Environmental Visage

BIOMASS UK NO. 4 LIMITED; DARTMOOR DISPERSION MODEL AND AIR QUALITY ASSESSMENT

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Executive Summary

A detailed air quality assessment has been undertaken on behalf of Biomass UK No. 4 Limited in order to consider a proposal to convert an existing wood fired Energy from Waste (EfW) plant, for the receipt and use of Refuse Derived Fuel (RDF) and determines the resultant impact on air quality. Dartmoor Bio Power was built as a 4.3 MW_e waste wood incineration plant. The generation capacity of the facility will remain at 4.3 MW_e with the switch to RDF and the facility will in future be known as Biomass Number 4 (Biomass No. 4).

Discharge characteristics for the proposed facility were provided by the technology providers via Biomass UK No. 4 Limited and suggest an overall increase in the volumetric flow-rate from that measured in 2018, although a proposed increase in the diameter of the stack results in a reduction in the velocity, and an increase in the temperature of the discharge from that of the existing, albeit not operational, facility. Mass emission rates were also reduced from the original scheme due to changes in the regulatory limits that will be applied to the site operations through the Environmental Permitting regime. That said, measured data from the existing plant, taken from the continuous emissions monitor in 2018 confirmed that the annual average discharge of key pollutants remained within the permitted emission limit values, and modelling has considered both the annual average discharge and the maximum allowable discharge of the existing facility in order to provide a comparison between the existing and proposed schemes.

The assessment of the proposed development has considered both long and short-term normal operating conditions, and other than normal operating conditions which can lead to elevated concentrations that are limited in their duration.

The results from a detailed dispersion modelling and air quality assessment confirmed that, when discharging via the proposed 35 m high chimney the contribution of most pollutants will have an insignificant impact on air quality in the surrounding area. Where contributions were not immediately screened as insignificant, both at discrete receptors and across the modelled grid, the predicted environmental concentrations were confirmed to remain within 70 % of the long-term Air Quality Standard or Environmental Assessment Level and hence were screened at the secondary assessment stage.

When considering the contribution of proposed emissions from the Biomass No. 4 facility in combination with other new or proposed facilities in the area, the cumulative short-term, 99.79th percentile hourly average contribution of Nitrogen Dioxide equates to 25 % of the AQS and therefore does not screen at the initial or secondary assessment stage. However, the predicted environmental concentration remains within the AQS, and it is therefore considered unlikely that levels of Nitrogen Dioxide in the local area will approach or exceed the Air Quality Standard objective value or result in any significant impact on human health.

Contributions to the Critical Loads of nutrient Nitrogen and acid deposition assigned to all local sensitive ecological receptors were also screened as insignificant whether considering the Biomass No. 4 plant in isolation or in combination with other local sites.

Short-term impacts resulting from allowable 30-minute emission remained within the most relevant assessment level despite applying an overly conservative assessment which considered the impact of half-hourly emissions against longer-term (generally hourly) assessment levels.

Finally, the potential for other than normal operating conditions to occur over the course of a year has also been considered and the impact of such incidents can be screened as insignificant.

Contents

Issue and Revision Record

Issue	Date	Author	Review / Authorise	Description
DRAFT	09/07/2021	A. Owen	ENVISAGE	Draft for Client comment
1	15/07/2021	A. Owen	ENVISAGE	Final report for issue
2	19/09/2023	A. Owen	ENVISAGE	Editorial changes – no technical update

1. Introduction

Environmental Visage Limited (Envisage) was commissioned by Biomass UK No. 4 Limited to prepare a detailed dispersion model and air quality assessment (AQA) of the proposed conversion of the Dartmoor Bio Power operation from wood fuel to Refuse Derived Fuel (RDF).

The Biomass UK No. 4 Limited site is situated at the northern most extent of the wider Plymouth area, in the Roborough area of the city. The existing site is situated off Belliver Way, with access via Haxter Close. The Dartmoor Bio Power plant is no longer operational and Biomass UK No. 4 Limited proposes to convert the plant to an RDF plant, commencing operations from 2023.

The proposed plant will maintain its current 4.3 MW electricity generation capacity and this dispersion model and AQA has been commissioned in order to demonstrate the likely suitability of proposed emissions from the adapted plant.

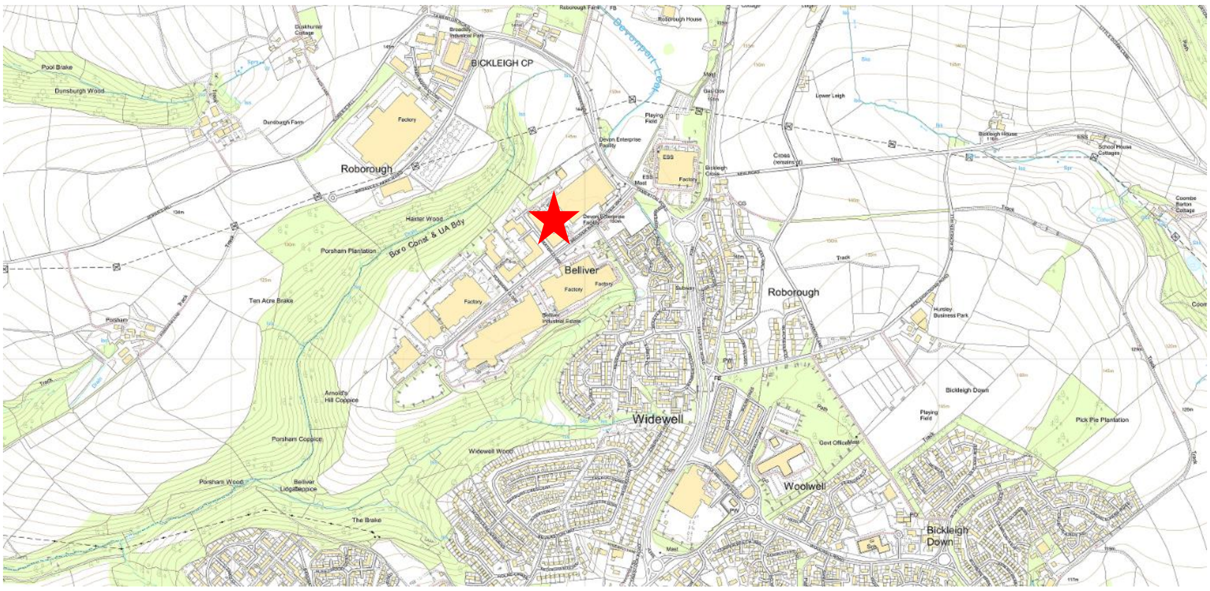
The discharge characteristics of the proposed facility were provided by the technology providers via Biomass UK No. 4 Limited and, due to the increased stack diameter proposed, the velocity of the discharge is reduced, despite an increased volumetric flow-rate. That said, the proposal includes an increased stack height to 35 m from the existing 27 m, and this higher release point promotes good dispersion of the plume. Mass emission rates were also reduced from the original scheme due to changes in the regulatory limits that will be applied to the site operations through the Environmental Permitting regime.

This study has considered the dispersion of the proposed release from the Biomass No. 4 plant, accounting for normal, short-term, and other than normal operating conditions. It compares the results to the existing, albeit non-operational Dartmoor Bio Power facility and considers the impact of other schemes in the local area which have been submitted for, or have recently gained planning consent, but which will not yet be contributing towards or considered within the background data available to the study.

1.1 Site Location and Local Setting

Biomass No. 4 is located to the north of Plymouth at national grid reference SX 499 624 (249895 062385). Figure 1 below shows the location of the existing Dartmoor Bio Power site, highlighted by the red star, proposed to become the Biomass No. 4 facility.

Figure 1 Site Location



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2. Methodology of and Inputs to the Detailed ADMS Dispersion Model Assessment

This section summarises the dispersion modelling methodology applied and the inputs into the Biomass No. 4 model prepared for the assessment.

2.1 ADMS Model

The Atmospheric Dispersion Modelling System (ADMS) Version 5.2 modelling software was applied and is one of a range of models available for assessing the impact of pollutant emissions to atmosphere on local air quality. Those used routinely in the UK for this sort of application include United States Environmental Protection Agency (US-EPA) models such as AERMOD, and the ADMS models developed in the UK by Cambridge Environmental Research Consultants (CERC).

The ADMS model can be used to assess ambient pollutant concentrations arising from a wide variety of emissions sources associated with an industrial process. It can be used for initial screening or more refined determination of ground level pollutant concentrations on either a short-term basis (up to 24-hour averages) or longer-term (monthly, quarterly or annual averages).

2.2 Modelling Uncertainty

Atmospheric dispersion modelling is not a precise science and results can be impacted by a variety of factors such as:

- Model uncertainty - due to limitations in the dispersion algorithms incorporated into the model and their ability to replicate "real life" situations;
- Data uncertainty - due to potential errors associated with emission estimates, discharge characteristics, land use characteristics and the relevance of the meteorological data to a particular location; and,
- Variability - randomness of measurements used.

CERC models are continually validated against available measured data obtained from real world situations, field campaigns and wind tunnel experiments. Validation of the ADMS dispersion models has been performed using many experimental datasets that test different aspects of the models, for instance: ground / high level sources, passive and buoyant releases, buildings, complex terrain, chemistry, deposition and plume visibility. These studies are both short-term as well as annual, and involve tracer gases or specific pollutants of interest.

Potential uncertainties in model results derived from the current study have been minimised as far as practicable, and a series of worst-case assumptions have been applied to the input data in order to provide a robust assessment. These included the following:

- Selection of the dispersion model - ADMS 5.2 is a commonly used atmospheric dispersion model which has been verified through a number of inter-comparison studies to ensure that model predictions are as accurate as possible;
- Meteorological data - Modelling was undertaken using hourly average meteorological data from the nearby Plymouth Mount Batten measurement station which is considered to be the most representative of local conditions;
- Operating conditions – The normal operating conditions of the plant are assumed to be continual (24 hours, seven days per week) and therefore represent the maximum possible operation of the facility. Additional consideration is given to short-term and other than normal operating conditions and thus the assessment as a whole is considered to be representative of worst-case process operations;
- Receptor locations - A 4 km x 4 km Cartesian grid with 20-metre grid spacing was utilised in the model in order to calculate maximum predicted concentrations in the vicinity of the Biomass No. 4 plant. Specific receptor locations were also included in the model to provide detailed assessment in local sensitive areas; and,

- Variability - All model inputs are as accurate as possible and worst-case conditions were considered as necessary in order to ensure a robust assessment of potential ground level pollutant concentrations.

Results were considered in the context of Air Quality Standards (AQS) objective values and relevant Environmental Assessment Levels (EALs) recommended by the Environment Agency, as well as the joint guidance of Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM). The application of the above measures to reduce uncertainty and the use of a series of worst-case assumptions relating to the operational performance of the process should result in model accuracy of an acceptable level.

2.3 Site Layout and Discharge Conditions

When compiling a dispersion model, it is important to accurately describe the emissions and discharge conditions of the release points being assessed, but also to identify infrastructure across the site or in the vicinity which could impact on the discharge from the point sources. Tables 1 and 2 below detail the stack infrastructure and discharge conditions, and the layout of buildings across the site which were included within the dispersion model to represent the proposed installation.

Table 1 Stack Location and Release Characteristics

Reference	**Main Stack (A1)**	
Stack Location (grid reference)	249895, 062350	
Stack Height (m)	35	
Stack Diameter (m)	1	
Efflux Temperature (^oC)	185	
Flue Gas Volumetric Flowrate (As Measured m^3 hr^{-1})	44,784	
Flue Gas Volumetric Flowrate (As Measured m^3 s^{-1})	12.44	
Efflux Velocity (m s^{-1})	15.84	
Flue Gas Volumetric Flowrate Nm^3 hr^{-1} (11 % O_2, dry, STP)	38,136	
Pollutant Concentration / Mass Release	**mg Nm^{-3}**	**g s^{-1}**
Oxides of Nitrogen (NO_x)	120	1.27
Nitrogen Dioxide (NO_2)*	60	0.635
Particulates (PM_{10})	5	0.053
Carbon Monoxide (CO)	50	0.530
Sulphur Dioxide (SO_2)	30	0.318
Hydrogen Chloride (HCl)	6	0.0636
Hydrogen Fluoride (HF)	1	0.0106
Volatile Organic Compounds (VOC)	10	0.106
Ammonia (NH_3)	10	0.106
Cadmium and Thallium (Cd and Tl)	0.02	0.000212
Mercury and its compounds (Hg)	0.02	0.000212
Group 3 metals (Pb, Ab, As, Cr, Co, Cu, Mn, Ni, V)	0.3	0.00318
Dioxin and Furans	0.00000004	4.24×10^{-10}
Combined Dioxins, Furans and PCBs	0.00000006	6.36×10^{-10}
Benzo[a]Pyrene (for PAH)	0.001	0.0000106

* Assumes 50 % conversion of NO_x to NO_2 in the short-term, in line with Environment Agency guidance[1].

As the site will undergo significant works during its refurbishment and redevelopment it will be classified as a new (or substantially refurbished) plant, and the technology providers have confirmed that the future process will be able to comply with the Best Available Techniques Associated Emissions Levels (BAT-AELs) pollutant concentrations specified in the BAT-Conclusions document[2] for new plant.

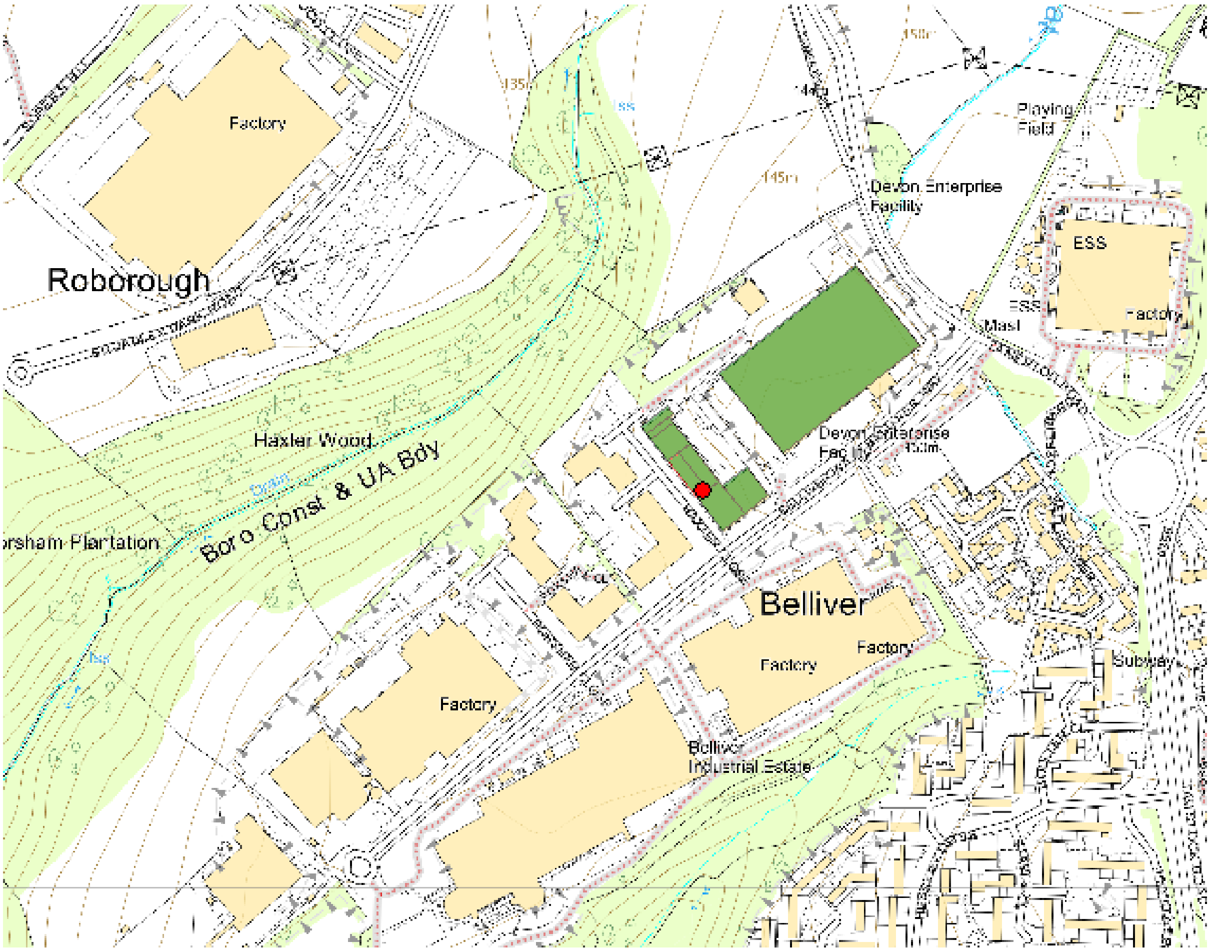
For the purpose of the detailed dispersion model and AQA it has been assumed that the plant operates continually and at full output throughout the year. The models were therefore run to calculate the annual average process contributions from the plant for all 8,760 hours (or 8,784 hours) of the year, and hence provide a worst-case assessment.

