Air Quality Impact Assessment

High Hedley Biogas

Report produced for **W J Drennan Ltd**

Provided by Walker Resource Management Ltd (WRM)

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1.0	11/08/2022	Final Draft

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1.0 INTRODUCTION

WRM Limited (WRM) were commissioned by High Hedley Biogas (hereby referred to as HHB) on behalf of W J Drennan Ltd to undertake an Air Quality Impact Assessment for the 499kW Combined Heat and Power (CHP) engine and gas flares as part of a permit variation application to operate an anaerobic digestion facility treating 55,000 tonnes of waste per annum. The installation is located on land at High Hedley Hope Farm, East Hedleyhope, Durham, DL13 4PR. Full details of the development can be found in the accompanying Non-Technical Summary (HHB-A01).

The Air Quality Impact Assessment (AQIA) is produced as part of a permit variation application to the Environment Agency (EA) to increase the site's throughput capacity to 55,000 tonnes per annum, which results in a treatment capacity of more than 100 tonnes per day. This AQIA clarifies the following details of the development:

- Stack heights and impact of buildings on pollutant dispersion; and
- Confirmation of emission pollutants and concentrations from each source.

1.1 Site Location

The anaerobic digestion facility is located in County Durham, approximately 0.79km northwest of the village of East Hedleyhope, approximately 0.77km south of the village of Hedley Hill and approximately 11.79km west of the city of Durham. The facility is located in a rural setting surrounding by agricultural land. The site's main access point is located off Commercial Street via the B6301.

The site, wholly owned by W.J. Drennan Limited, is situated next to High Hedley Hope Farm (also owned by Mr W.J, Drennan) and contains a weighbridge, site office, reception hall, two primary digesters, one pasteurisation tank, negative aeration system, biogas cleaning system, one combined heat and power (CHP) unit, a flare and a gas to grid entry system with gas flare. There are several sensitive receptors within 250m of the site boundary. Figure 1 indicates the local setting of the site, situated at grid reference NZ 15008 41013.

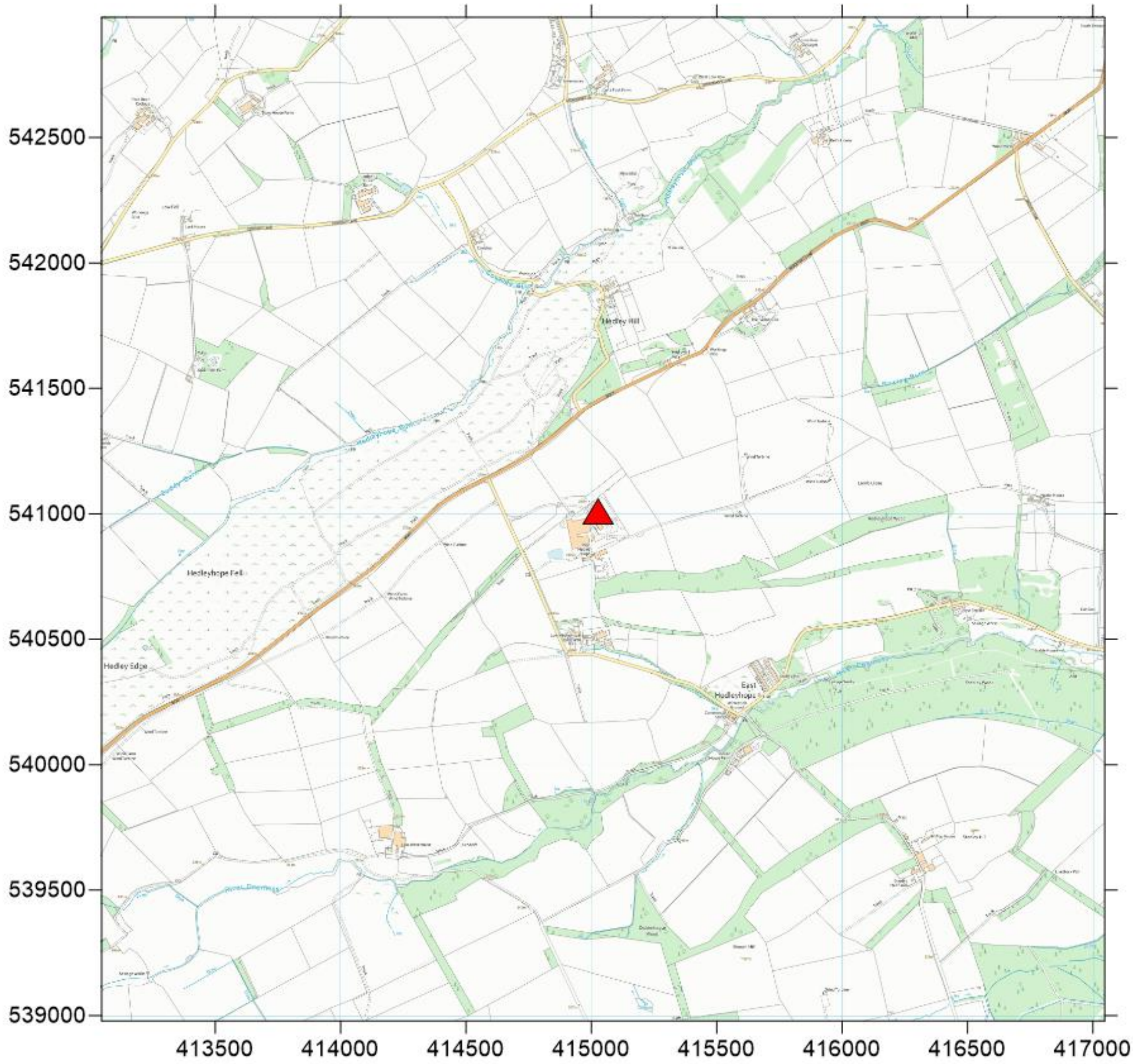

Figure 1 – Site Location on 4km x 4km Georeferenced Base Map

1.2 Proposed Operations

Air quality modelling requires that sources of emissions are defined in terms of dimensions, location and physical characteristics of temperature and velocity. This modelling study has been carried out to assess the potential impact on local air quality due to releases of atmospheric pollutants from the CHP stack and gas flares.

The 499kW CHP plant is fuelled by biomethane generated onsite. The CHP generates the power requirements across the site. The facility also has the ability to export electricity to the grid. The CHP provides one point source emission. The gas flares (one for the AD process and one for the gas to grid process) shall only be used in case of emergency and provide two point source emissions.

1.3 Scoping Assessment

This air quality impact assessment has been prepared by WRM based on a specific design proposed by HHB.

This assessment considers the impacts of combustion pollutants from the CHP and gas flares on sensitive receptors adjacent to the proposed development. The main aims are to:

- Confirm appropriate assessment criteria for the development;
- Quantify the main sources of pollutants;
- Consider site specific conditions likely to affect dispersion; and
- Assess stack heights taking into consideration downwash effects from buildings.

2.0 REGULATORY SETTING

In order to provide meaningful input parameters to be modelled against a set threshold value, the regulatory background to air quality modelling is provided. The regulatory setting forms the basis for the justification for model input data and the assessment of modelled output data against set values.

2.1 Air Quality Standards

EC Council Directive 96/62/EC on ambient air quality assessment and management (The Air Quality Framework Directive) established a framework through which the European Union will agree limits or target values for air pollutants. The limits within the EC Directive were implemented by The Air Quality Limit Value Regulations. EC Council Directive 2008/50/EC consolidated earlier air quality directives. The Limit Value Regulations set air quality standards for a range of air pollutants. The UK Government has published an Air Quality Strategy[1] which sets out how the Government proposes to fulfil the UK's obligations under the Air Quality Directive. The Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland sets out the policy, targets and objectives for a range of air pollutants.

The Technical Guidance[2] to local authorities for the review and assessment of air quality sets out the methods to be used to determine if the air quality objectives are likely to be achieved. The air quality standards are intended to protect human health and should apply to dwellings and land to which the public has access, irrespective of ownership.

2.2 Air Quality Strategy

The 'Air Quality Strategy for England, Scotland, Wales and Northern Ireland' (AQS) 2007, contains air quality objectives based on the protection of both human health and vegetation (ecosystems). The AQS sets out a framework for reducing hazards to health from air pollution and ensuring that international commitments are met.

These objectives have been set taking into account the Air Quality Standards defined in the Air Quality Standards Regulations 2007 (now superseded by the Air Quality Standards Regulations 2010).

2.3 Air Quality Management

The Environment Act 1995 requires the UK Government and the devolved administrations for Scotland and Wales to produce a national air quality strategy containing standards, objectives and measures for improving ambient air quality and mechanisms to keep these policies under review. In addition, it sets out the responsibilities of local authorities on air quality management.

Part IV of the Environment Act 1995 requires local authorities to periodically review and assess the quality of air within their administrative area. The reviews have to consider the present and future air quality and whether any air quality objectives prescribed in regulations are being achieved or are likely to be achieved in the future.

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[1] DEFRA (2007) T*he Air Quality Strategy for England, Scotland, Wales and Northern Ireland Vols 1 & 2*.

[2] DEFRA (2018) Review and Assessment Technical Guidance TG(16).

Where any of the prescribed air quality objectives are not likely to be achieved, the authority concerned must designate an Air Quality Management Area (AQMA). For each AQMA, the local authority has a duty to draw up an Air Quality Action Plan (AQAP) setting out the measures the authority intends to introduce to deliver improvements in local air quality in pursuit of the air quality objectives.

DEFRA has published technical guidance for use by local authorities in their review and assessment work. This guidance, referred to in this report as LAQM.TG(16), has been used where appropriate in the assessment presented here.

2.4 General Nuisance

Part III of the Environmental Protection Act (EPA) 1990 (as amended by the Noise and Statutory Nuisance Act 1993) contains the main legislation on Statutory Nuisance and allows local authorities and individuals to take action to prevent a statutory nuisance. Section 79 of the EPA defines, amongst other things, smoke, fumes, dust and smells emitted from industrial, trade or business premises so as to be prejudicial to health or a nuisance, as a potential Statutory Nuisance. It also defines accumulation or deposit, which is prejudicial to health as a nuisance.

2.5 Planning Policy Guidance

Policy guidance for local planning authorities regarding local air quality and new development is provided in the National Planning Policy Framework[3] (NPPF) superseding PPS23, which states that the 'existing, and likely future, air quality in the area [of proposed development plans], including any Air Quality Management Areas (AQMA) or other areas where air quality is likely to be poor' should be considered in the preparation of development plan documents and may also be material in the consideration of individual planning applications where pollution considerations arise.

A planning authority must also consider the potential implications of contamination when it is considering applications for planning permission. Specifically, PPS23 states 'Any consideration of the quality of land, air or water and potential impacts arising from development, possibly leading to an impact on health, is capable of being a material planning consideration, in so far as it arises or may arise from any land use'.

The proposed development will not be required to be regulated by the Environment Agency under an Environmental Permit according to the Environmental Permitting (England and Wales) Regulations[4]. The relationship between planning and pollution control is set out in NPPF in which it is stated 'the planning and pollution control systems are separate but complementary. Pollution control is concerned with preventing pollution through the use of measures to prohibit or limit the release of substances to the environment from different sources', whereas 'the planning system should focus on whether the development itself is an acceptable use of the land, and the impacts of those uses, rather than the control of processes or emissions themselves'. Therefore 'planning authorities should work on the assumption that the relevant pollution control regime will be properly applied and enforced. They should act to complement but not seek to duplicate it'.

[3] Department for Communities and Local Government (2012) *National Planning Policy Framework*. 2012.
[4] Environment Agency (2016) *Environmental Permitting (England and Wales) Regulations 2016 (SI 2016 No, 1154)*.

2.6 PPC Guidance

The Environment Agency for England has published Guidance[5] that should be taken into account when determining the level of assessment required for PPC process operations. H1 is general Guidance relating to all process operations that are subject to PPC. H1 provides information about methods for quantifying environmental impacts to soil, water and air. H1 includes a list of Environmental Quality Standards (EQS) and Environmental Assessment Levels (EAL) for air quality.

The air quality criteria used in this assessment are based on the EALs published in H1. This Guidance also sets out benchmarks to assess predicted rates of deposition of pollutants to land.

2.7 Air Quality Objectives

The UK Air Quality Strategy (UKAQS 2007) sets out a framework for the short to medium term, and the roles that Government, the Environment Agency, local government, industry & business, individuals and transport have in protecting and improving air quality.

The UKAQS includes more exacting standards for some pollutants than required by EC legislation. In the majority of cases, standards are carried into the Environmental Permitting regime as short and long term EALs. The Environment Agency's role in relation to Local Air Quality Management is described, with a commitment to ensuring that regulated installations will not contribute significantly to breaches of AQS objectives or EU limit values.

2.8 Sensitive Receptors

Nature conservation sites should be screened against the relevant standards if they occur within specified distance criteria, as detailed below:

- Special Protection Areas (SPAs), Special Areas of Conservation (SACs) or Ramsar sites within 10km of the installation;
- Sites of Special Scientific Interest (SSSIs) within 2 km of the installation; and
- National Nature Reserves (NNRs), Local Nature Reserves (LNRs), local wildlife sites and ancient woodland within 2km of the location of the installation.

According to the Guidance in LAQM-TG(16), air quality objectives should apply to all locations where members of the public may be reasonably likely to be exposed to air pollution for the duration of the relevant objective. Thus, short-term standards such as the 1-hour objective for NO_2 should apply to footpaths at site boundaries and other areas which may be frequented by the public even for a short period of time. Longer term objectives such as the 24-hour or annual mean should apply at houses or other locations which the public can be expected to occupy on a continuous basis. These objectives do not apply to exposure at the workplace. The long-term impacts on human health from exposure to residual process emissions of dioxins, furans and metals are mainly from ingestion, rather than inhalation.

[5] Environment Agency (2011) *Horizontal Guidance Note H1 – Annex f v.2.2*.

3.0 EMISSION INVENTORY AND BASELINE DATA

An emission inventory has been created from technical data for the proposed plant development as outlined in Section 1.2. Information has been provided by HHB.

3.1 Emission Inventory

WRM has compiled an inventory for the proposed process emissions based on technical data provided by technology providers for the project build, as well as emission limit values (ELVs) set out within Standard Rules SR2012 No12[6] which are themselves taken from the EA's guidance for monitoring landfill gas engine emissions[7] and gas flaring[8]. The emission inventory for the process is summarised in Table 1 below. The CHP stack is assumed to be one continuous emission point.

Table 1 – Summary of Emission Source

Source	Frequency	Conditions
499 kW CHP	Continuous	Elevated Point
AD Plant Gas Flare	Emergency	Elevated Point
Gas to Grid Flare	Emergency	Elevated Point

3.2 Background Pollution

Estimates of background pollution have been obtained from the DEFRA sponsored air quality archive[9]. The 2021 updates of the maps were used for NO_2, according to DEFRA guidance for new assessments, and incorporate background-based maps for years 2018 to 2030, as such no adjustment factor for year of study was required.

For CO and Benzene, the reference data for 2001 was applied, then projected forward for 2021 using the DEFRA Year Adjustment Calculator[10]. For SO_2, year adjustment factors are no longer provided because it is considered that SO_2 background levels would change very little, i.e. the factor would be close to one.

The data in Table 2 below presents the highest reported estimated background concentration within 2km of the proposed installation, within the study area.

