# ENVIRONMENTAL STATEMENT – VOLUME 1 – CHAPTER 6 AIR QUALITY

## Drax Bioenergy with Carbon Capture and Storage

**The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations (2009) - 5(2)(a)**

**Document Reference Number: 6.1.6**

**Applicant:** Drax Power Limited

**PINS Reference:** EN010120

**REVISION: 01**

**DATE: May 2022**

**DOCUMENT OWNER: WSP UK Limited**

**AUTHOR: D. Pawson**

**APPROVER: B. Tuckett-Jones**

**PUBLIC**

# TABLE OF CONTENTS



# TABLES

# 6. AIR QUALITY

## 6.1. INTRODUCTION

6.1.1. This chapter reports the outcome of the assessment of likely significant environmental effects arising from the Proposed Scheme on air quality.

6.1.2. Impacts during the construction, operation and decommissioning phases of the Proposed Scheme are assessed. A full description of the Proposed Scheme is described in **Chapter 2 (Site and Project Description)** of this ES (document reference 6.1.2).

6.1.3. This chapter (and its associated figures (**Volume 2**) and appendices (**Volume 3**)) is intended to be read as part of the wider ES with particular reference to **Chapter 8 (Ecology)** (document reference 6.1.8) and **Chapter 18 (Cumulative Effects)** (document reference 6.1.18) with respect to operational phase likely impacts and effects.

6.1.4. This chapter:

- **a.** Summarises the legislative and policy framework;
- **b.** Describes consultation undertaken to date;
- **c.** Describes the methodology followed for the assessment;
- **d.** Identifies the potential impacts as a result of the Proposed Scheme;
- **e.** Details the design, mitigation and enhancement measures that have been identified;
- **f.** Reports the assessment of the significant effects of the Proposed Scheme; and
- **g.** Details the monitoring that should be carried out for the Proposed Scheme.

6.1.5. The Proposed Scheme has the potential to affect air quality as a result of:

- **a.** During construction / decommissioning:
  - i. Emissions of dust and particulate matter generated by construction-related activities, for example, site clearance, stockpiling and materials transport.
- **b.** During operation:
  - ii. Air pollutant emissions released from stack sources running in association with the Proposed Scheme; and
  - iii. Cumulative impacts associated with air pollutant emissions released from stack sources running in association with the Proposed Scheme and other projects, as set out in **Chapter 18 (Cumulative Effects).**

### OPTIONALITY

6.1.6. Only the construction phase options, as described in **Chapter 2 (Site and Project Description)**, **paragraph 2.3.4**, affect the construction phase air quality assessment. Two options are being considered for the construction of the Proposed Scheme, both of which would be expected to start in early 2024, with the first BECCS Unit being operational by the end of 2027 and the second unit operational by the end of 2029.

6.1.7. For the purposes of the construction phase air quality assessment, Option 2 is considered to represent a relative worst-case scenario with respect to potential construction impacts on air quality, given that Carbon Capture Plant associated with Unit 1 and Unit 2 as well as the Common Plant would be constructed at the same time. Therefore, Option 2 forms the basis on which the construction phase air quality assessment has been completed.

6.1.8. As outlined in **Chapter 2 (Site and Project Description) paragraph 2.2.44**, it is assumed that the location of the Carbon Dioxide Delivery Terminal Compound will be within the Order Limits.

## 6.2. LEGISLATIVE AND POLICY FRAMEWORK

### LEGISLATIVE FRAMEWORK

6.2.1. The applicable legislative framework is summarised as follows.

#### International

**Industrial Emissions Directive 2010/75/EU**

6.2.2. Directive 2010/75/EU on industrial emissions (IED) recast seven earlier European Union (EU) directives related to industrial emissions, in particular Directive 2008/1/EC of 15 January 2008 concerning integrated pollution prevention and control (the Integrated Pollution Prevention and Control (IPPC) Directive) and Directive 2001/80/EC on the limitation of emissions of certain pollutants into the air from large combustion plants (the Large Combustion Plant Directive (LCPD)), such as Drax Power Station, into a single legislative instrument to improve the permitting, compliance and enforcement regimes adopted by Member States.

6.2.3. The IED is enacted in the UK via the Environmental Permitting (England and Wales) Regulations 2016 (EPR) (see **paragraph 6.2.12**).

#### National

**UK Air Quality Strategy and Air Quality Regulations**

6.2.4. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Vols. 1 and 2) (Dept. for Environment Food and Rural Affairs, 2007) sets standards for key air pollutants that reflect levels of pollution thought to avoid or minimise risks to health or ecosystems. The associated air quality objectives are policy targets, expressed as maximum permissible outdoor concentrations of pollutants that take account of economic efficiency, practicability, technical feasibility, and timescales.

6.2.5. The objectives for the pollutants considered in this assessment, as enacted by the Air Quality (England) Regulations 2000, are given in **Table 6.1**.

6.2.6. Further to the Air Quality (England) Regulations 2000, the Air Quality Standards Regulations 2010 as amended, which are transposed into UK law from the EU Ambient Air Quality Directive 2008/50/EC, set legally binding thresholds for the

concentration of pollutants in air for the protection of health and ecosystems. In the Standards Regulations, the thresholds are referred to as 'limit values'.

6.2.7. For the pollutants of interest to the Proposed Scheme, the limit values are numerically identical to the UK's objectives for all pollutants except $PM_{2.5}$ and enacted through the Air Quality Standards Regulations 2010, as amended. For $PM_{2.5}$, the limit value was amended (tightened) in 2020 by the Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020.

6.2.8. In addition to the statutory objectives and air quality standards, **Table 6.1** also includes the non-statutory, target concentrations for protected conservation areas and Environment Assessment Levels (EALs) for human health, which are applicable to this assessment, as referenced in Environment Agency guidance (Environment Agency, 2021).

**Table 6.1 - Air Quality Statutory and Non-Statutory Assessment Levels relevant to the Assessment of Impacts from the Proposed Scheme**

| Pollutant | Objective / Limit Value(1) (µg/m$^3$) | Target Value(2) (µg/m$^3$) | Measured as: | Set for protection of: |
|---|---|---|---|---|
| Nitrogen dioxide, $NO_2$ | 200 | - | 1-hour mean, not to be exceeded more than 18 times per year | Human health |
| | 40 | - | Annual mean | |
| Particulate matter, $PM_{10}$ | 40 | - | Annual mean | |
| | 50 | - | 24-hour mean, not to be exceeded more than 35 times per year | |
| Particulate matter, $PM_{2.5}$ | 20 | - | Annual Mean | |
| Sulphur dioxide, $SO_2$ | 266 | - | 15-minute mean not to be exceeded more than 35 times per year | |
| | 350 | - | 1-hour mean not to be exceeded more | |

| Pollutant | Objective / Limit Value[1] (µg/m$^3$) | Target Value[2] (µg/m$^3$) | Measured as: | Set for protection of: |
|---|---|---|---|---|
| | | | than 24 times per year | |
| | 125 | - | 24-hour mean not to be exceeded more than 3 times per year | |
| Ammonia, $NH_3$ | - | 180 | Annual mean | |
| | - | 2,500 | 1-hour mean | |
| Hydrogen chloride, HCl | - | 750 | 1-hour mean | |
| Monoethanolamine, MEA | - | 100 | 24-hour mean | |
| | - | 400 | 1-hour mean | |
| N-Nitrosodimethylamine (NDMA) | - | 0.0002 | Annual mean | |
| Nitrogen oxides, $NO_x$ | 30 | - | Annual mean | Ecosystems |
| | - | 75 | 24-hour mean | |
| $SO_2$ | - | 20 / 10[3] | Annual mean | |
| $NH_3$ | 6.2.9. | 1[3] / 3 | Annual mean | |

[1] Air Quality (England) Regulations 2000; Air Quality Standards Regulations 2010

[2] Environment Agency Guidance – targets for protected conservation areas and Environmental Assessment Levels (EALs) for human health

[3] Applicable where lichens or bryophytes are present

### Environment Act 2021

6.2.10. Following the departure of the UK from the EU, the Environment Act 2021 makes provision about targets, plans, and policies for improving the natural environment, including air quality. Specifically, the Act introduces a duty to set a legally binding

annual mean target for $PM_{2.5}$ (separate to the above amended limit value), in addition to a population exposure reduction target by October 2022[1].