Table 2 Local Building Dimensions

Building / Structure	Height (m)	Length (m)	Width (m)
Elevated Section (from which stack protrudes)	15.9	42	12.3
Fuel Store	12.89	31	27
Main Building 1	9.13	36.48	24.6
Main Building 2	9.13	42	12.3
Main Building 3	9.13	5.77	24.6
Main Building 4	18.5	24.32	24.6
Air Cooled Condensers	8.5	7.87	30
Neighbouring Building	8	91.14	154.94

The modelled layout is depicted in Figure 2 below.

Figure 2 Building Layout and Stack Location



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As the site has previously operated and therefore already has planning consent and an Environmental Permit with which it complied, data is available on the emissions from the Dartmoor Bio Power facility and these have been applied to assess the existing potential impact of emissions from the consented process. Modelling files were created to produce results for the existing plant operating as measured, and at emission limit values, for comparison with the proposed unit and were run with a single years' worth of meteorological conditions. The inputs into these models are presented in Table 3 over page.

Table 3 Existing Stack Location and Historical Release Characteristics

Reference			**Main Stack (A1)**	
Stack Location (grid reference)			249895, 062350	
Stack Height (m)			27	
Stack Diameter (m)			0.8	
Efflux Temperature (°C)			158	
Flue Gas Volumetric Flowrate (As Measured m^3 hr^{-1})			32,337	
Flue Gas Volumetric Flowrate (As Measured m^3 s^{-1})			8.98	
Efflux Velocity (m s^{-1})			17.87	
Flue Gas Volumetric Flowrate Nm^3 hr^{-1} (11 % O_2, dry, STP)			24,556	
Pollutant Concentration / Mass Release	**Measured 2018**		**Emission Limit**	
	mg Nm^{-3}	**g s^{-1}**	**mg Nm^{-3}**	**g s^{-1}**
Oxides of Nitrogen (NO_x)	154.08	1.05	200	1.36
Nitrogen Dioxide (NO_2)*	77.04	0.525	100	0.68
Particulates (PM_{10})	5.62	0.0383	10	0.0682
Carbon Monoxide (CO)	3.3	0.0225	50	0.341
Sulphur Dioxide (SO_2)	12.61	0.0860	50	0.341
Hydrogen Chloride (HCl)	7.84	0.0535	10	0.0682
Hydrogen Fluoride (HF)	-	-	1	0.00682
Volatile Organic Compounds (VOC)	-	-	10	0.0682

It is noted that the building layout for the existing plant was similar to that which is now proposed, although the area identified in Table 2 as 'Main Building 4' does not currently have a higher roof-line than the rest of the 'Main Building' units.

2.4 Local Environmental Conditions

Local environmental conditions describe the factors that might influence the dispersion process such as sharply rising terrain, etc. and also describe the locations at which pollutant concentrations are to be predicted. These include:

2.4.1 Local Terrain

Local terrain can affect wind flow patterns and, consequently, can affect the dispersion of atmospheric pollutants. The effects of terrain are not normally noticeable where the gradient is less than 10 %. As the Biomass No. 4 plant is situated close to the top of a hill, overlooking Plymouth which stretches to Plymouth Sound, terrain effects were included within the detailed modelling exercise using OS Terrain 50 digital data to map the terrain local to the plant, in order to ensure the model was as accurate as possible.

Terrain data was only applied to gridded and local receptor data. Receptors more than approximately 2 km away from the site were outside of the terrain mapping applied, and therefore no terrain data was considered when modelling these points.

2.4.2 Surface Roughness

Surface roughness defines the amount of near-ground turbulence that occurs as a consequence of surface features, such as land use (i.e. agriculture, water bodies, urbanisation, open parkland, woodland, etc.). Agricultural areas may have a surface roughness of approximately 0.2m to 0.3m whereas large cities and woodlands may have a roughness of 1 to 1.5m.

The Biomass No. 4 plant is located in Roborough, at the northernmost reaches of Plymouth. Although the city stretches out to the south, to the west, north, and east of the site, the land is more rural, with woodland, agriculture, and the moorland of the Dartmoor National Park situated locally. In order to account for the variations in surface roughness that may be present in the area, a spatially variable surface roughness file was created to ensure the appropriate consideration of turbulence impacts across the modelled area.

Similar to the terrain file however, the spatially variable surface roughness file was only applied to gridded and local receptor data. Receptors more than approximately 2 km away from the site were outside of the surface roughness data applied, and when modelling these points, an individual surface roughness figure of 0.2 was applied to account for the largely undeveloped nature of the area in the vicinity of the site.

2.4.3 Model Default Values Applied

The following values were retained as the default inputs defined by the model, in the absence of any site-specific data for the plant or the meteorological measurement station. The default values are defined for a typical rural UK site, and are considered appropriate due to the location of the industrial estate on the very outskirts of Plymouth.

Surface Albedo; 0.23 representing an area of non-snow covered land.

Priestley-Taylor Parameter; 1 representing moist grassland.

Minimum Monin-Obukhov Length; 1 m

2.4.4 Dry Deposition

As well as considering the potential contribution of pollution to air from the proposed Biomass No. 4 facility, pollutants can also be deposited onto the land in the vicinity of an emission source. Both dry and wet deposition remove material from a plume, depositing it onto the ground and altering the plume concentration. Dry deposition occurs when pollutants are brought to the surface by gravitational settling and turbulence, thereby depositing on the ground surface or on vegetation. Wet deposition occurs due to the scavenging of material from the plume either within cloud formations, where pollutants are absorbed into the rain, or below the cloud where they can be washed out of the plume by rainfall. These processes lead to a variation in the plume strength with distance, as well as potential changes in the vertical concentration profile.

Information from CERC, the company which developed the ADMS model, specifies that for Nitrogen Dioxide, Sulphur Dioxide and Ammonia, wet deposition from a short-range plume is much less significant compared with dry deposition, and therefore does not usually need to be considered. Wet deposition due to a primary release of Sulphur Trioxide or Sulphuric Acid would need to be considered if the release were significant, however, this does not apply in this instance. CERC's advice is supported by the Regulators guidance[3] which states that *"It is considered that the wet deposition of SO_2, NO_2 and NH_3 is not significant within a short range. However, wet deposition for HCl and HNO_3 should be considered where a process emits these species."* In the absence of any additional data, it is generally considered acceptable that total deposition (wet and dry) comprises 3 x dry deposition, where it is required to be included.

The detailed modelling exercise undertaken and reported here considered the effects of dry deposition only for Nitrogen Dioxide, Sulphur Dioxide and Ammonia. Deposition rates of Hydrogen Chloride and Hydrogen Fluoride are multiplied by 3 to represent total deposition for these highly soluble pollutants.

2.4.5 Output Grid

When setting up a receptor grid it is important to ensure that there are sufficient receptor points to be able to accurately predict the magnitude and location of the maximum process contribution. If the grid is too widely spaced, the maximum concentration may be missed. Modelling was undertaken using a 4 km x 4 km grid with 20-metre spacing. The site is located approximately centrally within the grid. Additionally, specific receptors, representing locations where members of the general public may be present for significant periods of time, as well as nearby ecological habitat receptors, were entered into the model.

The combination of emissions, atmospheric chemistry, and meteorology can drive substantial variation in the distribution of short-term pollutant concentrations across the year and across each day that underpin any given annual average process contribution. The air quality standards account for this by establishing both a long-term (annual mean) and a short-term (one-hour mean) where appropriate, to reflect the varying impacts on health of differing exposure to pollutants. For example, the long-term standard for NO_2 (40 µg m^{-3}) is lower than the short-term standard (200 µg m^{-3}) owing to the chronic health effects associated with exposure to a low concentration of pollutants for longer periods.

The AQS objectives apply at locations where members of the public would be exposed over the relevant exposure period. For example, the annual mean objective applies at the building facades of residential properties and public buildings, but does not apply in gardens of residential properties, at the building facades of offices or other places of work where exposure would be relatively short-term. The one hour mean objective would however, apply at any outdoor location where members of the public might reasonably be expected to spend an hour or longer.

A total of 43 receptors were included within the Biomass No. 4 modelling exercise, as shown in Figure 3 and listed in table 4. However, some of these are outside of the area mapped in Figure 3 and hence do not appear.

Figure 3 Location of Specific Receptors in Relation to the Biomass No. 4 Plant

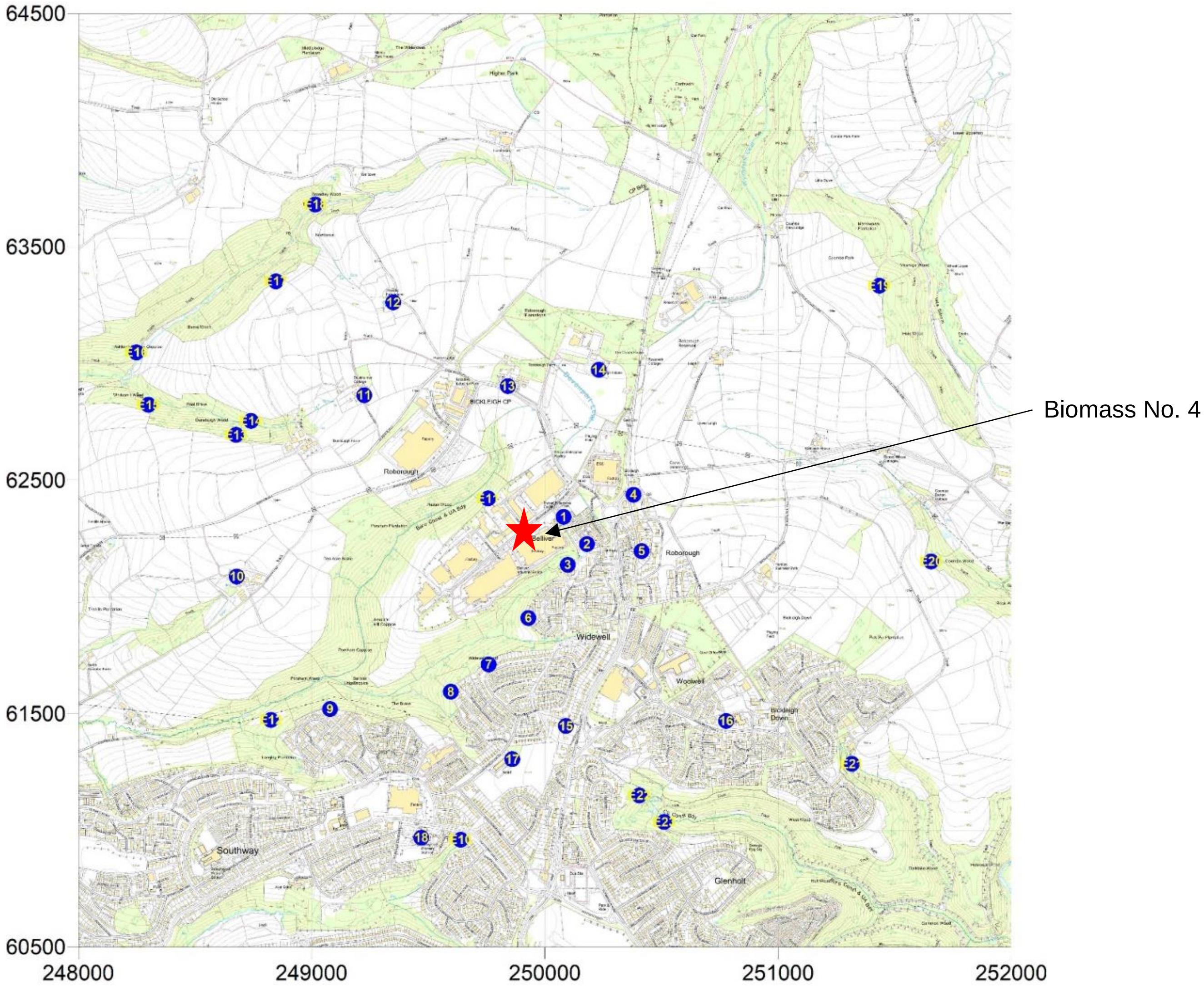

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Table 4 Specific Receptors Included in Detailed Modelling

Receptor	X	Y	Distance from Stack (m)	Receptor Name
1	250080	062343	185	Lady Fern Road, Belliver
2	250180	062227	310	Claytonia Close, Belliver
3	250097	062138	293	Hessary Drive, Belliver
4	250380	062438	493	45, Leat Walk, Woolwell
5	250414	062197	541	3, Tavistock Road, Woolwell
6	249928	061910	441	Legis Walk, Belliver
7	249758	061711	654	Beverston Way, Belliver
8	249596	061594	813	Highclere Gardens, Belliver
9	249078	061520	1,165	Langley Crescent, Southway
10	248678	062088	1,245	Soper's Hill, Bickleigh - North north-west
11	249225	062865	845	Soper's Hill, Bickleigh – North-west
12	249350	063262	1,062	Soper's Hill, Bickleigh - West
13	249841	062904	557	Tamerton Road, Woolwell
14	250231	062973	708	Roborough House, Woolwell
15	250090	061447	924	White Oaks, Widewell Lane, Belliver
16	250777	061469	1,247	Bickleigh Down CofE Primary School
17	249860	061305	1,046	Widewell Primary Academy, Belliver
18	249470	060969	1,445	Oakwood Primary Academy, Derriford,
19	249052	060181	2,327	Notre Dame RC School, Southway
CM 7	248731	058966	3,579	Continuous Roadside Monitor for NO_2, Tavistock Road, south of Derriford Hospital.
E1	253140	064160	3,716	South Dartmoor Woods SAC 1
E2	253233	063730	3,612	South Dartmoor Woods SAC 2
E3	253883	063447	4,136	South Dartmoor Woods SAC 3
E4	247342	065106	3,757	Plymouth Sound and Estuaries SAC 1
E5	247081	063261	2,958	Plymouth Sound and Estuaries SAC 2
E6	247371	062792	2,562	Tamar Estuaries Complex SPA 1
E7	246608	060909	3,589	Tamar Estuaries Complex SPA 2
E8	257257	064715	7,733	Dartmoor SAC 1
E9	260007	061407	10,156	Dartmoor SAC 2
E10	249638	060960	1,414	Southway Valley LNR
E11	249756	062422	157	Haxter Wood
E12	248825	061473	1,383	Langley Plantation
E13	248675	062694	1,268	Dunsburgh Wood (Ancient)
E14	248739	062755	1,225	Dunsburgh Wood (Ancient Replanted)
E15	248299	062823	1,665	Whiteshill Wood
E16	248248	063048	1,789	Blaxton Coppice
E17	248846	063353	1,451	Bame Wood
E18	249015	063682	1,596	Broadley Wood
E19	251433	063334	1,826	Hele Wood
E20	251655	062152	1,771	Coombe Wood
E21	251315	061285	1,775	Darklake Wood
E22	250404	061150	1,303	West Wood
E23	250511	061036	1,451	Holt Wood

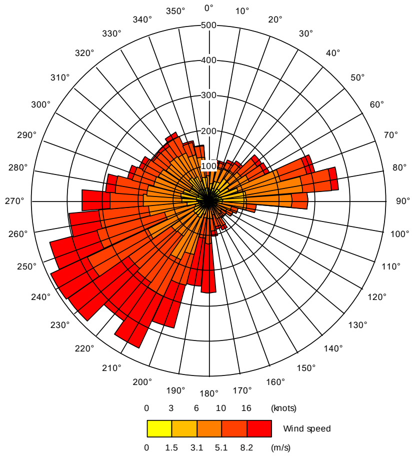
It should be noted that, although only a selection of discrete receptors has been chosen such as individual residential sites, or a single grid reference to represent a sensitive ecological area, the purpose of the Cartesian grid is to comprehensively model the pollutant dispersion across a designated area. Thus, other residential properties and the wider area of sensitive ecological sites within the gridded areas are fully considered by the model.

2.5 Meteorological Data

The detailed air quality assessment was undertaken using the ADMS Version 5.2 atmospheric dispersion model, applying the hourly average meteorological data set for the Plymouth Mount Batten measurement station, between 2016 and 2020. The Mount Batten meteorological measurement station is located approximately 10.2 km to the south of the site. The 2020 wind rose from the site is presented below and shows the prevailing winds from the south-west quarter. The meteorological record from Plymouth has any missing conditions replaced with data from nearby Exeter, and over the course of the five years, some periods of missing cloud-cover and / or wind speed and / or direction data were reported in this way.

Being an area developed with leisure facilities, the surface roughness of the meteorological station at Mount Batten was considered to best be described as parkland and / or open suburbia, and hence a surface roughness factor of 0.5 was applied to describe the area surrounding the monitoring point.

Figure 4 2020 Windrose for the Plymouth Mount Batten Meteorological Data Measurement Station



2.6 Background Air Quality

Background air quality data for 2023 in the locality of the development site were taken from the 2018 DEFRA Background Maps website[4].

Table 5 Background Levels of Pollution

Pollutant	Annual Average Concentration (µg m^{-3})	Short-Term Concentration (µg m^{-3})
Oxides of Nitrogen (NO_x)	11.72	23.44
Nitrogen Dioxide (NO_2)	8.99	17.99
NO_2 Measured on Tavistock Road (CM7) (2019)	18.7	37.4
Particulate Matter (PM_{10})	9.93	19.86
Particulate Matter ($PM_{2.5}$)	6.36	12.71
Carbon Monoxide (CO) (mg m^{-3})	0.113	0.226
Sulphur Dioxide (SO_2)	2.16	4.32
Benzene (VOC)	0.186	0.372
Concentrations at grid point 249500, 061500		

Note: The short-term concentration is calculated as twice the annual average.

