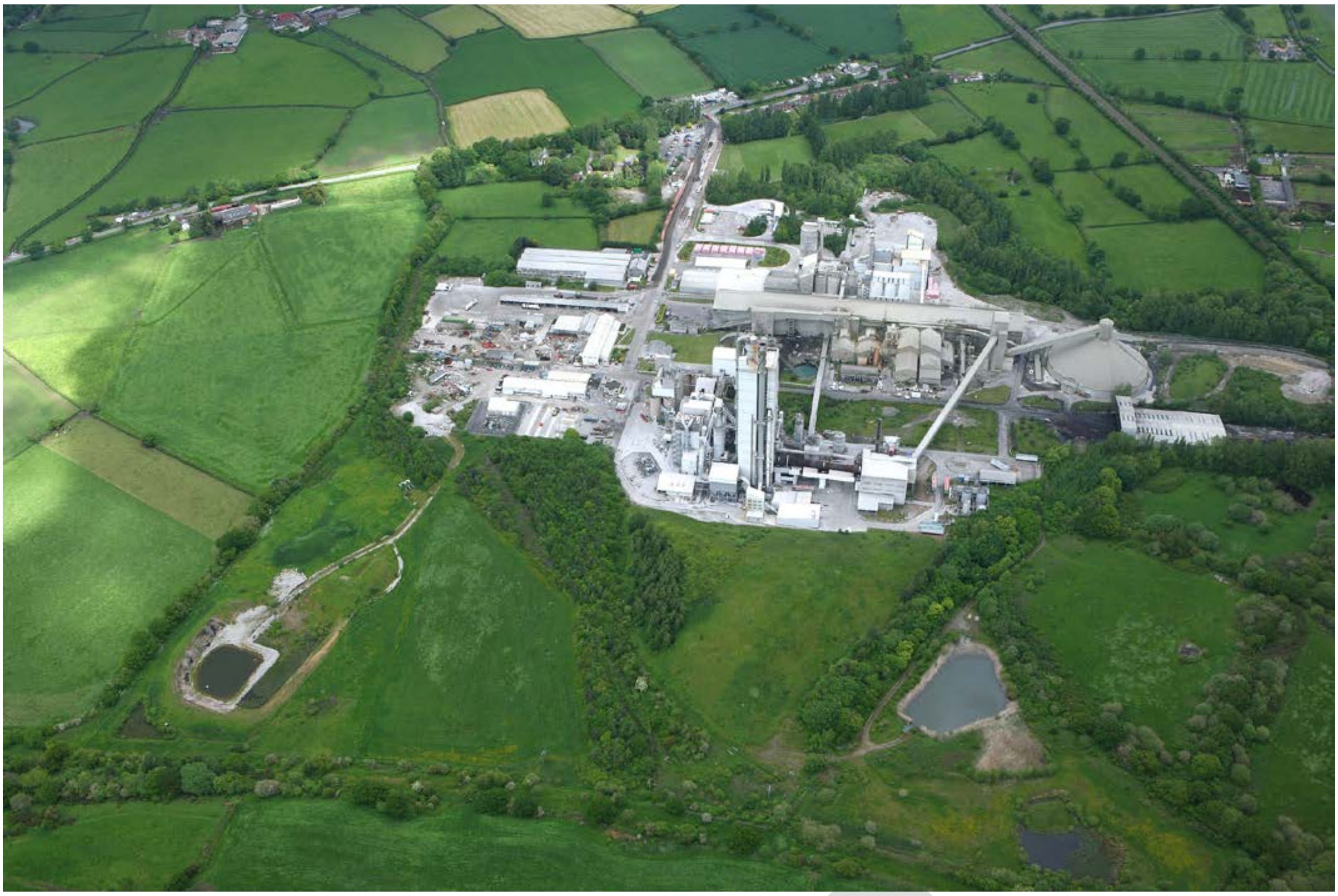

Castle Cement Limited

Carbon Capture and Storage Project – Padeswood, North Wales

Volume 4, Draft Technical Appendix 6.1

Air Quality Assessment

RSK

JUNE 2024

CONTENTS

TABLES

FIGURES

APPENDICES

1 INTRODUCTION

1.1 Background to the Proposed Development

1.1.1 RSK Environment Ltd (RSK) was commissioned to undertake an assessment of the potential air quality impacts associated with the proposed Padeswood Carbon Capture and Storage Project. **Volume 3, Figure 1.1** and **Figure 1.2** shows the proposed planning application boundary.

1.1.2 The Proposed Development comprises the following main elements:

- Post combustion carbon capture and compression (PCCCC) plant; and
- Combined heat and power (CHP) plant to provide the energy required for the PCCC plant.

1.1.3 The approximate centre of the Site is 329196, 362196. The Site is within the administration area of Flintshire County Council.

1.1.4 This report presents the findings of an assessment of existing/baseline air quality conditions and potential air quality impacts during the construction phase of the Proposed Development.

2 LEGISLATION, PLANNING POLICY AND GUIDANCE

2.1 Key Legislation

Air Quality Strategy

2.1.1 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 latest Air Quality Strategy for England, Scotland, Wales and Northern Ireland – Working Together for Clean Air[1], published in July 2007 sets air quality standards and objectives for ten key air pollutants to be achieved between 2003 and 2020.

2.1.2 The EU (European Union) Air Quality Framework Directive (1996)[2] 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[3], which retains the existing air quality standards and introduces new objectives for fine particulates ($PM_{2.5}$).

2.1.3 The Clean Air Strategy 2019[4] 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.

Air Quality Standards

2.1.4 The air quality standards in the United Kingdom are derived from EC directives and are adopted into Welsh law via the Air Quality Standards (Wales) Regulations 2010[5].

2.1.5 The relevant[6] standards for England and Wales to protect human health and vegetation are summarised in **Table 2.1**.

[1] https://assets.publishing.service.gov.uk/media/5a758459ed915d731495a940/pb12654-air-quality-strategy-vol1-070712.pdf

[2] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31996L0062&from=ES

[3] https://eur-lex.europa.eu/eli/dir/2008/50/oj

[4] https://www.gov.uk/government/publications/clean-air-strategy-2019

[5] https://www.legislation.gov.uk/wsi/2010/1433/contents/made

[6] https://uk-air.defra.gov.uk/assets/documents/Air_Quality_Objectives_Update.pdf

Table 2.1 Air Quality Standards Relevant to the Proposed Development

Substance	Averaging period	Exceedances allowed per year	Ground level concentration limit (µg/m³)
Nitrogen dioxide (NO_2) *	1 calendar year	N/A	40
	1 hour	18	200
Nitrogen oxides (NO_x)**	1 calendar year	NA	30
Particles Matter (PM_{10}) *	1 calendar year	N/A	40
	24 hours	35	50
Particles Matter ($PM_{2.5}$) *	Annual	N/A	20
Carbon monoxide (CO) *	Maximum daily running 8 hour mean	0	10,000
Sulphur dioxide (SO_2)	Annual**	N/A	20
	24 hours*	3	125
	1 hour*	24	350
	15 minutes*	35	266
* For the protection of human health **For the protection of vegetation and ecosystems			

The Environment Act (1995) and Environmental Protection Act (1990)

2.1.6 The objectives are to be used in the review and assessment of air quality by local authorities under Section 82 of the Environment Act (1995)[7], which inserts clauses into the Environmental Protection Act 1990[8]. If exceedances of the objectives or AQSs are measured or predicted through the review and assessment process, the local authority must declare an air quality management area (AQMA) under Section 83 of the Act and produce an air quality action plan to outline how air quality is to be improved.

Environmental Permitting Regulations

2.1.7 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 Environmental Permitting Regulations (EPR), which either set emission limit values

[7] https://www.legislation.gov.uk/id/ukpga/1995/25

[8] https://www.legislation.gov.uk/ukpga/1990/43/contents

with which the installation must comply and/or requires best available techniques (BAT) to be used at the installation site.

2.1.8 The Environmental Permitting (England and Wales) Regulations 2018[9] is the latest update to the Regulations and brings the Medium Combustion Plant Directive (MCPD) (2015/2193/EC)[10] into force in England and Wales. Natural Resources Wales, the regulatory authority in Wales, enforces the requirements of the Environmental Permitting Regulations and has regard for the AQSs and existing ambient air quality relative to these AQSs. The Emission Assessment Levels are summarised in **Table 2.2**.

Table 2.2 Emission Assessment Levels Relevant to the Proposed Development

Substance	Averaging period	Ground level concentration limit (µg/m^3)
Ammonia (NH_3)	Annual	180
	1 hour	2,500
Monoethanolamine (MEA)	24 hours	100
	1 hour	400
N-Nitrosodimethylamine (NDMA)	Annual	0.0002

National Emission Ceilings Regulations

2.1.9 The United Nations Economic Commission's Gothenburg Protocol[11] 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 sets 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[12] 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.

2.1.10 The National Emission Ceilings Regulations 2018[13] came into force in July 2018 and revokes 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.

9 https://www.legislation.gov.uk/uksi/2018/110/contents/made
10 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32015L2193
11 https://unece.org/gothenburg-protocol
12 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2016.344.01.0001.01.ENG
13 https://www.legislation.gov.uk/uksi/2018/129/contents/made

2.2 Key Guidance

2.2.1 Land-Use Planning & Development Control: Planning for Air Quality (Environmental Protection UK and Institute of Air Quality Management, 2017) ('the EPUK-IAQM guidance')

2.2.2 The EPUK-IAQM guidance[14] includes a method for screening the requirement for an air quality assessment, the undertaking of an air quality assessment, the determination of the air quality impact associated with a development proposal and whether the effects of these impacts are significant.

2.2.3 The approach to assess the impact magnitude at each receptor location, and the overall significance of effects of the change in pollutants concentrations as a result of the Proposed Development, was assessed in accordance with this guidance.

Local Air Quality Management Review and Assessment Technical Guidance

2.2.4 Department for Environment, Food and Rural Affairs (Defra) and the devolved administrations have 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)[15], has been used to identify locations where exposure can be considered 'relevant'. This is important as Directive 2008/50/EC[16] indicates that the AQSs should not be applied at any locations situated within areas where members of the public do not have access and there is no fixed habitation. These definitions provide greater clarity than those specified in the Environmental Permitting (England and Wales) Regulations 2018 guidance and broadly correlate such that these are considered more robust for use in an air quality assessment. The definitions identified in LAQM TG.22 are summarised in **Table 2.3**.

Table 2.3 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

[14] https://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf

[15] https://laqm.defra.gov.uk/wp-content/uploads/2022/08/LAQM-TG22-August-22-v1.0.pdf

[16] https://eur-lex.europa.eu/eli/dir/2008/50/oj

Averaging period	Locations where AQSs should be applied	Locations where AQSs should not be applied
		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.

Air emissions risk assessment for your environmental permit (Environment Agency, 2016)[17] ('the Defra and EA guidance')

2.2.5 This guidance, which was adopted in 2016 by Defra and the Environment Agency, 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. It is referred to as a relevant source of guidance in this assessment due to the absence of equivalent Natural Resources Wales guidance. A subsection of the guidance also outlines features of air quality assessment which should be submitted within the air quality assessment report. This

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

report has been written with reference to this document and has been used in conjunction with the Environmental Permitting (England and Wales) Regulations 2018 (latest updated 2023 version).

2.2.6 This Environment Agency guidance includes a number of target 'Predicted Environmental Concentrations' (PECs) for ecological receptors. The relevant target PECs for ecological receptors to this assessment are presented in **Table 2.4**.

Table 2.4 EA Guidance Targets for Protected Conservation Areas

Substance	Emission Period	Target (mean)
Nitrogen oxides (NO_x) (as NO_2)	Annual[1]	30 µg/m^3
	Daily	75 µg/m^3
Sulphur dioxide (as SO_2)	Annual[1]	20 µg/m^3 (10 µg/m^3 where lichens or bryophytes are present)
Ammonia (as NH_3)	Annual	1 µg/m^3 where lichens or bryophytes (including mosses, landworts and hornwarts) are present, 3 µg/m^3 where they're not present
[1]This is also a national air quality objective (part of the UK AQS) for the protection of vegetation and ecosystems		

AQTAG06: Technical Guidance on Detailed Modelling Approach for an Appropriate Assessment for Emissions to Air (Environment Agency, 2014) ('AQTAG.06')

2.2.7 There is no technical guidance in Wales on modelling approach for air quality assessment. So, the technical guidance in England is adopted in this report. The AQTAG06 guidance[18], 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.

Guidance on the Assessment of Dust from Demolition and Construction

2.2.8 The Institute of Air Quality Management (IAQM) published a guidance document (Holman et al., 2014) on the assessment of construction phase impacts (herein the 'IAQM construction dust guidance[19]'). The guidance was produced to provide advice to developers, consultants and environmental health officers on how to assess the impacts arising from construction activities. The emphasis of the methodology is on classifying sites according to the risk of impacts (in terms of dust nuisance, PM_{10}

[18] https://ukwin.org.uk/files/ea-disclosures/AQTAG06_Mar2014%20.pdf

[19] https://iaqm.co.uk/text/guidance/construction-dust-2014.pdf

impacts on public exposure and impact upon sensitive ecological receptors) and to identify mitigation measure appropriate to the level of risk identified.

Local Air Quality Management Technical Guidance

2.2.9 Defra and the devolved administrations have published technical guidance for use by local authorities in their air quality review and assessment work. This guidance, referred to in this document as the Local Air Quality Management Technical Guidance[20] (Defra, 2022) ('LAQM TG.22').

Critical Levels and Loads

2.2.10 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[21]).

2.2.11 The United Nations Economic Commission for Europe (UNECE) has 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).

2.2.12 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.

2.2.13 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."*

2.2.14 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.

2.2.15 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 2.1**. Critical loads for nutrient nitrogen are set under the Convention on Long-Range Transboundary Air Pollution and are based on empirical

[20] https://laqm.defra.gov.uk/wp-content/uploads/2022/08/LAQM-TG22-August-22-v1.0.pdf

[21] https://iris.who.int/bitstream/handle/10665/107335/9789289013581-eng.pdf?sequence=1

evidence, mainly observations from experiments and gradient studies (APIS, 2016 [22]). The critical loads used within this report are also presented in **Section 5**.

2.3 Planning Policy

2.3.1 The land use planning process is a key means of improving air quality, particularly in the long term, through the strategic location and design of new developments. Any air quality concern that relates to land use and its development can be a material consideration in the determination of planning applications.

Planning Policy Wales

2.3.2 Planning Policy Wales[23] (PPW) was published in February 2024 (Edition 12, superseding previous Planning Policy Statements. Regarding air quality, the PPW states that:

> *"Relevant considerations in making planning decisions for potentially polluting development are likely to include:*
> *location, including the reasons for selecting the chosen site itself;*
> - *location, including the reasons for selecting the chosen site itself;*
> - *impact on health and amenity;*
> - *effect of pollution on the natural and built environment and the enjoyment of areas of landscape and historic and cultural value;*
> - *impact on groundwater and surface water quality;*
> - *effect on biodiversity and ecosystem resilience, including where there may be cumulative impacts on air or water quality which may have adverse consequences for biodiversity and ecosystem resilience;*
> - *the risk and impact of potential pollution from the development, insofar as this might lead to the creation of, or worsen the situation in, an air quality management area, a noise action planning priority area or an area where there are sensitive receptors; and*
> - *impact on the road and other transport networks, and in particular on traffic generation, particularly where the Proposed Development is not transport infrastructure itself."*

2.3.3 PPW goes on to state:

> *"Early consideration is required to ascertain whether the location and design of Proposed Development is acceptable where air pollution or noise generating development is likely to affect a protected species, or is proposed in an area likely to affect a statutorily designated site (such as Natura 2000 sites or SSSIs) or a tranquil urban green space (including but not limited to formally designated 'quiet areas') valued for the restorative respite and contact with nature that they offer to residents of busy towns and cities."*

[22] https://www.apis.ac.uk/critical-loads-and-critical-levels-guide-data-provided-apis

[23] https://www.gov.wales/sites/default/files/publications/2024-02/planning-policy-wales-edition-12_1.pdf

Local Planning Policy

Flintshire Local Development Plan 2015-2030 (January 2023)

2.3.4 Flintshire County Council policies for managing developments are laid out in the Flintshire Local Development Plan[24] for Flintshire district which include Flintshire County Council policies relating to air quality. Policy PC2 General Requirements for Development states the following:

"*All development should:*

a. *harmonise with or enhance the character, local distinctiveness and appearance of the Site , existing building(s) and surrounding landscape/townscape;*
b. *not have a significant adverse impact on the safety and living conditions of nearby residents, other users of nearby land/property, or the community in general, through increased activity, disturbance, noise, dust, vibration, hazard, or the adverse effects of pollution;*
c. *take account of personal and community safety and security in its design and layout;*
d. *maximise sustainable travel choice by having safe and convenient access by foot, cycle, public transport and vehicles;*
e. *not have an unacceptable effect on the highway network or highway safety as a result of problems arising from traffic generation, inadequate and poorly located parking spaces, servicing and maneuvering;*
f. *not result in or be susceptible to problems related to foul and surface water drainage, land stability, contamination, flooding, or pollution of light, air and water, either on or off site.*"

Land-Use Planning & Development Control: Planning for Air Quality

2.3.5 Environmental Protection UK's (EPUK) and the IAQM jointly published a revised version of the guidance note 'Land-Use Planning & Development Control: Planning for Air Quality'[25] in 2017 (herein the 'EPUK-IAQM guidance') to facilitate consideration of air quality within local development control processes. It provides a framework for air quality considerations, promoting a consistent approach to the treatment of air quality issues within development control decisions.

2.3.6 The guidance includes methods for undertaken an air quality assessment and an approach for assessing the significance of effects. The guidance note is widely accepted as an appropriate reference method for this purpose.

[24] https://www.flintshire.gov.uk/en/PDFFiles/Planning/Examination-Library-Documents/LDP-Version-8.pdf

[25] https://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf

3 ASSESSMENT SCOPE

3.1 Overall Approach

3.1.1 The approach taken for assessing the potential air quality impacts of the Proposed Development may be summarised as follows:

- Baseline characterisation of local air quality;
- Qualitative impact assessment of the construction phase of the development using the 2024 IAQM guidance[26];
- Detailed dispersion modelling to predict the impact of emissions to air from the development on local air quality at nearby sensitive human and ecological receptors and across a modelled grid over the surrounding area; and
- Recommendation of mitigation measures, where appropriate, to ensure any adverse effects on air quality are minimised.

3.2 Baseline Characterisation

3.2.1 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.

3.2.2 A desk-based study has been undertaken including a review of monitoring data available from Flintshire County Council and estimated background data from the LAQM Support website maintained by Defra. Consideration has also been given to potential sources of air pollution and the presence of AQMAs.

3.3 Air Pollutants of Concern

3.3.1 As the Proposed Development includes a CHP and a PCCCC plant, the key air pollutants of concern for the Proposed Development are NO_2, NO_x, PM_{10}, $PM_{2.5}$, CO, HCl, NH_3, SO_2 and amine. The key air pollutants of concern for the operation of the existing gas boilers are mainly NO_x. 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.

[26] https://iaqm.co.uk/wp-content/uploads/2013/02/Construction-Dust-Guidance-Jan-2024.pdf

4 BASELINE AIR QUALITY CHARACTERISATION

4.1.1 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 Flintshire County Council and the LAQM Support website operated by Defra.

4.1.2 It is noted that the emissions from the existing plant already form part of the baseline data referred to above. These emissions also form part of the assessment scenario in the model and there will be some resultant double counting.

4.1.3 There is on-site monitoring undertaken by the Applicant in Penyffordd but the data averaging period and monitor availability does not allow for averaging over a full-calendar year. It is noted that there are emissions generated from the operation of the existing cement plant.

4.2 Emissions Sources and Key Air Pollutants

4.2.1 The Site is located to the south of A5118 and to the west of A550. The Site is located directly to the west of an existing railway between Buckley and Penyffordd railway stations. LAQM TG.22[27] does not identify the railway line as experiencing a high number of diesel locomotives, therefore, further assessment of railway emissions is not considered necessary.

4.2.2 The principal pollutants relevant to this assessment are considered to be NO_2, PM_{10} and $PM_{2.5}$, generally regarded as the most significant air pollutants released by combustion processes, or by proposals leading to an increase in traffic.

4.3 Presence of AQMAs

4.3.1 Flintshire County Council 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 Air Quality Management Areas (AQMAs), therefore, the Proposed Development site is not located within an AQMA.

4.4 Baseline Monitoring Data

4.4.1 There is on-site monitoring undertaken by the Applicant in Penyffordd. A summary of monitoring data is illustrated in in **Table 4.1**. It is noted that the data was obtained from March 2023 to January 2024.

[27] https://laqm.defra.gov.uk/wp-content/uploads/2022/08/LAQM-TG22-August-22-v1.0.pdf

Table 4.1 Annual Mean NO_2 Concentrations at the Diffusion Tube Location within 3km of the Site boundary

Location	Annual average NO_2 (µg/m³)	Annual average PM_{10} (µg/m³)	Annual average $PM_{2.5}$ (µg/m³)	24-hour mean PM_{10} (µg/m³)	8-hour rolling mean CO (µg/m³)	1-hour mean NO_2 (µg/m³)
Penyffordd	8.2*	3.5*	3.1*	11.4	0.6	80.5
AQS Objectives	40	40	20	50	10	200

Note: The data presented is from March 2023 to January 2024.

*The annual data is not derived from a full-year and only for 10 months.

4.4.2 According to the North Wales Authorities Collaborative Project 2023 Air Quality Progress Report[28], Flintshire County Council co-located three nitrogen dioxide (NO_2) diffusion tube monitors with an automatic monitor, which is owned by an external organisation during 2021. There were also a network of 59 NO_2 diffusion tubes monitoring locations across the district in 2022.

4.4.3 There were three diffusion tubes within 3km of the Site boundary. The monitoring data from sites within 3km from the Site boundary are reproduced in **Table 4.2**.

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

[28] https://www.conwy.gov.uk/en/Resident/Environmental-problems/assets-Air-Quality/documents/NW-Annual-Progress-Report-2023.pdf

Table 4.2 Annual Mean NO_2 Concentrations at the Diffusion Tube Location within 3km of the Site boundary

Site ID	Location	Site type	Approximate Distance from the Site boundary (km)	Annual Mean NO_2 Concentrations (µg/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

4.5 LAQM Background Data

4.5.1 In addition to the local monitoring data, estimated background air quality data available from the Local Air Quality Management (LAQM) website operated by Defra, may also be used to establish likely background air quality conditions at the Site.

4.5.2 This website provides estimated annual average background concentrations of NO_2, PM_{10} and $PM_{2.5}$ on a 1km^2 grid basis. **Table 4.3** reproduces estimated annual average background concentrations for the grid square containing the Proposed Development site for years from 2023 to 2025. No exceedances of the NO_2, PM_{10} or $PM_{2.5}$ AQSs are predicted. As background concentrations are predicted to fall with time, background concentrations in future years would not be expected to exceed their respective AQSs.

Table 4.3 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

Assessment Year	Estimated Annual Average Pollutant Concentrations Derived from the LAQM Website (µg/m^3)		
	NO_2	PM_{10}	$PM_{2.5}$
AQS	**40**	**40**	**20**

Note: Presented concentrations for 1 km^2 grid centred on 539500, 184500; approximate centre of development site is 329196, 362196.