6.2.11. The European Union (Withdrawal) Act 2018 ensures that the whole body of existing EU environmental law continues to have effect in UK law.

**Environmental Permitting (England and Wales) Regulations 2016**

6.2.12. The EPR 2016 require that permit conditions for new plant shall be set with reference to the latest reference documents on Best Available Techniques (BAT), and the associated BAT conclusions, and that existing permits shall be regularly reviewed in light of updated BAT conclusions.

6.2.13. The latest BAT conclusions for large combustion plants were adopted on 31 July 2017. For the purpose of this report, it is assumed that permit conditions for the existing plant will be set to meet the 2017 BAT conclusions, where applicable. Conditions for the BECCS plant, as part of the Proposed Scheme, will be the subject of a variation to the existing Environmental Permit, EPR/VP3530LS for Drax Power Station. This will be developed in parallel to the Application and submitted to the EA at the same time, or shortly after, the Application is submitted to PINS.

**Environment Act 1995**

6.2.14. Under Part IV of the Environment Act 1995 (as amended), local authorities must review and document local air quality within their area by way of staged appraisals and respond accordingly, with the aim of meeting the air quality objectives defined in the Air Quality Regulations. Where the objectives are not likely to be achieved, an authority is required to designate an Air Quality Management Area (AQMA). For each AQMA the local authority is required to draw up an Air Quality Action Plan (AQAP) to secure improvements in air quality and show how it intends to work towards achieving air quality standards in the future.

**Environmental Protection Act 1990**

6.2.15. With respect to the control of dust and particulates associated with construction, Section 79 of the Environmental Protection Act 1990 (as amended) gives the following definitions of statutory nuisance relevant to dust and particles:

a. “Any dust, steam, smell or other effluvia arising from industrial, trade or business premises or smoke, fumes or gases emitted from premises so as to be prejudicial to health or a nuisance”; and
b. “Any accumulation or deposit which is prejudicial to health or a nuisance”.

6.2.16. Following this, Section 80 says that where a statutory nuisance is shown to exist, the local authority must serve an abatement notice. Failure to comply with an abatement

[1] The Department for Environment Food and Rural Affairs (Defra) opened a consultation in March 2022 on proposed targets for $PM_{2.5}$. These comprise a maximum annual mean concentration of $PM_{2.5}$ of 10 µg/m$^3$ across England by 2040 and a 35% reduction in population exposure to $PM_{2.5}$ by 2040 (compared to a base year of 2018). The consultation closes 27June 2022.

notice is an offence and if necessary, the local authority may abate the nuisance and recover expenses.

6.2.17. There are no statutory limit values for dust deposition above which ‘nuisance’ is deemed to exist. Nuisance is a subjective concept and its perception is highly dependent upon the existing conditions and the change which has occurred.

6.2.18. Further detail is set out in **Section 4** of the **Statutory Nuisance Statement** (document reference 5.4).

## POLICY FRAMEWORK

6.2.19. The applicable policy framework is summarised as follows:

### National

6.2.20. The Department for Business, Energy and Industrial Strategy (BEIS, formerly DECC) published six National Policy Statements (NPS) for Energy in 2011. The most relevant NPS documents with respect to air quality are the Overarching National Policy Statement for Energy (EN-1) (BEIS, 2011) and National Policy Statement for Renewable Energy Infrastructure (EN-3) (BEIS, 2011).

**Overarching National Policy Statement for Energy (EN-1) (BEIS, 2011)**

6.2.21. Paragraphs 4.10.1 and 4.10.2 of NPS EN-1 state that "Issues relating to discharges or emissions from a proposed project which affect air quality...may be subject to separate regulation under the pollution control framework or other consenting and licensing regimes. The planning and pollution control systems are separate but complementary. The planning system controls the development and use of and in the public interest."

6.2.22. Paragraph 4.10.3 goes on to make clear that the Secretary of State "…should focus on whether the development itself is an acceptable use of the land, and on the impacts of that use, rather than the control of processes, emissions or discharges themselves. The [SoS] should work on the assumption that the relevant pollution control regime and environmental regulatory regimes, will be properly applied and enforced by the relevant regulator."

6.2.23. Paragraph 4.10.8 makes it clear that the SoS "…should not refuse consent on the basis of pollution impacts unless it has good reason to believe that any relevant necessary operational pollution control permits or licences or other consents will not subsequently be granted."

6.2.24. Accordingly, it is not for the DCO process to control the emissions from the Proposed Scheme, rather it is for the DCO Application to demonstrate that the emissions from the Proposed Scheme are acceptable in planning terms and that there is no reason why the Environment Agency (EA) would not grant an Environmental Permit for the Proposed Scheme. For this reason, the Applicant has engaged with the EA.

6.2.25. NPS EN-1 supports the use of Carbon Capture and Storage (CCS) and paragraph 4.7.5 states that "*All commercial scale fossil fuelled generating stations have to be carbon capture ready*."

6.2.26. Part 5 of NPS EN-1 details the potential impacts of energy infrastructure including air quality and emissions. Paragraph 5.2.1 of NPS EN-1 advises that the construction, operation and decommissioning of infrastructure development can "…*involve emissions to air which could lead to adverse impacts on health, on protected species and habitats, or on the wider countryside*." Paragraph 5.2.7 of NPS EN-1 states that an assessment should be undertaken, as part of the ES, detailing:

**a.** Any significant air emissions, their mitigation and any residual effects distinguishing between the project stages and taking account of any significant emissions from any road traffic generated by the project;

**b.** The predicted absolute emission levels of the proposed project, after mitigation methods have been applied;

**c.** Existing air quality levels and the relative change in air quality from existing levels; and

**d.** Any potential eutrophication impacts.

6.2.27. In terms of decision making, paragraphs 5.2.8 to 5.2.10 of NPS EN-1 set out the considerations that the SoS should make, including giving substantial weighting where a project would result in a deterioration in air quality in an area, or leads to a new area where air quality breaches relevant national air quality limits. Consideration should also be given where substantial changes in air quality levels are expected, even if this does not lead to any exceedances of national air quality limits.

6.2.28. Where relevant statutory air quality limits are likely to be breached, developers should work with relevant authorities to secure appropriate mitigation to allow the proposal to proceed. Where a project will lead to a non-compliance with a statutory limit, the SoS should refuse consent.

6.2.29. Given that the Proposed Scheme will be subject to the EPR 2016, the considerations set out in Section 4.10 of NPS EN-1 on the interface between planning and pollution control apply. Paragraph 4.10.3 states that "…*The IPC should work on the assumption that the relevant pollution control regime and other environmental regulatory regimes… will be properly applied and enforced by the relevant regulator. It should act to complement but not seek to duplicate them*."

**National Policy Statement for Renewable Energy Infrastructure (EN-3) (BEIS, 2011)**

6.2.30. Paragraph 2.5.40 of NPS EN-3 states that "The applicant's EIA should include an assessment of the air emissions resulting from the proposed infrastructure and demonstrate compliance with the relevant regulations." In terms of the SoS decision making, paragraph 2.5.42 states that "…the pollutants of concern arising from the combustion of biomass include $NO_x$, $SO_x$, particulates, and $CO_2$…", going on to confirm in paragraph 2.5.44 that "…where a proposed biomass combustion generating station meets the requirements of LCPD and will not exceed the local air

quality standards, the [SoS] should not regard the proposed biomass infrastructure as having adverse impacts on health".

