Hanson UK

Padeswood Carbon Capture and Storage Project

Air Quality Assessment

Report No: 444770-01 (00)

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RSK GENERAL NOTES

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Abbreviations

AGI	Above Ground Installation
AQMA	Air Quality Management Area
AQS	Air Quality Standard
CO_2	Carbon Dioxide
CO	Carbon Monoxide
DEFRA	Department for Environment, Food and Rural Affairs
EC	European Commission
EU	European Union
FCC	Flintshire County Council
HCl	Hydrogen Chloride
HF	Hydrogen Fluoride
IAQM	Institute of Air Quality Management
LAQM	Local Air Quality Management
NAQS	National Air Quality Strategy
NH_3	Ammonia
NMVOC	Non-methane Volatile Organic Compounds
NO_2	Nitrogen Dioxide
NO_x	Oxides of nitrogen
NPPF	National Planning Policy Framework
O_3	Ozone
PCCC	Post combustion carbon capture and compression
$PM_{2.5}$	Particulate matter of size fraction approximating to <2.5µm diameter
PM_{10}	Particulate matter of size fraction approximating to <10µm diameter
RSK	RSK Environment Limited
SO_2	Sulphur Dioxide
VOC	Volatile Organic Compounds

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1 INTRODUCTION

1.1 Background

RSK Environment Ltd (RSK) was commissioned to undertake an assessment of the potential air quality impacts associated with the proposed permit variation application for the installation of a Carbon Capture and Storage plant at the Padeswood Works facility (EPR/BL1096IB).

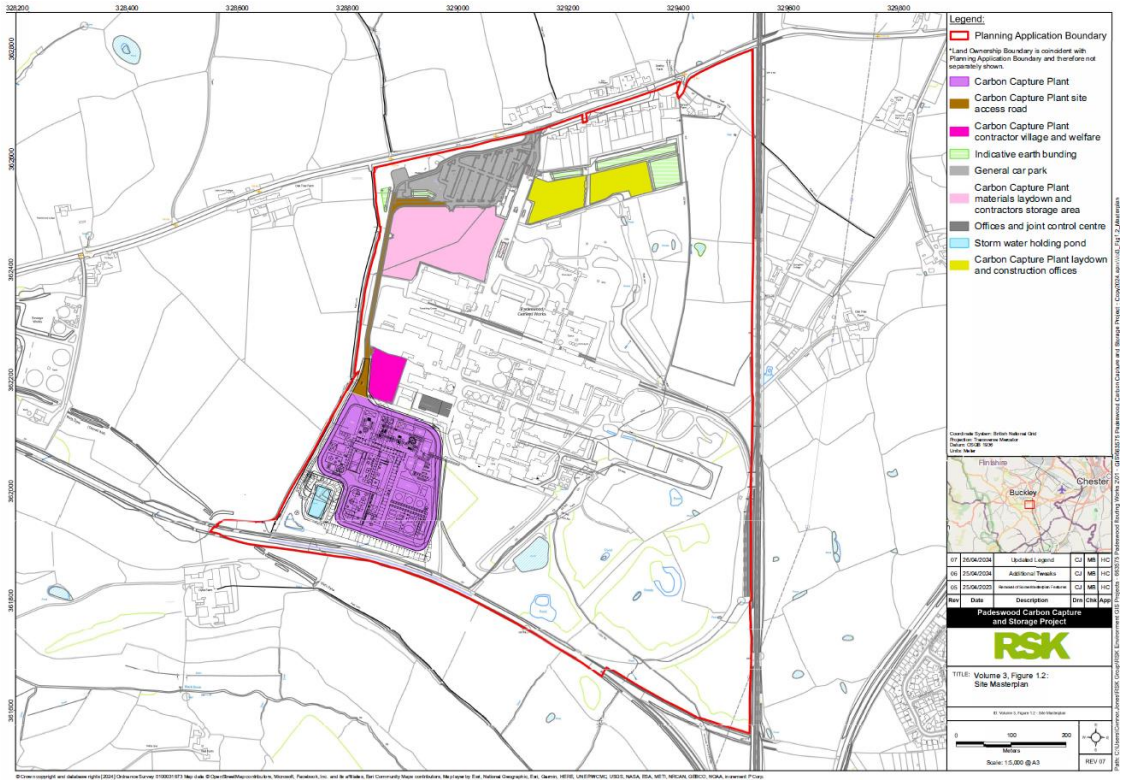
The site currently emits emissions to air from an existing kiln stack and a number of cement manufacturing process sources. The proposed variation will result in the routing of emissions from the existing kiln stack to a post combustion carbon capture and compression (PCCC) plant, thus, removing emissions carbon dioxide emissions (CO_2) and emitting the kiln's exhaust gas through a new dedicated PCCC stack. In addition, a new combined heat and power (CHP) plant will be installed to provide the energy required for the PCCC plant, with emissions also routed via the PCCC to the new PCCC stack.

This report presents the findings of the assessment associated with the changes in direct emissions as a result of the kiln and CHP emissions being treated in the PCCC and passing through the PCCC stack. Therefore, this assessment only considers pollutants already being emitted[1] from the installation; the impacts of emissions associated with the solvents used within the PCCC plant are contained within a separate technical appendix.

The approximate centre of the site is 329196, 362196 and is within the administration area of Flintshire County Council (FCC). Figure 1.1 details the location of the PCCC plant within the site.

[1] NO_2, NO_x, PM_{10}, $PM_{2.5}$, CO, HCl, HF, NH_3, SO_2, NMVOC, dioxins and metals

Figure 1.1: Proposed Development Site Location



2 Overview of Facilities Process

2.1 Existing Facility

The cement works at Padeswood manufactures cement from limestone, pulverised fuel ash ("PFA"), shale and sand, together with gypsum, and dispatches it in bulk tankers and as packed cement. The onsite kiln has a nominal capacity of 750,000 tonnes per annum and includes a five-stage cyclone pre-heater and a pre-calciner. Its advanced technology reduces energy consumption and significantly reduces emissions to air.

The main sources of emissions from the existing operations are from the existing kiln (emission point A8), which is permitted to use Waste Derived Fuels (including solid recovery fuel and shredded used motor vehicle tyres etc.). As such, it emits a range of pollutants associated with the burning of waste and is regulated under the Industrial Emissions Directive (IED)[2].

Other sources of emissions associated with the cement manufacturing process (mills, storage facilities etc.) only emit particulate matter.

2.2 Proposed Facility

2.2.1.1 PCCC Plant

In order to reduce the emissions of CO_2 associated with the existing facility, an amine-based PCCC plant will be installed at the facility. Emissions from the existing kiln will be routed to the PCCC, where CO_2 will be scrubbed, processed and sent off-site to storage.

The scrubbed exhaust gas will be then emitted to atmosphere via a separate, dedicated PCCC stack. Detailed information on the operation of the PCCC is contained within the assessment of the PCCC's solvent emissions. In addition to the new PCCC plant, a new combined heat and power (CHP) will be installed to supply power to the PCCC plant, with all emissions from the CHP plant treated in the capture plant and exhausted via the PCCC stack. As the CHP is required to power the PCCC, its emissions are tied to the use of the PPPC plant and will not operate independently.

The cement kiln operates in 4 modes and consequently the CHP and PCCC plant operate under the same four separate modes, with specific combustion and operating conditions for each for each mode provided by the operator. The four modes are:

- Mode 1. Raw Mill on and Coal Mill on, 65% time share within a week
- Mode 2. Raw Mill on and Coal Mill off, 25% time share within a week
- Mode 3. Raw Mill off and Coal Mill on, 9% time share within a week
- Mode 4. Raw Mill off and Coal Mill off, 1% time share within a week

[2] As committed to by the European Union Withdrawal Act 2018.

2.2.1.2 Existing Sources

The existing kiln stack will be retained and only used to discharge emissions from the kiln during PCCC startup or in emergency shutdown or maintenance of the PCCC or the CO_2 transport and storage system and clinker production continues. As such, it is expected that the two stacks are not operated at the same time.

All other existing sources of emissions from the cement manufacturing process will not be affected by the permit variation and will continue to operate as they currently operate.

3 LEGISLATION, PLANNING POLICY & GUIDANCE

3.1 Key Legislation

3.1.1 Air Quality Strategy

UK air quality policy is published under the umbrella of the Environment Act 1995, Part IV and specifically Section 80, the National Air Quality Strategy. The 2007 *Air Quality Strategy for England, Scotland, Wales and Northern Ireland – Working Together for Clean Air*, published in July 2007 sets air quality standards and objectives for ten key air pollutants to be achieved between 2003 and 2020.

The latest 2023 *air quality strategy*: Air quality Strategy: framework for local authority delivery, further sets out the actions that Defra expects local authorities to take in support of their long-term air quality goals, including the new $PM_{2.5}$ targets.

The EU (European Unit) Air Quality Framework Directive (1996) established a framework under which the EU could set limit or target values for specified pollutants. The directive identified several pollutants for which limit or target values have been, or will be set in subsequent 'daughter directives'. The framework and daughter directives were consolidated by Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe, which retains the existing air quality standards and introduces new objectives for fine particulates ($PM_{2.5}$).

The Clean Air Strategy 2019 supersedes the policies outlined in the 2007 strategy. This latest strategy aims to have a more joined-up approach, outlining actions the Government plans to take to reduce emissions from transport, homes, agriculture and industry. However, the air quality objectives remain as previously detailed within the 2007 strategy.

Environmental Permitting Regulations (EPR)

Many industrial processes have the potential to release pollution to land, air and water, with the potential to pose a health risk to people as well as damaging the environment. To prevent this, many industrial processes are regulated under the EPR, which either set emissions limit values with which the installation must comply and/or requires best available techniques (BAT) to be used at the installation site.

The Environmental Permitting (England and Wales) Regulations 2018 is the most applicable update to the Regulations and brings the Medium Combustion Plant Directive (MCPD) (2015/2193/EC) into force in England and Wales. Natural Resources Wales (NRW), the regulatory authority in Wales, enforce the requirements of the Environmental Permitting Regulations and have regard for the AQSs and existing ambient air quality relative to these AQSs.

3.1.2 National Emission Ceilings Regulations

The United Nations Economic Commission's Gothenburg Protocol sets the international context for ammonia emission reductions and lays out strict emission reduction obligations. The UK is a signatory to this international obligation in its own right. The Gothenburg Protocol set an 8% ammonia reduction target for the UK by 2020, compared to 2005 levels. This 8% target is also contained in the Directive 2016/2284/EU on the reduction of national emissions of certain atmospheric pollutants (the new National Emission Ceilings Directive). The UK's commitment to reduce ammonia under the Gothenburg Protocol is independent of its exit from the European Union.

The National Emission Ceilings Regulations 2018 came into force in July 2018 and revoke the National Emission Ceilings Regulations 2002. The regulations transpose EU Directive 2016/2284/EU into UK law. The regulations provide national emission ceilings and national emission reduction commitments for pollutants, including ammonia, in line with the United Nations Economic Commission's revised Gothenburg Protocol.

3.2 Guidance

3.2.1 Local Air Quality Management Review and Assessment Technical Guidance

Defra has published technical guidance for use by local authorities in their air quality review and assessment work. This guidance, referred to in this document as LAQM.TG (22), has been used to identify locations where exposure can be considered 'relevant'. This is important as Directive 2008/50/EC indicates that the AQSs should not be applied at any locations situated within areas where members of the public do not have regular access and there is no fixed habitation. These definitions provide greater clarity than applicable NRW guidance and are considered more robust for use in an air quality assessment. The definitions identified in LAQM TG.22 are summarised in Table 3.2 below.

Table 3.2: Locations where AQSs should and should not be applied, replicated from LAQM TG.22

Averaging period	Locations where AQSs should be applied	Locations where AQSs should not be applied
Annual mean	All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes etc.	Building façades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
24-hour mean and 8-hour mean	All locations where the annual mean objective would apply, together with hotels. Gardens of residential properties*	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
1-hour mean	All locations where the annual mean and: 24 and 8-hour mean objectives apply. Kerbside sites (for example, pavements of busy shopping streets). Those parts of car parks, bus stations and railway stations etc. which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more. Any outdoor locations where members of the public might reasonably expected to spend one hour or longer.	Kerbside sites where the public would not be expected to have regular access.
15-minute mean	All locations where members of the public might reasonably be exposed for a period of 15 minutes.	N/A

Notes: Such locations should represent parts of the garden where relevant public exposure to pollutants is likely, for example where there is seating or play areas. It is unlikely that relevant public exposure to pollutants would occur at the extremities of the garden boundary, or in front gardens, although local judgement should always be applied.

In all cases, the AQSs should not be applied at locations where health and safety at work provisions exist and where members of the public do not have access.

3.2.2 Air emissions risk assessment for your environmental permit (Environment Agency, 2024) ('EA guidance and Defra')

This guidance, which was adopted in 2016 (and updated in 2024) by the Environment Agency and Defra, outlines a procedure which can be used to determine when detailed dispersion modelling is required and the elements which are required as part of detailed dispersion modelling assessment. A subsection of the guidance also outlines features of air quality assessment which should be submitted within the air quality assessment report. This report has been written with reference to this document and has been used

in conjunction with the EA guidance (latest updated 2024 version). In absence of detailed guidance by NRW, the EA Defra guidance has been used. However, consideration has also been given to NRW's air quality modelling and risk assessment guidance[3].

3.2.3 AQTAG06: Technical Guidance on Detailed Modelling Approach for an Appropriate Assessment for Emissions to Air (Air Quality Technical Advisory. Group, 2014) ('AQTAG.06')

NRW has not published specific technical guidance on the modelling approach for air quality assessment under the Habitats regulations. So the technical guidance in England is adopted in this report. The AQTAG06 guidance, updated during 2014, provides technical guidance on how to approach detailed modelling of emissions to air when considering impacts on ecological receptors. It also includes a method which can be used to assess the potential impacts of nitrogen and acid deposition attributable to emissions of NO_x to air on local ecosystems.

[3] https://naturalresources.wales/about-us/what-we-do/our-roles-and-responsibilities/air-quality/air-quality-modelling-and-risk-assessment/?lang=en

4 Assessment Criteria

4.1.1 Air Quality Regulations

The air quality standards (AQSs) and air quality objectives (AQOs) in the United Kingdom are derived from EC directives and are adopted into Welsh law via the Air Quality (Wales) Regulations 2000, Air Quality (Wales) Amendment Regulations 2002 and via the Air Quality Standards (Wales) Regulations 2010.

The relevant[4] standards for England and Wales to protect human health are summarised in Table 4.1.

4.1: Air Quality Standards relevant to this assessment

Substance	Averaging period	Exceedances allowed per year	Ground level concentration limit (µg/m^3)
Nitrogen dioxide (NO_2)	calendar year	N/A	40
	1 hour	18	200
Particulate Matter (PM_{10})	calendar year	N/A	40
	24 hours	35	50
Particulate Matter ($PM_{2.5}$)	Annual	N/A	20
Carbon monoxide (CO)	Maximum daily running 8 hour mean	0	10,000
Benzene	Annual	N/A	5
Sulphur dioxide (SO_2)	24 hours	3	125
	1 hour	24	350
	15 minutes*	35	266
Lead (Pb)	calendar year	N/A	0.25*/0.5
Arsenic (As)**	calendar year	N/A	0.006
Cadmium (Cd)**	calendar year	N/A	0.005
Nickel (Ni)**	calendar year	N/A	0.02
* Designated as an Air Quality Strategy Objective ** Designated as an Air Quality Standards Regulations 2010 Target Value			

As part of their regulatory position, NRW have adopted the environment assessment levels (EALs) produced by the EA and Defra. These have been produced in order to regulate hazardous pollutants produced by industry that are not captured within the Air Quality Regulations. These are non-statutory guideline values and are contained within

[4] Relevance, in this case, is defined by the scope of the assessment.

its Air Emissions Risk (AER) guidance[5]. Typically, a site's compliance with these EALs would be based on a cost benefit analysis and discussions with NRW. The EALs relevant to this assessment are provided in **Table 4.2.**

Table 4.2: EAL relevant to this assessment

Substance	Emission Period	Concentration in µg/m^3
Hydrogen chloride (HCl)	Hourly	750
Hydrogen fluoride (HF)[1]	Hourly	160
Ammonia (NH_3)	Annual	180
	Hourly	2,500
Benzene	Daily	30
Carbon monoxide (CO)	Hourly	30,000
Antimony (Sb)	Annual	5
	Hourly	150
Chromium (Cr) III	Daily	2
Manganese (Mn)	Annual	0.15
	Hourly	1500
Nickel (Ni)	Hourly	0.7
Vanadium (Pb)	Daily	1
Mercury (Hg)	Daily	0.06
	Hourly	0.6
Cadmium (Cd)	Daily	0.03
Copper (Cu)	Daily	0.05
Cobalt (Co)	Annual	0.2
	Hourly	6

Note 1 - Defra guidance6 states: "It is unlikely that the ambient monthly mean would approach this value if the 1-hour guideline value for irritancy for hydrogen fluoride is not exceeded as an air pollutant emitted from a chimney stack" Based on the results for the hourly mean HF assessment, an assessment of the monthly HF EAL has not been undertaken.

4.1.2 Critical Levels and Loads

Excessive nitrogen deposition can lead to acidification and eutrophication of soils. In addition, species richness can be compromised, especially for slow growing species which may suffer from increased competition from invasive species (World Health Organisation, 2000).

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

[6] https://uk-air.defra.gov.uk/assets/documents/reports/cat11/0805151602_Halogen_and_Hydrogen_Halides_Addendum.pdf

The United Nations Economic Commission for Europe (UNECE) have set environmental criteria known as critical levels for the protection of vegetation from direct effects and critical loads to protect against the indirect effects of deposition of pollutants. Critical loads and levels are generally 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"* (Nilsson and Grennfelt, 1988).

It is important to distinguish between a critical load and a critical level. The critical load relates to the quantity of pollutant deposited from air to the ground, whereas the critical level refers to the gaseous concentration of a pollutant in the air.

Critical levels and loads are defined by the UNECE as:

- Critical levels: *"concentrations of pollutants in the atmosphere above which direct adverse effects on receptors, such as human beings, plants, ecosystems or materials, may occur according to present knowledge."*
- Critical loads: *"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."*

When pollutant loads (or concentrations) exceed the critical level or load it is considered that there is a potential risk of harmful effects. The excess over the critical level or load is termed the exceedance. A larger exceedance is often considered to represent a greater risk of damage.

Critical levels and loads have been designated within the UK based on the sensitivity and qualifying features of the receiving habitat. Critical levels for relevant pollutant are set as detailed in Table 4.3. Critical loads for nutrient nitrogen are set under the Convention on Long-Range Transboundary Air Pollution and are based on empirical evidence, mainly observations from experiments and gradient studies (APIS, 2016). The critical loads used within this report are also presented in Section 5.

Table 4.3: Critical levels applicable to this assessment

Substance	Emission Period	Air Quality Standard
Nitrogen oxides (NOx)	Annual[1]	30 µg/m^3 [1]
	Daily	75 µg/m^3 [2]
Sulphur dioxide	Annual[1]	20 µg/m^3 [1] (10 µg/m^3 where lichens or bryophytes are present)
Ammonia	Annual	3 µg/m^3 (1 µg/m^3 where lichens or bryophytes are present)
Hydrogen fluoride	Weekly Mean	0.5
	Daily Mean	5

Substance	Emission Period	Air Quality Standard
[1] Both an Air Quality Objective and critical level. Only the critical level applies at locations within 20 km from agglomerations (250,000 people) or within 5 km away from other built-up areas, industrial installations (PART A) or motorways or major roads with traffic counts of more than 50,000 vehicles per day. [2] A critical level defined by the World Health Organisation and is not an Air Quality Objective		

5 ASSESSMENT SCOPE

5.1 Overall Approach

The approach taken for assessing the potential air quality impacts of the proposed permit variation may be summarised as follows:

- Baseline characterisation of local air quality;
- Detailed dispersion modelling to predict the ground level concentrations at nearby sensitive human and ecological receptors due to the emissions to air from the existing and proposed operations; and
- Determination of the change in air quality concentrations due to the proposed permit variation and comparison of predicted environmental concentrations (PEC) against relevant air quality standards.

5.2 Baseline Characterisation

Existing or baseline air quality refers to the concentrations of relevant substances that are already present in ambient air. These substances are emitted by various sources, including road traffic, industrial, domestic, agricultural and natural sources.

A desk-based study has been undertaken, including a review of monitoring data available from FCC and estimated background data from the Department for Environment, Food and Rural Affairs (Defra). Consideration has also been given the presence of Air Quality Management Areas (AQMAs).

5.3 Air Pollutants of Concern

As the proposed operations include a CHP and the PCCC plant (as well as existing process sources), the key air pollutants of concern for future operations are NO_2, NO_x, PM_{10}, $PM_{2.5}$, CO, HCl, HF, NH_3, SO_2, non-methane volatile organic compounds (NMVOCs), dioxins and furans, and metals (As, Cd, Hg, Sb, Cr, Co, Cu, Mn, Ni, Pb and V). While $PM_{2.5}$ is a proportion of PM_{10}, it is assumed in the current study that the proportion is 100% for a conservative estimate.

In accordance with EA/NRW guidance, all emissions of NMVOCs has been considered to be benzene.

6 BASELINE AIR QUALITY CHARACTERISATION

Existing or baseline air quality refers to the concentrations of relevant substances that are already present in ambient air. These substances are emitted by various sources, including road traffic, industrial, domestic, agricultural and natural sources. Baseline air quality data employed in this study have been obtained from monitoring stations maintained by FCC and the background concentration maps produced by Defra.

It is noted that the emissions from the existing plant will already be present to some extent within local authority air quality monitoring data and, as a part A1 Installation, will also be contained within Defra's background maps. Therefore, the method of adding the modelled concentrations from the existing sources to the local background data, as used in this assessment, will result in some element of double counting. Therefore, this assessment is conservative in this respect.

6.1 Emissions Sources and Key Air Pollutants

The facility is located to the south of A5118 and to the west of A550. The facility is located directly to the west of an existing railway between Buckley and Penyffordd railway stations; however, LAQM TG.22 does not identify the railway line as experiencing a high number of diesel locomotives; therefore, further assessment of railway emissions is not considered necessary.

6.2 Presence of AQMAs

FCC is one of the six local authorities which encompass the North Wales region (The North Wales Authorities). The North Wales Authorities have not declared any AQMAs; therefore, the facility is not located within or adjacent to any AQMAs.

6.3 Baseline Monitoring Data

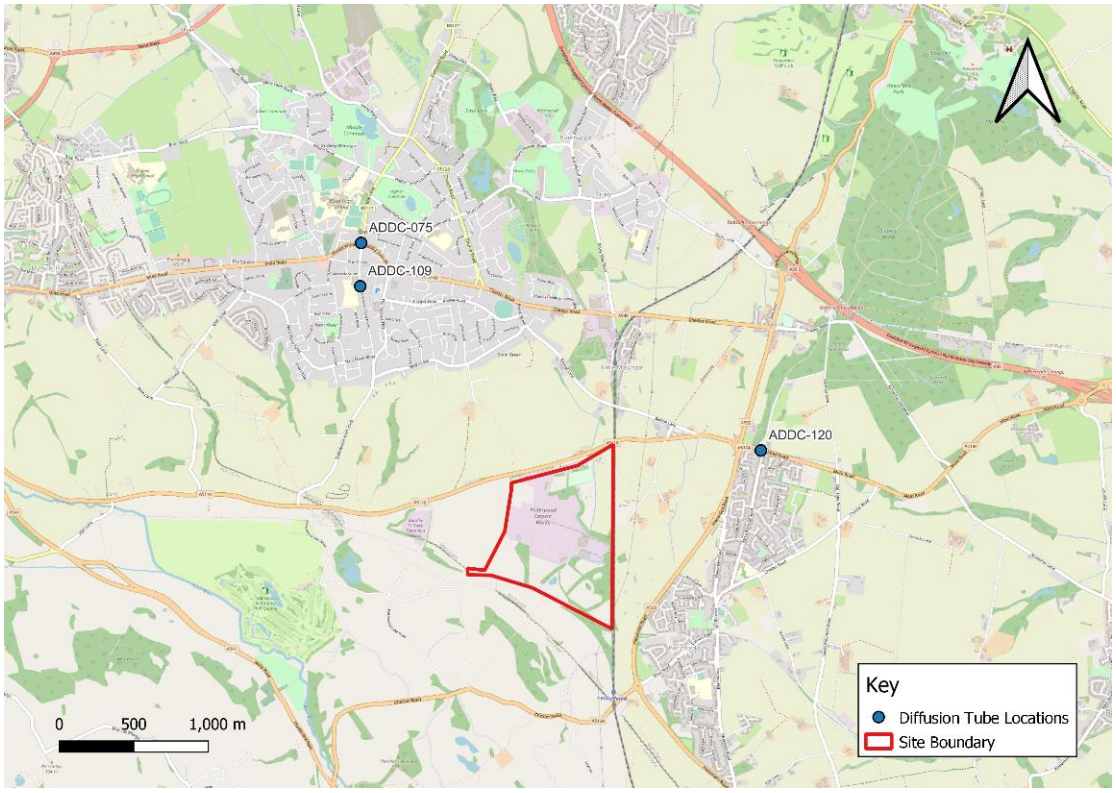
There are three automatic monitors within the North Wales Authorities Collaborative area. None of these is in the jurisdiction of FCC or in the study area. However, FCC does operate a network of 59 NO_2 diffusion tube monitoring locations. The monitoring data from the three monitors within 3 km of the facility are reproduced in Table 6.1 below.

The data from these tubes show that no exceedances of the annual mean NO_2 AQS were recorded during 2018 – 2022. Figure 6.1 shows all three monitoring locations within 3 km of the facility.

Table 6.1: Annual Mean NO_2 Concentrations at Diffusion Tube Locations within 3 km of the Facility

Site ID	Location	Site type	Approximate Distance from Site (km)	Annual Mean NO_2 Concentrations ($\mu g/m^3$)				
				2018	2019	2020	2021	2022
ADDC-120	Ysgol St John Penymynydd CH4 0LG	Kerbside	1.4	20.8	17.1	11.5	11.4	13.4
ADDC-109	Westwood CP School Padeswood Rd CH7 2JT	Kerbside	2.1	12.2	10.4	8.6	8.6	8.3
ADDC-075	17, Mill Lane, Buckley CH7 3HA	Kerbside	2.4	23.3	21.2	17.8	17.1	15.2

Figure 6.1 Monitoring Locations within 3 km of the Facility



@OpenStreetMap contributors, available under the Open Database Licence

6.4 LAQM Background Data

In addition to the local monitoring data, estimated background concentrations from Defra's background maps may also be used to establish likely background air quality conditions in the vicinity of the facility.

This website provides estimated annual average background concentrations of NO_2, PM_{10} and $PM_{2.5}$ on a 1km^2 grid basis. **Table 6.2** reproduces estimated annual average background concentrations for the grid square containing the facility for the years from 2023 to 2025.

Table 6.2: Estimated Background Annual Average NO_2, PM_{10} and $PM_{2.5}$ Concentrations at Proposed Development Site (from 2018 base map)

Assessment Year	Estimated Annual Average Pollutant Concentrations Derived from the LAQM Website (µg/m^3)		
	NO_2	PM_{10}	$PM_{2.5}$
2023	7.5	10.0	6.3
2024	7.2	9.9	6.2
2025	7.0	9.8	6.1
AQS	**40**	**40**	**20**

Note: Presented concentrations for 1 km^2 grid centred on 329500, 362500; approximate centre of development site is 329196, 362196.

The annual average background concentrations of SO_2, CO and Benzene on a 1km^2 grid basis are also provided in Defra website for the year 2001. Those background concentrations are presented in Table 6.3.

Table 6.3: Estimated Background Annual Average SO_2, CO and Benzene Concentrations at Proposed Development Site (from 2001 base map)

Assessment Year	Estimated Annual Average Pollutant Concentrations Derived from the LAQM Website (µg/m^3)		
	SO_2	CO	Benzene
2023	4.6	0.38	0.26
AQS	**N.A**	**10,000**	**5**

Note: Presented concentrations for 1 km^2 grid centred on 329500, 362500; approximate centre of development site is 329196, 362196.

Defra maps estimates no exceedances of any AQSs of background NO_2, PM_{10}, $PM_{2.5}$ SO_2, CO and benzene concentrations. As background concentrations are predicted to fall with time (as demonstrated above), background concentrations in future years would not be expected to exceed their respective AQSs.

6.5 Monitored Metal Concentration

Metal concentrations are measured in the UK by Defra under the Heavy Metals Network. The closest monitoring site with recent data is Walsall Pleck Park, approximately 96 km to the east of the proposed site. The mercury data has been extracted from Chilbolton Observatory. A summary of the monitoring data is detailed in Table 6.4.

Table 6.4: 2023 Monitored Metal Concentration at Walsall Pleck Park

Substance	Concentration in ng/m^3
Antimony	0.83
Arsenic	2.34
Lead	7.74
Cobalt	0.13
Copper	14.3
Manganese	7.09
Nickel	0.75
Vanadium	0.67
Mercury*	0.01
Cadmium	0.22
*Note: Monitored data of mercury is extracted from Chilbolton Observatory	

6.6 Other Pollutants

Hydrogen fluoride is not routinely monitored in ambient air due to its specialised nature and limited emission sources. A literature review reveals no sources of relevant baseline data; therefore, the baseline is assumed to be zero, and the assessment focuses on the process contribution (PC).

Baseline data for gaseous hydrogen chloride have been taken from the AGAnet and NAMN Ladybower monitoring site, located within the Peak District. Hydrogen chloride was not monitored at this location after 2015, measuring a concentration of 0.23 µg/m^3.

7 METHODOLOGY

7.1 Operational Impact Assessment

7.1.1 Modelling Software

The impact assessment of the site was undertaken using ADMS 6 (Version 6.0.0.1). This model, developed by the Cambridge Environmental Research Consultants (CERC), is a steady-state new-generation Gaussian plume atmospheric dispersion model. ADMS uses detailed information regarding the pollutant releases to predict ground-level concentrations and can account for local building effects, terrain features and local meteorological conditions.

Along with the AERMOD dispersion model, ADMS is commonly used within the UK for regulatory purposes and is judged fit for purpose for this assessment.