For the purposes of data input to the ADMS model, background units must be converted to ppb. The applied conversion factors for ppb to $\mu g/m^3$ are 1.91 (NO_2), 2.66 (SO_2), 3.25

[6] Environment Agency. SR2012 No 12: anaerobic digestion facility including use of the resultant biogas (waste recovery operation). Available from https://www.gov.uk/government/publications/sr2012-no12-anaerobic-digestion-facility-including-use-of-the-resultant-biogas-waste-recovery-operation. Accessed 23/06/2021.
[7] Environment Agency. LFTGN08 v2 2010: Guidance for monitoring landfill gas engine emissions. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/321617/LFTGN08.pdf
[8] Environment Agency. Guidance on Landfill Gas Flaring. https://www.sepa.org.uk/media/28988/guidance-on-landfill-gas-flaring.pdf
[9] DEFRA. LAQM data available from http://laqm.defra.gov.uk/?tool=background04. Accessed 05/02/2021.
[10] DEFRA. Adjustment calculator available from http://laqm.defra.gov.uk/tools-monitoring-data/year-adjustment.html Accessed 23/06/2021.

(Benzene). The conversion factor from ppm to mg/m^3 for (CO) is 1.16 (please note, the figure for CO needs to be converted to ppb following the initial conversion).

In addition, please note, the background figure for Benzene has been used for assessment of VOCs. It has therefore been entered into the model as the background for VOCs. The assessment after modelling has been undertaken against Benzene EALs.

Table 2 – Applied Background Air Quality Concentrations

NO2		Benzene		CO		SO2	
(µg/m^3)	ppb	(µg/m^3)	ppb	(mg/m^3)	ppb	(µg/m^3)	ppb
4.772	2.498	0.203	0.04	0.178	68.44	1.96	0.737

3.3 Human Receptors

A desk-top study was undertaken in order to identify any sensitive receptor locations in the vicinity of the site that required specific consideration during the assessment. The nearest residential property is ~70m south-west of the centre of the site. The location of the nearest sensitive receptors and the distances and direction of these receptors from the site are summarised in the table below, and are mapped out in Appendix A. The site is not within an air quality management area (AQMA).

Table 3 – Human Receptor Locations

Reference	Receptor	Distance to Site (m)	Coordinates (x,y)
HR01	Residential Properties Un-named road	885	415053, 541874
HR02	Un-named Cottage Un-Named Road	1,195	415151, 542176
HR03	Lane Foot Farm	1,740	415045, 542722
HR04	Greenacres Club Caravan Park	1,755	414865, 542733
HR05	Hedleyhill Villa B6301	670	415290, 541589
HR06	Residential Property Steadman’s Lane	1,780	415420, 542724
HR07	The Hemmels B6301	995	415618, 541788
HR08	Residential Properties off Steadman’s Lane	2,015	415831, 542835
HR09	Farm off Steadman’s Lane	1,730	415915, 542493
HR10	Un-Named Farm off Ivesley Lane	1,710	416750, 541048
HR11	Residential Properties B6301	2,245	416697, 542473
HR12	Ivesley Lane Farm	2,175	417020, 541847
HR13	Residential Properties Ivesley Cottages	1,425	416424, 540649
HR14	Stable House Farm	1,895	416867, 540482

Reference	Receptor	Distance to Site (m)	Coordinates (x,y)
HR15	Residential Properties Ivesley Lane	2,085	417055, 540474
HR16	Residential Properties West View/Deerness View	850	415638, 540403
HR17	Farm off Commercial Street	1,840	416285, 539653
HR18	Residential Properties Commercial Street	940	415559, 540200
HR19	Dicken House Farm	1,075	415615, 540068
HR20	Residential Properties Commercial Street	470	414960, 540515
HR21	Western Experience Equestrian Centre	495	414996, 540498
HR22	Low West House Farm	1,495	414208, 539728
HR23	South Shields Farm	2,061	412985, 541299
HR24	Greenfield Farm	1,725	413406, 541548
HR25	Lodge House Farm	1,550	414104, 542236
HR26	Stowhouse Farm Cottages	2,140	413663, 542616
HR27	Farm	1,215	414541, 542088
HR28	Farm	2,392	413238, 542566
HR29	High Hedley Hope Farm	70	414987, 540827
HR30	Unknown Building	800	415454, 540301
HR31	Lark Cottage Cowsley Lane	1,995	413380, 542095
HR32	Unknown Cottage	2,040	413375, 542161
HR33	Unknown Cottage	990	414787, 541934

3.4 Ecological Receptors

A desk-top study was undertaken in order to identify any ecological receptor locations in the vicinity of the site that required specific consideration during the assessment. In terms of identifying sensitive locations, consideration has been given to sensitive receptors at distances stated within section 2.8.

The location of the sensitive receptors and the distances from the site are summarised in the table below, and are mapped out in Appendix A.

Table 4 – Ecological Receptor Locations

Reference	Receptor	Habitat	Distance to Site (m)	Coordinates (x,y)
ER01	Hedleyhill Colliery Woods – LNR & LWS	Woodland	935	415879, 540516

Reference	Receptor	Habitat	Distance to Site (m)	Coordinates (x,y)
ER02	Hedleyhope Fell – LWS	Lowland Heathland	400	414736, 541268
ER03	Upper Deerness Valley – LWS	Deciduous Woodland	965	415493, 540151
ER04	Deerness Valley (1) – LWS	Woodland	995	415668, 540237
ER05	Deerness Valley (2) – LWS	Deciduous Woodland, Lowland Heathland & Semi-Improved Grassland	1,455	416473, 540788

3.5 Critical Loads and Levels

The Air Pollution Information System (APIS[11]) is a support tool for assessment of potential effects of air pollutants on habitats and species developed in partnership by the UK conservation agencies and regulatory agencies and the Centre for Ecology and Hydrology. APIS has been used to provide information on:

- Identification of whether the habitats present are sensitive;
- Critical levels and current baseline concentrations; and
- Critical loads and current N deposition rates.

[11] APIS http://www.apis.ac.uk [Accessed 24/06/2020]

4.0 ASSESSMENT METHODOLOGY

The following section outlines the data and model parameters utilised in order to model the emissions from the site at identified sensitive receptors. Identification is provided of data sources, input parameters within the chosen model and acknowledgement of uncertainty inherent with modelling exercises.

4.1 Dispersion Modelling

The transport and transformation of a pollutant in the boundary layer can be predicted with a reasonable degree of confidence using an appropriate mathematical model. The model used for this exercise is ADMS 5.2 which is developed by Cambridge Environmental Research Consultants (CERC) Ltd. ADMS 5 is a short-range dispersion modelling software package that simulates a wide range of buoyant and passive releases to atmosphere. It is a new generation model utilising boundary layer height and Monin-Obukhov length to describe the atmospheric boundary layer and a skewed Gaussian concentration distribution to calculate dispersion under convective conditions. The model utilises meteorological data to define conditions for plume rise, transport and diffusion. It estimates the concentration for each source and receptor combination for each hour of input meteorology and calculates user-selected long-term and short-term averages. The model is routinely used by UK environment agencies.

The principal factors affecting the concentration of a pollutant are:

- source characteristics including source strength, height of discharge, density, and temperature of the release;
- prevailing atmospheric conditions including wind speed, wind direction, cloud cover, precipitation, ambient temperature and the depth of the boundary layer; and
- adjacent buildings, topography and local surface conditions.

These factors can be assigned numerical values and the resultant downwind concentrations of pollutants may be predicted.

4.2 Approach to Model Uncertainty

Uncertainty in dispersion modelling predictions can be associated with a variety of factors, including:

- Model uncertainty - due to model limitations;
- Data uncertainty - due to errors in input data, including emission estimates, land use characteristics and meteorology; and,
- Variability - randomness of measurements used.

Potential uncertainties in model results have been minimised as far as practicable and worst-case inputs used in order to provide a robust assessment. This included the following:

- Choice of model - ADMS 5 is a commonly used atmospheric dispersion model and results have been verified through a number of studies to ensure predictions are as accurate as possible;
- Meteorological data - Modelling was undertaken using three annual meteorological data sets from the closest observation site to the facility, selecting the year in which the worst-case conditions were identified when modelled;

- Operating conditions - Operational parameters were supplied by Charlton Park based on proposed design and anticipated operational activities. As such, these are considered to be representative of likely operating conditions;
- Emission rates - Emission rates were derived from process design and are therefore considered to be representative of potential releases during normal operation;
- Receptor locations - Receptor points were included at sensitive locations to provide consideration of impacts on these areas. Emission levels at any point within the assessment extents may be derived from the output model results; 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 pollutant concentrations.

Results were considered in the context of the relevant assessment levels. It is considered that the use of the stated measures to reduce uncertainty and the use of worst-case assumptions when necessary has resulted in model accuracy of an acceptable level.

4.3 Model Parameters

The emission conditions of the identified pollutant sources are based on technical information provided by HHB and ELVs within Standard Rules SR2012 No12[12]. It should be noted that figures for the AD Plant Gas Flare were established using sectoral benchmarking based on similar specifications of flares as no data was available for this. Technical information was used for the following CHP and gas flares parameters, with all other emission parameters derived from Standard Rules SR2012 No12:

- Coordinates
- Exit Diameter
- Exit Temperature
- Efflux Velocity
- Release Height

These emission conditions are summarised in the table below, in accordance with the requirements of H1 and EA Guidelines. There are three combustion processes leading to the emission of pollutants that require assessment, the CHP, boiler stack and gas flare emitting pollutants are identified below for assessment inclusion.

Table 5 – Summary of Modelled Source Conditions

Parameter	CHP	Gas to Grid Gas Flare	AD Plant Gas Flare
Coordinates (x,y)	415054, 540956	415081, 540926	415051, 540982
Exit Diameter (m)	0.28	1.94	0.7
Exit Temperature (°C)	198	1000	850
Efflux Velocity (m/s)	22.6	12.6	9.75
Release Height (m)	10.5	7.67	5.11

[12]SR2012 No 12: anaerobic digestion facility including use of the resultant biogas (waste recovery operation)
https://www.gov.uk/government/publications/sr2012-no12-anaerobic-digestion-facility-including-use-of-the-resultant-biogas-waste-recovery-operation

NO_x Emission Rate (g/s)	0.2766	0.657	0.0615
CO Emission Rate (g/s)	0.7744	0.219	0.0205
SO_2 Emission Rate (g/s)	0.1936	n/a	n/a
VOC Emission Rate (g/s)	0.5531	0.0438	0.0041
O2 Emission Content (%)	8.4	10	12.1

The assessment considers pollutants based upon information supplied by technology providers and ELVs within Standard Rules SR2012 No12. The assessment includes NO_x as NO_2, since these are the main combustion pollutants from the CHP unit and gas flare. Additional pollutants of CO, Benzene and SO_2 are also included.

4.3.1 Meteorological Data

Meteorological data used in this assessment was taken from Ablemarle meteorological station, over the period of 2018 to 2020 (inclusive). The meteorological station is located approximately 29km north of the site. DEFRA guidance LAQM.TG(16) recommends meteorological stations within 30km of an assessment area as being suitable for detailed modelling. This is the closest meteorological station to the proposed site of development which most represents the land the development is to be situated on. All meteorological data used in the assessment was provided by the Met Office, which is an established distributor of meteorological data within the UK.

The worst-case results vary with the year of hourly sequential meteorological data used to predict dispersion. The worst-case meteorological data for dispersion is for the year 2020 and this has been used in all subsequent analysis. Met data for this period is presented as a wind rose in Figure 2 below, with all data in Appendix B.

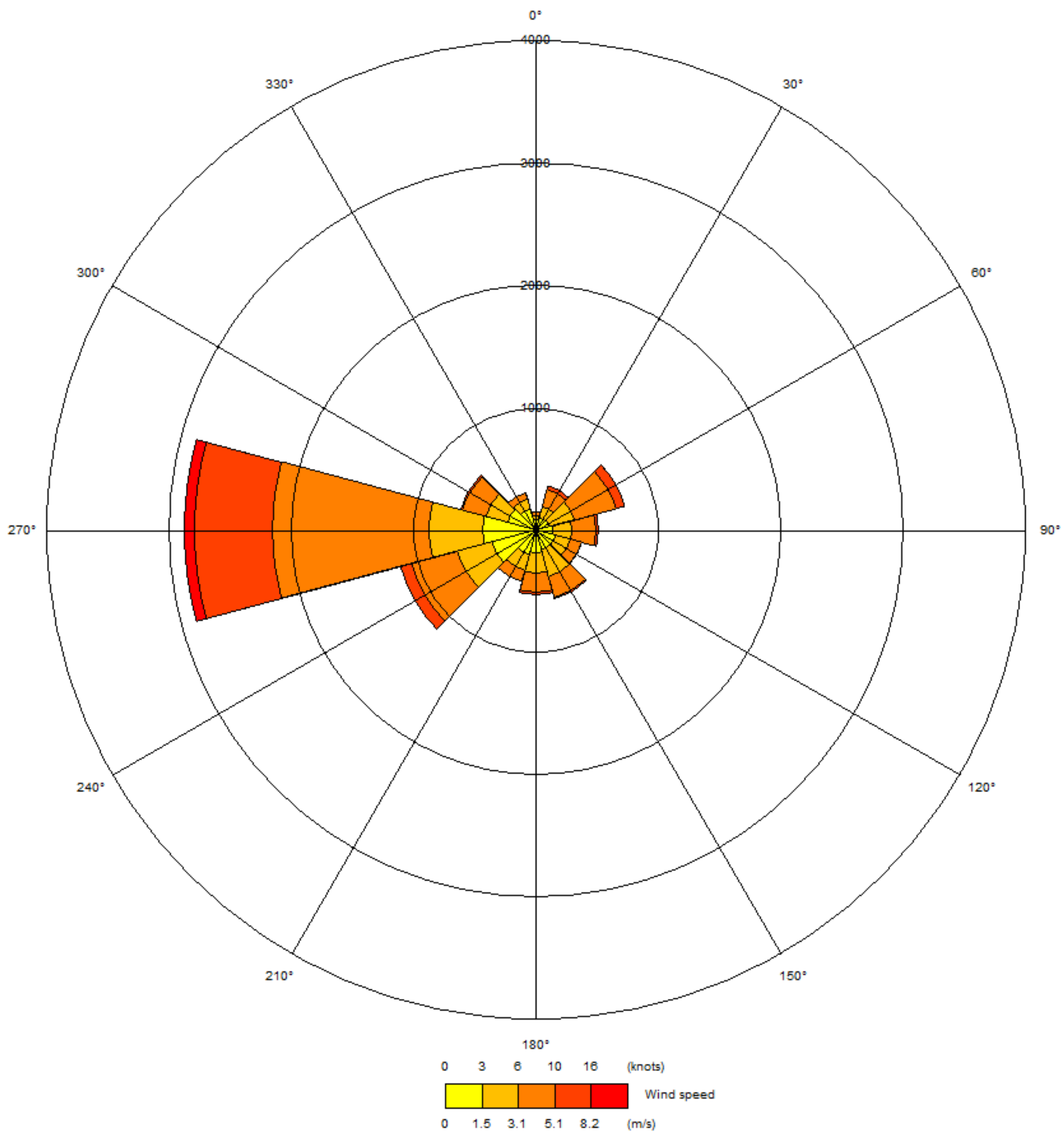


Figure 2 – Wind Rose of Ablemarle Meteorological Data for 2020

4.3.2 Terrain

The model terrain algorithm should only be used where slopes are >1:10. The proposed site is on level ground where terrain effects are unlikely to affect dispersion and terrain effects have therefore been discounted.