**Draft Revisions to NPS EN-1 and EN-3**

6.2.31. At the time of writing, a consultation was ongoing seeking views on the revised NPS following a review by BEIS. This includes revisions to EN-1 and EN-3 statements. However, the air quality-specific content of each revised statement remains substantially unchanged, including the considerations to be taken by the SoS as part of decision making, relative to existing statements, noting that reference to the LCPD is replaced with reference to the EPR 2016 and relevant BAT conclusions.

**National Planning Policy Framework (NPPF) (Ministry of Housing, Communities & Local Government, 2021)**

6.2.32. The Government's overall planning policies for England are described in the NPPF. One of the three overarching objectives of the NPPF is that the planning system should seek "…*to protect and enhance our natural, built and historic environment; including making effective use of land, improving biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy*".

6.2.33. In relation to air quality, the following paragraphs in the document are relevant to the Proposed Scheme:

**a.** Paragraph 55, which states *"Local Planning Authorities should consider whether otherwise unacceptable development could be made acceptable through the use of conditions or planning obligations. Planning obligations should only be used where it is not possible to address unacceptable impacts through a planning condition."*

**b.** Paragraph 174, which states *"Planning policies and decisions should contribute to and enhance the natural and local environment by: …e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality…";*

**c.** Paragraph 185, which states *"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development….";*

**d.** Paragraph 186, which states *"Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified... So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas…is consistent with the local air quality action plan.";* and

e. Paragraph 188, which states *"The focus of planning policies and decisions should be on whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a particular development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities."*

**National Planning Practice Guidance (NPPG) for Air Quality (Ministry of Housing, 2019)**

6.2.34. The NPPG for air quality provides guidance on how planning can take account of the impact of new development on air quality. As well as detailing the air quality considerations that planning needs to address, it provides guidance on the level of detail of the assessment and associated mitigation of impacts.

6.2.35. Relevant considerations given by the NPPG for air quality in determining a planning application include whether a development would:

a. *"Lead to changes (including any potential reductions) in vehicle-related emissions in the vicinity of the proposed development or further afield…*
b. *Introduce new point sources of air pollution (e.g. biomass boilers, combined heat and power plant)…*
c. *Expose people to harmful concentrations of air pollutants, including dust…*
d. *Give rise to unacceptable impacts during construction for nearby sensitive locations…*
e. *Have a potential adverse effect on biodiversity, especially where it would affect sites designated for their biodiversity value."*

6.2.36. The NPPG suggests that the following elements could form part of air quality assessments:

a. *"A description of baseline conditions and any air quality concerns affecting the area, and how these could change both with and without the proposed development;*
b. *Sensitive habitats (including designated sites of importance for biodiversity);*
c. *Assessment methods to be adopted and any requirements for the verification of modelling air quality;*
d. *The basis for assessing impacts and determining the significance of an impact;*
e. *Where relevant, the cumulative or in-combination effects arising from several developments;*
f. *Construction phase impacts;*
g. *Acceptable mitigation measures to reduce or remove adverse effects; and*
h. *Measures that could deliver improved air quality even when legally binding limits for concentrations of major air pollutants are not being breached."*

### Local

**Selby District Council Local Plan 2013 (Selby District Council, 2013)**

6.2.37. Policy SP18 – Protecting and Enhancing the Environment – of Selby District Council's (SDC) Core Strategy Local Plan, states that: "*The high quality and local distinctiveness of the natural and man-made environment will be sustained by… Ensuring that new development protects soil, air and water quality from all types of pollution*…".

**Selby District Council Draft Local Plan 2021 (Selby District Council, 2021)**

6.2.38. SDC's new Local Plan is currently under development and the current Local Plan Preferred Options Consultation 2021 document includes Policy NE8 – Air Quality, which outlines the Council's preferred approach to air quality in relation to new developments. The policy states that developments:

**a.** *"A…must not…result in further significant air quality deterioration, or the need to declare further AQMAs…and result in any increase in the number of people exposed to poor air quality…and conflict with elements of an Authority Air Quality Action Plan.*

**b.** *B…will only be permitted if the impact on air quality is acceptable and mechanisms are in place to mitigate adverse impacts and prevent further exposure to poor air quality. This will help to protect human health."*

**Selby Air Quality: Planning Guidance Note (2014) (Selby District Council, 2014)**

6.2.39. SDC published an air quality planning guidance note to support developers when preparing air quality assessments. The guidance includes a checklist that enables applicants to check all relevant information have been included in detailed air quality impact assessment.

6.2.40. An assessment of the relevant policies is detailed further in the **Planning Statement** (document reference 5.2).

## 6.3. CONSULTATION

6.3.1. **Table 6.2** provides a summary of the consultation undertaken in support of the preparation of this assessment.

**Table 6.2 - Consultation Summary Table**

| Date and Method of Consultation | Consultee | Summary of Key Topics discussed and Key Outcomes |
|---|---|---|
| 11 August 2021 – email and letter submitted to SDC by the Applicant | Selby District Council (SDC) | The letter from the Applicant focussed on the following key topics relating to the air quality assessment scope:<br>~ Defining the assessment study areas for the construction and operational phases<br>~ Establishing baseline conditions, including justification for not undertaking additional air quality surveys at this stage<br>~ Identifying sensitive receptors / resources within the operational study area<br>~ Potential impacts scoped in / out of the air quality assessment<br>~ The proposed assessment methodology and associated limitations and assumptions.<br>No direct response to this letter was received at the time of writing. However, SDC and North Yorkshire County Council (NYCC) addressed Chapter 6 (Air Quality) of the Preliminary Environmental Information Report (PEIR) (WSP, 2021) as part of their Section 42 (s42) Statutory Consultation response (see below). |
| 10 December 2021 – Section 42 Statutory Consultation letter submitted to the Applicant from SDC and North Yorkshire County Council (NYCC) | SDC and NYCC | SDC and NYCC addressed Chapter 6 (Air Quality) of the PEIR as part of their s42 Statutory Consultation response, dated 10 December 2021. In the s42 letter, SDC Environmental Health state in relation to air quality:<br>~ SDC considers that the scope of the construction phase assessment is justified and will be secured within the Construction Environmental Management Plan (CEMP).<br>~ In relation to effects of emissions from construction vehicles, SDC considers that scoping out a detailed assessment of these emissions is appropriate, given that the proximity of the works to the district's only designated AQMA is such that significant air quality impact from construction traffic movements is unlikely.<br>With respect to the operational phase assessment, SDC emphasise the need for the Applicant to accurately set the baseline data to reflect the assessment, notably by ensuring that data source modelling is aligned to the operation of two biomass units without BECCS from the Main Stack in the absence of coal-fired units. See **Section 6.5 Assessnent Methodology** for description of baseline air quality modelling scenario. |
| 11 August 2021 – email and letter submitted to the EA by the Applicant | Environment Agency (EA) | Email and letter submitted to the EA outlining the Applicant's proposed approach to the air quality assessment relevant to the DCO. |
| 23 August 2021 – email submitted by the EA to the Applicant in response to the Applicant's email dated 11 August 2021 | EA | Comments received from the EA provide observations and guidance focussed on refining the air quality assessment in relation to supporting a future environmental permit determination under the Environmental Permitting (England and Wales) Regulations 2016 (SI 2016/1154).<br>Specifically, the EA make recommendations with respect to:<br>**Emissions**<br>~ Justify the modelled emissions profile is considered a reasonable worst-case and the basis for this (see **paragraph 6.5.15** for details on emissions profiles).<br>~ The EA recommends the Applicant to propose emission limit values for directly emitted amines, nitrosamines and ammonia (see **Table 6.6** for details on modelled emissions concentrations from the Proposed Scheme BECCS units)<br>~ Provide evidence supporting selection of atmospheric reaction rates, justifying that these are reasonably sound. These may be compared with data from published literature for the same type of amine / nitrosamine, accompanied by background on how these were devised (e.g. from experiments, computational simulations), etc (see **paragraphs 6.5.21 to 6.5.25** and **Appendix 6.3 (Atmospheric Dispersion Modelling)** (document reference 6.3.6.3)). |