7.1.2 Assessment Scenarios

Two scenarios will be assessed in this report, as detailed below:

- An Existing Scenario: Kiln 4 (emission point A8) operating for 8760 hrs/yr, along with the 34 existing manufacturing process sources. These are all point source of particulate emissions.
- Proposed Scenario: The proposed PCCC plant operating for 8276 hrs/yr, and Kiln 4 operating for 484 hrs/yr. Typically, the PCCC plant will operate for 7400 hours per year. Thus, this assessment is conservative in this respect. The 34 existing manufacturing process sources will also be included in this scenario.

In the above proposed scenario, the proposed CHP will be operating to power the PCCC plant (so do not operate independently). As all emissions from the CHP will exhaust via the PCCC stack, the assumed emission limits of the PCCC stack incorporate the operation of the CHP.

7.1.3 Emission Sources and Operating Profile

Existing Emission Sources

Table 7.1 presents the physical and emission characteristics of Kiln 4 (emission point A8) during the existing scenario. It is assumed that in the existing scenario, the kiln operates 8760 hrs/yr. All information on physical and emission characteristics has been provided by the site operator.

Table 7.1: Physical and Emission Characteristics of Existing Kiln Included in the Assessment

Description	Kil 4 Existing Stack
Operation Hours per annum in proposed scenario	8760
Stack height above PCCC datum level (m)	117.9
Stack diameter (m)	3.35
Stack exhaust temperature (ºC)	135
Actual stack exit velocity (m/s)	15.4
Volumetric Flow Rate (m^3/s) – Actual	135.28
Volumetric Flow Rate (m^3/s) – Ref	66.27
Oxygen Content (%)	10.2
Moisture Content (%)	12.8
NO_x exhaust emissions rate (mg/Nm^3)	450
SO_2 exhaust emissions rate (mg/Nm^3)	200
CO exhaust emissions rate (mg/Nm^3)	1,200
PM_{10} exhaust emissions rate (mg/Nm^3)	10
HCL exhaust emissions rate (mg/Nm^3)	10
HF exhaust emissions rate (mg/Nm^3)	1
NH_3 exhaust emissions rate (mg/Nm^3)	70
Cd and TI exhaust emissions rate (mg/Nm^3)	0.05
Hg exhaust emissions rate (mg/Nm^3)	0.05
Group 3 Metal* exhaust emissions rate (mg/Nm^3)	0.5
NMVOC (assumed as benzene) exhaust emissions rate (mg/Nm^3)	50
Dioxins and Furans exhaust emissions rate (ng/Nm^3)	0.1
NO_x exhaust emissions rate (g/s)	29.82

SO_2 exhaust emissions rate (g/s)	13.25
CO exhaust emissions rate (g/s)	79.52
PM_{10} exhaust emissions rate (g/s)	0.66
HCL exhaust emissions rate (g/s)	0.66
NH_3 exhaust emissions rate (g/s)	4.64
HF exhaust emissions rate (g/s)	0.07
Cd and TI exhaust emissions rate (g/s)	0.003
Hg exhaust emissions rate (g/s)	0.003
Group 3 Metal* exhaust emissions rate (g/s)	0.033
NMVOC (assumed as benzene) exhaust emissions rate (g/s)	3.31
Dioxins and Furans exhaust emissions rate (µg/s)	0.007
Stack location	X: 329067 Y: 362058
Emission Concentration Release Conditions (REF): 273K, 101.3kPa, dry gas, 10% oxygen *Includes As, Sb, Co, Cr, Cu, Mn, Ni, Pb, V	

The emission rates and concentrations assumed for Kiln 4 are at the emission limit values and not the 'normal' values. Thus, the assessment is conversative in this respect.

As well as the kiln, existing operations include various sources of particulate matter from cement mills, silos and dedusting filters etc. These sources will continue to operate as they currently are following the permit variation. Details of existing sources are presented in Table 7.2 and location is shown in Figure A1. The emission rates have been calculated at the 10 mg/Nm_3 emission limit value for each of these sources. This is a conservative case as these sources do not all operate continuously or all at the same time.

Table 7.2 Point Source Parameter

Source	Source ID	X	Y	Height (m)	Temperature (°C)	Diameter (m)	Velocity (m/s)	PM_{10} Emission Rate (g/s)
Clinker Cooler	P1	329140	362040	35	92.85	1.89	8.6	0.360
Cement Mill 1	P2	329200	362134	17.5	79.85	0.51	4.1	0.007
Cement Mill 2	P3	329200	362134	12.7	79.85	0.51	4.1	0.007
Cement Mill 3	P4	329200	362134	27	79.85	1.7	5.5	0.193
Cement Mill 4 - Mill	P5	329228	362138	16.7	69.85	0.71	7.9	0.025

Cement Mill 4 - DCE	P6	329228	362138	21.5	69.85	1.27	10.6	0.214
Clinker Store BF41	P7	329241	362145	15	100	0.71	15	0.029
Raw Meal Blending	P8	329015	362138	26	24.85	0.5	12.6	0.023
Raw Meal Stoarge	P9	329086	362146	34	24.85	0.5	12.5	0.022
SILOS 1 - 4	P11	329203	362274	24	49.85	0.47	14.7	0.022
SILO 5	P12	329203	362274	27	49.85	0.47	1.8	0.003
SILO 6 - Bottom	P13	329167	362319	8	49.85	0.46	6.8	0.010
Packing Bay -	P14	329162	362308	27	49.85	0.51	8	0.014
Packing Bay -	P15	329162	362308	27	49.85	0.8	2.4	0.010
Silo 9 Bottom	P26	329240	362247	7	49.85	0.21	10.1	0.003
Silo 13	P28	329216	362262	31	49.85	0.25	11.1	0.005
Silo 14	P29	329216	362262	31	49.85	0.25	11.1	0.005
Silo 15	P30	329216	362262	31	49.85	0.25	11.1	0.005
Bottom of Silos 2, 3, 5	P32	329203	362274	6	49.85	0.34	14.4	0.011
Cement Mill 3 dedusting	P33	329200	362134	20	49.85	0.36	12.6	0.011
Limestone Receiving 1	P34	329194	362306	4	24.85	0.46	15.2	0.023
Limestone Receiving 2	P35	329194	362307	10	24.85	0.46	15.2	0.023
Limestone Receiving 3	P36	329194	362308	27	24.85	0.46	15.2	0.023
Pressure Relief Coal	P38	329060	362070	30	24.85	0.56	2	0.005
Dedusting Coal/Shale	P39	329015	362120	15	24.85	0.75	2	0.008
Arodo Packer filter	P40	329155	362305	15	24.85	0.6	15.7	0.041
Silo 6 top	P41	329166	362334	34	49.85	0.3	4.2	0.003
rail silo 1 dedusting Filter	P42	329200	362251	34	49.85	0.3	4.2	0.003
rail silo 2 dedusting Filter	P43	329209	362248	34	49.85	0.3	4.2	0.003
rail silo 3 dedusting Filter	P44	329218	362244	34	49.85	0.3	4.2	0.003
rail silo loading head	P45	329210	362250	5	49.85	0.35	16.6	0.014
clinker transport at mill 4	P46	329231	362200	5	49.85	0.3	4.2	0.003
clinker transport at mill 5	P47	329248	362283	25	49.85	0.3	4.2	0.003
Mill 5 Stack New	P48	329206	362293	47	94.35	2.35	8.3	0.140

Given that many of these sources will not be releasing particulate matter to atmosphere simultaneously it is considered unrealistic to model all the sources together at their peak release rates (which has been undertaken). Thus, the modelled ground level concentrations will be over-estimates of the true values.

Proposed Combustion Emission Sources

One PCCC plant is proposed to be installed at the facility, which will have its own dedicated stack. This will then replace the existing kiln stack (emission point A8). The existing kiln stack will only be used for the during PCCC start ups or if the PCCC is shutdown and clinker production continues. It is anticipated that it will operate for 484 hrs/yr (based on 94.5% availability of the PCCC relative to the kiln) and, as such, emissions from its operation have been include within the proposed scenario (using the modelled emission parameters from Table 7.1).

It is expected that the proposed PCCC plant will operate 8276 hrs/yr in four different modes of varying operational hours and exhaust gas oxygen content. Modes 1, 2 and 3 are assumed to be the normal operating scenario, while Mode 4 is an abnormal operating scenario. Table 7.3 details the physical and emission characteristics of the PCCC, which are based on data provided by the client. Again, details of the source locations are presented in Figure A1.

Table 7.3: Physical and Emission Characteristics of Proposed PCCC Plant Included in the Assessment

	Mode 1	Mode 2	Mode 3	Mode 4
Operating hours	5379	2069	745	83
Stack height above PCCC datum level (m)	117.9			
Stack diameter (m)	3.1			
Temperature (°C)	100	100	100	100
Oxygen Content (vol%-dry)	8.35	7.89	7.11	6.51
Moisture Content (vol%)	8.96	8.92	9.04	9.11
Volumetric Flow Rate (m^3/s) – Actual	126.84	117.60	112.94	103.56
Volumetric Flow Rate (m^3/s) – Ref	97.31	93.57	95.12	90.95
Actual stack exit velocity (m/s)	16.80	15.58	14.96	13.72
NO_x exhaust emissions rate (mg/Nm^3)	200			
SO_2 exhaust emissions rate (mg/Nm^3)	50			
CO exhaust emissions rate (mg/Nm^3)	400			
PM_{10} exhaust emissions rate (mg/Nm^3)	10			

HCL exhaust emissions rate (mg/Nm^3)	10			
NH_3 exhaust emissions rate (mg/Nm^3)	30			
HF exhaust emissions rate (mg/Nm^3)	1			
Cd and Tl exhaust emissions rate (mg/Nm^3)	0.05			
Hg exhaust emissions rate (mg/Nm^3)	0.05			
Group 3 Metal* exhaust emissions rate (mg/Nm^3)	0.5			
TOC exhaust emissions rate (mg/Nm^3)	30			
Dioxin and Furan exhaust emissions rate (ng/Nm^3)	0.1			
NO_x exhaust emissions rate (g/s)	19.46	18.71	19.02	18.19
SO_2 exhaust emissions rate (g/s)	4.87	4.68	4.76	4.55
CO exhaust emissions rate (g/s)	38.92	37.43	38.05	36.38
PM_{10} exhaust emissions rate (g/s)	0.97	0.94	0.95	0.91
HCL exhaust emissions rate (g/s)	0.97	0.94	0.95	0.91
NH_3 exhaust emissions rate (g/s)	2.92	2.81	2.85	2.73
HF exhaust emissions rate (g/s)	0.10	0.09	0.10	0.09
Cd and Tl exhaust emissions rate (g/s)	0.005	0.005	0.005	0.005
Hg exhaust emissions rate (g/s)	0.005	0.005	0.005	0.005
Group 3 Metal* exhaust emissions rate (g/s)	0.049	0.047	0.048	0.045
TOC exhaust emissions rate (g/s)	2.92	2.81	2.85	2.73
Dioxin and Furan exhaust emissions rate (µg/s)	0.0097	0.0094	0.0095	0.0091
Stack location	X: 328915 Y: 362079			
Emission Concentration Release Conditions (REF): 273K, 101.3kPa, dry gas, 10% oxygen *Includes As,Sb,Co,Cr,Cu,Mn,Ni,Pb,V				

It is noted that the total emission limit value of group 3 metal is 0.5 mg/Nm^3; however, based on the information provided by the client, the emission rate of each metal is assumed to correspond to the percentage of 0.5 mg/Nm^3, as described in Table 7.4.

Table 7.4: Percentage of Group 3 metal assessed

Metal	Percentage
Antimony	1.6%
Arsenic	0.9%
Lead	10.2%
Chromium	10.4%
Cobalt	1.1%
Copper	41.6%
Manganese	23.8%
Nickel	9.1%
Vanadium	1.3%

7.1.4 Buildings

In order to capture the potential influence of buildings/structures on the dispersion profile of emissions (e.g. building 'wake' and downwash effects), buildings and structures that are part of the site were included in the dispersion model. Heights for proposed on-site buildings were taken from elevation plans provided by the client. The locations and heights of these buildings/structures are listed in Table 7.5. The dimensions used for the new capture plant equipment is the maximum size expected it includes platforms and staircases round the structures as well.

Table 7.5 : Building Details included in the Air Quality Assessment

ID	Shape	Grid Ref (X, Y)	Height (m)	Length (m) / Diameter (m)	Width (m)	Angle (Degrees)
Pre-heat Tower	Rectangular	329,064,362,063	96	25	20	287
Clinker Store	Circular	329,332,362,146	40	76	76	0
Crane store	Rectangular	329,180,362,228	29	234	31	109
Clinker Transport	Rectangular	329,256,362,166	45	16	15	106
CO_2 Compressor	Rectangular	328,783,362,085	20	40	25	112
Gas Wash Tower	Rectangular	328,862,362,125	50	12	12	113
Absorber	Rectangular	328,857,362,106	60	12	12	108
Quencher	Rectangular	328,890,362,094	65	7.7	7.7	113
Regenerator	Circular	328,913,362,097	70	10	10	0
Flue Gas Stack	Circular	328,914,362,078	117	4	4	0

7.1.5 Meteorological Data

Hourly sequential meteorological data measured between 2018 and 2022 at the Hawarden weather station has been employed in the assessment. This meteorological station is located approximately 6.4 km northeast of the proposed development site and is considered to be the most representative of site conditions. The windroses for the of the meteorological years are presented in Appendix B.

There is meteorological data monitoring undertaken by the Applicant in the nearby village of Penyffordd. However, the data is not of sufficient length to be used within this modelling assessment.

7.1.6 Surface Roughness Length

A surface roughness length of 0.3 m was used in the dispersion modelling study for the dispersion site. This value is considered appropriate for the morphology of the assessment area and is suggested within ADMS 6 as being suitable for 'agricultural areas (max)'. A roughness length of 0.3 m was also considered appropriate for the morphology of the meteorological station.

7.1.7 Monin-Obukhov Length

The Monin-Obukhov length provides a measure of the stability of the atmosphere. A minimum Monin-Obukhov length of 10 m was used in the dispersion modelling for the study area and the meteorological station.

7.1.8 Terrain

50 m Ordnance Survey Panoramic digital terrain data was included in the assessment to account for topographical features (slopes that are greater than 1:10) of the land covering the model domain. Examination of digital terrain data for the study area does suggest significant gradients greater than 1:10 are not present; however, for completeness and to account for some significant gradients in the wider modelling domain, terrain has been included.

7.1.9 Discrete Receptors and Modelled Domain

7.1.9.1 Human Receptors

Following a review of the local area, representative worst case location sensitive human receptors have been selected and considered in the assessment. Furthermore, for the purpose of considering potential impacts at a greater number of locations, concentrations across a cartesian grid (spaced at 50 m) covering a domain of 6 x 6 km have also been included.

Details of all discrete human receptors included in the modelling study are summarised in Table 7.6. Each discrete human receptor was assumed to be 1.5 m above ground level (i.e. close to 'breathing height').

Table 7.6: Human Receptors Included in the Dispersion Modelling Assessment

Receptor ID	Receptor Location	Grid Reference	
		X	Y
R1	Padeswood Drive, Padeswood	329175	362639
R2	Chester Road, Padeswood	329286	362723
R3	Chester Road, Padeswood	328582	362534
R4	Chester Road, Padeswood	328363	362409

Receptor ID	Receptor Location	Grid Reference	
		X	Y
R5	Bannel Lane, Padeswood	329774	362672
R6	Chester Road, Padeswood	329918	362857
R7	Springfield, Penymynydd	329624	362422
R8	Hawarden Road, Penymynydd	330328	362451
R9	Aspen Way, Penymynydd	329844	361727
R10	Ffordd Derwyn, Penymynydd	329719	361423
R11	A5104, Penymynydd	329234	361109
R12	Leeswood, Mold	328521	361811
R13	Hawthorn Way, Penymynydd	330227	362197

7.1.9.2 Ecological Receptors

As per NRWs air quality risk assessment guidance, total annual mean NO_x concentrations should be calculated at discrete receptor locations within any SACs, SPAs and Ramsar sites within 15 km of the proposed development site, at any sites of special scientific interest (SSSIs) within 10km of the proposed development site and local nature sites (ancient woods, local wildlife sites and national and local nature reserves) within 2 km of the proposed development site, if the proposed facility will have a capacity of more than 50 MW_{th}.

RSK referred to the Multi-Agency Geographic Information for the Countryside (MAGIC) Maps website and Cofnod Record Centre to determine the presence of these sites within the identified distances from the site. These receptors included the closest locations within a range of wind directions and, therefore, has considered the worst-case locations within the designated ecological sites. Details of all discrete receptors included in the modelling study are summarised in Table 7.7 and shown in Figure A2 in Appendix A. All ecological receptors were modelled at ground level (i.e. 0 m) to allow for a conservative assessment.

Furthermore, for the purpose of considering potential impacts at a greater number of locations, a receptor grid with a spacing of 50 m covering approximately a domain of 10 x 10 km has also been included to cover areas where designated sites are present. All grid receptors were modelled at ground level (i.e. 0 m) to allow for a conservative assessment.

Table 7.7: Discrete Ecological Receptors (as worst-case locations) Included in the Dispersion Modelling Assessment

Receptor ID	Receptor	Distance to the Development Site (km)	Grid Reference	
			X	Y
E1	Buckley Claypits and Commons SSSI/ Deeside and Buckley Newt Sites SAC	1.7	329355	363689

Receptor ID	Receptor	Distance to the Development Site (km)	Grid Reference	
			X	Y
E2	Buckley Claypits and Commons SSSI/ Deeside and Buckley Newt Sites SAC	2.7	328520	364732
E3	Buckley Claypits and Commons SSSI/ Deeside and Buckley Newt Sites SAC	2.9	327689	364630
E4	Maes Y Grug SSSI/ Deeside and Buckley Newt Sites SAC	4.9	326204	366025
E5	Connah's Quay Ponds and Woodland SSSI/Deeside and Buckley Newt Sites SAC	5.1	328991	367166
E6	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	8.9	337227	365493
E7	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	7.2	333402	367839
E8	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	7.3	331620	368940
E9	Dee Estuary / Aber Afon Dyfrdwy SSSI/SAC	7.5	330273	369491
E10	Shotton Lagoons and Reedbeds SSSI	8.7	329592	370722
E11	Mynydd Y Fflint / Flint Mountain SSSI	9.8	323935	370432
E12	Coed Talon Marsh SSSI	4.0	327057	358648
E13	Chwarel Cambrian / Cambrian Quarry, Gwernymynydd SSSI	7.4	321679	362291
E14	Alyn Valley Woods and Alyn Gorge Caves SSSI/SAC	8.3	320814	362412
E15	Bryn Alyn SSSI	9.1	320763	358447
E16	Glaswelltiroedd Eryrys (Eryrys Grasslands) SSSI	9.3	320678	357963
E17	Llay Bog SSSI	7.2	332083	355487
E18	Chwarel Singret SSSI	7.9	334458	356229
E19	Marford Quarry SSSI	8.8	335677	356267
E20	Halkyn Mountain / Mynydd Helygain SAC	9.7	321418	368112
E21	Berwyn a Mynyddoedd De Clwyd / Berwyn and South Clwyd Mountains SAC	9.3	322825	355170
E22	Berwyn a Mynyddoedd De Clwyd / Berwyn and	10.3	325694	352356

Receptor ID	Receptor	Distance to the Development Site (km)	Grid Reference	
			X	Y
	South Clwyd Mountains SAC			
E23	Vicarage Moss SSSI/Ramsar	10.3	335819	354279
E24	Price's Hill Wood Ancient Woodland/ Flintshire Wildlife Site	1.6	330499	362853
E25	Bistre Wood Ancient Woodland/ Flintshire Wildlife Site	1.1	328147	362698
E26	Black Pool Plantation Flintshire Wildlife Site	0.5	328690	361716
E27	Hartsheath Flintshire Wildlife Site	1.1	328483	361121
E28	Pontblyddyn Marsh and Coppa Wood Flintshire Wildlife Site	1.7	327579	361251
E29	Padeswood Pool Flintshire Wildlife Site	1.3	327786	362181
E30	Padeswood Pasture Flintshire Wildlife Site	1.1	327941	362129
E31	Marleyfield Meadow Flintshire Wildlife Site	1.6	327708	362879
E32	Padeswood Marsh LWS	1.2	327937	361785
E33	Etna Road Pools LWS	2.4	328658	364426
E34	Plas Newydd Farm Lake LWS	1.4	329078	360620
E35	Riding School Wood and Grassland LWS	2.3	331330	362480
E36	Garth Wood and Hartsheath LWS	1.6	327773	363016
E37	Warred Dingle LWS	2.1	327161	361190
E38	Ancient Woodland 1	0.6	328436	361987
E39	Ancient Woodland 2	1.3	329876	361079
E40	Ancient Woodland 3	1.5	328909	360553
E41	Ancient Woodland 4	1.5	328185	360822
E42	Ancient Woodland 5	1.7	328357	360534
E43	Ancient Woodland 6	1.9	328560	360269
E44	Ancient Woodland 7	1.7	328062	360641
E45	Ancient Woodland 8	2.0	327411	363176
E46	Ancient Woodland 9	2.0	327342	363058
E47	Ancient Woodland 10	2.3	326876	362739
E48	Ancient Woodland 11	2.2	326919	361773
E49	Ancient Woodland 12	1.6	327563	361381
E50	Ancient Woodland 13	2.2	326987	361274
E51	Ancient Woodland 14	1.7	327596	361228
E52	Ancient Woodland 15	1.1	328341	361259

Receptor ID	Receptor	Distance to the Development Site (km)	Grid Reference	
			X	Y
E53	Ancient Woodland 16	1.9	327635	360884
E54	Ancient Woodland 17	2.2	327578	360448
E55	Ancient Woodland 18	2.2	327850	360214
E56	Ancient Woodland 19	2.3	331329	362469
E57	Ancient Woodland 20	2.1	331148	362584
E58	Ancient Woodland 21	1.2	327937	361785
E59	Ancient Woodland 22	2.4	328658	364426
E60	Ancient Woodland 23	1.4	329078	360620
E61	Ancient Woodland 24	2.3	331330	362480

7.2 Background Air Quality Data Used in the Modelling

7.2.1 Human Receptors

As discussed in Section 5, the nearest background monitoring location to the development site is ADDC-120, which is a kerbside monitoring location. It is considered to be suitable for nearby human receptors R8 – R10 and R13, which are judged to be near roadside locations. For other human receptors, which are considered to be away from local roads, Defra background data has been used. Table 7.8 details the background concentrations used for discrete human receptors within the assessment.

Table 7.8: 2023 Background NO and PM_{10} and 2001 Background SO_2 and CO used in the Dispersion Modelling Assessment

Receptor ID	Annual Average NO_2 ($\mu g/m^3$)	Annual Average PM_{10} ($\mu g/m^3$)	Annual Average SO_2 ($\mu g/m^3$)	Annual Average CO ($\mu g/m^3$)
R1	7.46	10.13	4.60	0.26
R2	7.46	10.13	4.60	0.26
R3	6.35	9.88	4.64	0.26
R4	6.35	9.88	4.64	0.26
R5	7.46	10.13	4.60	0.26
R6	7.46	10.13	4.60	0.26
R7	7.46	10.13	4.60	0.26
R8	13.4	10.28	4.64	0.26
R9	13.4	9.81	3.99	0.25
R10	13.4	9.81	3.99	0.25
R11	6.61	9.81	3.99	0.25
R12	6.36	9.98	3.96	0.25
R13	13.4	10.28	4.64	0.26

7.2.2 Ecological Receptors

Background NO_x, SO_2 and ammonia concentrations and background nitrogen and acid deposition fluxes for the area around the conservation sites were obtained from the APIS website.

Table 7.9 presents the estimated annual average background NO_x, SO_2 and ammonia concentrations at the discrete ecological receptors for the years 2019 – 2021 (latest available). Background concentrations were found to be comparable or exceeding the ammonia critical level at the majority of habitat sites.

Table 7.9: APIS Estimated Annual Average NO_x, SO_2 and ammonia background concentrations at Ecological Sites

Discrete Ecological Receptors	Ecological Site	2019 – 2021 Annual Average NO_x Concentration ($\mu g/m^3$)	2019 – 2021 Annual Average SO_2 Concentration ($\mu g/m^3$)	2019 – 2021 Annual Average Ammonia Concentration ($\mu g/m^3$)
E1	Buckley Claypits and Commons SSSI/ Deeside and Buckley Newt Sites SAC	10.89	1.82	2.21
E2	Buckley Claypits and Commons SSSI/ Deeside and Buckley Newt Sites SAC	10.02	1.99	2.12
E3	Buckley Claypits and Commons SSSI/ Deeside and Buckley Newt Sites SAC	11.06	1.96	1.56

Discrete Ecological Receptors	Ecological Site	2019 – 2021 Annual Average NO_x Concentration ($\mu g/m^3$)	2019 – 2021 Annual Average SO_2 Concentration ($\mu g/m^3$)	2019 – 2021 Annual Average Ammonia Concentration ($\mu g/m^3$)
E4	Maes Y Grug SSSI/ Deeside and Buckley Newt Sites SAC	8.11	1.64	2.06
E5	Connah's Quay Ponds and Woodland SSSI/Deeside and Buckley Newt Sites SAC	9.87	1.64	2.06
E6	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	11.22	1.90	2.93
E7	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	16.26	3.54	2.50
E8	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	13.61	2.44	2.32
E9	Dee Estuary / Aber Afon Dyfrdwy SSSI/SAC	11.21	2.87	2.12
E10	Shotton Lagoons and Reedbeds SSSI	14.65	4.83	2.06
E11	Mynydd Y Fflint / Flint Mountain SSSI	8.27	1.25	1.76
E12	Coed Talon Marsh SSSI	6.15	1.11	1.73
E13	Chwarel Cambrian / Cambrian Quarry, Gwernymynydd SSSI	6.12	1.22	1.59
E14	Alyn Valley Woods and Alyn Gorge Caves SSSI/SAC	5.73	1.09	1.49
E15	Bryn Alyn SSSI	4.93	0.89	1.35
E16	Glaswelltiroedd Eryrys (Eryrys Grasslands) SSSI	4.95	0.96	1.34
E17	Llay Bog SSSI	8.06	1.60	2.42
E18	Chwarel Singret SSSI	8.23	1.40	3.04
E19	Marford Quarry SSSI	10.78	1.32	3.17

Discrete Ecological Receptors	Ecological Site	2019 – 2021 Annual Average NO_x Concentration ($\mu g/m^3$)	2019 – 2021 Annual Average SO_2 Concentration ($\mu g/m^3$)	2019 – 2021 Annual Average Ammonia Concentration ($\mu g/m^3$)
E20	Halkyn Mountain / Mynydd Helygain SAC	6.57	1.31	1.67
E21	Berwyn a Mynyddoedd De Clwyd / Berwyn and South Clwyd Mountains SAC	4.94	0.86	1.23
E22	Berwyn a Mynyddoedd De Clwyd / Berwyn and South Clwyd Mountains SAC	5.30	0.94	1.17
E23	Vicarage Moss SSSI/Ramsar	8.35	1.81	2.37
E24	Price's Hill Wood Ancient Woodland/ Flintshire Wildlife Site	10.02	1.66	2.31
E25	Bistre Wood Ancient Woodland/ Flintshire Wildlife Site	8.69	1.39	2.05
E26	Black Pool Plantation Flintshire Wildlife Site	7.62	1.28	2.00
E27	Hartsheath Flintshire Wildlife Site	7.62	1.28	2.00
E28	Pontblyddyn Marsh and Coppa Wood Flintshire Wildlife Site	7.45	1.28	1.93
E29	Padeswood Pool Flintshire Wildlife Site	7.79	1.38	1.99
E30	Padeswood Pasture Flintshire Wildlife Site	7.79	1.38	1.99
E31	Marleyfield Meadow Flintshire Wildlife Site	7.79	1.38	1.99
E32	Padeswood Marsh LWS	7.04	1.41	1.66
E33	Etna Road Pools LWS	9.74	2.24	1.84
E34	Plas Newydd Farm Lake LWS	7.00	1.38	1.72

Discrete Ecological Receptors	Ecological Site	2019 – 2021 Annual Average NO_x Concentration ($\mu g/m^3$)	2019 – 2021 Annual Average SO_2 Concentration ($\mu g/m^3$)	2019 – 2021 Annual Average Ammonia Concentration ($\mu g/m^3$)
E35	Riding School Wood and Grassland LWS	8.93	1.64	2.03
E36	Garth Wood and Hartsheath LWS	9.26	2.45	1.76
E37	Warred Dingle LWS	7.04	1.41	1.66
E38	Ancient Woodland 1	7.40	1.42	1.72
E39	Ancient Woodland 2	8.24	1.55	1.77
E40	Ancient Woodland 3	6.70	1.36	1.66
E41	Ancient Woodland 4	6.70	1.36	1.66
E42	Ancient Woodland 5	6.70	1.36	1.66
E43	Ancient Woodland 6	6.70	1.36	1.66
E44	Ancient Woodland 7	6.70	1.36	1.66
E45	Ancient Woodland 8	9.26	2.45	1.76
E46	Ancient Woodland 9	9.26	2.45	1.76
E47	Ancient Woodland 10	7.19	1.52	1.67
E48	Ancient Woodland 11	6.81	1.37	1.61
E49	Ancient Woodland 12	7.04	1.41	1.66
E50	Ancient Woodland 13	6.81	1.37	1.61
E51	Ancient Woodland 14	7.04	1.41	1.66
E52	Ancient Woodland 15	7.40	1.42	1.72
E53	Ancient Woodland 16	6.82	1.44	1.60
E54	Ancient Woodland 17	6.82	1.44	1.60
E55	Ancient Woodland 18	6.82	1.44	1.60
E56	Ancient Woodland 19	8.93	1.64	2.03
E57	Ancient Woodland 20	8.93	1.64	2.03
E58	Ancient Woodland 21	10.12	1.86	1.88
E59	Ancient Woodland 22	10.12	1.86	1.88

Discrete Ecological Receptors	Ecological Site	2019 – 2021 Annual Average NO_x Concentration ($\mu g/m^3$)	2019 – 2021 Annual Average SO_2 Concentration ($\mu g/m^3$)	2019 – 2021 Annual Average Ammonia Concentration ($\mu g/m^3$)
E60	Ancient Woodland 23	10.12	1.86	1.88
E61	Ancient Woodland 24	10.12	1.86	1.88
Air Quality Objective / Critical Level*		**30**	**10 for all receptor except E10, E13 and E17-E19** **20 for E10, E13 and E17-E19**	**1 for all receptor except E10, E13 and E17-E19** **3 for E10, E13 and E17-E19**
*Air quality objective designated for the protection of vegetation and ecosystems.				

