL
NO_2	1 hour (99.79th %ile)	200	46.2	14.3	26.8	13	No	No	73.0	36

E.9 Under abnormal operations, the short-term NO_2 PC is predicted to be 26.8 µg.m^{-3}. This equates to 13% of the EAL of 200 µg.m^{-3} and cannot therefore be screened out without considering the PEC. The PEC during abnormal operations is 73.0 µg.m^{-3}, which is 36% of the EAL. The 64% headroom between the PEC and the EAL of 200 µg.m^{-3} is considered to provide sufficient headroom to avoid significant adverse effects to human health and the environment.

Long-term Impacts

E.10 The maximum long-term PC for NO_2 under normal operating conditions is 1.68 µg.m^{-3}. Under abnormal operations, emissions are expected to be 1.87 times the normal operating concentration for a maximum of 60 hours out of the year and, as such, the PC can be calculated using the following formula 1.68 x [(1.87 x 60/8760) + (8700/8760)], based on continuous operation throughout the year. The predicted long-term contributions from the energy recovery facility under normal and abnormal operations are set out in Table E.6.

Table E.6 Predicted Long-term Concentrations (µg.m^{-3}) During Normal and Abnormal Operations

Pollutant	Averaging Period	EAL	AC	Normal	Abnormal					
				Max PC	Max PC	Max PC as % of EAL	PC <10% EAL?	Screen Out	PEC	PEC as % of EAL
NO_2	Annual Mean	40	23.1	1.68	1.69	4	No	No	24.8	62

E.11 Under abnormal operations, the maximum long-term NO_2 PC is predicted to be 1.69 µg.m^{-3}. This equates to 4% of the EAL of 40 µg.m^{-3} and cannot therefore be screened out without considering the PEC. The PEC during abnormal operations is 24.8 µg.m^{-3}, which is 62% of the EAL. The 38% headroom between the PEC and the EAL of 40 µg.m^{-3} is considered to provide sufficient headroom to avoid significant adverse effects to human health and the environment.

Failure of the Bag Filters (Control of Particulates and Heavy Metals)

Short-term Impacts

E.12 The EAL makes provisions for a daily-mean PM_{10} concentration of 50 µg.m^{-3}, not to be exceeded more than 35 times a year. Under the IED, abnormal emissions must not last longer than four hours, after which time the energy recovery facility must cease operating.

E.13 As the EAL for PM_{10} is based on a daily-average, emissions during the abnormal operation have been calculated assuming that the plant operates abnormally for four hours during any 24 hour period. Part 3 to the IED specifies a maximum emission concentration during abnormal operations of 150 mg.Nm^{-3} (dry, 0^{0}C, 11% O_2) for total dust. When converted to 6% O_2 the emission concentration is 225 mg.Nm^{-3}. This is 30 times greater than the maximum emission concentration of 7.5 mg.Nm^{-3} (dry, 0^{0}C, 6% O_2) specified during normal operations. The 24-hour average PC for PM_{10} under abnormal operations has been calculated using the following formula: PC (normal) x [(30 x 4/24) + (20/24)].

E.14 The EALs for heavy metals are based upon hourly values, as such only the maximum hourly abnormal concentration needs to be considered. Assuming that the metals concentrations increase by the same ratio as total dust, the 1-hour PC for each of the heavy metals has been multiplied by 30 to predict the maximum hourly emissions of each during abnormal operations. The maximum abnormal PC is reported in Table E.11.