| Date and Method of Consultation | Consultee | Summary of Key Topics discussed and Key Outcomes |
|---|---|---|
| | | **Contributions from other facilities**<br>~ Evaluate whether the operation of the new Eggborough CCGT plant (or any other facility) would need to be included in the assessment of air quality impacts at sensitive receptors, including the impacts as appropriate (see **Section 6.5 Assessment Methodology and Section 6.12 Cumulative Effects**).<br>**Sensitive Receptors and AQMAs**<br>~ Justify whether choice of sensitive receptors is appropriate and include predictions at sensitive receptors located in relevant AQMAs (see **Section 6.8 Sensitive Receptors**).<br>~ Interpret the background pollution including spatial variations and provide evidence for the values selected for assessment purposes (see **Section 6.7 Baseline Conditions**).<br>**Habitats**<br>~ For SPAs, SACs and Ramsar Sites, consider other plans and permissions in your assessment that might contribute to ecological impacts (see **Section 6.8 Sensitive Receptors**).<br>**Uncertainty**<br>~ EA encourages consideration of the level of uncertainty in model predictions (see **paragraphs 6.5.55 to 6.5.60 for 'Assumptions and Limitations' and Appendix 6.3**). |
| 21 October 2021 – email submitted to the EA by the Applicant | EA | The Applicant responded directly to the EA on the above recommendations to seek further agreement and clarification on the approach adopted for the air quality assessment. The EA was also asked to confirm their position with respect to the Applicant's approach to defining baseline conditions and particularly the justification for not undertaking specific baseline air quality surveys. |
| 2 November 2021 – email submitted by the EA to the Applicant to the Applicant in response to the Applicant's email dated 21 October 2021 | EA | Comments received from the EA provided further clarification with respect to the following:<br>**Baseline conditions**<br>~ Applicant must provide robust evidence that pollutant background concentrations are likely to be representative of locations of exposure (see **Section 6.76.7 Baseline Conditions**).<br>**Emissions**<br>~ The emissions and composition of proprietary amine-based carbon capture solvents will be required for permit determination under the Environmental Permitting Regulations 2016 (see **paragraphs 6.5.21 to 6.5.25 and Appendix 6.3** for details of sensitivity testing completed in relation to amine compounds, given the confidentiality of the amine compounds relating to the proprietary solvent).<br>~ Strongly recommended that the Applicant provides satisfactory evidence supporting the Applicant's opinion of the need for risk evaluation of the detailed recipe of amine emissions in this particular case. This evidence must consider whether the modelled compounds are likely to be representative and / or would react in the atmosphere in a similar way to those emitted from the stack (see **paragraphs 6.5.21 to 6.5.25 and Appendix 6.3**).<br>~ EA recommends including evidence that the modelled pollutant mass rates would represent reasonable worst-cases, including potential degradation products released from the stack. If applicable, EA recommends differentiating contributions of directly emitted nitrosamines from those formed through atmospheric reactions (see **Table 6.6** for modelled mass emission rates and **Appendix 6.3** for details on direct and indirect nitrosamines)<br>~ EA recommends including robust evidence that the atmospheric kinetic parameters for MEA can be reasonably applied to any other primary, secondary or tertiary amine potentially released from the stack, whether this approximation represents reasonable worst-cases or |

| Date and Method of Consultation | Consultee | Summary of Key Topics discussed and Key Outcomes |
|---|---|---|
| | | outweighs the level of uncertainty in these parameters and the risk (see **paragraphs 6.5.21 to 6.5.25** and **Appendix 6.3**, which outlines the use of proxy amine compounds with the aim of addressing uncertainty given the confidentiality of the amine compounds relating to the proprietary solvent). |
| 10 December 2021 – Section 42 Statutory Consultation letter submitted to the Applicant from | EA | In the EA's Section 42 Consultation letter dated 10 December 2021, specifically in relation to Environmental Permitting, the EA states that "…*the operator will need to complete an air emissions risk assessment and compare the impact of any emissions to the environmental standards provided in the following guidance: Air emissions risk assessment for your environmental permit*."<br>The assessment of operational phase impacts reported herein (*see* ***Section 6.5 Assessment Methodology***) was undertaken with reference to the Environment Agency guidance (Environment Agency, 2021). |

6.3.2. An **EIA Scoping Opinion** (document reference 6.3.1.2) was received by the Applicant from the Planning Inspectorate (PINS) on behalf of the Secretary of State (SoS) on 26 February 2021, including formal responses from Statutory Consultees. The responses from PINS in relation to air quality and how these requirements are addressed by the Applicant are set out in **Appendix 4.2** (document reference 6.3.4.2).

## 6.4. SCOPE OF THE ASSESSMENT

6.4.1. The scope of this assessment has been established through an ongoing Scoping process. Further information can be found in **Chapter 4 (EIA Methodology)** (document reference 6.1.4)**.**

6.4.2. This section provides an update to the scope of the assessment and, where applicable, re-iterates the evidence base for scoping out elements following further iterative assessment.

### ELEMENTS SCOPED OUT OF THE ASSESSMENT

6.4.3. The elements shown in **Table 6.3** are not considered to give rise to likely significant effects as a result of the Proposed Scheme and have therefore not been considered within this assessment.

**Table 6.3 - Elements Scoped Out of the Assessment**

| Element scoped out | Justification |
|---|---|
| Cumulative uncontrolled emissions of fugitive dust, including $PM_{10}$, generated by construction and decommissioning phase activities associated with the Proposed Scheme and decommissioning activities relating to the Flue Gas Desulphurisation (FGD) Plant at Drax Power Station. | As described in **Chapter 2 (Site and Project Description)** the Applicant has full planning permission for the demolition of the redundant Flue Gas Desulphurisation (FGD) Plant and associated restoration works at Drax Power Station (2020/0994/FULM). The decommissioning and demolition works of Absorber Units 4, 5 and 6 are scheduled to take place prior to the start of the construction of the Proposed Scheme, whilst the demolition of Absorber Units 1, 2 and 3 are assumed to take place following the completion of the Proposed Scheme, secured pursuant to the DCO. As a consequence these activities cannot happen as part of BECCS. |
| Potential local dust and air quality impacts associated from construction activities within the Off-site Habitat Provision Area | Biodiversity mitigation and enhancements are proposed within the Off-site Habitat Provision Area (see **Figure 1.3 (Off-site Habitat Provision Area)**, (document reference 6.2.1.3)) linked to the Proposed Scheme. Given the low potential for dust generation associated with the nature of the proposed works within this area, an assessment of air quality impacts from construction activities has been scoped out. |
| Local air quality impacts associated with exhaust emissions of $NO_X$ / $NO_2$ and exhaust emissions of particulate matter arising from construction plant and equipment | There are no identified sensitive receptors located within 350 m of any of the proposed construction laydown areas (see **Section 6.6** for study area definitions). By conservatively assuming that any construction plant activities could occur anywhere within the Order Limits (see **Figure 6.1 (Construction Phase Assessment Study Area)** (document reference 6.2.6.1)), identified sensitive receptors within 350 m of the boundary would include Drax Abbey Farm, Foreman's Cottage, Old Lodge, Drax Sports and Social Club, the East Yorkshire Caravan Salvage, and residential receptors adjacent to Adamson Court and Hales Lane. Based on 2021 Defra mapped background pollutant data (see **Table 6.10**), annual mean concentrations of $NO_X$, $NO_2$, $PM_{10}$ and $PM_{2.5}$ are well below the respective statutory air quality standards. Therefore, emissions from construction plant and equipment are expected to have no significant effect on local air quality. Nevertheless, all construction plant and equipment would be maintained in good working order and not left running when not in use, as a matter of good practice.<br><br>SDC's s42 consultation letter (10 December 2021, see **Table 6.2**) stated that the scope of the construction phase assessment is justified. |
| Local air quality impacts associated with exhaust emissions of $NO_X$ / $NO_2$ and particulate matter from construction traffic generated by the Proposed Scheme | The EPUK / IAQM guidance (Environmental Protection UK & Institute of Air Quality Management, 2017) provides the following indicative traffic screening criteria when considering the need for an air quality assessment of vehicle emissions outside of an AQMA:<br>~ A change of LDV flows in excess of 500 annual average daily traffic (AADT); or<br>~ A change in HDV flows in excess of 100 AADT<br><br>Based on the peak construction year (2026, Option 2 construction programme) vehicle movements and routing derived by the Transport Assessment (see **Chapter 5 (Traffic and Transport)** (document reference 6.1.5) and **Table 6.4** below) and the **Outline Construction Traffic Management Plan** (document reference 6.3.5.1), LDV flows (523 AADT) are predicted to marginally exceed the above criterion on New Road (i.e. Site access). Similarly, the peak year HDV flows (197 AADT) are predicted to exceed the respective criterion on New Road and the A645/A614 linking the Site to the M62 motorway. However, there are no sensitive receptors located adjacent to these road links, except for eight residential properties located at 'White City' adjacent to the A645, all of which are located approximately 20 m or more from the roadside.<br><br>As stated by the EPUK / IAQM guidance, the need for air quality assessment is not necessitated by exceeding these criteria alone but should also consider other factors including existing and future background air quality. For the construction phase study area, the mapped existing (2021) and future (2027/29) annual mean background pollutant levels for each relevant pollutant ($NO_2$, $PM_{10}$, $PM_{2.5}$) are well below the respective statutory air quality standards, with maximum background concentrations less than 35% of the relevant standard for each pollutant (i.e. 65% headroom) (see **Table 6.12**). |