The chosen location for the background concentration represents the nearest, upwind location to the site and is representative of conditions approximately 950 m to the south south-west of the site.

Where available, background air quality data for 2023 were taken from the DEFRA Background Maps website as detailed in Table 5, and were supported by the latest available locally measured data, although background levels of other pollutants, such as Ammonia and metal species were drawn from measured concentrations across the national monitoring network. As not all stations monitor each pollutant, or indeed on every year, the nearest available and most recent data has been included where appropriate. In some instances, the average of all relevant monitoring results is considered. Table 6 summarises these other background concentrations.

There is no readily available background data for levels of Hydrogen Chloride or Hydrogen Fluoride in the UK generally, and hence, where these are required for inclusion in the assessment, estimated data was drawn from the 2006 EPAQS report on Halogens and Hydrogen Halides in Ambient Air[5].

Table 6 Summary of Other Monitored Background Data Applied to the Study

Pollutant	Monitoring Result	Monitoring Location	Distance from Site
Ammonia	0.326 µg m^{-3} (2020)	Yarner Wood	Approx. 33 km NW
Benzo[a]Pyrene	0.062 ng m^{-3} (2020)	Chilbolton	Approx. 205 km NW
Dioxins and Furans*	5.945 fg TEQ m-3 (2016)	Rural Site Average	Various
Arsenic	0.41 ng m^{-3} (2020)	Yarner Wood	Approx. 33 km NW
Cadmium	0.065 ng m^{-3} (2020)	Yarner Wood	Approx. 33 km NW
Chromium	0.5 ng m^{-3} (2020)	Yarner Wood	Approx. 33 km NW
Cobalt	0.027 ng m^{-3} (2020)	Yarner Wood	Approx. 33 km NW
Copper	0.94 ng m^{-3} (2020)	Yarner Wood	Approx. 33 km NW
Hydrogen Chloride	0.41 µg m^{-3}	2006 EPAQS report on Halogens and Hydrogen Halides in Ambient Air	
Hydrogen Fluoride	0.003 µg m^{-3}		
Lead	1.7 ng m^{-3} (2020)	Yarner Wood	Approx. 33 km NW
Manganese	1.9 ng m^{-3} (2020)	Yarner Wood	Approx. 33 km NW
Mercury	1.3 ng m^{-3} (2020)	Chilbolton	Approx. 205 km NW
Nickel	0.37 ng m^{-3} (2020)	Yarner Wood	Approx. 33 km NW
Poly Cyclic Biphenyls*	13.66 pg m^{-3} (2018)	Rural Site Average	Various
Vanadium	0.56 ng m^{-3} (2020)	Yarner Wood	Approx. 33 km NW

* Dioxins and Furans and PCBs are measured at six monitoring sites across the UK. Four of these are urban background sites and the average of the 2016 Dioxin and Furan results from these sites has been applied as the background. None of the sites are local to the proposed development and the measured concentrations can vary between the sites. As such, the application of the average figure is considered to be appropriate. Data is available for 2017 but reports limited (1 %) data capture and hence has been discounted. There is no, more recent data available. A similar approach was applied to PCB measurements from the same sites, although PCBs were most recently measured in 2018.

2.7 Determining Significance

The UK Government, via the Environment Agency, provides guidance for screening the significance of air quality impacts associated with the operation of industrial processes[1].

For long-term impacts, the guidance recommends a 1 % insignificance threshold relative to a long-term Air Quality Standard (AQS) or Environmental Assessment Level (EAL) of the substance being studied, with a corresponding 10 % insignificance threshold for the assessment of short-term impacts.

If both of these criteria are met, there is no requirement to do any further assessment of the substance and its impact is screened as insignificant.

If the initial criteria are not met, a second stage screening assessment is undertaken to determine the impact of the Predicted Environmental Concentration (PEC). The PEC is the sum of the Process Contribution (PC) plus the appropriate background concentration. The second stage screening assessment states that if:

- the short-term PC is less than 20 % of the short-term environmental standard minus twice the long-term background concentration; and
- the long-term PEC is less than 70 % of the long-term environmental standard,

there is no requirement to do any further assessment of the substance and its impact is screened as insignificant.

2.8 Other Assessment Criteria

Within this report, and in addition to applying the Environment Agency's screening methodology, descriptive terms for the impact significance of long-term contributions of NO_2 and PM_{10} are based on those published in Land Use Planning and Development Control: Planning for Air Quality (2017 Update) prepared by Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM)[6]. Impact description involves expressing the "*magnitude of incremental change as a proportion of a relevant assessment level and then examining this change in the context of the new total concentration and its relationship with the assessment criterion*". The EPUK / IAQM descriptor matrix is shown in the Table below:

Table 7 Definition of Impact Magnitude for Changes in Annual Mean Nitrogen Dioxide and Particulates (PM_{10}) Concentration

LT Average Concentration	Percentage Increase on Air Quality Assessment Level (AQAL)			
	1	2 - 5	6 – 10	> 10
75 % or less of AQAL	Negligible	Negligible	Slight	Moderate
76 – 94 % of AQAL	Negligible	Slight	Moderate	Moderate
95 – 102 % of AQAL	Slight	Moderate	Moderate	Substantial
103 – 109 % of AQAL	Moderate	Moderate	Substantial	Substantial
110 % or more of AQAL	Moderate	Substantial	Substantial	Substantial

The EPUK / IAQM guidance states that impacts on air quality, whether adverse or beneficial, will have an effect on human health that can be judged as "significant" or "not significant". The above assessment criteria were applied to the modelled increases in annual average NO_2 and PM_{10} concentrations due to the operation of the proposed Biomass No. 4 plant.

3. Dispersion Modelling Results

The results of the detailed dispersion modelling are presented in this section, considering the maximum modelled contribution of each pollutant across the modelled grid, when considering five years' worth of meteorological data, and assessing the impact of this on local air quality.

3.1 Results of Modelling Nitrogen Dioxide (NO_2)

The results from detailed modelling of Nitrogen Dioxide associated with emissions from the Biomass No. 4 plant are presented in the following table.

Table 8 Maximum Process Contribution of Nitrogen Dioxide (NO_2)

Statistic	Exceedance Threshold	Averaging Period	Approximate Concentration ($\mu g\ m^{-3}$)	Approximate % of AQS Value
Annual Average (PC)	40	Annual	1.24	**3.1 %**
Annual Average (PEC)			10.23	25.6 %
Short-Term 99.79% (PC)	200	1 hr	7.09	3.5 %
Short-Term 99.79% (PEC)			25.07	12.5 %

Figures in bold represent results which cannot immediately be screened as insignificant.

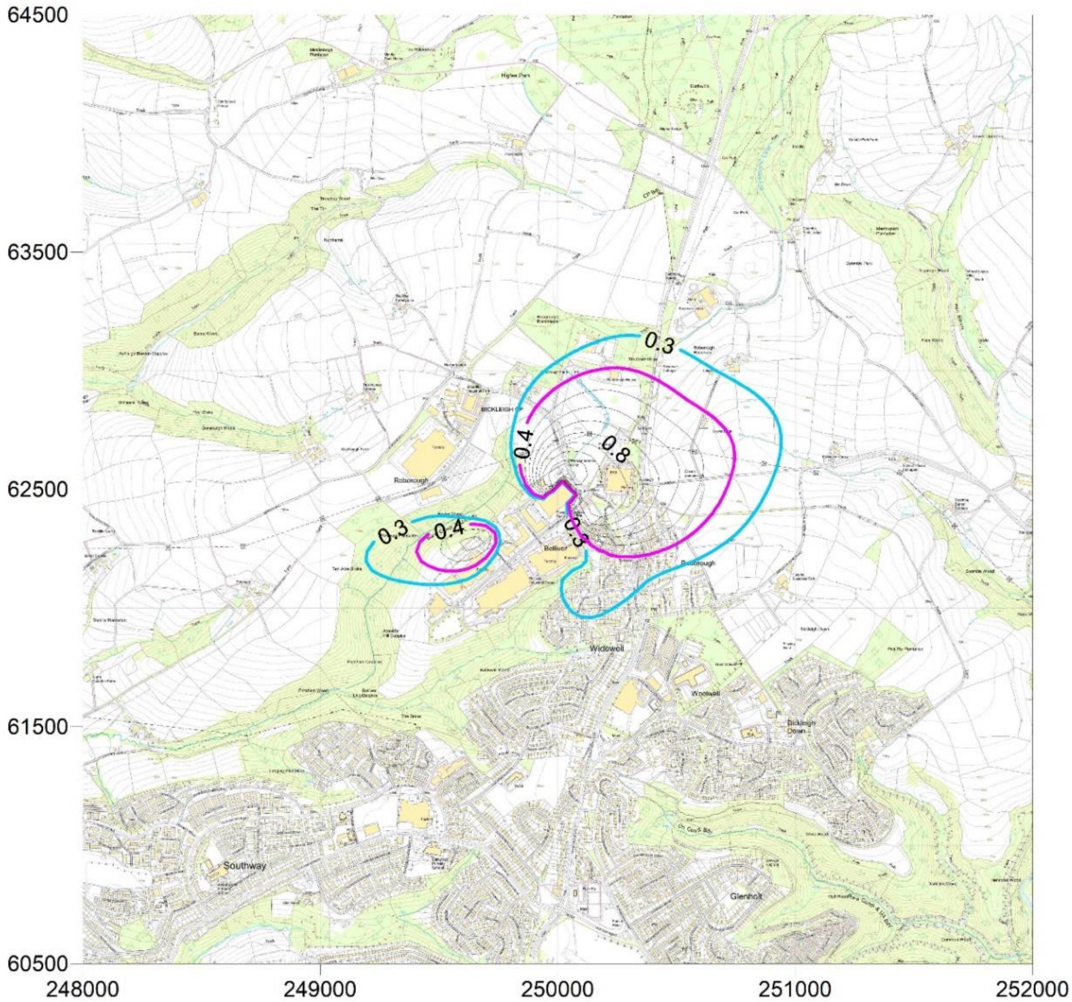
Data in Table 8 are based upon the maximum annual and 99.79th percentile hourly average NO_2 process contributions, due to emissions from the proposed Biomass No. 4 facility once converted to RDF firing. The maximum results from modelling five-years' worth of meteorological conditions are presented and are compared against the Air Quality Standards or Environmental Assessment Levels for NO_2 in ambient air, assuming continuous operations for the entire year.

The data presented are for both the maximum process contribution and the predicted environmental concentration for NO_2. PEC values take account of the DEFRA-estimated annual average background NO_2 concentration for 2023 of 8.99 µg m^{-3}, which is doubled to approximately 18 µg m^{-3} when considering the short-term concentrations.

The results show that, although not immediately screened as insignificant, with the annual average PC equating to slightly more than 3 % of the assessment level, the PEC screens at the secondary assessment stage, as the total annual average PEC remains well within the 70 % of the Air Quality Standard objective value.

In relation to the EPUK / IAQM guidance, the impact descriptor for an annual average contribution of approximately 3 % where the long-term average concentration remains at less than 75 % of the AQS would equate to a **negligible** impact at this point of maximum contribution. The model predicts the following pattern of dispersion for long-term contributions of NO_2.

Figure 5 Maximum Annual Average NO_2 Process Contribution (µg m^{-3}); 2020 Meteorological Conditions



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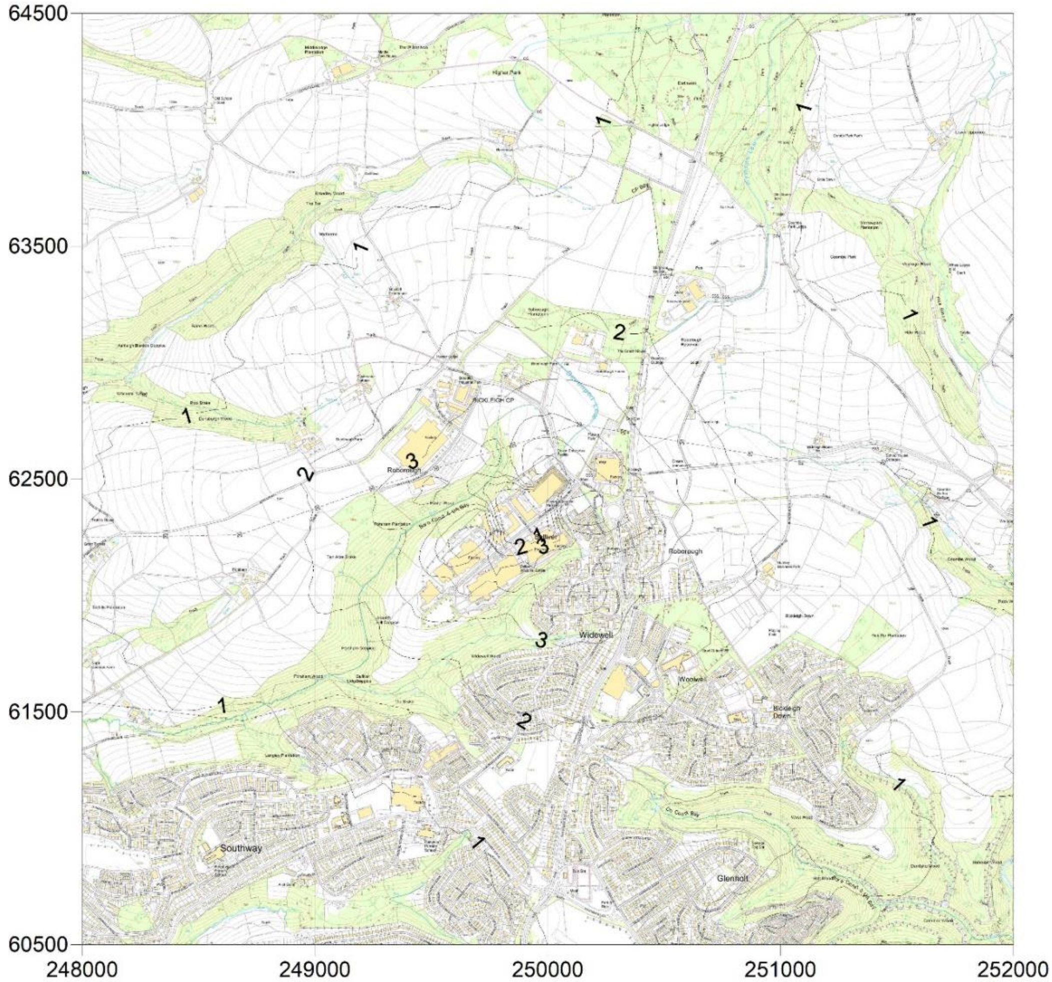
The coloured isopleths depict the point at which the contributions from the proposed Biomass No. 4 plant operations reduce to 1 % of the Air Quality Standard (0.4 µg m^{-3}) and the Environmental Assessment Level for the protection of ecological receptors (0.3 µg m^{-3}). Therefore, in all areas outside these contours, the annual average NO_2 process contribution can be regarded as insignificant in relation to Environment Agency guidance when assessing human health impacts and potential effects on ecological habitats respectively. The highest process contributions occur to the north-east of the site, approximately 239 m from the stack. Elevated concentrations are therefore experienced across the Biomass No. 4 and neighbouring sites on the industrial estate. However, the locations where contributions cannot immediately be screened as insignificant, are restricted to a relatively small area and are screened at the secondary assessment stage, remaining within 70 % of the assessment levels. Hence contributions are ultimately screened at all locations across the modelled grid, when applying the local background Nitrogen Dioxide levels.

The 99.79th percentile hourly average process contribution remains within 10 % of the short-term environmental standard and hence is immediately screened as insignificant. The corresponding contour plot for the maximum hourly average NO_2 process contribution is shown in Figure 6 below, assuming that 50 % of the NO_x emission is released as NO_2.

Figure 6 Maximum 99.79th Percentile Hourly Average NO_2 Process Contribution (µg m^{-3}); 2016 Meteorological Conditions



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With all contributions remaining within 10 % of the AQS objective value, they are immediately screened as insignificant, and no coloured isopleth is shown on the diagram. Further consideration is given to the impacts of Oxides of Nitrogen on sensitive ecological receptors in Section 5.

3.2 Sulphur Dioxide (SO_2)

The results from detailed modelling of Sulphur Dioxide associated with emissions from the proposed Biomass No. 4 operations are presented in the following table.

Table 9 Maximum Process Contribution of Sulphur Dioxide (SO_2)

Statistic	Exceedance Threshold (µg m^{-3})	Averaging Period	Approximate Concentration (µg m^{-3})	Approximate % of AQS / EAL Value
Annual Average (PC)	20*	Annual	0.311	**1.6 %**
Annual Average (PEC)			2.47	12.4 %
Short-Term 99.9 % (PC)	266	15 min	4.1	1.5 %
Short-Term 99.73 % (PC)	350	1 hr	3.53	1.0 %
Short-Term 99.73 % (PEC)			7.85	2.2 %
Short-Term 99.18 % (PC)	125	24 hr	2.38	1.9 %

* Assessment level of 10 µg m^{-3} where lichens and bryophytes are present, which is not the case here.

The results from the detailed modelling of emissions of SO_2 from the proposed Biomass No. 4 facility suggest that, when converted to RDF firing, the short-term process contributions to ground level concentrations of SO_2 will immediately screen as insignificant, remaining within 10 % of the assessment level. The long-term, annual average process contribution remains within the generic EAL for the protection of ecological areas and, although the percentage contribution is a little over 1 %, the location of this maximum point of impact is not in any specific ecological area, and the PEC remains well within 70 % of the EAL. Therefore, the annual average contributions are also screened as insignificant.