Table E.7: Predicted Short-term Concentrations (µg.m^{-3}) During Normal and Abnormal Operations

Pollutant	EAL	AC	Normal	Abnormal					
			Max PC	Max PC	PC as % of EAL	PC <10% EAL?	Screen Out	PEC	PEC as % of EAL
PM_{10}	50	-	0.2593	1.5126	3	Yes	Yes	-	-
Cd	No EAL	-	-	-	-	-	-	-	-
Tl	30	-	0.0072	0.2158	1	Yes	Yes	-	-
Hg	7.5	-	0.0072	0.2158	3	Yes	Yes	-	-
Sb	150	-	0.0719	2.1581	1	Yes	Yes	-	-
As	No EAL	-	-	-	-	-	-	-	
Cr	150	-	0.0719	2.1581	1	Yes	Yes	-	-
Co	6 (a)	0.0003	0.0719	2.1581	36	No	No	2.1584	36
Cu	200	-	0.0719	2.1581	1	Yes	Yes	-	-
Pb	No EAL	-	-	-	-	-	-	-	

Mn	1500	-	0.0719	2.1581	0	Yes	Yes	-	-
Ni	No EAL	-	-	-	-	-	-	-	-
V	1	0.0045	0.0719	2.1581	216	No	No	2.1626	216

(a) refers to EALs obtained from the EA's earlier Horizontal Guidance Note EPR H1 guidance note, as no levels are provided in the current guidance.

E.15 All short-term emissions, except vanadium and cobalt, can be screened-out as being insignificant solely by consideration of their PCs alone, as they are predicted to be below 10% of the short-term EAL.

E.16 For vanadium and cobalt, further consideration needs to be given to the PEC, which is predicted to be 216% of the short-term EAL for vanadium and 36% of the EAL for cobalt. The PEC for cobalt is below the relevant EAL, and the effects are considered to be not significant.

E.17 The Environment Agency Group 3 guidance requires the assessment to progress to the second stage assessment for those metals that cannot be screened out based on 100% of the emission limit. As vanadium cannot be screened out at Step 1, it has been considered in more detail as part of the Step 2 assessment which assumes each element is emitted at 11% of the total Group 3 limit. The results are shown below.

Table E.8: Predicted Long-term Concentrations (µg.m^{-3}) During Normal and Abnormal Operations – Step 2

Pollutant	EAL	AC	Normal	Abnormal					
			Max PC	Max PC	PC as % of EAL	PC <1% EAL?	Screen Out	PEC	PEC as % of EAL
V	1	0.0045	0.0719	0.2398	24	No	No	0.2442	24

E.18 The results of the step 2 assessment show the PEC for vanadium to be below the relevant EAL and is considered to provide sufficient headroom to avoid significant adverse effects to human health and the environment.

Long-term Impacts

E.19 Under abnormal operations, emissions will be thirteen times the normal operating concentration for a maximum of 60 hours out of the year and, as such, the annual-mean PC for PM_{10} has been calculated using the following formula: [PC (normal) x ((30 x 60/8760) + (8700/8760)].

Table E.9: Predicted Long-term Concentrations (µg.m^{-3}) During Normal and Abnormal Operations

Pollutant	EAL	AC	Normal	Abnormal					
			Max PC	Max PC	PC as % of EAL	PC <1% EAL?	Screen Out	PEC	PEC as % of EAL
PM_{10}	40	-	0.0798	0.0957	0	Yes	Yes	-	-

Cd	0.005	0.0014	0.0003	0.0004	8	No	No	0.0018	36
Tl	1	-	0.0003	0.0004	0	Yes	Yes	-	-
Hg	0.25	-	0.0003	0.0004	0	Yes	Yes	-	-
Sb	5	-	0.0032	0.0038	0	Yes	Yes	-	-
As	0.003	0.0008	0.0032	0.0038	128	No	No	0.0046	155
Cr	5	-	0.0032	0.0038	0	Yes	Yes	-	-
Cr (VI)	0.0002	-	0.0000	0.0000	1	Yes	Yes	-	-
Co (a)	0.2	0.0003	0.0032	0.0038	2	No	No	0.0041	2
Cu	10	-	0.0032	0.0038	0	Yes	Yes	-	-
Pb	0.25	0.0156	0.0032	0.0038	2	No	No	0.0194	8
Mn	0.15	0.0459	0.0032	0.0038	3	No	No	0.0498	33
Ni	0.02	0.0050	0.0032	0.0038	19	No	No	0.0088	44
V	5	-	0.0032	0.0038	0	Yes	Yes	-	-

(a) refers to EALs obtained from the EA's earlier Horizontal Guidance Note EPR H1 guidance note, as no levels are provided in the current guidance.