The background nitrogen and acid deposition rates obtained from APIS, and used in this assessment, are presented in Table 7.10. The background deposition values have been based on the designated features of the SSSIs or the broad habitat types of the local sites that are most sensitive to nitrogen and acid deposition.

The nitrogen deposition and acid deposition background fluxes were compared to the applicable nitrogen critical loads. The relevant ammonia critical level and critical loads for nitrogen deposition and acidification, taken from APIS, at the identified ecological receptors are presented in Table 7.11.

Table 7.10: Background Nitrogen Deposition Rates and Acid Deposition Rates used in the Assessment

Receptor ID	Ecological Site	Designated Feature/ Broad Habitat Type	Habitat Applied in the Assessment	Existing Background Nitrogen Deposition Rate (kgN/ha/yr)	Existing Background N Acid Deposition Rate (keq/ha/yr)	Existing Background S Acid Deposition Rate (keq/ha/yr)
E1	Buckley Claypits and Commons SSSI/ Deeside and Buckley Newt Sites SAC	Acidophilous Quercus forest	Unmanaged Broadleafed/ Coniferous Woodland	**34.25**	2.47	0.21
E2	Buckley Claypits and Commons SSSI/ Deeside and Buckley Newt Sites SAC	Acidophilous Quercus forest	Unmanaged Broadleafed/ Coniferous Woodland	**33.42**	2.39	0.22

Receptor ID	Ecological Site	Designated Feature/ Broad Habitat Type	Habitat Applied in the Assessment	Existing Background Nitrogen Deposition Rate (kgN/ha/yr)	Existing Background N Acid Deposition Rate (keq/ha/yr)	Existing Background S Acid Deposition Rate (keq/ha/yr)
E3	Buckley Claypits and Commons SSSI/ Deeside and Buckley Newt Sites SAC	Acidophilous Quercus forest	Unmanaged Broadleafed/ Coniferous Woodland	**32.58**	2.33	0.22
E4	Maes Y Grug SSSI/ Deeside and Buckley Newt Sites SAC	Acidophilous Quercus forest	Unmanaged Broadleafed/ Coniferous Woodland	**32.46**	2.32	0.25
E5	Connah's Quay Ponds and Woodland SSSI/Deeside and Buckley Newt Sites SAC	Acidophilous Quercus forest	Unmanaged Broadleafed/ Coniferous Woodland	**32.46**	2.32	0.25
E6	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	Acidophilous Quercus forest	Unmanaged Broadleafed/ Coniferous Woodland	**40.08**	2.86	0.22
E7	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	Acidophilous Quercus forest	Unmanaged Broadleafed/ Coniferous Woodland	**35.58**	2.54	0.24
E8	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	Acidophilous Quercus forest	Unmanaged Broadleafed/ Coniferous Woodland	**34.92**	2.41	0.25
E9	Dee Estuary / Aber Afon Dyfrdwy SSSI/SAC	Coastal dune grasslands (grey dunes) - acid type European dry heaths	Coastal dune grasslands (grey dunes) - acid type Dwarf shrub heath	**19.48**	2.41	0.25
E10	Shotton Lagoons and Reedbeds SSSI	Coastal dune grasslands (grey dunes) - acid type European dry heaths	Coastal dune grasslands (grey dunes) - acid type Dwarf shrub heath	**19.04**	1.36	0.26
E11	Mynydd Y Fflint / Flint Mountain SSSI	Other: Other Tall Herb And Fern	Other: Other Tall Herb And Fern	**18.31**	1.31	0.17
E12	Coed Talon Marsh SSSI	Salix cinerea-Galium palustre woodland	Moist and wet dune slacks	**32.20**	1.49	0.18

Receptor ID	Ecological Site	Designated Feature/ Broad Habitat Type	Habitat Applied in the Assessment	Existing Background Nitrogen Deposition Rate (kgN/ha/yr)	Existing Background N Acid Deposition Rate (keq/ha/yr)	Existing Background S Acid Deposition Rate (keq/ha/yr)
E13	Chwarel Cambrian / Cambrian Quarry, Gwernymynydd SSSI	Rhinolophus hipposideros	Broadleaved and mixed woodlands	**30.20**	2.16	0.21
E14	Alyn Valley Woods and Alyn Gorge Caves SSSI/SAC	Avenula pubescens grassland: Dactylis glomerata-Briza media subcommunity	Semi-dry Perennial calcareous grassland (basic meadow steppe)	**17.51**	2.11	0.2
E15	Bryn Alyn SSSI	Festuca ovina-Agrostis capillaris-Thymus praecox grassland: Trifolium repens-Luzula campestris subcommunity	Semi-dry Perennial calcareous grassland (basic meadow steppe).	**16.66**	2.12	0.2
E16	Glaswelltiroedd Eryrys (Eryrys Grasslands) SSSI	Low and medium altitude hay meadows	Low and medium altitude hay meadows	**16.44**	1.41	0.17
E17	Llay Bog SSSI	Broadleaved deciduous woodland	Broadleaved deciduous woodland	**36.73**	1.59	0.18
E18	Chwarel Singret SSSI	Broadleaved and mixed woodlands	Broadleaved and mixed woodlands	**39.26**	2.7	0.22
E19	Marford Quarry SSSI	Broadleaved and mixed woodlands	Broadleaved and mixed woodlands	**40.24**	2.87	0.19
E20	Halkyn Mountain / Mynydd Helygain SAC	Arctic-alpine calcareous grassland	Arctic-alpine calcareous grassland	**18.97**	1.35	0.17
E21	Berwyn a Mynyddoedd De Clwyd / Berwyn and South Clwyd Mountains SAC	Arctic-alpine calcareous grassland Blanket bogs	Arctic-alpine calcareous grassland Blanket bogs	**19.48**	1.39	0.17
E22	Berwyn a Mynyddoedd De Clwyd / Berwyn and South Clwyd Mountains SAC	Arctic-alpine calcareous grassland Blanket bogs	Arctic-alpine calcareous grassland Blanket bogs	**19.42**	1.39	0.17

Receptor ID	Ecological Site	Designated Feature/ Broad Habitat Type	Habitat Applied in the Assessment	Existing Background Nitrogen Deposition Rate (kgN/ha/yr)	Existing Background N Acid Deposition Rate (keq/ha/yr)	Existing Background S Acid Deposition Rate (keq/ha/yr)
E23	Vicarage Moss SSSI/Ramsar	Fen - topogenous mires in valleys, basins and flood plains-	Valley mires, poor fens and transition mires	**36.64**	2.62	0.21
E24	Price's Hill Wood Ancient Woodland/ Flintshire Wildlife Site	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**35.87**	2.56	0.2
E25	Bistre Wood Ancient Woodland/ Flintshire Wildlife Site	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**33.73**	2.41	0.2
E26	Black Pool Plantation Flintshire Wildlife Site	Fen	Fen	**21.09**	1.51	0.17
E27	Hartsheath Flintshire Wildlife Site	Lowland pasture and parkland	Lowland pasture and parkland	**33.63**	2.4	0.21
E28	Pontblyddyn Marsh and Coppa Wood Flintshire Wildlife Site	Pasture/ meadow and scrub Broadleaved woodland and scrub	Pasture/ meadow and scrub Broadleaved woodland and scrub	**32.55**	2.32	0.21
E29	Padeswood Pool Flintshire Wildlife Site	Wet woodland/ Fen	Wet woodland/ Fen	**20.53**	1.47	0.17
E30	Padeswood Pasture Flintshire Wildlife Site	Pasture/ meadow and scrub	Pasture/ meadow and scrub	**20.53**	1.47	0.17
E31	Marleyfield Meadow Flintshire Wildlife Site	Pasture/meadow and scrub Broadleaved woodland and scrub	Pasture/meadow and scrub	**20.53**	2.33	0.2
E32	Padeswood Marsh LWS	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**30.31**	2.16	0.21
E33	Etna Road Pools LWS	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**31.33**	2.24	0.23
E34	Plas Newydd Farm Lake LWS	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**32.07**	2.29	0.21
E35	Riding School Wood and Grassland LWS	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**34.20**	2.44	0.2

Receptor ID	Ecological Site	Designated Feature/ Broad Habitat Type	Habitat Applied in the Assessment	Existing Background Nitrogen Deposition Rate (kgN/ha/yr)	Existing Background N Acid Deposition Rate (keq/ha/yr)	Existing Background S Acid Deposition Rate (keq/ha/yr)
E36	Garth Wood and Hartsheath LWS	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**30.54**	2.18	0.22
E37	Warred Dingle LWS	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**30.31**	2.16	0.21
E38	Ancient Woodland 1	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**31.26**	2.23	0.21
E39	Ancient Woodland 2	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**32.21**	2.3	0.21
E40	Ancient Woodland 3	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**31.10**	2.22	0.21
E41	Ancient Woodland 4	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**31.10**	2.22	0.21
E42	Ancient Woodland 5	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**31.10**	2.22	0.21
E43	Ancient Woodland 6	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**31.10**	2.22	0.21
E44	Ancient Woodland 7	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**31.10**	2.22	0.21
E45	Ancient Woodland 8	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**30.54**	2.18	0.22
E46	Ancient Woodland 9	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**30.54**	2.18	0.22
E47	Ancient Woodland 10	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**30.07**	2.15	0.2
E48	Ancient Woodland 11	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**29.92**	2.14	0.21
E49	Ancient Woodland 12	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**30.31**	2.16	0.21
E50	Ancient Woodland 13	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**29.92**	2.14	0.21
E51	Ancient Woodland 14	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**30.31**	2.16	0.21
E52	Ancient Woodland 15	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**31.26**	2.23	0.21

Receptor ID	Ecological Site	Designated Feature/ Broad Habitat Type	Habitat Applied in the Assessment	Existing Background Nitrogen Deposition Rate (kgN/ha/yr)	Existing Background N Acid Deposition Rate (keq/ha/yr)	Existing Background S Acid Deposition Rate (keq/ha/yr)
E53	Ancient Woodland 16	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**30.13**	2.15	0.21
E54	Ancient Woodland 17	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**30.13**	2.15	0.21
E55	Ancient Woodland 18	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**30.13**	2.15	0.21
E56	Ancient Woodland 19	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**34.20**	2.44	0.2
E57	Ancient Woodland 20	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**34.20**	2.44	0.2
E58	Ancient Woodland 21	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**33.27**	2.38	0.2
E59	Ancient Woodland 22	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**33.27**	2.38	0.2
E60	Ancient Woodland 23	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**33.27**	2.38	0.2
E61	Ancient Woodland 24	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**33.27**	2.38	0.2
Bold text indicates an exceedance of the lower critical load range for this habitat						

Table 7.11: Critical Loads for Ammonia, Nitrogen and Acid Deposition

Receptor ID	Designated Feature/ Broad Habitat Type	Ammonia Critical Level (µg/m^3)	Nutrient Nitrogen Critical Load* (kgN/ha/yr	CLMaxS (keqN/ha/yr)	CLMinN (keqN/ha/yr)	CLMaxN (keqS/ha/yr)
E1	Buckley Claypits and Commons SSSI/ Deeside and Buckley Newt Sites SAC	1	10-15	2.642	0.357	2.999
E2	Buckley Claypits and Commons SSSI/ Deeside and Buckley Newt Sites SAC	1	10-15	2.642	0.357	2.999

Receptor ID	Designated Feature/ Broad Habitat Type	Ammonia Critical Level (µg/m^3)	Nutrient Nitrogen Critical Load* (kgN/ha/yr	CLMaxS (keqN/ha/yr)	CLMinN (keqN/ha/yr)	CLMaxN (keqS/ha/yr)
E3	Buckley Claypits and Commons SSSI/ Deeside and Buckley Newt Sites SAC	1	10-15	2.642	0.357	2.999
E4	Maes Y Grug SSSI/ Deeside and Buckley Newt Sites SAC	1	10-15	1.477	0.357	1.834
E5	Connah's Quay Ponds and Woodland SSSI/Deeside and Buckley Newt Sites SAC	1	10-15	2.642	0.357	2.999
E6	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	1	10-15	3.583	0.357	3.94
E7	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	1	10-15	3.583	0.357	3.94
E8	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	1	10-15	3.583	0.357	3.94
E9	Dee Estuary / Aber Afon Dyfrdwy SSSI/SAC	1	5-10	4.12	0.892	4.972
E10	Shotton Lagoons and Reedbeds SSSI	3	5-10	4.12	0.892	4.972
E11	Mynydd Y Fflint / Flint Mountain SSSI	1	10-15	0.349	0.142	0.634
E12	Coed Talon Marsh SSSI	1	5-15	0.349	0.142	0.634
E13	Chwarel Cambrian / Cambrian Quarry, Gwernymynydd SSSI	3	10-15	5.955	0.142	6.097
E14	Alyn Valley Woods and Alyn Gorge Caves SSSI/SAC	1	10-20	4	0.856	4.856

Receptor ID	Designated Feature/ Broad Habitat Type	Ammonia Critical Level (µg/m^3)	Nutrient Nitrogen Critical Load* (kgN/ha/yr	CLMaxS (keqN/ha/yr)	CLMinN (keqN/ha/yr)	CLMaxN (keqS/ha/yr)
E15	Bryn Alyn SSSI	1	10-20	4	0.856	4.856
E16	Glaswelltiroed d Eryrys (Eryrys Grasslands) SSSI	1	10-20	4	0.856	4.856
E17	Llay Bog SSSI	3	10-15	1.696	0.357	1.918
E18	Chwarel Singret SSSI	3	10-15	1.696	0.357	1.918
E19	Marford Quarry SSSI	3	10-15	1.023	0.142	1.165
E20	Halkyn Mountain / Mynydd Helygain SAC	1	5-10	4	1.071	5.071
E21	Berwyn a Mynyddoedd De Clwyd / Berwyn and South Clwyd Mountains SAC	1	5-10	1.046	0.321	1.367
E22	Berwyn a Mynyddoedd De Clwyd / Berwyn and South Clwyd Mountains SAC	1	5-10	1.046	0.321	1.367
E23	Vicarage Moss SSSI/Ramsar	1	5-15	0.198	0.321	0.519
E24	Price's Hill Wood Ancient Woodland/ Flintshire Wildlife Site	1	10-15	2.643	0.357	3
E25	Bistre Wood Ancient Woodland/ Flintshire Wildlife Site	1	10-15	2.632	0.357	2.989
E26	Black Pool Plantation Flintshire Wildlife Site	1	5-15	Not Sensitive to acidity		
E27	Hartsheath Flintshire Wildlife Site	1	20-30	2.632	0.357	2.989
E28	Pontblyddyn Marsh and Coppa Wood Flintshire Wildlife Site	1	10-15	1.643	0.142	1.785

Receptor ID	Designated Feature/ Broad Habitat Type	Ammonia Critical Level (µg/m^3)	Nutrient Nitrogen Critical Load* (kgN/ha/yr	CLMaxS (keqN/ha/yr)	CLMinN (keqN/ha/yr)	CLMaxN (keqS/ha/yr)
E29	Padeswood Pool Flintshire Wildlife Site	1	10-15	2.637	0.357	2.994
E30	Padeswood Pasture Flintshire Wildlife Site	1	20-30	2.637	0.357	2.994
E31	Marleyfield Meadow Flintshire Wildlife Site	1	10-15	2.637	0.357	2.994
E32	Padeswood Marsh LWS	1	10-15	1.643	0.142	1.785
E33	Etna Road Pools LWS	1	10-15	2.638	0.357	2.995
E34	Plas Newydd Farm Lake LWS	1	10-15	1.504	0.357	1.861
E35	Riding School Wood and Grassland LWS	1	10-15	2.64	0.357	2.997
E36	Garth Wood and Hartsheath LWS	1	10-15	2.637	0.357	2.994
E37	Warred Dingle LWS	1	10-15	1.643	0.412	1.785
E38	Ancient Woodland 1	1	10-15	2.632	0.357	2.989
E39	Ancient Woodland 2	1	10-15	2.618	0.357	2.975
E40	Ancient Woodland 3	1	10-15	2.635	0.357	2.992
E41	Ancient Woodland 4	1	10-15	2.635	0.357	2.992
E42	Ancient Woodland 5	1	10-15	2.635	0.357	2.992
E43	Ancient Woodland 6	1	10-15	2.635	0.357	2.992
E44	Ancient Woodland 7	1	10-15	2.635	0.357	2.992
E45	Ancient Woodland 8	1	10-15	2.637	0.357	2.994
E46	Ancient Woodland 9	1	10-15	2.637	0.357	2.994
E47	Ancient Woodland 10	1	10-15	2.642	0.357	2.999
E48	Ancient Woodland 11	1	10-15	1.649	0.142	1.791
E49	Ancient Woodland 12	1	10-15	1.643	0.142	1.785

Receptor ID	Designated Feature/ Broad Habitat Type	Ammonia Critical Level (µg/m^3)	Nutrient Nitrogen Critical Load* (kgN/ha/yr	CLMaxS (keqN/ha/yr)	CLMinN (keqN/ha/yr)	CLMaxN (keqS/ha/yr)
E50	Ancient Woodland 13	1	10-15	1.649	0.142	1.791
E51	Ancient Woodland 14	1	10-15	1.643	0.142	1.785
E52	Ancient Woodland 15	1	10-15	2.632	0.357	2.989
E53	Ancient Woodland 16	1	10-15	1.647	0.142	1.789
E54	Ancient Woodland 17	1	10-15	1.647	0.142	1.789
E55	Ancient Woodland 18	1	10-15	1.647	0.142	1.789
E56	Ancient Woodland 19	1	10-15	2.64	0.357	2.997
E57	Ancient Woodland 20	1	10-15	2.64	0.357	2.997
E58	Ancient Woodland 21	1	10-15	2.643	0.357	3
E59	Ancient Woodland 22	1	10-15	2.643	0.357	3
E60	Ancient Woodland 23	1	10-15	2.643	0.357	3
E61	Ancient Woodland 24	1	10-15	2.643	0.357	3
*Lower critical load used in assessment for conservative assessment						

7.2.3 Processing of Results

7.2.3.1 NOx to NO_2 conversion

NO_x emitted to the atmosphere as a result of combustion will consist largely of nitric oxide (NO). Once released into the atmosphere, NO is oxidised to NO_2, which is of concern with respect to health and other impacts. The proportion of NO converted to NO_2 depends on a number of factors including wind speed, distance from the source, solar irradiation and the availability of oxidants, such as ozone (O_3). The dispersion modelling exercise predicts concentrations of NO_x which subsequently require conversion to NO_2 for comparison with objectives for human health. The long and short-term predicted NO_x PCs have been converted to the respective NO_2 concentrations using 70% for long-term emissions and 35% for short term emissions based on 'worst case' conversion criteria referenced by the Environment Agency[7]. For comparison with the NO_x objectives for no conversion is necessary.

[7] Environment Agency, (n.d.). CONVERSION RATIOS FOR NO_X AND NO_2.

7.2.3.2 *Annual Mean Post Processing*

To account for the fact that some sources (such as kiln 4) will operate for less than a full year, time factors (484/8760 etc.) have been applied to the process contribution for each continuous source and summed together to provide a total PC at each receptor.

The same principle has been applied for the different operating modes of the PCCC stack, i.e., the results of each mode of operating have been time factored and summed together to estimate the total annual impacts.

7.2.3.3 *Short - Term Post Processing*

No factoring has been undertaken for comparison of the facility's impacts against the short-term objectives. With regards to the short term impacts of the multiple modes of operations, the results presented assume that the PCCC plant has been operating in mode 4, which is 1% of operating hours all year (the worst case mode in terms of predicted ground level concentrations).

7.2.3.4 *PEC Calculations*

The total pollutant concentrations (Predicted Environmental Concentrations (PECs)) are calculated from the PC as follows:

- Annual mean pollutant standards: PEC = Process Contribution (PC) + Background Concentration
- Other (short term) standards: $PEC_{short\ term} = PC_{short\ term} + (2 \times Background_{long\ term})$.

7.2.4 Nitrogen and Acid Deposition Calculations

Deposition rates were calculated using empirical methods recommended by the EA AQTAG06[8]. Dry deposition flux was calculated using the following equation:

Dry deposition flux ($\mu g/m^2/s$) = ground level concentration ($\mu g/m^3$) x deposition velocity (m/s)

Wet deposition occurs via the incorporation of the pollutant into water droplets which are then removed in rain or snow and is not considered significant over short distances compared with dry deposition and therefore for the purposes of this assessment (in accordance with AQTAG06), wet deposition has not been considered.

It is judged that the exclusion of wet deposition for HCl is unlikely to change the conclusions of this assessment. The conservative assumptions included within the modelling is likely to offset an increases in acid deposition fluxes due to wet deposition.

The applied deposition velocities for the relevant chemical species are as shown in the table below.

[8] AQTAG06 – Technical Guidance on detailed modelling approach for an appropriate assessment for emissions to air. Environment Agency, March 2014 version.

Table 7.12: Applied Deposition Velocities

Pollutant	Deposition Velocity (m s^{-1})	
	Short Vegetation	Long Vegetation/Forest
NOx	0.0015	0.003
SO_2	0.012	0.024
NH_3	0.02	0.03
HCL	0.025	0.06

For the purposes of this assessment, dry deposition rates of nitrogen and acidic equivalents at the identified ecological receptors have been calculated by applying the appropriate deposition velocities ('forest' or 'grassland) to the modelled annual mean concentrations of NOx, SO_2, ammonia and HCL.

The critical loads for nitrogen (N) are recorded in units of kgN/ha/yr. The deposition PC is converted from µg/m^2/s to units of kgN/ha/year by multiplying the dry deposition flux by the standard conversion factor of 95.9 and 260 for NOx and NH_3, respectively.

The acid critical loads are provided in units of equivalents (keq/ha/year), which is a measure of how acidifying the chemical species can be. The deposition PC is converted from µg/m^2/s to units of keq/ha/year by a standard conversion factors for N, S, NH_3 and HCl of 6.84, 9.84, 18.5 and 8.63, respectfully.

7.3 Significance Criteria

To determine whether ambient air quality impacts are significant, the total modelled long and short term PECs at the discrete receptors and across the modelled grid were compared to the relevant AQSs as listed in Section 3. However, it is common practice to use the following screening criteria to assess the significance of PCs from the site's operations:

- if the short term PC is less than 10% of the short term environmental standard, then a PC can be considered insignificant; and
- if the long term PC is less than 1% of the long term environmental standard: then a PC can be considered insignificant.

Where PCs are insignificant or the PECS are not greater than 70% of the objectives, the impacts from the facility are judged to be not significant. Where any PECs are greater than 70%, the conservativeness of the assessment and the contribution from the background will be considered when assessing significance.

Where emissions affect nature sites, EA guidance suggests that impacts (PCs) on internationally (SAC, SPA, Ramsar) or nationally (SSSI's) designated sites that are below the above criteria can be classed as insignificant, with no further assessment

needed. Impacts on locally designated sites can be considered insignificant where the PCs are less than 100% of the objective (for both long and short-term impacts).

7.4 Uncertainties and Assumptions

The following uncertainties and assumptions have been made in the air quality assessment:

- Estimated background data from the Defra LAQM website and the APIS website were used in the assessment. It is assumed that these background concentrations are likely to be applicable for the lifetime of the Proposed Development, which is considered to be a conservative assumption.
- There will be uncertainties introduced because the modelling has simplified real-world processes into a series of algorithms. For example, it has been assumed that wind conditions measured at the Hawarden weather station for 2018 to 2022 were representative of wind conditions at and around the Site. Furthermore, it has been assumed that the subsequent dispersion of emitted pollutants will conform to a Gaussian distribution in order to simplify the real-world dilution and dispersion conditions.
- There is an element of uncertainty in all measured and modelled data. All values presented in this report are considered reasonable estimates. Where estimations in emissions are made, these are overestimated and hence the impacts on local air quality reported are considered to be conservative in nature. Emissions have been assessed at the proposed emission limit values operating for the majority of the year. In reality, it is likely that actual emissions will be lower and in some cases significantly lower than the proposed ELV and over less operational hours. Also, the all sources emissions of existing cement works other than kiln are both included in the baseline and project contribution and this leads to a conservative assessment for particulate matter.
- Where information is not yet known, a conservative approach has been adopted and professional judgement has been used based on the scale of the Proposed Development and experience of working on similar schemes. Furthermore, conservative rating has been selected.
- For modelling purposes, it is assumed that all TOC will be transformed into Benzene, which is considered to be a conservative assumption.
- The depletion of ammonia has not been considered within the model and therefore, is likely to overestimate the ammonia, nutrient nitrogen and acid deposition critical loads.

8 ASSESSMENT OF IMPACTS IN OPERATIONAL PHASE

The results of the above assessment on human health receptors are presented in the section below. The discussion of results and an overall determination of significance has been presented within section 8.3 of this report.

8.1 Impacts on Human Receptors

The results section below presents the maximum PCs and magnitude of change between the existing and proposed operations. The maximum concentrations are presented for all assessed discrete receptors across any of the meteorological years modelled. The maximum PECs for the proposed operation have also been compared against the relevant air quality standard. A maximum on the grid is also presented for all results.

8.1.1 Annual Mean NO_2 Impacts

As shown in Table 8.1, predicted annual mean NO_2 PCs resulting from the operation of the proposed facility are below the 1% screening criteria, and future operation annual mean NO_2 PECs are below 70% of the AQS at all relevant discrete receptor locations. Also, it is noted that the net change in annual mean NO_2 concentrations show a reduction in annual mean NO_2 concentrations.

The highest future annual mean NO_2 PC was predicted to be 0.37 µg/m^3 at R10 (see **Table 8.1**).

Table 8.1: Predicted Annual NO_2 Concentrations at Discrete Receptors – Maximum 5-Year Results for Each Receptor

Receptor ID	Annual Mean NO_2 Background (µg/m^3)	Annual Mean NO_2 Concentration (µg/m^3)					
		PC (Existing Scenario) (µg/m^3)	PC (Proposed Scenario) (µg/m^3)	Change in PC	PC (Proposed Scenario) as % of Objective	PEC (µg/m^3)	PEC as % of Objective
R1	7.46	0.20	0.08	-0.11	0.2%	7.54	18.8%
R2	7.46	0.23	0.11	-0.13	0.3%	7.56	18.9%
R3	6.35	0.52	0.20	-0.32	0.5%	6.55	16.4%
R4	6.35	0.31	0.12	-0.18	0.3%	6.47	16.2%
R5	7.46	0.80	0.26	-0.54	0.7%	7.72	19.3%
R6	7.46	0.70	0.26	-0.43	0.7%	7.72	19.3%
R7	7.46	0.74	0.22	-0.53	0.5%	7.67	19.2%
R8	13.4	0.58	0.22	-0.36	0.5%	13.62	34.0%
R9	13.4	0.60	0.25	-0.36	0.6%	13.65	34.1%
R10	13.4	1.03	0.37	-0.66	0.9%	13.77	34.4%
R11	6.61	0.24	0.18	-0.06	0.5%	6.80	17.0%

Receptor ID	Annual Mean NO_2 Background ($\mu g/m^3$)	Annual Mean NO_2 Concentration ($\mu g/m^3$)					
		PC (Existing Scenario) ($\mu g/m^3$)	PC (Proposed Scenario) ($\mu g/m^3$)	Change in PC	PC (Proposed Scenario) as % of Objective	PEC ($\mu g/m^3$)	PEC as % of Objective
R12	6.36	0.17	0.06	-0.11	0.2%	6.42	16.0%
R13	13.4	0.47	0.18	-0.29	0.4%	13.58	33.9%
Maximum Outside Boundary	7.46	1.16	0.49	-0.68	1.2%	7.94	19.9%
AQS / EAL Objective	40 $\mu g/m^3$						

8.1.2 99.8th Hourly Mean NO_2 Concentrations

The predicted 99.8th percentile 1-hour mean NO_2 PCs for the proposed facility are all below the 10% screening criteria at all receptors, and future 1-hour mean NO_2 PECs are well below the AQS. Also, it is noted that the net change in 1-hour mean NO_2 PCs show a reduction when compared to the existing scenario.

The highest future hourly mean NO_2 PC was predicted to be 5.03 $\mu g/m^3$ at R4 (see **Table 8.2**).

Table 8.2 Predicted Hourly Mean NO_2 Concentrations at Discrete Receptors – Maximum 5-year Results for Each Receptor

Receptor ID	Annual Mean NO_2 Background ($\mu g/m^3$)	99.8th Hourly Mean NO_2 Concentration ($\mu g/m^3$)					
		PC from existing stack ($\mu g/m^3$)	PC from proposed stack ($\mu g/m^3$)	Change in PC	PC from proposed stack as % of Objective	PEC ($\mu g/m^3$)	PEC as % of Objective
R1	7.46	5.87	3.44	-2.43	1.7%	20.78	10.4%
R2	7.46	6.34	3.78	-2.56	1.9%	21.25	10.6%
R3	6.35	7.13	4.87	-2.27	2.4%	19.83	9.9%
R4	6.35	6.87	5.03	-1.83	2.5%	19.56	9.8%
R5	7.46	7.47	4.43	-3.04	2.2%	22.38	11.2%
R6	7.46	6.64	4.02	-2.62	2.0%	21.55	10.8%
R7	7.46	7.82	3.98	-3.84	2.0%	22.73	11.4%
R8	13.4	6.24	3.77	-2.47	1.9%	33.04	16.5%
R9	13.4	6.99	4.31	-2.68	2.2%	33.79	16.9%
R10	13.4	7.81	4.79	-3.02	2.4%	34.61	17.3%
R11	6.61	6.63	4.88	-1.75	2.4%	19.86	9.9%
R12	6.36	6.59	4.54	-2.05	2.3%	19.30	9.6%
R13	13.4	6.47	3.81	-2.66	1.9%	33.27	16.6%
Maximum Outside Boundary	7.46	8.47	6.19	-2.28	3.1%	23.38	11.7%

Receptor ID	Annual Mean NO_2 Background ($\mu g/m^3$)	99.8th Hourly Mean NO_2 Concentration ($\mu g/m^3$)					
		PC from existing stack ($\mu g/m^3$)	PC from proposed stack ($\mu g/m^3$)	Change in PC	PC from proposed stack as % of Objective	PEC ($\mu g/m^3$)	PEC as % of Objective
AQS / EAL Objective	200 $\mu g/m^3$						

8.1.3 Annual Mean PM_{10} Impacts

As shown in Table 8.3, predicted annual mean PM_{10} PCs resulting from the operation of the proposed facility are below the 1% screening criteria, and future operation annual mean PM_{10} PECs are below 70% of the AQS at all relevant discrete receptor locations. Also, it is noted that the net change in annual mean PM_{10} concentrations show a reduction in annual mean PM_{10} concentrations. The exception is at receptor 10, where there is predicted to be a 0.1% increase in concentration due to the proposed permit variation.