| Element scoped out | Justification |
|---|---|
| | Given the low existing background air pollutant levels and distance from the roadside to the identified sensitive receptors adjacent to the affected road links, the short-term change in vehicle emissions attributed to construction traffic will have insignificant local air quality effects.<br><br>All remaining road links affected by construction vehicle movements generated by the Proposed Scheme are predicted to experience an increase in LDV and HDV flows below the above criteria (see **Table 6.4**).<br><br>There is one affected road link (A1041 Park Street) that connects to the Selby AQMA (A19 New Street). More stringent screening criteria are applied to road links within or adjacent to an AQMA, as given by the IAQM / EPUK guidance:<br>~ A change of LDV flows in excess of 100 annual average daily traffic (AADT); or<br>~ A change in HDV flows in excess of 25 AADT<br><br>The A1041 road linking to the Selby AQMA is predicted to experience peak year construction vehicle movements of ten LDV AADT movements relating to construction worker trips, and zero HDV movements as this road does not form part of the assigned HDV construction vehicle route. Therefore, movements on within and near to the AQMA will remain well below the above criteria.<br><br>As such, emissions from construction traffic movements are expected to have no significant effect on local air quality both within and outside of the Selby AQMA.<br><br>This approach was agreed to by the Planning Inspectorate in the **Scoping Opinion** dated February 2021, provided that appropriate evidence could be provided, as is presented above. |
| Local air quality impacts associated with exhaust emissions of $NO_X$ / $NO_2$ and particulate matter from operational traffic generated by the Proposed Scheme | Based on operational phase vehicle trips generated by the Proposed Scheme, as derived by the Transport Assessment (see **Table 6.5**), the maximum generated LDV flows (28 AADT) and HDV flows (20 AADT) on any road link are predicted to be below the respective IAQM / EPUK screening criteria for both within and outside of an AQMA.<br><br>As such, and accounting for the existing and future low background pollutant levels within the operational phase study area, the change in traffic will have no significant effect on local air quality.<br><br>This approach was agreed to by the Planning Inspectorate in the **Scoping Opinion** dated February 2021, provided that appropriate evidence could be provided, as is presented above. |
| Emissions of ammonia ($NH_3$) from proposed ammonia air stripper as part of the Proposed Scheme Wastewater Treatment Plant (WWTP) | The proposed $NH_3$ air stripper, which was referenced in **paragraph 2.2.42 of Chapter 2 (Site and Project Description)** of the PEIR (WSP, 2021) and assessed in Chapter 6 (Air Quality) of the PEIR (WSP, 2021), would have provided a point source of $NH_3$ emissions to the atmosphere. However, the $NH_3$ air stripper has been removed from the Proposed Scheme and replaced with a steam stripper which is described in **paragraph 2.2.24 of Chapter 2 (Site and Project Description)** of this ES. This therefore removes the point source of emissions to the atmosphere. |

### Table 6.4 - Peak construction year (2026) annual average daily traffic flows generated by Proposed Scheme

| Road Link | Construction Vehicle Trips (Peak Construction Year, 2026)* | | |
|---|---|---|---|
| | LDV (AADT) | HDV (AADT) | Total AADT |
| New Road (Access to Site) | 523 | 197 | 720 |
| A645 (linking to A614) | 324 | 197 | 521 |
| A614 (linking to M62) | 324 | 197 | 521 |
| M62 (east of J36) | 63 | 99 | 161 |
| M62 (west of J36) | 262 | 99 | 360 |
| A654 (linking to A1041) | 199 | 0 | 199 |
| A1041 (linking to A63) | 199 | 0 | 199 |
| A63 (east of junction with A1041) | 26 | 0 | 26 |
| A63 (west of junction with A1041) | 162 | 0 | 162 |
| A1041 (linking to Selby AQMA) | 10 | 0 | 10 |
| Note: * Vehicle trips provided as two-way flows (values rounded to whole numbers) | | | |

### Table 6.5 - Operation phase annual average daily traffic flows generated by Proposed Scheme

| Road Link | Operation Phase Vehicle Trips* | | |
|---|---|---|---|
| | LDV (AADT) | HDV (AADT) | Total AADT |
| New Road (Access to Site) | 28 | 20 | 47 |
| A645 (linking to A614) | 17 | 12 | 29 |
| A614 (linking to M62) | 17 | 12 | 29 |
| M62 (east of J36) | 4 | 2 | 6 |
| M62 (west of J36) | 14 | 10 | 24 |

| Road Link | Operation Phase Vehicle Trips* | | |
|---|---|---|---|
| | LDV (AADT) | HDV (AADT) | Total AADT |
| A654 (linking to A1041) | 10 | 8 | 18 |
| A1041 (linking to A63) | 10 | 8 | 18 |
| A63 (east of junction with A1041) | 1 | 1 | 2 |
| A63 (west of junction with A1041) | 8 | 6 | 15 |
| A1041 (linking to Selby AQMA) | 0 | 0 | 0 |
| Note: * Vehicle trips provided as two-way flows (values rounded to whole numbers) | | | |

## ELEMENTS SCOPED INTO THE ASSESSMENT

### Construction and Decommissioning Phase

6.4.4. The following elements are considered to have the potential to give rise to likely significant effects during construction of the Proposed Scheme and have therefore been considered within this assessment:

**a.** Uncontrolled emissions of fugitive dust, including $PM_{10}$, generated by construction and decommissioning phase activities associated with the Proposed Scheme with the potential to cause dust soiling of properties and / or impact human health at identified sensitive receptor locations within the construction phase study area (see **Section 6.6**).

### Operational Phase

6.4.5. The following elements are considered to have the potential to give rise to likely significant effects during operation of the Proposed Scheme and have therefore been considered within this assessment:

**a.** Emissions to air associated with the Proposed Scheme, specifically the operation of BECCS for existing Biomass Units 1 and 2, with the potential to impact human health and / or nitrogen-sensitive and acid-sensitive habitats at identified sensitive receptors within the operation phase study area (see **Section 6.6**); and

**b.** Cumulative emissions to air from the operation of Units 1 and 2 with the Proposed Scheme and from other relevant projects (see **paragraph 6.5.27**) with the potential to impact human health and / or nitrogen-sensitive and acid-sensitive habitats at identified sensitive receptors within the operation phase study area.