E.20 All long-term emissions except Cd, As, Co, Pb, Mn and Ni, can be screened out as being insignificant by consideration of the PCs alone, as they are predicted to be below 1% of the long-term EAL.

E.21 The PEC for all pollutants except As are below the relevant EALs, which are considered to provide sufficient headroom to avoid significant adverse effects to human health and the environment.

E.22 The Environment Agency Group 3 guidance requires the assessment to progress to the second stage assessment for those metals that cannot be screened out based on 100% of the emission limit. As arsenic cannot be screened out at Step 1, it has been considered in more detail as part of the Step 2 assessment which assumes each element is emitted at 11% of the total Group 3 limit. The results are shown below.

Table E.10: Predicted Long-term Concentrations (µg.m^{-3}) During Normal and Abnormal Operations – Step 2

Pollutant	EAL	AC	Normal	Abnormal					
			Max PC	Max PC	PC as % of EAL	PC <1% EAL?	Screen Out	PEC	PEC as % of EAL
As	0.003	0.0008	0.00032	0.00043	14	No	No	0.0012	41

E.23 The results of the step 2 assessment show the PEC for As to be below the relevant EAL and is considered to provide sufficient headroom to avoid significant adverse effects to human health and the environment.

Dioxins and Furans

E.24 There is no reliable figure available for the likely unabated concentration of dioxins. As such, in-line with EA assessment methodology, the emission limit has been multiplied by a factor of 100, to assess the effects. In practice, given that dioxins are most likely to be associated with the particulate phase, this is a very conservative assumption and the factor of 30 derived for unabated particulate emissions would be a more realistic assumption.

Short-term Impacts

E.25 The effect of elevated short-term emissions of dioxins and furans is not considered likely to be significant as they accumulate slowly in the body over time due to inhalation and ingestion (a time period of 70 years is assumed for lifetime exposure to dioxins and furans). Accordingly, a short-term emission of 100 times the benchmark value for four hours will have no acute effect by inhalation on human health.

Long-term Impacts

E.26 An increase of 100 times the benchmark value for 60 hours per year will increase the amount deposited over a year at any given site by a factor of [(100 x 60/8760) + (8700/8760)] = 1.67.

E.27 The Human Health Risk Assessment (HHRA) produced by Gair Consulting Ltd provides the calculated Mean Daily Intake (MDI) on page 24 which is the typical intake from background sources (including dietary intake) across the UK and the Tolerable Daily Intake (TDI) .

E.28 The PC for normal conditions has been multiplied by a factor of 1.67 to determine the abnormal PC. The results are provided in Table E.11.

Table E.11: Impact Analysis TDI Maximum for Dioxins During Normal and Abnormal Operations

Maximum Impacted Receptor	MDI as % of TDI	Process Contribution as % of TDI (Normal)	Process Contribution as % of TDI (Abnormal)	Overall % of TDI (sum of MDI and Abnormal)
Adult	35%	7.1%	11.9%	46.9%
Child	90%	10.4%	17.4%	107.4%

E.29 The results show that the overall dioxins for adult receptors are below the TDI. For child receptors the overall dioxins is 107.4% of the TDI. Paragraph 3 on page 24 of the draft HHRA explains how although the overall % of TDI (normal) is 100.4% *"it should be noted that the TDI for PCCD/Fs is* *set for the purposes of assessing lifetime exposure and these elevated background exposures for children are therefore not representative of long term exposure*".

Failure of the Acid Gas Abatement System

Short-term Impacts

E.30 Failure of the acid gas abatement system has been considered as follows. The unabated emission of each acid gas is expected to be HCl 850 mg.m^{-3}, HF 15 mg.m^{-3} and SO_2 300 mg.m^{-3} at 6% O_2. The abnormal PC has been calculated based on the ratio of unabated emissions to the emission concentration used in the assessment and reported in Table E.12.