The highest future annual mean PM_{10} PC concentration was predicted to be 0.03 $\mu g/m^3$ at R10 (see **Table 8.3**).

8.1.4 Annual Mean $PM_{2.5}$ Impacts

Assuming that all PM_{10} are $PM_{2.5}$ (see **Table 8.3**), PC resulting from the operation of the proposed facility are below the 1% screening criteria, and future operation annual mean $PM_{2.5}$ PECs are below 70% of the AQS at all relevant discrete receptor locations. Also, it is noted that the net change in annual mean $PM_{2.5}$ concentrations show a reduction in annual mean $PM_{2.5}$ concentrations. The exception is at receptor 10, where there is predicted to be a 0.2% increase in concentration due to the proposed permit variation.

8.1.5 90.41th Daily Mean PM_{10} Concentrations

The predicted 90.41th percentile 24-hour mean PM_{10} PCs for the proposed facility are all below the 10% screening criteria at all receptors, and future 24-hour mean PM_{10} PECs are well below the AQS. Also, it is noted that the net change in 24-hour mean PCs concentrations show a reduction when compared to the existing scenario.

The highest daily mean PM_{10} concentration was predicted to be 0.11 $\mu g/m^3$ at R7 (see **Table 8.4**).

Table 8.3: Predicted Annual PM_{10} Concentrations at Discrete Receptors - Maximum 5-year Results for Each Receptor

Receptor ID	Annual Mean PM_{10} Background ($\mu g/m^3$)	Annual Mean PM10 Concentration ($\mu g/m^3$)						
		PC (Existing Scenario) ($\mu g/m^3$)[1]	PC (Proposed Scenario) ($\mu g/m^3$)$_1$	Change in PC	PC (Proposed Scenario) as % of Objective[1]	PC of existing (non PCCC stack) PM sources	PEC ($\mu g/m^3$)	PEC as % of Objective
R1	10.13	<0.01	0.01	<0.01	<0.1%	1.09	11.23	28.1%
R2	10.13	0.01	0.01	<0.01	<0.1%	0.50	10.64	26.6%
R3	9.88	0.01	0.01	<0.01	<0.1%	0.41	10.30	25.7%
R4	9.88	0.01	0.01	<0.01	<0.1%	0.17	10.05	25.1%
R5	10.13	0.02	0.02	-0.01	<0.1%	0.45	10.60	26.5%
R6	10.13	0.02	0.02	<0.01	<0.1%	0.31	10.46	26.1%
R7	10.13	0.02	0.01	-0.01	<0.1%	0.82	10.96	27.4%
R8	10.28	0.01	0.01	<0.01	<0.1%	0.30	10.60	26.5%
R9	9.81	0.01	0.02	<0.01	<0.1%	0.52	10.35	25.9%
R10	9.81	0.02	0.03	<0.01	0.1%	0.53	10.37	25.9%
R11	9.81	0.01	0.01	0.01	<0.1%	0.10	9.93	24.8%
R12	9.98	<0.01	<0.01	<0.01	<0.1%	0.13	10.12	25.3%
R13	10.28	0.01	0.01	<0.01	<0.1%	0.34	10.64	26.6%
Maximum Outside Boundary	10.13	0.03	0.03	0.01	0.1%	1.92	12.09	30.2%
AQS / EAL Objective	40 $\mu g/m^3$							

Note 1 – Main Stack only

Table 8.4: Predicted Daily Mean PM_{10} Concentrations at Discrete Receptors - Maximum 5-year Results for Each Receptor

Receptor ID	Annual Mean PM_{10} Background ($\mu g/m^3$)	Daily Mean PM_{10} Concentration ($\mu g/m^3$)					
		PC of existing PM sources ($\mu g/m^3$)[2]	PC of Proposed PM Source ($\mu g/m^3$)[2]	Change in PC	PC of Proposed Source as % of Objective [2]	PEC ($\mu g/m^3$)[1]	PEC as % of Objective
R1	10.13	0.02	0.02	0.01	0.0%	23.01	46.0%
R2	10.13	0.02	0.03	0.01	0.1%	21.62	43.2%
R3	9.88	0.04	0.06	0.02	0.1%	21.05	42.1%
R4	9.88	0.02	0.03	0.02	0.1%	20.33	40.7%
R5	10.13	0.06	0.07	0.01	0.1%	21.76	43.5%
R6	10.13	0.05	0.07	0.02	0.1%	21.25	42.5%
R7	10.13	0.07	0.06	-0.01	0.1%	23.20	46.4%
R8	10.28	0.05	0.05	0.01	0.1%	21.51	43.0%
R9	9.81	0.05	0.07	0.02	0.1%	21.25	42.5%
R10	9.81	0.09	0.11	0.01	0.2%	21.43	42.9%
R11	9.81	0.02	0.06	0.04	0.1%	20.07	40.1%
R12	9.98	0.00	0.02	0.01	0.0%	20.40	40.8%
R13	10.28	0.04	0.05	0.01	0.1%	21.75	43.5%
Maximum Outside Boundary	10.13	0.10	0.14	0.04	0.3%	25.39	50.8%
AQS / EAL Objective	50 $\mu g/m^3$						

Note 1 - Due to the existing cement processing sources being included in the model, the background + proposed (PCCC) operations do not total the PEC.

Note 2– Main Stack only

8.1.6 8-Hour Carbon Monoxide Impacts

The predicted 100th percentile 8-hour mean CO PCs for the proposed facility are all below the 10% screening criteria at all receptors. Also, it is noted that the net change in 8-hour mean PCs concentrations show a reduction when compared to the existing scenario.

The highest 8-hourly mean CO concentration was predicted to be 24.68 µg/m^3 at R2 (see **Table 8.5**).

Due to the low magnitude of the impacts and low background values (see Section 6), PECs have not been presented.

Table 8.5 Predicted 8-hour CO Concentrations at Discrete Receptors - Maximum 5-year Results for Each Receptor

Receptor ID	8-hour Mean CO Concentration (µg/m^3)			
	PC from existing stack (µg/m^3)	PC from proposed stack (µg/m^3)	Change in PC	PC from proposed stack as % of Objective
R1	41.81	10.97	-30.84	0.1%
R2	46.77	12.65	-34.12	0.1%
R3	47.70	24.68	-23.02	0.2%
R4	40.63	19.41	-21.22	0.2%
R5	48.65	18.47	-30.18	0.2%
R6	42.72	16.91	-25.81	0.2%
R7	54.50	21.46	-33.04	0.2%
R8	44.14	15.19	-28.95	0.2%
R9	45.78	19.05	-26.73	0.2%
R10	51.76	23.01	-28.75	0.2%
R11	29.46	19.88	-9.58	0.2%
R12	47.59	15.15	-32.45	0.2%
R13	42.05	14.75	-27.29	0.1%
Maximum Outside Boundary	57.92	25.63	-32.23	0.3%
AQS / EAL Objective	10,000 µg/m^3			

8.1.7 Hourly Carbon Monoxide Impacts

The predicted 100th percentile 1-hour mean CO PCs for the proposed facility are all below the 10% screening criteria at all receptors. Also, it is noted that the net change in 1-hour mean PCs concentrations show a reduction when compared to the existing scenario.

The highest hourly mean CO concentration was predicted to be 52.21 µg/m^3 at R1 (see **Table 8.6**).

Due to the low magnitude of the impacts and low background values (see Section 6), PECs have not been presented.

Table 8.6 Predicted Hourly CO Concentrations at Discrete Receptors - Maximum 5-year Results for Each Receptor

Receptor ID	Hourly Mean CO Concentration (µg/m³)			
	PC from existing stack (µg/m³)	PC from proposed stack (µg/m³)	Change in PC	PC from proposed stack as % of Objective
R1	79.87	52.21	-27.66	0.2%
R2	72.37	45.76	-26.61	0.2%
R3	72.75	51.33	-21.42	0.2%
R4	71.78	46.49	-25.28	0.2%
R5	66.03	35.12	-30.91	0.1%
R6	57.82	29.92	-27.91	0.1%
R7	66.08	40.92	-25.16	0.1%
R8	51.20	26.25	-24.95	0.1%
R9	64.43	34.36	-30.06	0.1%
R10	63.99	33.17	-30.83	0.1%
R11	62.49	34.07	-28.43	0.1%
R12	79.16	51.19	-27.97	0.2%
R13	56.13	26.99	-29.14	0.1%
Maximum Outside Boundary	108.08	82.72	-25.36	0.3%
AQS / EAL Objective	30,000 µg/m³			

8.1.8 99.18th Daily Mean SO_2 Concentrations

The predicted 99.18th percentile 24-hour mean SO_2 PCs for the proposed facility are all below the 10% screening criteria at all receptors. Also, it is noted that the net change in 24-hour mean PCs concentrations show a reduction when compared to the existing scenario.

The highest daily mean SO_2 concentration was predicted to be 0.95 µg/m³ at R5 (see **Table 8.7**).

Due to the low magnitude of the impacts and low background values (see Section 6), PECs have not been presented.

Table 8.7 Predicted Daily Mean SO_2 Concentrations at Discrete Receptors - Maximum 5-year Results for Each Receptor

Receptor ID	Annual Mean SO_2 Background (µg/m³)	99.18th Daily Mean SO_2 Concentration (µg/m³)			
		PC from existing stack (µg/m³)	PC from proposed stack (µg/m³)	Change in PC	PC from proposed stack as % of Objective
R1	4.60	1.57	0.40	-1.17	0.3%
R2	4.60	1.77	0.49	-1.28	0.4%

Receptor ID	Annual Mean SO_2 Background ($\mu g/m^3$)	99.18th Daily Mean SO_2 Concentration ($\mu g/m^3$)			
		PC from existing stack ($\mu g/m^3$)	PC from proposed stack ($\mu g/m^3$)	Change in PC	PC from proposed stack as % of Objective
R3	4.64	2.72	0.70	-2.02	0.6%
R4	4.64	2.75	0.80	-1.94	0.6%
R5	4.60	3.97	0.95	-3.02	0.8%
R6	4.60	3.73	0.87	-2.86	0.7%
R7	4.60	3.77	0.73	-3.04	0.6%
R8	4.64	2.87	0.77	-2.10	0.6%
R9	3.99	3.44	0.89	-2.55	0.7%
R10	3.99	3.88	0.93	-2.95	0.7%
R11	3.99	1.39	0.77	-0.62	0.6%
R12	3.96	2.20	0.49	-1.71	0.4%
R13	4.64	3.11	0.72	-2.39	0.6%
Maximum Outside Boundary	4.60	4.74	1.27	-3.46	1.0%
AQS / EAL Objective	125 $\mu g/m^3$				

8.1.9 99.73th Hourly Mean SO_2 Concentrations

The predicted 99.73th percentile 1-hour mean SO_2 PCs for the proposed facility are all below the 10% screening criteria at all receptors. Also, it is noted that the net change in 1-hour mean PCs concentrations show a reduction when compared to the existing scenario.

The highest hourly mean SO_2 concentration was predicted to be 3.28 $\mu g/m^3$ at R11 (see **Table 8.8**).

Due to the low magnitude of the impacts and low background values (see Section 6), PECs have not been presented.

Table 8.8 Predicted Hourly Mean SO_2 Concentrations at Discrete Receptors - Maximum 5-year Results for Each Receptor

Receptor ID	Annual Mean SO_2 Background ($\mu g/m^3$)	99.73th Hourly Mean SO_2 Concentration ($\mu g/m^3$)			
		PC from existing stack ($\mu g/m^3$)	PC from proposed stack ($\mu g/m^3$)	Change in PC	PC from proposed stack as % of Objective
R1	4.60	6.99	1.79	-5.19	0.5%
R2	4.60	7.49	2.42	-5.07	0.7%
R3	4.64	8.76	3.02	-5.74	0.9%
R4	4.64	8.32	3.07	-5.25	0.9%
R5	4.60	9.43	2.99	-6.43	0.9%
R6	4.60	8.31	2.82	-5.48	0.8%

Receptor ID	Annual Mean SO_2 Background ($\mu g/m^3$)	99.73th Hourly Mean SO_2 Concentration ($\mu g/m^3$)			
		PC from existing stack ($\mu g/m^3$)	PC from proposed stack ($\mu g/m^3$)	Change in PC	PC from proposed stack as % of Objective
R7	4.60	9.83	2.60	-7.23	0.7%
R8	4.64	7.83	2.67	-5.16	0.8%
R9	3.99	8.65	2.92	-5.73	0.8%
R10	3.99	9.85	3.30	-6.54	0.9%
R11	3.99	7.91	3.28	-4.63	0.9%
R12	3.96	7.99	2.14	-5.85	0.6%
R13	4.64	7.85	2.66	-5.19	0.8%
Maximum Outside Boundary	4.60	10.48	4.08	-6.40	1.2%
AQS / EAL Objective	350 $\mu g/m^3$				

8.1.10 99.99th 15-min Mean SO_2 Concentrations

The predicted 99.99th percentile 15-minute mean SO_2 PCs for the proposed facility are all below the 10% screening criteria at all receptors. Also, it is noted that the net change in 15-minute mean PCs concentrations show a reduction when compared to the existing scenario.

The highest 15-minute mean SO_2 concentration was predicted to be 7.29 $\mu g/m^3$ at R6 (see **Table 8.9**).

Due to the low magnitude of the impacts and low background values (see Section 6), PECs have not been presented.

Table 8.9 Predicted 15-minute Mean SO_2 Concentrations at Discrete Receptors - Maximum 5-year Results for Each Receptor

Receptor ID	Annual Mean SO_2 Background ($\mu g/m^3$)	99.99th Hourly Mean SO_2 Concentration ($\mu g/m^3$)			
		PC from existing stack ($\mu g/m^3$)	PC from proposed stack ($\mu g/m^3$)	Change in PC	PC from proposed stack as % of Objective
R1	4.60	14.02	6.87	-7.15	2.6%
R2	4.60	12.63	6.09	-6.55	2.3%
R3	4.64	12.83	6.78	-6.05	2.5%
R4	4.64	12.73	6.19	-6.54	2.3%
R5	4.60	11.85	6.83	-5.03	2.6%
R6	4.60	10.44	7.29	-3.15	2.7%
R7	4.60	13.31	5.74	-7.57	2.2%
R8	4.64	13.94	6.53	-7.41	2.5%
R9	3.99	11.95	4.65	-7.30	1.7%
R10	3.99	11.36	4.68	-6.69	1.8%

Receptor ID	Annual Mean SO_2 Background (µg/m³)	99.99th Hourly Mean SO_2 Concentration (µg/m³)			
		PC from existing stack (µg/m³)	PC from proposed stack (µg/m³)	Change in PC	PC from proposed stack as % of Objective
R11	3.99	11.17	4.65	-6.52	1.7%
R12	3.96	13.84	7.26	-6.58	2.7%
R13	4.64	10.18	3.94	-6.24	1.5%
Maximum Outside Boundary	4.60	25.59	14.66	-10.93	9.6%
AQS / EAL Objective	266 µg/m³				

8.1.11 Annual Benzene Impacts

As shown in **Table 8.10**, predicted annual mean benzene PCs resulting from the operation of the proposed facility exceed 1% screening criteria at 4 receptors, and future operation annual mean benzene PECs are below 70% of the AQS at all relevant discrete receptor locations. Also, it is noted that the net change in annual mean benzene concentrations show a reduction. The exception is at receptor 11, where there is predicted to be a 0.01 µg/m³ increase in concentration due to the proposed permit variation.

The highest future annual mean PM_{10} PC concentration was predicted to be 0.08 µg/m³ at R10 (see **Table 8.10**).

Table 8.10 Predicted Annual Benzene Concentrations at Discrete Receptors - Maximum 5-year Results for Each Receptor

Receptor ID	Annual Mean Benzene Concentration (µg/m³)					
	PC (Existing Scenario) (µg/m³)	PC (Proposed Scenario) (µg/m³)	Change in PC	PC from proposed stack as % of Objective	PEC (µg/m³)	PEC as % of Objective
R1	0.02	0.02	<0.01	0.3%	0.28	5.5%
R2	0.03	0.02	<0.01	0.5%	0.28	5.7%
R3	0.05	0.04	-0.02	0.8%	0.30	6.0%
R4	0.03	0.03	-0.01	0.5%	0.29	5.7%
R5	0.09	0.06	-0.03	1.1%	0.32	6.3%
R6	0.08	0.05	-0.02	1.1%	0.31	6.3%
R7	0.08	0.04	-0.04	0.9%	0.30	6.1%
R8	0.06	0.05	-0.02	0.9%	0.31	6.1%
R9	0.05	0.05	-0.02	1.0%	0.31	6.2%
R10	0.11	0.08	-0.04	1.6%	0.34	6.8%
R11	0.03	0.04	0.01	0.8%	0.30	6.0%
R12	0.02	0.01	-0.01	0.3%	0.27	5.5%
R13	0.05	0.04	-0.02	0.7%	0.30	5.9%

Receptor ID	Annual Mean Benzene Concentration (µg/m³)					
	PC (Existing Scenario) (µg/m³)	PC (Proposed Scenario) (µg/m³)	Change in PC	PC from proposed stack as % of Objective	PEC (µg/m³)	PEC as % of Objective
Maximum Outside Boundary	0.13	0.10	-0.03	2.0%	0.36	7.2%
AQS / EAL Objective	5 µg/m³					

8.1.12 Daily Benzene Impacts

The predicted 100th percentile 24-hour mean benzene PCs for the proposed facility are all below the 10% screening criteria at all receptors. Also, it is noted that the net change in 24-hour mean PCs concentrations show a reduction when compared to the existing scenario.

The highest 24-hour mean benzene concentration was predicted to be 0.69 µg/m³ at R10 (see **Table 8.11**).

Due to the low magnitude of the impacts and low background values (see Section 6), PECs have not been presented.

Table 8.11 Predicted Daily Benzene Concentrations at Discrete Receptors - Maximum 5-year Results for Each Receptor

Receptor ID	Daily Mean Benzene Concentration (µg/m³)			
	PC from existing stack (µg/m³)	PC from proposed stack (µg/m³)	Change in PC	PC from proposed stack as % of Objective
R1	0.72	0.32	-0.40	1.1%
R2	0.73	0.37	-0.36	1.2%
R3	0.95	0.67	-0.54	2.2%
R4	0.69	0.63	-0.14	2.1%
R5	1.41	0.61	-0.79	2.0%
R6	1.11	0.64	-0.48	2.1%
R7	1.31	0.57	-0.74	1.9%
R8	0.86	0.65	-0.21	2.2%
R9	1.08	0.63	-0.45	2.1%
R10	1.05	0.69	-0.73	2.3%
R11	0.65	0.57	-0.08	1.9%
R12	0.92	0.38	-0.54	1.3%
R13	1.19	0.64	-0.55	2.1%
Maximum Outside Boundary	1.92	0.96	-0.95	3.2%
AQS / EAL Objective	30 µg/m³			

8.1.13 Annual Dioxin and Furan Impacts

As shown in **Table 8.12**, predicted annual mean dioxin and furans PCs show a small increase between the existing and proposed operations. As there is no dioxin and furans air quality standard a comparison with a standard is not possible. However, as the previous Human health Risk Assessment (for Kiln 4) concluded the "daily intake would also be approximately 1.26% of the current daily intake of an average individual", it is not judged that the below increase would significantly alter the conclusions of the previous HHRA. As such, an additional human health risk assessment to assess the impacts of dioxin and furans is not judged to be required.

Table 8.12 Predicted Annual Dioxin and Furan Concentrations at Discrete Receptors - Maximum 5-year Results for Each Receptor

Receptor ID	Annual Mean Dioxin and Furan Concentration (µg/m^3)			
	PC (Existing Scenario) (µg/m^3)	PC (Proposed Scenario) (µg/m^3)	Change in PC	PC from proposed stack as % of Objective
R1	4.36E-08	5.6E-08	1.3E-08	<0.01%
R2	5.21E-08	7.4E-08	2.2E-08	<0.01%
R3	1.15E-07	1.4E-07	2.0E-08	<0.01%
R4	6.84E-08	8.4E-08	1.6E-08	<0.01%
R5	1.78E-07	1.8E-07	-9.6E-10	<0.01%
R6	1.54E-07	1.8E-07	2.1E-08	<0.01%
R7	1.65E-07	1.4E-07	-2.2E-08	<0.01%
R8	1.28E-07	1.5E-07	1.7E-08	<0.01%
R9	1.34E-07	1.7E-07	3.2E-08	<0.01%
R10	2.30E-07	2.5E-07	2.2E-08	<0.01%
R11	5.38E-08	1.3E-07	7.4E-08	<0.01%
R12	3.87E-08	4.1E-08	2.4E-09	<0.01%
R13	1.04E-07	1.2E-07	1.5E-08	<0.01%
Maximum Outside Boundary	2.59E-07	3.3E-07	7.2E-08	<0.01%

8.1.14 Hourly Hydrogen Chloride Impacts

The predicted 100th percentile 1-hour mean hydrogen chloride PCs for the proposed facility are all below the 10% screening criteria at all receptors. All receptors are predicted to see an increase in impacts due to proposed variation.

The highest 1-hour mean hydrogen chloride concentration was predicted to be 1.31 µg/m^3 at R1 (see **Table 8.14**).

Due to the low magnitude of the impacts and low background values (see Section 6), PECs have not been presented.

Table 8.13 Predicted Hourly HCl Concentrations at Discrete Receptors - Maximum 5-year Results for Each Receptor

Receptor ID	Hourly Mean HCl Concentration (µg/m^3)			
	PC from existing stack (µg/m^3)	PC from proposed stack (µg/m^3)	Change in PC	PC from proposed stack as % of Objective
R1	0.66	1.31	0.64	0.2%
R2	0.60	1.14	0.54	0.2%
R3	0.60	1.29	0.68	0.2%
R4	0.60	1.17	0.58	0.2%
R5	0.55	1.26	0.71	0.2%
R6	0.48	1.32	0.84	0.2%
R7	0.55	1.09	0.46	0.1%
R8	0.42	1.13	0.56	0.2%
R9	0.53	0.86	0.30	0.1%
R10	0.53	0.86	0.33	0.1%
R11	0.52	0.86	0.34	0.1%
R12	0.66	1.39	0.73	0.2%
R13	0.47	0.69	0.23	0.1%
Maximum Outside Boundary	0.90	2.07	1.17	0.3%
AQS / EAL Objective	750 µg/m^3			

8.1.15 Hourly Hydrogen Fluoride Impacts

The predicted 100th percentile 1-hour mean hydrogen fluoride PCs for the proposed facility are all below the 10% screening criteria at all receptors. All receptors are predicted to see an increase in impacts due to proposed variation.

The highest 1-hour mean hydrogen fluoride concentration was predicted to be 0.13 µg/m^3 at R1 (see **Table 8.15**).

Due to the low magnitude of the impacts and low background values (see Section 6), PECs have not been presented.

Table 8.14 Predicted Hourly HF Concentrations at Discrete Receptors - Maximum 5-year Results for Each Receptor

Receptor ID	Hourly Mean HF Concentration (µg/m^3)			
	PC from existing stack (µg/m^3)	PC from proposed stack (µg/m^3)	Change in PC	PC from proposed stack as % of Objective
R1	0.07	0.13	0.06	0.1%
R2	0.06	0.11	0.05	0.1%
R3	0.06	0.13	0.07	0.1%
R4	0.06	0.12	0.06	0.1%
R5	0.06	0.09	0.03	0.1%
R6	0.05	0.07	0.03	<0.1%

Receptor ID	Hourly Mean HF Concentration (µg/m³)			
	PC from existing stack (µg/m³)	PC from proposed stack (µg/m³)	Change in PC	PC from proposed stack as % of Objective
R7	0.06	0.10	0.05	0.1%
R8	0.04	0.07	0.02	<0.1%
R9	0.05	0.09	0.03	0.1%
R10	0.05	0.08	0.03	0.1%
R11	0.05	0.09	0.03	0.1%
R12	0.07	0.13	0.06	0.1%
R13	0.05	0.07	0.02	<0.1%
Maximum Outside Boundary	0.09	0.21	0.12	0.1%
AQS / EAL Objective	160 µg/m³			

8.1.16 Metal Impacts

The maximum concentration of each metal at the assessed discrete receptors across any of the meteorological years modelled, is described in **Table 8.16** – **Table 8.27** below.

As shown below, predicted annual mean metal PCs resulting from the operation of the site are below 1% screening criteria, and short term (daily and hourly mean) metal PCs are below 10% of the EAL at all relevant discrete receptor locations.

Due to the low magnitude of the impacts and low background values (see Section 6), PECs have not been presented.

Table 8.15: Predicted Antimony Concentrations at Discrete Receptors - Maximum 5-year Results for Each Receptor

Receptor ID	Annual Mean Antimony Concentration (µg/m³)				Hourly Mean Antimony Concentration (µg/m³)			
	PC (Existing Scenario) (µg/m³)	PC (Proposed Scenario) (µg/m³)	Change in PC	PC from proposed scenario as % of Objective	PC from existing stack (µg/m³)	PC from proposed stack (µg/m³)	Change in PC	PC from proposed stack as % of Objective
R1	3.4E-06	4.4E-06	9.8E-07	<0.01%	5.2E-04	1.0E-03	5.0E-04	<0.01%
R2	4.1E-06	5.7E-06	1.7E-06	<0.01%	4.7E-04	8.9E-04	4.2E-04	<0.01%
R3	9.0E-06	1.1E-05	1.6E-06	<0.01%	4.7E-04	1.0E-03	5.3E-04	<0.01%
R4	5.3E-06	6.5E-06	1.2E-06	<0.01%	4.7E-04	9.0E-04	4.4E-04	<0.01%
R5	1.4E-05	1.4E-05	-2.2E-08	<0.01%	4.3E-04	6.8E-04	2.5E-04	<0.01%
R6	1.2E-05	1.4E-05	1.6E-06	<0.01%	3.7E-04	5.8E-04	2.1E-04	<0.01%
R7	1.3E-05	1.1E-05	-1.7E-06	<0.01%	4.3E-04	8.0E-04	3.7E-04	<0.01%
R8	1.0E-05	1.1E-05	1.4E-06	<0.01%	3.3E-04	5.1E-04	1.8E-04	<0.01%

Receptor ID	Annual Mean Antimony Concentration (µg/m³)				Hourly Mean Antimony Concentration (µg/m³)			
	PC (Existing Scenario) (µg/m³)	PC (Proposed Scenario) (µg/m³)	Change in PC	PC from proposed scenario as % of Objective	PC from existing stack (µg/m³)	PC from proposed stack (µg/m³)	Change in PC	PC from proposed stack as % of Objective
R9	1.0E-05	1.3E-05	2.5E-06	<0.01%	4.2E-04	6.7E-04	2.5E-04	<0.01%
R10	1.8E-05	2.0E-05	1.7E-06	<0.01%	4.1E-04	6.4E-04	2.3E-04	<0.01%
R11	4.2E-06	9.9E-06	5.8E-06	<0.01%	4.1E-04	6.6E-04	2.6E-04	<0.01%
R12	3.0E-06	3.2E-06	1.9E-07	<0.01%	5.1E-04	1.0E-03	4.8E-04	<0.01%
R13	8.1E-06	9.2E-06	1.2E-06	<0.01%	3.6E-04	5.2E-04	1.6E-04	<0.01%
Maximum Outside Boundary	2.0E-05	2.6E-05	5.6E-06	<0.01%	7.0E-04	1.6E-03	9.1E-04	<0.01%
AQS / EAL Objective	5 µg/m³				150 µg/m³			

Table 8.16: Predicted Arsenic Concentrations at Discrete Receptors - Maximum 5-year Results for Each Receptor

Receptor ID	Annual Mean Arsenic Concentration (µg/m³)			
	PC (Existing Scenario) (µg/m³)	PC (Proposed Scenario) (µg/m³)	Change in PC	PC from proposed scenario as % of Objective
R1	1.9E-06	2.5E-06	5.6E-07	0.04%
R2	2.3E-06	3.3E-06	9.6E-07	0.05%
R3	5.1E-06	6.0E-06	8.9E-07	0.10%
R4	3.0E-06	3.7E-06	6.9E-07	0.06%
R5	7.9E-06	7.9E-06	-4.3E-08	0.13%
R6	6.9E-06	7.8E-06	9.3E-07	0.13%
R7	7.3E-06	6.4E-06	-9.6E-07	0.11%
R8	5.7E-06	6.5E-06	7.7E-07	0.11%
R9	6.0E-06	7.4E-06	1.4E-06	0.12%
R10	1.0E-05	1.1E-05	9.7E-07	0.19%
R11	2.4E-06	5.7E-06	3.3E-06	0.09%
R12	1.7E-06	1.8E-06	1.1E-07	0.03%
R13	4.6E-06	5.3E-06	6.7E-07	0.09%
Maximum Outside Boundary	1.1E-05	1.5E-05	3.2E-06	0.24%
AQS / EAL Objective	0.006 µg/m³			

Table 8.17: Predicted Lead Concentrations at Discrete Receptors - Maximum 5-year Results for Each Receptor

Receptor ID	Annual Mean Lead Concentration (µg/m^3)			
	PC (Existing Scenario) (µg/m^3)	PC (Proposed Scenario) (µg/m^3)	Change in PC	PC from proposed stack as % of Objective
R1	2.2E-05	2.9E-05	6.4E-06	0.01%
R2	2.7E-05	3.8E-05	1.1E-05	0.02%
R3	5.9E-05	6.9E-05	1.0E-05	0.03%
R4	3.5E-05	4.3E-05	8.0E-06	0.02%
R5	9.1E-05	9.0E-05	-4.9E-07	0.04%
R6	7.9E-05	9.0E-05	1.1E-05	0.04%
R7	8.4E-05	7.3E-05	-1.1E-05	0.03%
R8	6.6E-05	7.4E-05	8.9E-06	0.03%
R9	6.9E-05	8.5E-05	1.7E-05	0.03%
R10	1.2E-04	1.3E-04	1.1E-05	0.05%
R11	2.8E-05	6.5E-05	3.8E-05	0.03%
R12	2.0E-05	2.1E-05	1.2E-06	0.01%
R13	5.3E-05	6.1E-05	7.7E-06	0.02%
Maximum Outside Boundary	1.3E-04	1.7E-04	3.7E-05	0.07%
AQS / EAL Objective	0.25 µg/m^3			