4.6 Background Air Quality at the Site

4.6.1 The EPUK-IAQM 2017 guidance[29] indicates that the annual mean PM_{10} concentrations tend to be greater than ~31µg/m^3 for an exceedance of the daily mean PM_{10} AQS to be likely. LAQM TG.22[30] indicates that the annual mean NO_2 concentrations tend to be greater than 60µg/m^3 for an exceedance of the hourly mean NO_2 AQS to be likely. Based on the monitoring data available and the estimated background concentrations, it is considered unlikely that short-term NO_2 and PM_{10} AQSs would be exceeded at or in close proximity to the Site boundary.

4.6.2 Annual NO_2 monitoring data from diffusion tubes within 3km of the Site boundary were recorded to be well below the NO_2 annual average air quality standard. The estimated background concentrations available from Defra suggest the annual mean NO_2, PM_{10} and $PM_{2.5}$ AQSs are unlikely to be exceeded. Overall, air quality at the Site is generally good.

[29] https://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf

[30] https://laqm.defra.gov.uk/wp-content/uploads/2022/08/LAQM-TG22-August-22-v1.0.pdf

5 METHODOLOGY

5.1 Construction Phase Assessment

Construction Phase: Dust and Particulate Matter

5.1.1 Construction works for the Proposed Development have the potential to lead to the release of fugitive dust and particulate matter. An assessment of the likely significant effects of construction phase dust and particulate matter at sensitive receptors has therefore been undertaken following the IAQM's construction dust guidance[31].

5.1.2 Three separate dust impacts were considered:

- Disamenity to dust soiling;
- The risk of health effects due to an increase in exposure to PM_{10}; and
- Harm to ecological receptors.

5.1.3 In order to assess the potential impacts of construction, activities are divided into four types:

- Demolition[32];
- Earthworks[33];
- Construction[34]; and
- Trackout[35].

5.1.4 The risk of dust and PM_{10} causing disamenity and/or health or ecological impacts was based on an assessment of likely emissions magnitude and the sensitivity of the surrounding environment. The risk category may be different for each of the four construction-related activities.

5.1.5 **Appendix A** sets out the construction dust assessment methodology in detail as per IAQM construction dust guidance[36]. Once the level of risk has been determined, then site specific mitigation proportionate to the level of risk can be identified (as detailed in **Appendix B**).

5.2 Operational Impact Assessment

Modelling Software

5.2.1 The impact assessment of operational emissions was undertaken using ADMS 6 (Version 6.0.0.1). This model uses detailed information regarding the pollutant releases, local building effects and local meteorological conditions, to predict

[31] https://iaqm.co.uk/wp-content/uploads/2013/02/Construction-Dust-Guidance-Jan-2024.pdf

[32] Any activity involved with the removal of an existing structure (or structures). This may also be referred to as de-construction, specifically when a building is to be removed a small part at a time.

[33] Covers the processes of soil-stripping, ground-levelling, excavation and landscaping.

[34] Any activity involved with the provision of a new structure (or structures), its modification or refurbishment. A structure will include a residential dwelling, office building, retail outlet, road, etc.

[35] Trackout is defined as the transport of dust and dirt from the construction / demolition-sites onto public road network, where it may be deposited and then re-suspended by vehicles using the network.

[36] https://iaqm.co.uk/wp-content/uploads/2013/02/Construction-Dust-Guidance-Jan-2024.pdf

pollutant concentrations at specific locations selected by the user and is approved by Natural Resources Wales and other statutory agencies for regulatory applications.

Modelling of Amine Compounds

Overview of Amines, Nitrosamines and Nitramines

5.2.2 Amines are organic derivatives of ammonia (NH_3), wherein one or more of the hydrogens (H) atoms are replaced by a substituent organic group (R). The type of amine can be defined as primary, secondary, or tertiary, based on the number of H atoms that are replaced:

- Primary amine ($R-NH_2$) where 1 H-atom is replaced
  - e.g., Monoethanolamine, MEA
- Secondary amine (R_2-NH) where 2 H-atoms are replaced
  - e.g., Dimethylamine, DMA
- Tertiary amine (R_3-N) where 3 H-atoms are replaced
  - e.g., Trimethylamine, TMA

5.2.3 The amines referred to in ADMS, Amine 1, Amine 2, Nitrosamine 1 and Nitrosamine 2 are represented in the assessment as detailed below.

5.2.4 The proxy compound for 'Amine 1' is MEA and the proxy for 'Amine 2' is dimethylamine (DMA), which is a precursor to the formation of NDMA. NDMA has also been used as a proxy for directly emitted nitrosamines (i.e., 'Nitrosamine 1' and 'Nitrosamine 2')[37]

5.2.5 Amine-based solvents are used in the carbon capture process to remove carbon dioxide (CO_2) from flue gases. However, the amine compounds included within the solvent make-up can react with substances other than CO_2 to create new, potentially harmful compounds (e.g., nitrosamines and nitramines), both within the carbon capture process and in the atmosphere following release of the treated post-combustion flue gases. Therefore, it is important that emissions to atmosphere, associated chemical transformations, and dispersion and deposition within the Study Area are represented within the air quality model.

5.2.6 Direct emissions of nitrosamines, associated with potential solvent degradation within the CCS process and entrainment within the flue gas, are expected to be negligible. Nevertheless, direct mass emissions of nitrosamines from the CCS process in the assessment of the Proposed Development have been modelled based on reasonable worst-case nominal emissions provided by the technology supplier as per **Table 5.1**, for all hours of the year. However, the majority of nitrosamine and nitramine compounds associated with the Proposed Development will form in the atmosphere as a result of the complex reactions outlined below (i.e., 'indirect' emissions).

5.2.7 Nitrosamines and nitramines are organic compounds, formed by reactions with nitrogen monoxide (NO) and nitrogen dioxide (NO_2), respectively. The chemical

[37] Although MEA (as proxy for 'Amine 1') does not react directly with other substances to form a stable nitrosamine compound (Scottish Environment Protection Agency, 2015), for the purposes of providing a conservative assessment, it has been assumed that all direct emissions of 'Nitrosamine 1' from the stack will be as NDMA. The use of DMA (as proxy for 'Amine 2') means that all direct and indirect emissions of 'Nitrosamine 2' will be as NDMA.

structure of nitrosamines is R_2N-NO and the structure of nitramines is R_2N- NO_2, formed from the original amine, where R is usually an alkyl group. Nitrosamines are susceptible to photodegradation and therefore generally short-lived in the atmosphere (~5 min). In contrast, nitramines are more stable and will have longer atmospheric residence times (~2 days) (Sørensen, 2013[38]). As such, the stability of nitramines indicates an increased potential for accumulation in the atmosphere relative to nitrosamines.

5.2.8 Existing toxicological data indicates that most nitrosamines are carcinogenic, with the most widely researched nitrosamine being N-nitrosodimethylamine (NDMA), formed from DMA, due to its toxicity. Accordingly, the EAL established by the Environment Agency for the assessment of nitrosamines is derived for NDMA. Less is known about nitramines, but they have the potential to be mutagenic and carcinogenic although typically less potent than nitrosamines, with some research studies indicating that nitramines are at least six times less toxic (Gjernes, 2013[39]) and fifteen times less mutagenic (Wagner, 2014[40]) than nitrosamines.

5.2.9 To ensure a conservative approach to the assessment of nitrosamines and nitramines relating to the Proposed Development, the modelled concentrations of each compound in this study have been summed (i.e. nitrosamines + nitramines) at each receptor and compared to the EAL for NDMA.

Modelling Amine Chemistry in ADMS

5.2.10 For the assessment of amines and associated degradation products relating to the proprietary amine-based solvent proposed for use with the Proposed Development, the ADMS Amine Chemistry Module (CERC, 2016[41]) has been utilised to model the chemical reactions associated with the release of specified amine compounds and formation of associated nitrosamines and nitramines in the atmosphere.

5.2.11 As there is no amine modelling recommendation for air quality assessment in Natural Resources Wales guidance, the Environment Agency recommendation is adopted in this report. Whilst the Environment Agency acknowledges that the uncertainty associated with modelling of amines is likely to be very high, the Environment Agency's latest guidance (Environment Agency, 2021[42]) on the assessment of impacts to air quality from amine-based post-combustion carbon capture plants states *"…the only commercially available modelling software to evaluate the potential impacts from amines and amine degradation products releases is the amines module within ADMS. The amines chemistry module is based on established science considering published research on mechanisms of formation of toxic compounds. Although the validation of the module is not possible at the moment, the ADMS air*

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[38] Sørensen L, da Silva E F, Brakstad O G, Zahlsen K and Booth A (2013) Preliminary Studies into the Environmental Fate of Nitrosamine and Nitramine Compounds in Aquatic Systems. Energy Procedia 37, 683-690

[39] https://www.sciencedirect.com/science/article/pii/S1876610213001720

[40] Wagner E D, Osiol J, Mitch W A and Plewa M J (2014) Comparative in vitro toxicity of nitrosamines and nitramines associated with amine-based carbon capture and storage. Environmental Science and Technology 48(14), 8203-11

[41] https://www.cerc.co.uk/environmental-software/assets/data/doc_userguides/CERC_ADMS_6_Amine_chemistry_supplement.pdf

[42] https://ukccsrc.ac.uk/wp-content/uploads/2021/11/AQMAU-C2025-RP01.pdf

dispersion modelling algorithms are continually validated against real world situations, field campaigns and wind tunnel experiments."

5.2.12 The mechanisms for the formation of nitrosamines and nitramines in the atmosphere are complex. However, the main initial reaction of amines in the atmosphere is with hydroxyl (OH) radicals and it is this reaction on which the ADMS amine chemistry scheme is based (CERC, 2016). As described above, the subsequent formation of nitrosamines and nitramines are attributed to reactions with NO and NO_2, however, they can further degrade in the atmosphere (e.g., through photo-oxidation and subsequent reaction with oxygen molecules to form imines, which are relatively stable and non-toxic compounds (Manzoor, 2015[43])).

5.2.13 Primary amines do not form stable nitrosamines, meaning that any such nitrosamines would be rapidly isomerised to the respective imine. However, secondary and tertiary amines do form stable nitrosamines. The ADMS module includes an option to allow only unstable nitrosamines to be created (i.e., assuming emissions of primary amines only), if selected by the model user, meaning all nitrosamine concentration outputs are set to zero and only nitramines will form. This option was not selected for the modelling assessment, regardless of the amine compound being emitted (i.e., primary, secondary, and / or tertiary).

5.2.14 The general reaction scheme simulated by the ADMS amines module is as follows:

AMINE + hydroxyl radical (•*OH*)	→	amino RADICAL + H_2O	(1a)
	→	non-amine radical ($RN(H)C^{\bullet}H_2$) + H_2O	(1b)
amino RADICAL + O_2	→	imine + hydroperoxyl (HO_2)	(2)
amino RADICAL + *NO*	→	NITROSAMINE	(3)
amino RADICAL + NO_2	→	NITRAMINE	(4a)
	→	imine + nitrous acid (*HONO*)	(4b)
NITROSAMINE	$\xrightarrow{h\upsilon}$	amino RADICAL	(5)

5.2.15 The amount of nitrosamine and nitramine formed in the atmosphere is dependent on the initial reaction of the amine with the OH radical – specifically the branching ratio of the abstraction of an H atom from the amino group (N-H) (i.e. forming the amino RADICAL) to the abstraction from the methyl group (C-H) (i.e. forming the non-amine radical) – where a lower branching ratio will result in fewer amino radicals being made available and thus fewer nitrosamine / nitramine compounds being formed. However, a number of other variables play an essential role in the potential formation of nitrosamines and nitramines in the atmosphere and are required for the ADMS amine chemistry module to run, including:

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[43] Saba Manzoor, Anna Korre, Sevket Durucan and Alexandra Simperler (2015) Atmospheric chemistry modelling of amine emissions from post combustion CO2 capture technology. Energy Procedia 63 (2014), 822 – 829

- Ambient concentrations of the OH radical;
  - A representative annual average OH radical concentration for the UK was sourced from published research (Walker, 2015[44]), based on measurements taken from a series of daytime and night-time flights over the UK in summer 2010 and winter 2011 using the fluorescence assay by gas expansion (FAGE) technique. In the absence of sunlight, OH is not formed at night and therefore OH was not detected above the instrument's limit of detection during any of the night-time or winter daytime flights.
  - An upper limit OH concentration of 1.8 x 106 molecules cm^{-3} is reported, which is calculated based on summer daytime flights only.
  - This is the value used to feed into the amine chemistry modelling and is likely to be conservative (skewed high) as an annual average due to there being more daylight hours in summer relative to winter (i.e. if more OH radicals are available in the atmosphere, daytime amine degradation increases, resulting in increased production of nitrosamine / nitramine compounds).
- Photolysis rates applicable to the region of study;
  - The ADMS meteorological pre-processor provides hourly information with respect to incoming solar radiation (K) specific to the meteorological year data and latitude. A subsequent calculation is completed using the K values to derive hourly photolysis rates, which are then used to calculate an annual average rate constant for NO_2 (jNO_2) (CERC, 2016).
  - The meteorological data used in the amine chemistry module aligns with that used for modelling of all other non-amine related pollutants, comprising hourly data for years 2018-2022 inclusive from Hawarden station.
- Ambient concentrations of ozone (O_3) and NO_x (i.e. NO and NO_2);
  - The amine reaction scheme requires hourly background levels of NO_x and O_3 equivalent to the year of meteorological data. Hourly data for these species were sourced from Defra's Wirral Tranmere AURN monitoring site, representing urban background levels, for the years 2018-2022 inclusive.
  - Background NO_x concentrations are used to dictate the availability of NO and NO_2 in the formation of nitrosamines and nitramines, respectively, on an hourly basis.
  - The hydroxyl radical concentration varies based on a number of factors, including solar radiation, latitude, and background levels of O_3. The ADMS amine module requires a constant, 'c', which is used to calculate hourly varying OH radical concentrations for the region of study. The value for c is derived based on the relationship between annual average values for jNO_2, O_3 and OH radical concentrations as described above.

[44] Walker HM, Stone D, Ingham T, Vaughan S, Cain M, Jones RL, Kennedy OJ, McLeod M, Ouyang B, Pyle J, Bauguitte S, Bandy B, Forster G, Evans MJ, Hamilton JF, Hopkins JR, Lee JD, Lewis AC, Lidster RT, Punjabi S, Morgan WT, Heard DE. Night-time measurements of HOx during the RONOCO project and analysis of the sources of HO2. Atmos. Chem. Phys. 2015;15:8179-8200

5.2.16 The reaction rates and associated kinetic parameters input to ADMS v6.0.0.1 for the 'AMINE', 'amine RADICAL', 'NITROSAMINE', and 'NITRAMINE' species need to be defined by the model user.

5.2.17 The general description of the ADMS amine chemistry scheme can be summarised in five steps:

- On an hourly basis, ADMS uses the above input parameters to model concentrations of the species of interest as well as the age of the primary pollutants (e.g., amines) at each receptor / grid point using the standard ADMS dispersion algorithms.
- Using the 'dilution and entrainment' scheme within the ADMS amines module, the primary pollutant concentrations are adjusted to removed dilution effects (i.e. becoming increasingly conservative with distance from stack exit).
- The chemistry reaction scheme requires consideration of timescales, so that after each hourly dispersion calculation, the 'age' of the pollutants is calculated based on the plume travel time. The chemical reaction equations are applied over a time (dt) to all pollutants from the source.
- At this point, the 'dilution and entrainment' scheme is used to dilute all pollutants as ambient air, containing the background pollutants, is entrained into the plume.
- Steps 3 and 4 are repeated for each time step until time becomes equal to the pollutant 'age'.

5.2.18 An overview of the input variables required by the amine chemistry module in ADMS is provided in **Table 5.1**. It is noted that most of the amine data is not available at this stage. Data which is not available was taken from the development with similar discharge data and technology (Drax Bioenergy CCS), and literature review. For modelling purposes, the mid-point of these reported value has been used and presented in **Table 5.1**.

Table 5.1 Parameters relating to the ADMS Amine Chemistry Module applicable to the Proposed Development

Parameter	Units	Notes	MEA	DMA	Source
Amine Emission	g/s	Emission rate for amine compounds	0.42	0.42	As per Table 5.1
Direct nitrosamine emission	g/s	Emission rate for nitrosamine compounds	8×10^{-6}	8×10^{-6}	As per Table 5.1
NO_x emission	g/s	Emission rate for NO_x	16.86	16.86	As per Table 5.1
Amine compound & Molar mass	g/mol	Name of amine compounds included in ADMS Amine Chemistry Module	Amine 1 (MEA): 61 Amine 2 (DMA): 45 Nitrosamine 1 (from MEA): 90 Nitrosamine 2 (from NDEA): 74 Nitramine 1 (from MEA):106 Nitramine 2 (from DMA): 90		Drax CCS (2022)
Amine/OH reaction rate constant, k1	/ppb/s	Relating to the reaction of the emitted amine with the OH radical	1.90	1.46	CERC (2012)
Amino radical/O2 reaction rate constant, k2	/ppb/s	Relating to the reaction of the amino radical with oxygen (forming imine)	4.44×10^{-8}	4.19×10^{-8}	CERC (2012) Manzoor (2014)
Rate constant for formation of nitrosamine, k3	/ppb/s	Relating to the formation of nitrosamine from the reaction of the amino radical with NO	0.00345	0.00192	CERC (2012) Manzoor (2014)
Rate constant	/ppb/s	Relating to the formation	0.0037	0.00715	CERC (2012)

Parameter	Units	Notes	MEA	DMA	Source
for formation of nitramine, k4a		of nitramine from the reaction of the amino radical with NO2			Manzoor (2014)
Amino radical/NO_2 reaction rate constant, k4	/ppb/s	Relating to the reaction of the amino radical with NO2 (forming imine or nitramine)	0.0079	0.0513	CERC (2012) Manzoor (2014)
Branching ratio for amine/OH reaction	Dimensionless	The ratio of H atom abstraction from amino group (N-H) to the methyl group (C-H)	0.10	0.40	CERC (2012) Manzoor (2014)
Ratio of j(nitrosamine)/jNO_2	Dimensionless	Ratio of photolysis rate constants for the nitrosamine and NO2	Not applicable to MEA (‘Amine 1’) because primary amines do not form stable nitrosamines (CERC, 2012).	5.15×10^{-4}	Nielson (2010)
			Not applicable to MEA	0.39	Nielson (2010)
Constant, c, for OH concentration calculations	s	Constant for calculating hourly varying OH concentrations, based on relationship between annual average jNO2, O3 and OH	Value of c ranges between 1.64×10^{-3} s^{-1} and 2.17×10^{-3} s^{-1} dependent on met year (modelling completed across five years of met data)		

Parameter	Units	Notes	MEA	DMA	Source
		concentrations			
Atmospheric O_2 concentration	ppb	Concentration of oxygen in air (equivalent to 21% mixing ratio)	209,406,000 ppb		
Raio of NO_x to NO_2 in the exhaust gas	%	Raio of NO_x to NO_2 in the exhaust gas	5-10%		Nielson (2010)
Background NOx / NO2 and O3 concentrations	µg/m^3	Ambient hourly concentrations for each species sourced from representative monitoring location	Defra AURN urban background monitoring site at Wirral Tranmere aligning with met data years (2016-2021)		

Emission Sources and Operating profile

Proposed Combustion Emission Sources

5.2.19 The Proposed Development comprises a Carbon Capture Plant with integral CHP. The Carbon Capture Plant will treat emitted flue gases from the exisiting cement works to remove CO_2 with residual emissions emitted via a new stack to be created as part of the Proposed Development. The existing kiln stack will then only be used during kiln start-up and CCS shutdown. The location of the stacks is shown in **Figure D1** in **Appendix D**. **Table 5.2** presents the physical and emission characteristics of the CCS emissions which are based on data sheets provided by the Applicant.

5.2.20 The existing stack is assumed in the model to operate for 3% of total working hours, which is 263 hrs/yr. It is expected that the proposed PCCCC plant will operate the remaining 8,497 hrs/yr. It is expected that the two stacks are not operated at the same time. Assessment of the PCCCC emissions has been carried out at the proposed emission limit values to represent a worst case scenario The emission rate of the proposed PCCCC plant is less than that of existing kiln stack due to the incorporation of more modern standards of abatement into the plant design than applied at the time the existing stack was constructed.

Table 5.2 Physical and emission characteristics included in the assessment

Description	Existing Stack	Proposed Stack
Plant	**Kiln Stack**	**PCCCC plant**
Operation Hours per annum	263	8,497
Stack height above ground level (m)	117.9	117.9
Stack diameter (m)	3.35	3
Stack exhaust temperature (°C)	135	85
Actual stack exit velocity (m/s)	15.4	14.94
Volumetric Flow Rate (m^3/s) – Actual	158.06	105.64
Volumetric Flow Rate (m^3/s) – Ref	90.53	84.31
NO_x exhaust emissions rate (mg/Nm^3)	450	200
SO_2 exhaust emissions rate (mg/Nm^3)	200	50
CO exhaust emissions rate (mg/Nm^3)	1,200	400
PM_{10} exhaust emissions rate (mg/Nm^3)	10	10
HCl exhaust emissions rate (mg/Nm^3)	10	10
NH_3 exhaust emissions rate (mg/Nm^3)	70	30
Amine 1 exhaust emissions rate (mg/Nm^3)	-	5
Amine 2 exhaust emissions rate (mg/Nm^3)	-	5
Nitrosamine 1 exhaust emissions rate (mg/Nm^3)	-	0.0001

Description	Existing Stack	Proposed Stack
Nitrosamine 2 exhaust emissions rate (mg/Nm^3)	-	0.0001
NO_x exhaust emissions rate (g/s)	29.82	16.86
SO_2 exhaust emissions rate (g/s)	13.25	4.22
CO exhaust emissions rate (g/s)	79.52	33.72
PM_{10} exhaust emissions rate (g/s)	0.66	0.84
HCl exhaust emissions rate (g/s)	0.66	0.84
NH_3 exhaust emissions rate (g/s)	4.64	2.53
Amine 1 exhaust emissions rate (g/s)	-	0.42
Amine 2 exhaust emissions rate (g/s)	-	0.42
Nitrosamine 1 exhaust emissions rate (g/s)	-	0.000008
Nitrosamine 2 exhaust emissions rate (g/s)	-	0.000008
Annual NOx mass emissions (tonnes/yr)	28.2*	515.8*
Annual SO_2 mass emissions (tonnes/yr)	12.5*	128.9*
Annual CO mass emissions (tonnes/yr)	75.3*	1031.6*
Annual PM_{10} mass emissions (tonnes/yr)	0.6*	25.8*
Annual HCl mass emissions (tonnes/yr)	0.6*	25.8*
Annual NH_3 mass emissions (tonnes/yr)	4.4*	25.8*
Annual Amine 1 mass emissions (tonnes/yr)	-	12.9*
Annual Amine 2 mass emissions (tonnes/yr)	-	12.9*

Description	Existing Stack	Proposed Stack
Annual Nitrosamine 1 mass emissions (tonnes/yr)	-	0.0002*
Annual Nitrosamine 2 mass emissions (tonnes/yr)	-	0.0002*
Stack location	X: 329067 Y: 362058	X: 328915 Y: 362079
Emission Concentration Release Conditions (REF): 273K, 101.3kPa, dry gas, 10% oxygen *Based on the operational hours of stacks		

Existing Particulate Matter (PM) Emission Sources

5.2.21 The existing cement works includes a number of particulate matter emission sources. These are included in the Proposed Development model set-up as are expected to continue largely unaffected by the Carbon Capture Plant. Details of existing sources are presented in **Table 5.3** and location is shown in **Figure D1**.