3.3 Particulates (PM_{10})

The following results relate to emissions of particulates from the Biomass No. 4 facility, assuming that all of the particles released are less than 10 µm in diameter; PM_{10}.

Table 10 Maximum Process Contribution for Particulates

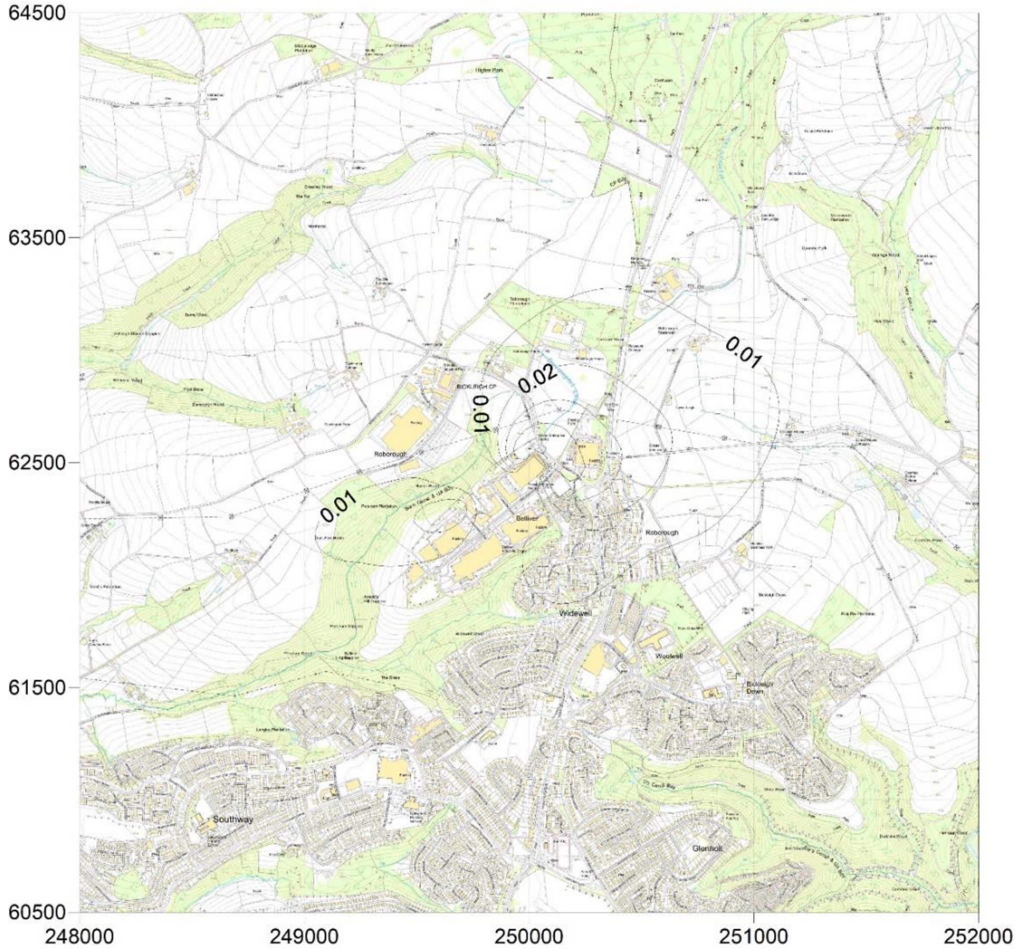
Statistic	Exceedance Threshold (µg m^{-3})	Averaging Period	Approximate Concentration (µg m^{-3})	Approximate % of AQS Objective Value
Annual Average (PC)	40	Annual	0.052	0.13 %
Annual Average (PEC)			9.98	24.9 %
Daily average 90.41 % (PC)	50	24 hr	0.163	0.33 %
Daily average 90.41% (PEC)			20.02	40 %

Data in Table 10 are based upon the maximum annual and 90.41st percentile 24-hourly average PM_{10} PC, due to emissions from the Biomass No. 4 facility when firing RDF. The maximum result from modelling five-years' worth of meteorological conditions are presented for each statistic and are compared against the Air Quality Standards for PM_{10}, assuming continuous operations for the entire year. The data presented are for both the maximum process contribution and the predicted environmental concentration for particulate, with the PEC values taking account of the DEFRA-estimated annual average background PM_{10} concentration for 2023 of 9.93 µg m^{-3}, which is doubled to approximately 20 µg m^{-3} when considering the short-term concentrations.

The results show that whether considering the annual average or short-term process contributions, the impact of emissions of PM_{10} from the Biomass No. 4 facility when firing RDF can immediately be screened as insignificant. In relation to the EPUK / IAQM guidance, the impact descriptor of an annual average contribution of less than 1 % resulting in a long-term average concentration of less than 75 % would equate to a **negligible** impact at this point of maximum contribution.

When the results from modelling the impact of emissions from the Biomass No. 4 plant are plotted, the following patterns of dispersion are seen.

Figure 7 Maximum Annual Average Particulate Matter Process Contribution as PM_{10} ($\mu g\ m^{-3}$); 2020 Meteorological Conditions



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The lack of a coloured isopleth in Figure 7 above confirms that the annual average process contribution of PM_{10} remains within 1 % (0.4 $\mu g\ m^{-3}$) of the annual average Air Quality Standard and will not have a significant impact on the health of people living and working nearby.

Similar conclusions can be drawn for emissions of fine particles ($PM_{2.5}$), as their dispersion characteristics are virtually identical to those of the overall PM_{10} fraction. That said, the assessment level for $PM_{2.5}$ is lower than that of PM_{10}, with an annual average assessment level of 20 $\mu g\ m^{-3}$. A process contribution of approximately 0.052 $\mu g\ m^{-3}$ would therefore equate to 0.26 % of the Air Quality Standard and, similar to the assessment of PM_{10} emissions, would be screened as insignificant at the initial assessment stage.

On the basis of the above results, the impact on local air quality of emissions of particulates from the Biomass No. 4 facility can be screened as insignificant and requires no further assessment.

3.4 Carbon Monoxide (CO)

The results from detailed modelling of Carbon Monoxide from the proposed Biomass No. 4 plant are presented in the table over page.

Table 11 Maximum Process Contribution for Carbon Monoxide (CO)

Statistic	Exceedance Threshold (mg m^{-3})	Averaging Period	Approximate Concentration (mg m^{-3})	Approximate % of AQS Value
Short-Term 100 % (PC)	10	Maximum Rolling 8 hr Average	0.008	0.08 %
Short-Term 100 % (PEC)			0.23	2.3 %

Detailed modelling predicted that the maximum rolling 8-hour average ground-level process contribution for CO associated with emissions from the Biomass No. 4 facility would be approximately 0.08 % of the AQS objective value of 10 mg m^{-3}, and can therefore immediately be screened as insignificant.

3.5 Volatile Organic Compounds (VOCs)

The results from detailed modelling of VOCs are presented in the Table below.

Table 12 Maximum Process Contribution for VOCs

Statistic	Exceedance Threshold (µg m^{-3})	Averaging Period	Approximate Concentration (µg m^{-3})	Approximate % of AQS Value
Annual Average (PC)	5	Annual	0.104	**2.1 %**
Annual Average (PEC)			0.29	5.8 %

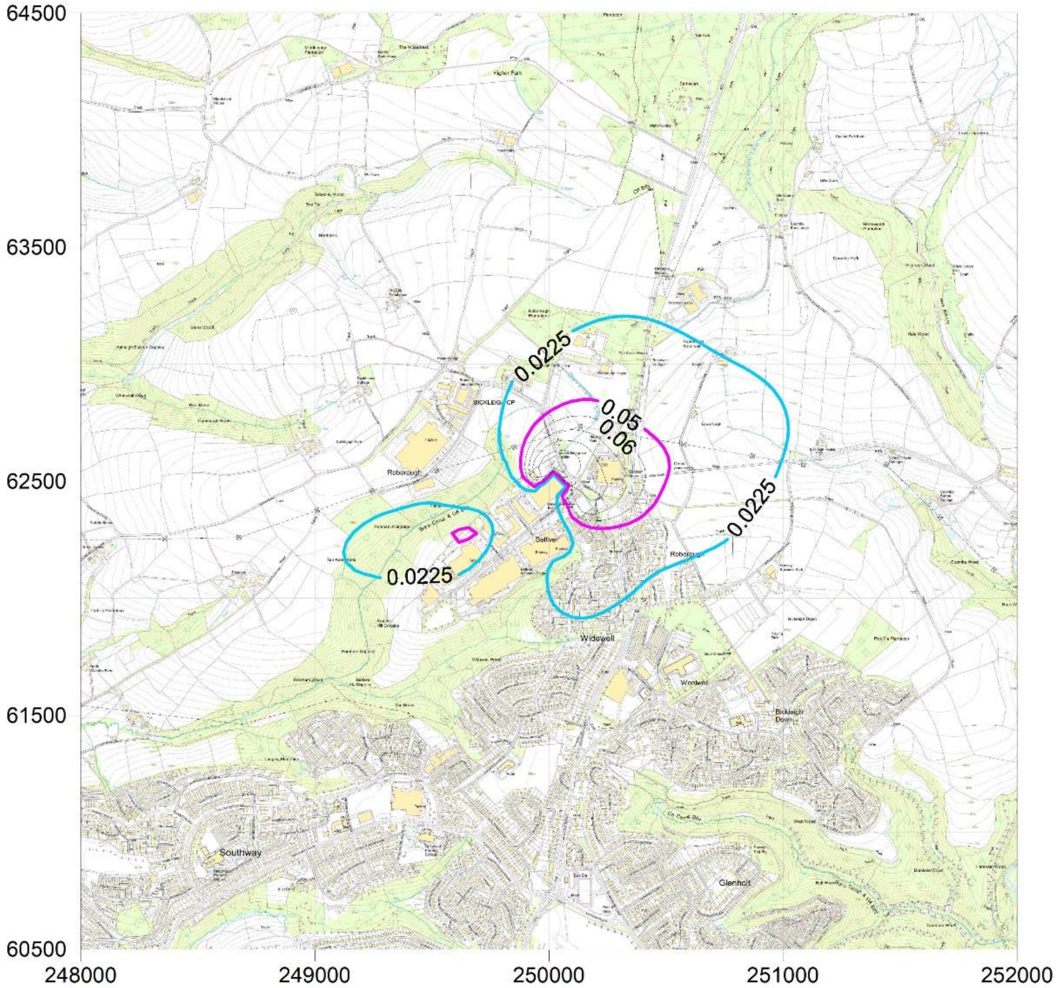
There are no assessment levels for combined VOC emissions as they comprise a mixture of organic compounds, although Benzene, a VOC, does have an Air Quality Standard. There is no information available about the proportion of Benzene that may be present in the VOC emission from the Biomass No. 4 plant although, it is likely to be a very small percentage of the total. However, in order to provide a worst-case assessment, the annual average process contribution for total VOCs was compared against the annual AQS objective value for Benzene of 5 µg m^{-3}.

The model predicted a maximum annual average process contribution of approximately 0.1 µg m^{-3} for total VOC emissions, which equates to approximately 2.1 % of the Benzene AQS and is not therefore immediately screened as insignificant. However, when including the annual average background concentration of 0.186 µg m^{-3}, the PEC equates to less than 6 % of the AQS and hence can be screened as insignificant at the secondary assessment stage, despite the conservative assessment applied.

The Air Quality Standard for 1,3-Butadiene, another VOC species, is less than half that of Benzene, at 2.25 µg m^{-3} and the emission of VOC from the Biomass No. 4 plant would therefore equate to approximately 5 % of the AQS should it all be released as 1,3-Butadiene. A local estimated background concentration of 0.0497 µg m^{-3} 1,3 Butadiene would result in a PEC of approximately 0.154 µg m^{-3} at the point of maximum contribution and, equating to approximately 7 % of the AQS, can be screened as insignificant at the secondary assessment stage.

The isopleth diagram presented over page shows the annual average process contribution of Volatile Organic Compounds, and as previously, the highest concentrations occur to the north-east of the site. The 1 % insignificance isopleths are shown for assessments of total VOC contributions against the AQS for Benzene (magenta contour) and 1,3-Butadiene (turquoise contour). However, with total VOCs comprising a number of different species, the actual impact of these individual species across the area will be much smaller in both its concentration and extent.

Figure 8 Maximum Annual Average Process Contribution of VOC (µg m^{-3}); 2020 Meteorological Conditions



3.6 Ammonia

The results from detailed modelling of Ammonia are presented in the Table below.

Table 13 Maximum Process Contribution for Ammonia (µg m^{-3})

Statistic - for the protection of human health	Exceedance Threshold (µg m^{-3})	Averaging Period	Approximate Concentration (µg m^{-3})	Approximate % of EAL Value
Annual Average (PC)	180	Annual	0.104	0.1 %
Short-Term 100 % (PC)	2,500	1 hr	5	0.2 %

Different Environmental Assessment Levels exist for Ammonia depending on whether the protection of human health or the environment is the driving factor. The data in Table 13 is assessed against the EALs for the protection of human health and, with process contributions equating to a fraction of 1 % of both the long and short-term EALs, can immediately be screened as insignificant.

Further consideration is given to the impacts of Ammonia on sensitive ecological receptors in Section 5.

3.7 Hydrogen Chloride (HCl)

The results from detailed modelling of HCl are presented in the following Table.

Table 14 Maximum Process Contribution for Hydrogen Chloride (µg m^{-3})

Statistic	Exceedance Threshold (µg m^{-3})	Averaging Period	Approximate Concentration (µg m^{-3})	Approximate % of EAL Value
Short-Term 100 % (PC)	750	1 hr	3	0.4 %

There is no Air Quality Standard for HCl and the assessment level was therefore based upon Environment Agency guidance for short-term (1 hour) assessments. The Environment Agency guidance does not recommend a long-term EAL for HCl, therefore the results relate solely to the hourly average process contribution.

Detailed modelling predicts a maximum hourly average PC for HCl of approximately 3 µg m^{-3}, equating to 0.4 % of the EAL of 750 µg m^{-3}, which is insignificant in relation to Environment Agency guidance. The results indicate that emissions of HCl are unlikely to have a significant impact on air quality in the vicinity of the site and the overall impact on local human health and the environment may be described as negligible. Accordingly, emissions of HCl do not require further assessment, although deposition impacts on ecological receptors are considered further in Section 5.

3.8 Hydrogen Fluoride (HF)

The results from detailed modelling of Hydrogen Fluoride are presented in the following Table.

Table 15 Maximum Process Contribution for Hydrogen Fluoride (µg m^{-3})

Statistic	Exceedance Threshold (µg m^{-3})	Averaging Period	Approximate Concentration (µg m^{-3})	Approximate % of EAL Value
Annual (PC)	16	Monthly	0.01 (Annual)	0.1 %
Short-Term 100 % (PC)	160	1 hr	0.5	0.3 %

Detailed modelling predicted that both the annual average (assessed against the monthly average EAL) and the maximum hourly average process contributions for HF associated with emissions from the Biomass No. 4 facility converted to fire RDF, would be a fraction of 1 % and 10 % of the long and short-term EALs respectively and are therefore screened as insignificant in relation to Environment Agency guidance. The overall potential impact on human health receptors may therefore be described as negligible and accordingly, emissions of HF do not require further assessment for their potential effects on human health, although they are considered further in relation to their potential impact on ecological receptors in Section 5.

3.9 Cadmium and Thallium (Cd and Tl)

The results from detailed modelling of Cadmium and Thallium are presented in the following table and are reported on the basis that all of the emissions occur as Cadmium.

Table 16 Maximum Process Contribution for Cadmium and Thallium (ng m^{-3})

Statistic	Exceedance Threshold (ng m^{-3})	Averaging Period	Approximate Concentration (ng m^{-3})	Approximate % of AQS Value
Annual (PC)	5	Annual	0.207	**4.1 %**
Annual (PEC)			0.27	5.4 %

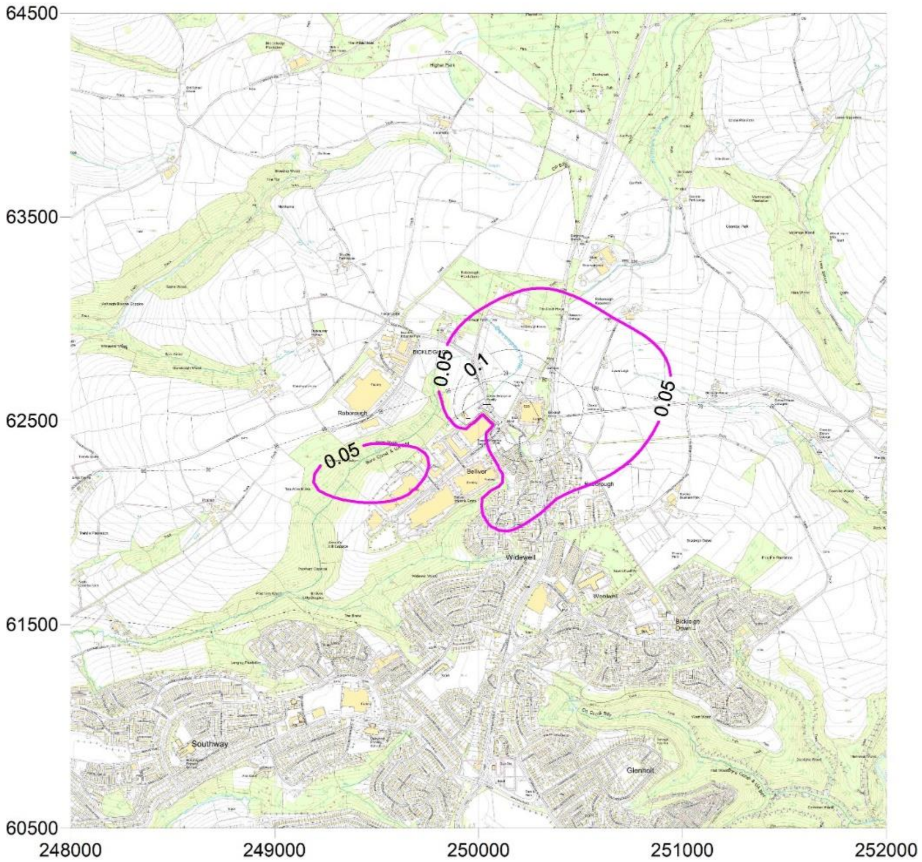
Figures in bold represent results which cannot immediately be screened as insignificant.