Table 8.18: Predicted Chromium Concentrations at Discrete Receptors - Maximum 5-year Results for Each Receptor

Receptor ID	Daily Mean Chromium Concentration (µg/m^3)			
	PC from existing stack (µg/m^3)	PC from proposed stack (µg/m^3)	Change in PC	PC from proposed stack as % of Objective
R1	7.5E-04	5.5E-04	-2.0E-04	0.03%
R2	7.6E-04	5.9E-04	-1.2E-04	0.03%
R3	1.3E-03	1.2E-03	-1.0E-04	0.06%
R4	8.0E-04	9.1E-04	2.9E-04	0.05%
R5	1.5E-03	1.1E-03	-4.0E-04	0.05%
R6	1.2E-03	1.1E-03	-5.6E-05	0.06%
R7	1.4E-03	9.8E-04	-3.9E-04	0.05%
R8	9.0E-04	9.1E-04	2.3E-04	0.05%
R9	1.1E-03	1.1E-03	-3.5E-05	0.05%
R10	1.5E-03	1.2E-03	-2.8E-04	0.06%
R11	6.8E-04	9.9E-04	3.1E-04	0.05%

Receptor ID	Daily Mean Chromium Concentration (µg/m³)			
	PC from existing stack (µg/m³)	PC from proposed stack (µg/m³)	Change in PC	PC from proposed stack as % of Objective
R12	9.6E-04	5.9E-04	-2.9E-04	0.03%
R13	1.2E-03	1.1E-03	-1.3E-04	0.06%
Maximum Outside Boundary	2.0E-03	1.7E-03	-3.3E-04	0.08%
AQS / EAL Objective	2 µg/m³			

Table 8.19: Predicted Cobalt Concentrations at Discrete Receptors - Maximum 5-year Results for Each Receptor

Receptor ID	Annual Mean Cobalt Concentration (µg/m³)				Hourly Mean Cobalt Concentration (µg/m³)			
	PC (Existing Scenario) (µg/m³)	PC (Proposed Scenario) (µg/m³)	Change in PC	PC from proposed scenario as % of Objective	PC from existing stack (µg/m³)	PC from proposed stack (µg/m³)	Change in PC	PC from proposed stack as % of Objective
R1	2.42E-06	3.12E-06	7.0E-07	<0.01%	3.7E-04	7.3E-04	3.6E-04	0.01%
R2	2.89E-06	4.09E-06	1.2E-06	<0.01%	3.4E-04	6.4E-04	3.0E-04	0.01%
R3	6.41E-06	7.52E-06	1.1E-06	<0.01%	3.4E-04	7.1E-04	3.8E-04	0.01%
R4	3.80E-06	4.67E-06	8.7E-07	<0.01%	3.3E-04	6.5E-04	3.1E-04	0.01%
R5	9.88E-06	9.83E-06	-5.3E-08	<0.01%	3.1E-04	4.9E-04	1.8E-04	0.01%
R6	8.58E-06	9.75E-06	1.2E-06	<0.01%	2.7E-04	4.2E-04	1.5E-04	0.01%
R7	9.16E-06	7.96E-06	-1.2E-06	<0.01%	3.1E-04	5.7E-04	2.6E-04	0.01%
R8	7.13E-06	8.09E-06	9.7E-07	<0.01%	2.4E-04	3.6E-04	1.3E-04	0.01%
R9	7.47E-06	9.27E-06	1.8E-06	<0.01%	3.0E-04	4.8E-04	1.8E-04	0.01%
R10	1.28E-05	1.40E-05	1.2E-06	0.01%	3.0E-04	4.6E-04	1.6E-04	0.01%
R11	2.99E-06	7.10E-06	4.1E-06	<0.01%	2.9E-04	4.7E-04	1.8E-04	0.01%
R12	2.15E-06	2.29E-06	1.4E-07	<0.01%	3.7E-04	7.1E-04	3.4E-04	0.01%
R13	5.77E-06	6.60E-06	8.3E-07	<0.01%	2.6E-04	3.7E-04	1.1E-04	0.01%
Maximum Outside Boundary	1.44E-05	1.84E-05	4.0E-06	0.01%	5.0E-04	1.1E-03	6.5E-04	0.02%
AQS / EAL Objective	0.2 µg/m³				6 µg/m³			

Table 8.20: Predicted Copper Concentrations at Discrete Receptors - Maximum 5-year Results for Each Receptor

Receptor ID	Daily Mean Copper Concentration (µg/m^3)			
	PC from existing stack (µg/m^3)	PC from proposed stack (µg/m^3)	Change in PC	PC from proposed stack as % of Objective
R1	0.0030	0.0022	-0.0008	4.38%
R2	0.0030	0.0026	-0.0005	5.13%
R3	0.0051	0.0047	-0.0004	9.33%
R4	0.0032	0.0043	0.0011	8.67%
R5	0.0058	0.0043	-0.0016	8.51%
R6	0.0046	0.0044	-0.0002	8.82%
R7	0.0054	0.0039	-0.0015	7.82%
R8	0.0036	0.0045	0.0009	9.04%
R9	0.0045	0.0044	-0.0001	8.72%
R10	0.0059	0.0048	-0.0011	9.57%
R11	0.0027	0.0039	0.0012	7.90%
R12	0.0038	0.0027	-0.0012	5.32%
R13	0.0049	0.0044	-0.0005	8.84%
Maximum Outside Boundary	0.0080	0.0067	-0.0013	13.32%
AQS / EAL Objective	0.05 µg/m^3			

Table 8.21: Predicted Manganese Concentrations at Discrete Receptors - Maximum 5-year Results for Each Receptor

Receptor ID	Annual Mean Manganese Concentration (µg/m^3)				Hourly Mean Manganese Concentration (µg/m^3)			
	PC (Existing Scenario) (µg/m^3)	PC (Proposed Scenario) (µg/m^3)	Change in PC	PC from proposed scenario as % of Objective	PC from existing stack (µg/m^3)	PC from proposed stack (µg/m^3)	Change in PC	PC from proposed stack as % of Objective
R1	5.19E-05	6.68E-05	1.49E-05	0.04%	0.0079	0.0155	7.6E-03	<0.01%
R2	6.19E-05	8.75E-05	2.56E-05	0.06%	0.0072	0.0136	6.4E-03	<0.01%
R3	1.37E-04	1.61E-04	2.38E-05	0.11%	0.0072	0.0153	8.0E-03	<0.01%
R4	8.14E-05	9.99E-05	1.85E-05	0.07%	0.0071	0.0138	6.7E-03	<0.01%
R5	2.11E-04	2.10E-04	-1.14E-06	0.14%	0.0065	0.0104	3.9E-03	<0.01%
R6	1.84E-04	2.09E-04	2.49E-05	0.14%	0.0057	0.0089	3.2E-03	<0.01%
R7	1.96E-04	1.70E-04	-2.57E-05	0.11%	0.0065	0.0122	5.6E-03	<0.01%
R8	1.53E-04	1.73E-04	2.07E-05	0.12%	0.0051	0.0078	2.7E-03	<0.01%
R9	1.60E-04	1.98E-04	3.85E-05	0.13%	0.0064	0.0102	3.8E-03	<0.01%

Receptor ID	Annual Mean Manganese Concentration (µg/m³)				Hourly Mean Manganese Concentration (µg/m³)			
	PC (Existing Scenario) (µg/m³)	PC (Proposed Scenario) (µg/m³)	Change in PC	PC from proposed scenario as % of Objective	PC from existing stack (µg/m³)	PC from proposed stack (µg/m³)	Change in PC	PC from proposed stack as % of Objective
R10	2.73E-04	2.99E-04	2.60E-05	0.20%	0.0063	0.0099	3.5E-03	<0.01%
R11	6.40E-05	1.52E-04	8.80E-05	0.10%	0.0062	0.0101	3.9E-03	<0.01%
R12	4.61E-05	4.90E-05	2.90E-06	0.03%	0.0078	0.0152	7.4E-03	<0.01%
R13	1.23E-04	1.41E-04	1.78E-05	0.09%	0.0056	0.0080	2.5E-03	<0.01%
Maximum Outside Boundary	3.07E-04	3.93E-04	8.56E-05	0.26%	0.0107	0.0246	1.4E-02	<0.01%
AQS / EAL Objective	0.15 µg/m³				1500 µg/m³			

Table 8.22: Predicted Nickel Concentrations at Discrete Receptors - Maximum 5-year Results for Each Receptor

Receptor ID	Annual Mean Nickel Concentration (µg/m³)				Hourly Mean Nickel Concentration (µg/m³)			
	PC (Existing Scenario) (µg/m³)	PC (Proposed Scenario) (µg/m³)	Change in PC	PC from proposed scenario as % of Objective	PC from existing stack (µg/m³)	PC from proposed stack (µg/m³)	Change in PC	PC from proposed stack as % of Objective
R1	1.99E-05	2.56E-05	5.72E-06	0.13%	0.003	0.006	0.003	0.85%
R2	2.37E-05	3.35E-05	9.80E-06	0.17%	0.003	0.005	0.002	0.74%
R3	5.25E-05	6.17E-05	9.12E-06	0.31%	0.003	0.006	0.003	0.84%
R4	3.12E-05	3.83E-05	7.10E-06	0.19%	0.003	0.005	0.003	0.76%
R5	8.10E-05	8.06E-05	-4.38E-07	0.40%	0.003	0.004	0.001	0.57%
R6	7.04E-05	7.99E-05	9.55E-06	0.40%	0.002	0.003	0.001	0.49%
R7	7.51E-05	6.53E-05	-9.84E-06	0.33%	0.003	0.005	0.002	0.67%
R8	5.84E-05	6.64E-05	7.93E-06	0.33%	0.002	0.003	0.001	0.43%
R9	6.12E-05	7.60E-05	1.48E-05	0.38%	0.002	0.004	0.001	0.56%
R10	1.05E-04	1.15E-04	9.97E-06	0.57%	0.002	0.004	0.001	0.54%
R11	2.45E-05	5.82E-05	3.37E-05	0.29%	0.002	0.004	0.002	0.55%
R12	1.76E-05	1.88E-05	1.11E-06	0.09%	0.003	0.006	0.003	0.83%
R13	4.73E-05	5.41E-05	6.83E-06	0.27%	0.002	0.003	0.001	0.44%
Maximum Outside Boundary	1.18E-04	1.51E-04	3.28E-05	0.75%	0.004	0.009	0.005	1.35%
AQS / EAL Objective	0.02 µg/m³				0.7 µg/m³			

Table 8.23: Predicted Vanadium Concentrations at Discrete Receptors - Maximum 5-year Results for Each Receptor

Receptor ID	Daily Mean Vanadium Concentration (µg/m³)			
	PC from existing stack (µg/m³)	PC from proposed stack (µg/m³)	Change in PC	PC from proposed stack as % of Objective
R1	9.57E-05	7.03E-05	-2.54E-05	0.01%
R2	9.73E-05	8.23E-05	-1.50E-05	0.01%
R3	1.63E-04	1.50E-04	-1.29E-05	0.01%
R4	1.02E-04	1.39E-04	3.67E-05	0.01%
R5	1.88E-04	1.37E-04	-5.10E-05	0.01%
R6	1.49E-04	1.42E-04	-7.14E-06	0.01%
R7	1.75E-04	1.26E-04	-4.92E-05	0.01%
R8	1.15E-04	1.45E-04	2.97E-05	0.01%
R9	1.44E-04	1.40E-04	-4.52E-06	0.01%
R10	1.90E-04	1.54E-04	-3.61E-05	0.02%
R11	8.74E-05	1.27E-04	3.93E-05	0.01%
R12	1.23E-04	8.53E-05	-3.76E-05	0.01%
R13	1.59E-04	1.42E-04	-1.69E-05	0.01%
Maximum Outside Boundary	2.56E-04	2.14E-04	-4.21E-05	0.02%
AQS / EAL Objective	1 µg/m³			

Table 8.24: Predicted Cadmium Concentrations at Discrete Receptors - Maximum 5-year Results for Each Receptor

Receptor ID	Daily Mean Cadmium Concentration (µg/m³)			
	PC from existing stack (µg/m³)	PC from proposed stack (µg/m³)	Change in PC	PC from proposed stack as % of Objective
R1	0.0007	0.0004	-0.0003	1.3%
R2	0.0007	0.0004	-0.0003	1.4%
R3	0.0010	0.0008	-0.0001	2.7%
R4	0.0007	0.0006	-0.0001	2.1%
R5	0.0014	0.0007	-0.0007	2.5%
R6	0.0011	0.0008	-0.0003	2.6%
R7	0.0013	0.0007	-0.0006	2.3%
R8	0.0009	0.0006	-0.0002	2.1%
R9	0.0011	0.0008	-0.0003	2.5%
R10	0.0011	0.0008	-0.0002	2.8%
R11	0.0007	0.0007	0.0000	2.3%

Receptor ID	Daily Mean Cadmium Concentration (µg/m³)			
	PC from existing stack (µg/m³)	PC from proposed stack (µg/m³)	Change in PC	PC from proposed stack as % of Objective
R12	0.0009	0.0004	-0.0005	1.4%
R13	0.0012	0.0008	-0.0004	2.6%
Maximum Outside Boundary	0.0019	0.0012	-0.0008	3.9%
AQS / EAL Objective	0.03 µg/m³			

Table 8.25: Predicted Mercury Concentrations at Discrete Receptors - Maximum 5-year Results for Each Receptor

Receptor ID	Daily Mean Mercury Concentration (µg/m³)				Hourly Mean Mercury Concentration (µg/m³)			
	PC from existing stack (µg/m³)	PC from proposed stack (µg/m³)	Change in PC	PC from proposed stack as % of Objective	PC from existing stack (µg/m³)	PC from proposed stack (µg/m³)	Change in PC	PC from proposed stack as % of Objective
R1	0.0007	0.0004	-0.0003	0.6%	0.0033	0.0065	0.0032	1.1%
R2	0.0007	0.0004	-0.0003	0.7%	0.0030	0.0057	0.0027	1.0%
R3	0.0010	0.0008	-0.0001	1.4%	0.0030	0.0064	0.0034	1.1%
R4	0.0007	0.0006	-0.0001	1.1%	0.0030	0.0058	0.0028	1.0%
R5	0.0014	0.0007	-0.0007	1.2%	0.0028	0.0044	0.0016	0.7%
R6	0.0011	0.0008	-0.0003	1.3%	0.0024	0.0037	0.0013	0.6%
R7	0.0013	0.0007	-0.0006	1.1%	0.0028	0.0051	0.0024	0.9%
R8	0.0009	0.0006	-0.0002	1.1%	0.0021	0.0033	0.0011	0.5%
R9	0.0011	0.0008	-0.0003	1.3%	0.0027	0.0043	0.0016	0.7%
R10	0.0011	0.0008	-0.0002	1.4%	0.0027	0.0041	0.0015	0.7%
R11	0.0007	0.0007	0.0000	1.2%	0.0026	0.0043	0.0017	0.7%
R12	0.0009	0.0004	-0.0005	0.7%	0.0033	0.0064	0.0031	1.1%
R13	0.0012	0.0008	-0.0004	1.3%	0.0023	0.0034	0.0010	0.6%
Maximum Outside Boundary	0.0019	0.0012	-0.0008	1.9%	0.0045	0.0103	0.0058	1.7%
AQS / EAL Objective	0.06 µg/m³				0.6 µg/m³			

8.1.17 Ammonia Impacts

The predicted annual mean and 100th percentile 1-hour mean ammonia PCs for the proposed facility are all below the long and short term screening criteria of 1% and 10%, respectively, at all receptors. All receptors are predicted to see a reduction in impacts due to proposed variation.

Due to the low magnitude of the impacts and low background values (see Section 6), PECs have not been presented.

Table 8.26: Predicted Ammonia Concentrations at Discrete Receptors - Maximum 5-year Results for Each Receptor

Receptor ID	Annual Mean Ammonia Concentration (µg/m³)				Hourly Mean Ammonia Concentration (µg/m³)			
	PC (Existing Scenario) (µg/m³)	PC (Proposed Scenario) (µg/m³)	Change in PC	PC from proposed scenario as % of Objective	PC from existing stack (µg/m³)	PC from proposed stack (µg/m³)	Change in PC	PC from proposed stack as % of Objective
R1	0.03	0.02	-0.01	<0.1%	4.66	3.92	-0.74	0.2%
R2	0.04	0.02	-0.01	<0.1%	4.22	3.43	-0.79	0.1%
R3	0.08	0.04	-0.04	<0.1%	4.24	3.86	-0.38	0.2%
R4	0.05	0.03	-0.02	<0.1%	4.19	3.52	-0.67	0.1%
R5	0.12	0.06	-0.07	<0.1%	3.85	3.78	-0.07	0.2%
R6	0.11	0.06	-0.05	<0.1%	3.37	3.96	0.58	0.2%
R7	0.12	0.05	-0.07	<0.1%	4.42	3.26	-1.16	0.1%
R8	0.09	0.05	-0.04	<0.1%	4.05	3.39	-0.66	0.1%
R9	0.09	0.05	-0.04	<0.1%	3.97	2.58	-1.39	0.1%
R10	0.16	0.08	-0.08	<0.1%	3.73	2.59	-1.15	0.1%
R11	0.04	0.04	0.00	<0.1%	3.67	2.58	-1.09	0.1%
R12	0.03	0.01	-0.01	<0.1%	4.62	4.17	-0.45	0.2%
R13	0.07	0.04	-0.03	<0.1%	3.28	2.08	-1.19	0.1%
Maximum Outside Boundary	0.18	0.10	-0.08	0.1%	6.31	6.21	-0.10	0.2%
AQS / EAL Objective	180 µg/m³				2,500 µg/m³			

8.2 Impacts on Ecological Receptors

The results section below presents the maximum PCs and magnitude of change between the existing and proposed operations. The maximum concentrations are presented for all assessed discrete ecological receptors across any of the meteorological years modelled. The maximum PECs for the proposed operation have also been compared against the relevant air quality standard.

8.2.1 Annual Mean NO_x Concentrations

The predicted maximum annual mean NOx PCs do not exceed the screening criteria of 1% at any SPA/SAC/Ramsar locations, except at receptor E3. No exceedances of the screening threshold of 100% are predicted at any ancient woodlands or LWS. Meanwhile, the predicted environmental concentration (PEC) at all receptors is below 70% of the critical level. Also, it is noted that the net change in annual mean NO_x concentrations shows a reduction in annual mean NO_x concentrations.

Table 8.27: Annual Average NOx Concentrations at Ecologically Sensitive Sites - Maximum 5-year Results for Each Receptor (E1 – E23 represent European Sites)

Receptor ID	Background Annual Mean NO_X baseline ($\mu g/m^3$)	NO_X PC (Existing Scenario) ($\mu g/m^3$)	NO_X PC (Proposed Scenario) ($\mu g/m^3$)	Change in PC	PC as a % of AQS/ EAL	NO_X PEC ($\mu g/m^3$)	PEC as a % of AQS/EAL
E1	10.89	0.27	0.16	-0.11	0.5%	24.21	32.3%
E2	10.02	0.50	0.27	-0.24	0.9%	22.18	29.6%
E3	11.06	0.73	0.50	-0.22	1.7%	25.36	33.8%
E4	8.11	0.39	0.29	-0.10	1.0%	18.16	24.2%
E5	9.87	0.16	0.10	-0.06	0.3%	20.81	27.8%
E6	11.22	0.10	0.07	-0.03	0.2%	23.32	31.1%
E7	16.26	0.08	0.06	-0.02	0.2%	33.45	44.6%
E8	13.61	0.07	0.05	-0.02	0.2%	27.97	37.3%
E9	11.21	0.07	0.05	-0.02	0.2%	23.39	31.2%
E10	14.65	0.08	0.05	-0.03	0.2%	30.31	40.4%
E11	8.27	0.25	0.19	-0.06	0.6%	17.67	23.6%
E12	6.15	0.09	0.06	-0.03	0.2%	14.10	18.8%
E13	6.12	0.04	0.03	-0.01	0.1%	13.03	17.4%
E14	5.73	0.03	0.02	-0.01	0.1%	12.19	16.3%
E15	4.93	0.04	0.03	-0.01	0.1%	10.38	13.8%
E16	4.95	0.04	0.03	-0.01	0.1%	10.54	14.1%
E17	8.06	0.14	0.10	-0.04	0.3%	17.54	23.4%
E18	8.23	0.18	0.12	-0.06	0.4%	17.64	23.5%
E19	10.78	0.13	0.09	-0.04	0.3%	22.41	29.9%
E20	6.57	0.10	0.06	-0.04	0.2%	13.95	18.6%
E21	4.94	0.04	0.03	-0.01	0.1%	10.46	13.9%
E22	5.30	0.03	0.02	-0.01	0.1%	11.12	14.8%
E23	8.35	0.14	0.10	-0.05	0.3%	17.63	23.5%
E24	10.02	0.60	0.34	-0.26	1.1%	24.23	32.3%
E25	8.69	0.47	0.29	-0.18	1.0%	22.47	30.0%
E26	7.62	0.13	0.06	-0.07	0.2%	17.84	23.8%
E27	7.62	0.19	0.12	-0.07	0.4%	19.27	25.7%
E28	7.45	0.17	0.13	-0.05	0.4%	19.03	25.4%
E29	7.79	0.21	0.15	-0.06	0.5%	20.73	27.6%
E30	7.79	0.22	0.14	-0.08	0.5%	20.64	27.5%
E31	7.79	0.36	0.24	-0.12	0.8%	19.98	26.6%
E32	7.04	0.20	0.13	-0.07	0.4%	17.69	23.6%
E33	9.74	0.50	0.26	-0.24	0.9%	21.84	29.1%
E34	7.00	0.15	0.12	-0.03	0.4%	16.89	22.5%
E35	8.93	0.33	0.20	-0.12	0.7%	20.59	27.5%
E36	9.26	0.43	0.29	-0.14	1.0%	24.13	32.2%
E37	7.04	0.15	0.12	-0.04	0.4%	17.64	23.5%
E38	7.40	0.19	0.07	-0.12	0.2%	17.27	23.0%
E39	8.24	1.10	0.66	-0.44	2.2%	21.60	28.8%
E40	6.70	0.14	0.11	-0.03	0.4%	16.73	22.3%
E41	6.70	0.18	0.12	-0.07	0.4%	16.74	22.3%
E42	6.70	0.15	0.11	-0.04	0.4%	16.49	22.0%
E43	6.70	0.13	0.10	-0.03	0.3%	16.46	21.9%

Receptor ID	Background Annual Mean NO_X baseline ($\mu g/m^3$)	NO_X PC (Existing Scenario) ($\mu g/m^3$)	NO_X PC (Proposed Scenario) ($\mu g/m^3$)	Change in PC	PC as a % of AQS/ EAL	NO_X PEC ($\mu g/m^3$)	PEC as a % of AQS/EAL
E44	6.70	0.17	0.11	-0.06	0.4%	16.66	22.2%
E45	9.26	0.35	0.24	-0.12	0.8%	23.01	30.7%
E46	9.26	0.31	0.21	-0.10	0.7%	22.18	29.6%
E47	7.19	0.20	0.16	-0.04	0.5%	17.39	23.2%
E48	6.81	0.13	0.10	-0.03	0.3%	16.39	21.8%
E49	7.04	0.17	0.13	-0.04	0.4%	18.25	24.3%
E50	6.81	0.14	0.11	-0.03	0.4%	16.74	22.3%
E51	7.04	0.18	0.13	-0.05	0.4%	18.18	24.2%
E52	7.40	0.21	0.12	-0.09	0.4%	18.77	25.0%
E53	6.82	0.17	0.12	-0.05	0.4%	17.33	23.1%
E54	6.82	0.16	0.11	-0.04	0.4%	16.95	22.6%
E55	6.82	0.15	0.10	-0.05	0.3%	16.71	22.3%
E56	8.93	0.33	0.20	-0.12	0.7%	20.62	27.5%
E57	8.93	0.37	0.23	-0.14	0.8%	20.72	27.6%
E58	10.12	0.45	0.28	-0.17	0.9%	23.73	31.6%
E59	10.12	0.43	0.27	-0.16	0.9%	23.40	31.2%
E60	10.12	0.39	0.25	-0.13	0.8%	22.87	30.5%
E61	10.12	0.40	0.26	-0.14	0.9%	22.85	30.5%
AQS / EAL Objective	30 $\mu g/m^3$						
Note: The screening criteria of E1 – E23 and E24 – E61 are 1% and 100% respectively of AQS							

8.2.2 Daily Mean NO_x concentrations

The predicted maximum 100th percentile daily mean NOx PCs are well below the screening criteria of 10% at all SPA/SAC/Ramsar receptor locations. In addition, all predicted PECs are well below the 100th percentile daily mean NOx critical level of 75 $\mu g/m^3$. No exceedances of the screening threshold of 100% are predicted at any ancient woodlands or LWS.

Table 8.28: Daily Average NOx Concentrations at Ecologically Sensitive Sites Maximum 5-year Results for Each Receptor (E1 – E23 represent European Sites)

Receptor ID	Background Annual Mean NO_X baseline ($\mu g/m^3$)	NO_X PC (Existing Stack) ($\mu g/m^3$)	NO_X PC (Proposed Stack) ($\mu g/m^3$)	Change in PC	PC as a % of AQS/EAL	NO_X PEC ($\mu g/m^3$)	PEC as a % of AQS/EAL
E1	10.89	5.76	2.42	-3.34	3.2%	27.55	36.7%
E2	10.02	4.18	2.14	-2.04	2.9%	24.21	32.3%
E3	11.06	5.26	3.23	-2.03	4.3%	27.38	36.5%
E4	8.11	3.05	1.92	-1.14	2.6%	19.28	25.7%
E5	9.87	1.68	1.08	-0.60	1.4%	21.41	28.5%
E6	11.22	1.29	0.72	-0.56	1.0%	23.72	31.6%
E7	16.26	1.37	0.93	-0.44	1.2%	33.90	45.2%
E8	13.61	1.06	0.75	-0.31	1.0%	28.28	37.7%

Receptor ID	Background Annual Mean NO_X baseline ($\mu g/m^3$)	NO_X PC (Existing Stack) ($\mu g/m^3$)	NO_X PC (Proposed Stack) ($\mu g/m^3$)	Change in PC	PC as a % of AQS/EAL	NO_X PEC ($\mu g/m^3$)	PEC as a % of AQS/EAL
E9	11.21	1.47	0.96	-0.51	1.3%	23.90	31.9%
E10	14.65	1.34	0.86	-0.48	1.2%	30.64	40.9%
E11	8.27	1.69	1.13	-0.57	1.5%	18.23	24.3%
E12	6.15	2.48	1.80	-0.68	2.4%	14.77	19.7%
E13	6.12	1.23	0.72	-0.51	1.0%	13.46	18.0%
E14	5.73	1.12	0.55	-0.57	0.7%	12.58	16.8%
E15	4.93	0.76	0.53	-0.23	0.7%	10.61	14.1%
E16	4.95	0.93	0.63	-0.30	0.8%	10.84	14.5%
E17	8.06	2.26	0.88	-1.39	1.2%	18.39	24.5%
E18	8.23	1.88	1.18	-0.71	1.6%	18.35	24.5%
E19	10.78	1.33	0.84	-0.49	1.1%	22.90	30.5%
E20	6.57	1.19	0.74	-0.45	1.0%	14.33	19.1%
E21	4.94	0.86	0.58	-0.28	0.8%	10.74	14.3%
E22	5.30	0.70	0.45	-0.25	0.6%	11.30	15.1%
E23	8.35	1.46	0.93	-0.53	1.2%	18.16	24.2%
E24	10.02	8.44	4.19	-4.25	5.6%	28.48	38.0%
E25	8.69	11.23	3.79	-7.44	5.1%	28.61	38.2%
E26	7.62	3.82	2.02	-1.80	2.7%	19.06	25.4%
E27	7.62	6.35	3.62	-2.73	4.8%	21.59	28.8%
E28	7.45	6.81	4.13	-2.68	5.5%	21.71	28.9%
E29	7.79	10.22	3.34	-6.88	4.4%	25.80	34.4%
E30	7.79	11.61	3.16	-8.46	4.2%	27.19	36.3%
E31	7.79	6.72	3.67	-3.06	4.9%	22.30	29.7%
E32	7.04	7.93	3.61	-4.32	4.8%	22.01	29.4%
E33	9.74	4.13	2.36	-1.77	3.1%	23.61	31.5%
E34	7.00	3.73	2.89	-0.84	3.9%	17.73	23.6%
E35	8.93	5.19	2.73	-2.45	3.6%	23.05	30.7%
E36	9.26	9.45	3.79	-5.65	5.1%	27.97	37.3%
E37	7.04	5.42	3.52	-1.90	4.7%	19.50	26.0%
E38	7.40	9.86	2.47	-7.39	3.3%	24.66	32.9%
E39	8.24	10.18	5.12	-5.06	6.8%	26.66	35.5%
E40	6.70	3.83	3.33	-0.49	4.4%	17.23	23.0%
E41	6.70	4.75	3.34	-1.41	4.4%	18.15	24.2%
E42	6.70	3.90	2.93	-0.98	3.9%	17.30	23.1%
E43	6.70	3.78	3.06	-0.72	4.1%	17.18	22.9%
E44	6.70	4.22	3.26	-0.96	4.3%	17.62	23.5%
E45	9.26	6.65	3.22	-3.43	4.3%	25.17	33.6%
E46	9.26	5.83	3.12	-2.70	4.2%	24.35	32.5%
E47	7.19	4.11	2.88	-1.23	3.8%	18.49	24.7%
E48	6.81	3.94	2.77	-1.18	3.7%	17.56	23.4%
E49	7.04	6.84	3.85	-2.99	5.1%	20.92	27.9%
E50	6.81	4.33	2.50	-1.83	3.3%	17.95	23.9%
E51	7.04	6.96	4.10	-2.87	5.5%	21.04	28.1%
E52	7.40	6.37	3.33	-3.04	4.4%	21.17	28.2%
E53	6.82	5.76	2.98	-2.78	4.0%	19.40	25.9%

Receptor ID	Background Annual Mean NO_X baseline ($\mu g/m^3$)	NO_X PC (Existing Stack) ($\mu g/m^3$)	NO_X PC (Proposed Stack) ($\mu g/m^3$)	Change in PC	PC as a % of AQS/EAL	NO_X PEC ($\mu g/m^3$)	PEC as a % of AQS/EAL
E54	6.82	4.42	3.31	-1.11	4.4%	18.06	24.1%
E55	6.82	3.83	3.07	-0.76	4.1%	17.47	23.3%
E56	8.93	5.18	2.76	-2.42	3.7%	23.04	30.7%
E57	8.93	5.25	2.86	-2.40	3.8%	23.11	30.8%
E58	10.12	6.06	3.49	-2.58	4.6%	26.30	35.1%
E59	10.12	5.11	3.16	-1.95	4.2%	25.35	33.8%
E60	10.12	4.56	2.63	-1.93	3.5%	24.80	33.1%
E61	10.12	4.61	2.61	-2.01	3.5%	24.85	33.1%
AQS / EAL Objective	75 $\mu g/m^3$						
Note: The screening criteria of E1 – E23 and E24 – E61 are 10% and 100% respectively of AQS							

8.2.3 Annual Mean SO_2 Concentrations

The predicted maximum annual mean SO_2 PCs do not exceed the screening criteria of 1% at any SPA/SAC/Ramsar locations, except at receptor E3. No exceedances of the screening threshold of 100% are predicted at any ancient woodlands or LWS. Meanwhile, the predicted environmental concentration (PEC) at all receptors is below 70% of the critical level. Also, it is noted that the net change in annual mean SO_2 concentrations shows a reduction in annual mean SO_2 concentrations.