5.2.22 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. In addition, the emission rates and concentrations assumed for Kiln 4 are at the peak values and not the 'normal' values. Thus, the modelled ground level concentrations will be over-estimates of the true values.

Table 5.3: Parameter of Existing PM Source

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

Source	Source ID	X	Y	Height (m)	Temperature (°C)	Diameter (m)	Velocity (m/s)	PM_{10} Emission Rate (g/s)
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

Buildings

5.2.23 In order to capture the potential influence of buildings/structures on the dispersion profile of combustion emissions (e.g. building 'wake' and downwash effects), buildings and structures proposed as part of the Proposed Development were included in the dispersion model. Heights for proposed on-site buildings were taken from the elevation plan. The locations and heights of these buildings/structures are listed in **Table 5.4**.

Table 5.4 Building Details included in the Air Quality Assessment

ID	Shape	Grid Ref (X, Y)	Height (m)	Length (m) / Diameter (m)	Width (m)	Angle (Degrees)
Building004	Rectangular	329064,362063	96	25	20	287
Building001	Circular	329332,362146	40	76	76	0
Building002	Rectangular	329180,362228	29	234	31	109
Building003	Rectangular	329256,362166	45	16	15	106
CO_2 Compressor	Rectangular	328783,362085	20	14	20	112
Gas Heater	Rectangular	328830,362133	7	7	11	112
Gas Wash Tower	Rectangular	328862,362125	40	7	7	113
Absorber	Rectangular	328857,362106	40	7	7	108
Quencher	Rectangular	328890,362094	46	7	7	113
Regenerator	Circular	328913,362097	46	6	6	0
Flue Gas Stack	Circular	328914,362078	111	4	4	0

Meteorological Data

5.2.24 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 6.4km north east of the Site boundary and is considered to be the most representative of site conditions.

5.2.25 The maximum predicted pollutant concentrations for each of the five years have been reported. The windroses for the weather station are presented in **Appendix E**.

Surface Roughness Length

5.2.26 A surface roughness length of 0.3m 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 0.3m was also considered appropriate for the morphology of the meteorological station.

Monin-Obukhov Length

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

Terrain

5.2.28 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.

5.3 Discrete Receptors and Modelled Domain

Human Receptors

5.3.1 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 by producing isopleths (pollution concentration contours), for the predicted annual concentrations, hypothetical grid receptors spaced at 20m covering approximately a domain of 2km x 2km have also been included.

5.3.2 Details of all discrete human receptors included in the modelling study are summarised in **Table 5.5**. Each discrete human receptor was assumed to be 1.5m above ground level (i.e. close to 'breathing height').

Table 5.5 Human receptors included in the dispersion modelling assessment

Receptor ID	Receptor Location	Grid Reference	
		X	Y
R1	Padeswood Drive, Mold	329175	362639
R2	Chester Road, Mold	329286	362723
R3	Chester Road, Mold	328582	362534
R4	Chester Road, Mold	328363	362409
R5	Bannel Lane, Mold	329774	362672
R6	Chester Road, Mold	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

Ecological Receptors

5.3.3 As the Environment Agency 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 15km of the Site boundary, at any sites of Special Scientific Interest (SSSIs) within 10km of the Site boundary and local nature sites (ancient woods, local wildlife sites and national and local nature reserves) within 2km of the Site boundary, if the proposed CHP will have a capacity of more than 50 megawatts.

5.3.4 RSK referred to the Multi-Agency Geographic Information for the Countryside (MAGIC) Maps website to determine the presence of these sites within the identified distances from the Site boundary. These receptors included the closest locations within a range of wind directions and therefore considered to include the worst-case locations within the designated ecological sites. Details of all discrete receptors included in the modelling study are summarised in **Table 5.6** and shown in **Figure D2** in **Appendix D**. All ecological receptors were modelled at ground level (i.e. 0 m) to allow for a conservative assessment.

5.3.5 Furthermore, for the purpose of considering potential impacts at a greater number of locations by producing isopleths (pollution concentration contours), for the predicted annual concentrations, hypothetical grid receptors spaced at 50m covering approximately a domain of 10km x 10km have also been included, to cover areas where designated sites are present. All grid receptors were modelled at ground level (i.e. 0m) to allow for a conservative assessment.

Table 5.6 Discrete ecological receptors (as worst-case locations) included in the dispersion modelling assessment

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

Receptor ID	Receptor	Distance to the Site boundary (km)	Grid Reference	
			X	Y
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 South Clwyd Mountains SAC	10.3	325694	352356
E23	Price's Hill Wood Ancient Woodland/ Flintshire Wildlife Site	1.6	330499	362853
E24	Bistre Wood Ancient Woodland/ Flintshire Wildlife Site	1.1	328147	362698

Receptor ID	Receptor	Distance to the Site boundary (km)	Grid Reference	
			X	Y
E25	Black Pool Plantation Flintshire Wildlife Site	0.5	328690	361716
E26	Hartsheath Flintshire Wildlife Site	1.1	328483	361121
E27	Pontblyddyn Marsh and Coppa Wood Flintshire Wildlife Site	1.7	327579	361251
E28	Padeswood Pool Flintshire Wildlife Site	1.3	327786	362181
E29	Padeswood Pasture Flintshire Wildlife Site	1.1	327941	362129
E30	Marleyfield Meadow Flintshire Wildlife Site	1.6	327708	362879

5.4 Difficulties and Uncertainties

5.4.1 The following difficulties and uncertainties have been identified 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 and will remain so for the duration of the Proposed Development operation. 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 8760 hours per year actual emissions will be lower and in some cases significantly lower than the proposed ELV and over less operational hours. Also, the emissions of existing cement works are both included in the

baseline and project contribution and this leads to a conservative assessment.

- 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.

5.5 Background Air Quality Data Used in the Modelling

5.5.1 For human receptors, due to lack of representative monitoring data in the Study Area, background NO_2, PM_{10}, SO_2 and CO concentrations have been obtained from the Defra LAQM background maps.

5.5.2 For ecological receptors, background NO_x, ammonia, acid deposition and nitrogen deposition values were taken from the APIS website. The grid reference and a habitat type for each ecological receptor were entered into the search tool in order to obtain background concentrations for the relevant grid squares for each receptor. Ecological receptor background concentrations used within the assessment are presented in **Tables 5.8 - 5.10**.

Human Receptors

5.5.3 As discussed in **Section 4**, the nearest background monitoring location to the development site is ADDC-120, which is a kerbside monitoring location. It is not considered to be used as background concentration so the Defra background data is used. **Table 5.7** details background concentrations used for discrete human receptors within the assessment.

Table 5.7 2023 background NO_2 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	7.62	10.28	4.64	0.26
R9	6.61	9.81	3.99	0.25
R10	6.61	9.81	3.99	0.25
R11	6.61	9.81	3.99	0.25
R12	6.36	9.98	3.96	0.25

Ecological Receptors

5.5.4 Background NO_x and ammonia concentrations and background nitrogen deposition rates for the area around the conservation sites were obtained from the APIS website using the 'search by location' function. The ecological data for SSSI was obtained using the 'site relevant critical load' function from the APIS website. This data is based on resolutions of 1km to 5km grid squares.

5.5.5 **Table 5.8** presents the estimated annual average background NO_x and ammonia concentrations at the discrete ecological receptors for the years 2019 – 2021 (latest available). Ammonia process contributions (PCs) were compared to the applicable ammonia critical levels.

Table 5.8 APIS Estimated Annual Average NO_x at Ecological Sites

Discrete Ecological Receptors	Ecological Site	2019 – 2021 Annual Average NO_x 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	2.21
E2	Buckley Claypits and Commons SSSI/ Deeside and Buckley Newt Sites SAC	10.02	2.12
E3	Buckley Claypits and Commons SSSI/ Deeside and Buckley Newt Sites SAC	11.06	1.56
E4	Maes Y Grug SSSI/ Deeside and Buckley Newt Sites SAC	8.11	2.06
E5	Connah's Quay Ponds and Woodland SSSI/Deeside and Buckley Newt Sites SAC	9.87	2.06
E6	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	11.22	2.93
E7	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	16.26	2.50

Discrete Ecological Receptors	Ecological Site	2019 – 2021 Annual Average NO_x Concentration (µg/m³)	2019 – 2021 Annual Average Ammonia Concentration (µg/m³)
E8	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	13.61	2.32
E9	Dee Estuary / Aber Afon Dyfrdwy SSSI/SAC	11.21	2.12
E10	Shotton Lagoons and Reedbeds SSSI	14.65	2.06
E11	Mynydd Y Fflint / Flint Mountain SSSI	8.27	1.76
E12	Coed Talon Marsh SSSI	6.15	1.73
E13	Chwarel Cambrian / Cambrian Quarry, Gwernymynydd SSSI	6.12	1.59
E14	Alyn Valley Woods and Alyn Gorge Caves SSSI/SAC	5.73	1.49
E15	Bryn Alyn SSSI	4.93	1.35
E16	Glaswelltiroedd Eryrys (Eryrys Grasslands) SSSI	4.95	1.34
E17	Llay Bog SSSI	8.06	2.42
E18	Chwarel Singret SSSI	8.23	3.04
E19	Marford Quarry SSSI	10.78	3.17
E20	Halkyn Mountain / Mynydd Helygain SAC	6.57	1.67
E21	Berwyn a Mynyddoedd De Clwyd / Berwyn and South Clwyd Mountains SAC	4.94	1.23
E22	Berwyn a Mynyddoedd De Clwyd / Berwyn and South Clwyd Mountains SAC	5.30	1.17

Discrete Ecological Receptors	Ecological Site	2019 – 2021 Annual Average NO_x Concentration (µg/m^3)	2019 – 2021 Annual Average Ammonia Concentration (µg/m^3)
E23	Price's Hill Wood Ancient Woodland/ Flintshire Wildlife Site	10.02	2.31
E24	Bistre Wood Ancient Woodland/ Flintshire Wildlife Site	8.69	2.05
E25	Black Pool Plantation Flintshire Wildlife Site	7.62	2.00
E26	Hartsheath Flintshire Wildlife Site	7.62	2.00
E27	Pontblyddyn Marsh and Coppa Wood Flintshire Wildlife Site	7.45	1.93
E28	Padeswood Pool Flintshire Wildlife Site	7.79	1.99
E29	Padeswood Pasture Flintshire Wildlife Site	7.79	1.99
E30	Marleyfield Meadow Flintshire Wildlife Site	7.79	1.99
Air Quality Objective / Critical Level*		**30**	**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.			

5.5.6 The nitrogen deposition and acid deposition values were taken from the APIS 'search by location' tool whereas broad habitat type was determined using the MAGIC Maps website and information from the local environmental records centre and APIS for the SSSI. The background nitrogen and acid deposition rates obtained from APIS, used in this assessment are presented in **Table 5.9**.

5.5.7 The habitat recorded below and 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 PCs were compared to the applicable nitrogen deposition lower critical loads. The acid deposition PCs were compared to the critical load. 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 5.9**.

Table 5.8 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
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

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)
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

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)
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
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

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)
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
E23	Price’s Hill Wood Ancient Woodland/ Flintshire Wildlife Site	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**35.87**	2.56	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)
E24	Bistre Wood Ancient Woodland/ Flintshire Wildlife Site	Broadleaved woodland and scrub	Broadleaved woodland and scrub	**33.73**	2.41	0.2
E25	Black Pool Plantation Flintshire Wildlife Site	Fen	Fen	**21.09**	1.51	0.17
E26	Hartsheath Flintshire Wildlife Site	Lowland pasture and parkland	Lowland pasture and parkland	**33.63**	2.4	0.21
E27	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
E28	Padeswood Pool Flintshire Wildlife Site	Wet woodland/ Fen	Wet woodland/ Fen	**20.53**	1.47	0.17
E29	Padeswood Pasture Flintshire Wildlife Site	Pasture/ meadow and scrub	Pasture/ meadow and scrub	**20.53**	1.47	0.17
E30	Marleyfield Meadow Flintshire Wildlife Site	Pasture/meadow and scrub Broadleaved woodland and scrub	Pasture/meadow and scrub	**20.53**	2.33	0.2
Bold text indicates an exceedance of the lower critical load range for this habitat						

Processing of Results

5.5.8 NO_x emitted to the atmosphere as a result of combustion processes 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 Natural Resources Wales[45]. For comparison with the NO_x objectives for ecological receptors, the results do not need to be converted as above.

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

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

Nitrogen and Acid Deposition Calculations

5.5.10 Total annual mean NO_x concentrations, and acid and nitrogen deposition rates, were calculated at the identified discrete ecological receptor locations. The contribution of NO_2 emitted by the plant to nitrogen and acid deposition on sensitive ecological receptors has been determined by following the methodology set out in AQTAG06 (EA, 2014).

5.5.11 The broad habitat types identifiable at each ecological site were determined using information available on the APIS for the purpose of the nitrogen and acid deposition calculations. Where more than one habitat type was identified within each ecological site, it has been assumed that the habitat most sensitive to the Proposed Development is represented at the modelled discrete receptor location, for a conservative assessment.

5.5.12 Background NO_x concentrations, the critical nitrogen deposition loading capacities, the nitrogen acid deposition loading capacities, and background nitrogen and acid deposition rates, were obtained from the APIS website.

5.5.13 The nitrogen deposition PCs were compared to the applicable nitrogen deposition lower critical loads. The acid deposition PCs were compared to the critical load. The relevant critical loads for nitrogen deposition and acidification critical loads, taken from APIS, at the identified ecological receptors are presented in **Table 5.10**. The results of the dispersion modelling assessment are discussed in **Section 7**.

[45] https://cdn.naturalresources.wales/media/687136/nrw-specified-generators-modelling-guidanceinterim-final.pdf?mode=pad&rnd=131838216500000000.

Table 5.9 Critical loads for ammonia, nitrogen and acid deposition

Receptor ID	Designated Feature/ Broad Habitat Type	Ammonia Critical Level ($\mu g/m^3$)	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
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

Receptor ID	Designated Feature/ Broad Habitat Type	Ammonia Critical Level (µg/m³)	Nutrient Nitrogen Critical Load* (kgN/ha/yr	CLMaxS (keqN/ha/yr)	CLMinN (keqN/ha/yr)	CLMaxN (keqS/ha/yr)
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
E15	Bryn Alyn SSSI	1	10-20	4	0.856	4.856

Receptor ID	Designated Feature/ Broad Habitat Type	Ammonia Critical Level (µg/m³)	Nutrient Nitrogen Critical Load* (kgN/ha/ yr	CLMaxS (keqN/ha/ yr)	CLMinN (keqN/ha/ yr)	CLMaxN (keqS/ha/ yr)
E16	Glaswelltiroedd 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	Price's Hill Wood Ancient Woodland/ Flintshire Wildlife Site	1	10-15	2.643	0.357	3

Receptor ID	Designated Feature/ Broad Habitat Type	Ammonia Critical Level (µg/m³)	Nutrient Nitrogen Critical Load* (kgN/ha/yr	CLMaxS (keqN/ha/yr)	CLMinN (keqN/ha/yr)	CLMaxN (keqS/ha/yr)
E24	Bistre Wood Ancient Woodland/ Flintshire Wildlife Site	1	10-15	2.632	0.357	2.989
E25	Black Pool Plantation Flintshire Wildlife Site	1	5-15	Not Sensitive to acidity		
E26	Hartsheath Flintshire Wildlife Site	1	20-30	2.632	0.357	2.989
E27	Pontblyddyn Marsh and Coppa Wood Flintshire Wildlife Site	1	10-15	1.643	0.142	1.785
E28	Padeswood Pool Flintshire Wildlife Site	1	10-15	2.637	0.357	2.994
E29	Padeswood Pasture Flintshire Wildlife Site	1	20-30	2.637	0.357	2.994
E30	Marleyfield Meadow Flintshire Wildlife Site	1	10-15	2.637	0.357	2.994
*Lower critical load used in assessment for conservative assessment						

5.6 Significance Criteria

5.6.1 The EPUK/IAQM guidance[46] recommends that the degree of effect is described by expressing the magnitude of incremental change as a proportion of the relevant assessment level and examining this change in the context of the new total concentration and its relationship with the assessment criterion. **Table C1** in **Appendix C** presents the suggested framework describing the long-term human-health air quality impacts on sensitive receptors in the surrounding area.

[46] https://iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf

5.6.2 The significance of emissions from the Proposed Development on human receptors has been determined using the criteria outlined in the EPUK/IAQM guidance and the Defra & EA (2016) guidance[47].

5.6.3 The significance of emissions from the Proposed Development on ecological receptors has been determined using the criteria outlined in the Defra, EA (2016) 'Air emissions risk assessment for your environmental permit' guidance[48].

5.6.4 This states that the environmental concentration of substance released into the air, which is known as the process contribution, from the Proposed Development can be considered to be insignificant if the following primary criteria are met:

- The short-term PC is less than 10 % of the short-term AQS/environmental assessment level (EAL); and
- The long-term PC is less than 1 % of the long-term AQS/EAL.

5.6.5 If these criteria are met then the effect can be considered to be insignificant, if the criteria aren't met, then the secondary stage criteria can be used, which are:

- The short-term PC is less than 20 % of the short-term AQS/EAL minus twice the long-term background concentration; and
- The long-term PEC is less than 70 % of the long-term AQS/EAL.

5.6.6 If the second stage criteria are met, then the effect can be considered to be insignificant. However, if the criteria are not met, this does not necessarily mean an effect is significant and consideration has been given as to whether the PEC exceeds the relevant standards and taking account of the conservative nature of this assessment.

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

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

6 ASSESSMENT OF IMPACTS IN CONSTRUCTION PHASE

6.1.1 Atmospheric emissions from construction activities will depend on a combination of the potential for emissions (the type of activity and prevailing conditions) and the effectiveness of control measures. In general terms, there are two sources of emissions that will need to be controlled to minimise the potential for adverse environmental effects:

- Exhaust emissions from site plant, equipment and vehicles; and
- Fugitive dust emissions from site activities.

Exhaust Emissions from Plant and Vehicles

6.1.2 The operation of vehicles and equipment powered by internal combustion engines results in the emission of exhaust gases containing the pollutants NO_x, PM_{10}, volatile organic compounds (VOCs) and carbon monoxide (CO). The quantities emitted depend on factors such as engine type, service history, pattern of usage and fuel composition.

6.1.3 Construction traffic will comprise haulage/construction vehicles and vehicles used for workers' trips to and from the Site. The greatest impact on air quality due to emission from construction phase vehicles will be in areas adjacent to the site access and nearby road network.

6.1.4 According to **Volume 2, Chapter 11**), it is anticipated that the change of AADT of HGV and LGV is 173 and 325 in the peak HGV period of construction phase respectively. Whilst the threshold for further assessment referred in the IAQM guidance is for 100 AADT HGV, it is only the 4-month period of peak construction within the overall 37-month construction period. The change of AADT of HGV and LGV for 37-month average in total construction programme is 47 and 325 respectively, which is considered unlikely to cause a significant impact on local air quality, in accordance with the IAQM guidance.

6.1.5 The operation of site equipment and machinery will result in emissions to atmosphere of exhaust gases, but with suitable controls and site management such emissions are unlikely to be significant (as per LAQM.TG.22[49]).

Fugitive Dust Emissions

6.1.6 Fugitive dust emissions arising from construction activities are likely to be variable in nature and will depend upon the type and extent of the activity, soil type and moisture content, road surface conditions and weather conditions. Periods of dry weather combined with higher-than-average wind speeds have the potential to generate more dust.

6.1.7 The construction activities anticipated as part of the Proposed Development that are often the most significant potential sources of fugitive dust emissions are:

[49] https://laqm.defra.gov.uk/wp-content/uploads/2022/08/LAQM-TG22-August-22-v1.0.pdf

- Demolition of existing buildings (Padeswood Hall, Padeswood Hall Farm and associated outbuildings) and the size reduction and handling of materials;
- Earth moving, due to the handling, storage and disposal of soil and subsoil materials;
- Construction aggregate usage, due to the transport, unloading, storage and use of dry and dusty materials (such as cement and sand);
- Movement of heavy site vehicles on dry or untreated haul routes; and
- Movement of vehicles over surfaces where muddy materials have been transferred off-site (for example, on to public highways).

6.1.8 Fugitive dust arising from construction and demolition activities is mainly of a particle size greater than the PM_{10} fraction (that which can potentially impact upon human health). However, it is noted that demolition and construction activities may contribute to local PM_{10} concentrations. Appropriate dust control measures can be highly effective for controlling emissions from potentially dust generating activities identified above, and adverse effects can be greatly reduced or eliminated.

6.1.9 Refer to **Appendix A** for further explanation of the tendency of dust to remain airborne.

Potential Dust Emission Magnitude

6.1.10 With reference to the IAQM guidance[50] criteria outlined in **Appendix A**, the dust emissions magnitude for demolition, earthworks, construction and trackout activities are summarised in **Table 6.1, Table 6.2, Table 6.3** and **Table 6.4**. Risk categories for the construction activities are summarised in **Table 6.5**.

6.1.11 Where information is not currently available, worst-case assumptions have been made to ensure a conservative assessment.

Table 6.1 Summary of dust emissions magnitude of demolition activities (before mitigation)

Demolition Criteria	Dust Emissions Class	Evaluation of the Effects
Total volume of buildings to be demolished	Small	<500m^3
On-site crushing and screening	Small	No
Height of demolition activities above ground	Small	<6m
Dust potential of demolition materials	Medium	Yes. Typical dust associated with masonry building demolition.
Times at which activities undertaken	Large	Will depend on when planning permission is issued. Worst-case scenario has been assumed.

[50] https://iaqm.co.uk/wp-content/uploads/2013/02/Construction-Dust-Guidance-Jan-2024.pdf

Demolition Criteria	Dust Emissions Class	Evaluation of the Effects
Overall Rating	**Small**	Conservative rating based on professional judgement

Table 6.2 Summary of dust emissions magnitude of earthworks activities (before mitigation)

Earthworks Criteria	Dust Emissions Class	Evaluation of the Effects
Total site area	Medium	18,000 – 110,000m^2
Soil type	Large	Clay
Earth moving vehicles at any one time	Medium	5-10
Height of bunds	Medium	3-6m
Work times	Large	Will depend on when planning permission is issued. Worst-case scenario has been assumed.
Overall Rating	**Large**	Conservative rating based on professional judgement

Table 6.3 Summary of dust emissions magnitude of construction activities (before mitigation)

Construction Criteria	Dust Emissions Class	Evaluation of the Effects
Total building volume	Medium	Estimated to be 12,000-75,000m^3
On-site concrete batching or sandblasting proposed	Medium	Yes
Dust potential of construction materials	Medium	Aggregates, concrete.
Overall Rating	**Medium**	Conservative rating based on professional judgement

Table 6.4 Summary of dust emissions magnitude of trackout activities (before mitigation)

Trackout Criteria	Dust Emissions Class	Evaluation of the Effects
Number of HDV>3.5t per day	Large	Estimated to be >50
Length of unpaved road	Medium	Estimated to be 50-100 m
Overall Rating	**Large**	Conservative rating based on professional judgement

Table 6.5 Summary of dust emission magnitude of the Site (before mitigation)

Construction Activities	Dust Emissions Class
Demolition	Small
Earthworks	Large
Construction	Medium
Trackout	Large

Sensitivity of the Area

6.1.12 As per the IAQM Guidance[51], the sensitivity of the area takes into account a number of factors, including:

- The specific sensitivities of receptors in the area;
- The proximity and number of those receptors;
- In the case of PM_{10}, the local background concentration; and
- Site specific factors, such as whether there are natural shelters, such as trees, to reduce the risk of wind-blown dust.