## 6.5. ASSESSMENT METHODOLOGY

6.5.1. The approach to the assessment of the Proposed Scheme is based on the outcomes of consultation with both the Environmental Health Officer (EHO) at SDC and the Environment Agency (EA), as set out in in **Section 6.3.**

6.5.2. The scope of the assessment includes the following:

**a.** Qualitative assessment of dust and emissions from construction and decommissioning works; and

**b.** Quantitative assessment of point source emissions to air from the operation of the Proposed Scheme.

### CONSTRUCTION PHASE ASSESSMENT

6.5.3. Construction phase activities associated with the Proposed Scheme may result in the generation of fugitive dust emissions which, if transported beyond the Order Limits, can have an adverse impact on local air quality.

6.5.4. Dust comprises particles typically in the size range 1-75 micrometres (µm) in aerodynamic diameter and is created through the action of crushing and abrasive forces on materials. The larger dust particles fall out of the atmosphere quickly after initial release and therefore tend to be deposited in close proximity to the source of emission. Dust, therefore, is unlikely to cause long-term or widespread changes to local air quality; however, its deposition on property and cars can cause 'soiling' and discolouration. This may result in complaints of nuisance through amenity loss or perceived damage caused, which is usually temporary.

6.5.5. The smaller particles of dust (not exceeding 10 µm in aerodynamic diameter) are known as particulate matter ($PM_{10}$) and represent only a small proportion of total dust released; this includes a finer fraction, known as $PM_{2.5}$ (with an aerodynamic diameter not exceeding 2.5 µm). As these particles are at the smaller end of the size range of dust particles, they remain suspended in the atmosphere for a longer period of time than the larger particles and can therefore be transported by wind over a wider area. $PM_{10}$ and $PM_{2.5}$ are small enough to be drawn into the lungs during breathing which, in sensitive members of the public, could have a potential impact on health. However, ambient dust emissions from construction activities relevant to human health would be as $PM_{10}$ and predominantly in the coarse fraction ($PM_{2.5\text{-}10}$) rather than in the $PM_{2.5}$ fraction (IAQM, 2016). As such, the construction phase dust assessment focuses on levels of $PM_{10}$ with respect to human receptors.

6.5.6. An assessment of the likely significant impacts on local air quality due to the generation and dispersion of dust and $PM_{10}$ during the construction phase has been undertaken using the relevant assessment methodology published by the IAQM (IAQM, 2016), the available construction information for the Proposed Scheme and professional judgement.

6.5.7. As outlined in **Chapter 2 (Site and Project Description)**, two options are being considered for the construction of the Proposed Scheme, both of which would be expected to start in early 2024 with the first BECCS Unit being operational by the end

of 2027 and the second unit operational by the end of 2029. However, for the purposes of the construction phase air quality assessment, Option 2 is considered to represent a relative worst-case scenario with respect to potential construction impacts on air quality, given that Carbon Capture Plant associated with Unit 1 and Unit 2 as well as the Common Plant would be constructed at the same time.

6.5.8. The IAQM guidance facilitates assessment of the potential for dust nuisance and impact to human health and ecosystems to occur due to activities carried out during the following stages of construction:

a. Demolition – Any activity involved with the removal of an existing structure (or structures). Whilst there are no demolition works proposed as part of the Proposed Scheme construction, it is likely that during the decommissioning phase, some structures would undergo demolition;
b. Earthworks – Covers the processes of soil-stripping, ground-levelling, excavation and landscaping;
c. Construction – Any activity involved with the provision of a new structure(s) (e.g. building, road etc.), its modification or refurbishment; and
d. Trackout – The transport of dust and dirt from the Site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network. This arises when HDVs leave the Site with dusty materials, which may then spill onto the road, and / or when HDVs transfer dust and dirt onto the road after travelling on site.

6.5.9. The assessment considers the nature and scale of the activities undertaken for each source and the sensitivity of the area to an increase in dust and $PM_{10}$ levels, which enables an appropriate level of risk to be assigned. Risks are described in terms of there being a low, medium or high risk of dust impacts.

6.5.10. Following the assignment of risk, site specific mitigation proportionate to the level of risk is identified for the Proposed Scheme, and the significance of residual effects is determined. Details of the qualitative construction dust risk assessment, following the IAQM guidance (IAQM, 2016), has been included in **Appendix 6.2 (Construction and Decommissioning Phase Dust Assessment)** (document reference 6.3.6.2) to inform the measures required as part of the Construction Environmental Management Plan (CEMP).

### OPERATIONAL PHASE ASSESSMENT

6.5.11. The assessment of point source emissions from the Proposed Scheme is based on a dispersion modelling exercise undertaken using the ADMS model (v5.2) published by Cambridge Environmental Research Consultants (CERC). The model has been validated against both field studies and wind tunnel studies of dispersion and is widely used for air quality impact assessment in the UK.

6.5.12. The atmospheric dispersion model considers the effects of terrain, roughness length and buildings (as appropriate for the location), together with, and in accordance with EA guidance (Environment Agency, 2021), five years of recent meteorological data from RAF Waddington.

6.5.13. The air pollutants assessed as part of the operational phase air quality assessment comprise:

a. Oxides of nitrogen, $NO_x$;
b. Ammonia, $NH_3$;
c. Particulate matter (capturing both $PM_{10}$ and $PM_{2.5}$);
d. Hydrogen chloride, HCl;
e. Sulphur dioxide, $SO_2$; and
f. Amine and nitrosamine compounds associated with the use of a proprietary solvent as part of the Proposed Scheme BECCS process. For the purposes of this assessment, all modelled amine concentration outputs are treated as monoethanolamine (MEA) and all nitrosamine concentration outputs as N-nitrosodimethylamine (NDMA) for comparison with the associated non-statutory assessment levels set by the EA (see **Table 6.1**).

6.5.14. Details of the adopted atmospheric dispersion modelling approach, including the treatment and assessment of amine and nitrosamine emissions, are provided in **Appendix 6.3**. However, key information relating to the dispersion modelling methodology is summarised in the subsections below.

## Modelled Scenarios

### Core Scenarios

6.5.15. The air quality assessment for the operational phase has focussed on the following core model scenarios:

a. **Baseline:**
   i. Operation of existing four biomass units (4 x 660 MW output) from Main Stack (259 m agl);
   ii. All units assumed to be running at full load for 4,000 hours per year, representing a reasonable likely operating profile based on a 'mid-merit' operating regime[2];
   iii. The two coal-fired units are not included in the Baseline (or Proposed Scheme scenario) because they stopped generating electricity commercially in March 2021 and formal closure of these units is expected before the Proposed Scheme commences operation.

[2] This reflects Drax Power Station's proposed baseline, taking account of current market prices for power and biomass fuel and the conclusion of subsidy support in 2027. It is also a functionality similar to the 'mid-merit' regime recognised by the Environment Agency under the IED, which meant operating between 1,500 and 4,000 hours per year for coal and gas plant to limit the annual emissions profile. However, the purpose for applying a 'mid-merit' approach to the Baseline scenario is not to seek less strict emission limits, but it is intended to represent a likely operating hours regime. Whilst sustainable biomass is a renewable fuel that delivers significant carbon savings relative to fossil fuels and hence not subject to the same level of regulatory control, the principle of 'mid-merit' is considered to be a reasonable proxy for a baseline scenario as it sets out the number of operating hours that was acknowledged would be required for plant that would operate as dispatchable plant at times of low supply / high demand or for grid support purposes.

b. **With Proposed Scheme** ("With Proposed Scheme scenario"):
   i. Operation of two biomass units with CCS (Unit 1 & Unit 2; 660 MW output per unit) from the Main Stack (259 m agl), assumed to be running continuously at full load (8,760 hours per year), representing a reasonable worst-case operating profile;
   ii. Operation of two biomass units without CCS (Unit 3 & Unit 4; 600 MW output per unit) from the Main Stack (259 m agl) assumed to be running at full load for 4,000 hours per year, representing a reasonable operating profile based on a 'mid-merit' operating regime[2];
c. **With Proposed Scheme and Other Projects** (Cumulative Impacts) ("With Proposed Scheme and Other Projects scenario"):
   i. Operation of Proposed Scheme as per above With Proposed Scheme scenario;
   ii. Emissions sources associated with relevant other projects, for which development has been approved or approval is being sought, have been sourced from the respective project planning documents and, where possible, emission sources have been included in the atmospheric dispersion model as part of this scenario;
   iii. The 'other projects' included in this scenario are provided below (see paragraph 6.5.27).