4.3.3 Buildings / Tanks

The dispersion model used can take account of the effects of recirculating flow or downwash effects caused by buildings / tanks near the point of release, although these effects are generally not important where the release is close to the ground. Building / tank effects have been considered for all point source releases. The details of buildings / tanks used in the assessment are presented in the table below, and schematically in Figure 3.

Table 6 – Buildings Included within Model Assessment

Reference	Building	Coordinates (x,y)	Shape	Height (m)	Length / Diameter (m)	Width (m)	Angle (º)
1	Reception Hall	415035, 540952	Rectangular	11	30	18	146
2	Pasteurisation Unit	415046, 540988	Rectangular	6.5	7.7	5.7	146
3	Liquid Waste Tank 1	415023, 540983	Circular	9.4	3.4	n/a	0
4	Liquid Waste Tank 2	415027, 540986	Circular	9.4	3.4	n/a	0
5	Liquid Waste Tank 3	415025, 540979	Circular	11.28	4.3	n/a	0
6	Liquid Waste Tank 4	415028, 540976	Circular	10.8	3.11	n/a	0
7	Liquid Waste Tank 5	415032, 540978	Circular	10.8	3.11	n/a	0
8	Liquid Waste Tank 6	415017, 540982	Circular	11.28	4.3	n/a	0
9	Digester 1	415022, 541003	Circular	10	23	n/a	0
10	Digester 2	415007, 541025	Circular	10	23	n/a	0
11	Separator	415012, 540987	Rectangular	1.2	2.8	2.1	0
12	Biofilter	415046, 540965	Rectangular	6	6.83	6.83	146
13	Gas Upgrader	415083, 540959	Rectangular	2.85	12.19	4	236
14	Grid Entry Unit	415098, 540970	Rectangular	2.65	5.5	4	236
15	Substation	415063, 540961	Rectangular	3.8	5	3.5	236
16	Substation Container	415058, 540970	Rectangular	2.56	6	2.5	146
17	Unknown Tank 1	415034, 540982	Rectangular	2.56	5.7	2.6	146

Reference	Building	Coordinates (x,y)	Shape	Height (m)	Length / Diameter (m)	Width (m)	Angle (°)
18	Unknown Tank 2	415037, 540984	Rectangular	3.5	6.26	2.88	146
19	CHP Container	415053, 540957	Rectangular	2.9	10.9	2.9	146

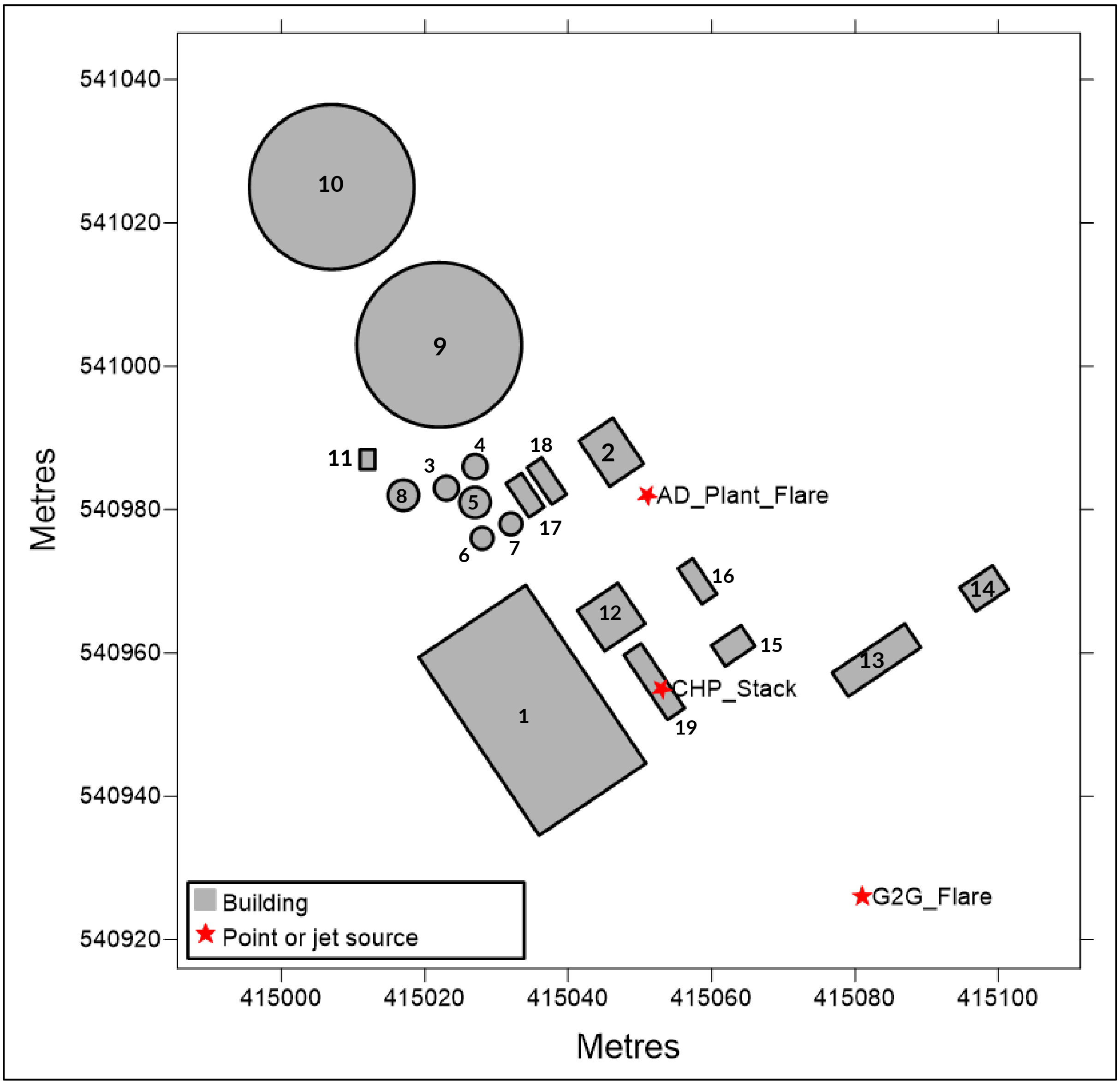


Figure 3 – Building and Point Sources Layout

4.4 Special Treatment of Model Results

Nitric Oxide to NO2 Conversion

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

Following the EA Air Quality Modelling and Assessment Unit (AQMAU) guidance on conversion ratio for NO_x and NO_2, a worst-case scenario has been applied in that 35% of NO_x is presented as NO_2 in relation to short-term impacts and 70% of NO_x is present as NO_2 in relation to long-term impacts.

Averaging Periods

Where the short-term environmental standard is measured using a time period other than hourly, conversion factors are applied to model results to present the correct concentrations. Hourly concentrations are therefore multiplied by the appropriate factor identified below:

- 1.34 to convert to a 15-minute average
- 0.7 to convert to an 8-hour average
- 0.59 to convert to a 24-hour average

4.5 Human Receptor Assessment

The Environment Agency publishes a list of pollutants to include within an assessment where released at source. The H1 document includes a list of Environmental Quality Standards (EQS) and Environmental Assessment Levels (EAL) for air quality. The air quality criteria used in this assessment are based on the EALs published in H1. This Guidance also sets out benchmarks to assess predicted rates of deposition of pollutants to land. The environmental assessment levels for human receptors is provided in the table below for the appropriate averaging period and pollutants.

Table 7 – Human Receptor Environment Assessment Levels (EAL)

Pollutant	Averaging Period	EAL (µg/m^3)
Nitrogen Dioxide	1-hour mean ≤18 exceedances	200
	Annual mean	40
Sulphur Dioxide	15-min mean ≤35 exceedances	266
	1-hour mean ≤24 exceedances	350
	24-hour mean ≤3 exceedances	125
Benzene	24-hour mean 0 exceedances	195
	Annual mean	5
Carbon Monoxide	Maximum daily running 8-hour mean	10,000

4.6 Ecological Receptor Assessment

The EA's Operational Instruction details how the air quality impacts on ecological sites should be assessed. This guidance provides risk-based screening criteria to determine whether impacts will:

- Have a likely significant effect on a European site;
- Be an operation likely to damage (OLD) a Site of Special Scientific Interest (SSSI); or
- Result in significant pollution of a National Nature Reserve (NNR), Local Nature Reserve (LNR), Local Wildlife Site (LWS) or ancient woodland (AWL).

The environmental assessment levels for ecological receptors is provided in the table below for the appropriate averaging period and pollutants.

Table 8 - Ecological Receptor Environment Assessment Levels (EAL)

Pollutant	Averaging Period	EAL (µg/m^3)
Sulphur Dioxide	Annual mean	10 (where lichens or bryophytes are present) 20 (where they're not present)
Nitrogen Oxide (as NO_2)	Annual mean	30
Nitrogen Oxide (as NO_2)	Daily mean	75

4.7 Critical Load Assessment

Designated habitats may contain species, habitats or other receptors which are potentially sensitive to atmospheric pollution for which indicative exposure thresholds for their protection have been defined. These thresholds are known as Critical Levels (for airborne concentrations) and Critical Loads (for deposition rates).

Critical levels are a quantitative estimate of exposure to one or more airborne pollutants in gaseous form, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge. Critical levels for the protection of vegetation and ecosystems are specified within the Air Quality Standards Regulations.

Critical loads are a quantitative estimate of exposure to deposition of one or more pollutants, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge. Critical loads are set for the deposition of various substances to sensitive ecosystems.

Empirical critical loads for eutrophication (derived from a range of experimental studies) are assigned based for different habitats, including grassland ecosystems, mire, bog and fen habitats, freshwaters, heathland ecosystems, coastal and marine habitats, and forest habitats and can be obtained from the UK Air Pollution Information System (APIS).

4.7.1 Deposition Rates

Deposition rates for the process contribution (PC), were calculated using empirical methods recommended by the EA (AQTAG06)[13]. If the annual average ground level concentration of a pollutant is Pc (µg/m^3) and the dry deposition velocity for that pollutant is Vd (m/s) then the annual dry deposition rate Dr (kg/ha/yr) is calculated from the following formula:

[13] Environment Agency AQTAG06 *Technical guidance on detailed modelling approach for an appropriate assessment for emissions to air Status*: Updated version, (Approved March 2014).

$$D_r = Vd \times Pc \times Mf \times Cf$$

Where:
Mf = 14/46 for NO_2
32/64 for SO_2
1/17 for NH_3
1/35 for HCl

and converts from nitrogen dioxide to nitrogen, sulphur dioxide to sulphur and hydrogen chloride to hydrogen.

Cf = the conversion factor value (315.36) which converts to kg/ha/yr.

Dry deposition velocities vary depending on the type of land mass and weather conditions such as humidity. The following values have been used for Vd, as presented within the Technical Guidance note.

- NO_2 – 0.0015 m/s
- SO_2 – 0.012 m/s
- NH_3 – 0.02 m/s
- HCl – 0.025 m/s

In order to calculate acid deposition in terms of k_{eq}/ha/yr from deposition data (calculated using the equation above) in terms of kg/ha/yr the following conversion factors are used:

- Nitrogen derived acid deposition: 1kg N/ha/yr is equal to 1/14 keq N/ha/yr
- Sulphur derived acid deposition: 1 kg S/ha/yr is equal to 1/16 keq S/ha/yr

4.8 Significance of Impact

This air quality impact assessment (AQIA) will provide quantitative predictions for a range of pollutants and to help assess their significance. The structure for assessing the significance of air quality impacts is set out in the table below.

Table 9 – Assessment Matrix for Determination of Significance

Predicted Impact	Significance	Justification
Process Contribution + baseline greater than EAL	Major	Exceeding any air quality limit value would be unacceptable in terms of human health, or where the impact would have significant ecological impacts.
Process Contribution + baseline <100% of EAL	Moderate	Risk based approach advocated by Environment Agency taking account of model headroom and uncertainty. May not be acceptable for sensitive ecological and human receptors.
Process Contribution + baseline <70% of EAL	Minor	Risk based approach advocated by Environment Agency taking account of model headroom and uncertainty.
Process Contribution <10% of EAL	Negligible	Adopted risk-based approach taking into account the factor of 10.

Predicted Impact	Significance	Justification
Process Contribution <1% of EAL	Insignificant	The assessment criteria proposed within H1 screening tool which states that process contributions can be considered insignificant if the long-term process contribution is <1% of the long-term environmental standard.

5.0 SENSITIVITY ANALYSIS

This section presents the potential air quality impacts associated with the operational phase of the site, the mitigation measures that will be employed and any residual impacts. Appendix C and D summarise the findings of the potential emissions and the scale and extent of potential impacts. Aspects of the assessment are discussed in more detail below.

It is a requirement of the Royal Meteorological Society Guidelines on Dispersion Modelling[14] and a subsequent review[15] that dispersion modelling studies should include a sensitivity analysis for model inputs, to provide an estimate of the possible errors in the predictions. The potential errors in predictions were outlined in Section 4. The sensitivity analysis conducted for this study considers the likely variability and errors arising from meteorological data, surface roughness and stack heights.

The Environment Agency's method for assessing model uncertainty[16] indicates that the confidence in the model is low. However, the approach to assessment is the method normally accepted by DEFRA, the EA and other regulatory bodies. The main causes of model uncertainties are:

- potential combination of the effects of terrain and buildings on dispersion;
- uncertainties in source estimates for diffuse releases; and
- the low model headroom.

Despite these uncertainties, the modelling provides a useful comparison between the likely impact for the baseline and as proposed Scenarios.

5.1.1 Meteorological Variability

Initially, the model predictions consider the variability of emissions around the site for a range of years (Ablemarle meteorological station 2018 to 2020 inclusive). This sensitivity analysis considers the predicted NO_2 for the proposed release conditions. This indicates that for the proposed release conditions, the worst case NO_2 results vary with the year of hourly sequential meteorological data used to predict dispersion.

The worst-case impact predicted to occur varies from year to year and according to receptor. The worst-case factors for year to year have been taken into account in the assessment as identified in the table below.

Table 10 – PEC NO_2 (Annual Mean) Predictions with Met Data Year Adjustments

Met Data Year	2018	2019	2020
NO_2 ($\mu g/m^3$)	5.490	5.46	5.493

[14] Royal Meteorological Society (1995) *Atmospheric Dispersion Modelling Guidelines on the justification of choice and use of models and the communication and reporting of results.*
[15] Atmospheric Dispersion Modelling Liaison Committee (2004) *Guidelines for the Preparation of Dispersion Modelling Assessments for Compliance with Regulatory Requirements – an Update to the 1995 Royal Meteorological Society Guidance.*
[16] Ji Ping Shi and Betty Ng (2004) *Risk based pragmatic approach to address model uncertainty. Air Quality Modelling and Assessment Unit.* Environment Agency: Cardiff.

5.1.2 Surface Roughness

The land around the site consists of agricultural activity and residential uses. The model runs were initially conducted assuming a surface roughness of 0.2m typically associated with agriculture.

The dispersion model has been run using surface roughness values of 0.1m, 0.2m, 0.3m, 0.5m and 1.0m across the domain. These are likely to represent the credible range of worst-case dispersion factors within the study area. The worst case predicted impact occurs at the most affected dwellings when a surface roughness value of 1.0m is assumed (see Table 11 below). This has therefore been adopted throughout to represent worst case scenario modelling.