6.1.13 Consideration is given to human and ecological receptors, distances are calculated from the construction Site boundary and the trackout route proposed. Where necessary, for example, if the trackout route is not yet known, a conservative view on the likely route has been taken.

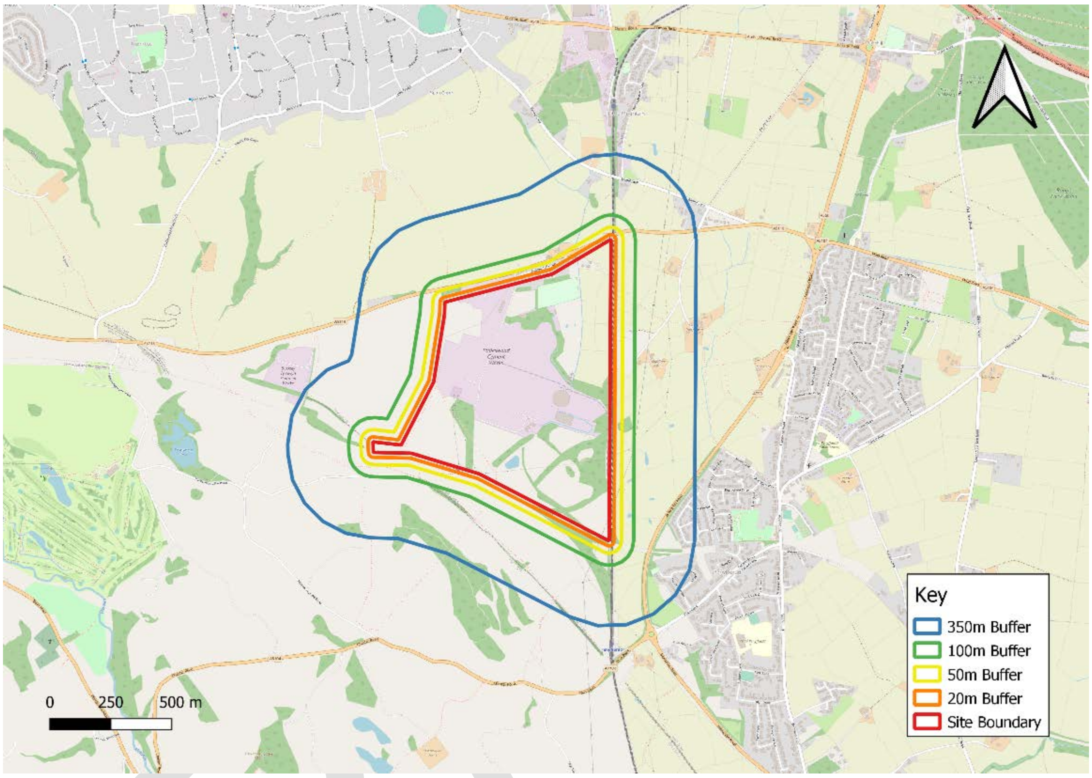
6.1.14 **Figure 6.1A** and **Figure 6.2A** show maps indicating the demolition/earthworks/construction and trackout buffers, respectively, for identifying the sensitivity of the area. **Table 6.6** presents the determined sensitivity of the area. Construction activities are relevant up to 350m from Site boundary whereas trackout activities are only considered relevant up to 50m from the edge of the road, as per the IAQM guidance [52]. Only 20m and 50m buffers have been included for trackout for this reason.

[51] https://iaqm.co.uk/wp-content/uploads/2013/02/Construction-Dust-Guidance-Jan-2024.pdf

[52] https://iaqm.co.uk/wp-content/uploads/2013/02/Construction-Dust-Guidance-Jan-2024.pdf

6.1.15 No designated ecological receptors have been identified within 50m of the Site boundary or the anticipated trackout route, therefore following the IAQM guidance[53]

Figure 6.1A Demolition/earthworks/construction activities buffer map



ecological receptors have been screened out of this part of the assessment.

[53] https://iaqm.co.uk/wp-content/uploads/2013/02/Construction-Dust-Guidance-Jan-2024.pdf

Figure 6.2A Trackout activities buffer map

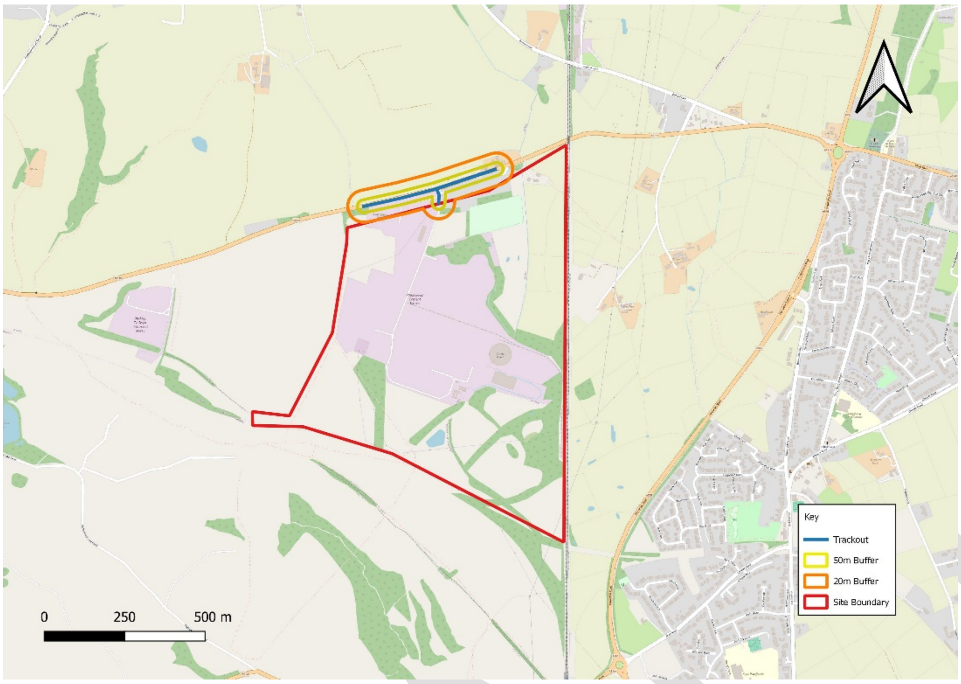


Table 6.6 Sensitivity of the area

Potential Impact		Sensitivity of the surrounding area			
		Demolition	Earthworks	Construction	Trackout
Dust soiling	Receptor sensitivity	High	High	High	High
	Number of receptors	1-10	1-10	1-10	10-100
	Distance from the source	<20 m	<20 m	<20 m	<2 0m
	Sensitivity of the area	**Medium**	**Medium**	**Medium**	**High**
Human health	Receptor sensitivity	High	High	High	High
	Annual mean PM_{10} concentration	<24 µg/m³	<24 µg/m³	<24 µg/m³	<24 µg/m³
	Number of receptors	<100	<100	<100	<100

Potential Impact		Sensitivity of the surrounding area			
		Demolition	Earthworks	Construction	Trackout
	Distance from the source	<20 m	<20 m	<20 m	<20 m
	Sensitivity of the area	**Low**	**Low**	**Low**	**Low**
Ecological	Receptor sensitivity	N/A			

Risk of Impacts

6.1.16 The dust emission magnitude is combined with the sensitivity of the area to determine the risk of impacts of construction activities before mitigation; these are evaluated based on risk categories of each activity in **Appendix A**. The risk of dust impacts from construction activities is identified in **Table 6.7**.

6.1.17 Site specific mitigation measures to reduce construction phase impacts are defined based on this assessment in **Section 6 and Appendix B**.

Table 6.7 Summary of the Dust Risk from Construction Activities

Potential Impact	Dust Risk Impact			
	Demolition	Earthworks	Construction	Trackout
Dust soiling	Low Risk	Medium Risk	Medium Risk	High Risk
Human health	Negligible	Low Risk	Low Risk	Low Risk
Ecological	N/A			

7 ASSESSMENT OF IMPACTS IN OPERATIONAL PHASE

7.1 Impacts on Human Receptors

7.1.1 The main impact of the Proposed Development is considered to be flue gas emissions from the CCS process on sensitive receptors in the area surrounding the Site. The modelling results of highest concentration predicted across all five meteorological years are presented in the following subsections for discrete human and ecological receptors. The IAQM planning guidance[54] provides a framework to identify the significance of effects.

Annual Mean NO_2 Impacts

7.1.2 The AQS objective for annual mean NO_2 concentrations is 40 µg/m^3. The maximum magnitude of change in annual mean NO_2 concentrations at the assessed discrete receptors representative of relevant human exposure, assessed across any of the meteorological years modelled, is described in **Table 7.1**.

7.1.3 The results of the assessment indicate that with the Proposed Development, predicted annual mean NO_2 concentrations for all receptor locations will be below the AQS. The highest annual mean NO_2 concentration was predicted to be 0.38 µg/m^3 at R10 (refer to **Table 7.1**).

7.1.4 The comparison of annual mean NO_2 concentrations between the 'Baseline' and 'Proposed Development' scenarios is presented in **Table 7.1**. The results as percentages of the Air Quality Assessment Level (AQAL) (i.e. the UK AQS objectives) are also presented which are used in the determination of significance of effects (based on the EPUK-IAQM guidance). The changes in annual mean NO_2 concentrations at relevant receptors as a result of the additional emissions from the Proposed Development, range between 0.2 % and 1.0 % of the AQAL. The effects of the Proposed Development on nearby sensitive are predicted to be 'negligible' at all relevant receptor locations, in accordance with the EPUK-IAQM guidance.

7.1.5 In accordance with EPUK-IAQM guidance, the effect of the Proposed Development on annual mean NO_2 concentrations at sensitive human receptors, prior to mitigation, is considered to be **'not significant'**.

54 https://iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf

Table 7.1 Predicted annual NO_2 concentrations at discrete receptors - highest results for each receptor

Receptor ID	Annual Mean NO_2 Background (Baseline) (µg/m³)	Annual Mean NO_2 Concentration (µg/m³)				
		PC	PEC	as PEC % of Objective	Change between Baseline and Proposed as % of AQS Objective	Impact
R1	7.46	0.09	7.55	18.9%	0.2%	Negligible
R2	7.46	0.12	7.58	18.9%	0.3%	Negligible
R3	6.35	0.22	6.57	16.4%	0.5%	Negligible
R4	6.35	0.14	6.49	16.2%	0.4%	Negligible
R5	7.46	0.26	7.72	19.3%	0.7%	Negligible
R6	7.46	0.26	7.71	19.3%	0.6%	Negligible
R7	7.46	0.22	7.68	19.2%	0.6%	Negligible
R8	7.62	0.21	7.84	19.6%	0.5%	Negligible
R9	6.61	0.26	6.87	17.2%	0.6%	Negligible
R10	6.61	0.38	6.99	17.5%	1.0%	Negligible
R11	6.61	0.21	6.82	17.0%	0.5%	Negligible
R12	6.36	0.07	6.43	16.1%	0.2%	Negligible
AQS / EAL Objective	40 µg/m³					

99.8th Hourly Mean NO_2 Concentrations

7.1.6 The maximum 99.8th hourly mean NO_2 concentrations at the assessed discrete human receptors representative of relevant exposure, assessed across any of the meteorological years modelled, is described.

7.1.7 The results of the assessment indicate that with the Proposed Development (inclusive of existing emission sources), predicted hourly mean NO_2 concentrations for all receptor locations will be below the AQS objective. The assessment predicts that, with the Proposed Development in place, predicted hourly mean NO_2 concentrations are well below the hourly mean NO_2 AQS objective at all modelled receptors (refer to **Table 7.2).** In accordance with EPUK-IAQM guidance, the effect of the Proposed Development on hourly mean NO_2 concentrations at sensitive human receptors, prior to mitigation, is considered to be **'not significant'.**

Table 7.2 Predicted hourly mean NO_2 concentrations at discrete receptors - highest results for each receptor

Receptor ID	Hourly Mean NO_2 Concentration (µg/m³)		
	Proposed Future (Without Background)	As % of AQS Objective	Impact
R1	7.43	3.7%	Negligible
R2	7.51	3.8%	Negligible
R3	8.70	4.4%	Negligible
R4	7.98	4.0%	Negligible
R5	8.31	4.2%	Negligible
R6	7.14	3.6%	Negligible
R7	9.56	4.8%	Negligible
R8	6.67	3.3%	Negligible
R9	7.98	4.0%	Negligible
R10	8.70	4.3%	Negligible
R11	7.14	3.6%	Negligible
R12	8.38	4.2%	Negligible
AQS / EAL Objective	**200 µg/m³**		

Annual Mean PM_{10} Impacts

7.1.8 The AQS objective for annual mean PM_{10} concentrations is 40 µg/m³. The maximum magnitude of change in annual mean PM_{10} concentrations at the assessed discrete receptors representative of relevant human exposure, assessed across any of the meteorological years modelled, is described in **Table 7.3**.

7.1.9 The results of the assessment indicate that with the Proposed Development, and existing PM sources, predicted annual mean PM_{10} concentrations for all receptor locations will be below the AQS. The highest annual mean PM_{10} PEC concentration was predicted to be 11.23 µg/m³ at R1 (refer to **Table 7.3**).

7.1.10 As illustrated in **Table 7.3**, the comparison of annual mean PM10 concentrations between the 'Baseline' and 'Proposed Development' scenarios is presented. The results as percentages of the Air Quality Assessment Level (AQAL) (i.e. the UK AQS objectives) are also presented which are used in the determination of significance of effects (based on the EPUK-IAQM guidance). The changes in annual mean PM_{10} concentrations at relevant receptors as a result of the additional emissions from the Proposed Development, range between 0.3% and 2.2% of the AQAL. The effects of the Proposed Development on nearby sensitive are predicted to be 'negligible' at all relevant receptor locations, in accordance with the EPUK-IAQM guidance.

7.1.11 In accordance with EPUK-IAQM guidance, the effect of the Proposed Development on annual mean PM_{10} concentrations at sensitive human receptors, prior to mitigation, is considered to be **‘not significant’**.

Table 7.3 Predicted annual PM_{10} concentrations at discrete receptors - highest results for each receptor

Receptor ID	Annual Mean PM_{10} Background (µg/m³)	Annual Mean PM10 Concentration (µg/m³)					
		PC of Proposed Source (µg/m³)	PC of existing PM sources (µg/m³)	Proposed future (Total) (µg/m³)	as % of Objective	Change between Baseline and Proposed as % of AQS Objective	Impact
R1	10.13	0.01	1.09	11.23	22.5%	2.2%	Negligible
R2	10.13	0.01	0.50	10.64	21.3%	1.0%	Negligible
R3	9.88	0.02	0.41	10.30	20.6%	0.8%	Negligible
R4	9.88	0.01	0.17	10.05	20.1%	0.4%	Negligible
R5	10.13	0.02	0.45	10.60	21.2%	0.9%	Negligible
R6	10.13	0.02	0.31	10.46	20.9%	0.7%	Negligible
R7	10.13	0.02	0.82	10.96	21.9%	1.7%	Negligible
R8	10.28	0.01	0.30	10.60	21.2%	0.6%	Negligible
R9	9.81	0.02	0.52	10.35	20.7%	1.1%	Negligible
R10	9.81	0.03	0.53	10.37	20.7%	1.1%	Negligible
R11	9.81	0.01	0.10	9.93	19.9%	0.2%	Negligible
R12	9.98	0.01	0.13	10.12	20.2%	0.3%	Negligible
AQS / EAL Objective	40 µg/m³						

90.41th Daily Mean PM_{10} Concentrations

7.1.12 The maximum 90.41th daily mean PM_{10} concentrations at the assessed discrete human receptors representative of relevant exposure, assessed across any of the meteorological years modelled, is described in **Table 7.4**.

7.1.13 The results of the assessment indicate that with the Proposed Development, and existing PM sources, predicted daily mean PM_{10} concentrations for all receptor locations are below the AQS objective. Predicted PCs of daily mean PM_{10} concentration are below 10 % of the AQS at all receptors, furthermore, all predicted daily mean PM_{10} PECs at discrete receptors are well below the AQS. The highest daily mean PM_{10} concentration was predicted to be 2.97 µg/m^3 at R07 (refer to **Table 7.4**). In accordance with EPUK-IAQM guidance, the effect of the Proposed Development on hourly mean PM_{10} concentrations at sensitive human receptors, prior to mitigation, is considered to be **'not significant'**.

Table 7.4 Predicted daily mean PM_{10} concentrations at discrete receptors - highest results for each receptor

Receptor ID	Annual Mean PM_{10} Background (µg/m³)	Daily Mean PM_{10} Concentration (µg/m³)				
		PC of Proposed Source (µg/m³)	PC of existing PM sources (µg/m³)	Total Concentration without background (µg/m³)	as % of Objective	Impact
R1	10.13	0.02	2.72	2.75	5.5%	Negligible
R2	10.13	0.02	1.32	1.35	2.7%	Negligible
R3	9.88	0.06	1.23	1.29	2.6%	Negligible
R4	9.88	0.02	0.54	0.56	1.1%	Negligible
R5	10.13	0.08	1.43	1.50	3.0%	Negligible
R6	10.13	0.06	0.91	0.97	1.9%	Negligible
R7	10.13	0.10	2.88	2.97	5.9%	Negligible
R8	10.28	0.05	0.88	0.94	1.9%	Negligible
R9	9.81	0.06	1.55	1.61	3.2%	Negligible
R10	9.81	0.12	1.70	1.81	3.6%	Negligible
R11	9.81	0.02	0.38	0.40	0.8%	Negligible
R12	9.98	0.01	0.43	0.44	0.9%	Negligible
AQS / EAL Objective	50 µg/m³					

8-hour Mean CO Concentrations

7.1.14 The maximum 8-hour mean CO concentrations at the assessed discrete human receptors representative of relevant exposure, assessed across any of the meteorological years modelled, is described in **Table 7.5**.

7.1.15 The results of the assessment indicate that with the predicted 8-hour mean CO concentrations for all receptor locations are below the AQS objective. Predicted PCs of 8-hour mean CO concentration are below 10% of the AQS at all receptors, furthermore, all predicted 8-hour mean CO PECs at discrete receptors are well below the AQS. The highest 8-hour mean CO concentration was predicted to be 66.41 µg/m^3 at R07 (refer to **Table 7.5**). In accordance with EPUK-IAQM guidance, the effect of the Proposed Development on 8-hour mean CO concentrations at sensitive human receptors, prior to mitigation, is considered to be **'not significant'**.

Table 7.5 Predicted 8-hour mean CO concentrations at discrete receptors - highest results for each receptor

Receptor ID	8-hour mean CO Concentration (µg/m^3)		
	Process Contribution	As % of AQS Objective	Impact
R1	53.40	0.5%	Negligible
R2	56.38	0.6%	Negligible
R3	61.47	0.6%	Negligible
R4	47.20	0.5%	Negligible
R5	54.70	0.5%	Negligible
R6	46.08	0.5%	Negligible
R7	66.41	0.7%	Negligible
R8	47.86	0.5%	Negligible
R9	53.41	0.5%	Negligible
R10	58.39	0.6%	Negligible
R11	32.25	0.3%	Negligible
R12	60.60	0.6%	Negligible
AQS / EAL Objective	**10,000 µg/m^3**		

99.19th Daily Mean SO_2 Concentrations

7.1.16 The maximum 99.19th daily mean SO_2 concentrations at the assessed discrete human receptors representative of relevant exposure, assessed across any of the meteorological years modelled, is described in **Table 7.6**.

7.1.17 The results of the assessment indicate that with the Proposed Development (including existing SO_2 sources), predicted daily mean SO_2 concentrations for all receptor locations are below the AQS objective. Predicted PCs of daily mean SO_2 concentration are below 10% of the AQS at all receptors, furthermore, all predicted daily mean SO_2 PECs at discrete receptors are well below the AQS. The highest daily mean SO_2 concentration was predicted to be 5.36 µg/m^3 at R07 (refer to **Table 7.6**). In accordance with EPUK-IAQM guidance, the effect of the Proposed Development on hourly mean SO_2 concentrations at sensitive human receptors, prior to mitigation, is considered to be '**not significant'**.

Table 7.6 Predicted daily mean SO_2 concentrations at discrete receptors - highest results for each receptor

Receptor ID	99.19th Daily Mean SO_2 Concentration (µg/m^3)		
	Proposed Future (Without Background)	As % of AQS Objective	Impact
R1	2.40	1.9%	Negligible
R2	2.34	1.9%	Negligible
R3	3.90	3.1%	Negligible
R4	3.47	2.8%	Negligible
R5	4.69	3.8%	Negligible
R6	4.17	3.3%	Negligible
R7	5.36	4.3%	Negligible
R8	3.27	2.6%	Negligible
R9	3.94	3.2%	Negligible
R10	4.89	3.9%	Negligible
R11	1.53	1.2%	Negligible
R12	2.96	2.4%	Negligible
AQS / EAL Objective	**125 µg/m^3**		

99.73th Hourly Mean SO_2 Concentrations

7.1.18 The maximum 99.73th hourly mean SO_2 concentrations at the assessed discrete human receptors representative of relevant exposure, assessed across any of the meteorological years modelled, is described in **Table 7.7**.

7.1.19 The results of the assessment indicate that with the Proposed Development (inclusive of existing sources of SO_2), predicted hourly mean SO_2 concentrations for all receptor locations are below the AQS objective. Predicted PCs of daily mean SO_2 concentration are below 10% of the AQS at all receptors, furthermore, all predicted hourly mean SO_2 PECs at discrete receptors are well below the AQS. The highest daily mean SO_2 concentration was predicted to be 12.01 µg/m^3 at R07 (refer to **Table 7.7**). In accordance with EPUK-IAQM guidance, the effect of the Proposed Development on hourly mean SO_2 concentrations at sensitive human receptors, prior to mitigation, is considered to be **'not significant'.**

Table 7.7 Predicted hourly mean SO_2 concentrations at discrete receptors - highest results for each receptor

Receptor ID	99.73th Hourly Mean SO_2 Concentration (µg/m^3)		
	Proposed Future (Without Background)	As % of AQS Objective	Impact
R1	8.94	2.6%	Negligible
R2	9.34	2.7%	Negligible
R3	10.87	3.1%	Negligible
R4	9.72	2.8%	Negligible
R5	10.44	3.0%	Negligible
R6	8.91	2.5%	Negligible
R7	12.01	3.4%	Negligible
R8	8.43	2.4%	Negligible
R9	9.96	2.8%	Negligible
R10	10.90	3.1%	Negligible
R11	8.72	2.5%	Negligible
R12	10.34	3.0%	Negligible
AQS / EAL Objective	**350 µg/m^3**		

99.99th 15-min Mean SO_2 Concentrations

7.1.20 The maximum 99.99th 15-min mean SO_2 concentrations at the assessed discrete human receptors representative of relevant exposure, assessed across any of the meteorological years modelled, is described in **Table 7.8**.