**Sensitivity Test: Worst Case Emissions Profile**

6.5.16. Further sensitivity modelling was undertaken for the same scenarios as above, but assuming that all four biomass units in the Baseline scenario and non-CCS Units 3 & 4 in the 'With Proposed Scheme' scenario would be operating at full load for all hours of the year (8,760 hours). This represents a worst case emissions profile for both the Baseline and the With Proposed Scheme scenario. Model results relating to these sensitivity scenarios are reported in **Appendix 6.4 (Operational Phase Air Quality Assessment Results Tables: Human Receptors) and Appendix 6.5 (Operational Phase Air Quality Assessment Results Tables: Ecological Receptors)**[3].

6.5.17. The core and sensitivity test model scenarios have been undertaken for assessment purposes so that emissions from the consented biomass plant with BECCS applied can be understood; and consent is not sought (as it has already been obtained) for specific load profiles of Units 1-4 at Drax Power Station. As such, it is important to note that the effects identified cannot be considered to be simply due to the impacts of the operation of the Proposed Scheme – the impacts presented are a combination of the changes to dispersion from the Main Stack caused by the installation of BECCS, the consequences of the use of an amine solvent as part of the BECCS

[3] Whilst total process impacts increase in both the Baseline and With Proposed Scheme scenarios under full load operating conditions, the impact of the Proposed Scheme, defined as the difference between the Proposed Scheme and Baseline scenario, is lower than presented for the core model scenarios (i.e. worst realistic operating case).

process, and an assumed change in load profile to Units 1 and 2; and are therefore the With Proposed Scheme scenario.

### Modelled Stack Parameters

6.5.18. The stack parameters for the Baseline and With Proposed Scheme scenarios are provided in **Table 6.6** below. The flue discharge conditions for the four biomass units represent baseload operation (i.e. full load) for any given hour of operation, both in the Baseline and With Proposed Scheme scenarios. Therefore, in a mid-merit operating profile (i.e. as per core model scenarios for Baseline & With Proposed Scheme), the respective units are assumed to operate at full load for 4,000 hours per annum. In continuous baseload operation (i.e. as per sensitivity test scenarios for Baseline & With Proposed Scheme), all four units are assumed to operate at full load for 8,760 hours (i.e. all hours of year).

6.5.19. Unless stated otherwise in the below tables, all pollutant emission concentrations are based on the respective emission limit values (ELVs) as per the IED and / or associated EU Best Available Techniques (BAT) associated emission levels (BAT-AELs) as per BAT conclusions for large combustion plants (European Commission, 2017).

**Table 6.6 - Emission Parameters for the Baseline and With Proposed Scheme Scenarios**

| Parameter | Baseline (per Unit) | With Scheme Scenario (per Unit *with* CCS)* | With Scheme Scenario (per Unit *without* CCS)** |
|---|---|---|---|
| No. Biomass Units | 4 | 2 | 2 |
| No. flues | 2 | 1 | 1 |
| Stack height (m agl) | 259 | 259 | 259 |
| Flue diameter (m) | 8 | 8 | 8 |
| Discharge Temp (°C) | 144.2 | 80.0 | 144.2 |
| Vol. flow ($Nm^3/s$) (1) | 573.0 | 444.5 | 573.0 |
| Vol. flow ($Am^3/s$) (2) | 992.5 | 686.4 | 992.5 |
| $NO_x$ exit concentration ($mg/Nm^3$) (3) | 160 | 160 | 160 |
| $NH_3$ exit concentration ($mg/Nm^3$) | 10 | 10 | 10 |

| Parameter | Baseline (per Unit) | With Scheme Scenario (per Unit *with* CCS)* | With Scheme Scenario (per Unit *without* CCS)** |
|---|---|---|---|
| Dust ($PM_{10}$/$PM_{2.5}$) exit concentration ($mg/Nm^3$) (3) | 10 | 10 | 10 |
| HCl exit concentration ($mg/Nm^3$) (3) | 5 | 5 | 5 |
| $SO_2$ exit concentration ($mg/Nm^3$) (3) | 100 | 100 | 100 |
| Amine 1 ($mg/Nm^3$) (3), (4) | - | 0.5 | - |
| Amine 2 ($mg/Nm^3$) (4) | - | 0.3 | - |
| Nitrosamine 1 ($mg/Nm^3$) (5) | - | 0.0001 | - |
| Nitrosamine 2 ($mg/Nm^3$) (5) | - | 0.0001 | - |

Notes:

* Applicable to Unit 1 & Unit 2 only (with CCS)

** Applicable to Units 3 & Unit 4 only (without CCS)

(1) – Calculated at 273.15 Kelvin (0°C), pressure of 101.3 kPa, dry, 6% $O_2$.

(2) – Actual discharge conditions, 4.9% $H_2O$, 7.4% $O_2$.

(3) – Representative of yearly average BAT-AELs. Corresponding daily average BAT-AELs provided in Appendix 6.3.

(4) – Representative of proposed yearly average ELVs. Corresponding proposed daily average ELVs for amines provided in Appendix 6.3. The proposed ELVs exceed the reasonable worst-case design emissions concentrations provided by the technology supplier (MHI).

(5) – These are not proposed ELVs, but represent nominal emission concentrations provided by MHI based on expected baseload operation, representing reasonable worst-case direct emissions. Contributions to ground level nitrosamine concentrations from direct emissions are shown to be insignificant (<0.2% of EAL for NDMA; see Appendix 6.4).

6.5.20. Given that there will be multiple flues within the Main Stack (i.e. one flue per two biomass units) in both the Baseline and With Proposed Scheme scenarios, emissions from these flues will in effect act as a single plume with combined source characteristics. The combined stack characteristics modelled within ADMS 5.2, in

addition to the modelled parameters for the ammonia air stripper, are presented in **Table 6.7** and associated details provided in **Appendix 6.3**.

**Table 6.7 - Combined Flue Emissions Parameters used in Dispersion Modelling**

| Parameter | Baseline Scenario | With Proposed Scheme Scenario |
|---|---|---|
| Emission Source | Biomass Units | Biomass Units |
| No. Units | 4 | 4 (1) |
| Stack height (m agl) | 259 | 259 |
| Stack location X, Y (m) | 466124, 427224 | 466124, 427224 |
| No. flues | 2 | 2 (1) |
| Effective Flue diameter (m) | 11.3 | 11.3 |
| Discharge Temp (°C) | 144.2 | 116.8 |
| Exit velocity (m/s) | 39.5 | 33.5 |
| Vol. flow ($Am^3/s$) | 3,970 | 3,370 |
| $NO_x$ emission rate (g/s) | 366.7 | 325.5 |
| $NH_3$ emission rate (g/s) | 22.9 | 20.3 |
| $PM_{10}/PM_{2.5}$ emission rate (g/s) | 22.9 | 20.3 |
| HCl emission rate (g/s) | 11.5 | 10.2 |
| $SO_2$ emission rate (g/s) | 229.2 | 203.4 |
| Amine 1 emission rate (g/s) | - | 0.3 |
| Amine 2 emission rate (g/s) | - | 0.2 |
| Nitrosamine 1 emission rate (g/s) | - | 0.0001 |
| Nitrosamine 2 emission rate (g/s) | - | 0.0001 |

(1) – Units 1 & 2 with CCS and Units 3 & 4 without CCS. One flue will serve the units with CCS and second flue will serve the units without CCS

### Amine Chemistry Modelling

6.5.21. For the assessment of amines and nitrosamines from the Proposed Scheme BECCS plant, the ADMS Amine Chemistry Module (CERC, 2016) has been utilised to model the chemical reactions associated with the formation of nitrosamines and nitramines in the atmosphere. Reaction rate coefficients specific to the amines associated with the proprietary amine solvent proposed for use in the BECCS process, as part of the Proposed Scheme, have been provided by the BECCS technology supplier (Mitsubishi Heavy Industries, MHI) for use in the atmospheric dispersion modelling.