Table 11 – PEC NO_2 (Annual Mean) Predictions with Surface Roughness Adjustments

Surface Roughness	0.1m	0.2m	0.3m	0.5m	1.0m
NO_2 (µg/m^3)	5.45	5.49	5.52	5.55	5.59

5.1.3 Release Height

The model sensitivity analysis has so far considered the likely impact from the CHP (10.5m) stack height. Further analysis is undertaken to determine whether increasing the stack height of the CHP will significantly improve dispersion.

The effect of increased stack heights has been considered for all emissions of NO_2 for a range of stack heights between 10.5m and 14.5m at 1m intervals. A stack height of 10.5m has been chosen as it provides the most conservative estimate. The results are summarised in Table 12 below.

Table 12 – PEC NO_2 (Annual Mean) Predictions with Amended Stack Heights

CHP Release Height	10.5m	11.5m	12.5m	13.5m	14.5m
NO_2 (µg/m^3)	5.59	5.55	5.51	5.48	5.44

6.0 IMPACT ASSESSMENT

This section presents the potential air quality impacts associated with the operational phase of the proposed development, the mitigation measures that will be employed and any residual impacts. Appendix C and D summarise the findings of the potential emissions and the scale and extent of potential impacts. Aspects of the assessment are discussed in more detail below.

6.1 Applied Scenarios

The predicted contours for airborne pollutants are plotted in Appendix C. The predicted concentrations at sensitive receptors are included within Appendix D and summarised in section 6.2. These predictions are based on the worst-case dispersion conditions for surface roughness (0.5m), meteorology (2018), building effects and at the stack height (10.5m). These scenarios are based upon the CHP engine running constantly for the long-term assessment, and upon the CHP engine and the gas flare running constantly for the short-term assessment. These scenarios are considered to be conservative as actual running times are likely to be less than this. The gas flare shall only be used in case of emergency.

The criteria used to assess the significance of these predictions were presented earlier in Section 4.8. The significance of these predicted concentrations and deposits is summarised in Section 6.2, where the predicted value is expressed as a percentage of the EAL.

6.2 Impact Assessment at Human Receptors

The worst-case air quality impacts are summarised in the following sections for each pollutant and averaging period. The Process Contributions (PCs) and Predicted Environmental Concentrations (PECs) predicted at each sensitive receptor are itemised in Appendix E.

6.2.1 Long Term NO_2

Predicted annual mean maximum NO_2 PCs and PECs are presented within Table 13. Reference should be made to Appendix C for an illustration of the long-term (annual mean) NO_2 contour plot.

Table 13 – Predicted Max Annual Mean NO_2 Concentrations

	CHP				
Emission	**EAL (µg/m^3)**	**PC (µg/m^3)**	**PC% EAL**	**PEC (µg/m^3)**	**PEC% EAL**
Annual Mean NO_2	40	0.55	1.4	5.59	14
Significance	Negligible (PC <10% of EAL)				

6.2.2 Long Term Benzene (VOCs)

As stated previously, as VOCs don't have their own EAL, the EAL for Benzene has been chosen in line with modelling guidance (Gov.UK) *Air emissions risk assessment for your environmental permit* which states – *'If you release volatile organic compounds into the air and do not know what all the substances in them are, treat them all as 100% benzene in your risk assessment.'*

In the model, background benzene has been input as VOCs and output of the model as VOC. The output is then compared after the EAL for Benzene below.

Predicted annual mean maximum Benzene PCs and PECs are presented within Table 14. Reference should be made to Appendix C for an illustration of the long-term (annual mean) Benzene contour plot.

Table 14 – Predicted Max Annual Mean Benzene Concentrations

	CHP				
Emission	**EAL (µg/m^3)**	**PC (µg/m^3)**	**PC% EAL**	**PEC (µg/m^3)**	**PEC% EAL**
Annual Mean Benzene	5	1.57	31.4	1.70	34
Significance	Minor (PEC <70% of EAL)				

6.2.3 Short Term NO_2

Predicted 1-hr mean NO_2 maximum PCs and PECs are presented within Table 15. Reference should be made to Appendix C for an illustration of the short-term (1hr mean) NO_2 contour plot.

Table 15 – Max Predicted NO_2 Short Term Concentrations

	CHP and Flares				
Emission	**EAL (µg/m^3)**	**PC (µg/m^3)**	**PC% EAL**	**PEC (µg/m^3)**	**PEC% EAL**
1hr NO_2	200	10.94	5.47	12.62	6.34
Significance	Negligible (PC <10% of EAL)				

6.2.4 Short Term Benzene (VOCs)

Predicted 24-hr mean Benzene maximum PCs and PECs are presented within Table 16. Reference should be made to Appendix C for an illustration of the short-term (24hr mean) BENZENE contour plot.

Table 16 – Max Predicted Benzene Short Term Concentrations

	CHP and Flares				
Emission	**EAL (µg/m^3)**	**PC (µg/m^3)**	**PC% EAL**	**PEC (µg/m^3)**	**PEC% EAL**
24hr Benzene	195	32.54	16.69	32.62	16.73
Significance	Minor (PEC <70% of EAL)				

6.2.5 Short Term SO_2

Predicted short term SO_2 maximum PCs and PECs are presented within Table 17. Reference should be made to Appendix C for an illustration of the short-term SO_2 contour plot.

Table 17 – Max Predicted SO_2 Short Term Concentrations

	CHP and Flares				
Emission	**EAL (µg/m3)**	**PC (µg/m^3)**	**PC% EAL**	**PEC (µg/m^3)**	**PEC% EAL**
1hr SO_2	350	19.22	5.5	21.21	6.06
24hr SO_2	125	11.34	9.07	12.51	10.01
15min SO_2	266	25.75	9.68	28.42	10.68
Significance	Negligible (PC <10% of EAL)				

6.2.6 Short Term CO

Predicted 8-hr mean CO maximum PCs and PECs are presented within Table 18. Reference should be made to Appendix C for an illustration of the short-term (8hr mean) CO contour plot.

Table 18 – Max Predicted CO Short Term Concentrations

	CHP and Flares				
Emission	**EAL (µg/m^3)**	**PC (µg/m^3)**	**PC% EAL**	**PEC (µg/m^3)**	**PEC% EAL**
8hr CO	10,000	54.68	0.54	110.64	1.11
Significance	Insignificant (PC< 1% EAL)				

6.2.7 Exceedance Analysis

In addition to UK Air Quality Strategy (AQS) objectives, the modelled pollutant emissions are also considered in context of Ambient Air Directive (AAD) Limit Values for the number of exceedances permitted within a given emission period. The results of this assessment are identified in Table 19 for the emissions resultant from the proposed development. The results identify that no exceedances for any pollutant are modelled under the worst-case exposure scenario.

Table 19 – Summary of Modelled Emission Period Exceedances

Pollutant	Emission Period	Limit	Permitted Exceedances	Modelled Exceedances
NO_2	1hr	200 µg/m³	≤18	0
NO_2	Annual	40 µg/m³	0	0
Benzene	1hr	195 µg/m³	0	0
Benzene	Annual	5 µg/m³	0	0
SO_2	15mins	266 µg/m³	≤35	0
SO_2	1hr	350 µg/m³	≤24	0
SO_2	24hr	125 µg/m³	≤3	0
CO	8hr Average in 24hrs	10,000 µg/m³	0	0

6.2.8 Impact Assessment at Ecological Receptors

Modelling of impacts at ecological receptors has been undertaken for the proposed site, to determine impacts on critical loads and critical levels, as presented within the following subsections.

6.2.9 Annual Mean NO_2

Predicted annual mean maximum nitrogen oxide as NO_2 PCs and PECs are presented within Table 20 for each sensitive habitat.

Table 20 - Annual Mean NO_2 Concentrations

	CHP					
Receptor	EAL (µg/m³)	PC (µg/m³)	PC% EAL	PEC (µg/m³)	PEC% EAL	Significance
ER01	30	0.14	0.47	4.95	16.50	Insignificant (PC< 1% EAL)
ER02	30	0.19	0.63	4.99	16.63	Insignificant (PC< 1% EAL)
ER03	30	0.04	0.13	4.84	16.13	Insignificant (PC< 1% EAL)
ER04	30	0.05	0.17	4.85	16.17	Insignificant (PC< 1% EAL)
ER05	30	0.18	0.6	4.98	16.60	Insignificant (PC< 1% EAL)

6.2.10 Daily Mean NO_2

Predicted daily mean maximum nitrogen oxide as NO_2 PCs and PECs are presented within Table 21 for each sensitive habitat.

Table 21 - Daily Mean NO_2 Concentrations

	CHP and Flares					
Receptor	**EAL (µg/m³)**	**PC (µg/m³)**	**PC% EAL**	**PEC (µg/m³)**	**PEC% EAL**	**Significance**
ER01	75	4.29	5.72	20.80	27.73	Negligible (PC <10% of EAL)
ER02	75	5.12	6.83	21.63	28.84	Negligible (PC <10% of EAL)
ER03	75	2.28	3.04	18.79	25.05	Negligible (PC <10% of EAL)
ER04	75	2.21	2.94	18.71	24.95	Negligible (PC <10% of EAL)
ER05	75	2.45	3.27	18.96	25.28	Negligible (PC <10% of EAL)

6.2.11 Annual Mean SO_2

Predicted daily mean maximum SO_2 PCs and PECs are presented within Table 22 for each sensitive habitat.

Table 22 - Annual Mean SO_2 Concentrations

	CHP					
Receptor	**EAL (µg/m³)**	**PC (µg/m³)**	**PC% EAL**	**PEC (µg/m³)**	**PEC% EAL**	**Significance**
ER01	10	0.10	1.00	2.09	20.9	Negligible (PC <10% of EAL)
ER02	10	0.13	1.3	2.12	21.2	Negligible (PC <10% of EAL)
ER03	10	0.03	0.3	2.02	20.2	Insignificant (PC< 1% EAL)
ER04	10	0.04	0.4	2.03	20.3	Insignificant (PC< 1% EAL)
ER05	10	0.12	1.2	2.12	21.2	Negligible (PC <10% of EAL)

6.2.12 Critical Loads

The process contribution to critical loads for nitrogen deposition and acid deposition are presented in Table 23 below with critical load values.

Table 23 – Critical Load Evaluation

Habitat	Nutrient Nitrogen (kg/ha/yr)			Acid Deposition (k_{eq}/ha/yr)		
	Critical Load	PC	PC as % CL	Critical Load	PC	PC as % CL
ER01	10	0.002	0.02	2.13	0.01	<0.01
ER02	10	0.001	0.01	1.4	0.02	0.9
ER03	10	0.011	0.21	2.13	<0.01	<0.01
ER04	10	0.008	0.16	2.13	<0.01	<0.01
ER05	10	0.007	0.15	1.35	0.02	0.01

The predicted deposition at the ecologically sensitive habitats within the scope of this study are likely to be insignificant for both acid and nitrogen deposition when compared to critical loads (less than 100% of the critical load).

6.3 Assessment Summary

This assessment indicates that air emissions from the CHP and Gas Flares are likely to range from insignificant to major for all emission sources at both long and short-term exposure scenarios. The assessment includes both human and ecological receptors. Analysis has taken account of the downwash effect of buildings and stack height.

The short and long-term assessment of the significance of impact from the CHP and Gas Flare is summarised in the table below.

Table 24 – Summary of the Assessment of Significance

<table>
<tr><th>Receptor Type</th><th>Assessment Scenario</th><th>Emission</th><th>Predicted Significance of Impact</th></tr>
<tr><td rowspan="6">Human</td><td rowspan="2">Long Term</td><td>NO_2</td><td>Negligible (PC <10% of EAL)</td></tr>
<tr><td>Benzene</td><td>Minor (PEC <70% of EAL)</td></tr>
<tr><td rowspan="4">Short Term</td><td>NO_2</td><td>Negligible (PEC <70% of EAL)</td></tr>
<tr><td>Benzene</td><td>Minor (PEC <70% of EAL)</td></tr>
<tr><td>SO_2</td><td>Negligible (PEC <70% of EAL)</td></tr>
<tr><td>CO</td><td>Insignificant (PC< 1% EAL)</td></tr>
<tr><td rowspan="2">Environmental</td><td>Long Term</td><td colspan="2" rowspan="2">See above</td></tr>
<tr><td>Short Term</td></tr>
</table>

7.0 PROPOSED MITIGATION MEASURES

The following measures are proposed to prevent or minimise impacts on air pollution:

- The emissions from the site shall be compliant with the likely emission limit values.
- Monitoring in line with permit shall be conducted by independent testing agencies.
- Supervisory staff shall be trained to ensure that the works are operated within specification.
- All process operations shall be subject to routine planned preventative maintenance.

8.0 CONCLUSIONS

The following conclusions are drawn from the modelled output data and justification for model approach discussed throughout. The applied scenarios are based upon the CHP engine running constantly for the long-term assessment, and upon the CHP engine and the two gas flares running for the short-term assessment. These scenarios are considered to be conservative as actual running times are likely to be less than this. The gas flares shall only be used in case of emergencies.

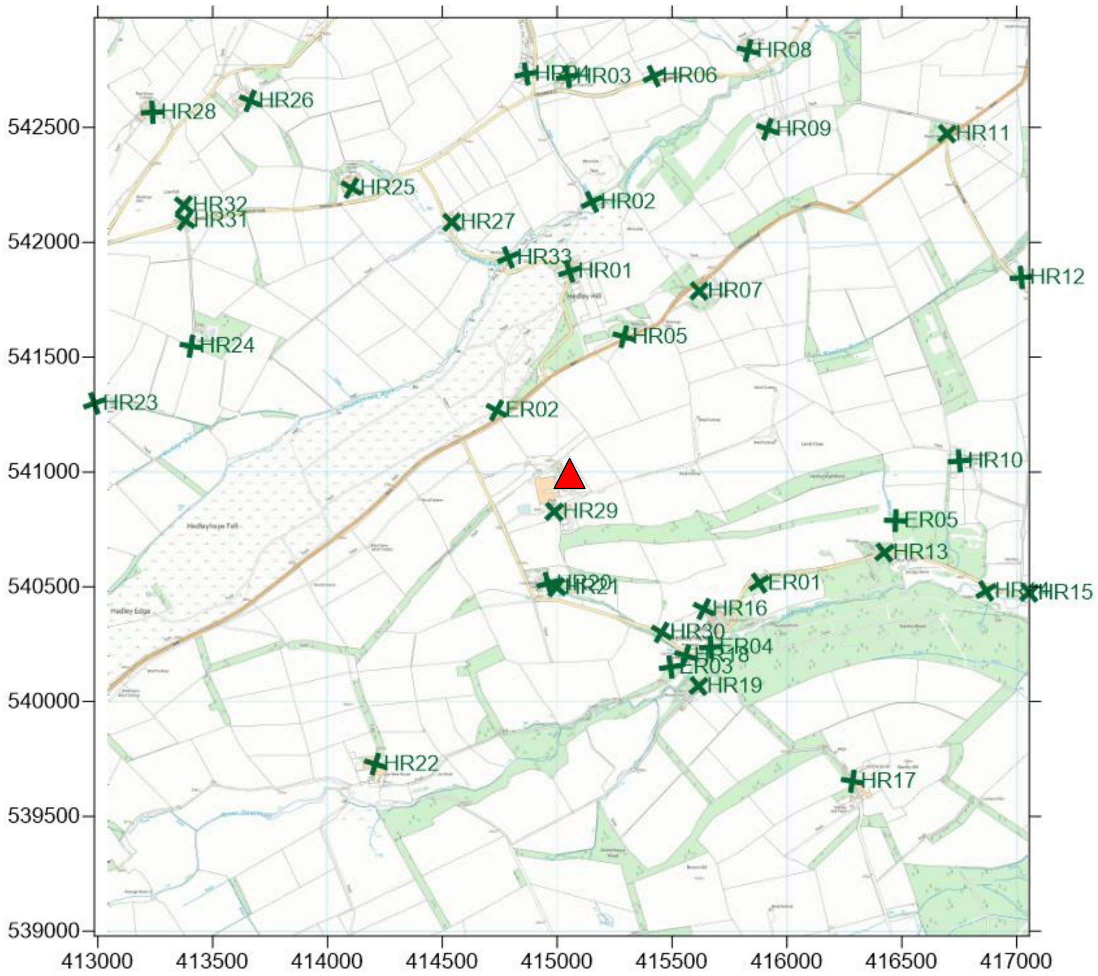
8.1 Human Exposure

- Baseline air quality around the CHP engine and emergency gas flares is within European Limit Values and UK objectives.
- The overall confidence in the model predictions is medium. A detailed model sensitivity analysis has been conducted to improve the robustness of the predictions.
- The assessment takes account of the worst-case model predictions, the relevant Environmental Assessment Level (EAL) and the significance criteria as detailed.
- Exposure to the annual mean NO_2 is likely to be **negligible.**
- Exposure to the annual mean Benzene is likely to be **minor.**
- Short-term exposure to NO_2, Benzene, CO and SO_2, is predicted to range from **insignificant to minor**.
- The emissions from the CHP engine and gas flares are unlikely to result in air quality objectives not being met or limit values being exceeded.