Table E.12: Predicted Short-term Concentrations (µg.m^{-3}) During Normal and Abnormal Operations

Pollutant	Averaging Period	EAL	Normal	Abnormal						
			Max PC	Max PC	PC as % of EAL	PC <10% EAL?	Screen Out	AC	PEC	PEC as % of EAL
HCl	1 hour (max)	750	2.88	203.8	27	No	No	0.27	204.09	27
HF	1 hour (max)	160	0.36	3.6	2	Yes	Yes		-	-
SO_2	15 min (99.9th %ile)	266	12.25	61.3	23	No	No	26.0	87.3	33
	1 hr (99.73th %ile)	350	10.32	51.6	15	No	No	26.0	77.59	22
	Daily-mean (99.18th %ile)	125	4.15	20.8	17	No	No	26.0	46.77	37

E.31 The predicted PECs for short-term emissions of HCl, HF and SO_2 are below the EALs over the relevant averaging periods and as such will have no significant adverse effect.

Failure of the Activated Carbon Injection System (Vapour phase heavy metal and dioxin and furan control)

E.32 Chemosphere, Vol 45, No 8 pp 1151 - 1157 reports that activated carbon injection systems are up to 98.7% efficient in the removal of dioxins and furans. As such it has been conservatively assumed that in the event of a failure of the activated carbon system all emission will increase by an order of 100 times.

Dioxins and Furans

E.33 Abnormal emissions with an increase by an order of 100 times for Dioxins and Furans has already been discussed in paragraphs E.24 to E.29.

Metals

Short-term Impacts

E.34 Based on the assumption above it has been assumed that heavy metals are emitted at 100 times the mass emitted under normal operations. Table E.13 sets out the PC under abnormal operations.

E.35 It should be noted that the Activated Carbon injection system is used to control vapour phase emissions of metals. Most metals will be in the particulate phase, with only Hg and a limited amount of Cd emitted as vapour at the stack temperature of around 72^{0}C. Some metals, such as Cu, may be volatised at this temperature but it unlikely that elements with a higher melting point, e.g. V and Ni will vaporise.

Table E.13: Predicted Short-term Concentrations (µg.m^{-3}) During Normal and Abnormal Operations

Pollutant	EAL	AC	Normal	Abnormal					
			Max PC	Max PC	PC as % of EAL	PC <10% EAL?	Screen Out	PEC	PEC as % of EAL
Cd	No EAL	-	-	-	-	-	-	-	-
Tl	30	-	0.0072	0.72	2	Yes	Yes	-	-
Hg	7.5	-	0.0072	0.72	10	Yes	Yes	-	-
Sb	150	-	0.0719	7.19	5	Yes	Yes	-	-
As	No EAL	-	-	-	-	-	-	-	-
Cr	150	-	0.0719	7.19	5	Yes	Yes	-	-
Co	6 (a)	0.00028	0.0719	7.19	120	No	No	7.19	120
Cu	200	-	0.0719	7.19	4	Yes	Yes	-	-
Pb	No EAL	-	-	-	-	-	-	-	-
Mn	1500	-	0.0719	7.19	0	Yes	Yes	-	-
Ni	No EAL	-	-	-	-	-	-	-	-
V	1	0.004	0.0719	7.19	719	No	No	7.20	720

(a) refers to EALs obtained from the EA's earlier Horizontal Guidance Note EPR H1 guidance note, as no levels are provided in the current guidance.

E.36 All short-term emissions, with the exception of Co and V are below 10% of the EAL and can be screened out as insignificant.

E.37 The Environment Agency Group 3 guidance requires the assessment to progress to the second stage assessment for those metals that cannot be screened out based on 100% of the emission limit. Co and V cannot be screened out at Step 1, these two metals have to be considered in more detail as part of the Step 2 assessment which assumes each element is emitted at 11% of the total Group 3 limit. The results are shown below.