Table 8.29: Annual Average SO_2 Concentrations at Ecologically Sensitive Sites - Maximum 5-year Results for Each Receptor (E1 – E23 represent European Sites)

Receptor ID	Background Annual Mean SO_2 baseline ($\mu g/m^3$)	SO_2 PC (Existing Scenario) ($\mu g/m^3$)	SO_2 PC (Proposed Scenario) ($\mu g/m^3$)	Change in PC	PC as a % of AQS/EAL	SO_2 PEC ($\mu g/m^3$)	PEC as a % of AQS/EAL
E1	1.82	0.12	0.04	-0.08	0.4%	1.86	19%
E2	1.99	0.22	0.08	-0.15	0.8%	2.07	21%
E3	1.96	0.32	0.13	-0.19	1.3%	2.09	21%
E4	1.64	0.17	0.08	-0.10	0.8%	1.72	17%
E5	1.64	0.07	0.03	-0.04	0.3%	1.67	17%
E6	1.90	0.04	0.02	-0.02	0.2%	1.91	19%
E7	3.54	0.04	0.02	-0.02	0.2%	3.56	36%
E8	2.44	0.03	0.01	-0.02	0.1%	2.45	25%
E9	2.87	0.03	0.01	-0.02	0.1%	2.89	29%
E10	4.83	0.03	0.01	-0.02	0.1%	4.84	24%
E11	1.25	0.11	0.05	-0.06	0.5%	1.30	13%
E12	1.11	0.04	0.02	-0.02	0.2%	1.13	11%
E13	1.22	0.02	0.01	-0.01	0.0%	1.23	6%
E14	1.09	0.01	0.01	-0.01	0.1%	1.09	11%
E15	0.89	0.02	0.01	-0.01	0.1%	0.90	9%
E16	0.96	0.02	0.01	-0.01	0.1%	0.96	10%
E17	1.60	0.06	0.03	-0.03	0.1%	1.62	8%
E18	1.40	0.08	0.03	-0.05	0.2%	1.43	7%
E19	1.32	0.06	0.02	-0.03	0.1%	1.34	7%

Receptor ID	Background Annual Mean SO_2 baseline ($\mu g/m^3$)	SO_2 PC (Existing Scenario) ($\mu g/m^3$)	SO_2 PC (Proposed Scenario) ($\mu g/m^3$)	Change in PC	PC as a % of AQS/ EAL	SO_2 PEC ($\mu g/m^3$)	PEC as a % of AQS/EAL
E20	1.31	0.04	0.02	-0.03	0.2%	1.33	13%
E21	0.86	0.02	0.01	-0.01	0.1%	0.87	9%
E22	0.94	0.01	0.01	-0.01	0.1%	0.94	9%
E23	1.81	0.06	0.03	-0.04	0.3%	1.84	18%
E24	1.66	0.27	0.09	-0.18	0.9%	1.75	18%
E25	1.39	0.21	0.08	-0.13	0.8%	1.47	15%
E26	1.28	0.06	0.02	-0.04	0.2%	1.30	13%
E27	1.28	0.08	0.04	-0.05	0.4%	1.32	13%
E28	1.28	0.08	0.03	-0.04	0.3%	1.31	13%
E29	1.38	0.09	0.04	-0.05	0.4%	1.42	14%
E30	1.38	0.10	0.04	-0.06	0.4%	1.42	14%
E31	1.38	0.16	0.07	-0.09	0.7%	1.45	15%
E32	1.41	0.09	0.03	-0.06	0.3%	1.44	14%
E33	2.24	0.22	0.07	-0.15	0.7%	2.31	23%
E34	1.38	0.07	0.03	-0.03	0.3%	1.41	14%
E35	1.64	0.14	0.05	-0.09	0.5%	1.69	17%
E36	2.45	0.19	0.09	-0.11	0.9%	2.54	25%
E37	1.41	0.07	0.03	-0.04	0.3%	1.44	14%
E38	1.42	0.08	0.02	-0.06	0.2%	1.44	14%
E39	1.55	0.49	0.18	-0.31	1.8%	1.73	17%
E40	1.36	0.06	0.03	-0.03	0.3%	1.39	14%
E41	1.36	0.08	0.04	-0.05	0.4%	1.40	14%
E42	1.36	0.07	0.03	-0.04	0.3%	1.39	14%
E43	1.36	0.06	0.03	-0.03	0.3%	1.39	14%
E44	1.36	0.08	0.03	-0.04	0.3%	1.39	14%
E45	2.45	0.16	0.07	-0.09	0.7%	2.52	25%
E46	2.45	0.14	0.06	-0.07	0.6%	2.51	25%
E47	1.52	0.09	0.04	-0.05	0.4%	1.56	16%
E48	1.37	0.06	0.03	-0.03	0.3%	1.40	14%
E49	1.41	0.08	0.03	-0.04	0.3%	1.44	14%
E50	1.37	0.06	0.03	-0.03	0.3%	1.40	13%
E51	1.41	0.08	0.03	-0.04	0.3%	1.44	12%
E52	1.42	0.10	0.04	-0.05	0.3%	1.46	11%
E53	1.44	0.08	0.03	-0.04	0.2%	1.47	11%
E54	1.44	0.07	0.03	-0.04	0.2%	1.47	10%
E55	1.44	0.07	0.03	-0.04	0.2%	1.47	9%
E56	1.64	0.14	0.05	-0.09	0.3%	1.69	10%
E57	1.64	0.16	0.06	-0.10	0.3%	1.70	9%
E58	1.86	0.20	0.07	-0.13	0.4%	1.93	10%
E59	1.86	0.19	0.07	-0.12	0.4%	1.93	10%
E60	1.86	0.17	0.07	-0.10	0.3%	1.93	9%
E61	1.86	0.18	0.07	-0.11	0.3%	1.93	9%
AQS / EAL Objective	**10 for all receptor except E10, E13 and E17-E19 20 for E10, E13 and E17-E19**						

Receptor ID	Background Annual Mean SO_2 baseline ($\mu g/m^3$)	SO_2 PC (Existing Scenario) ($\mu g/m^3$)	SO_2 PC (Proposed Scenario) ($\mu g/m^3$)	Change in PC	PC as a % of AQS/ EAL	SO_2 PEC ($\mu g/m^3$)	PEC as a % of AQS/EAL
Note: The screening criteria of E1 – E23 and E24 – E61 are 1% and 100% respectively of AQS							

8.2.4 Annual Mean Ammonia Concentrations

The predicted maximum annual mean ammonia PCs at the discrete receptor points are shown in **Table 8.31**. The results show that predicted PCs to atmospheric ammonia concentrations for the future operations scenario are below the 1% screening criteria at the discrete receptors representing SACs, SPAs and SSSIs, except receptors E1-E8, E10-E11 and E18-E20. It is further noted that the total ammonia concentration exceeded the critical levels at all receptor locations due to the high background ammonia concentration already exceeding the critical levels. No exceedance of the EA threshold of 100% of the relevant critical levels is predicted at the ancient woodlands and LWS.

It is noted that there is no increase in impacts predicted at any receptors when compared to the existing scenario. Furthermore, the depletion of ammonia has not been modelled; therefore, the assessment is judged to be conservative.

Table 8.30: Annual Average NH_3 Concentrations at Ecologically Sensitive Sites Maximum 5-year Results for Each Receptor (exceedances shown in bold)

Receptor ID	Background Annual Mean NH_3 baseline ($\mu g/m^3$)	NH_3 PC (Existing Scenario) ($\mu g/m^3$)	NH_3 PC (Proposed Scenario) ($\mu g/m^3$)	Change in PC	PC as a % of AQS/EAL	NH_3 PEC ($\mu g/m^3$)	PEC as a % of AQS/EAL
E1	**2.21**	0.04	0.02	-0.02	2.3%	**2.23**	**223%**
E2	**2.12**	0.08	0.04	-0.04	4.3%	**2.16**	**216%**
E3	**1.56**	0.11	0.08	-0.04	7.6%	**1.64**	**164%**
E4	**2.06**	0.06	0.04	-0.02	4.4%	**2.10**	**210%**
E5	**2.06**	0.02	0.01	-0.01	1.5%	**2.07**	**207%**
E6	**2.93**	0.02	0.01	0.00	1.0%	**2.94**	**294%**
E7	**2.50**	0.01	0.01	0.00	0.9%	**2.51**	**251%**
E8	**2.32**	0.01	0.01	0.00	0.7%	**2.33**	**233%**
E9	**2.12**	0.01	0.01	0.00	0.7%	**2.13**	**213%**
E10	2.06	0.01	0.01	0.00	0.3%	2.07	69%
E11	**1.76**	0.04	0.03	-0.01	2.9%	**1.78**	**178%**
E12	**1.73**	0.01	0.01	0.00	0.9%	**1.74**	**174%**
E13	1.59	0.01	0.00	0.00	0.1%	1.59	53%
E14	**1.49**	0.01	0.00	0.00	0.3%	**1.49**	**149%**
E15	**1.35**	0.01	0.00	0.00	0.4%	**1.36**	**136%**
E16	**1.34**	0.01	0.00	0.00	0.4%	**1.34**	**134%**
E17	2.42	0.02	0.01	-0.01	0.5%	2.43	81%
E18	3.04	0.03	0.02	-0.01	0.6%	3.06	102%
E19	3.17	0.02	0.01	-0.01	0.4%	3.18	106%
E20	**1.67**	0.02	0.01	0.00	1.1%	**1.68**	**168%**
E21	**1.23**	0.01	0.00	0.00	0.4%	**1.23**	**123%**
E22	**1.17**	0.00	0.00	0.00	0.3%	**1.17**	**117%**

Receptor ID	Background Annual Mean NH_3 baseline ($\mu g/m^3$)	NH_3 PC (Existing Scenario) ($\mu g/m^3$)	NH_3 PC (Proposed Scenario) ($\mu g/m^3$)	Change in PC	PC as a % of AQS/EAL	NH_3 PEC ($\mu g/m^3$)	PEC as a % of AQS/EAL
E23	**2.37**	0.02	0.01	-0.01	1.4%	**2.38**	**238%**
E24	**2.31**	0.09	0.05	-0.04	5.1%	**2.36**	**236%**
E25	**2.05**	0.07	0.05	-0.03	4.8%	**2.10**	**210%**
E26	**2.00**	0.02	0.01	-0.01	1.2%	**2.01**	**201%**
E27	**2.00**	0.03	0.02	-0.01	2.0%	**2.02**	**202%**
E28	**1.93**	0.03	0.02	-0.01	1.9%	**1.95**	**195%**
E29	**1.99**	0.03	0.02	-0.01	2.2%	**2.01**	**201%**
E30	**1.99**	0.03	0.02	-0.01	2.1%	**2.01**	**201%**
E31	**1.99**	0.06	0.04	-0.01	4.2%	**2.03**	**203%**
E32	**1.66**	0.03	0.02	-0.01	2.0%	**1.68**	**168%**
E33	**1.84**	0.08	0.04	-0.04	4.2%	**1.88**	**188%**
E34	**1.72**	0.02	0.02	0.00	2.0%	**1.74**	**174%**
E35	**2.03**	0.05	0.03	-0.02	3.0%	**2.06**	**206%**
E36	**1.76**	0.07	0.05	-0.02	4.9%	**1.81**	**181%**
E37	**1.66**	0.02	0.02	-0.01	1.8%	**1.68**	**168%**
E38	**1.72**	0.03	0.01	-0.02	1.1%	**1.73**	**173%**
E39	**1.77**	0.17	0.10	-0.07	9.9%	**1.87**	**187%**
E40	**1.66**	0.02	0.02	0.00	1.8%	**1.68**	**168%**
E41	**1.66**	0.03	0.02	-0.01	2.0%	**1.68**	**168%**
E42	**1.66**	0.02	0.02	-0.01	1.7%	**1.68**	**168%**
E43	**1.66**	0.02	0.02	0.00	1.6%	**1.68**	**168%**
E44	**1.66**	0.03	0.02	-0.01	1.9%	**1.68**	**168%**
E45	**1.76**	0.05	0.04	-0.01	4.1%	**1.80**	**180%**
E46	**1.76**	0.05	0.04	-0.01	3.6%	**1.80**	**180%**
E47	**1.67**	0.03	0.02	-0.01	2.4%	**1.69**	**169%**
E48	**1.61**	0.02	0.02	0.00	1.5%	**1.63**	**163%**
E49	**1.66**	0.03	0.02	-0.01	1.9%	**1.68**	**168%**
E50	**1.61**	0.02	0.02	-0.01	1.6%	**1.63**	**163%**
E51	**1.66**	0.03	0.02	-0.01	1.9%	**1.68**	**168%**
E52	**1.72**	0.03	0.02	-0.01	2.3%	**1.74**	**174%**
E53	**1.60**	0.03	0.02	-0.01	1.9%	**1.62**	**162%**
E54	**1.60**	0.02	0.02	-0.01	1.8%	**1.62**	**162%**
E55	**1.60**	0.02	0.02	-0.01	1.7%	**1.62**	**162%**
E56	**2.03**	0.05	0.03	-0.02	3.0%	**2.06**	**206%**
E57	**2.03**	0.06	0.03	-0.02	3.4%	**2.06**	**206%**
E58	**1.88**	0.07	0.04	-0.03	4.2%	**1.92**	**192%**
E59	**1.88**	0.07	0.04	-0.03	4.1%	**1.92**	**192%**
E60	**1.88**	0.06	0.04	-0.02	3.8%	**1.92**	**192%**
E61	**1.88**	0.06	0.04	-0.02	3.9%	**1.92**	**192%**
AQS / EAL Objective	**1 for all receptor except E10, E13 and E17-E19** **3 for E10, E13 and E17-E19**						
Note: The screening criteria of E1 – E23 and E24 – E61 are 1% and 100% respectively of AQS							

8.2.5 Weekly Mean HF concentrations

The predicted maximum weekly hydrogen fluoride PCs at the discrete receptor points are shown in **Table 8.31**[9]. The results show that predicted PCs to ground level hydrogen fluoride concentrations for the future operations scenario are above the 1% screening criteria at the discrete receptors representing SACs, SPAs and SSSIs. However, as there is not background data for HF available (and would be considered minimal), there is judged to be no exceedances of the HF weekly mean critical level. Furthermore, there is are no exceedances of the screening threshold of 100% are predicted at any ancient woodlands or LWS.

Table 8.31: Weekly Average HF Concentrations at Ecologically Sensitive Sites Maximum 5-year Results for Each Receptor (E1 – E23 represent European Sites)

Receptor ID	HF PC (Existing Stack) (µg/m^3)	HF PC (Proposed Stack) (µg/m^3)	Change in PC	PC as a % of AQS/EAL
E1	0.02	0.05	0.03	9.4%
E2	0.02	0.03	0.01	5.7%
E3	0.02	0.03	0.01	5.5%
E4	0.01	0.02	0.01	3.7%
E5	0.01	0.02	0.01	4.2%
E6	0.01	0.01	<0.01	2.5%
E7	0.01	0.02	0.01	4.3%
E8	0.01	0.03	0.01	5.0%
E9	0.01	0.02	0.01	3.4%
E10	0.01	0.02	0.01	3.1%
E11	0.01	0.01	<0.01	2.1%
E12	0.02	0.03	0.01	6.2%
E13	0.01	0.01	<0.01	2.4%
E14	0.01	0.01	<0.01	1.9%
E15	0.00	0.01	<0.01	1.2%
E16	0.00	0.01	<0.01	1.2%
E17	0.01	0.01	<0.01	2.4%
E18	0.01	0.01	<0.01	2.4%
E19	0.01	0.01	<0.01	2.2%
E20	0.01	0.01	<0.01	1.9%
E21	0.01	0.01	<0.01	1.5%
E22	0.00	0.01	<0.01	1.6%
E23	0.01	0.01	<0.01	1.8%
E24	0.01	0.02	0.01	3.7%
E25	0.01	0.03	0.01	5.6%
E26	0.02	0.04	0.03	8.9%
E27	0.02	0.03	0.02	6.9%
E28	0.02	0.04	0.02	8.1%
E29	0.02	0.03	0.01	5.3%
E30	0.01	0.03	0.01	5.5%
E31	0.02	0.03	0.01	6.4%

[9] Calculated by multiplying the 1-hour hydrogen fluoride concentration by 0.31, as recommended by the Environment Agency (https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit)

Receptor ID	HF PC (Existing Stack) (µg/m^3)	HF PC (Proposed Stack) (µg/m^3)	Change in PC	PC as a % of AQS/EAL
E32	0.01	0.04	0.02	7.2%
E33	0.02	0.03	0.01	6.3%
E34	0.02	0.04	0.02	8.5%
E35	0.02	0.02	<0.01	3.5%
E36	0.02	0.04	0.02	7.5%
E37	0.02	0.04	0.02	7.8%
E38	0.02	0.04	0.02	8.3%
E39	0.02	0.03	0.01	5.5%
E40	0.02	0.04	0.03	8.9%
E41	0.02	0.05	0.02	9.3%
E42	0.02	0.04	0.02	8.3%
E43	0.02	0.04	0.02	8.9%
E44	0.02	0.05	0.03	10.6%
E45	0.02	0.03	0.01	6.7%
E46	0.02	0.03	0.02	6.7%
E47	0.02	0.04	0.02	7.5%
E48	0.02	0.03	0.01	6.8%
E49	0.02	0.04	0.02	7.4%
E50	0.02	0.04	0.02	7.0%
E51	0.02	0.04	0.02	8.1%
E52	0.02	0.05	0.03	9.1%
E53	0.02	0.05	0.03	9.8%
E54	0.02	0.05	0.02	9.0%
E55	0.02	0.06	0.04	12.4%
E56	0.02	0.02	<0.01	3.6%
E57	0.01	0.02	<0.01	3.3%
E58	0.01	0.02	0.01	3.9%
E59	0.01	0.02	0.01	4.4%
E60	0.02	0.02	0.01	4.9%
E61	0.01	0.02	0.01	4.7%
AQS / EAL Objective	0.5 µg/m^3			
Note: The screening criteria of E1 – E23 and E24 – E61 are 1% and 100% respectively of AQS				

8.2.6 Daily Mean HF concentrations

The predicted maximum daily hydrogen fluoride PCs at the discrete receptor points are shown in **Table 8.32**[10]. The results show that predicted PCs to ground level hydrogen fluoride concentrations for the future operations scenario are below the 10% screening criteria at the discrete receptors representing SACs, SPAs and SSSIs. Furthermore, there is are no exceedances of the screening threshold of 100% are predicted at any ancient woodlands or LWS.

[10] Calculated by multiplying the 1-hour hydrogen fluoride concentration by 0.59, as recommended by the Environment Agency (https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit)

Table 8.32: Daily Average HF Concentrations at Ecologically Sensitive Sites Maximum 5-year Results for Each Receptor (E1 – E23 represent European Sites)

Receptor ID	HF PC (Existing Stack) (µg/m^3)	HF PC (Proposed Stack) (µg/m^3)	Change in PC	PC as a % of AQS/EAL
E1	0.03	0.09	0.06	1.8%
E2	0.03	0.05	0.02	1.1%
E3	0.03	0.05	0.02	1.0%
E4	0.02	0.04	0.01	0.7%
E5	0.02	0.04	0.02	0.8%
E6	0.02	0.02	<0.01	0.5%
E7	0.03	0.04	0.01	0.8%
E8	0.02	0.05	0.02	1.0%
E9	0.02	0.03	0.01	0.6%
E10	0.02	0.03	0.01	0.6%
E11	0.01	0.02	0.01	0.4%
E12	0.03	0.06	0.03	1.2%
E13	0.01	0.02	0.01	0.5%
E14	0.01	0.02	0.01	0.4%
E15	0.01	0.01	<0.01	0.2%
E16	0.01	0.01	<0.01	0.2%
E17	0.01	0.02	0.01	0.5%
E18	0.01	0.02	0.01	0.4%
E19	0.01	0.02	0.01	0.4%
E20	0.01	0.02	0.01	0.4%
E21	0.01	0.01	<0.01	0.3%
E22	0.01	0.02	0.01	0.3%
E23	0.01	0.02	0.01	0.3%
E24	0.02	0.04	0.01	0.7%
E25	0.03	0.05	0.03	1.1%
E26	0.03	0.08	0.05	1.7%
E27	0.03	0.07	0.04	1.3%
E28	0.04	0.08	0.04	1.5%
E29	0.03	0.05	0.02	1.0%
E30	0.03	0.05	0.02	1.0%
E31	0.04	0.06	0.02	1.2%
E32	0.03	0.07	0.04	1.4%
E33	0.03	0.06	0.03	1.2%
E34	0.04	0.08	0.04	1.6%
E35	0.03	0.03	<0.01	0.7%
E36	0.04	0.07	0.03	1.4%
E37	0.04	0.07	0.03	1.5%
E38	0.04	0.08	0.04	1.6%
E39	0.03	0.05	0.02	1.0%
E40	0.04	0.08	0.05	1.7%
E41	0.04	0.09	0.05	1.8%
E42	0.04	0.08	0.04	1.6%
E43	0.04	0.08	0.04	1.7%

Receptor ID	HF PC (Existing Stack) (µg/m^3)	HF PC (Proposed Stack) (µg/m^3)	Change in PC	PC as a % of AQS/EAL
E44	0.04	0.10	0.06	2.0%
E45	0.04	0.06	0.03	1.3%
E46	0.04	0.06	0.03	1.3%
E47	0.03	0.07	0.04	1.4%
E48	0.04	0.07	0.03	1.3%
E49	0.04	0.07	0.03	1.4%
E50	0.04	0.07	0.03	1.3%
E51	0.04	0.08	0.04	1.5%
E52	0.04	0.09	0.05	1.7%
E53	0.04	0.09	0.05	1.9%
E54	0.05	0.09	0.04	1.7%
E55	0.04	0.12	0.07	2.4%
E56	0.03	0.03	0.01	0.7%
E57	0.03	0.03	0.01	0.6%
E58	0.02	0.04	0.02	0.7%
E59	0.02	0.04	0.02	0.8%
E60	0.03	0.05	0.01	0.9%
E61	0.03	0.05	0.02	0.9%
AQS / EAL Objective	5 µg/m^3			
Note: The screening criteria of E1 – E23 and E24 – E61 are 10% and 100% respectively of AQS				

8.2.7 Nitrogen Deposition

The predicted nitrogen deposition fluxed at the discrete receptor points are shown in Table 8.33. The results of the model run show that predicted fluxes to nitrogen deposition for the scenario are below the criteria of 1% of the relevant critical level from the EA and Defra 2016 guidance at the discrete receptors representing SACs, SPAs and SSSIs except E1-E5, E11, E17-R20 and E23. No exceedance of the EA threshold of 100% of the relevant critical levels is predicted at the ancient woodlands and LWS.

It is noted that the total nitrogen deposition exceeded the lower critical loads at all receptor locations, due to the high background nitrogen deposition (as such PECs have not been presented). Also, it is noted that beneficial reduction in impacts are predicted at all receptors when compared to the existing scenario permitted under the Environmental Permit

8.2.8 Acid Deposition

The predicted acid deposition at the discrete receptor points are shown in Table 8.34. The results of the model run show that predicted PCs to acid deposition due to the proposed variation is below the criteria of 1% of the relevant critical level from the EA and Defra 2016 guidance at the discrete receptors representing SACs, SPAs and SSSIs except E02-E04, E17-E20 and E23. No exceedance of the EA threshold of 100% of the relevant critical levels is predicted at the ancient woodlands and LWS.

Table 8.33: Nitrogen Deposition Contribution at Ecological Sensitive Sites (E1 – E23 represent European Sites)

Receptor ID	Receptor	Broad Habitat Type	PC (Existing Scenario) (kg N/ha/yr)	PC (Proposed Scenario) (kg N/ha/yr)	Change in PC	Background N Deposition (kg N/ha/yr)	Total N Deposition (kg N/ha/yr)	Lower Critical Load	Process Contribution as a % of Lower Critical Load
E1	Buckley Claypits and Commons SSSI/ Deeside and Buckley Newt Sites SAC	Acidophilous Quercus forest	0.380	0.213	-0.167	34.248	34.461	10	2.134%
E2	Buckley Claypits and Commons SSSI/ Deeside and Buckley Newt Sites SAC	Acidophilous Quercus forest	0.713	0.393	-0.320	33.415	33.808	10	3.933%
E3	Buckley Claypits and Commons SSSI/ Deeside and Buckley Newt Sites SAC	Acidophilous Quercus forest	1.028	0.690	-0.337	32.582	33.272	10	6.903%
E4	Maes Y Grug SSSI/ Deeside and Buckley Newt Sites SAC	Acidophilous Quercus forest	0.552	0.402	-0.150	32.460	32.862	10	4.025%
E5	Connah's Quay Ponds and Woodland SSSI/Deeside and Buckley Newt Sites SAC	Acidophilous Quercus forest	0.220	0.135	-0.085	32.460	32.595	10	1.346%
E6	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	Acidophilous Quercus forest	0.137	0.094	-0.043	40.079	40.173	10	0.938%
E7	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	Acidophilous Quercus forest	0.118	0.082	-0.036	35.576	35.658	10	0.822%
E8	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	Acidophilous Quercus forest	0.095	0.066	-0.029	34.922	34.988	10	0.659%

Receptor ID	Receptor	Broad Habitat Type	PC (Existing Scenario) (kg N/ha/yr)	PC (Proposed Scenario) (kg N/ha/yr)	Change in PC	Background N Deposition (kg N/ha/yr)	Total N Deposition (kg N/ha/yr)	Lower Critical Load	Process Contribution as a % of Lower Critical Load
E9	Dee Estuary / Aber Afon Dyfrdwy SSSI/SAC	Coastal dune grasslands (grey dunes) - acid type European dry heaths	0.066	0.044	-0.022	19.480	19.524	5	0.873%
E10	Shotton Lagoons and Reedbeds SSSI	Coastal dune grasslands (grey dunes) - acid type European dry heaths	0.071	0.046	-0.024	19.043	19.089	10	0.463%
E11	Mynydd Y Fflint / Flint Mountain SSSI	Other: Other Tall Herb And Fern	0.232	0.168	-0.064	18.310	18.478	10	1.679%
E12	Coed Talon Marsh SSSI	Salix cinerea-Galium palustre woodland	0.121	0.085	-0.037	32.200	32.285	10	0.847%
E13	Chwarel Cambrian / Cambrian Quarry, Gwernymynydd SSSI	Rhinolophus hipposideros	0.054	0.037	-0.016	30.202	30.239	10	0.372%
E14	Alyn Valley Woods and Alyn Gorge Caves SSSI/SAC	Avenula pubescens grassland: Dactylis glomerata-Briza media subcommunity	0.030	0.020	-0.010	17.511	17.531	10	0.204%
E15	Bryn Alyn SSSI	Festuca ovina-Agrostis capillaris-Thymus praecox grassland: Trifolium repens-Luzula campestris subcommunity	0.035	0.024	-0.011	16.655	16.679	10	0.245%

Receptor ID	Receptor	Broad Habitat Type	PC (Existing Scenario) (kg N/ha/yr)	PC (Proposed Scenario) (kg N/ha/yr)	Change in PC	Background N Deposition (kg N/ha/yr)	Total N Deposition (kg N/ha/yr)	Lower Critical Load	Process Contribution as a % of Lower Critical Load
E16	Glaswelltiroedd Eryrys (Eryrys Grasslands) SSSI	Low and medium altitude hay meadows	0.037	0.026	-0.012	16.441	16.467	10	0.256%
E17	Llay Bog SSSI	Broadleaved deciduous woodland	0.194	0.136	-0.059	36.731	36.867	10	1.356%
E18	Chwarel Singret SSSI	Broadleaved and mixed woodlands	0.259	0.169	-0.090	39.256	39.425	10	1.690%
E19	Marford Quarry SSSI	Broadleaved and mixed woodlands	0.180	0.119	-0.062	40.240	40.359	10	1.187%
E20	Halkyn Mountain / Mynydd Helygain SAC	Arctic-alpine calcareous grassland	0.092	0.064	-0.028	18.966	19.030	5	1.272%
E21	Berwyn a Mynyddoedd De Clwyd / Berwyn and South Clwyd Mountains SAC	Arctic-alpine calcareous grassland Blanket bogs	0.035	0.024	-0.011	19.482	19.506	5	0.472%
E22	Berwyn a Mynyddoedd De Clwyd / Berwyn and South Clwyd Mountains SAC	Arctic-alpine calcareous grassland Blanket bogs	0.027	0.018	-0.009	19.419	19.437	5	0.367%
E23	Vicarage Moss SSSI/Ramsar	Fen - topogenous mires in valleys, basins and flood plains-	0.199	0.131	-0.069	36.640	36.771	5	2.618%
E24	Price's Hill Wood Ancient Woodland/ Flintshire Wildlife Site	Broadleaved woodland and scrub	0.855	0.469	-0.386	35.870	36.339	10	4.688%
E25	Bistre Wood Ancient Woodland/ Flintshire Wildlife Site	Broadleaved woodland and scrub	0.667	0.438	-0.229	33.730	34.168	10	4.381%