7.1.21 The results of the assessment indicate that with the Proposed Development (inclusive of existing source of SO_2), predicted 15-min mean SO_2 concentrations for all receptor locations are below the AQS objective. Predicted PCs of 15-min mean SO_2 concentration are below 10% of the AQS at all receptors, furthermore, all predicted 15-min mean SO_2 PECs at discrete receptors are well below the AQS. The highest 15-min mean SO_2 concentration was predicted to be 5.36 µg/m^3 at R07 (refer to **Table 7.8**). In accordance with EPUK-IAQM guidance, the effect of the Proposed Development on 15-min mean SO_2 concentrations at sensitive human receptors, prior to mitigation, is considered to be **'not significant'**.

Table 7.8 Predicted 15-min mean SO_2 concentrations at discrete receptors - highest results for each receptor

Receptor ID	99.99th 15-min Mean SO_2 Concentration (µg/m^3)		
	Proposed Future (Without Background)	As % of AQS Objective	Impact
R1	14.91	5.6%	Negligible
R2	13.16	4.9%	Negligible
R3	13.52	5.1%	Negligible
R4	13.33	5.0%	Negligible
R5	12.76	4.8%	Negligible
R6	10.92	4.1%	Negligible
R7	14.18	5.3%	Negligible
R8	14.61	5.5%	Negligible
R9	12.38	4.7%	Negligible
R10	12.49	4.7%	Negligible
R11	12.16	4.6%	Negligible
R12	14.59	5.5%	Negligible
AQS / EAL Objective	**266 µg/m^3**		

Daily Mean Amine Concentrations

7.1.22 The maximum daily mean amine concentrations at the assessed discrete human receptors representative of relevant exposure, assessed across any of the meteorological years modelled, is described in **Table 7.9**.

7.1.23 The results of the assessment indicate that with the Proposed Development, predicted daily mean amine concentrations for all receptor locations are below the AQS objective. Predicted PCs of daily mean amine concentration are below 10% of the AQS at all receptors. In accordance with EPUK-IAQM guidance, the effect of the Proposed Development on daily mean amine concentrations at sensitive human receptors, prior to mitigation, is considered to be **'not significant'.**

Table 7.9 Predicted daily mean amine concentrations at discrete receptors - highest results for each receptor

Receptor ID	Daily Mean Amine Concentration (μg/m^3)		
	Proposed Future* (Without Background)	As % of AQS Objective	Impact
R1	0.11	0.1%	Negligible
R2	0.13	0.1%	Negligible
R3	0.24	0.2%	Negligible
R4	0.23	0.2%	Negligible
R5	0.21	0.2%	Negligible
R6	0.22	0.2%	Negligible
R7	0.20	0.2%	Negligible
R8	0.21	0.2%	Negligible
R9	0.21	0.2%	Negligible
R10	0.23	0.2%	Negligible
R11	0.20	0.2%	Negligible
R12	0.15	0.2%	Negligible
AQS / EAL Objective	**100 μg/m^3**		

***** Maximum modelled amine concentrations based on sum of 'Amine 1' + 'Amine 2' maxima, which is potentially conservative because the 'Amine 1' maximum concentration could occur at a different time (hour/day) to the 'Amine 2' maximum concentration at any given receptor or grid point.

Hourly Mean Amine Concentrations

7.1.24 The maximum hourly mean amine concentrations at the assessed discrete human receptors representative of relevant exposure, assessed across any of the meteorological years modelled, is described in **Table 7.10**.

7.1.25 The results of the assessment indicate that with the Proposed Development, predicted hourly mean amine concentrations for all receptor locations are below the AQS objective. Predicted PCs of hourly mean amine concentration are below 10% of the AQS at all receptors. In accordance with EPUK-IAQM guidance, the effect of the Proposed Development on hourly mean amine concentrations at sensitive human receptors, prior to mitigation, is considered to be **'not significant'.**

Table 7.10 Predicted daily mean amine concentrations at discrete receptors - highest results for each receptor

Receptor ID	Hourly Mean Amine Concentration (µg/m^3)		
	Proposed Future* (Without Background)	As % of AQS Objective	Impact
R1	0.11	0.3%	Negligible
R2	0.13	0.3%	Negligible
R3	0.24	0.3%	Negligible
R4	0.23	0.3%	Negligible
R5	0.21	0.3%	Negligible
R6	0.22	0.3%	Negligible
R7	0.20	0.3%	Negligible
R8	0.21	0.3%	Negligible
R9	0.21	0.2%	Negligible
R10	0.23	0.2%	Negligible
R11	0.20	0.2%	Negligible
R12	0.15	0.4%	Negligible
AQS / EAL Objective	**400 µg/m^3**		

***** Maximum modelled amine concentrations based on sum of 'Amine 1' + 'Amine 2' maxima, which is potentially conservative because the 'Amine 1' maximum concentration could occur at a different time (hour/day) to the 'Amine 2' maximum concentration at any given receptor or grid point.

Annual Mean Nitrosamine (as NDMA) Impacts

7.1.26 The results of the assessment indicate that with the Proposed Development, predicted annual mean nitrosamine (as NDMA) concentrations for all receptor locations will be below the AQS (refer to **Table 7.11**).

7.1.27 The effects of the Proposed Development on nearby sensitive are predicted to be 'negligible' at all relevant receptor locations, in accordance with the EPUK-IAQM guidance.

7.1.28 In accordance with EPUK-IAQM guidance, the effect of the Proposed Development on annual mean nitrosamine (as NDMA) concentrations at sensitive human receptors, prior to mitigation, is considered to be 'not significant' except at R10, which is considered to be **"slightly adverse".**

Table 7.11 Predicted annual mean Nitrosamine (as NDMA) concentrations at discrete receptors - highest results for each receptor

Receptor ID	Annual Mean nitrosamine (as NDMA) Concentration (ng/m^3)				
	Direct*	Indirect**	Total***	As % of AQS Objective	Impact
R1	0.0002	0.0021	0.0022	1.1%	Negligible
R2	0.0002	0.0029	0.0031	1.5%	Negligible
R3	0.0004	0.0063	0.0067	3.4%	Negligible
R4	0.0002	0.0068	0.0070	3.5%	Negligible
R5	0.0004	0.0053	0.0058	2.9%	Negligible
R6	0.0004	0.0057	0.0061	3.0%	Negligible
R7	0.0004	0.0037	0.0040	2.0%	Negligible
R8	0.0004	0.0048	0.0052	2.6%	Negligible
R9	0.0004	0.0058	0.0062	3.1%	Negligible
R10	0.0006	0.0119	0.0125	6.3%	Slight adverse
R11	0.0003	0.0079	0.0082	4.1%	Negligible
R12	0.0001	0.0036	0.0037	1.8%	Negligible
AQS / EAL Objective	**0.2 ng/m^3**				

*Based on direct mass emissions of 'Nitrosamine 1' and 'Nitrosamine 2' from CCS Stack only.

**Accounts for application of ADMS Amine Chemistry Module and relates to indirect formation of nitrosamines and nitramines through atmospheric reactions.

***Equal to sum of modelled direct and indirect nitrosamine + nitramine concentrations.

7.2 Impacts on Ecological Receptors

Annual Mean NO_x Concentrations

7.2.1 **Table 7.12** presents the maximum annual mean NO_x process contributions (PCs) and predicted environmental concentrations (PECs) at each of the assessed ecological receptor locations out of those obtained from the three meteorological years modelled has been compared to the annual mean NO_x EAL.

Table 7.12 Annual average NO_x concentrations at ecologically sensitive sites

Receptor ID	Background Annual Mean NO_X baseline (µg/m³)	AQS/EAL (µg/m³)	NO_X PC (µg/m³)	PC as a % of AQS/EAL	NO_X PEC (µg/m³)	PEC as a % of AQS/EAL
E1	10.89	30	0.15	0.5%	11.04	36.8%
E2	10.02	30	0.25	0.8%	10.27	34.2%
E3	11.06	30	0.49	1.6%	11.55	38.5%
E4	8.11	30	0.28	0.9%	8.39	28.0%
E5	9.87	30	0.09	0.3%	9.96	33.2%
E6	11.22	30	0.06	0.2%	11.28	37.6%
E7	16.26	30	0.05	0.2%	16.32	54.4%
E8	13.61	30	0.04	0.1%	13.65	45.5%
E9	11.21	30	0.04	0.1%	11.26	37.5%
E10	14.65	30	0.05	0.2%	14.70	49.0%
E11	8.27	30	0.18	0.6%	8.45	28.2%
E12	6.15	30	0.05	0.2%	6.20	20.7%
E13	6.12	30	0.02	0.1%	6.14	20.5%
E14	5.73	30	0.02	0.1%	5.75	19.2%
E15	4.93	30	0.02	0.1%	4.95	16.5%
E16	4.95	30	0.03	0.1%	4.98	16.6%
E17	8.06	30	0.09	0.3%	8.15	27.2%
E18	8.23	30	0.11	0.4%	8.34	27.8%
E19	10.78	30	0.07	0.2%	10.86	36.2%
E20	6.57	30	0.06	0.2%	6.62	22.1%
E21	4.94	30	0.02	0.1%	4.97	16.6%
E22	5.30	30	0.02	0.1%	5.32	17.7%
E23	10.02	30	0.32	1.1%	10.34	34.5%
E24	8.69	30	0.31	1.0%	9.00	30.0%
E25	7.62	30	0.07	0.2%	7.69	25.6%
E26	7.62	30	0.13	0.4%	7.75	25.8%
E27	7.45	30	0.14	0.5%	7.59	25.3%
E28	7.79	30	0.15	0.5%	7.94	26.5%
E29	7.79	30	0.14	0.5%	7.93	26.4%
E30	7.79	30	0.24	0.8%	8.03	26.8%

7.2.2 The predicted maximum annual mean NO_x PCs are well below the Environment Agency screening criteria of 1% at all SPA/SAC/Ramsar receptor locations except E03. Meanwhile, the predicted environmental concentration (PEC) at E03 is below 70% of AQS.

7.2.3 No exceedance of the Environment Agency threshold of 100% of the relevant critical levels is predicted at the ancient woodlands and Local Wildlife Sites.

Daily Mean NO_x concentrations

7.2.4 **Table 7.13** presents the maximum daily mean NO_x PCs and PECs at each of the assessed ecological receptor. The results have been compared to the daily NO_x EAL.

7.2.5 The predicted maximum daily mean NO_x PCs are well below the Environment Agency screening criteria of 10% at all discrete receptor locations at all SPA/SAC/Ramsar receptor locations. In addition, the predicted PEC is well below the daily mean NOx EAL of 75 µg/m^3 at all receptor locations.

7.2.6 No exceedance of the Environment Agency threshold of 100% of the relevant critical levels is predicted at the ancient woodlands and LWS.

7.2.7 Therefore, the impact of the Proposed Development on daily mean NO_x concentrations, on ecological receptors is considered to be 'not significant'.

Table 7.13 Daily average NOx concentrations at ecologically sensitive sites

Receptor ID	Background Annual Mean NO_x baseline (µg/m^3)	AQS/EAL (µg/m^3)	NO_x PC (µg/m^3)	PC as a % of AQS/EAL	NO_x PEC (µg/m^3)	PEC as a % of AQS/EAL
E1	10.89	75	6.15	8.2%	27.93	37.2%
E2	10.02	75	4.41	5.9%	24.45	32.6%
E3	11.06	75	5.37	7.2%	27.50	36.7%
E4	8.11	75	3.17	4.2%	19.40	25.9%
E5	9.87	75	1.71	2.3%	21.44	28.6%
E6	11.22	75	1.30	1.7%	23.73	31.6%
E7	16.26	75	1.37	1.8%	33.89	45.2%
E8	13.61	75	1.06	1.4%	28.28	37.7%
E9	11.21	75	1.52	2.0%	23.95	31.9%
E10	14.65	75	1.37	1.8%	30.67	40.9%
E11	8.27	75	1.75	2.3%	18.29	24.4%
E12	6.15	75	2.55	3.4%	14.85	19.8%
E13	6.12	75	1.30	1.7%	13.54	18.0%
E14	5.73	75	1.18	1.6%	12.64	16.9%
E15	4.93	75	0.78	1.0%	10.63	14.2%
E16	4.95	75	0.94	1.3%	10.85	14.5%
E17	8.06	75	2.39	3.2%	18.52	24.7%
E18	8.23	75	1.95	2.6%	18.41	24.6%
E19	10.78	75	1.34	1.8%	22.91	30.5%
E20	6.57	75	1.30	1.7%	14.43	19.2%
E21	4.94	75	0.87	1.2%	10.76	14.3%
E22	5.30	75	0.70	0.9%	11.31	15.1%
E23	10.02	75	8.92	11.9%	28.96	38.6%
E24	8.69	75	12.83	17.1%	30.21	40.3%

Receptor ID	Background Annual Mean NO_X baseline (µg/m³)	AQS/EAL (µg/m³)	NO_X PC (µg/m³)	PC as a % of AQS/EAL	NO_X PEC (µg/m³)	PEC as a % of AQS/EAL
E25	7.62	75	6.28	8.4%	21.52	28.7%
E26	7.62	75	7.08	9.4%	22.32	29.8%
E27	7.45	75	7.60	10.1%	22.50	30.0%
E28	7.79	75	11.10	14.8%	26.68	35.6%
E29	7.79	75	12.84	17.1%	28.42	37.9%
E30	7.79	75	7.74	10.3%	23.32	31.1%

Annual Mean SO_2 Concentrations

7.2.8 Table **7.14** presents the maximum annual mean SO_2 PCs at each of the assessed ecological receptor locations out of those obtained from the five meteorological years modelled has been compared to the annual mean SO_2 EAL.

Table 7.14 Annual average SO_2 concentrations at ecologically sensitive sites

Receptor ID	AQS/EAL (µg/m³)	SO_2 PC (µg/m³)	PC as a % of AQS/EAL
E1	10	0.04	0.2%
E2	10	0.07	0.3%
E3	10	0.12	0.6%
E4	10	0.07	0.4%
E5	10	0.02	0.1%
E6	10	0.02	0.1%
E7	10	0.01	0.1%
E8	10	0.01	0.1%
E9	10	0.01	0.1%
E10	10	0.01	0.1%
E11	10	0.04	0.2%
E12	10	0.01	0.1%
E13	10	0.01	0.0%
E14	10	0.01	0.0%
E15	10	0.01	0.0%
E16	10	0.01	0.0%
E17	10	0.02	0.1%
E18	10	0.03	0.1%
E19	10	0.02	0.1%
E20	10	0.02	0.1%
E21	10	0.01	0.0%

Receptor ID	AQS/EAL (µg/m³)	SO_2 PC (µg/m³)	PC as a % of AQS/EAL
E22	10	0.00	0.0%
E23	10	0.08	0.4%
E24	10	0.09	0.4%
E25	10	0.02	0.1%
E26	10	0.04	0.2%
E27	10	0.03	0.2%
E28	10	0.04	0.2%
E29	10	0.04	0.2%
E30	10	0.07	0.4%

7.2.9 The predicted maximum annual mean SO_2 PCs are well below the Environment Agency screening criteria of 1% at all SPA/SAC/Ramsar receptor locations.

7.2.10 No exceedance of the Environment Agency threshold of 100% of the relevant critical levels is predicted at the ancient woodlands and Local Wildlife Sites.

7.2.11 Therefore, the impact of the Proposed Development on annual mean NO_x concentrations, on ecological receptors, is considered to be 'not significant'.

Annual Mean Ammonia Concentrations

7.2.12 The predicted maximum annual mean ammonia PCs at the discrete receptor points are shown in **Table 7.15**. The results of the model run show that predicted PCs to atmospheric ammonia concentrations for the 'Proposed Development' scenario are below the criteria of 1% of the relevant critical level from the EA and Defra 2016 guidance[55] at the discrete receptors representing SACs, SPAs and SSSIs except E01-E05, E11 and E20. It is 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.

7.2.13 No exceedance of the Environment Agency threshold of 100% of the relevant critical levels is predicted at the ancient woodlands and Local Wildlife Sites.

7.2.14 Therefore, the impact of the Proposed Development on annual ammonia concentrations is considered to be negligible and the effect is considered as not significant, except E1-E5, E11 and E20. The impact at these locations exceeds the threshold of 'insignificance' as referred in the Defra and Environment Agency guidance and is therefore assessed further in the Habitats Regulation Screening Assessment report (as provided in **Volume 4, Technical Appendix 5.3**).

Table 7.15 Annual average NH_3 concentrations at ecologically sensitive sites

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

Receptor ID	Background Annual Mean NH_3 baseline (μg/m^3)	AQS/EAL (μg/m^3)	NH_3 PC (μg/m^3)	PC as a % of AQS/EAL	NH_3 PEC (μg/m^3)	PEC as a % of AQS/EAL
E1	10.89	1	0.02	2.3%	2.21	221%
E2	10.02	1	0.04	4.0%	2.12	212%
E3	11.06	1	0.07	7.4%	1.56	156%
E4	8.11	1	0.04	4.2%	2.06	206%
E5	9.87	1	0.01	1.4%	2.06	206%
E6	11.22	1	0.01	0.9%	2.93	293%
E7	16.26	1	0.01	0.8%	2.50	250%
E8	13.61	1	0.01	0.6%	2.32	232%
E9	11.21	1	0.01	0.7%	2.12	212%
E10	14.65	3	0.01	0.2%	2.06	69%
E11	8.27	1	0.03	2.7%	1.76	176%
E12	6.15	1	0.01	0.9%	1.73	173%
E13	6.12	3	0.00	0.1%	1.59	53%
E14	5.73	1	0.00	0.3%	1.49	149%
E15	4.93	1	0.00	0.4%	1.35	135%
E16	4.95	1	0.00	0.4%	1.34	134%
E17	8.06	3	0.01	0.4%	2.42	81%
E18	8.23	3	0.02	0.5%	3.04	101%
E19	10.78	3	0.01	0.4%	3.17	106%
E20	6.57	1	0.01	1.0%	1.67	167%
E21	4.94	1	0.00	0.4%	1.23	123%
E22	5.30	1	0.00	0.3%	1.17	117%
E23	10.02	1	0.05	4.9%	2.31	231%
E24	8.69	1	0.05	5.1%	2.05	205%
E25	7.62	1	0.01	1.5%	2.00	200%
E26	7.62	1	0.02	2.2%	2.00	200%
E27	7.45	1	0.02	2.1%	1.93	193%
E28	7.79	1	0.02	2.3%	1.99	199%
E29	7.79	1	0.02	2.2%	1.99	199%
E30	7.79	1	0.04	4.3%	1.99	199%

Nitrogen Deposition

7.2.15 The predicted nitrogen deposition at the discrete receptor points are shown in Table **7.16**. The results of the model run show that predicted PCs to nitrogen deposition for the ‘Proposed Development’ scenario are below the criteria of 1% of the relevant critical level from the Environment Agency and Defra 2016 guidance at the discrete receptors representing SACs, SPAs and SSSIs except E01-E05, E11 and E18-E20.

7.2.16 No exceedance of the Environment Agency threshold of 100% of the relevant critical levels is predicted at the ancient woodlands and Local Wildlife Sites.

7.2.17 Therefore, the impact of the Proposed Development on annual mean nitrogen deposition is considered to be negligible and the effect is considered as not significant, except E01-E5, E11 and E18-E20. The impact at these locations exceeds the threshold of 'insignificance' as referred in the Defra and Environment Agency guidance and is therefore assessed further in the Habitats Regulation Screening Assessment report (as provided in **Volume 4, Technical Appendix 5.3**).

7.2.18 It is noted that the total nitrogen deposition exceeded the lower critical loads at all receptor locations, due to the high background nitrogen deposition already exceeding the lower critical loads.

Acid Deposition

7.2.19 The predicted acid deposition at the discrete receptor points are shown in **Table 7.17**. The results of the model run show that predicted PCs to acid deposition for the 'Proposed Development' scenario are below the criteria of 1% of the relevant critical level from the Environment Agency and Defra 2016 guidance at the discrete receptors representing SACs, SPAs and SSSIs except E02-E04 and E17-E19.

7.2.20 No exceedance of the Environment Agency threshold of 100% of the relevant critical levels is predicted at the ancient woodlands and Local Wildlife Sites.

7.2.21 Therefore, the impact of the Proposed Development on annual acid deposition rates is considered to be negligible and the effect is considered as not significant, except E02-E04 and E17-E19, The impact at these locations exceeds the threshold of 'insignificance' as referred in the Defra and Environment Agency guidance and is therefore assessed further in the Habitats Regulation Screening Assessment report (as provided in **Volume 4, Technical Appendix 5.3**).