The Air Quality Standards Regulations (England) 2010 specify a target value of 5 ng m^{-3} for Cadmium as an annual average in the PM_{10} fraction of particulate emissions. However, no information is available on the Cadmium content of any PM_{10} emissions that may be emitted from the Biomass No. 4 facility, and therefore, as a worst-case assessment it was assumed that all of the Cadmium and Thallium emissions were associated with the PM_{10} release, and that emissions were totally as Cadmium.

Detailed modelling predicts an annual average process contribution for Cadmium of approximately 0.2 ng m^{-3}, which equates to approximately 4.1 % of the AQS objective. As the maximum modelled PC is over the Environment Agency's 1 % insignificance threshold, data from the Heavy Metals Monitoring Network rural background measurement station at Yarner Wood[7], which suggests an annual average Cadmium concentration in 2020 of 0.065 ng m^{-3}, was added to the result to determine the predicted environmental concentration. The resulting maximum PEC value for Cadmium associated with the future operation of the Biomass No. 4 plant is therefore 0.27 ng m^{-3}, or about 5.4 % of the AQS objective value, and in line with Environment Agency guidance does not require further assessment.

It should be noted that the emissions data for Cadmium used in modelling were derived from the IED emission limit value for the combined emissions of both Cadmium and Thallium (0.02 mg Nm^{-3}), and it is assumed that all of the emission was as Cadmium. Therefore, the value used in the assessment likely over-estimates the situation for Cadmium significantly. Despite this, the isopleth diagram shown in Figure 9 below depicts the anticipated pattern of dispersion when the emissions from the Biomass No. 4 facility are plotted over a map of the local area. The magenta isopleth denotes the 1 % point of insignificance (0.05 ng m^{-3}), and therefore, in all areas outside of this contour line, the impact of emissions of Cadmium and Thallium can immediately be screened as insignificant. The highest process contributions again occur to the north-east of the Biomass No. 4 facility and, within the coloured contour, the overall PEC is screened at the secondary assessment stage.

Figure 9 Maximum Annual Average Process Contribution of Cadmium (ng m^{-3}); 2020 Meteorological Conditions



3.10 Mercury and its Compounds (Hg)

The results from detailed modelling of Mercury and its compounds are presented in the following table.

Table 17 Maximum Process Contribution for Mercury and its Compounds (µg m^{-3})

Statistic	Exceedance Threshold (µg m^{-3})	Averaging Period	Approximate Concentration (µg m^{-3})	Approximate % of EAL Value
Annual (PC)	0.25	Annual	0.00021	0.08 %
Short-Term 100 % (PC)	7.5	1 hr	0.01	0.13 %

Detailed modelling predicted that both the annual average and the maximum hourly average process contributions for Mercury associated with the emissions from the future operation of the Biomass No. 4 facility would be a fraction of 1 % and 10 % of the long and short-term EALs respectively and are therefore screened as insignificant in relation to Environment Agency guidance. As such, emissions of Mercury are unlikely to have a significant impact on local air quality in the vicinity of the site and the overall potential impact on human health receptors may be described as negligible. Emissions of Mercury do not require any further assessment.

3.11 Group 3 Metals

The BAT-Conclusions specify an achievable emission level for total Group 3 metals for existing plant of 0.3 mg Nm^{-3}. The Group 3 metals classification comprises Antimony (Sb), Arsenic (As), Lead (Pb), Chromium (Cr), Cobalt (Co), Copper (Cu), Manganese (Mn), Nickel (Ni), and Vanadium (V), and the BAT-AEL relates to the sum of these emitted species.

The Environment Agency has issued guidance on metals impact assessment[8] and recommends a stepwise approach to the assessment of Group 3 metals. The guidance is applicable for use when assessing the impact of Municipal Waste Incineration (MSW) and waste wood co-incineration facilities and is therefore appropriate for considering the results of the proposed facility. The first step is based upon the assumption that each of the nine metal species is emitted at the IED emission limit value of 0.3 mg Nm^{-3} for Group 3 metals. The results from this initial screening assessment are reported below.

Table 18 Maximum Annual Average Process Contribution for Group 3 Metals – Step 1 Screening

Metal Species	Exceedance Threshold (µg m^{-3})	Approximate Concentration (µg m^{-3})	Approximate % of EAL Value
Antimony	5	0.0031	0.062 %
Arsenic	0.003	0.0031	**104 %**
Chromium$^{(VI)}$	0.0002	0.0031	**1,554 %**
Cobalt	0.2 (*IPPC H1)	0.0031	**1.55 %**
Copper	10	0.0031	0.031 %
Lead	0.25	0.0031	**1.24 %**
Manganese	0.15	0.0031	**2.07 %**
Nickel	0.02	0.0031	**15.54 %**
Vanadium	5	0.0031	0.062 %

As previously, figures in bold represent results which cannot immediately be screened as insignificant. It is noted * that in the absence of current guidance, and to provide an indicative assessment for Cobalt, the exceedance threshold is based on guidance, now withdrawn, provided by the Environment Agency.

The Environment Agency guidance on metals assessment requires that where the PC of any metal exceeds 1 % of a long-term or 10 % of a short-term environmental standard, the PEC should be compared against the environmental standard. Table 19 therefore provides this assessment with background data being drawn from the Yarner Wood monitoring data for heavy metals in 2020.

Table 19 Calculation and Screening of the Predicted Environmental Concentration of Metals

Metal Species	Background Concentration (µg m^{-3})	PEC (µg m^{-3})	Approximate % of EAL Value
Arsenic	0.0004	0.0035	**117 %**
Chromium$^{(VI)}$	0.0005	0.0036	**1,804 %**
Cobalt	0.00003	0.00314	2 %
Lead	0.0017	0.0048	2 %
Manganese	0.0019	0.0050	3 %
Nickel	0.0004	0.0035	17 %

The Environment Agency guidance on metals assessment requires that where the PEC is greater than 100 % of the environmental standard, further consideration is required, and the results in Table 19 demonstrate that only contributions of Arsenic and Chromium$^{(VI)}$ therefore continue to require further assessment.

The final, 'case specific' screening recommended by the Environment Agency uses measured emissions data from operational MSW incineration and waste wood co-incineration plant to assess the likely contributions of individual metal species to the total. On the basis of measurements undertaken at facilities between 2007 and 2015, the Environment Agency published the percentage contributions of each metal species to the limit value, for use in calculating the likely release of species whose PC were greater than 1 % of the long-term assessment level in Step 1.

The calculated percentages specified in the guidance note are representative of the BAT-AEL specified for Group 3 metals in Annex VI of the IED (0.5 mg Nm^{-3}). However, the data have been extrapolated in Table 20 to present the maximum measured emissions concentrations specified in the guidance note, as a percentage of the 0.3 mg Nm^{-3} emission limit value that will be applied to future operations.

Table 20 Percentage Contribution of Species for the Step 2 Assessment of Group 3 Metals

Metal Species	Maximum Measured Concentration (mg Nm^{-3})	Percentage Contribution to 0.3 mg Nm^{-3} ELV
Antimony	0.0115	3.8 %
Arsenic	0.025	8.3 %
Chromium$^{(VI)}$	0.00013	0.043 %
Cobalt	0.0056	1.9 %
Copper	0.029	9.7 %
Lead	0.0503	16.8 %
Manganese	0.060	20.0 %
Nickel	0.220	73.3 %
Vanadium	0.006	2.0 %

In the first instance, the Step 2 screening assessment should be based upon the maximum emissions and resultant percentage contributions as specified in the above table, and the measured data from the nearest Heavy Metals Monitoring Network site, in this case at Yarner Wood. A similar assessment of PC and PEC values should be applied as in Step 1. Therefore, the calculated maximum percentage contributions of Arsenic and Chromium$^{(VI)}$ were applied to the total process contribution of 0.0031 µg m^{-3} and the results for the predicted environmental concentrations are presented in the following table.

Table 21 Maximum Annual Average Predicted Environmental Concentration of Arsenic and Chromium$^{(VI)}$ – Step 2 Screening

Metal Species	Exceedance Threshold ($\mu g\ m^{-3}$)	PC ($\mu g\ m^{-3}$)	Percentage of the AQS/EAL	Background Concentration ($\mu g\ m^{-3}$)	PEC ($\mu g\ m^{-3}$)	Approximate % of EAL Value
Arsenic	0.003	0.00026	**8.6%**	0.0004	0.00067	22%
Chromium$^{(VI)}$	0.0002	1.34E-06	0.7%	0.0001	0.0001013	51%

* Note: The background concentration of Chromium$^{(VI)}$ is assumed to equate to 20 % of the total Chromium background as measured at Yarner Wood in 2020 (0.0005 $\mu g\ m^{-3}$).

As can be seen, although the calculated PC for Arsenic continues to equate to more than 1 % of the EAL, the PC of Chromium$^{(VI)}$ can be screened as insignificant. With the PEC for both pollutants remaining within 70 % of the EAL when applying the background concentrations measured at or calculated from the Yarner Wood monitoring station, all contributions of heavy metals can ultimately be screened as insignificant.

3.12 Polycyclic Aromatic Hydrocarbons (PAH as B[a]P)

Although measured discharges of total PAH identified in the 2019 Best Available Techniques Reference Note reported concentrations of up to 0.05 mg Nm^{-3} (50,000 ng Nm^{-3}) from incineration processes, emissions of Benzo[a]Pyrene (B[a]P) were reported to a maximum of 0.001 mg Nm^{-3} (1,000 ng Nm^{-3}). The Air Quality Standards Regulations (England) 2010 specify a target value of 0.25 ng m^{-3} for B[a]P and there is an additional European obligation to limit total ambient PAH to 1 ng m^{-3} as an annual average in the PM_{10} fraction.

However, no information is available on the PAH content of any PM_{10} that may be emitted from the process or that which is already present in the environment. Within this assessment therefore, the lower of the two target values has been applied and considers emissions of B[a]P at 0.001 mg Nm^{-3}, rather than total PAH discharges.

The results from detailed modelling of Benzo[a]Pyrene (for PAH) are presented in the following table.

Table 22 Maximum Process Contribution for Benzo[a]Pyrene (ng m^{-3})

Statistic	Exceedance Threshold (ng m^{-3})	Averaging Period	Approximate Concentration (ng m^{-3})	Approximate % of AQS Value
Annual (PC)	0.25	Annual	0.0104	**4.1 %**
Annual (PEC)			0.072	28.9 %

Figures in bold represent results which cannot immediately be screened as insignificant.

Detailed modelling predicts a maximum annual average process contribution for B[a]P of approximately 0.01 ng m^{-3}, equating to about 4.1 % of the AQS objective value, which is therefore in excess of the Environment Agency's 1 % insignificance threshold. Measured data from the Chilbolton Observatory monitoring station reported a background concentration of B[a]P in 2020 of 0.062 ng m^{-3}.

The resulting maximum predicted environmental concentration value for B[a]P associated with the operation of the proposed Biomass No. 4 facility is therefore 0.072 ng m^{-3}, or about 29 % of the AQS objective value, and, in line with Environment Agency guidance is screened as insignificant and does not require further assessment.

3.13 Dioxins and Furans, and Poly Chlorinated Biphenyls

The results from detailed modelling of Dioxins and Furans are presented in the following table.

Table 23 Maximum Process Contribution for Dioxins and Furans (µg m^{-3})

Statistic	Averaging Period	Approximate Concentration (µg m^{-3})
Annual (PC)	Annual	4.15 x 10^{-10}
Hourly (PC)	1 hr	2.00 x 10^{-08}

There is a general concern within the population at large about the potential health effects associated with exposure to Dioxins and Furans in the emissions from industrial processes. However, there are no Air Quality Standards or Environmental Assessment Levels for Dioxins.

The maximum annual PC for Dioxins associated with emissions from the proposed Biomass No. 4 facility when modelled at the BAT-AEL concentration of 0.06 ng Nm^{-3} was approximately 0.415 fg m^{-3}, at the point of maximum process contribution, which occurs approximately 239 metres to the north-east of the Biomass No. 4 chimney. This location represents a point within the industrial estate and does not occur at a point of long-term human exposure. The maximum hourly average PC for Dioxins was predicted to be approximately 20 fg m^{-3}, occurring approximately 105 metres to the north, north-west of the Biomass No. 4 discharge point, within the hedgerow of the industrial estate and, similar to the annual average contribution, is not a location of any sensitive human health receptor.

Emissions of Dioxins from the Biomass No. 4 process are therefore not expected to significantly increase the airborne concentration or deposition rate of Dioxins and Furans over what may be currently experienced in the locality.

It should be also noted that, as for each of the modelled pollutants, the Dioxin emissions profile was based on the long-term ELV of 0.06 ng Nm^{-3} prescribed by the current BAT-Conclusions document. The Biomass No. 4 facility will always aim to operate in compliance with emissions standards specified within its Environmental Permit, and Dioxin emissions are expected to generally be below the emission limit value. The emissions profile is therefore considered to be overly pessimistic, and to result in higher predicted process contributions than are considered likely.

3.14 Deposition of Metals to Land

Some substances can have an impact when absorbed by soil and leaves and thus, Environmental Assessment Levels have been set for deposition rates. Table 24 considers the modelled deposition of metal species from the proposed operation of the Biomass No. 4 facility, when taking account of dry deposition factors.

Table 24 Results of Metals Deposition and Assessment of Impact

Metal Species	Modelled Deposition (µg m^{-2} s^{-1})	Modelled Deposition (mg m^{-2} day^{-1})	EAL (mg m^{-2} day^{-1})	Approximate % of EAL Value
Arsenic	0.00000606	0.000523	0.02	**2.62 %**
Cadmium	0.000000404	0.0000349	0.009	0.39 %
Chromium	0.00000606	0.000523	1.5	0.03 %
Copper	0.00000606	0.000523	0.25	0.21 %
Lead	0.00000606	0.000523	1.1	0.05 %
Mercury	0.000000404	0.0000349	0.004	0.87 %
Nickel	0.00000606	0.000523	0.11	0.48 %

With the exception of Arsenic, the process contribution of each of the metal species considered equates to less than 1 % of the EAL. Therefore, the potential impact of metals deposition is screened as insignificant and most species require no further assessment.

Although the stated deposition rates of Arsenic equate to approximately 2.6 % of the Environmental Assessment Level for Arsenic deposition, and no background deposition levels are available to apply to the calculation of a PEC, it must be remembered that the modelling assessment combines emissions of all nine, Group 3 metal species and that Arsenic will only make up a portion of that total. Assuming an even split of the total between the nine metal species, the deposition rate of Arsenic would equate to less than 0.3 % of the EAL, and thus it is likely that the actual contribution of the Biomass No. 4 plant to levels of deposited Arsenic in the local area will be within 1 % of the EAL and can be screened as insignificant. However, even assuming that the full contribution of the Group 3 metals is deposited as Arsenic, with a process contribution of less than 3 %, it is unlikely that the EAL for deposited levels of Arsenic will be exceeded unless significant other contributors are present in the local area.

4. Comparison With the Existing Dartmoor Bio Power Plant Operations

As the Biomass No. 4 operation will replace the existing Dartmoor Bio Power facility, it is reasonable to assess the difference in potential impact of both facilities. Table 3 in Section 2.3 provided details of the existing 27 m high stack and historical release characteristics, and these were applied to the ADMS model assessments to determine the process contributions from the Dartmoor Bio Power facility, both when modelling measured data from the operational plant and when modelling the emission limit values in order to provide a direct comparison with the data produced for the Biomass No. 4 plant.

Table 25 below summarises the results and demonstrates that the proposed operations, which include a higher release point of 35 m, an increased discharge temperature and generally lower emission levels, consistently result in lower process contributions than when modelling the Dartmoor Bio Power plant at the Permitted emission level values.