Table E.14: Predicted Long-term Concentrations (µg.m^{-3}) During Normal and Abnormal Operations – Step 2

Pollutant	EAL	AC	Normal	Abnormal					
			Max PC	Max PC	PC as % of EAL	PC <1% EAL?	Screen Out	PEC	PEC as % of EAL
Co	0.003	0.0003	0.0080	0.7993	13	No	No	0.7996	13
V	0.0002	0.0020	0.0080	0.7993	80	No	No	0.8013	80

E.38 The results of the step 2 assessment show the PECs for Co and V to be below the relevant EAL, and can be screened out as insignificant.

E.39 It should be noted that the Activated Carbon injection system is used to control vapour phase emissions of metals. Most metals will be in the particulate phase, with only Hg and a limited amount of Cd emitted as vapour. As such failure of the Activated Carbon injection system is unlikely to lead to any significant short-term emissions of metals. No significant adverse effect on human health is anticipated.

Long-term Impacts

E.40 Based on the assumption used above that heavy metals are emitted at 100 times the normal emission concentration for a maximum of 60 hours then under abnormal operations the impact can be calculated using the following formula: PC (normal) x [(100 x 60/8760) + (8700/8760)]. Table E.15 sets out the PC under abnormal operations.

Table E.15: Predicted Long-term Concentrations (µg.m^{-3}) During Normal and Abnormal Operations

Pollutant	EAL	AC	Normal	Abnormal					
			Max PC	Max PC	PC as % of EQS	PC <1% EAL?	Screen Out	PEC	PEC as % of EAL
Cd	0.005	0.00140	0.0003	0.0005	11	No	No	0.0019	39
Tl	1	-	0.0003	0.0005	0	Yes	Yes	-	-

Hg	0.25	-	0.0003	0.0005	0	Yes	Yes	-	-
Sb	5	-	0.0032	0.0054	0	Yes	Yes	-	-
As	0.003	0.00081	0.0032	0.0054	179	No	No	0.0062	206
Cr	5	-	0.0032	0.0054	0	Yes	Yes	-	-
Cr (VI)	0.0002	-	0.0000	0.0000	1	Yes	Yes	-	-
Co	0.2 (a)	0.00028	0.0032	0.0054	3	No	No	0.0056	3
Cu	10	-	0.0032	0.0054	0	Yes	Yes	-	-
Pb	0.25	0.01561	0.0032	0.0054	2	No	No	0.0210	8
Mn	0.15	0.03000	0.0032	0.0054	4	No	No	0.0354	24
Ni	0.02	0.00499	0.0032	0.0054	27	No	No	0.0103	52
V	5	-	0.0032	0.0054	0	Yes	Yes	-	-

(a) refers to EALs obtained from the EA's earlier Horizontal Guidance Note EPR H1 guidance note, as no levels are provided in the current guidance.

E.41 All long-term emissions, with the exception of As are below the EAL and can be screened out as insignificant.

E.42 The Environment Agency Group 3 guidance requires the assessment to progress to the second stage assessment for those metals that cannot be screened out based on 100% of the emission limit. As arsenic cannot be screened out at Step 1, it has to be considered in more detail as part of the Step 2 assessment which assumes each element is emitted at 11% of the total Group 3 limit. The results are shown below.

Table E.16: Predicted Long-term Concentrations (µg.m^{-3}) During Normal and Abnormal Operations – Step 2

Pollutant	EAL	AC	Normal	Abnormal					
			Max PC	Max PC	PC as % of EAL	PC <1% EAL?	Screen Out	PEC	PEC as % of EAL
As	0.003	0.0008	0.0004	0.0006	20	No	No	0.0014	47

E.43 The results of the step 2 assessment shows the PEC for As to be below the relevant EAL and can be screened out as insignificant.

E.44 It should be noted that the Activated Carbon injection system is used to control vapour phase emissions of metals. Most metals will be in the particulate phase, with only Hg and a limited amount of Cd emitted as vapour at the stack temperature of around 72^{0}C. As such failure of the Activated Carbon injection system is unlikely to lead to any significant short-term impact.

Summary of Conclusions

E.45 Under abnormal operations, all air quality impacts are considered to have an insignificant effect.

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