8.2 Ecological Exposure

- The critical loads at designated sites within vicinity of the CHP engine are likely to be **insignificant** for both acid and nitrogen deposition.

APPENDIX A – SENSITIVE RECEPTORS LOCATION MAP



HR RECEPTORS MAP	
✚	Sensitive Receptors
▲	Site Location

WRM/1055/W04

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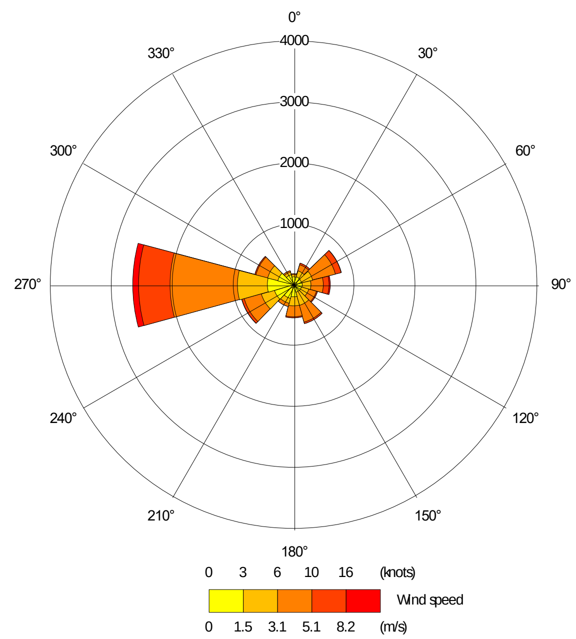
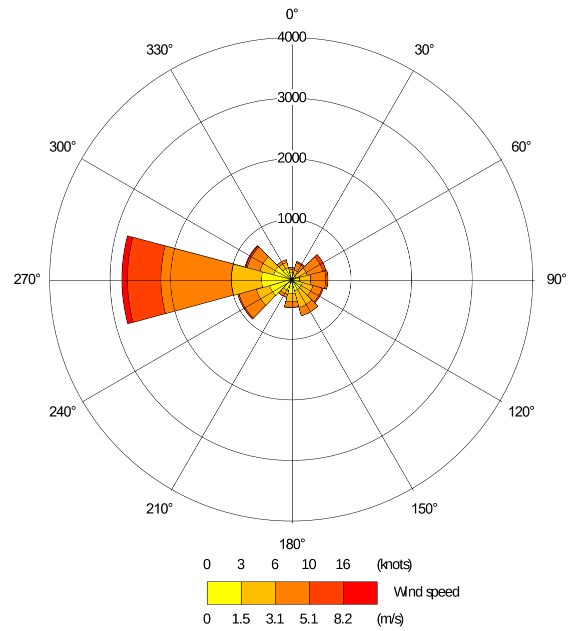
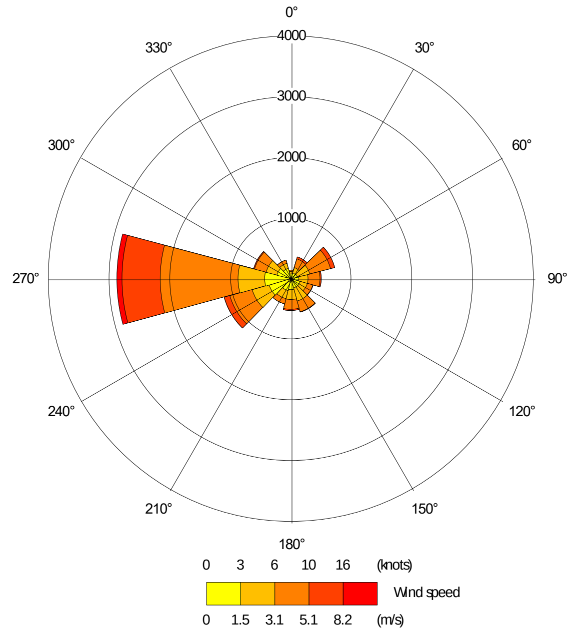
APPENDIX B – WEATHER DATA SETS



Ablemarle Met Data - 2018



Ablemarle Met Data - 2019

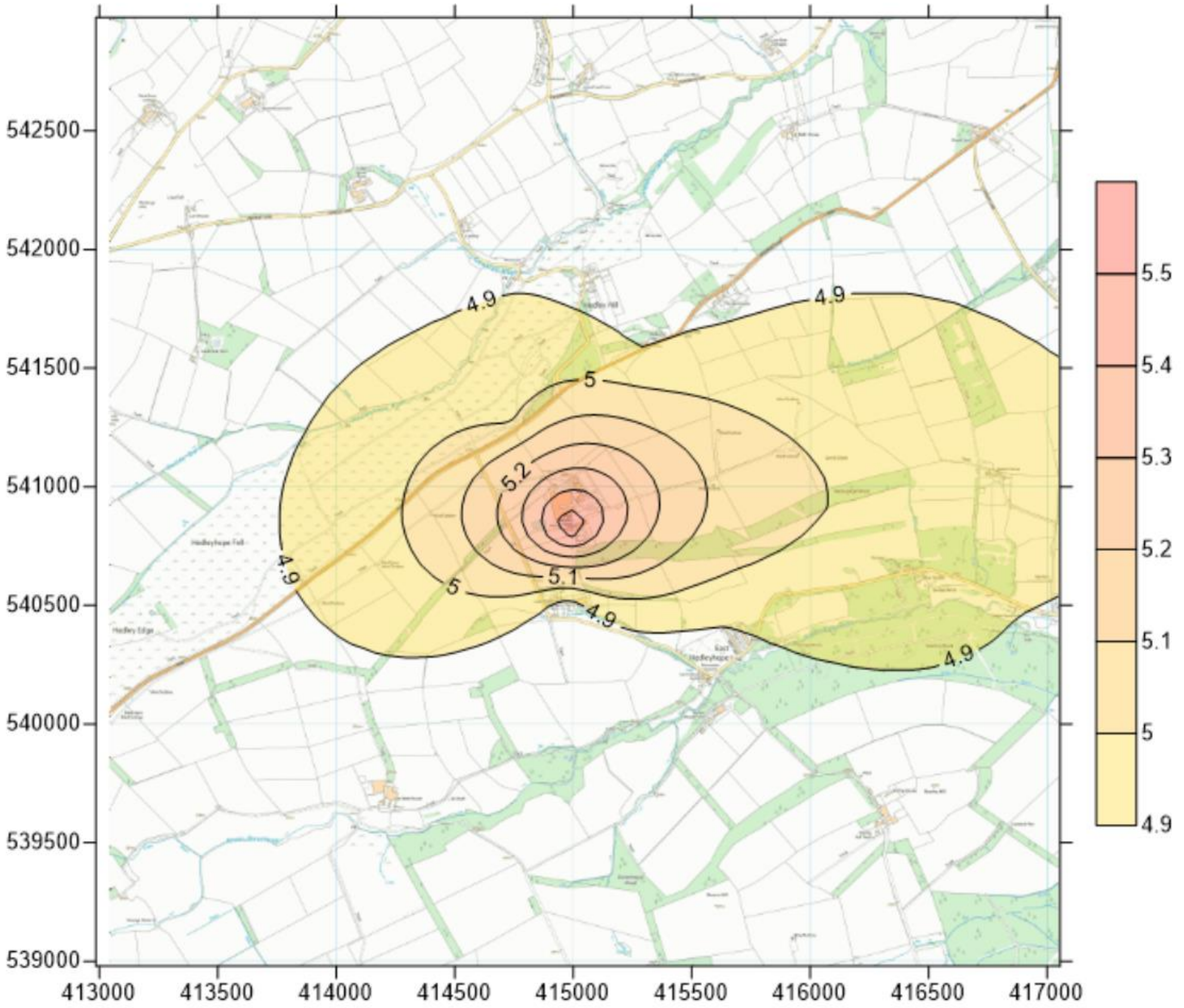


Ablemarle Met Data - 2020

Met Office

Data Supplier

APPENDIX C – DISPERSION MODEL PLOTS



Long Term NO_2

Units = µg/m^3

EAL = 40 µg/m^3

SR = 1.0
RH = 10.5m
Met year = 2020

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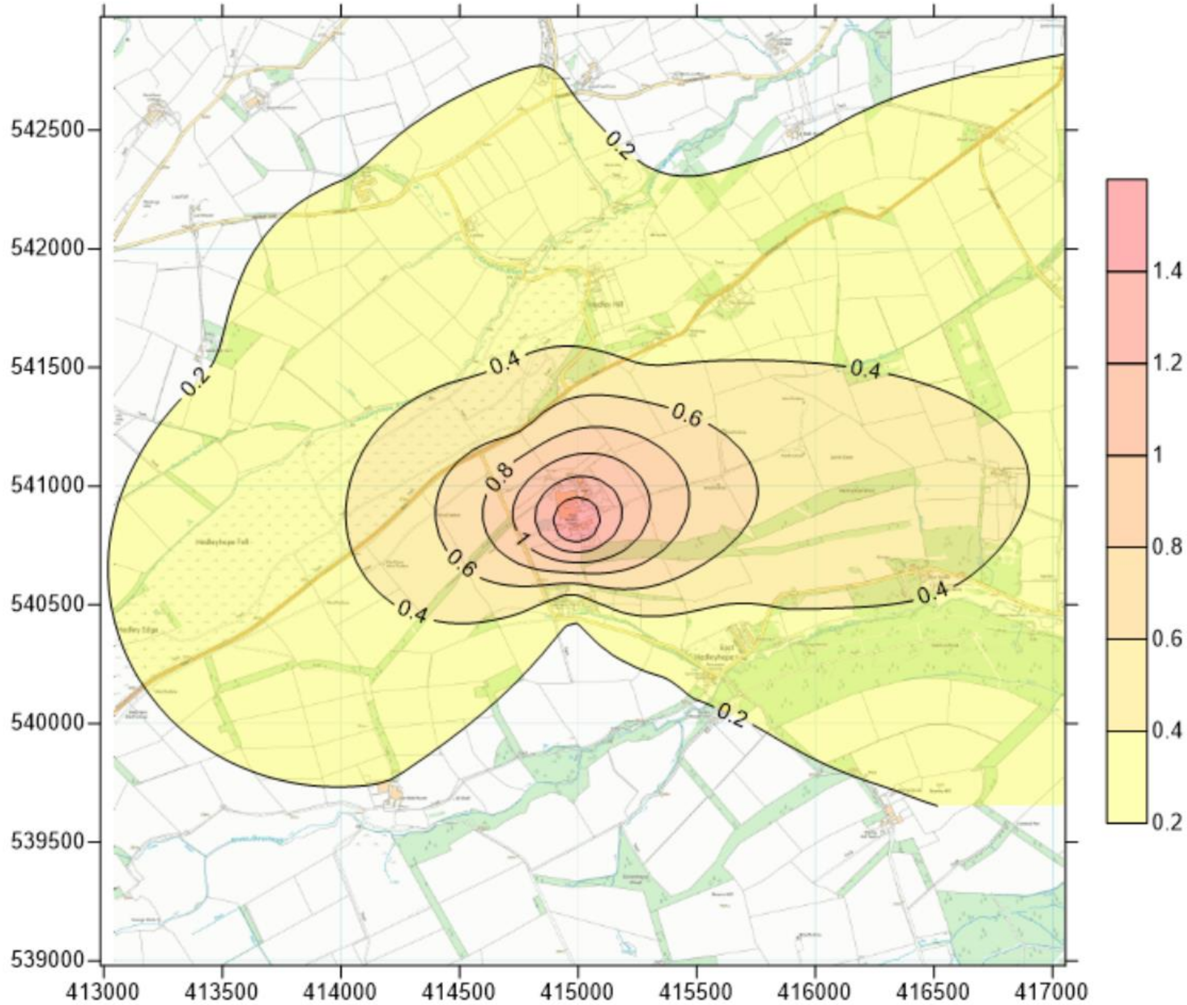

Long Term Benzene

Units = µg/m³

EAL = 5 µg/m³

SR = 1.0
RH = 10.5m
Met year = 2020

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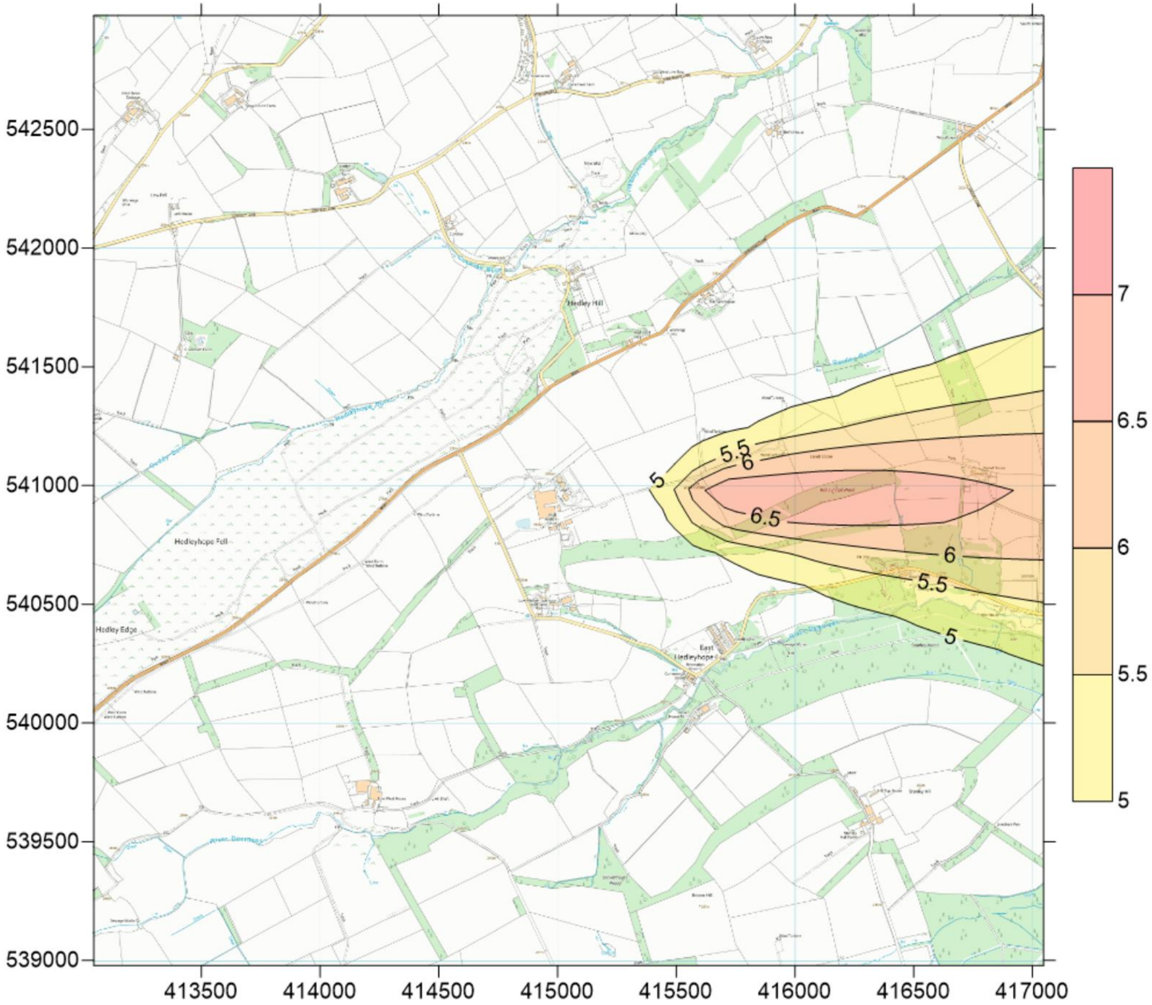
WRM