Table 7.16 Nitrogen deposition contribution at ecological sensitive sites

Receptor ID	Receptor	Broad Habitat Type	PC (kg N/ha/yr)	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	0.205	34.248	34.453	10	2.1%
E2	Buckley Claypits and Commons SSSI/ Deeside and Buckley Newt Sites SAC	Acidophilous Quercus forest	0.364	33.415	33.779	10	3.6%
E3	Buckley Claypits and Commons SSSI/ Deeside and Buckley Newt Sites SAC	Acidophilous Quercus forest	0.677	32.582	33.259	10	6.8%
E4	Maes Y Grug SSSI/ Deeside and Buckley Newt Sites SAC	Acidophilous Quercus forest	0.383	32.460	32.843	10	3.8%
E5	Connah's Quay Ponds and Woodland SSSI/Deeside and Buckley Newt Sites SAC	Acidophilous Quercus forest	0.125	32.460	32.585	10	1.2%
E6	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	Acidophilous Quercus forest	0.084	40.079	40.163	10	0.8%
E7	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	Acidophilous Quercus forest	0.074	35.576	35.650	10	0.7%
E8	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	Acidophilous Quercus forest	0.059	34.922	34.981	10	0.6%

Receptor ID	Receptor	Broad Habitat Type	PC (kg N/ha/yr)	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	0.040	19.480	19.520	5	0.8%
E10	Shotton Lagoons and Reedbeds SSSI	European dry heaths	0.042	19.043	19.085	10	0.4%
E11	Mynydd Y Fflint / Flint Mountain SSSI	Coastal dune grasslands (grey dunes) - acid type	0.157	18.310	18.467	10	1.6%
E12	Coed Talon Marsh SSSI	European dry heaths	0.050	32.200	32.250	10	0.5%
E13	Chwarel Cambrian / Cambrian Quarry, Gwernymynydd SSSI	Other: Other Tall Herb And Fern	0.033	30.202	30.235	10	0.3%
E14	Alyn Valley Woods and Alyn Gorge Caves SSSI/SAC	Salix cinerea-Galium palustre woodland	0.028	17.511	17.539	10	0.3%
E15	Bryn Alyn SSSI	Rhinolophus hipposideros	0.034	16.655	16.689	10	0.3%
E16	Glaswelltiroedd Erryrys (Erryrys Grasslands) SSSI	Avenula pubescens grassland: Dactylis glomerata-Briza media subcommunity	0.023	16.441	16.464	10	0.2%
E17	Llay Bog SSSI	Festuca ovina-Agrostis capillaris-Thymus praecox grassland: Trifolium repens-Luzula campestris subcommunity	0.077	36.731	36.808	10	

Receptor ID	Receptor	Broad Habitat Type	PC (kg N/ha/yr)	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
E18	Chwarel Singret SSSI	Low and medium altitude hay meadows	0.148	39.256	39.404	10	0.8%
E19	Marford Quarry SSSI	Broadleaved deciduous woodland	0.103	40.240	40.343	10	1.5%
E20	Halkyn Mountain / Mynydd Helygain SAC	Broadleaved and mixed woodlands	0.058	18.966	19.024	5	1.0%
E21	Berwyn a Mynyddoedd De Clwyd / Berwyn and South Clwyd Mountains SAC	Broadleaved and mixed woodlands	0.021	19.482	19.503	5	1.2%
E22	Berwyn a Mynyddoedd De Clwyd / Berwyn and South Clwyd Mountains SAC	Arctic-alpine calcareous grassland	0.017	19.419	19.436	5	0.4%
E23	Price's Hill Wood Ancient Woodland/ Flintshire Wildlife Site	Arctic-alpine calcareous grassland	0.444	35.870	36.314	10	0.3%
E24	Bistre Wood Ancient Woodland/ Flintshire Wildlife Site	Blanket bogs	0.461	33.730	34.191	10	4.4%
E25	Black Pool Plantation Flintshire Wildlife Site	Arctic-alpine calcareous grassland	0.128	21.090	21.218	5	4.6%
E26	Hartsheath Flintshire Wildlife Site	Blanket bogs	0.194	33.630	33.824	20	2.6%

Receptor ID	Receptor	Broad Habitat Type	PC (kg N/ha/yr)	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
E27	Pontblyddyn Marsh and Coppa Wood Flintshire Wildlife Site	Broadleaved woodland and scrub	0.190	32.550	32.740	10	1.0%
E28	Padeswood Pool Flintshire Wildlife Site	Broadleaved woodland and scrub	0.207	20.530	20.737	10	1.9%
E29	Padeswood Pasture Flintshire Wildlife Site	Fen	0.199	20.530	20.729	20	2.1%
E30	Marleyfield Meadow Flintshire Wildlife Site	Lowland pasture and parkland	0.381	20.530	20.911	10	1.0%

Table 7.17 Acid deposition at ecological sensitive sites

Receptor ID	Receptor	Broad Habitat Type	Process Nitrogen Acid Deposition (keq/ha/yr)	Process Sulphur Acid Deposition (keq/ha/yr)	Background Acid Deposition (keq/ha/yr)		Maximum Critical Load (Sulphur) (keq/ha/yr)	Minimum Critical Load (Nitrogen) (keq/ha/yr)	Maximum Critical Load (Nitrogen) (keq/ha/yr)	Process Contribution as a % of lower critical load	
					Nitrogen	Sulphur				PC	PEC
E1	Buckley Claypits and Commons SSSI/ Deeside and Buckley Newt Sites SAC	Unmanaged Broadleafed/ Coniferous Woodland	0.0146	0.013	2.470	0.210	2.642	0.357	2.999	0.9%	90.7%
E2	Buckley Claypits and Commons SSSI/ Deeside and Buckley Newt Sites SAC	Unmanaged Broadleafed/ Coniferous Woodland	0.0259	0.022	2.390	0.220	2.642	0.357	2.999	1.6%	89.4%
E3	Buckley Claypits and Commons SSSI/ Deeside and Buckley Newt Sites SAC	Unmanaged Broadleafed/ Coniferous Woodland	0.0482	0.042	2.330	0.220	2.642	0.357	2.999	3.0%	89.4%
E4	Maes Y Grug SSSI/ Deeside and Buckley	Unmanaged Broadleafe	0.0273	0.024	2.320	0.250	1.477	0.357	1.834	2.8%	144.2%

Receptor ID	Receptor	Broad Habitat Type	Process Nitrogen Acid Deposition (keq/ha/yr)	Process Sulphur Acid Deposition (keq/ha/yr)	Background Acid Deposition (keq/ha/yr)		Maximum Critical Load (Sulphur) (keq/ha/yr)	Minimum Critical Load (Nitrogen) (keq/ha/yr)	Maximum Critical Load (Nitrogen) (keq/ha/yr)	Process Contribution as a % of lower critical load	
					Nitrogen	Sulphur				PC	PEC
	Newt Sites SAC	d/ Coniferous Woodland									
E5	Connah's Quay Ponds and Woodland SSSI/Deeside and Buckley Newt Sites SAC	Unmanaged Broadleafed/ Coniferous Woodland	0.0089	0.008	2.320	0.250	2.642	0.357	2.999	0.6%	86.5%
E6	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	Unmanaged Broadleafed/ Coniferous Woodland	0.0059	0.005	2.860	0.220	3.583	0.357	3.940	0.3%	78.6%
E7	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	Unmanaged Broadleafed/ Coniferous Woodland	0.0053	0.005	2.540	0.240	3.583	0.357	3.940	0.3%	70.9%
E8	Afon Dyfrdwy (River Dee) SSSI/SAC/SPA	Unmanaged Broadleafed/	0.0042	0.004	2.410	0.250	3.583	0.357	3.940	0.2%	67.8%

Receptor ID	Receptor	Broad Habitat Type	Process Nitrogen Acid Deposition (keq/ha/yr)	Process Sulphur Acid Deposition (keq/ha/yr)	Background Acid Deposition (keq/ha/yr)		Maximum Critical Load (Sulphur) (keq/ha/yr)	Minimum Critical Load (Nitrogen) (keq/ha/yr)	Maximum Critical Load (Nitrogen) (keq/ha/yr)	Process Contribution as a % of lower critical load	
					Nitrogen	Sulphur				PC	PEC
		Coniferous Woodland									
E9	Dee Estuary / Aber Afon Dyfrdwy SSSI/SAC	Coastal dune grasslands (grey dunes) - acid type Dwarf shrub heath	0.0029	0.002	2.410	0.250	4.120	0.892	4.972	0.1%	53.63%
E10	Shotton Lagoons and Reedbeds SSSI	Coastal dune grasslands (grey dunes) - acid type Dwarf shrub heath	0.0030	0.002	1.360	0.260	4.120	0.892	4.972	0.1%	32.7%
E11	Mynydd Y Fflint / Flint Mountain SSSI	Other: Other Tall Herb And Fern	0.0112	0.007	1.310	0.170	4.000	1.071	5.071	0.4%	29.7%

Receptor ID	Receptor	Broad Habitat Type	Process Nitrogen Acid Deposition (keq/ha/yr)	Process Sulphur Acid Deposition (keq/ha/yr)	Background Acid Deposition (keq/ha/yr)		Maximum Critical Load (Sulphur) (keq/ha/yr)	Minimum Critical Load (Nitrogen) (keq/ha/yr)	Maximum Critical Load (Nitrogen) (keq/ha/yr)	Process Contribution as a % of lower critical load	
					Nitrogen	Sulphur				PC	PEC
E12	Coed Talon Marsh SSSI	Moist and wet dune slacks	0.0035	0.002	1.490	0.180	4.000	0.856	4.856	0.1%	34.6%
E13	Chwarel Cambrian / Cambrian Quarry, Gwernymynydd SSSI	Broadleaved and mixed woodlands	0.0023	0.002	2.160	0.210	5.955	0.142	6.097	0.1%	39.0%
E14	Alyn Valley Woods and Alyn Gorge Caves SSSI/SAC	Semi-dry Perennial calcareous grassland (basic meadow steppe)	0.0020	0.002	2.110	0.200	5.951	0.142	6.093	0.1%	38.0%
E15	Bryn Alyn SSSI	Semi-dry Perennial calcareous grassland (basic meadow steppe).	0.0024	0.002	2.120	0.200	6.098	0.142	6.240	0.1%	37.23%
E16	Glaswelltiroedd Eryrys (Eryrys	Low and medium altitude	0.002	0.001	1.410	0.170	4.000	0.856	4.856	0.1%	32.6%

Receptor ID	Receptor	Broad Habitat Type	Process Nitrogen Acid Deposition (keq/ha/yr)	Process Sulphur Acid Deposition (keq/ha/yr)	Background Acid Deposition (keq/ha/yr)		Maximum Critical Load (Sulphur) (keq/ha/yr)	Minimum Critical Load (Nitrogen) (keq/ha/yr)	Maximum Critical Load (Nitrogen) (keq/ha/yr)	Process Contribution as a % of lower critical load	
					Nitrogen	Sulphur				PC	PEC
	Grasslands) SSSI	hay meadows									
E17	Llay Bog SSSI	Broadleaved deciduous woodland	0.006	0.004	1.590	0.180	0.274	0.321	0.595	1.5%	299.6%
E18	Chwarel Singret SSSI	Broadleaved and mixed woodlands	0.011	0.009	2.700	0.220	1.138	0.142	1.280	1.5%	230.3%
E19	Marford Quarry SSSI	Broadleaved and mixed woodlands	0.007	0.006	2.870	0.190	1.023	0.142	1.165	1.2%	264.4%
E20	Halkyn Mountain / Mynydd Helygain SAC	Arctic-alpine calcareous grassland	0.004	0.003	1.350	0.170	4.000	1.071	5.071	0.1%	30.2%
E21	Berwyn a Mynyddoedd De Clwyd / Berwyn and South Clwyd Mountains SAC	Arctic-alpine calcareous grassland Blanket bogs	0.002	0.001	1.390	0.170	1.046	0.321	1.367	0.2%	114.4%
E22	Berwyn a Mynyddoedd	Arctic-alpine	0.001	0.001	1.390	0.170	1.046	0.321	1.367	0.1%	114.3%

Receptor ID	Receptor	Broad Habitat Type	Process Nitrogen Acid Deposition (keq/ha/yr)	Process Sulphur Acid Deposition (keq/ha/yr)	Background Acid Deposition (keq/ha/yr)		Maximum Critical Load (Sulphur) (keq/ha/yr)	Minimum Critical Load (Nitrogen) (keq/ha/yr)	Maximum Critical Load (Nitrogen) (keq/ha/yr)	Process Contribution as a % of lower critical load	
					Nitrogen	Sulphur				PC	PEC
	De Clwyd / Berwyn and South Clwyd Mountains SAC	calcareous grassland Blanket bogs									
E23	Price's Hill Wood Ancient Woodland/ Flintshire Wildlife Site	Broadleaved woodland and scrub	0.032	0.028	2.560	0.200	2.643	0.357	3.000	2.0%	94.9%
E24	Bistre Wood Ancient Woodland/ Flintshire Wildlife Site	Broadleaved woodland and scrub	0.033	0.028	2.410	0.200	2.632	0.357	2.989	2.0%	90.3%
E25	Black Pool Plantation Flintshire Wildlife Site	Fen	0.009	0.008	1.510	0.170	Not Sensitive to Acidity				
E26	Hartsheath Flintshire Wildlife Site	Lowland pasture and parkland	0.014	0.012	2.400	0.210	2.632	0.357	2.989	0.9%	88.6%
E27	Pontblyddyn Marsh and Coppa Wood	Pasture/ meadow and scrub	0.014	0.012	2.320	0.210	1.643	0.142	1.785	1.4%	143.8%

Receptor ID	Receptor	Broad Habitat Type	Process Nitrogen Acid Deposition (keq/ha/yr)	Process Sulphur Acid Deposition (keq/ha/yr)	Background Acid Deposition (keq/ha/yr)		Maximum Critical Load (Sulphur) (keq/ha/yr)	Minimum Critical Load (Nitrogen) (keq/ha/yr)	Maximum Critical Load (Nitrogen) (keq/ha/yr)	Process Contribution as a % of lower critical load	
					Nitrogen	Sulphur				PC	PEC
	Flintshire Wildlife Site	Broadleaved woodland and scrub									
E28	Padeswood Pool Flintshire Wildlife Site	Wet woodland/ Fen	0.015	0.013	1.470	0.170	2.637	0.357	2.994	0.9%	56.1%
E29	Padeswood Pasture Flintshire Wildlife Site	Pasture/ meadow and scrub	0.014	0.012	1.470	0.170	2.637	0.357	2.994	0.9%	56.1%
E30	Marleyfield Meadow Flintshire Wildlife Site	Pasture/meadow and scrub	0.027	0.023	2.330	0.200	2.637	0.357	2.994	1.7%	86.9%

7.3 Emissions to Air from Operational Phase Traffic

7.3.1 The principal operational phase air quality impact is likely to be associated with traffic emissions as a result of any changes in traffic flows or flow composition the development may bring. The EPUK-IAQM 2017 guidance provides indicative criteria to determine when an air quality assessment is likely to be required.

7.3.2 The transport consultant has stated that, “For the operation phase, this will not exceed 500 AADT for LGVs or 100 AADT for HGVs". This is therefore below the EPUK-IAQM screening criteria for a development outside an AQMA. Therefore, none of the screening criteria in the IAQM is triggered.

7.4 Overall Effects

7.4.1 As identified above:

- For human receptors, there are no predicted exceedances representative of relevant exposure of the annual mean NO_2 and hourly NO_2 AQSs at any of the relevant discrete off-site sensitive human receptor locations;
- There are no predicted exceedances representative of relevant exposure of the annual mean PM_{10} and daily PM_{10} AQSs at any of the relevant discrete off-site sensitive human receptor locations;
- There are no predicted exceedances representative of relevant exposure of the daily SO_2, hourly SO_2 and 15-min SO_2 AQSs at any of the relevant discrete off-site sensitive human receptor locations;
- There are no predicted exceedances representative of relevant exposure of the daily amine, hourly amine and annual Nitrosamine (as NDMA) AQSs at any of the relevant discrete off-site sensitive human receptor locations;
- For ecological receptors, the predicted maximum annual mean NO_x and SO_2 PCs are well below the EA screening criteria of 1% at all SPA/SAC/Ramsar/SSSI receptor locations except E03. Meanwhile, the PEC at E03 is below the Environment Agency screening criteria of 70%, and the predicted maximum daily mean NO_x PCs are well below the Environment Agency screening criteria of 10% at all discrete receptor locations;
- The predicted ammonia PCs for the proposed use, as a percentage of the critical level are below the 1% EA screening criteria except receptors E01-E05, E11 and E20;
- The predicted nitrogen deposition PCs for the proposed use, as a percentage of the critical load are below the 1% EA screening criteria except E01-E05, E11 and E18-E20;
- The predicted ammonia PCs for the proposed use, as a percentage of the critical level are below the 1% EA screening criteria except receptors E02-E04 and E17-E19; and
- No exceedance of the Environment Agency threshold of 100% of the relevant critical levels is predicted at the ancient woodlands and Local Wildlife Sites.

8 MITIGATION MEASURES

8.1 Construction Phase Mitigation

8.1.1 The dust emitting activities outlined in **Section 5.1** can be effectively controlled by appropriate dust control measures and any adverse effects can be greatly reduced or eliminated.

8.1.2 It is recommended that a dust management plan (DMP), which may be as part of a Construction Environmental Management Plan (CEMP), for the construction phase should be prepared and agreed with the Flintshire County Council to ensure that the potential for adverse environmental effects on local receptors is minimised. The DMP should include *inter alia*, measures for controlling dust and general pollution from site construction operations and include details of any monitoring scheme, if appropriate. Controls should be applied throughout the construction period to ensure that emissions are mitigated.

8.1.3 The dust risk categories identified have been used to define appropriate, site-specific mitigation methods. More detailed, site-specific mitigation measures are contained in **Appendix B**.

8.1.4 The traffic effects of the Proposed Development during the construction phase will be limited to a relatively short period and will be along traffic routes employed by haulage/construction vehicles and workers. Any effects on air quality will be temporary i.e. during the construction period only, and can be suitably controlled by the employment of mitigation measures appropriate to the Proposed Development.

8.1.5 With implementation of the proposed construction phase mitigation measures (detailed in **Appendix B**), the residual impacts are considered to be negligible.

8.2 Operational Phase Mitigation

8.2.1 The assessment predicts that the significant effects at habitats sensitive to ammonia, nitrogen deposition and acid deposition could not be screened out. It should be noted that the contribution of Proposed Development to ammonia, nutrient nitrogen and acidification is small relative to critical levels and critical loads. Any exceedances that do occur are due to elevated background concentrations and deposition rates.

8.2.2 It is recommended that the continuous monitoring of atmospheric emissions be carried out to verify that the limits assumed in this assessment are accurate and therefore that the effects on the designated ecological sites do not exceed those assessed in this report and in the Habitats Regulation Assessment report (as provided in **Volume 4, Technical Appendix 5.3**). Due to the precautionary nature of this assessment, monitoring may indicate that emissions are lower than those assessed through this assessment.

9 SUMMARY

9.1.1 An assessment of 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.

9.1.2 An assessment of construction phase impacts has been undertaken following the IAQM construction dust guidance. Mitigation measures are recommended to reduce the risk of dust and particulate matter being generated and re-suspended. With implementation of the appropriate measures, no significant impacts are anticipated during the construction phase.

9.1.3 In operation phase, the highest predicted impacts at any of the modelled discrete receptor locations representative of relevant exposure in any of the five modelled meteorological years have been reported and compared to the relevant AQSs. For human receptors, there are no predicted exceedances representative of relevant exposure of the annual mean NO_2, hourly NO_2, annual PM_{10}, daily PM_{10}, daily SO_2, hourly SO_2, 15-minute SO_2, daily amine, hourly amine and annual Nitrosamine (as NDMA) AQSs at any of the relevant discrete off-site sensitive human receptor locations. Therefore, the effect of the Proposed Development on human health is considered to be not significant.

9.1.4 For ecological receptors, the predicted maximum PECs of annual mean NO_x concentrations are below the NOx EAL of 30 µg/m^3 at all discrete receptor locations except E3, and well below 100% for other discrete receptor points at the ancient woodland and Local Wildlife Site. Meanwhile, the PEC at E3 is below 70% of AQS. The effect of the Proposed Development on annual and daily mean NO_x concentrations is considered to be insignificant.

9.1.5 The predicted ammonia, nitrogen deposition and acid deposition PCs, as a percentage of the relevant critical level and critical loads are below the screening criteria of 1% from the EA and Defra 2018 guidance at all discrete receptor points representing the SACs, SPAs and SSSIs except E1-ER5, E11 and E17-E20. The predicted PCs are also well below the 100% Environment Agency screening criteria at all discrete receptor points representing the LWRs and ancient woodland. Therefore, the effect of the Proposed Development cannot be screened out for ammonia, nitrogen deposition and acid deposition and is therefore assessed further in the Habitats Regulation Screening Assessment report (**Volume 4, Technical Appendix 5.3**).

9.1.6 Based on the results of the assessment, it is judged that with appropriate mitigation, the Proposed Development complies with relevant national and local planning policies and that there are no air quality constraints for the development proposal.

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APPENDIX A
CONSTRUCTION DUST ASSESSMENT METHODOLOGY

This appendix contains the construction dust assessment methodology used in the assessment.

To assess the potential impacts, construction activities are divided into demolition, earthworks, construction and trackout. The descriptors included in this section are based upon the IAQM construction dust guidance. The assessment follows the steps recommended in the guidance.

<u>Step 1</u>: Screen the requirement for assessment

The first step is to screen out the requirement for a construction dust assessment, this is usually a somewhat conservative level of screening. An assessment is usually required where there is:

- a 'human receptor' within:
  - 350m of the boundary of the Site ; or
  - 50m of the route used by construction vehicles on the public highway, up to 500m from the Site entrance(s).
- an 'ecological receptor':
  - 50m of the boundary of the Site ; or
  - 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the Site entrance(s).

<u>Step 2A</u>: Defining the Potential Dust Emission Magnitude

Demolition

The dust emission magnitude category for demolition is varied for each site in terms of timing, building type, duration and scale. Examples of the potential dust emission classes are provided in the guidance as follows:

- **Large**: Total building volume >50,000m^3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >20m above ground level;
- **Medium**: Total building volume 20,000m^3 – 50,000m^3, potentially dusty construction material, demolition activities 10m – 20m above ground level; and
- **Small**: Total building volume <20,000m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10m above ground, demolition during wetter months.

Earthworks

The dust emission magnitude category for earthworks is varied for each site in terms of timing, geology, topography and duration. Examples of the potential dust emission classes are provided in the guidance as follows:

- **Large**: Total site area >10,000m^2, potentially dusty soil type (e.g. clay), >10 heavy earth moving vehicles active at any one time, formation of bunds >8m in height, total material moved >100,000 tonnes;

- **Medium**: Total site area 2,500 – 10,000m^2, moderately dusty soil type (e.g. silt), 5 – 10 heavy earth moving vehicles active at any one time, formation of bunds 4 – 8m in height, total material moved 20,000 – 100,000 tonnes; and
- **Small**: Total site area < 2,500m^2, soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4m in height, total material moved <10,000 tonnes, earthworks during wetter months.

Construction

The dust emission magnitude category for construction is varied for each site in terms of timing, building type, duration, and scale. Examples of the potential dust emissions classes are provided in the guidance as follows:

- **Large**: Total building volume >100,000m^3, on-site concrete batching, sandblasting;
- **Medium**: Total building volume 25,000 – 100,000m^3, potentially dusty construction material (e.g. concrete), on-site concrete batching; and
- **Small**: Total building volume <25,000m^3, construction material with low potential for dust release (e.g. metal cladding or timber).

Trackout

Factors which determine the dust emission magnitude class of trackout activities are vehicle size, vehicle speed, vehicle number, geology and duration. Examples of the potential dust emissions classes are provided in the guidance as follows:

- **Large**: >50 HDV (>3.5t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100m;
- **Medium**: 10 – 50 HDV (>3.5t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 – 100m; and
- **Small**: <10 HDV (>3.5t) outward movements in any one day, surface material with low potential for dust release, unpaved road length <50m.

Step 2B: Defining the Sensitivity of the Area

The sensitivity of the area is defined for dust soiling, human health and ecosystems. The sensitivity of the area takes into account the following factors:

- The specific sensitivities of receptors in the area;
- The proximity and number of those receptors;
- In the case of PM_{10}, the local background concentration; and
- Site-specific factors, such as whether here are natural shelters such as trees, to reduce the risk of wind-blown dust.

Table A1 has been used to define the sensitivity of different types of receptors to dust soiling, health effects and ecological effects.

Table A1bSensitivity of the Area Surrounding the Site

Sensitivity of Area	Dust Soiling	Human Receptors	Ecological Receptors
High	• Users can reasonably expect enjoyment of a high level of amenity. • The appearance, aesthetics or value of their property would be diminished by soiling. • The people or property would reasonably be expected to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land. • Examples include dwellings, museums and other culturally important collections, medium and long term car parks and car showrooms.	• Locations where members of the public are exposed over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day) • Examples include residential properties, hospitals, schools and residential care homes should also be considered as having equal sensitivity to residential areas for the purposes of this assessment.	• Locations with an international or national designation *and* the designated features may be affected by dust soiling. • Locations where there is a community of a particularly dust sensitive species such as vascular species included in the Red Data List For Great Britain**.** • Examples include a Special Area of Conservation (SAC) designated for acid heathlands or a local site designated for lichens adjacent to the demolition of a large site containing concrete (alkali) buildings.

Sensitivity of Area	Dust Soiling	Human Receptors	Ecological Receptors
Medium	• Users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home. • The appearance, aesthetics or value of their property could be diminished by soiling. • The people or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land. • Examples include parks and places of work.	• Locations where the people exposed are workers and exposure is over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). • Examples include office and shop workers, but will generally not include workers occupationally exposed to PM_{10}, as protection is covered by Health and Safety at Work legislation.	• Locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown. • Locations with a national designation where the features may be affected by dust deposition. • Example is a Site of Special Scientific Interest (SSSI) with dust sensitive features.