Table 25 Comparison of Existing and Proposed Plant Contributions (µg m^{-3})

Pollutant	Modelling Applying 2018 Measured Data	Modelling Applying Existing ELVs	Modelling Applying Future ELVs (35 m Stack)	Comparison of Future Impact Against Existing
Annual NO_2	3.17	4.11	1.24	Reduction
99.79th Percentile Hourly NO_2	14.82	19.20	7.02	Reduction
Max 24-Hour NO_x	23.27	30.14	10.96	Reduction
99.9th Percentile 15-minute SO_2	2.70	10.72	4.03	Reduction on existing ELV
Annual SO_2	0.260	1.031	0.311	Reduction on existing ELV
99.73rd Percentile Hourly SO_2	2.41	9.54	3.48	Reduction on existing ELV
99.18th Percentile 24-Hour SO_2	1.48	5.87	2.38	Reduction on existing ELV
Max Hourly HCl	7.25	9.24	3.00	Reduction
Max 8-Hourly CO*	0.000579	0.00878	0.00693	Reduction on existing ELV
Annual PM_{10}	0.116	0.206	0.0518	Reduction
90.41st Percentile PM_{10}	0.369	0.658	0.163	Reduction
Annual HF	N/M	0.0206	0.0104	Reduction on existing ELV
Max Hourly HF	N/M	0.9240	0.500	Reduction on existing ELV

N/M: Not measured / no measured data provided.
* CO contributions reported in mg m^{-3}

The results in Table 25 also confirm that the proposed operation of the Biomass No. 4 facility generally results in lower contributions than when modelling annual average measured concentrations from 2018 when the plant was operational. As such, the results of the modelling confirm that, subject to the as built plant accurately reflecting the design detail, the overall impact of emissions to atmosphere will likely reduce from those which are already consented and Permitted.

5. Cumulative Impacts

Whilst the application of background data can reasonably represent the contributions made by local facilities to existing levels of air pollution in a given area, the measured or calculated background values do not account for contributions from any proposed scheme which may be consented but may not yet be or may only recently be operational, or for schemes which are passing through the planning process and which could become consented in the near future. To account for such projects, a cumulative modelling assessment can be produced which considers emissions from all proposed plant, which in this case includes the Biomass No. 4 plant plus contributions from the proposed Plessey Semi-Conductors 19 m discharge stack serving their Metal Organic Chemical Vapour Deposition reactor abatement system[9], and a proposed combined heat and power (CHP) plant to be developed at Becton Dickinson UK Limited on Belliver Way[10].

5.1 Cumulative Inputs

Information on the additional inputs from Plessey Semi-Conductors and Becton Dickinson are detailed in Table 26.

Table 26 Additional Inputs to the Cumulative Assessment Model

Site	Plessey Semi-Conductors	Becton Dickinson UK
Planning Application Date	2016	2021
Status	Consented and developed	Application submitted, awaiting decision
Location of Stack(s)	250307, 062527	250000, 062320 and 250001, 062320
Stack Height (m)	19	15
Stack Diameter (m)	0.9	0.6
Stack Temperature (°C)	120	210
Volumetric Flow Rate (Nm^3 s^{-1})	2.49	5.63
NO_x Emission (g s^{-1})	0.1584	0.535
NH_3 Emission (g s^{-1})	0.04721	-
CO Emission (g s^{-1})	-	5.63
Building 1 Grid Reference	250259.34, 062540.87	249965.51, 062210.79
Building 1 Height (m)	16	14
Building 1 Width (m)	97.9	98.4
Building 1 Length (m)	97.25	158.78
Building 2 Grid Reference	-	250063.12, 062237.18
Building 2 Height (m)	-	14
Building 2 Width (m)	-	50.38
Building 2 Length (m)	-	38.4

Note: although several buildings were included in the original Becton Dickinson UK model, only the two buildings which are considered to be most significant to the CHP stacks have been added to this modelling exercise.

5.2 Results of Cumulative Assessment

When modelled together with discharges from the Plessey Semi-Conductors site and the proposed CHP units at Becton Dickinson UK Limited, the cumulative Biomass No. 4 assessment returned the following results:

Table 27 Results of Cumulative Assessment of Releases of Nitrogen Dioxide, Ammonia and Carbon Monoxide

Statistic	Exceedance Threshold	Averaging Period	Approximate Concentration ($\mu g\ m^{-3}$)	Approximate % of AQS Value
NO_2 Annual Average (PC)	40	Annual	7.88	**20 %**
NO_2 Annual Average (PEC)			16.87	42 %
NO_2 Short-Term 99.79% (PC)	200	1 hr	49.95	**25 %**
NO_2 Short-Term 99.79% (PEC)			67.93	34 %
NH_3 Annual Average (PC)	180	Annual	0.709	0.4 %
NH_3 Annual Average (PEC)			1.04	0.6 %
NH_3 Short-Term (PC)	2,500	1 hr	18.26	0.7 %
NH_3 Short-Term (PEC)			18.91	0.8 %
CO Short-Term 100 % (PC)	10	Maximum Rolling 8 hr Average	0.715	7 %
CO Short-Term 100 % (PEC)			0.94	9 %

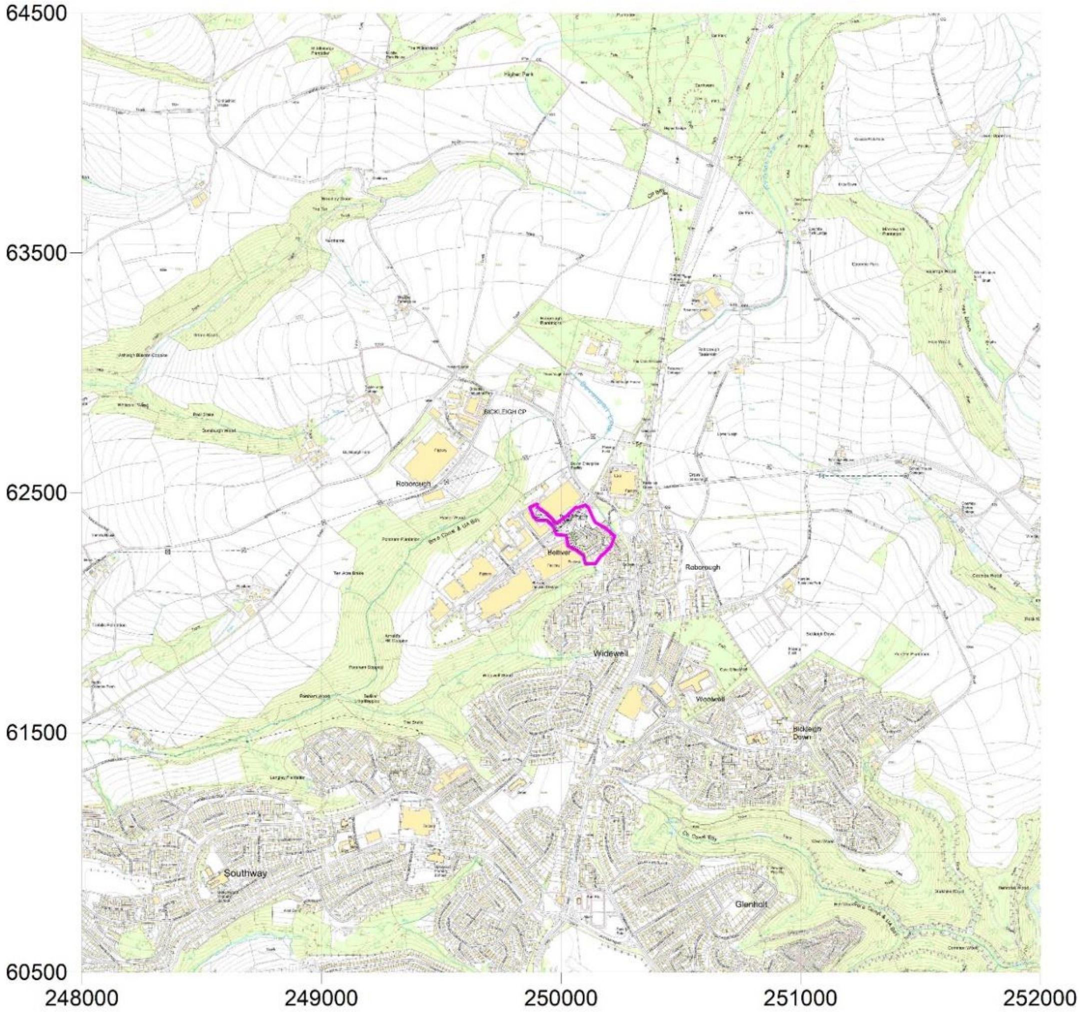
Cumulative process contributions of Ammonia and Carbon Monoxide immediately screen as insignificant and require no further assessment.

Annual average contributions of Nitrogen Dioxide equate to approximately 20 % of the long-term AQS and are not immediately screened, although screen as insignificant when the PEC is calculated to equate to approximately 42 % of the AQS.

The cumulative short-term, 99.79th percentile hourly average contribution of Nitrogen Dioxide equates to 25 % of the AQS and therefore does not screen at the initial or secondary assessment stage. However, the predicted environmental concentration remains within the AQS, equating to approximately 34 % of the assessment level. Considering this result represents the existing background plus all additional contributions which have the potential to impact on the environment in the immediate vicinity of the Biomass No. 4 plant, it is considered unlikely that the levels of Nitrogen Dioxide in the local area will approach or exceed the Air Quality Standard objective value, and despite not screening as insignificant, there is little likelihood of any significant impact on human health due to exposure to Nitrogen Dioxide as a result of these industrial emissions.

The maximum 99.79th percentile hourly average NO_2 process contribution from five years' worth of meteorological modelling was predicted when applying the 2017 meteorological data and occurs within the Becton Dickinson UK site boundary, approximately 172 m east of the Biomass No. 4 release point, but less than 120 m from the proposed CHP release points. The isopleth diagram in Figure 10 over page demonstrates that the most significant short-term effects of Nitrogen Dioxide occur to the east of the Becton Dickinson site, and reduce rapidly with distance from the CHPs. The magenta isopleth denotes the point at which the process contributions equate to 10 % of the 99.79th percentile hourly average AQS and, for the most part, the area within this contour also remains within 20 % of the AQS, with just a small portion of the neighbouring gardens potentially receiving contributions of between 20 and 25 % of the AQS. However, as already noted, this result refers to the worst condition over 5 years' worth of modelling, the impacted area is minimal and the overall predicted environmental concentration is unlikely to approach or exceed the AQS. As such, and whilst accepting that the cumulative process contribution of short-term NO_2 is not screened as insignificant, it is unlikely to have any significant health effects.

Figure 10 Maximum Cumulative 99.79th Percentile Hourly Average NO_2 Process Contribution ($\mu g\ m^{-3}$); 2017 Meteorological Conditions



6. Air Quality Impacts at Specific Receptors

The model was also set up to calculate the impact of emissions at forty-three specific receptors in the vicinity of the site. The locations of the nearest of these receptors were shown in Figure 3, and represent sensitive ecological sites (twenty-three receptor locations), locations where members of the general public may be present for extended periods of time, either through residence in a particular area, or as a result of their employment (nineteen receptor locations), as well as a single location where air quality monitoring is undertaken by Plymouth City Council on Tavistock Road, south of Derriford Hospital.

6.1 Process Contributions to Air Quality and Critical Levels

Process contributions were immediately screened as insignificant for almost all pollutants at almost all receptor locations and hence, limited further assessment is required. Annual average concentrations of NO_x as NO_2, VOCs, Cadmium, and PAH were not immediately screened at the nearest human health receptors, and Table 28 therefore details the process contributions at these locations and considers the resultant predicted environmental concentrations of these species.

Table 28 Process Contributions (PC) and Predicted Environmental Concentrations (PEC) of Annual Average NO_x as NO_2, VOCs, Cadmium and PAH at Local Human Health Receptors

Receptor Number	PC NO_x as NO_2 ($\mu g\ m^{-3}$)	Percentage of the AQS	PEC	Approximate % of AQS Value	PC VOC ($\mu g\ m^{-3}$)	Percentage of the EAL	PEC	Approximate % of EAL Value
1	0.464	**1.2 %**	9.45	24 %	0.03876	0.78 %	0.4106	8.2 %
2	0.407	**1.0 %**	9.40	23 %	0.03398	0.68 %	0.4058	8.1 %
3	0.385	1.0 %	9.37	23 %	0.03212	0.64 %	0.4040	8.1 %
4	0.729	**1.8 %**	9.72	24 %	0.06084	**1.22 %**	0.4327	8.7 %
5	0.424	**1.1 %**	9.41	24 %	0.03542	0.71 %	0.4073	8.1 %
6	0.198	0.49 %	9.19	23 %	0.01649	0.33 %	0.3883	7.8 %
7	0.112	0.28 %	9.10	23 %	0.00933	0.19 %	0.3812	7.6 %
8	0.078	0.19 %	9.07	23 %	0.00648	0.13 %	0.3783	7.6 %
9	0.074	0.18 %	9.06	23 %	0.00616	0.12 %	0.3780	7.6 %
10	0.184	0.46 %	9.17	23 %	0.01537	0.31 %	0.3872	7.7 %
11	0.106	0.26 %	9.10	23 %	0.00883	0.18 %	0.3807	7.6 %
12	0.091	0.23 %	9.08	23 %	0.00762	0.15 %	0.3795	7.6 %
13	0.325	0.81 %	9.31	23 %	0.02712	0.54 %	0.39896	8.0 %
14	0.472	**1.2 %**	9.46	24 %	0.03937	0.79 %	0.4112	8.2 %
Receptor Number	**PC Cadmium ($\mu g\ m^{-3}$)**	**Percentage of the EAL**	**PEC**	**Approximate % of EAL Value**	**PC PAH ($\mu g\ m^{-3}$)**	**Percentage of the EAL**	**PEC**	**Approximate % of EAL Value**
1	0.0775	**1.55 %**	0.143	2.9 %	0.00388	**1.6 %**	0.0659	26 %
2	0.0680	**1.36 %**	0.133	2.7 %	0.00340	**1.4 %**	0.0654	26 %
3	0.0642	**1.28 %**	0.129	2.6 %	0.00321	**1.3 %**	0.0652	26 %
4	0.1217	**2.43 %**	0.187	3.7 %	0.00608	**2.4 %**	0.0681	27 %
5	0.0708	**1.42 %**	0.136	2.7 %	0.00354	**1.4 %**	0.0655	26 %
6	0.0330	0.66 %	0.098	2.0 %	0.00165	0.7 %	0.0636	25 %
7	0.0187	0.37 %	0.084	1.7 %	0.00093	0.4 %	0.0629	25 %
8	0.0130	0.26 %	0.078	1.6 %	0.00065	0.3 %	0.0626	25 %
9	0.0123	0.25 %	0.077	1.5 %	0.00062	0.2 %	0.0626	25 %
10	0.0307	0.61 %	0.096	1.9 %	0.00154	0.6 %	0.0635	25 %
11	0.0177	0.35 %	0.083	1.7 %	0.00088	0.4 %	0.0629	25 %
12	0.0152	0.30 %	0.080	1.6 %	0.00076	0.3 %	0.0628	25 %
13	0.0542	**1.08 %**	0.119	2.4 %	0.00271	**1.1 %**	0.0647	26 %
14	0.0787	**1.57 %**	0.144	2.9 %	0.00394	**1.6 %**	0.0659	26 %

As previously and noting that most pollutants at the majority of the modelled human health, ecological and air quality monitoring receptor points immediately screen as insignificant, the results presented in bold in Table 28 above are those which do not immediately screen. However, even these screen as insignificant at the secondary assessment stage.

6.2 Deposition Assessment

Critical Loads are defined as: "a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge". Critical Loads are assigned for deposited levels of nutrient Nitrogen and acid where they may impact on the designated features of sensitive ecological habitats and an assessment has therefore been made of the likely levels of deposition and the potential impact on the receptor Critical Loads.

Tables 29 to 31 present the calculated deposition of nutrient Nitrogen and acid to each discrete specified receptor location, with multiple points modelled across the South Dartmoor Woods SAC, Plymouth Sound and Estuaries SAC, Tamar Estuaries Complex SPA, and Dartmoor SAC, as detailed in Table 4. Levels of Nitrogen deposited from NO_x have been reduced to 70 % of the total, as NO does not deposit to any significant extent and as such the reduced levels represent the likely deposited NO_2 fraction.

The results show that contributions to nutrient Nitrogen deposition at all sites equate to less than 1 % of the site-specific Critical Load and can therefore be screened as insignificant.

Contributions of acid deposition to the South Dartmoor Woods SAC and the Dartmoor SAC also remain within 1 % of the site-specific Critical Loads and are screened, as do the Southway Valley Local Nature Reserve and many of the local and ancient woodlands. The three exceptions are Hele Wood, Coombe Wood, and West Wood which are predicted to receive deposited levels of acid between 1 and 1.5 % of the Critical Loads. However, as the assessment of local nature sites such as woodland areas is different from national designated sites and simply requires that the PC remains within 100 % of the environmental standard[1], the contributions are screened as insignificant, and no further assessment is required.

Tables 32 – 34 present the deposition levels from the cumulative assessment in order to demonstrate that, when considered with other locally proposed or recently consented developments, the contributions to nutrient Nitrogen and acid deposition continue to be screened as insignificant. Although contributions from Nitrogen based pollutants (NO_x and Ammonia) do increase when considering the Biomass No. 4 plant in combination with other local sites, and more of the local sites receive deposits of nutrient Nitrogen (Receptors E11 – E14 and E19 – E23) and acid (Receptors E11, E13, E19, E20 and E22) equating to more than 1 % of the assessment level, with a maximum deposition level of 5.75 % of the Critical Load for nutrient Nitrogen reported at E11 all contributions remain well within 100 % of the environmental standards and hence are screened as insignificant. Cumulative levels of nutrient Nitrogen and acid deposition equate to less than 1 % of the site-specific Critical Loads at all designated, National Site Network receptors, and hence are screened as insignificant.