Short Term NO_2

Units = µg/m³

EAL = 200 µg/m³

SR = 1.0
RH = 10.5m
Met year = 2020

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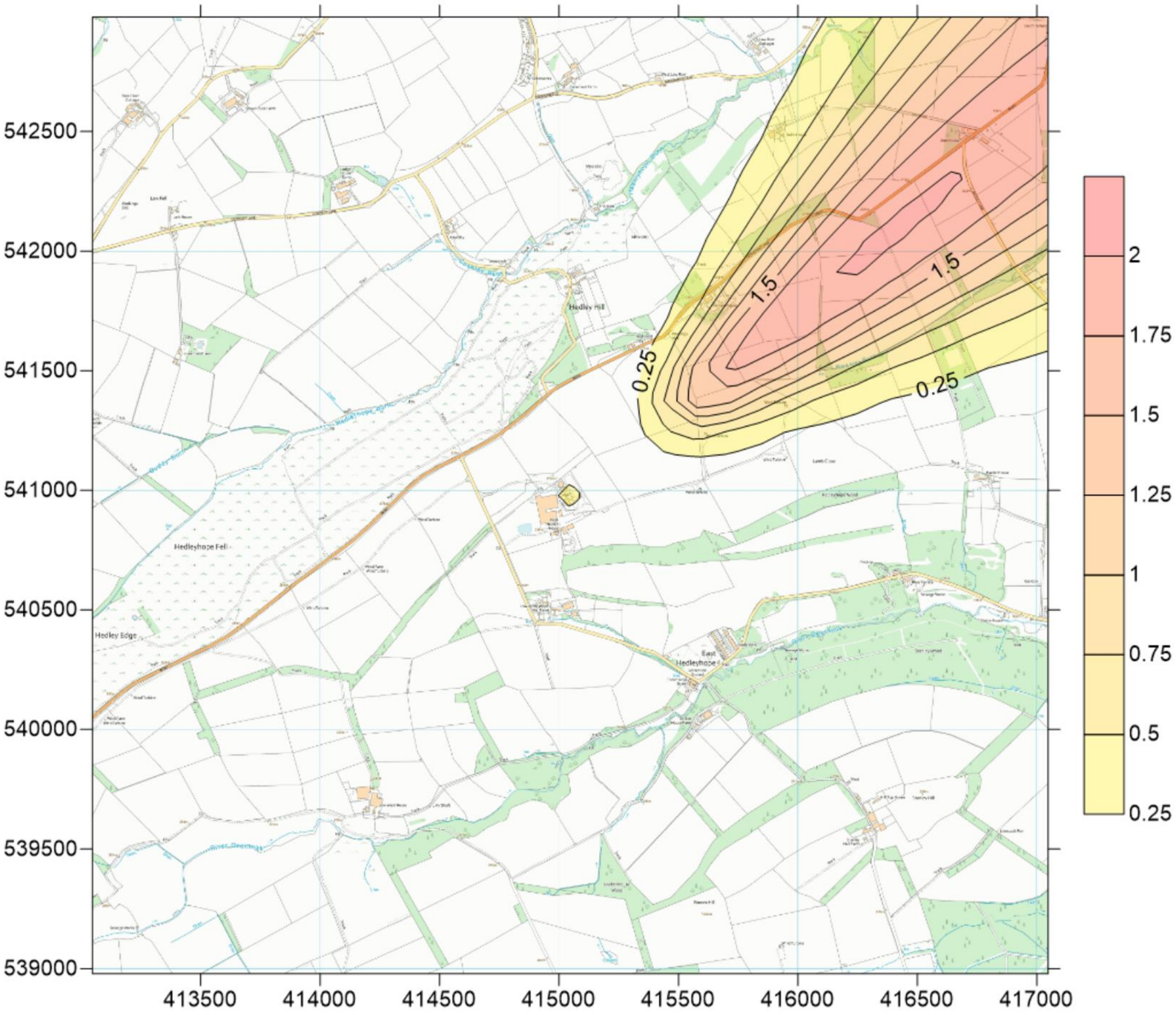

Short Term Benzene

Units = µg/m^3

EAL =195 µg/m^3

SR = 1.0
RH = 10.5m
Met year = 2020

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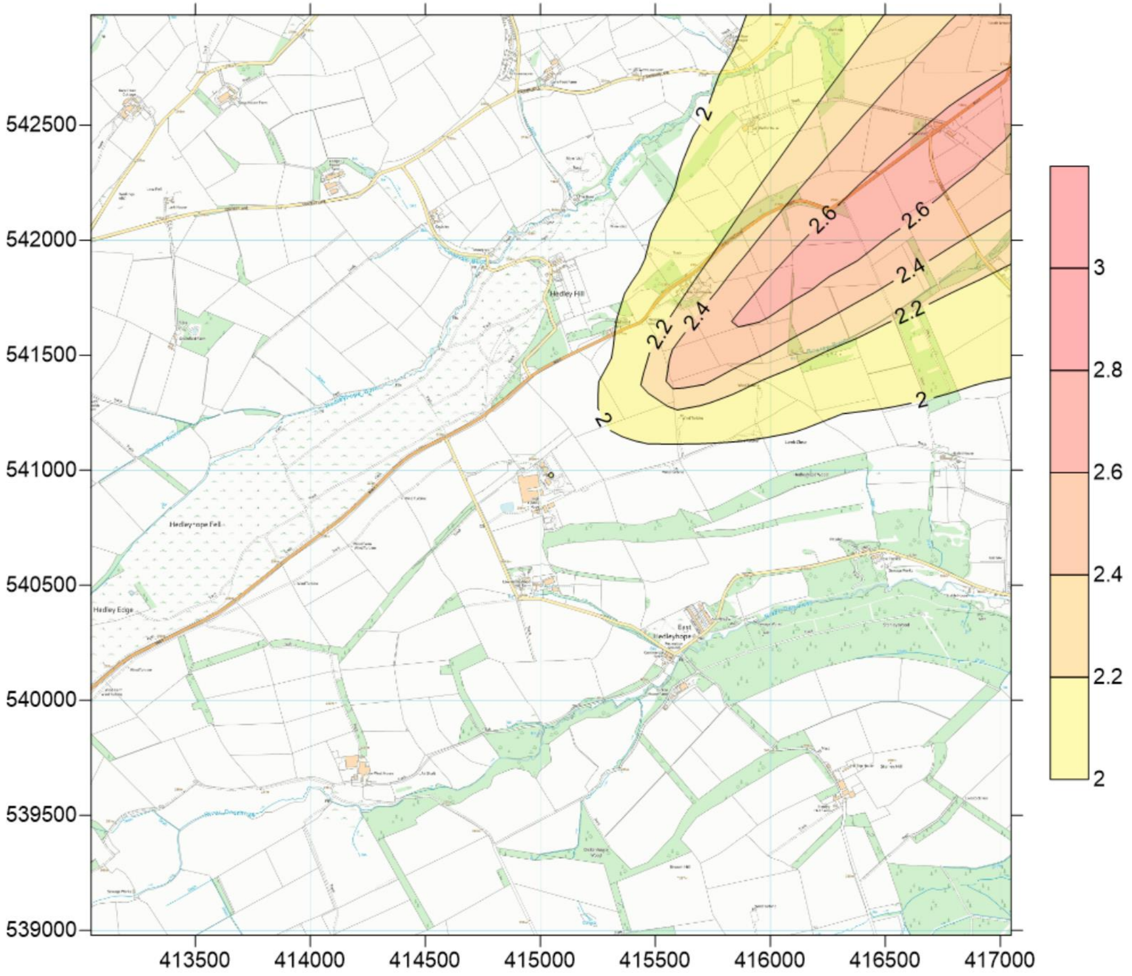

Short Term SO2

Units = µg/m^3

EAL = 266 µg/m3

SR = 1.0
RH = 10.5m
Met year = 2020

WRM/1055/W04

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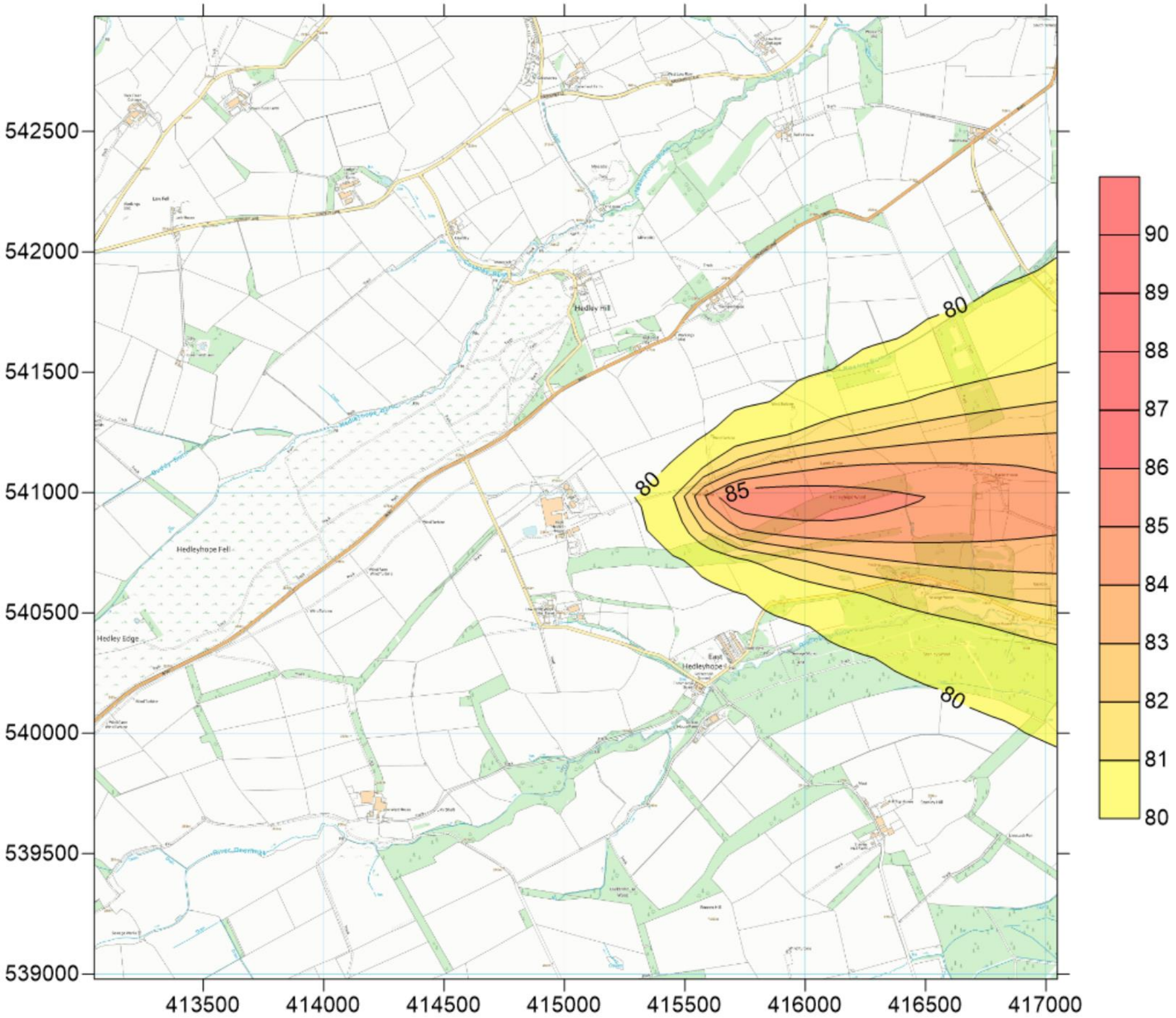

Short Term CO

Units = µg/m³

EAL = 10,000 µg/m³

SR = 1.0
RH = 10.5m
Met year = 2020

WRM/1055/W04

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High Hedley Hope Farm, East Hedleyhope, Durham, DL13 4PR

APPENDIX D – MODEL SENSITIVITY ANALYSIS DATA

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m³) NO_2 CHP	LT PEC (ug/m³) NO_2 CHP
HR01	415053	541874	0	0.08	4.88053
HR02	415151	542176	0	0.04	4.84545
HR03	415045	542722	0	0.03	4.83576
HR04	414865	542733	0	0.04	4.84452
HR05	415290	541589	0	0.06	4.86727
HR06	415420	542724	0	0.02	4.82394
HR07	415618	541788	0	0.04	4.84293
HR08	415831	542835	0	0.02	4.82012
HR09	415915	542493	0	0.02	4.82347
HR10	416750	541048	0	0.23	5.03567
HR11	416697	542473	0	0.02	4.82847
HR12	417020	541847	0	0.06	4.86727
HR13	416424	540649	0	0.22	5.01966
HR14	416867	540482	0	0.14	4.94127
HR15	417055	540474	0	0.13	4.93448
HR16	415638	540403	0	0.06	4.86026
HR17	416285	539653	0	0.02	4.81981
HR18	415559	540200	0	0.02	4.82446
HR19	415615	540068	0	0.02	4.82009
HR20	414960	540515	0	0.06	4.86187
HR21	414996	540498	0	0.05	4.85091
HR22	414208	539728	0	0.03	4.83603
HR23	412985	541299	0	0.04	4.83952
HR24	413406	541548	0	0.03	4.83502
HR25	414104	542236	0	0.05	4.85154
HR26	413663	542616	0	0.03	4.8339
HR27	414541	542088	0	0.09	4.88936
HR28	413238	542566	0	0.02	4.82728
HR29	414969	540916	0	0.69	5.49042
HR30	415454	540301	0	0.02	4.82906
HR31	413380	542095	0	0.03	4.83167
HR32	413375	542161	0	0.03	4.83119
HR33	414787	541934	0	0.11	4.9167
ER01	415879	540516	0	0.14	4.94594
ER02	414736	541268	0	0.21	5.01097
ER03	415493	540151	0	0.02	4.82247
ER04	415668	540237	0	0.03	4.83088
ER05	416473	540788	0	0.27	5.0738
MAX				**0.69**	**5.49**
Surface Roughness		0.2			
Buildings		On			