Receptor ID	Receptor	Broad Habitat Type	PC (Existing Scenario) (kg N/ha/yr)	PC (Proposed Scenario) (kg N/ha/yr)	Change in PC	Background N Deposition (kg N/ha/yr)	Total N Deposition (kg N/ha/yr)	Lower Critical Load	Process Contribution as a % of Lower Critical Load
E26	Black Pool Plantation Flintshire Wildlife Site	Fen	0.181	0.106	-0.075	21.090	21.196	5	2.118%
E27	Hartsheath Flintshire Wildlife Site	Lowland pasture and parkland	0.269	0.184	-0.085	33.630	33.814	20	0.920%
E28	Pontblyddyn Marsh and Coppa Wood Flintshire Wildlife Site	Pasture/ meadow and scrub Broadleaved woodland and scrub	0.246	0.177	-0.069	32.550	32.727	10	1.770%
E29	Padeswood Pool Flintshire Wildlife Site	Wet woodland/ Fen	0.296	0.200	-0.096	20.530	20.730	10	2.001%
E30	Padeswood Pasture Flintshire Wildlife Site	Pasture/ meadow and scrub	0.311	0.189	-0.121	20.530	20.719	20	0.947%
E31	Marleyfield Meadow Flintshire Wildlife Site	Pasture/meadow and scrub Broadleaved woodland and scrub	0.516	0.386	-0.130	20.530	20.916	10	3.857%
E32	Padeswood Marsh LWS	Broadleaved woodland and scrub	0.287	0.182	-0.105	30.310	30.492	10	1.818%
E33	Etna Road Pools LWS	Broadleaved woodland and scrub	0.710	0.381	-0.328	31.330	31.711	10	3.815%
E34	Plas Newydd Farm Lake LWS	Broadleaved woodland and scrub	0.213	0.183	-0.030	32.070	32.253	10	1.830%
E35	Riding School Wood and Grassland LWS	Broadleaved woodland and scrub	0.462	0.279	-0.183	34.200	34.479	10	2.786%

Receptor ID	Receptor	Broad Habitat Type	PC (Existing Scenario) (kg N/ha/yr)	PC (Proposed Scenario) (kg N/ha/yr)	Change in PC	Background N Deposition (kg N/ha/yr)	Total N Deposition (kg N/ha/yr)	Lower Critical Load	Process Contribution as a % of Lower Critical Load
E36	Garth Wood and Hartsheath LWS	Broadleaved woodland and scrub	0.615	0.450	-0.165	30.540	30.990	10	4.502%
E37	Warred Dingle LWS	Broadleaved woodland and scrub	0.219	0.162	-0.057	30.310	30.472	10	1.621%
E38	Ancient Woodland 1	Broadleaved woodland and scrub	0.268	0.100	-0.167	31.260	31.360	10	1.004%
E39	Ancient Woodland 2	Broadleaved woodland and scrub	1.555	0.905	-0.650	32.210	33.115	10	9.050%
E40	Ancient Woodland 3	Broadleaved woodland and scrub	0.194	0.162	-0.033	31.100	31.262	10	1.617%
E41	Ancient Woodland 4	Broadleaved woodland and scrub	0.261	0.185	-0.077	31.100	31.285	10	1.848%
E42	Ancient Woodland 5	Broadleaved woodland and scrub	0.212	0.154	-0.058	31.100	31.254	10	1.541%
E43	Ancient Woodland 6	Broadleaved woodland and scrub	0.187	0.148	-0.039	31.100	31.248	10	1.477%
E44	Ancient Woodland 7	Broadleaved woodland and scrub	0.246	0.175	-0.071	31.100	31.275	10	1.749%
E45	Ancient Woodland 8	Broadleaved woodland and scrub	0.500	0.373	-0.127	30.540	30.913	10	3.732%
E46	Ancient Woodland 9	Broadleaved woodland and scrub	0.435	0.329	-0.106	30.540	30.869	10	3.294%
E47	Ancient Woodland 10	Broadleaved woodland and scrub	0.285	0.218	-0.067	30.070	30.288	10	2.183%

Receptor ID	Receptor	Broad Habitat Type	PC (Existing Scenario) (kg N/ha/yr)	PC (Proposed Scenario) (kg N/ha/yr)	Change in PC	Background N Deposition (kg N/ha/yr)	Total N Deposition (kg N/ha/yr)	Lower Critical Load	Process Contribution as a % of Lower Critical Load
E48	Ancient Woodland 11	Broadleaved woodland and scrub	0.183	0.138	-0.044	29.920	30.058	10	1.384%
E49	Ancient Woodland 12	Broadleaved woodland and scrub	0.242	0.176	-0.066	30.310	30.486	10	1.760%
E50	Ancient Woodland 13	Broadleaved woodland and scrub	0.196	0.148	-0.048	29.920	30.068	10	1.478%
E51	Ancient Woodland 14	Broadleaved woodland and scrub	0.248	0.178	-0.070	30.310	30.488	10	1.781%
E52	Ancient Woodland 15	Broadleaved woodland and scrub	0.303	0.212	-0.090	31.260	31.472	10	2.124%
E53	Ancient Woodland 16	Broadleaved woodland and scrub	0.241	0.175	-0.066	30.130	30.305	10	1.752%
E54	Ancient Woodland 17	Broadleaved woodland and scrub	0.220	0.163	-0.057	30.130	30.293	10	1.635%
E55	Ancient Woodland 18	Broadleaved woodland and scrub	0.213	0.152	-0.061	30.130	30.282	10	1.516%
E56	Ancient Woodland 19	Broadleaved woodland and scrub	0.460	0.278	-0.182	34.200	34.478	10	2.778%
E57	Ancient Woodland 20	Broadleaved woodland and scrub	0.521	0.310	-0.211	34.200	34.510	10	3.104%
E58	Ancient Woodland 21	Broadleaved woodland and scrub	0.638	0.384	-0.253	33.270	33.654	10	3.841%
E59	Ancient Woodland 22	Broadleaved woodland and scrub	0.606	0.376	-0.231	33.270	33.646	10	3.756%

Receptor ID	Receptor	Broad Habitat Type	PC (Existing Scenario) (kg N/ha/yr)	PC (Proposed Scenario) (kg N/ha/yr)	Change in PC	Background N Deposition (kg N/ha/yr)	Total N Deposition (kg N/ha/yr)	Lower Critical Load	Process Contribution as a % of Lower Critical Load
E60	Ancient Woodland 23	Broadleaved woodland and scrub	0.545	0.349	-0.196	33.270	33.619	10	3.492%
E61	Ancient Woodland 24	Broadleaved woodland and scrub	0.561	0.356	-0.205	33.270	33.626	10	3.562%

Table 8.34: Acid Deposition at Ecological Sensitive Sites (E1 – E23 represent European Sites)

Receptor ID	Receptor	Broad Habitat Type	Process N Acid Deposition (Existing) (keq/ha/yr)	Process S Acid Deposition (Existing) (keq/ha/yr)	Process N Acid Deposition (Proposed) (keq/ha/yr)	Process S Acid Deposition (Proposed) (keq/ha/yr)	Background Acid Deposition (keq/ha/yr)		Maximum Critical Load (S) (keq/ha/yr)	Minimum Critical Load (N) (keq/ha/yr)	Maximum Critical Load (Nitrogen) (keq/ha/yr)	PC and as a % of lower critical load
							Nitrogen	Sulphur				
E1	Buckley Claypits and Commons SSSI/ Deeside and Buckley Newt Sites SAC	Acidophilous Quercus forest	0.0271	0.031	0.0152	0.014	2.47	0.21	2.642	0.357	2.999	0.959%
E2	Buckley Claypits and Commons SSSI/ Deeside and Buckley Newt Sites SAC	Acidophilous Quercus forest	0.0508	0.059	0.0280	0.025	2.39	0.22	2.642	0.357	2.999	1.770%
E3	Buckley Claypits and Commons SSSI/ Deeside and Buckley Newt Sites SAC	Acidophilous Quercus forest	0.0731	0.085	0.0491	0.044	2.33	0.22	2.642	0.357	2.999	3.095%
E4	Maes Y Grug SSSI/ Deeside and Buckley Newt Sites SAC	Acidophilous Quercus forest	0.0393	0.045	0.0286	0.026	2.32	0.25	1.477	0.357	1.834	2.953%
E5	Connah's Quay Ponds and Woodland SSSI/Deeside and Buckley Newt Sites SAC	Acidophilous Quercus forest	0.0156	0.018	0.0096	0.009	2.32	0.25	2.642	0.357	2.999	0.605%
E6	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	Acidophilous Quercus forest	0.0098	0.011	0.0067	0.006	2.86	0.22	3.583	0.357	3.94	0.321%
E7	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	Acidophilous Quercus forest	0.0084	0.010	0.0059	0.005	2.54	0.24	3.583	0.357	3.94	0.281%
E8	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	Acidophilous Quercus forest	0.0068	0.008	0.0047	0.004	2.41	0.25	3.583	0.357	3.94	0.225%
E9	Dee Estuary / Aber Afon Dyfrdwy SSSI/SAC	Coastal dune grasslands (grey dunes) - acid type European dry heaths	0.0047	0.004	0.0031	0.002	2.41	0.25	4.12	0.892	4.972	0.104%
E10	Shotton Lagoons and Reedbeds SSSI	Coastal dune grasslands (grey dunes) - acid type European dry heaths	0.0050	0.004	0.0033	0.002	1.36	0.26	4.12	0.892	4.972	0.110%

Receptor ID	Receptor	Broad Habitat Type	Process N Acid Deposition (Existing) (keq/ha/yr)	Process S Acid Deposition (Existing) (keq/ha/yr)	Process N Acid Deposition (Proposed) (keq/ha/yr)	Process S Acid Deposition (Proposed) (keq/ha/yr)	Background Acid Deposition (keq/ha/yr)		Maximum Critical Load (S) (keq/ha/yr)	Minimum Critical Load (N) (keq/ha/yr)	Maximum Critical Load (Nitrogen) (keq/ha/yr)	PC and as a % of lower critical load
							Nitrogen	Sulphur				
E11	Mynydd Y Fflint / Flint Mountain SSSI	Other: Other Tall Herb And Fern	0.0165	0.015	0.0119	0.008	1.31	0.17	0.349	0.142	0.634	3.133%
E12	Coed Talon Marsh SSSI	Salix cinerea-Galium palustre woodland	0.0086	0.010	0.0060	0.005	1.49	0.18	0.349	0.142	0.634	1.799%
E13	Chwarel Cambrian / Cambrian Quarry, Gwernymynydd SSSI	Rhinolophus hipposideros	0.0038	0.004	0.0026	0.002	2.16	0.21	5.955	0.142	6.097	0.082%
E14	Alyn Valley Woods and Alyn Gorge Caves SSSI/SAC	Avenula pubescens grassland: Dactylis glomerata-Briza media subcommunity	0.0022	0.002	0.0015	0.001	2.11	0.2	4	0.856	4.856	0.050%
E15	Bryn Alyn SSSI	Festuca ovina-Agrostis capillaris-Thymus praecox grassland: Trifolium repens-Luzula campestris subcommunity	0.0025	0.002	0.0017	0.001	2.12	0.2	4	0.856	4.856	0.060%
E16	Glaswelltiroedd Eryrys (Eryrys Grasslands) SSSI	Low and medium altitude hay meadows	0.003	0.002	0.002	0.001	1.41	0.17	4	0.856	4.856	0.062%
E17	Llay Bog SSSI	Broadleaved deciduous woodland	0.014	0.016	0.010	0.009	1.59	0.18	1.696	0.357	1.918	0.954%
E18	Chwarel Singret SSSI	Broadleaved and mixed woodlands	0.018	0.021	0.012	0.011	2.7	0.22	1.696	0.357	1.918	1.190%
E19	Marford Quarry SSSI	Broadleaved and mixed woodlands	0.013	0.015	0.008	0.008	2.87	0.19	1.023	0.142	1.165	1.375%
E20	Halkyn Mountain / Mynydd Helygain SAC	Arctic-alpine calcareous grassland	0.007	0.006	0.005	0.003	1.35	0.17	4	1.071	5.071	0.149%

Receptor ID	Receptor	Broad Habitat Type	Process N Acid Deposition (Existing) (keq/ha/yr)	Process S Acid Deposition (Existing) (keq/ha/yr)	Process N Acid Deposition (Proposed) (keq/ha/yr)	Process S Acid Deposition (Proposed) (keq/ha/yr)	Background Acid Deposition (keq/ha/yr)		Maximum Critical Load (S) (keq/ha/yr)	Minimum Critical Load (N) (keq/ha/yr)	Maximum Critical Load (Nitrogen) (keq/ha/yr)	PC and as a % of lower critical load
							Nitrogen	Sulphur				
E21	Berwyn a Mynyddoedd De Clwyd / Berwyn and South Clwyd Mountains SAC	Arctic-alpine calcareous grassland Blanket bogs	0.002	0.002	0.002	0.001	1.39	0.17	1.046	0.321	1.367	0.205%
E22	Berwyn a Mynyddoedd De Clwyd / Berwyn and South Clwyd Mountains SAC	Arctic-alpine calcareous grassland Blanket bogs	0.002	0.002	0.001	0.001	1.39	0.17	1.046	0.321	1.367	0.159%
E23	Vicarage Moss SSSI/Ramsar	Fen - topogenous mires in valleys, basins and flood plains-	0.014	0.016	0.009	0.008	2.62	0.21	0.198	0.321	0.519	3.406%
E24	Price's Hill Wood Ancient Woodland/ Flintshire Wildlife Site	Broadleaved woodland and scrub	0.061	0.070	0.033	0.030	2.56	0.2	2.643	0.357	3	2.108%
E25	Bistre Wood Ancient Woodland/ Flintshire Wildlife Site	Broadleaved woodland and scrub	0.047	0.055	0.031	0.028	2.41	0.2	2.632	0.357	2.989	1.967%
E26	Black Pool Plantation Flintshire Wildlife Site	Fen	0.013	0.015	0.008	0.007	1.51	0.17	Not Sensitive to acidity			
E27	Hartsheath Flintshire Wildlife Site	Lowland pasture and parkland	0.019	0.022	0.013	0.012	2.4	0.21	2.632	0.357	2.989	0.827%
E28	Pontblyddyn Marsh and Coppa Wood Flintshire Wildlife Site	Pasture/ meadow and scrub Broadleaved woodland and scrub	0.018	0.020	0.013	0.011	2.32	0.21	1.643	0.142	1.785	1.329%
E29	Padeswood Pool Flintshire Wildlife Site	Wet woodland/ Fen	0.021	0.024	0.014	0.013	1.47	0.17	2.637	0.357	2.994	0.897%
E30	Padeswood Pasture Flintshire Wildlife Site	Pasture/ meadow and scrub	0.022	0.026	0.013	0.012	1.47	0.17	2.637	0.357	2.994	0.850%
E31	Marleyfield Meadow Flintshire Wildlife Site	Pasture/meadow and scrub	0.037	0.042	0.027	0.024	2.33	0.2	2.637	0.357	2.994	1.730%

Receptor ID	Receptor	Broad Habitat Type	Process N Acid Deposition (Existing) (keq/ha/yr)	Process S Acid Deposition (Existing) (keq/ha/yr)	Process N Acid Deposition (Proposed) (keq/ha/yr)	Process S Acid Deposition (Proposed) (keq/ha/yr)	Background Acid Deposition (keq/ha/yr)		Maximum Critical Load (S) (keq/ha/yr)	Minimum Critical Load (N) (keq/ha/yr)	Maximum Critical Load (Nitrogen) (keq/ha/yr)	PC and as a % of lower critical load
							Nitrogen	Sulphur				
		Broadleaved woodland and scrub										
E32	Padeswood Marsh LWS	Broadleaved woodland and scrub	0.020	0.024	0.013	0.011	2.16	0.21	1.643	0.142	1.785	1.367%
E33	Etna Road Pools LWS	Broadleaved woodland and scrub	0.050	0.058	0.027	0.024	2.24	0.23	2.638	0.357	2.995	1.719%
E34	Plas Newydd Farm Lake LWS	Broadleaved woodland and scrub	0.015	0.018	0.013	0.012	2.29	0.21	1.504	0.357	1.861	1.319%
E35	Riding School Wood and Grassland LWS	Broadleaved woodland and scrub	0.033	0.038	0.020	0.018	2.44	0.2	2.64	0.357	2.997	1.251%
E36	Garth Wood and Hartsheath LWS	Broadleaved woodland and scrub	0.044	0.051	0.032	0.028	2.18	0.22	2.637	0.357	2.994	2.019%
E37	Warred Dingle LWS	Broadleaved woodland and scrub	0.016	0.018	0.012	0.010	2.16	0.21	1.643	0.412	1.785	1.219%
E38	Ancient Woodland 1	Broadleaved woodland and scrub	0.019	0.022	0.007	0.006	2.23	0.21	2.632	0.357	2.989	0.453%
E39	Ancient Woodland 2	Broadleaved woodland and scrub	0.111	0.128	0.064	0.058	2.3	0.21	2.618	0.357	2.975	4.098%
E40	Ancient Woodland 3	Broadleaved woodland and scrub	0.014	0.016	0.012	0.010	2.22	0.21	2.635	0.357	2.992	0.725%
E41	Ancient Woodland 4	Broadleaved woodland and scrub	0.019	0.021	0.013	0.012	2.22	0.21	2.635	0.357	2.992	0.830%
E42	Ancient Woodland 5	Broadleaved woodland and scrub	0.015	0.017	0.011	0.010	2.22	0.21	2.635	0.357	2.992	0.693%
E43	Ancient Woodland 6	Broadleaved woodland and scrub	0.013	0.015	0.011	0.009	2.22	0.21	2.635	0.357	2.992	0.663%
E44	Ancient Woodland 7	Broadleaved woodland and scrub	0.018	0.020	0.012	0.011	2.22	0.21	2.635	0.357	2.992	0.786%

Receptor ID	Receptor	Broad Habitat Type	Process N Acid Deposition (Existing) (keq/ha/yr)	Process S Acid Deposition (Existing) (keq/ha/yr)	Process N Acid Deposition (Proposed) (keq/ha/yr)	Process S Acid Deposition (Proposed) (keq/ha/yr)	Background Acid Deposition (keq/ha/yr)		Maximum Critical Load (S) (keq/ha/yr)	Minimum Critical Load (N) (keq/ha/yr)	Maximum Critical Load (Nitrogen) (keq/ha/yr)	PC and as a % of lower critical load
							Nitrogen	Sulphur				
E45	Ancient Woodland 8	Broadleaved woodland and scrub	0.036	0.041	0.027	0.024	2.18	0.22	2.637	0.357	2.994	1.675%
E46	Ancient Woodland 9	Broadleaved woodland and scrub	0.031	0.036	0.023	0.021	2.18	0.22	2.637	0.357	2.994	1.479%
E47	Ancient Woodland 10	Broadleaved woodland and scrub	0.020	0.023	0.016	0.014	2.15	0.2	2.642	0.357	2.999	0.979%
E48	Ancient Woodland 11	Broadleaved woodland and scrub	0.013	0.015	0.010	0.009	2.14	0.21	1.649	0.142	1.791	1.038%
E49	Ancient Woodland 12	Broadleaved woodland and scrub	0.017	0.020	0.013	0.011	2.16	0.21	1.643	0.142	1.785	1.323%
E50	Ancient Woodland 13	Broadleaved woodland and scrub	0.014	0.016	0.011	0.009	2.14	0.21	1.649	0.142	1.791	1.108%
E51	Ancient Woodland 14	Broadleaved woodland and scrub	0.018	0.020	0.013	0.011	2.16	0.21	1.643	0.142	1.785	1.338%
E52	Ancient Woodland 15	Broadleaved woodland and scrub	0.022	0.025	0.015	0.013	2.23	0.21	2.632	0.357	2.989	0.509%
E53	Ancient Woodland 16	Broadleaved woodland and scrub	0.017	0.020	0.012	0.011	2.15	0.21	1.647	0.142	1.789	0.674%
E54	Ancient Woodland 17	Broadleaved woodland and scrub	0.016	0.018	0.012	0.010	2.15	0.21	1.647	0.142	1.789	0.629%
E55	Ancient Woodland 18	Broadleaved woodland and scrub	0.015	0.017	0.011	0.010	2.15	0.21	1.647	0.142	1.789	0.584%
E56	Ancient Woodland 19	Broadleaved woodland and scrub	0.033	0.038	0.020	0.018	2.44	0.2	2.64	0.357	2.997	0.667%
E57	Ancient Woodland 20	Broadleaved woodland and scrub	0.037	0.043	0.022	0.020	2.44	0.2	2.64	0.357	2.997	0.746%
E58	Ancient Woodland 21	Broadleaved woodland and scrub	0.045	0.052	0.027	0.024	2.38	0.2	2.643	0.357	3	0.926%

Receptor ID	Receptor	Broad Habitat Type	Process N Acid Deposition (Existing) (keq/ha/yr)	Process S Acid Deposition (Existing) (keq/ha/yr)	Process N Acid Deposition (Proposed) (keq/ha/yr)	Process S Acid Deposition (Proposed) (keq/ha/yr)	Background Acid Deposition (keq/ha/yr)		Maximum Critical Load (S) (keq/ha/yr)	Minimum Critical Load (N) (keq/ha/yr)	Maximum Critical Load (Nitrogen) (keq/ha/yr)	PC and as a % of lower critical load
							Nitrogen	Sulphur				
E59	Ancient Woodland 22	Broadleaved woodland and scrub	0.043	0.050	0.027	0.024	2.38	0.2	2.643	0.357	3	0.905%
E60	Ancient Woodland 23	Broadleaved woodland and scrub	0.039	0.045	0.025	0.022	2.38	0.2	2.643	0.357	3	0.841%
E61	Ancient Woodland 24	Broadleaved woodland and scrub	0.040	0.046	0.025	0.023	2.38	0.2	2.643	0.357	3	0.858%

8.3 Overall Results

The effects on nearby human receptors due to the proposed variation can be summarised below:

- there are no predicted exceedances of the 1% of 10% screening thresholds due to the emissions from the proposed PCCC stack. The exception is for the benzene annual mean, where the PC exceeds 1%. This is due to the extremely conservative assumption that all emissions of NMVOC compounds are benzene.
- PECs (background + PC) are not predicted to exceed any AQS at any assessed location. Generally, PECs are well below the AQS set for each pollutant.
- for pollutants such as NO_2, SO_2, PM_{10}, benzene and CO, there is a general reduction in impacts due to the proposed variation. This is due to the proposed reduction in emission limit values for the new stack when compared with the existing. In general, the mass gas flow rate has increased from the stack, so for pollutants where the emission limit value has not been reduced, there are small increases in impacts. However, these are generally for emissions of pollutants such as the metals, HCl and HF, where impacts are far below the screening thresholds.
- Based on the previous HHRA and only a slight increase in dioxins and furans ground level concentrations, an additional HHRA is not judged to be required.

The effects on nearby ecological receptors due to the proposed variation can be summarised below:

- the predicted maximum annual mean NO_x and SO_2 PCs are below the screening criteria of 1% at all SPA/SAC/Ramsar/SSSI receptor locations, except for receptor E03. Meanwhile, the PECs at E03 (and all other receptors) are below the relevant critical levels.
- The 24-hour mean 100th percentile NO_X PCs are well below the screening criteria of 10% at all ecological receptor locations. Furthermore, all 24-hour NOx PEC are below the 24-hour critical level.
- The predicted ammonia PCs due to the proposed variation are below the 1% screening criteria, except at receptors E1-E6, E11 and E20;
- The predicted nitrogen deposition fluxes due to the proposed variation are below the 1% EA screening criteria, except at receptors E1-E5, E11, E17-R20 and E23;
- The predicted acid deposition fluxes due to the proposed variation are below the 1% screening criteria, except at receptors E02-E04, E11-12, E18-E19 and E23;
- No exceedance of the EA threshold of 100% of the relevant critical levels is predicted at the ancient woodlands and LWS; and
- There are widespread predicted PEC exceedances of the ammonia critical level and nutrient nitrogen and acid deposition critical loads. This is due to the background concentration already exceeding the critical level/loads, which is common across most parts of the U.K.
- The assessment against ecological receptors is judged to be conservative, especially regarding the effects of ammonia depletion not being considered and the assumption that the plant will emit at its ELVs for the majority of the year.

9 MITIGATION MEASURES

9.1 Operational Phase Mitigation

The assessment predicts exceedance of the PC screening thresholds and PECs against the ammonia critical level and nutrient nitrogen and acid deposition critical loads. While the conservative nature of the modelling assessment may have overpredicted impacts at some ecological sites, due to the elevated backgrounds, all continuous monitoring of in-stack emissions put in place for the protection of ecologically sensitive sites within the current permit should continue.

10 CONCLUSIONS

An assessment of the air quality impacts of the Padeswood Carbon Capture and Storage Project has been undertaken, with reference to existing air quality in the area and relevant air quality legislation, policy and guidance.

This assessment only considers pollutants already emitted from the installation; the impacts of emissions associated with the solvents used within the PCCC plant are contained within a separate technical appendix.

The maximum predicted impacts at modelled discrete receptor locations across five modelled meteorological years have been reported and compared to the relevant AQSs. Where relevant, the modelling methodology used has been conservative methodology, in line with industry guidance.

With the exception of the ground-level concentrations of benzene, there are no predicted exceedances of the 1% of 10% screening thresholds at nearby human receptors due to emissions from the proposed PCCC stack or the entire facility. Furthermore, no total concentrations (background + concentrations from the facility) are predicted to exceed any Air Quality Standards at any assessed location, and there is a general reduction in ground-level concentrations due to the proposed variation. When considering the above, the impacts on human receptors due to the proposed variation are considered not to be significant.

For ecological receptors, there are predicted to be exceedances of long-term screening thresholds against the ammonia, nitrogen deposition and acid deposition critical levels/loads at nearby European designated sites due to the operation of the proposed PCCC stack. Furthermore, while there are also predicted exceedances of the ammonia critical level and nutrient nitrogen and acid deposition critical loads, these are due to existing background concentrations exceeding the critical loads rather than due to the contribution from the operation of the facility following the variation.

It is not possible for the air quality assessment to determine the overall significance of the total concentrations/fluxes at each specific habitat site. However, when considering the conservativeness of the assessment, which will likely overpredict impacts at nearby ecological sites, the proposed mitigation, and the reduction in impacts due to the proposed variation, the proposed variation itself is not judged to have a significant impact on nearby ecological sites.

Overall, the effects of the proposed variation are judged not to be significant.