Table 29 Assessment of Contribution to Nutrient Nitrogen and Acid Critical Loads at National Site Network Receptors

Nutrient Nitrogen	E1	E2	E3	E4	E5	E6	E7	E8	E9
Rate of Total Deposition as N (kg N/ha/yr)	0.030487	0.0311	0.0236	0.0056	0.0122	0.023	0.016	0.006	0.0038
Current Maximum Background (kg N/ha/yr)	28.4	28.4	28.4	17.9	17.9	16.7	16.7	24.40	24.40
Low End of Critical Load Range (kg N/ha/yr)	10	10	10	20	20	20	20	5	5
Deposition as % of Lower Critical Load	0.30%	0.31%	0.24%	0.03%	0.06%	0.11%	0.08%	0.11%	0.08%
Total Deposited Acid	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**	**E9**
Rate of Total Dry Deposition as N (keq/ha/yr)	0.00217	0.00221	0.00168	0.0004	0.0009	0.0016	0.0011	0.00041	0.00027
Low End of Critical Load Range N (CLminN keq/ha/yr)	0.642	0.642	0.642	Not Sensitive to Acid				0.321	0.321
Deposition as % of Lower Critical Load	0.34%	0.34%	0.26%					0.13%	0.08%
Current Maximum N Background (keq/ha/yr)	2.00	2.00	2.00	1.30	1.30	1.20	1.20	1.7	1.7
PEC N (keq/ha/yr)	2.0022	2.0022	2.0017	1.300	1.301	1.202	1.201	1.700	1.700
Is PEC N > CLminN?	Yes	Yes	Yes	N/A				Yes	Yes
Rate of Total Dry Deposition as S (keq/ha/yr)	0.00207	0.00211	0.00159	0.0003	0.0007	0.0013	0.0009	0.00033	0.00022
Rate of Total Deposition as HCl (kg H/ha/yr)	0.00230	0.00234	0.00172	0.0003	0.0007	0.0012	0.0009	0.00031	0.00020
Rate of Total Deposition as HF (kg H/ha/yr)	0.00032	0.00033	0.00024	0.0001	0.0002	0.0003	0.0002	0.00009	0.00005
Rate of Total Deposition as S and H (keq/ha/yr)	0.00470	0.00478	0.00355	0.00072	0.00155	0.00287	0.00201	0.00072	0.00047
Low End of Critical Load Range S (CLmaxS keq/ha/yr)	0.45000	0.45000	0.45000	Not Sensitive to Acid				0.509	0.509
Deposition as % of Lower Critical Load	1.04%	1.06%	0.79%					0.14%	0.09%
Current Maximum S Background (keq/ha/yr)	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.3	0.3
PEC S and H (keq/ha/yr)	0.3047	0.3048	0.3036	0.2007	0.2016	0.2029	0.2020	0.3007	0.3005
PC Acid (Combined N and S keq/ha/yr)	0.0069	0.0070	0.0052	0.0011	0.0024	0.0045	0.0032	0.0011	0.0007
Minimum Critical Load (CLmaxN keq/ha/yr)	1.202	1.202	1.202	Not Sensitive to Acid				0.83	0.83
% of Critical Load	0.57%	0.58%	0.44%					0.14%	0.09%
Combined Acid Background (keq/ha/yr)	2.30	2.30	2.30	1.50	1.50	1.40	1.40	2.00	2.00
PEC Acid (keq/ha/yr)	2.3069	2.3070	2.3052	1.5011	1.5024	1.4045	1.4032	2.0011	2.0007
% of Critical Load	192%	192%	192%	N/A				241%	241%

Table 30 Assessment of Contribution to Nutrient Nitrogen and Acid Critical Loads at Other Sensitive Ecological Receptors

Nutrient Nitrogen	**E10**	**E11**	**E12**	**E13**	**E14**	**E15**	**E16**
Rate of Total Deposition as N (kg N/ha/yr)	0.0315	0.0473	0.0500	0.0687	0.0625	0.04458	0.02976
Current Maximum Background (kg N/ha/yr)	23.8	23.8	23.8	23.8	23.8	23.8	23.8
Low End of Critical Load Range (kg N/ha/yr)	10	10	10	10	10	10	10
Deposition as % of Lower Critical Load	0.31%	0.47%	0.50%	0.69%	0.62%	0.45%	0.30%
Total Deposited Acid	**E10**	**E11**	**E12**	**E13**	**E14**	**E15**	**E16**
Rate of Total Dry Deposition as N (keq/ha/yr)	0.00224	0.00337	0.00356	0.00489	0.00445	0.00317	0.00212
Low End of Critical Load Range N (CLminN keq/ha/yr)	0.285	0.285	0.142	0.142	0.142	0.142	0.142
Deposition as % of Lower Critical Load	0.79%	**1.18%**	**2.51%**	**3.44%**	**3.13%**	**2.24%**	**1.49%**
Current Maximum N Background (keq/ha/yr)	1.7	1.7	1.7	1.7	1.7	1.7	1.7
PEC N (keq/ha/yr)	1.702	1.703	1.704	1.705	1.704	1.703	1.702
Is PEC N > CLminN?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rate of Total Dry Deposition as S (keq/ha/yr)	0.00215	0.00327	0.00343	0.00471	0.00429	0.00305	0.00204
Rate of Total Deposition as HCl (kg H/ha/yr)	0.00251	0.00394	0.00399	0.00542	0.00495	0.00347	0.00232
Rate of Total Deposition as HF (kg H/ha/yr)	0.00029	0.00050	0.00051	0.00070	0.00064	0.00045	0.00031
Rate of Total Deposition as S and H (keq/ha/yr)	0.00495	0.00772	0.00793	0.01083	0.00989	0.00697	0.00466
Low End of Critical Load Range S (CLmaxS keq/ha/yr)	1.25600	1.26700	1.86300	1.87100	1.87100	1.87100	1.87500
Deposition as % of Lower Critical Load	0.39%	0.61%	0.43%	0.58%	0.53%	0.37%	0.25%
Current Maximum S Background (keq/ha/yr)	0.22	0.22	0.22	0.22	0.22	0.22	0.22
PEC S and H (keq/ha/yr)	0.2250	0.2277	0.2279	0.2308	0.2299	0.2270	0.2247
PC Acid (Combined N and S keq/ha/yr)	0.0072	0.0111	0.0115	0.0157	0.0143	0.0101	0.0068
Minimum Critical Load (CLmaxN keq/ha/yr)	1.541	1.552	2.005	2.013	2.013	2.013	2.017
% of Critical Load	0.47%	0.71%	0.57%	0.78%	0.71%	0.50%	0.34%
Combined Acid Background (keq/ha/yr)	1.92	1.92	1.92	1.92	1.92	1.92	1.92
PEC Acid (keq/ha/yr)	1.93	1.93	1.93	1.94	1.93	1.93	1.93
% of Critical Load	125%	124%	96%	96%	96%	96%	96%

Table 31 Assessment of Contribution to Nutrient Nitrogen and Acid Critical Loads at Other Sensitive Ecological Receptors

Nutrient Nitrogen	**E17**	**E18**	**E19**	**E20**	**E21**	**E22**	**E23**
Rate of Total Deposition as N (kg N/ha/yr)	0.03902	0.03612	0.09778	0.08516	0.05298	0.07349	0.06567
Current Maximum Background (kg N/ha/yr)	23.8	23.8	23.8	23.8	23.8	23.8	23.8
Low End of Critical Load Range (kg N/ha/yr)	10	10	10	10	10	10	10
Deposition as % of Lower Critical Load	0.39%	0.36%	0.98%	0.85%	0.53%	0.73%	0.66%
Total Deposited Acid	**E17**	**E18**	**E19**	**E20**	**E21**	**E22**	**E23**
Rate of Total Dry Deposition as N (keq/ha/yr)	0.00278	0.00257	0.00696	0.00606	0.00377	0.00523	0.00468
Low End of Critical Load Range N (CLminN keq/ha/yr)	0.142	0.285	0.285	0.285	0.285	0.285	0.285
Deposition as % of Lower Critical Load	**1.96%**	0.90%	**2.44%**	**2.13%**	**1.32%**	**1.84%**	**1.64%**
Current Maximum N Background (keq/ha/yr)	1.7	1.7	1.7	1.7	1.7	1.7	1.7
PEC N (keq/ha/yr)	1.703	1.703	1.707	1.706	1.704	1.705	1.705
Is PEC N > CLminN?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rate of Total Dry Deposition as S (keq/ha/yr)	0.00268	0.00248	0.00671	0.00580	0.00359	0.00502	0.00448
Rate of Total Deposition as HCl (kg H/ha/yr)	0.00308	0.00282	0.00784	0.00666	0.00419	0.00592	0.00526
Rate of Total Deposition as HF (kg H/ha/yr)	0.00041	0.00039	0.00105	0.00084	0.00048	0.00071	0.00063
Rate of Total Deposition as S and H (keq/ha/yr)	0.00617	0.00569	0.01560	0.01329	0.00827	0.01164	0.01037
Low End of Critical Load Range S (CLmaxS keq/ha/yr)	1.87500	1.26900	1.24300	1.23800	1.23300	1.23500	1.23500
Deposition as % of Lower Critical Load	0.33%	0.45%	**1.26%**	1.07%	0.67%	0.94%	0.84%
Current Maximum S Background (keq/ha/yr)	0.22	0.22	0.21	0.21	0.21	0.21	0.21
PEC S and H (keq/ha/yr)	0.2262	0.2257	0.2256	0.2233	0.2183	0.2216	0.2204
PC Acid (Combined N and S keq/ha/yr)	0.0089	0.0083	0.0226	0.0194	0.0120	0.0169	0.0150
Minimum Critical Load (CLmaxN keq/ha/yr)	2.017	1.554	1.528	1.523	1.518	1.520	1.520
% of Critical Load	0.44%	0.53%	**1.48%**	**1.27%**	0.79%	**1.11%**	0.99%
Combined Acid Background (keq/ha/yr)	1.92	1.92	1.91	1.91	1.91	1.91	1.91
PEC Acid (keq/ha/yr)	1.93	1.93	1.93	1.93	1.92	1.93	1.93
% of Critical Load	96%	124%	126%	127%	127%	127%	127%

Table 32 Assessment of Contribution to Nutrient Nitrogen and Acid Critical Loads at National Site Network Receptors Cumulative Impacts

Nutrient Nitrogen	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**	**E9**
Rate of Total Deposition as N (kg N/ha/yr)	0.054856	0.0566	0.0430	0.0093	0.0227	0.041	0.029	0.010	0.0067
Current Maximum Background (kg N/ha/yr)	28.4	28.4	28.4	17.9	17.9	16.7	16.7	24.40	24.40
Low End of Critical Load Range (kg N/ha/yr)	10	10	10	20	20	20	20	5	5
Deposition as % of Lower Critical Load	0.55%	0.57%	0.43%	0.05%	0.11%	0.21%	0.15%	0.20%	0.13%
Total Deposited Acid	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**	**E9**
Rate of Total Dry Deposition as N (keq/ha/yr)	0.0039	0.0040	0.0031	0.0007	0.0016	0.0029	0.0021	0.00071	0.00048
Low End of Critical Load Range N (CLminN keq/ha/yr)	0.642	0.642	0.642	Not Sensitive to Acid				0.321	0.321
Deposition as % of Lower Critical Load	0.61%	0.63%	0.48%					0.22%	0.15%
Current Maximum N Background (keq/ha/yr)	2.00	2.00	2.00	1.30	1.30	1.20	1.20	1.7	1.7
PEC N (keq/ha/yr)	2.0039	2.0040	2.0031	1.301	1.302	1.203	1.202	1.701	1.700
Is PEC N > CLminN?	Yes	Yes	Yes	N/A				Yes	Yes
Rate of Total Dry Deposition as S (keq/ha/yr)	0.0021	0.0021	0.0016	0.0003	0.0007	0.0013	0.0009	0.00033	0.00022
Rate of Total Deposition as HCl (kg H/ha/yr)	0.0023	0.0023	0.0017	0.0003	0.0007	0.0012	0.0009	0.00031	0.00020
Rate of Total Deposition as HF (kg H/ha/yr)	0.0003	0.0003	0.0002	0.0001	0.0002	0.0003	0.0002	0.00009	0.000052
Rate of Total Deposition as S and H (keq/ha/yr)	0.0047	0.0048	0.0036	0.00072	0.00155	0.00287	0.00201	0.00072	0.00047
Low End of Critical Load Range S (CLmaxS keq/ha/yr)	0.45	0.45	0.45	Not Sensitive to Acid				0.509	0.509
Deposition as % of Lower Critical Load	1.04%	1.06%	0.79%					0.14%	0.09%
Current Maximum S Background (keq/ha/yr)	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.3	0.3
PEC S and H (keq/ha/yr)	0.3047	0.3048	0.3036	0.2007	0.2016	0.2029	0.2020	0.3007	0.3005
PC Acid (Combined N and S keq/ha/yr)	0.0086	0.0088	0.0066	0.0014	0.0032	0.0058	0.0041	0.0014	0.0009
Minimum Critical Load (CLmaxN keq/ha/yr)	1.202	1.202	1.202	Not Sensitive to Acid				0.83	0.83
% of Critical Load	0.72%	0.73%	0.55%					0.17%	0.11%
Combined Acid Background (keq/ha/yr)	2.30	2.30	2.30	1.50	1.50	1.40	1.40	2.00	2.00
PEC Acid (keq/ha/yr)	2.3086	2.3088	2.3066	1.5014	1.5032	1.4058	1.4041	2.0014	2.0009
% of Critical Load	192%	192%	192%	N/A				241%	241%

Table 33 Assessment of Contribution to Nutrient Nitrogen and Acid Critical Loads at Other Sensitive Ecological Receptors – Cumulative Impacts

Nutrient Nitrogen	**E10**	**E11**	**E12**	**E13**	**E14**	**E15**	**E16**
Rate of Total Deposition as N (kg N/ha/yr)	0.0578	0.5745	0.1065	0.1431	0.1301	0.09316	0.06099
Current Maximum Background (kg N/ha/yr)	23.8	23.8	23.8	23.8	23.8	23.8	23.8
Low End of Critical Load Range (kg N/ha/yr)	10	10	10	10	10	10	10
Deposition as % of Lower Critical Load	0.58%	**5.75%**	**1.06%**	**1.43%**	**1.30%**	0.93%	0.61%
Total Deposited Acid	**E10**	**E11**	**E12**	**E13**	**E14**	**E15**	**E16**
Rate of Total Dry Deposition as N (keq/ha/yr)	0.0041	0.0409	0.0076	0.0102	0.0093	0.0066	0.0043
Low End of Critical Load Range N (CLminN keq/ha/yr)	0.285	0.285	0.142	0.142	0.142	0.142	0.142
Deposition as % of Lower Critical Load	**1.44%**	**14.36%**	**5.34%**	**7.17%**	**6.52%**	**4.67%**	**3.06%**
Current Maximum N Background (keq/ha/yr)	1.7	1.7	1.7	1.7	1.7	1.7	1.7
PEC N (keq/ha/yr)	1.704	1.741	1.708	1.710	1.709	1.707	1.704
Is PEC N > CLminN?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rate of Total Dry Deposition as S (keq/ha/yr)	0.0021	0.0033	0.0034	0.0047	0.0043	0.0031	0.0020
Rate of Total Deposition as HCl (kg H/ha/yr)	0.0025	0.0039	0.0040	0.0054	0.0050	0.0035	0.0023
Rate of Total Deposition as HF (kg H/ha/yr)	0.0003	0.0005	0.0005	0.0007	0.0006	0.0005	0.0003
Rate of Total Deposition as S and H (keq/ha/yr)	0.0050	0.0077	0.0079	0.0108	0.0099	0.0070	0.0047
Low End of Critical Load Range S (CLmaxS keq/ha/yr)	1.256	1.267	1.863	1.871	1.871	1.871	1.875
Deposition as % of Lower Critical Load	0.39%	0.61%	0.43%	0.58%	0.53%	0.37%	0.25%
Current Maximum S Background (keq/ha/yr)	0.22	0.22	0.22	0.22	0.22	0.22	0.22
PEC S and H (keq/ha/yr)	0.2250	0.2277	0.2279	0.2308	0.2299	0.2270	0.2247
PC Acid (Combined N and S keq/ha/yr)	0.0091	0.0486	0.0155	0.0210	0.0192	0.0136	0.0090
Minimum Critical Load (CLmaxN keq/ha/yr)	1.541	1.552	2.005	2.013	2.013	2.013	2.017
% of Critical Load	0.59%	3.13%	0.77%	1.04%	0.95%	0.68%	0.45%
Combined Acid Background (keq/ha/yr)	1.92	1.92	1.92	1.92	1.92	1.92	1.92
PEC Acid (keq/ha/yr)	1.93	1.97	1.94	1.94	1.94	1.93	1.93
% of Critical Load	125%	127%	97%	96%	96%	96%	96%