Stack Height CHP	10.5			
Met Data	**2018**			
		High Hedley		

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m^3) NO_2 CHP	LT PEC (ug/m^3) NO_2 CHP
HR01	415053	541874	0	0.06	4.86121
HR02	415151	542176	0	0.03	4.83555
HR03	415045	542722	0	0.02	4.82877
HR04	414865	542733	0	0.03	4.83614
HR05	415290	541589	0	0.04	4.84603
HR06	415420	542724	0	0.01	4.81875
HR07	415618	541788	0	0.03	4.83765
HR08	415831	542835	0	0.01	4.81456
HR09	415915	542493	0	0.01	4.81783
HR10	416750	541048	0	0.24	5.04454
HR11	416697	542473	0	0.02	4.82825
HR12	417020	541847	0	0.07	4.87839
HR13	416424	540649	0	0.22	5.02706
HR14	416867	540482	0	0.14	4.94711
HR15	417055	540474	0	0.13	4.93882
HR16	415638	540403	0	0.08	4.88812
HR17	416285	539653	0	0.03	4.83007
HR18	415559	540200	0	0.04	4.84019
HR19	415615	540068	0	0.03	4.83327
HR20	414960	540515	0	0.07	4.87897
HR21	414996	540498	0	0.07	4.87131
HR22	414208	539728	0	0.02	4.82936
HR23	412985	541299	0	0.04	4.84705
HR24	413406	541548	0	0.05	4.85257
HR25	414104	542236	0	0.04	4.84395
HR26	413663	542616	0	0.03	4.82988
HR27	414541	542088	0	0.08	4.88394
HR28	413238	542566	0	0.02	4.82676
HR29	414969	540916	0	0.66	5.4579
HR30	415454	540301	0	0.04	4.84769
HR31	413380	542095	0	0.03	4.83455
HR32	413375	542161	0	0.03	4.83303
HR33	414787	541934	0	0.10	4.90263
ER01	415879	540516	0	0.17	4.97126
ER02	414736	541268	0	0.17	4.977
ER03	415493	540151	0	0.03	4.83815
ER04	415668	540237	0	0.05	4.84949
ER05	416473	540788	0	0.28	5.08015
MAX				**0.66**	**5.46**
Surface Roughness		0.2			
Buildings		On			

Stack Height CHP	10.5			
Met Data	**2019**			
		High Hedley		

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m³) NO_2 CHP	LT PEC (ug/m³) NO_2 CHP
HR01	415053	541874	0	0.07	4.87658
HR02	415151	542176	0	0.04	4.84308
HR03	415045	542722	0	0.03	4.83466
HR04	414865	542733	0	0.04	4.84395
HR05	415290	541589	0	0.07	4.87337
HR06	415420	542724	0	0.02	4.82341
HR07	415618	541788	0	0.06	4.86533
HR08	415831	542835	0	0.02	4.82323
HR09	415915	542493	0	0.03	4.83019
HR10	416750	541048	0	0.21	5.01571
HR11	416697	542473	0	0.04	4.84444
HR12	417020	541847	0	0.08	4.88508
HR13	416424	540649	0	0.20	5.00047
HR14	416867	540482	0	0.12	4.92533
HR15	417055	540474	0	0.11	4.91811
HR16	415638	540403	0	0.07	4.87443
HR17	416285	539653	0	0.02	4.82622
HR18	415559	540200	0	0.04	4.84113
HR19	415615	540068	0	0.03	4.83455
HR20	414960	540515	0	0.05	4.85868
HR21	414996	540498	0	0.04	4.84837
HR22	414208	539728	0	0.03	4.83509
HR23	412985	541299	0	0.03	4.82945
HR24	413406	541548	0	0.03	4.83118
HR25	414104	542236	0	0.03	4.83747
HR26	413663	542616	0	0.02	4.82479
HR27	414541	542088	0	0.07	4.87428
HR28	413238	542566	0	0.02	4.82043
HR29	414969	540916	0	0.69	5.49251
HR30	415454	540301	0	0.05	4.8507
HR31	413380	542095	0	0.02	4.82509
HR32	413375	542161	0	0.02	4.82417
HR33	414787	541934	0	0.10	4.90676
ER01	415879	540516	0	0.14	4.94088
ER02	414736	541268	0	0.14	4.94225
ER03	415493	540151	0	0.04	4.84047
ER04	415668	540237	0	0.04	4.8443
ER05	416473	540788	0	0.24	5.04786
MAX				**0.69**	**5.49**
Surface Roughness		0.2			
Buildings		On			

Stack Height CHP	10.5			
Met Data	**2020**			
		High Hedley		

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m^3) NO_2 CHP	LT PEC (ug/m^3) NO_2 CHP
HR01	415053	541874	0	0.07	4.87409
HR02	415151	542176	0	0.04	4.84285
HR03	415045	542722	0	0.03	4.83556
HR04	414865	542733	0	0.04	4.84597
HR05	415290	541589	0	0.07	4.87102
HR06	415420	542724	0	0.02	4.8233
HR07	415618	541788	0	0.06	4.86794
HR08	415831	542835	0	0.02	4.82278
HR09	415915	542493	0	0.03	4.83083
HR10	416750	541048	0	0.25	5.05064
HR11	416697	542473	0	0.04	4.84509
HR12	417020	541847	0	0.09	4.89459
HR13	416424	540649	0	0.22	5.02443
HR14	416867	540482	0	0.14	4.94026
HR15	417055	540474	0	0.13	4.93338
HR16	415638	540403	0	0.07	4.8786
HR17	416285	539653	0	0.02	4.82678
HR18	415559	540200	0	0.04	4.84056
HR19	415615	540068	0	0.03	4.83453
HR20	414960	540515	0	0.05	4.8565
HR21	414996	540498	0	0.04	4.84615
HR22	414208	539728	0	0.03	4.83701
HR23	412985	541299	0	0.03	4.8312
HR24	413406	541548	0	0.03	4.83222
HR25	414104	542236	0	0.03	4.8382
HR26	413663	542616	0	0.02	4.82505
HR27	414541	542088	0	0.07	4.87678
HR28	413238	542566	0	0.01	4.81922
HR29	414969	540916	0	0.65	5.45172
HR30	415454	540301	0	0.05	4.84959
HR31	413380	542095	0	0.02	4.82452
HR32	413375	542161	0	0.02	4.82331
HR33	414787	541934	0	0.10	4.90819
ER01	415879	540516	0	0.15	4.95324
ER02	414736	541268	0	0.12	4.92903
ER03	415493	540151	0	0.04	4.84041
ER04	415668	540237	0	0.04	4.84427
ER05	416473	540788	0	0.28	5.0835
MAX				**0.65**	**5.45**
Surface Roughness		**0.1**			
Buildings		On			

Stack Height CHP	10.5			
Met Data	2020			
		High Hedley		

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m^3) NO_2 CHP	LT PEC (ug/m^3) NO_2 CHP
HR01	415053	541874	0	0.07	4.87658
HR02	415151	542176	0	0.04	4.84308
HR03	415045	542722	0	0.03	4.83466
HR04	414865	542733	0	0.04	4.84395
HR05	415290	541589	0	0.07	4.87337
HR06	415420	542724	0	0.02	4.82341
HR07	415618	541788	0	0.06	4.86533
HR08	415831	542835	0	0.02	4.82323
HR09	415915	542493	0	0.03	4.83019
HR10	416750	541048	0	0.21	5.01571
HR11	416697	542473	0	0.04	4.84444
HR12	417020	541847	0	0.08	4.88508
HR13	416424	540649	0	0.20	5.00047
HR14	416867	540482	0	0.12	4.92533
HR15	417055	540474	0	0.11	4.91811
HR16	415638	540403	0	0.07	4.87443
HR17	416285	539653	0	0.02	4.82622
HR18	415559	540200	0	0.04	4.84113
HR19	415615	540068	0	0.03	4.83455
HR20	414960	540515	0	0.05	4.85868
HR21	414996	540498	0	0.04	4.84837
HR22	414208	539728	0	0.03	4.83509
HR23	412985	541299	0	0.03	4.82945
HR24	413406	541548	0	0.03	4.83118
HR25	414104	542236	0	0.03	4.83747
HR26	413663	542616	0	0.02	4.82479
HR27	414541	542088	0	0.07	4.87428
HR28	413238	542566	0	0.02	4.82043
HR29	414969	540916	0	0.69	5.49251
HR30	415454	540301	0	0.05	4.8507
HR31	413380	542095	0	0.02	4.82509
HR32	413375	542161	0	0.02	4.82417
HR33	414787	541934	0	0.10	4.90676
ER01	415879	540516	0	0.14	4.94088
ER02	414736	541268	0	0.14	4.94225
ER03	415493	540151	0	0.04	4.84047
ER04	415668	540237	0	0.04	4.8443
ER05	416473	540788	0	0.24	5.04786
MAX				**0.69**	**5.49**
Surface Roughness		**0.2**			
Buildings		On			

Stack Height CHP	10.5			
Met Data	2020			
		High Hedley		

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m^3) NO_2 CHP	LT PEC (ug/m^3) NO_2 CHP
HR01	415053	541874	0	0.07	4.87693
HR02	415151	542176	0	0.04	4.84305
HR03	415045	542722	0	0.03	4.83391
HR04	414865	542733	0	0.04	4.84243
HR05	415290	541589	0	0.07	4.87553
HR06	415420	542724	0	0.02	4.82386
HR07	415618	541788	0	0.06	4.86528
HR08	415831	542835	0	0.02	4.82383
HR09	415915	542493	0	0.03	4.83062
HR10	416750	541048	0	0.20	5.00117
HR11	416697	542473	0	0.04	4.84514
HR12	417020	541847	0	0.08	4.88131
HR13	416424	540649	0	0.19	4.99024
HR14	416867	540482	0	0.11	4.91922
HR15	417055	540474	0	0.11	4.91179
HR16	415638	540403	0	0.07	4.87534
HR17	416285	539653	0	0.02	4.82682
HR18	415559	540200	0	0.04	4.84094
HR19	415615	540068	0	0.03	4.83408
HR20	414960	540515	0	0.05	4.85932
HR21	414996	540498	0	0.04	4.84927
HR22	414208	539728	0	0.03	4.83458
HR23	412985	541299	0	0.02	4.82919
HR24	413406	541548	0	0.03	4.83137
HR25	414104	542236	0	0.03	4.8368
HR26	413663	542616	0	0.02	4.8251
HR27	414541	542088	0	0.07	4.87142
HR28	413238	542566	0	0.02	4.82171
HR29	414969	540916	0	0.72	5.52375
HR30	415454	540301	0	0.05	4.85037
HR31	413380	542095	0	0.02	4.82613
HR32	413375	542161	0	0.02	4.82535
HR33	414787	541934	0	0.10	4.90377
ER01	415879	540516	0	0.13	4.93855
ER02	414736	541268	0	0.15	4.95011
ER03	415493	540151	0	0.04	4.8397
ER04	415668	540237	0	0.04	4.84512
ER05	416473	540788	0	0.23	5.03199
MAX				**0.72**	**5.52**
Surface Roughness		**0.3**			
Buildings		On			

Stack Height CHP	10.5			
Met Data	2020			
		High Hedley		

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m3) NO_2 CHP	LT PEC (ug/m3) NO_2 CHP
HR01	415053	541874	0	0.07	4.87582
HR02	415151	542176	0	0.04	4.8431
HR03	415045	542722	0	0.03	4.83342
HR04	414865	542733	0	0.04	4.84082
HR05	415290	541589	0	0.08	4.87962
HR06	415420	542724	0	0.02	4.82508
HR07	415618	541788	0	0.06	4.86691
HR08	415831	542835	0	0.02	4.82475
HR09	415915	542493	0	0.03	4.83147
HR10	416750	541048	0	0.18	4.97983
HR11	416697	542473	0	0.04	4.84504
HR12	417020	541847	0	0.07	4.87665
HR13	416424	540649	0	0.17	4.97451
HR14	416867	540482	0	0.10	4.90886
HR15	417055	540474	0	0.10	4.90092
HR16	415638	540403	0	0.08	4.88088
HR17	416285	539653	0	0.02	4.82815
HR18	415559	540200	0	0.04	4.84305
HR19	415615	540068	0	0.03	4.83581
HR20	414960	540515	0	0.06	4.86257
HR21	414996	540498	0	0.05	4.85234
HR22	414208	539728	0	0.03	4.83628
HR23	412985	541299	0	0.02	4.82836
HR24	413406	541548	0	0.03	4.83211
HR25	414104	542236	0	0.04	4.84
HR26	413663	542616	0	0.02	4.82803
HR27	414541	542088	0	0.07	4.8701
HR28	413238	542566	0	0.02	4.82418
HR29	414969	540916	0	0.74	5.546
HR30	415454	540301	0	0.05	4.85212
HR31	413380	542095	0	0.02	4.82804
HR32	413375	542161	0	0.02	4.82753
HR33	414787	541934	0	0.10	4.89971
ER01	415879	540516	0	0.14	4.94202
ER02	414736	541268	0	0.17	4.96952
ER03	415493	540151	0	0.04	4.84095
ER04	415668	540237	0	0.04	4.84874
ER05	416473	540788	0	0.20	5.00765
MAX				**0.74**	**5.55**
Surface Roughness		**0.5**			
Buildings		On			

Stack Height CHP	10.5			
Met Data	2020			
		High Hedley		

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m^3) NO_2 CHP	LT PEC (ug/m^3) NO_2 CHP
HR01	415053	541874	0	0.07	4.87518
HR02	415151	542176	0	0.04	4.84617
HR03	415045	542722	0	0.03	4.83459
HR04	414865	542733	0	0.03	4.83935
HR05	415290	541589	0	0.09	4.89069
HR06	415420	542724	0	0.02	4.82834
HR07	415618	541788	0	0.07	4.87384
HR08	415831	542835	0	0.02	4.82712
HR09	415915	542493	0	0.03	4.8348
HR10	416750	541048	0	0.15	4.95633
HR11	416697	542473	0	0.04	4.84689
HR12	417020	541847	0	0.07	4.87314
HR13	416424	540649	0	0.15	4.95782
HR14	416867	540482	0	0.09	4.89916
HR15	417055	540474	0	0.09	4.89099
HR16	415638	540403	0	0.08	4.88917
HR17	416285	539653	0	0.03	4.83107
HR18	415559	540200	0	0.04	4.84762
HR19	415615	540068	0	0.04	4.83996
HR20	414960	540515	0	0.07	4.86945
HR21	414996	540498	0	0.05	4.85892
HR22	414208	539728	0	0.03	4.8359
HR23	412985	541299	0	0.02	4.82652
HR24	413406	541548	0	0.03	4.83161
HR25	414104	542236	0	0.04	4.84064
HR26	413663	542616	0	0.02	4.82887
HR27	414541	542088	0	0.06	4.86413
HR28	413238	542566	0	0.02	4.82523
HR29	414969	540916	0	0.78	5.58896
HR30	415454	540301	0	0.05	4.85642
HR31	413380	542095	0	0.02	4.82899
HR32	413375	542161	0	0.02	4.82863
HR33	414787	541934	0	0.08	4.88918
ER01	415879	540516	0	0.14	4.94793
ER02	414736	541268	0	0.19	4.99292
ER03	415493	540151	0	0.04	4.84492
ER04	415668	540237	0	0.05	4.85462
ER05	416473	540788	0	0.18	4.98134
MAX				**0.78**	**5.59**
Surface Roughness		**1.0**			
Buildings		On			