Sensitivity of Area	Dust Soiling	Human Receptors	Ecological Receptors
Low	• The enjoyment of amenity would not reasonably be expected. • Property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling. • There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. • Examples include playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads.	• Locations where human exposure is transient. • Indicative examples include public footpaths, playing fields, parks and shopping streets.	• Locations with a local designation where the features may be affected by dust deposition. • Example is a local Nature Reserve with dust sensitive features.

Based on the sensitivities assigned of the different types of receptors surrounding the Site and numbers of receptors within certain distances of the Site , a sensitivity classification for the area can be defined for each. Tables A2 to A4 indicate the method used to determine the sensitivity of the area for dust soiling, human health and ecological impacts, respectively.

For trackout, as per the IAQM construction dust guidance, it is only considered necessary to consider trackout impacts up to 50m from the edge of the road.

Table A2 Sensitivity of the area to dust soiling effects on people and property

Receptor Sensitivity	Number of Receptors	Distances from the Source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table A3 Sensitivity of the area to Human Health Impacts

Receptor Sensitivity	Annual Mean PM_{10} Conc.	Number of Receptors	Distances from the Source (m)				
			<20	<50	<100	<200	<350
High	>32$\mu g/m^3$	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32$\mu g/m^3$	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28$\mu g/m^3$	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24 $\mu g/m^3$	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>32$\mu g/m^3$	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	28-32$\mu g/m^3$	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	24-28$\mu g/m^3$	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<24 $\mu g/m^3$	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Table A4 Sensitivity of the area to Ecological Impacts

Receptor Sensitivity	Distances from the Source (m)	
	<20	<50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

<u>Step 2C</u>: Defining the Risk of Impacts

The final step is to use both the dust emission magnitude classification with the sensitivity of the area, to determine a potential risk of impacts for each construction activity, before the application of mitigation. Tables A5 to A7 indicate the method used to assign the level of risk for each construction activity.

Table A5 Risk of Dust Impacts from Demolition

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Table A6 Risk of Dust Impacts from Earthworks/Construction

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table A7 Risk of Dust Impacts from Trackout

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

APPENDIX B SITE SPECIFIC MITIGATION MEASURES

Site-specific mitigation measures are divided into general measures, applicable to all sites and measures specific to demolition, earthworks, construction and trackout. Depending on the level of risk assigned to each site, different mitigation is assigned. The method of assigning mitigation measures as detailed in the IAQM guidance has been used.

For those mitigation measures that are general, the highest risk has been applied. In this case, the 'medium risk' site mitigation measures have been applied, as determined by the dust risk assessment in Section 5. There are two categories of mitigation measure – 'highly recommended' and 'desirable', which are indicated according to the dust risk level identified in Table A5-A7. Desirable measures are presented in *italics*.

Site Management

- Develop and implement a stakeholder communications plan that includes community engagement before work commences on-site.
- Develop a dust management plan.
- Display the name and contact details of person(s) accountable for air quality pollutant emissions and dust issues on the Site boundary.
- Display the head or regional office contact information.
- Record and respond to all dust and air quality pollutant emissions complaints.
- Make a complaints log available to the local authority when asked.
- Carry out regular site inspections to monitor compliance with air quality and dust control procedures, record inspection results, and make an inspection log available to the local authority when asked.
- Increase the frequency of site inspections by those accountable for dust and air quality pollutant emissions issues when activities with a high potential to produce dust and emissions and dust are being carried out, and during prolonged dry or windy conditions.
- Record any exceptional incidents that cause dust and air quality pollutant emissions, either on or off the Site , and the action taken to resolve the situation is recorded in the log book.

Preparing and Maintaining the Site

- Plan site layout: machinery and dust causing activities should be located away from receptors.
- Erect solid screens or barriers around dust activities or the Site boundary that are, at least, as high as any stockpiles on-site.
- Fully enclosure site or specific operations where there is a high potential for dust production and the Site is active for an extensive period.
- Avoid site runoff of water or mud.
- Keep site fencing, barriers and scaffolding clean using wet methods.
- Remove materials from site as soon as possible.

- Cover, seed or fence stockpiles to prevent wind whipping.
- *Carry out regular dust soiling checks of buildings within 100m of Site boundary and cleaning to be provided if necessary.*
- Agree monitoring locations with Local Authority.
- Where possible, commence baseline monitoring at least three months before phase begins.
- Put in place real-time dust and air quality pollutant monitors across the Site and ensure they are checked regularly.

Operating Vehicles/Machinery and Sustainable Travel

- Ensure all non-road mobile machinery (NRMM) comply with the standards set within the MOL SPG.
- Ensure all vehicles switch off engines when stationary, avoiding idling.
- Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where possible.
- *Impose and signpost a maximum-speed-limit of 10mph on surfaced haul routes and work areas.*
- Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.
- Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing).

Operations

- Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.
- Ensure an adequate water supply on the Site for effective dust/particulate matter mitigation (using recycled water where possible).
- Use enclosed chutes, conveyors and covered skips.
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
- Ensure equipment is readily available on-site to lean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.

Waste Management

- Reuse and recycle waste to reduce dust from waste materials.
- No bonfires or burning of waste materials.

Specific to Demolition

- *Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).*
- Ensure water suppression is used during demolition operations.
- Avoid explosive blasting, using appropriate manual or mechanical alternatives.
- Bag and remove any biological debris or damp down such material before demolition.

<u>Specific to Earthworks</u>

Low risk, no specific mitigation measure is required.

<u>Specific to Construction</u>

- *Avoid scabbling (roughening of concrete surfaces) if possible.*
- *Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.*

<u>Specific to Trackout</u>

- *Regularly use a water-assisted dust sweeper on the access and local roads, as necessary, to remove any material tracked out of the Site .*
- *Avoid any dry sweeping of large areas.*
- *Ensure vehicles entering and leaving sites are securely covered to prevent escape of materials during transport.*
- *Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the Site where reasonably practicable).*

APPENDIX C IAQM IMPACT SIGNIFICANCE CRITERIA

This appendix contains the significance criteria used in the assessment for the operational impact assessment from the 2017 EPUK-IAQM guidance.

To assess the impacts of a development on the surrounding area, the EPUK-IAQM 2017 guidance recommends that the degree of an impact is described by expressing the magnitude of incremental change as a proportion of the relevant assessment level and examining this change in the context of the new total concentration and its relationship with the assessment criterion. Table C1 presents the suggested framework, provided within the EPUK/IAQM guidance, for describing the impacts.

Table C1: Impact Descriptors for Individual Receptors

Long term average concentration at receptors in assessment year	% Change in Concentration Relative to Air Quality Assessment Level (AQAL)			
	1	2-5	6-10	>10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76-94% AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Moderate	Moderate	Substantia l	Substantial
110% or more of AQAL	Moderate	Substantial	Substantia l	Substantial

Notes

AQAL = Air Quality Assessment Level, which for this assessment related to the UK Air Quality Strategy Objectives.

Where the % change in concentrations is <0.5%, the change is described as 'negligible' regardless of the concentration.

Where concentrations increase the impact is described as adverse, and where it decrease as beneficial.

The EPUK/IAQM guidance notes that the criteria in Table C1 should be used to describe impacts at individual receptors and should only be considered as a starting point to make a judgement on significance of effects, as other influences may need to be accounted for. The EPUK/IAQM guidance states that the assessment of overall significance should be based on professional judgement, taking into account several factors, including:

- The existing and future air quality in the absence of the development;
- The extent of current and future population exposure to the impacts; and
- The influence and validity of any assumptions adopted when undertaking the prediction of impacts.

The EPUK/IAQM guidance states that for most road transport related emissions, long-term average concentrations are the most useful for evaluating the severity of impacts.

For short term (sub-hourly, hourly and daily averages) pollutant concentrations from sources such as the Proposed Development ('point' sources), the EPUK / IAQM guidance recommends that the impact is described with reference to the magnitude of the impact from the process without consideration of the background concentrations. This assumes that the background concentrations will be smaller than the peak concentrations caused by a substantial plume. Where the impact is ≤10% of an AQAL, it is negligible; impacts in the range 11-20% are slight, 21-50% are moderate and those ≥51% are substantial.

APPENDIX D FIGURES

This appendix contains the following figures referenced within this report:

Figure D1 Sources and buildings included in the dispersion modelling assessment

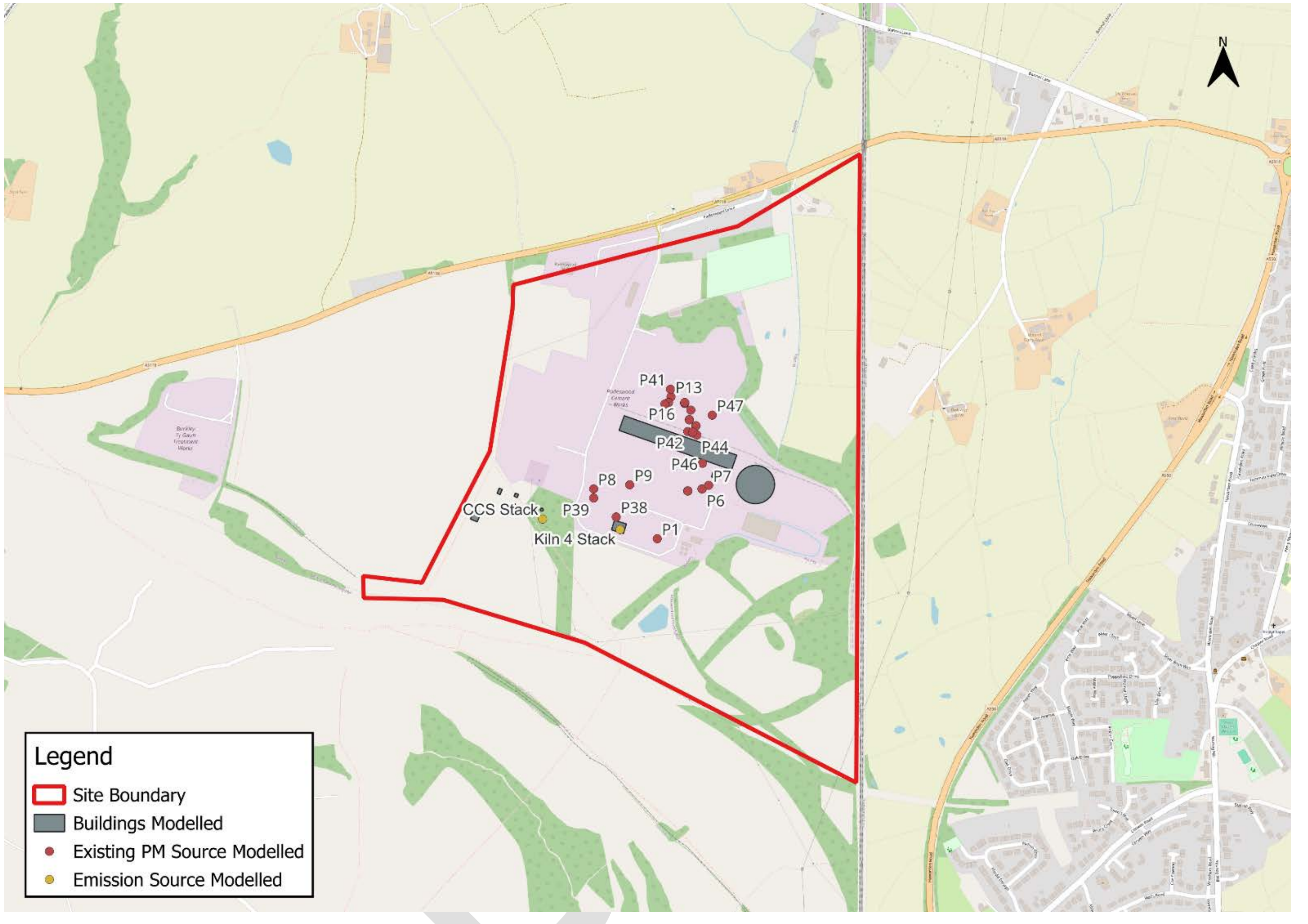

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Figure D2 Human Receptors included in the dispersion modelling assessment

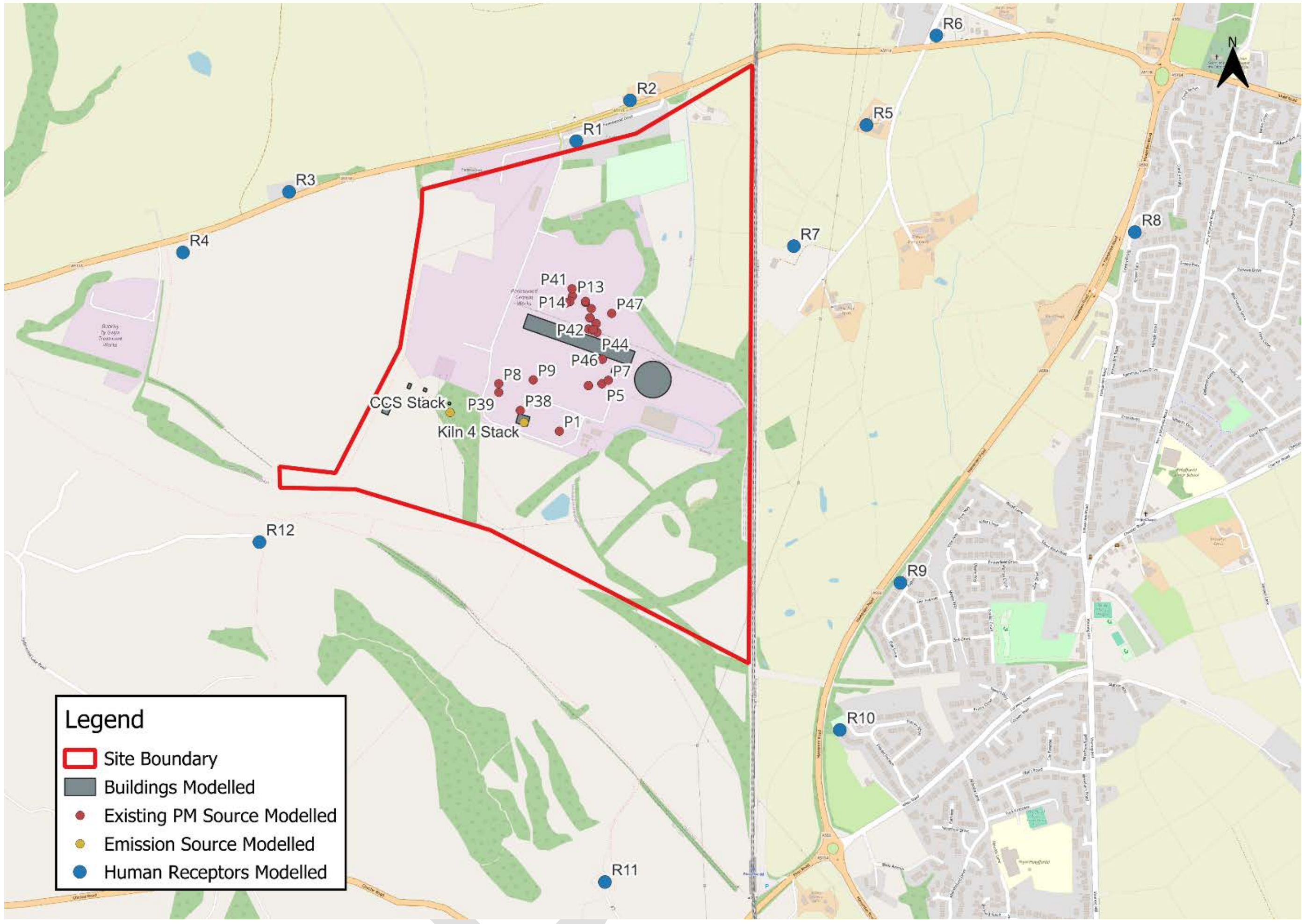
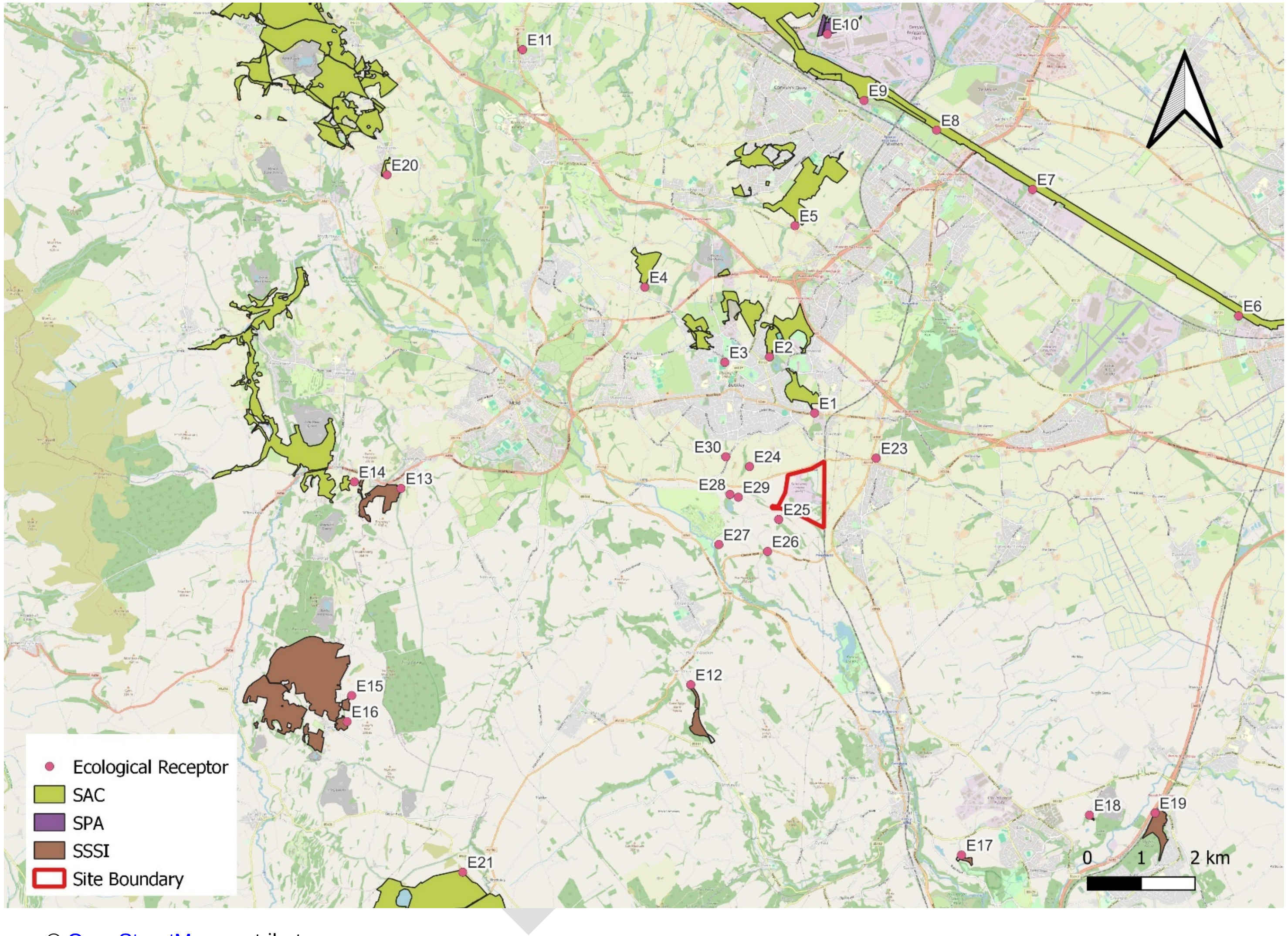


Figure D3 Ecological receptors included in the dispersion modelling assessment



APPENDIX E WINDROSES

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

Figure E1 Windrose for the Hawarden Weather Station – 2018

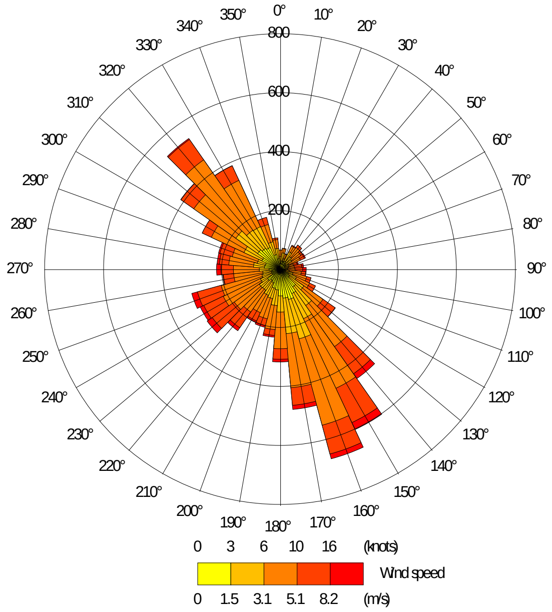


Figure E2 Windrose for the Hawarden Weather Station – 2019

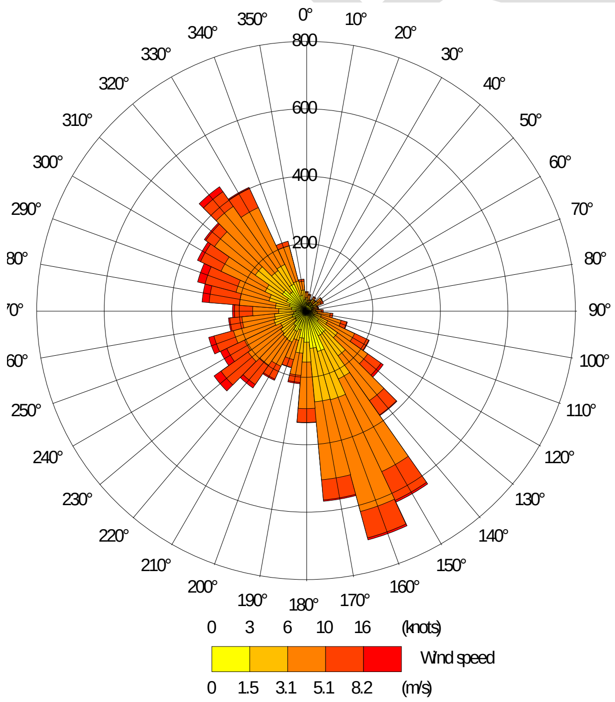


Figure E3 Windrose for the Hawarden Weather Station – 2020

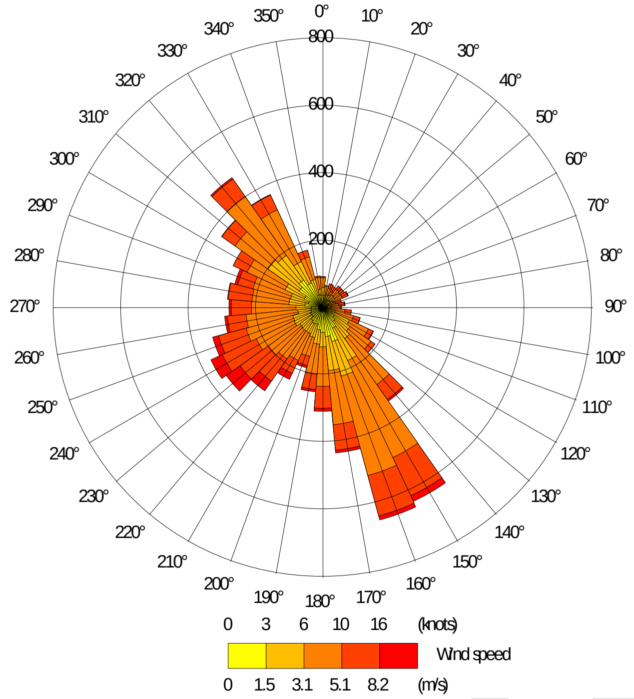


Figure E4 Windrose for the Hawarden Weather Station – 2021

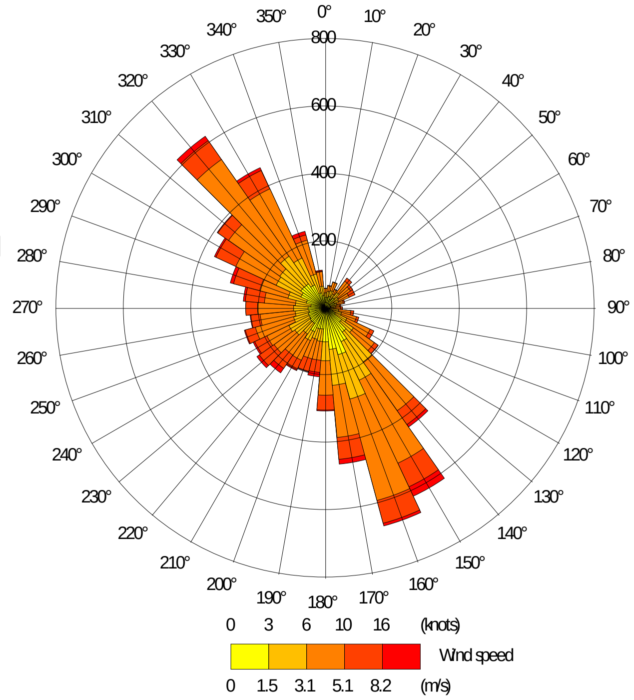
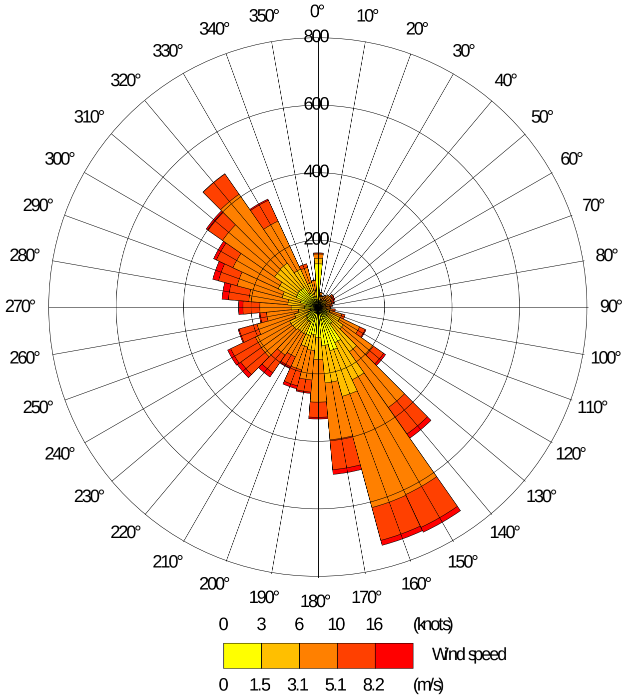


Figure E5 Windrose for the Hawarden Weather Station – 2022



APPENDIX F 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 which experienced the highest pollutant concentrations (2021). Average background pollutant concentrations across the Study Area have been applied.