Table 34 Assessment of Contribution to Nutrient Nitrogen and Acid Critical Loads at Other Sensitive Ecological Receptors – Cumulative Impacts

Nutrient Nitrogen	**E17**	**E18**	**E19**	**E20**	**E21**	**E22**	**E23**
Rate of Total Deposition as N (kg N/ha/yr)	0.06683	0.06184	0.18782	0.18468	0.11418	0.13226	0.11876
Current Maximum Background (kg N/ha/yr)	23.8	23.8	23.8	23.8	23.8	23.8	23.8
Low End of Critical Load Range (kg N/ha/yr)	10	10	10	10	10	10	10
Deposition as % of Lower Critical Load	0.67%	0.62%	**1.88%**	**1.85%**	**1.14%**	**1.32%**	**1.19%**
Total Deposited Acid	**E17**	**E18**	**E19**	**E20**	**E21**	**E22**	**E23**
Rate of Total Dry Deposition as N (keq/ha/yr)	0.0048	0.0044	0.0134	0.0132	0.0081	0.0094	0.0085
Low End of Critical Load Range N (CLminN keq/ha/yr)	0.142	0.285	0.285	0.285	0.285	0.285	0.285
Deposition as % of Lower Critical Load	**3.35%**	**1.55%**	**4.69%**	**4.61%**	**2.85%**	**3.30%**	**2.97%**
Current Maximum N Background (keq/ha/yr)	1.7	1.7	1.7	1.7	1.7	1.7	1.7
PEC N (keq/ha/yr)	1.705	1.704	1.713	1.713	1.708	1.709	1.708
Is PEC N > CLminN?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rate of Total Dry Deposition as S (keq/ha/yr)	0.0027	0.0025	0.0067	0.0058	0.0036	0.0050	0.0045
Rate of Total Deposition as HCl (kg H/ha/yr)	0.0031	0.0028	0.0078	0.0067	0.0042	0.0059	0.0053
Rate of Total Deposition as HF (kg H/ha/yr)	0.0004	0.0004	0.0011	0.0008	0.0005	0.0007	0.0006
Rate of Total Deposition as S and H (keq/ha/yr)	0.0062	0.0057	0.0156	0.0133	0.0083	0.0116	0.0104
Low End of Critical Load Range S (CLmaxS keq/ha/yr)	1.875	1.269	1.243	1.238	1.233	1.235	1.235
Deposition as % of Lower Critical Load	0.33%	0.45%	**1.26%**	1.07%	0.67%	0.94%	0.84%
Current Maximum S Background (keq/ha/yr)	0.22	0.22	0.21	0.21	0.21	0.21	0.21
PEC S and H (keq/ha/yr)	0.2262	0.2257	0.2256	0.2233	0.2183	0.2216	0.2204
PC Acid (Combined N and S keq/ha/yr)	0.0109	0.0101	0.0290	0.0264	0.0164	0.0211	0.0188
Minimum Critical Load (CLmaxN keq/ha/yr)	2.017	1.554	1.528	1.523	1.518	1.520	1.520
% of Critical Load	0.54%	0.65%	**1.90%**	**1.74%**	1.08%	**1.39%**	1.24%
Combined Acid Background (keq/ha/yr)	1.92	1.92	1.91	1.91	1.91	1.91	1.91
PEC Acid (keq/ha/yr)	1.93	1.93	1.94	1.94	1.93	1.93	1.93
% of Critical Load	96%	124%	127%	127%	127%	127%	127%

7. Short-Term Releases and Other than Normal Operating Conditions

In addition to the basic model parameters included in the study, consideration has been given to the potential for system failures, through the modelling of short-term allowable emission levels, specified in the Industrial Emissions Directive. Although the daily emission limit values specified in the Directive are expected to be met for the vast majority of the time, the Directive also allows for transient increases in the emitted concentration of some pollutants and as such, a series of half-hourly average limit values are specified which have been modelled to estimate the maximum likely short-term contributions.

Due to the transient nature of these permissible conditions, it is inappropriate to calculate percentile values based upon annual operation at the half-hourly limit values. Accordingly, assessment of these discharges generally considers the maximum, 100^{th} percentile value in order to represent the absolute worst-case short-term process contribution associated with emissions from the plant at the half-hourly Industrial Emissions Directive limit values, although percentile results for averaging periods of less than 30 minutes, are also included for information.

Table 35 Potential Short-Term Emissions

Pollutant Species	30-Minute Average (mg Nm^{-3})	Release Rate (g s^{-1})
NO_x	400	4.24
SO_2	200	2.12
CO	100	1.06
Particulate Matter (as PM_{10})	30	0.318
HF	4	0.0424
HCl	60	0.636
Volatile Organic Compounds (VOC)	20	0.212

A worst-case assessment has also been undertaken to determine the likely impact of abatement system failures, based on the maximum allowable period of operation above the emission limit values, as specified in Article 46 (6) of the IED. This states that plant shall under no circumstances continue to incinerate waste for a period of more than 4 hours uninterrupted where emission limit values are exceeded, and the cumulative duration of operation in such conditions over one year shall not exceed 60 hours. As such, the abatement failure assessment assumes that the plant exceeds the normal and half-hourly emission limit values for a total of 60 hours in a year.

In the absence of any other data, and in order to provide a worst-case assessment, emissions during an abatement failure are modelled at double the allowable 30-minute average concentrations with the exception of emissions of Carbon Monoxide which are assumed to quadruple, and particulate matter as PM_{10} which has a maximum half-hourly average specified in the IED of 150 mg Nm^{-3} during these times. Emissions of metal compounds are also assumed to double from the normal emission limit values, in the event of a failure of the abatement system. These assumptions are based on historic data from other waste to energy plants where emissions from abatement system failures have been monitored or estimated, and demonstrate a maximum percentage increase of 100 % for most species, with most remaining well within that level, although with CO emissions equating to 400 % of the allowable 30-minute release[11].

The assumption that releases may, for the most part, double in the event of an abatement failure generally represents a significant over-estimate based on the historic data available and it is important to recognise that, due to the monitoring and control requirements of all incineration plant, it is not permissible to operate at elevated emissions levels for prolonged periods. The Industrial Emissions Directive states that:

- Waste gases from waste incineration plants and waste co-incineration plants shall be discharged in a controlled way by means of a stack the height of which is calculated in such a way as to safeguard human health and the environment.
- In the case of a breakdown, the operator shall reduce or close-down operations as soon as practicable until normal operations can be restored.

- Waste incineration plants and waste co-incineration plants shall operate an automatic system to prevent waste feed in the following situations:
  - at start-up, until 850 °C has been reached;
  - whenever the temperature is not maintained at 850 °C;
  - whenever the continuous measurements show that any emission limit value is exceeded due to disturbances or failures of the waste gas cleaning devices.

As such, any increase in emissions to the half-hourly maximum level would be closely monitored, and plant operations would be corrected such that the daily permissible emissions limits are not generally exceeded. Where, for example, abatement failures are observed, plant operations would be corrected or stopped immediately, and hence, any elevated discharge would be for a very limited period.

The impact of short-term (30-minute) operational releases is considered in Table 36, with the likely process contributions from discharges at the maximum half-hourly limit values presented.

Table 36 Maximum Process Contributions During Operation at 30-Minute Emission Limit Values

Pollutant Parameter	Short-Term PC ($\mu g\ m^{-3}$)	Short-Term AQS / EAL	% AQS / EAL	Short-Term PEC ($\mu g\ m^{-3}$)	% AQS / EAL
Maximum Hourly Average NO_2	99.95	200	**50 %**	117.94	59 %
Maximum 15-Minute Average SO_2	102.51	266	**39 %**	106.83	40 %
99.9^{th} Percentile 15-Minute Average SO_2	27.31	266	**10 %**	31.63	12 %
Maximum Hourly Average SO_2	99.95	350	**29 %**	104.27	30 %
Maximum Hourly Average HCl	29.99	750	4 %	30.81	4 %
Maximum Hourly Average HF	2.00	160	1.25 %	2.01	1 %
Maximum Hourly Average CO ($mg\ m^{-3}$)	0.01	10	0.11 %	0.24	2 %
Maximum Hourly Average Particulate Matter (as PM_{10})	14.99	50	**30 %**	34.85	70 %
Maximum Hourly Average VOC	10.00	195	5 %	10.37	5 %

Note: The Environmental Assessment Level stated for VOC is the hourly limit for Benzene.

When applying the usual short-term assessment whereby a short-term PC of less than 10 % can be screened as insignificant, the hourly average contributions to HCl, HF, CO and VOCs screen at the initial assessment stage. However, short-term process contributions of NO_2, 15-minute and maximum hourly SO_2, and maximum hourly contribution of PM_{10} do not immediately screen, although each pollutant PEC remains within 70 % of the short-term AQS objective value.

In Table 37 over page, the short-term assessment levels have been revised in order to remove the existing short-term background, calculated as twice the annual average background concentration, and the process contributions are compared to these alternative assessment levels. When assessed against their percentile values, short-term contributions of NO_2 and 15-minute SO_2 screen at the secondary assessment level, however, the maximum short-term contributions cannot be screened as insignificant.

Table 37 Second Stage Screening of Process Contributions During Operation at 30-Minute Emission Limit Values

Pollutant Parameter	Annual Background (µg m^{-3})	AQS – (2 x Background)	Short-Term PC (µg m^{-3})	% AQS
Maximum Hourly Average NO_2	17.99	182.01	99.95	**55 %**
99.79th Percentile Hourly Average NO_2	17.99	182.01	23.66	13 %
Maximum 15-Minute Average SO_2	4.32	261.68	102.51	**39 %**
99.9th Percentile 15-Minute Average SO_2	4.32	345.68	27.31	10 %
Maximum Hourly Average SO_2	4.32	345.68	99.95	**29 %**
Maximum Hourly Average Particulate Matter (as PM_{10})	19.86	30.14	14.99	**50 %**

Despite not screening as insignificant, the results in Table 37 confirm that none of the predicted environmental concentrations are likely to exceed the most relevant AQS or EAL for pollutants, when discharging at the allowable short-term 30-minute emission limit values.

When considering the potential for abnormal operating conditions to occur and assuming a doubling of the short-term process contributions for most species, the quadrupling of contributions of CO, and a maximum PM_{10} release of 150 mg Nm^{-3} in the event of a failure of the abatement plant, the resultant process contributions and predicted environmental concentrations would continue to remain within the relevant Environmental Quality Standard as detailed in Table 38 over page.

Table 38 Annual Contribution to Pollutant Levels Assuming a Maximum of 60-Hours Abnormal Operations

Pollutant	Annual Average PC (µg m^{-3})	PC for 8,700 Hours (µg m^{-3})	Abnormal Annual Average PC (µg m^{-3})	PC for 60 Hours (µg m^{-3})	Total PC (µg m^{-3})	PC as % of AQS / EAL	Long-Term Background (µg m^{-3})	PEC (µg m^{-3})	AQS / EAL (µg m^{-3})	PEC as % of AQS / EAL
NO_2	1.242	1.233	8.30	0.0568	1.29	**3.22%**	8.99	10.28	40	26%
SO_2	0.311	0.309	4.14	0.0284	0.337	**1.69%**	2.2	2.50	20	12%
HCl	0.062	0.062	1.24	0.0085	0.0703	0.01%	0.41	0.480	750	0.06%
HF	0.010	0.010	0.08	0.0005	0.0108	0.07%	0.003	0.014	16	0.09%
VOC	0.104	0.103	0.42	0.0029	0.106	**2.12%**	0.186	0.292	5	6%
CO (mg m^{-3})	0.008	0.008	0.04	0.0003	0.0086	0.09%	0.226	0.235	10	2%
PM_{10}	0.052	0.051	1.56	0.0107	0.0621	0.16%	9.93	9.99	40	25%
Cd	0.207	0.206	0.415	0.0028	0.209	**4.17%**	0.0650	0.2737	5	5%
Hg	0.0002	0.0002	0.0004	0.000003	0.0002	0.083%	0.0013	0.0015	0.25	1%
Pb	0.0031	0.003	0.0062	0.000043	0.0031	**1.25%**	0.0017	0.0048	0.25	2%

*HCl has a short-term Environmental Assessment Level only.

The results in Table 38 present the annual contribution to pollution levels, assuming that an abnormal release, due for example to an abatement system failure, occurs for the maximum allowable 60-hour per year period. Normal operational conditions have been assumed for the remainder of the year and the annual average process contributions are therefore pro-rated to account for a normal discharge during 8,700 hours in the year, and an elevated discharge for the remaining 60 hours.

Assessing the overall potential longer-term process contributions and predicted environmental concentrations in this way provides a robust assessment of pollutant discharges where only longer-term standards are in place. The calculation also presents a realistic, but conservative worst-case assessment as, although the site has the potential to exceed the emission limits specified by the IED for up to 60 hours per year, it will not necessarily do so and additionally, calculating the increase in emissions over the course of the year ensures that all meteorological conditions, including the worst-case conditions for the discharge from the flues, are accounted for in the assessment. Although occasional exceedances of the emission limit values may occur in line with the allowable exceedances identified by the IED, these will not necessarily occur during poor meteorological conditions, will not necessarily be allowed to continue for up to four hours at a time, and will not necessarily occur for a total of 60 hours per year.

Despite the robustness and somewhat conservative nature of this assessment, the results in Table 38 predict that half of the process contributions continue to be screened at the initial assessment stage, and the environmental concentration of all pollutants will remain well within 70 % of the AQS or EAL despite the elevated emissions assumed to occur on a temporary basis through abnormal emissions and the potential failure of abatement systems. As such, the pollutant contributions from all allowable operations can be screened as insignificant.

8. Conclusions

A detailed air quality assessment has been undertaken on behalf of Biomass UK No. 4 Limited to consider the proposal to convert an existing wood fired Energy from Waste plant, for the receipt and use of Refuse Derived Fuel (RDF), and determines the resultant impact on air quality. Dartmoor Bio Power was originally built as a 4.3 MW_e waste wood incineration plant. The adapted facility will be known as Biomass Number 4 (Biomass No. 4), and will maintain its existing generation capacity with the switch to RDF.

Discharge characteristics for the proposed facility were provided by the technology providers via Biomass UK No. 4 Limited and suggest an overall increase in the volumetric flow-rate from that measured in 2018, and an increase in the temperature of the discharge from that of the existing, albeit not operational, facility. Mass emission rates were reduced from the original scheme due to changes in the regulatory limits that will be applied to the site operations through the Environmental Permit.

The detailed air quality assessment was undertaken using the ADMS Version 5.2 atmospheric dispersion model, utilising hourly average meteorological data sets for the Plymouth Mount Batten measurement station, which is located approximately 10.2 km to the south of the site. Spatially variable terrain and surface roughness files were also included within the assessment.

The results confirmed that, when discharging via the proposed 35 m high chimney, and thereby increasing the current (27 m) discharge height, the contribution of most pollutants will have an insignificant impact on air quality in the surrounding area. Where contributions were not immediately screened as insignificant, the predicted environmental concentrations were confirmed to remain within 70 % of the Air Quality Standard or Environmental Assessment Level and hence were screened at the secondary assessment stage.

When considering the contribution of proposed emissions from the Biomass No. 4 facility in combination with other new or proposed facilities in the area, the cumulative short-term, 99.79th percentile hourly average contribution of Nitrogen Dioxide equates to 25 % of the AQS and therefore does not screen at the initial or secondary assessment stage. However, the predicted environmental concentration remains within the AQS, equating to approximately 34 % of the assessment level and therefore, it is considered unlikely that levels of Nitrogen Dioxide in the local area will approach or exceed the Air Quality Standard objective value, and despite not screening as insignificant, there is little likelihood of any significant impact on human health due to exposure to Nitrogen Dioxide as a result of these industrial emissions.

Consideration of impacts at discrete sensitive receptors predicted that, although most are insignificant, the annual average concentrations of NO_x as NO_2, VOC, Cadmium, and PAH were not immediately screened at some of the nearest human health receptors. However, all screen as insignificant during the secondary assessment.

Contributions to the Critical Loads assigned to all local sensitive ecological receptors were also screened as insignificant. Levels of nutrient Nitrogen deposition at all sites equates to less than 1 % of the site-specific Critical Load and contributions of acid deposition to the South Dartmoor Woods SAC and the Dartmoor SAC also remain within 1 % of the site-specific Critical Loads. Neither the Plymouth Sound and Estuaries SAC, nor the Tamar Estuaries Complex SPA are sensitive to acid deposition. Process contributions to acid deposition at local nature sites remain within 100 % of the environmental standard, and therefore screen as insignificant in accordance with the assessment criteria for such sites.

Although contributions from Nitrogen based pollutants (NO_x and Ammonia) do increase when considering the Biomass No. 4 plant in combination with other local sites, and more of the local sites receive deposits of nutrient Nitrogen and acid deposition equating to more than 1 % of the assessment level, process contributions to designates sites remain within 1 % of the Critical Loads and all contributions to local sites remain well within 100 % of the environmental standards and are therefore screened as insignificant.

Short-term impacts are less easily defined due to the lack of directly comparable assessment levels. However, even when applying an overly conservative assessment, considering the worst-case results of shorter-term (half-hourly) emissions against longer-term (hourly) assessment levels the environmental concentration of the majority of pollutants do not exceed the most appropriate assessment level.

Finally, the potential for other than normal operating conditions to occur over the course of a year has been considered and the impact of such incidents can be screened as insignificant.

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