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APPENDIX A FIGURES

This appendix contains the following figures referenced within this report:

Figure A1: Sources and buildings included in the Dispersion Modelling Assessment

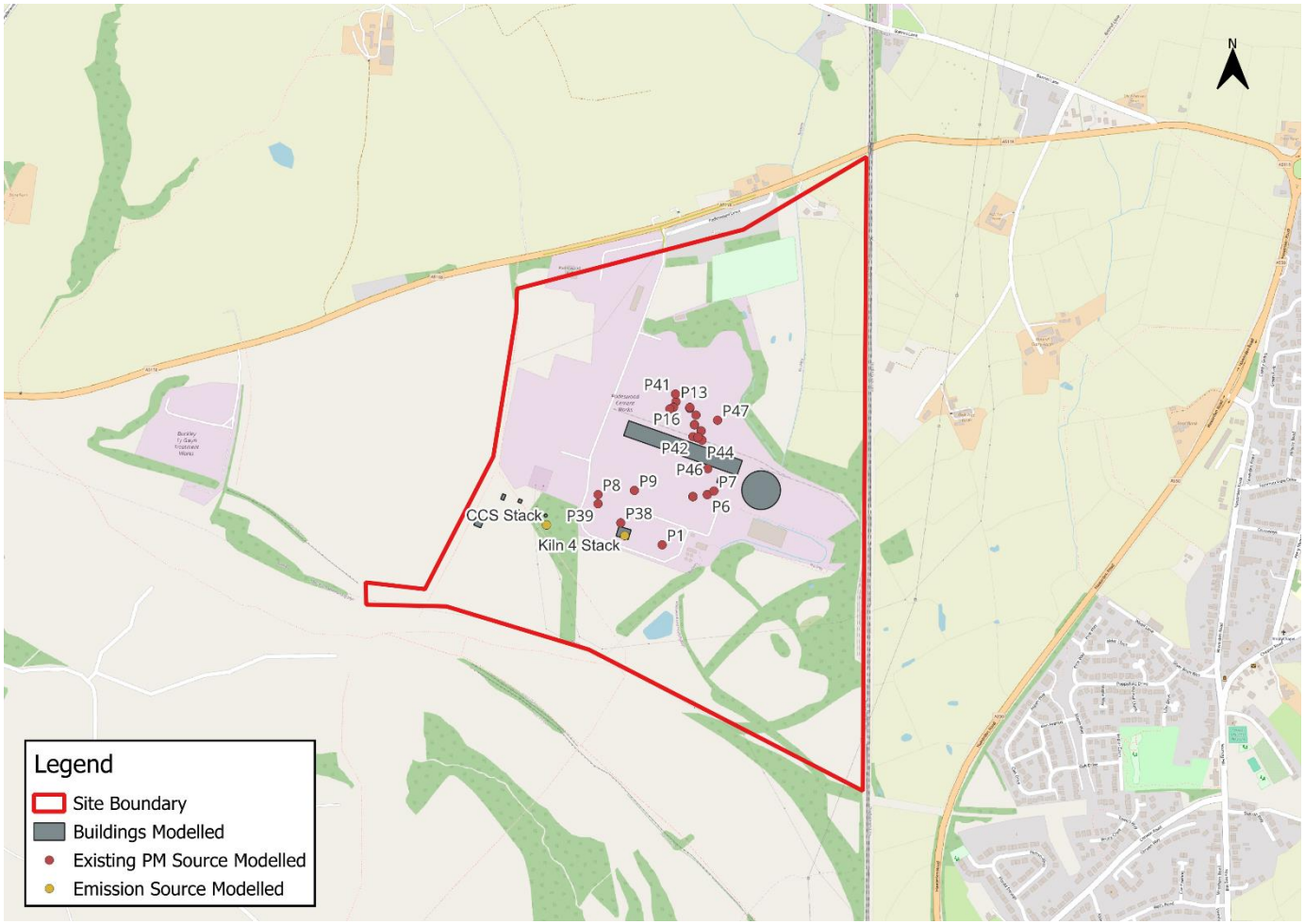

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Figure A2: Human Receptors included in the Dispersion Modelling Assessment

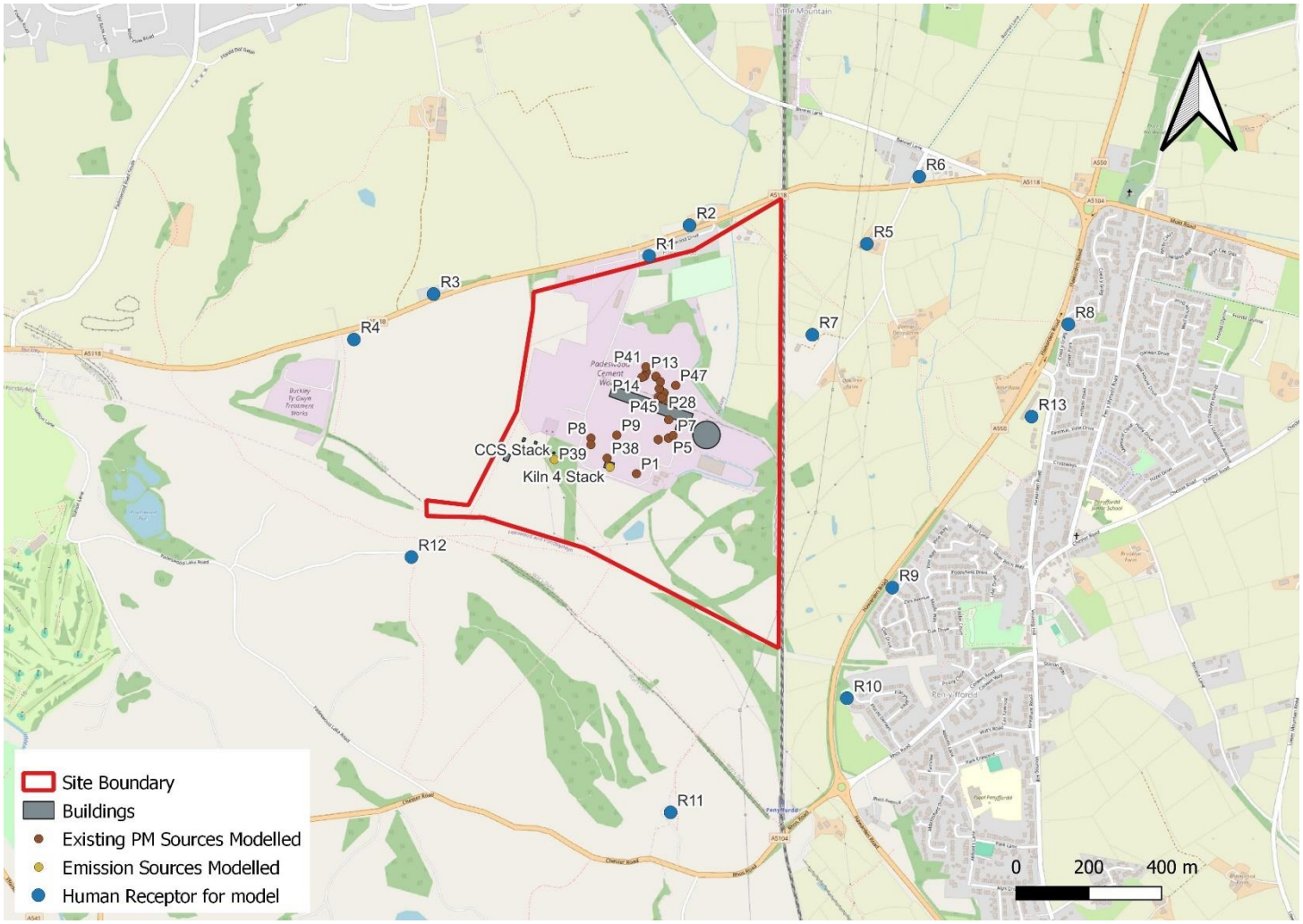

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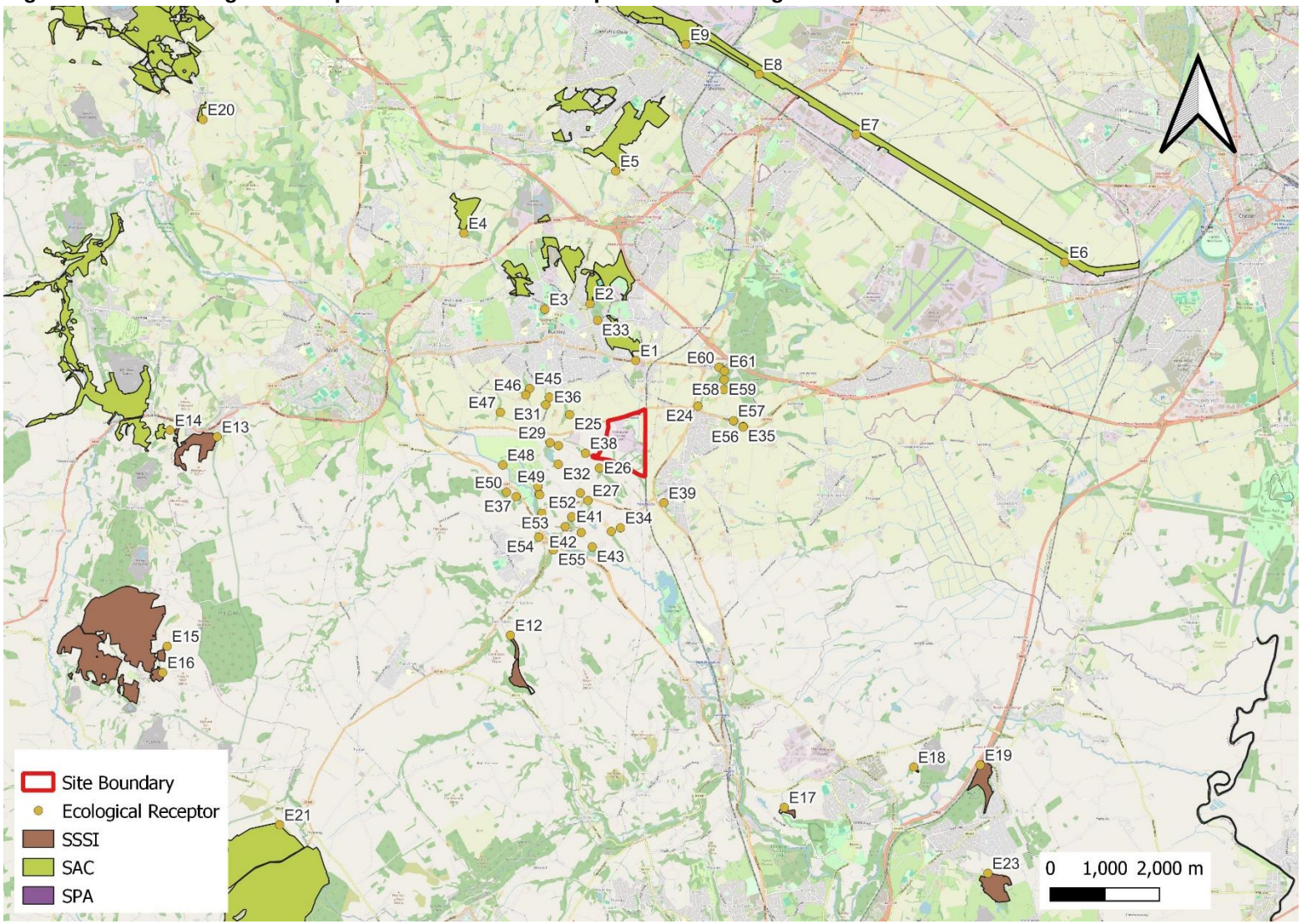
Figure A3: Ecological Receptors included in the Dispersion Modelling Assessment



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APPENDIX B: WINDROSES

This appendix contains the 2018 – 2022 windroses for the Hawarden Weather Station

Figure B1: Windrose for the Hawarden Weather Station – 2018

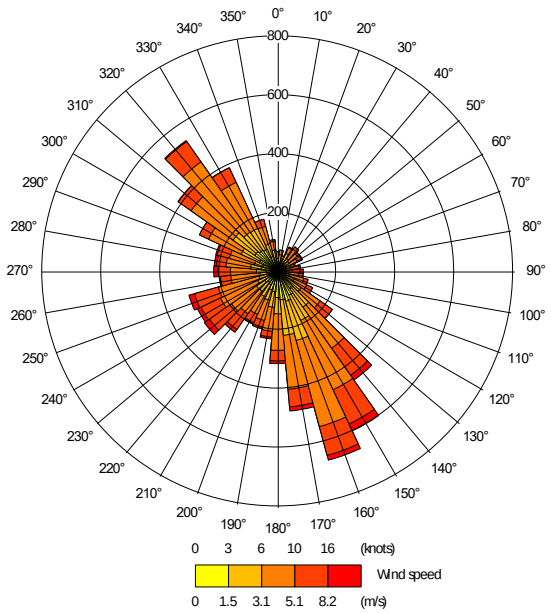


Figure B2: Windrose for the Hawarden Weather Station – 2019

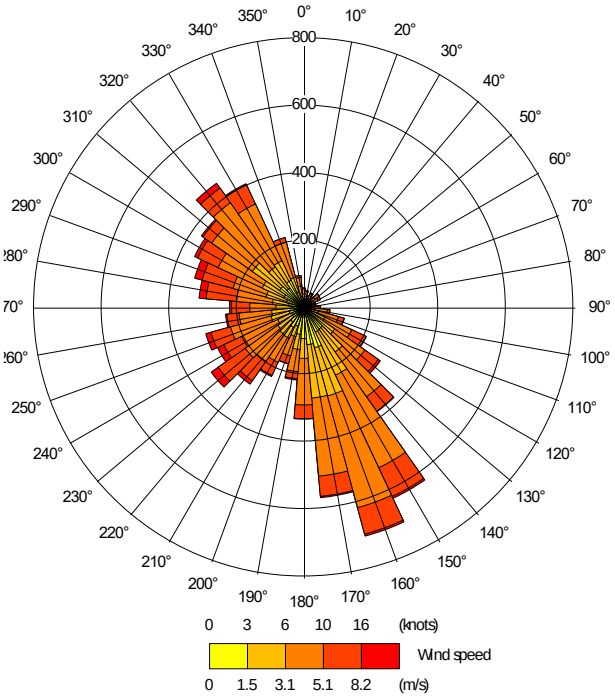


Figure B3: Windrose for the Hawarden Weather Station – 2020

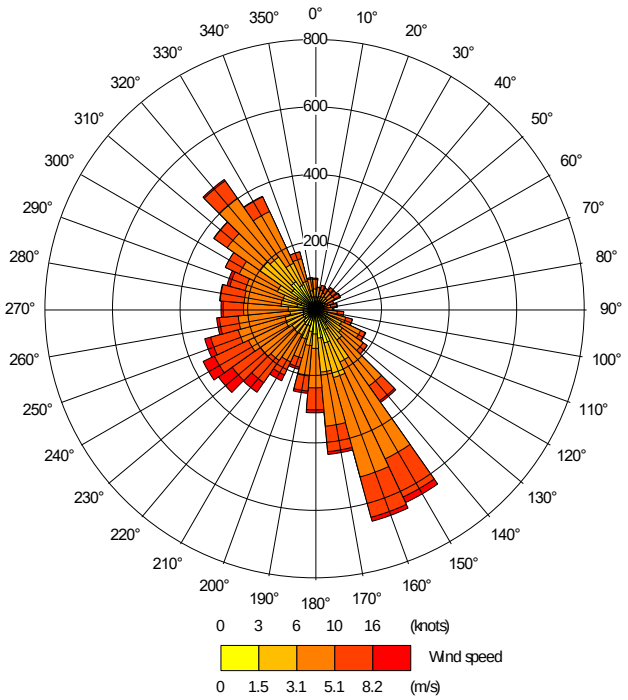


Figure B4: Windrose for the Hawarden Weather Station – 2021

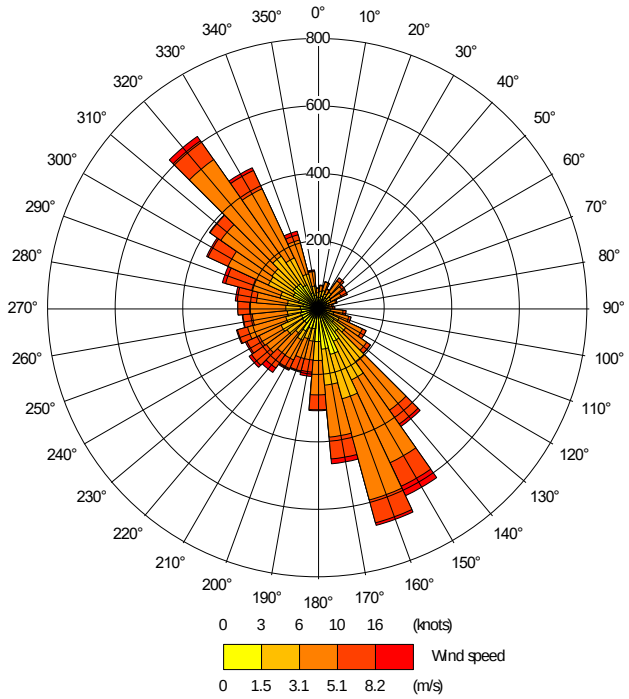
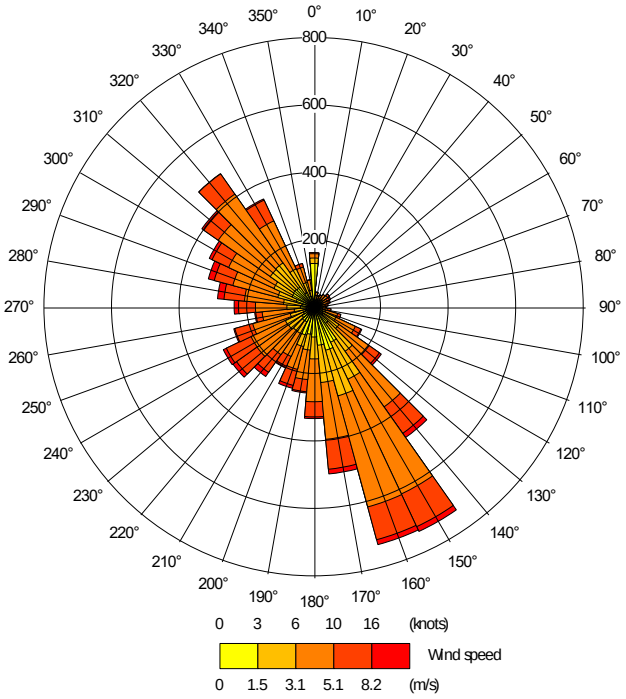


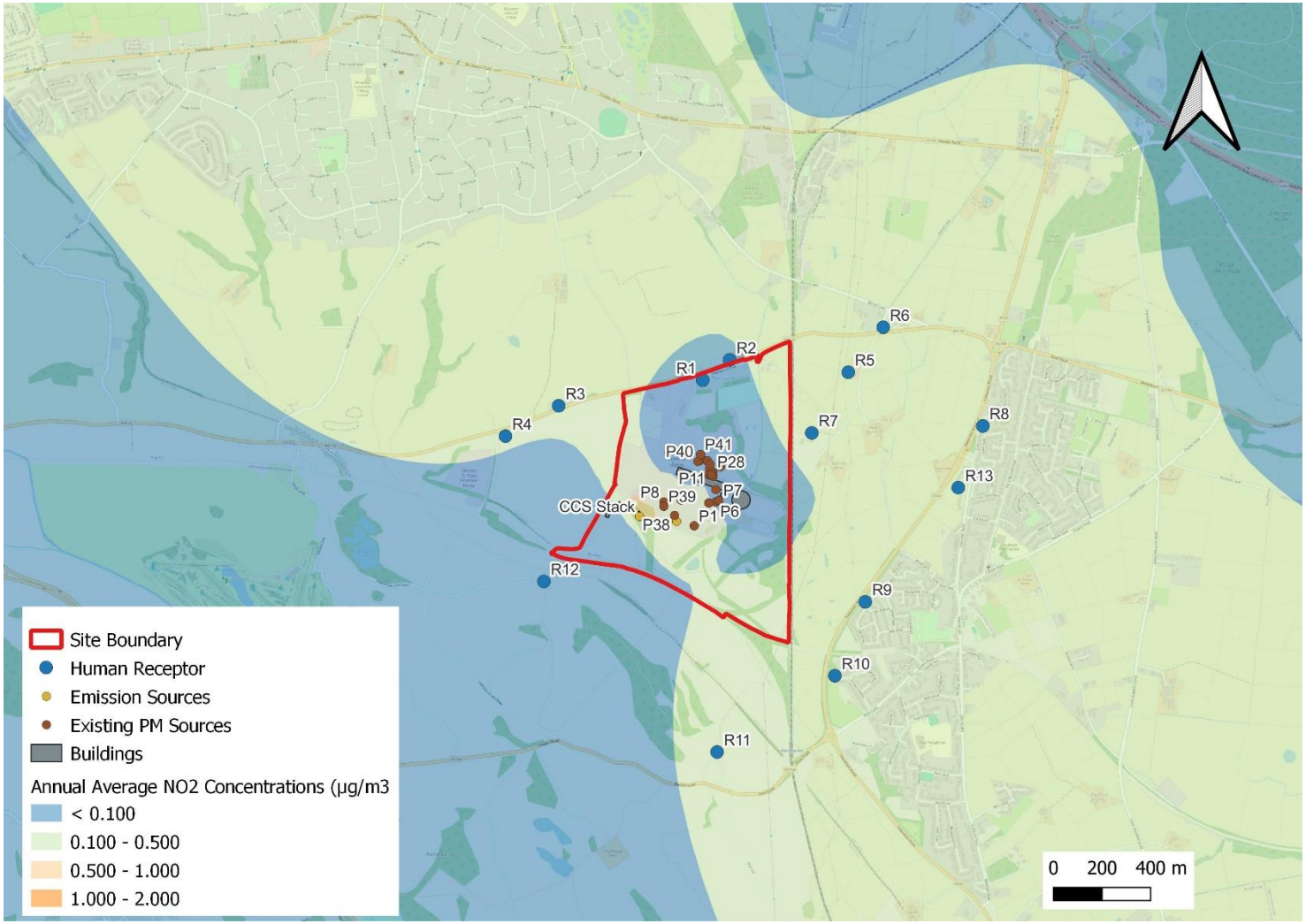
Figure B5: Windrose for the Hawarden Weather Station – 2022



APPENDIX C - CONTOUR PLOTS SHOWING PREDICTED POLLUTANT CONCENTRATIONS

This appendix contains contour plot (isopleths) illustrating the dispersion profiles of emission components released from the plant. The data is based on the meteorological data year (not necessarily the worst case year for all standard and time averages.

Figure C1 Predicted Annual Average NO_2 Concentrations (µg/m^3) PC – relevant for human receptor locations – 2021 met data



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© Figure C2: Predicted 99.8th Percentile of Hourly NO_2 Concentrations (µg/m^3) PC – relevant for human receptor locations – 2021 met

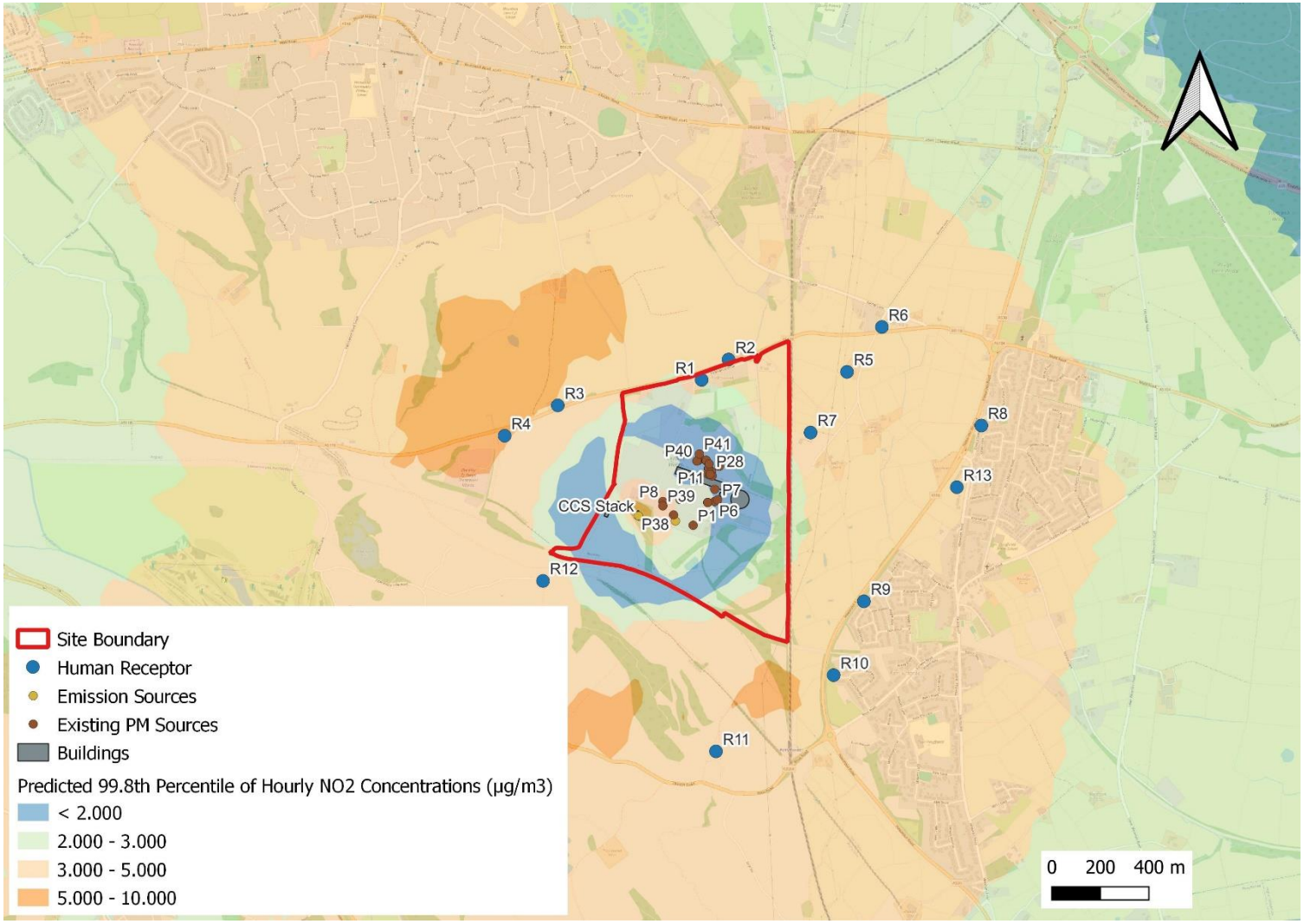

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Figure C3 Predicted Annual Average PM_{10} Concentrations (µg/m^3) PC – relevant for human receptor locations – 2021 met data

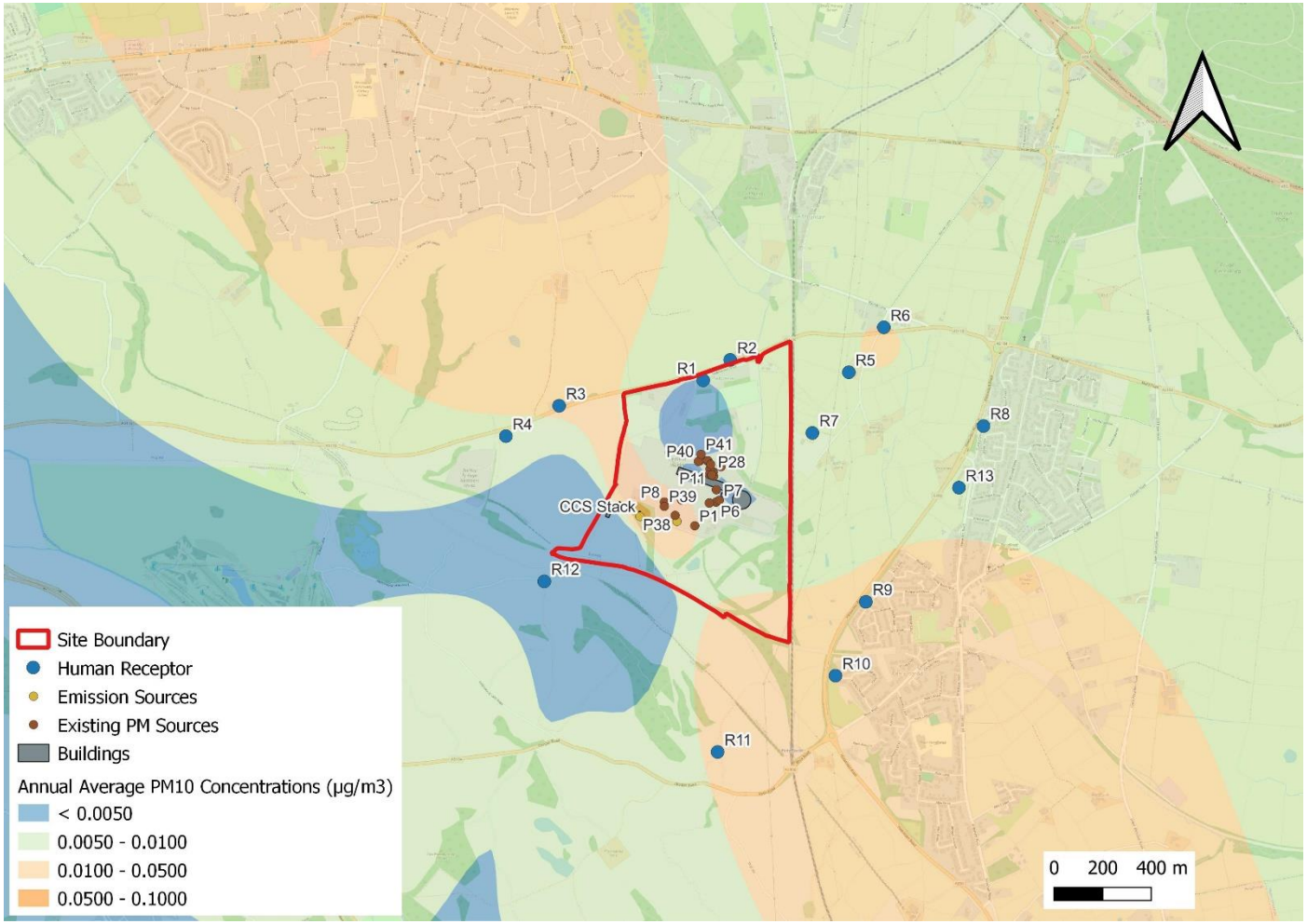

Figure C4: Predicted Daily Average NO_x Concentrations (µg/m^3) PC – relevant for ecological receptor locations – 2021 met data

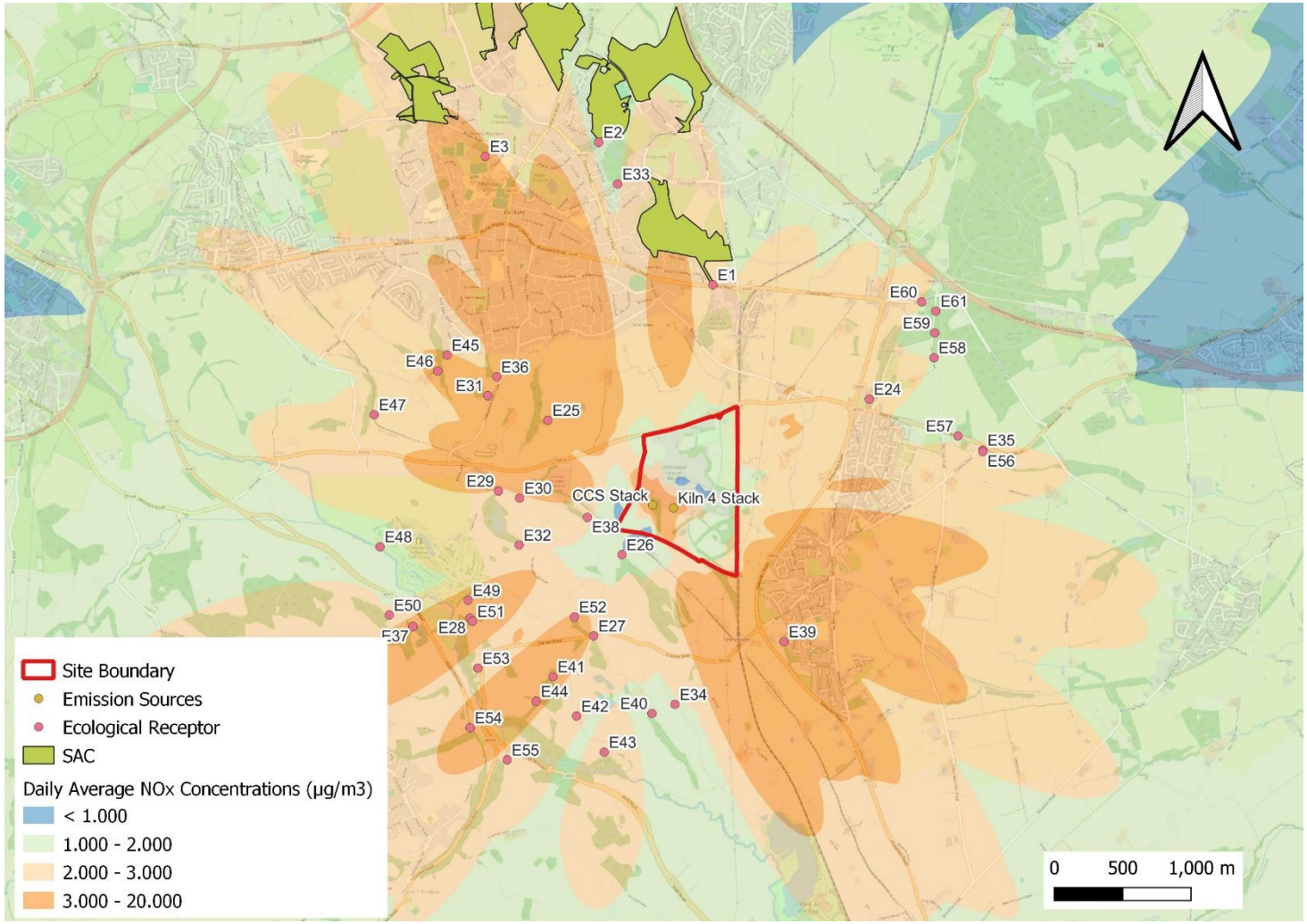

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Figure C5: Predicted Annual Mean NH_3 Concentrations (µg/m^3) PC – relevant for ecological receptor locations – 2021 met data