Figure F1 Predicted Annual Average NO_2 Concentrations (µg/m³) PEC – relevant for human receptor locations – 2021 met data

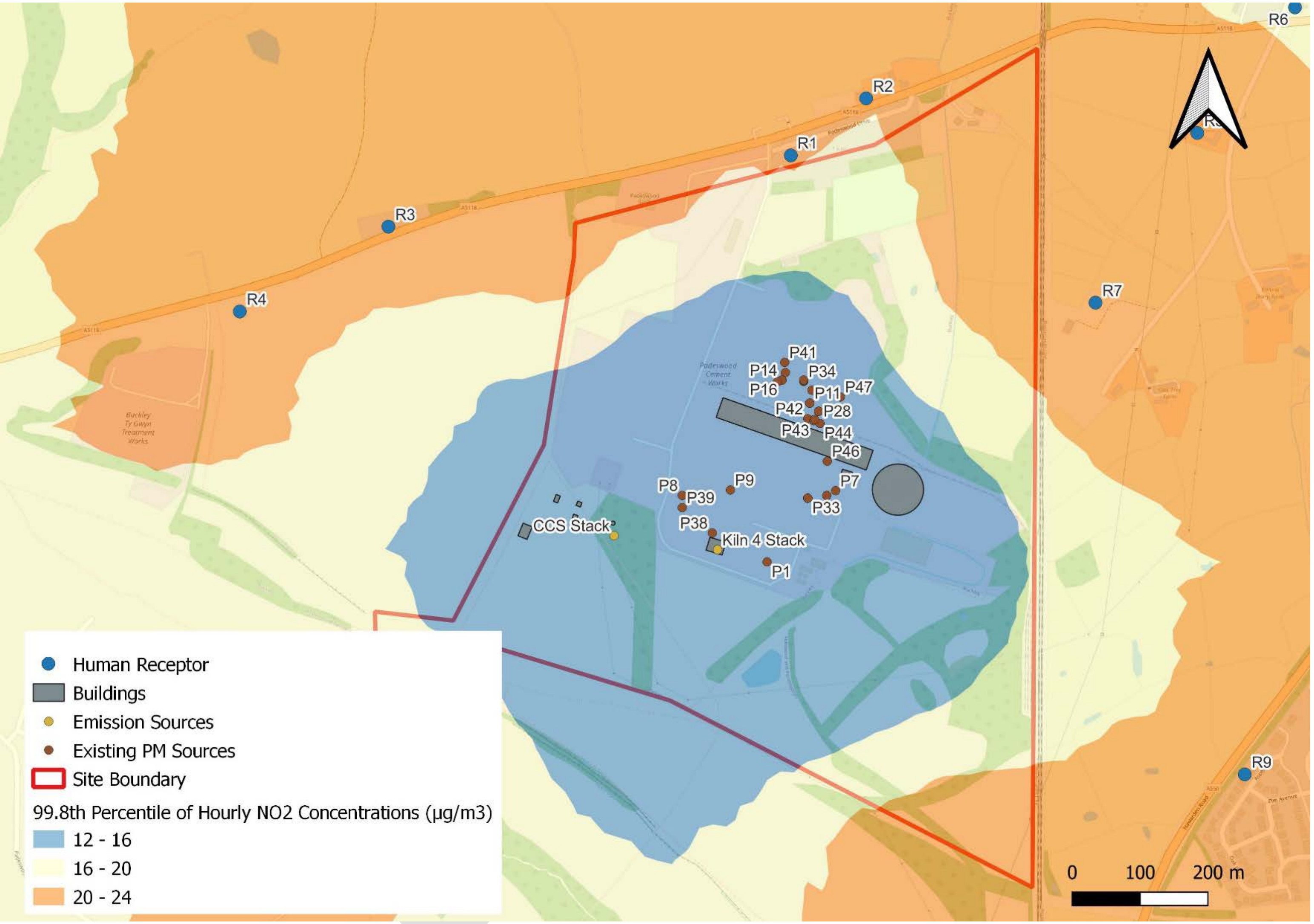


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Figure F2 Predicted 99.8th Percentile of Hourly NO_2 Concentrations (µg/m³) PEC – relevant for human receptor locations – 2021 met data

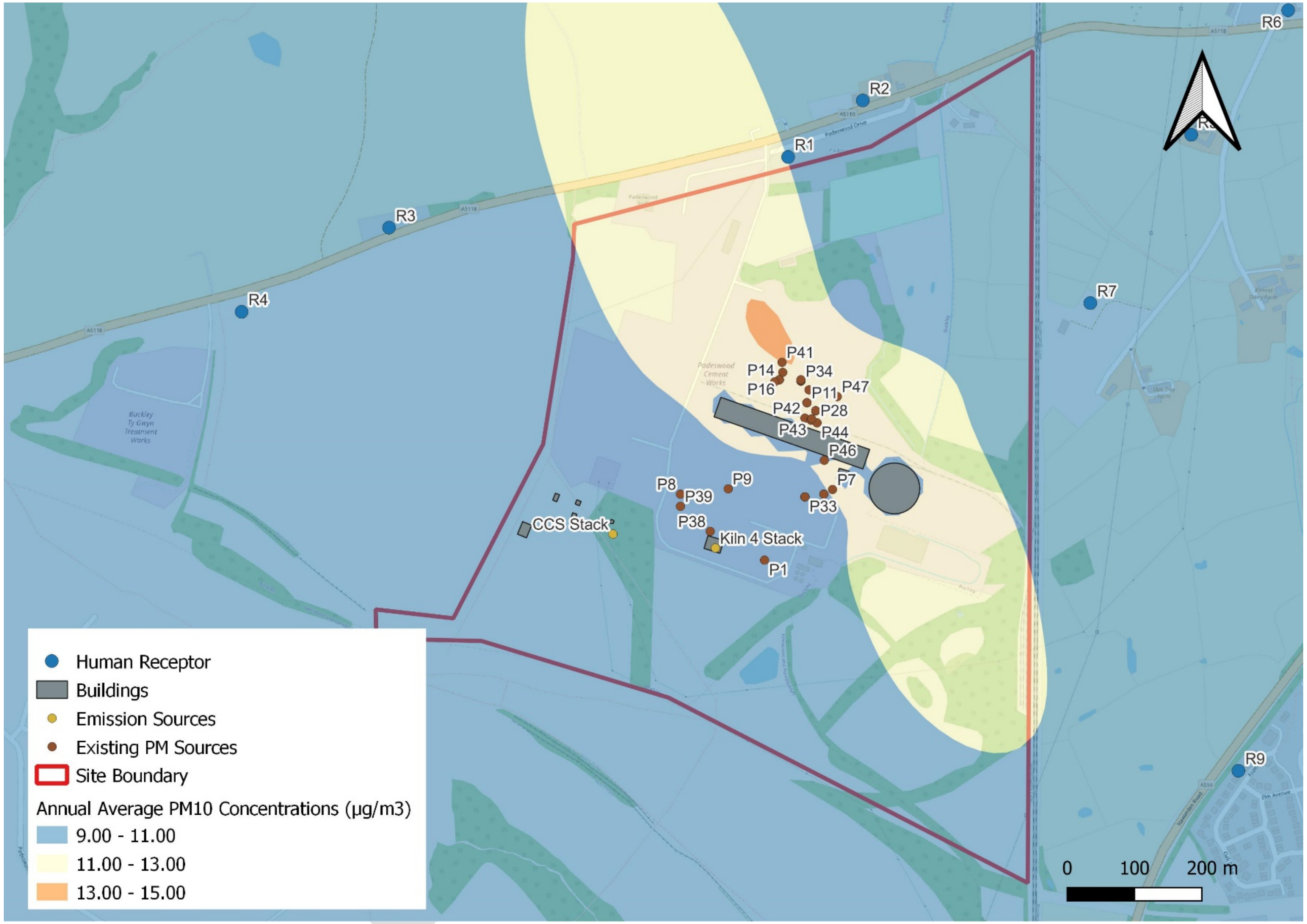

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Figure F3 Predicted Annual Average PM_{10} Concentrations (µg/m^3) PEC – relevant for human receptor locations – 2021 met data

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Figure F4 Predicted 90.41th Percentile of Daily PM_{10} Concentrations (µg/m^3) PEC – relevant for human receptor locations – 2021 met data

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Figure F5 Predicted 100th Daily Amine Concentrations (µg/m³) PC – relevant for human receptor locations – 2021 met data

Figure F6 Predicted 100th Hourly Amine Concentrations (µg/m³) PEC – relevant for human receptor locations – 2021 met data

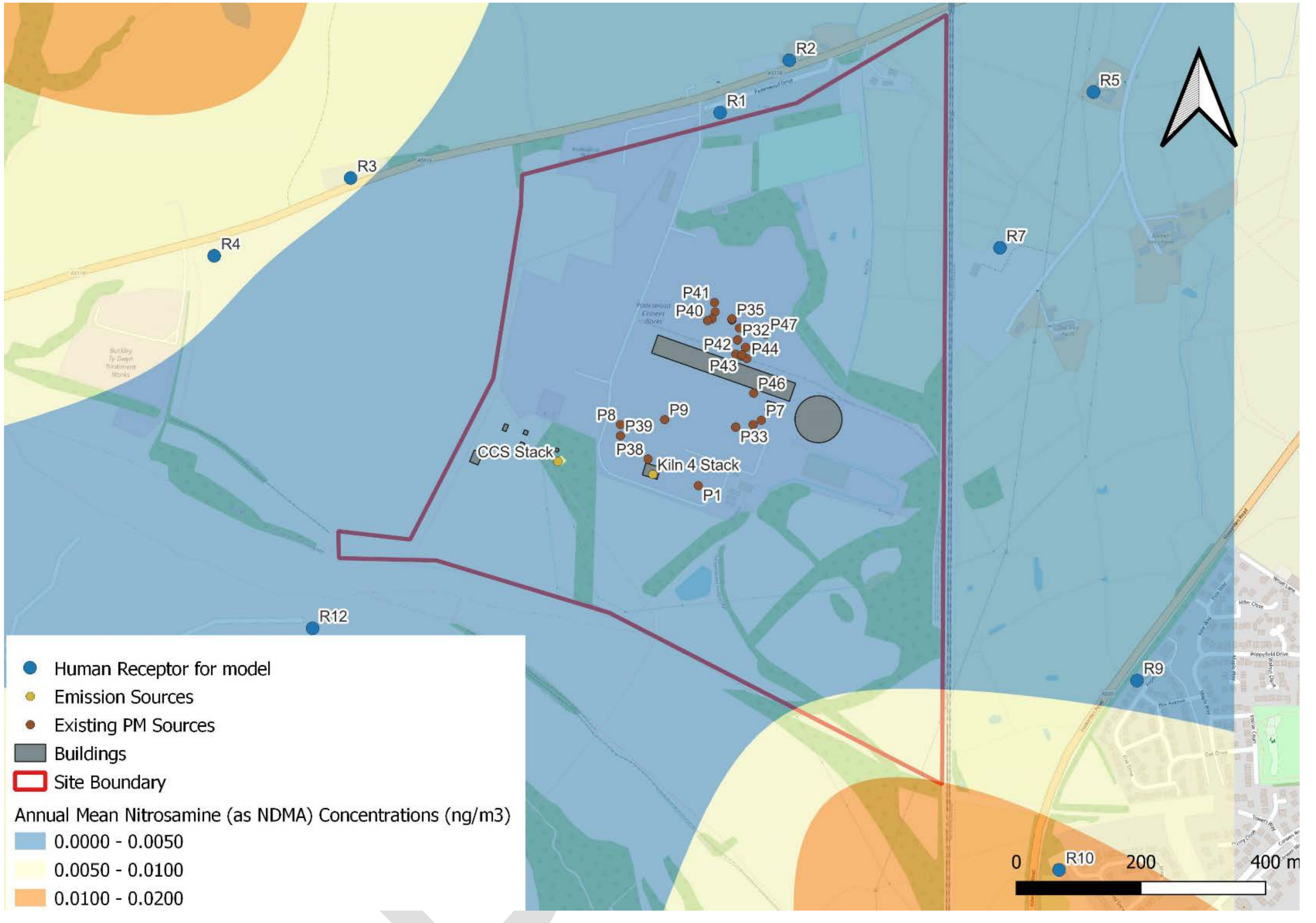

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Figure F7 Predicted Annual Mean Nitrosamine (as NDMA) Concentrations (ng/m^3) PEC – relevant for human receptor locations – 2021 met data

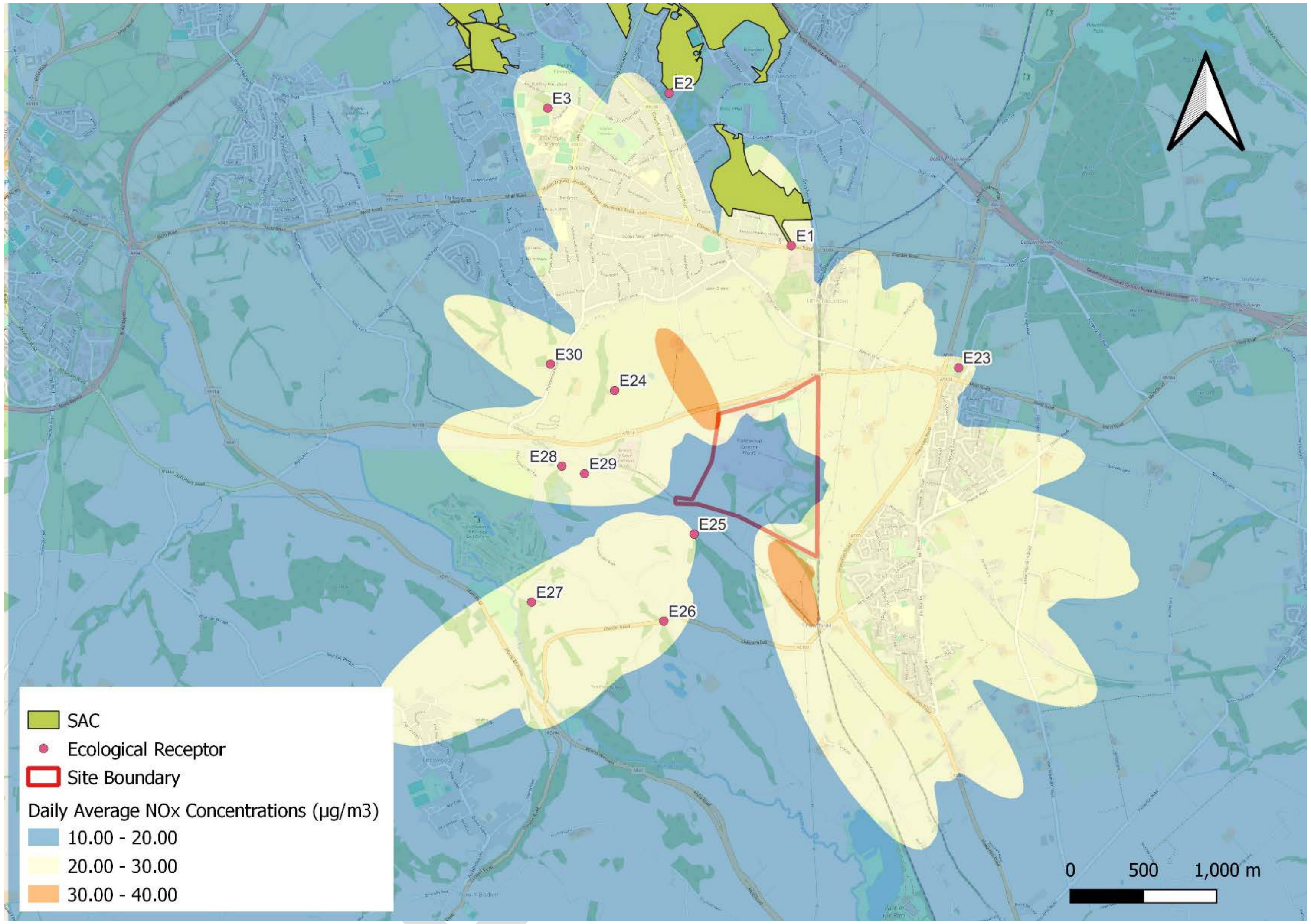

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Figure F8 Predicted Daily Average NO_x Concentrations (µg/m^3) PEC – relevant for ecological receptor locations – 2021 met data

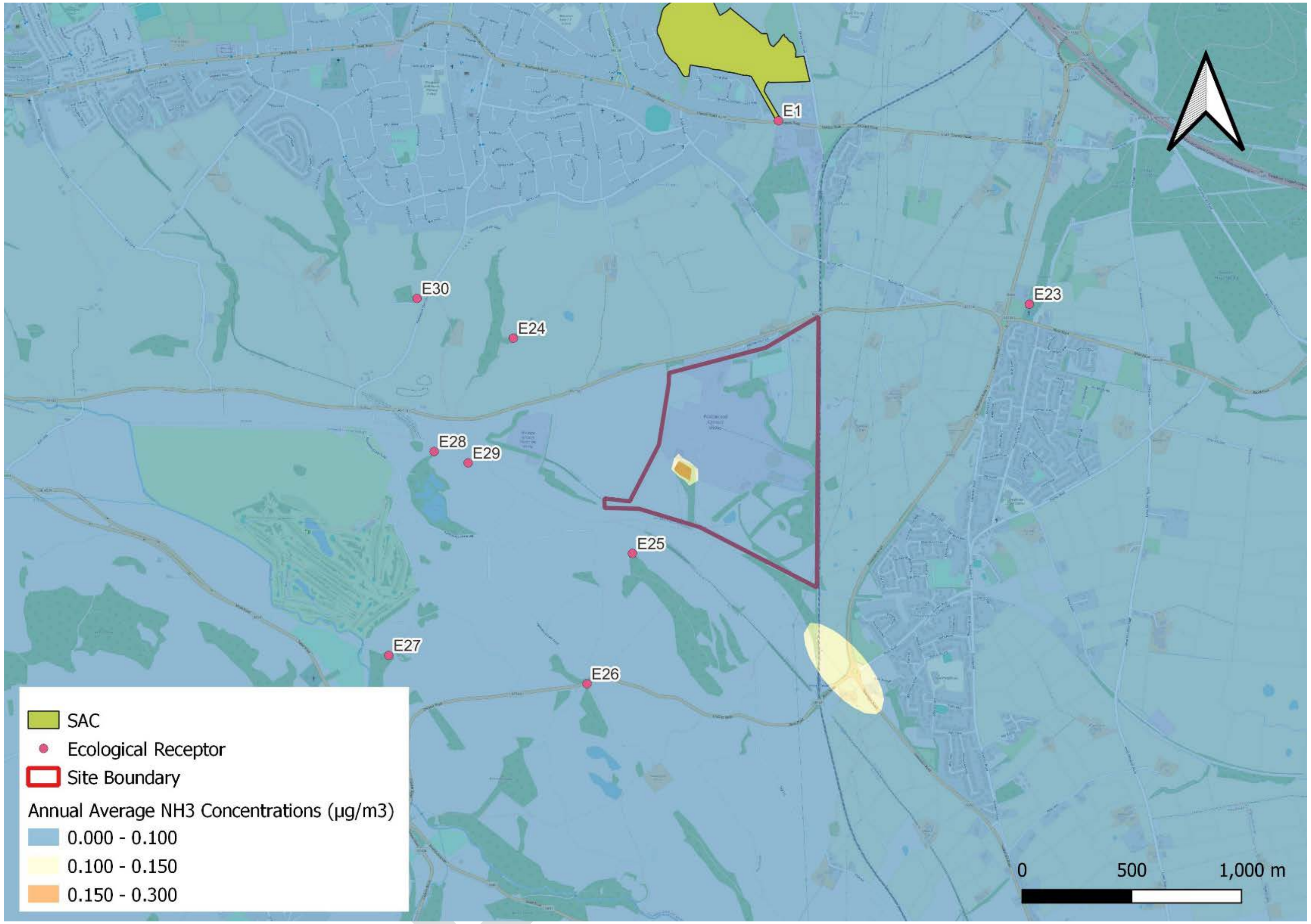

Figure F9 Predicted Annual Mean NH_3 Concentrations (µg/m^3) PC – relevant for ecological receptor locations – 2021 met data