Stack Height CHP	10.5			
Met Data	2020			
		High Hedley		

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m^3) NO_2 CHP	LT PEC (ug/m^3) NO_2 CHP
HR01	415053	541874	0	0.07	4.87518
HR02	415151	542176	0	0.04	4.84617
HR03	415045	542722	0	0.03	4.83459
HR04	414865	542733	0	0.03	4.83935
HR05	415290	541589	0	0.09	4.89069
HR06	415420	542724	0	0.02	4.82834
HR07	415618	541788	0	0.07	4.87384
HR08	415831	542835	0	0.02	4.82712
HR09	415915	542493	0	0.03	4.8348
HR10	416750	541048	0	0.15	4.95633
HR11	416697	542473	0	0.04	4.84689
HR12	417020	541847	0	0.07	4.87314
HR13	416424	540649	0	0.15	4.95782
HR14	416867	540482	0	0.09	4.89916
HR15	417055	540474	0	0.09	4.89099
HR16	415638	540403	0	0.08	4.88917
HR17	416285	539653	0	0.03	4.83107
HR18	415559	540200	0	0.04	4.84762
HR19	415615	540068	0	0.04	4.83996
HR20	414960	540515	0	0.07	4.86945
HR21	414996	540498	0	0.05	4.85892
HR22	414208	539728	0	0.03	4.8359
HR23	412985	541299	0	0.02	4.82652
HR24	413406	541548	0	0.03	4.83161
HR25	414104	542236	0	0.04	4.84064
HR26	413663	542616	0	0.02	4.82887
HR27	414541	542088	0	0.06	4.86413
HR28	413238	542566	0	0.02	4.82523
HR29	414969	540916	0	0.78	5.58896
HR30	415454	540301	0	0.05	4.85642
HR31	413380	542095	0	0.02	4.82899
HR32	413375	542161	0	0.02	4.82863
HR33	414787	541934	0	0.08	4.88918
ER01	415879	540516	0	0.14	4.94793
ER02	414736	541268	0	0.19	4.99292
ER03	415493	540151	0	0.04	4.84492
ER04	415668	540237	0	0.05	4.85462
ER05	416473	540788	0	0.18	4.98134
MAX				**0.78**	**5.59**
Surface Roughness		1.0			
Buildings		On			

Stack Height CHP	**10.5**			
Met Data	2020			
		High Hedley		

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m^3) NO_2 CHP	LT PEC (ug/m^3) NO_2 CHP
HR01	415053	541874	0	0.07	4.87271
HR02	415151	542176	0	0.04	4.84427
HR03	415045	542722	0	0.03	4.83328
HR04	414865	542733	0	0.03	4.83805
HR05	415290	541589	0	0.08	4.88563
HR06	415420	542724	0	0.02	4.82703
HR07	415618	541788	0	0.07	4.86984
HR08	415831	542835	0	0.02	4.82588
HR09	415915	542493	0	0.03	4.83308
HR10	416750	541048	0	0.15	4.9518
HR11	416697	542473	0	0.04	4.84473
HR12	417020	541847	0	0.07	4.8704
HR13	416424	540649	0	0.15	4.95257
HR14	416867	540482	0	0.09	4.89572
HR15	417055	540474	0	0.08	4.888
HR16	415638	540403	0	0.08	4.88214
HR17	416285	539653	0	0.02	4.82922
HR18	415559	540200	0	0.04	4.84535
HR19	415615	540068	0	0.03	4.83804
HR20	414960	540515	0	0.06	4.86755
HR21	414996	540498	0	0.05	4.85722
HR22	414208	539728	0	0.03	4.83472
HR23	412985	541299	0	0.02	4.82562
HR24	413406	541548	0	0.03	4.83029
HR25	414104	542236	0	0.03	4.83916
HR26	413663	542616	0	0.02	4.82775
HR27	414541	542088	0	0.06	4.86242
HR28	413238	542566	0	0.02	4.82418
HR29	414969	540916	0	0.75	5.55123
HR30	415454	540301	0	0.05	4.85399
HR31	413380	542095	0	0.02	4.82768
HR32	413375	542161	0	0.02	4.82734
HR33	414787	541934	0	0.08	4.88697
ER01	415879	540516	0	0.13	4.9378
ER02	414736	541268	0	0.18	4.98447
ER03	415493	540151	0	0.04	4.84295
ER04	415668	540237	0	0.05	4.85128
ER05	416473	540788	0	0.17	4.97601
MAX				**0.75**	**5.55**
Surface Roughness		1.0			
Buildings		On			

Stack Height CHP	**11.5**			
Met Data	2020			
		High Hedley		

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m^3) NO_2 CHP	LT PEC (ug/m^3) NO_2 CHP
HR01	415053	541874	0	0.07	4.87046
HR02	415151	542176	0	0.04	4.84249
HR03	415045	542722	0	0.03	4.83202
HR04	414865	542733	0	0.03	4.83679
HR05	415290	541589	0	0.08	4.88121
HR06	415420	542724	0	0.02	4.82575
HR07	415618	541788	0	0.06	4.8662
HR08	415831	542835	0	0.02	4.82465
HR09	415915	542493	0	0.03	4.8314
HR10	416750	541048	0	0.14	4.94738
HR11	416697	542473	0	0.04	4.84258
HR12	417020	541847	0	0.06	4.86768
HR13	416424	540649	0	0.14	4.94777
HR14	416867	540482	0	0.09	4.89258
HR15	417055	540474	0	0.08	4.88519
HR16	415638	540403	0	0.07	4.87796
HR17	416285	539653	0	0.02	4.82771
HR18	415559	540200	0	0.04	4.84343
HR19	415615	540068	0	0.03	4.83635
HR20	414960	540515	0	0.06	4.86578
HR21	414996	540498	0	0.05	4.85565
HR22	414208	539728	0	0.03	4.83359
HR23	412985	541299	0	0.02	4.82475
HR24	413406	541548	0	0.02	4.82903
HR25	414104	542236	0	0.03	4.83773
HR26	413663	542616	0	0.02	4.82665
HR27	414541	542088	0	0.06	4.86079
HR28	413238	542566	0	0.02	4.82311
HR29	414969	540916	0	0.71	5.51363
HR30	415454	540301	0	0.05	4.8519
HR31	413380	542095	0	0.02	4.82638
HR32	413375	542161	0	0.02	4.82605
HR33	414787	541934	0	0.08	4.88491
ER01	415879	540516	0	0.13	4.93187
ER02	414736	541268	0	0.17	4.97674
ER03	415493	540151	0	0.04	4.84121
ER04	415668	540237	0	0.04	4.84881
ER05	416473	540788	0	0.17	4.97093
MAX				**0.71**	**5.51**
Surface Roughness		1.0			
Buildings		On			

Stack Height CHP	**12.5**			
Met Data	2020			
		High Hedley		

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m^3) NO_2 CHP	LT PEC (ug/m^3) NO_2 CHP
HR01	415053	541874	0	0.06	4.86837
HR02	415151	542176	0	0.04	4.84083
HR03	415045	542722	0	0.03	4.83083
HR04	414865	542733	0	0.03	4.83561
HR05	415290	541589	0	0.07	4.87727
HR06	415420	542724	0	0.02	4.82453
HR07	415618	541788	0	0.06	4.86288
HR08	415831	542835	0	0.02	4.82345
HR09	415915	542493	0	0.03	4.8298
HR10	416750	541048	0	0.14	4.94283
HR11	416697	542473	0	0.04	4.84046
HR12	417020	541847	0	0.06	4.86484
HR13	416424	540649	0	0.14	4.94297
HR14	416867	540482	0	0.08	4.88941
HR15	417055	540474	0	0.08	4.88234
HR16	415638	540403	0	0.07	4.87406
HR17	416285	539653	0	0.02	4.82626
HR18	415559	540200	0	0.04	4.84168
HR19	415615	540068	0	0.03	4.83484
HR20	414960	540515	0	0.06	4.86409
HR21	414996	540498	0	0.05	4.8542
HR22	414208	539728	0	0.03	4.83253
HR23	412985	541299	0	0.02	4.82387
HR24	413406	541548	0	0.02	4.8278
HR25	414104	542236	0	0.03	4.83641
HR26	413663	542616	0	0.02	4.82561
HR27	414541	542088	0	0.05	4.85929
HR28	413238	542566	0	0.02	4.82208
HR29	414969	540916	0	0.67	5.4768
HR30	415454	540301	0	0.05	4.85003
HR31	413380	542095	0	0.02	4.82511
HR32	413375	542161	0	0.02	4.8248
HR33	414787	541934	0	0.08	4.88298
ER01	415879	540516	0	0.12	4.92619
ER02	414736	541268	0	0.17	4.96988
ER03	415493	540151	0	0.04	4.83964
ER04	415668	540237	0	0.04	4.84653
ER05	416473	540788	0	0.16	4.96581
MAX				**0.67**	**5.48**
Surface Roughness		1.0			
Buildings		On			

Stack Height CHP	**13.5**			
Met Data	2020			
		High Hedley		

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m^3) NO_2 CHP	LT PEC (ug/m^3) NO_2 CHP
HR01	415053	541874	0	0.06	4.86647
HR02	415151	542176	0	0.03	4.83932
HR03	415045	542722	0	0.03	4.82971
HR04	414865	542733	0	0.03	4.8345
HR05	415290	541589	0	0.07	4.87382
HR06	415420	542724	0	0.02	4.82335
HR07	415618	541788	0	0.06	4.85989
HR08	415831	542835	0	0.02	4.82228
HR09	415915	542493	0	0.02	4.82826
HR10	416750	541048	0	0.13	4.93825
HR11	416697	542473	0	0.03	4.8384
HR12	417020	541847	0	0.06	4.86207
HR13	416424	540649	0	0.13	4.93838
HR14	416867	540482	0	0.08	4.88632
HR15	417055	540474	0	0.08	4.87954
HR16	415638	540403	0	0.07	4.87055
HR17	416285	539653	0	0.02	4.82493
HR18	415559	540200	0	0.04	4.84016
HR19	415615	540068	0	0.03	4.8335
HR20	414960	540515	0	0.06	4.86249
HR21	414996	540498	0	0.05	4.85281
HR22	414208	539728	0	0.03	4.83156
HR23	412985	541299	0	0.02	4.82305
HR24	413406	541548	0	0.02	4.82668
HR25	414104	542236	0	0.03	4.83518
HR26	413663	542616	0	0.02	4.82464
HR27	414541	542088	0	0.05	4.85792
HR28	413238	542566	0	0.02	4.8211
HR29	414969	540916	0	0.64	5.43995
HR30	415454	540301	0	0.04	4.84836
HR31	413380	542095	0	0.02	4.82394
HR32	413375	542161	0	0.02	4.82364
HR33	414787	541934	0	0.08	4.88119
ER01	415879	540516	0	0.12	4.9209
ER02	414736	541268	0	0.16	4.96357
ER03	415493	540151	0	0.03	4.83825
ER04	415668	540237	0	0.04	4.8445
ER05	416473	540788	0	0.16	4.96085
MAX				**0.64**	**5.44**
Surface Roughness		1.0			
Buildings		On			

Stack Height CHP	**14.5**			
Met Data	2020			
		High Hedley		

APPENDIX E – LONG TERM PC/PEC DATA OUTPUT

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m^3) NO_2 CHP	LT PEC (ug/m^3) NO_2 CHP	LT PC (ug/m^3) SO2 CHP	LT PEC (ug/m^3) SO2 CHP	LT PC (ug/m^3) Benzene CHP	LT PEC (ug/m^3) Benzene CHP
HR01	415053	541874	0	0.07	4.88	0.05	2.04	0.14	0.27
HR02	415151	542176	0	0.04	4.85	0.03	2.02	0.08	0.22
HR03	415045	542722	0	0.03	4.83	0.02	2.01	0.06	0.19
HR04	414865	542733	0	0.03	4.84	0.02	2.02	0.07	0.20
HR05	415290	541589	0	0.09	4.89	0.06	2.05	0.17	0.31
HR06	415420	542724	0	0.02	4.83	0.02	2.01	0.05	0.18
HR07	415618	541788	0	0.07	4.87	0.05	2.04	0.14	0.27
HR08	415831	542835	0	0.02	4.83	0.02	2.01	0.05	0.18
HR09	415915	542493	0	0.03	4.83	0.02	2.01	0.06	0.19
HR10	416750	541048	0	0.15	4.96	0.11	2.10	0.30	0.44
HR11	416697	542473	0	0.04	4.85	0.03	2.02	0.08	0.22
HR12	417020	541847	0	0.07	4.87	0.05	2.04	0.14	0.27
HR13	416424	540649	0	0.15	4.96	0.11	2.10	0.31	0.44
HR14	416867	540482	0	0.09	4.90	0.07	2.06	0.19	0.32
HR15	417055	540474	0	0.09	4.89	0.06	2.05	0.17	0.31
HR16	415638	540403	0	0.08	4.89	0.06	2.05	0.17	0.30
HR17	416285	539653	0	0.03	4.83	0.02	2.01	0.05	0.19
HR18	415559	540200	0	0.04	4.85	0.03	2.02	0.09	0.22
HR19	415615	540068	0	0.04	4.84	0.02	2.02	0.07	0.20
HR20	414960	540515	0	0.07	4.87	0.05	2.04	0.13	0.26
HR21	414996	540498	0	0.05	4.86	0.04	2.03	0.11	0.24
HR22	414208	539728	0	0.03	4.84	0.02	2.01	0.06	0.20
HR23	412985	541299	0	0.02	4.83	0.02	2.01	0.04	0.18
HR24	413406	541548	0	0.03	4.83	0.02	2.01	0.05	0.19
HR25	414104	542236	0	0.04	4.84	0.03	2.02	0.07	0.21
HR26	413663	542616	0	0.02	4.83	0.02	2.01	0.05	0.18

HR27	414541	542088	0	0.06	4.86	0.04	2.03	0.12	0.25
HR28	413238	542566	0	0.02	4.83	0.01	2.01	0.04	0.17
HR29	414969	540916	0	0.78	5.59	0.55	2.54	1.57	1.70
HR30	415454	540301	0	0.05	4.86	0.04	2.03	0.10	0.24
HR31	413380	542095	0	0.02	4.83	0.02	2.01	0.05	0.18
HR32	413375	542161	0	0.02	4.83	0.02	2.01	0.05	0.18
HR33	414787	541934	0	0.08	4.89	0.06	2.05	0.17	0.30
ER01	415879	540516	0	0.14	4.95	0.10	2.09	0.29	0.42
ER02	414736	541268	0	0.19	4.99	0.13	2.12	0.38	0.51
ER03	415493	540151	0	0.04	4.84	0.03	2.02	0.08	0.21
ER04	415668	540237	0	0.05	4.85	0.04	2.03	0.10	0.23
ER05	416473	540788	0	0.18	4.98	0.12	2.12	0.35	0.49
MAX				**0.78**	**5.59**	**0.55**	**2.54**	**1.57**	**1.70**
			x0.7	**0.55**					
		Difference in PC		0.24					
	PEC with 70% PC conversion				5.35				

Surface Roughness	1.0	
Buildings	On	
Stack Height CHP	10.5	
Met Data	2020	
High Hedley		

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