6.5.22. Given that the specified reactivity data for the proprietary amine and nitrosamine compounds remain confidential, additional model sensitivity testing has been completed based on applying amine reaction rate coefficients equivalent to proxy amine and nitrosamine compounds, for which published data in the public domain are available.

6.5.23. Namely, 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')[4].

6.5.24. The use of MEA as a proxy compound enables direct comparison with the Environment Agency's EALs for MEA. The use of DMA ensures that any predicted atmospheric formation of nitrosamine, in addition to directly emitted nitrosamines, will be as NDMA, which also allows for direct comparison with the Agency's EAL for NDMA (see **Table 6.1**).

6.5.25. The MEA and NDMA reaction rate coefficients applied in the amine sensitivity testing have covered low, mid, and high range values based on literature research for these compounds. The equivalent reaction rate coefficients for the confidential amine compounds fall within the tested range of values applicable to MEA and DMA, thereby addressing uncertainty in key parameters used in modelling amine chemistry within ADMS. Furthermore, the dispersion modelling results for amines and nitrosamines reported in this Chapter have incorporated a number of conservative assumptions, as summarised in the **Assessment Assumption and Limitations** outlined in **paragraphs 6.5.55 - 6.5.60**.

6.5.26. See **Appendix 6.3** for further details on the atmospheric dispersion model input parameters, assumptions and limitations, post-processing of model outputs and associated sensitivity testing that has been completed.

[4] 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.

## Emissions Sources from Other Projects (Cumulative Impacts)

6.5.27. The following projects have been identified for inclusion in the operation phase cumulative impacts assessment, for which development has been approved or approval is being sought[5]:

a. **Eggborough Combined Cycle Gas Turbine (CCGT) Power Station**[6], proposed opening year of 2022 (*not operational at time of writing*);
b. **Keadby 2 CCGT Power Station**[7], proposed opening year of 2022 (*not operational at time of writing*);
c. **Keadby 3 CCGT with Carbon Capture Power Station**[8], proposed opening year of 2026;
d. **Energy from Waste (EfW) Plant, Kirk Sandall**[9], proposed opening year not known.

6.5.28. The equivalent point sources of emissions from each of the above projects were modelled using ADMS v5.2 as part of the cumulative impacts assessment. The associated stack emissions parameters are presented in **Table 6.8**, with data obtained from the respective air quality assessment reports / ES chapters published with each of the above development applications.

6.5.29. The emissions from each source were modelled for each hour of the year (8,760 hours), thus providing a worst-case assessment of long-term (annual mean) impacts. Given the extremely low likelihood of peak operating conditions coinciding across all different emissions sources at any given time, assessment of cumulative short-term air quality impacts (e.g. hourly, daily) has not been undertaken.

[5] Ferrybridge D CCGT (PINS reference: EN010094), at the time of writing, publicly available environmental information has not progressed beyond Scoping Opinion. Whilst emissions from this project have the potential to contribute to cumulative impacts within the study area, there is insufficient environmental information available to include it as part of this assessment. https://infrastructure.planninginspectorate.gov.uk/projects/yorkshire-and-the-humber/ferrybridge-d-combined-cycle-gas-turbine-ccgt-power-station-project/
[6] Development Consent Order (PINS reference: EN010081) granted 20 September 2018; https://infrastructure.planninginspectorate.gov.uk/projects/yorkshire-and-the-humber/eggborough-ccgt/?ipcsection=docs
[7] Consent granted 1 March 2019; https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/820117/Keadby_II_Decision_Letter_-_01_March_2019.pdf
[8] Development Consent Order application (PINS reference: *EN010114*), undergoing examination at the time of writing; https://infrastructure.planninginspectorate.gov.uk/projects/yorkshire-and-the-humber/keadby-3-carbon-capture-power-station/#
[9] Planning application reference: *20/01774/TIPA* (Land North West Of Sandall Stones Road Kirk Sandall Doncaster)

### Table 6.8 - Flue Emissions Parameters for Other Projects included in Cumulative Impacts Dispersion Modelling

| Parameter | Eggborough | | Keadby 2 | Keadby 3 | Kirk Sandall |
|---|---|---|---|---|---|
| | CCGT (per unit) | Peaking plant [1] (per unit) | HRSG [2] stack | CCP [3] Absorber Stack | EfW Plant Stack |
| No. Units | 3 | 10 | 1 | 1 | 1 |
| No. flues | 3 | 10 | 1 | 1 | 1 |
| Stack location X, Y (m) | 457600, 423934 | 457520, 423950 | 482670, 411606 | 481820, 412158 | 460707, 407179 |
| Stack height (m agl) | 90 | 45 | 75 | 105 | 95 |
| Flue diameter (m) | 8.1 | 1.2 | 8.0 | 6.8 | 2.6 |
| Effective stack diameter (m agl) | 17.2 [4] | 8.5 [4] | 8.0 | 6.8 | 2.6 |
| Discharge Temp (°C) | 75 | 355 | 74.1 | 60 | 135 |
| Vol. flow ($Am^3/s$) | 3600 [5] | 305 [5] | 1030 | 856.4 | 81.2 |
| Exit velocity (m/s) | 15.5 [5] | 5.4 [5] | 20.5 | 24.3 | 15.0 |
| $NO_x$ emission rate (g/s) | 172.5 [5] | 17.9 [5] | 39.5 | 32.4 | 8.1 |
| $NH_3$ emission rate (g/s) | - | - | 4.4 | 1.1 | 0.7 |
| $PM_{10}/PM_{2.5}$ emission rate (g/s) | - | - | - | - | 0.3 |

Sources:

Eggborough – Data taken from Table 8.10 based on worst-case modelled scenario described in paragraph 8.6.17 and Table 8.9 of Chapter 8 – Air Quality, ES Volume 1 (Eggborough Power Ltd, 2017)

Keadby 2 and Keadby 3 – Data for both sources taken from Table 2 and Table 3 of Appendix 8B: Air Quality – Operational Phase, Keadby 3 ES Volume 2 (Keadby Generation Ltd, May 2021)

| Parameter | Eggborough | | Keadby 2 | Keadby 3 | Kirk Sandall |
|---|---|---|---|---|---|
| | CCGT (per unit) | Peaking plant (1) (per unit) | HRSG (2) stack | CCP (3) Absorber Stack | EfW Plant Stack |
| EfW Kirk Sandall – Data taken from Table 20 and Table 21 of the Air Quality Assessment Report published with the planning application (BH EnergyGap (Doncaster) Limited, June 2020)<br>Notes:<br>(1) Reciprocating gas engines<br>(2) Heat Recovery Steam Generator<br>(3) Carbon Capture Plant<br>(4) Effective stack diameter combines all flues for the respective source<br>(5) Values based on all units for the respective source | | | | | |

6.5.30. The Keadby 3 air quality assessment included amines chemistry modelling (Keadby Generation Ltd, May 2021), which was based on sensitivity testing of a range of reaction parameters for proxy amine compounds, with results treated as MEA and NDMA for comparison with the relevant EALs. Given the complexity and uncertainty in the amine chemistry methodology, conservatism applied to both the Proposed Scheme modelling and Keadby 3 modelling (Keadby Generation Ltd, May 2021), and specifically the use of proxy compounds where the precise chemical make-up of the proprietary amine solvent is unknown or cannot be disclosed[10], it was not considered appropriate to undertake modelling of cumulative impacts associated with amine compounds.

6.5.31. Instead, for the purposes of providing a qualitative judgement on potential cumulative impacts, a conservative approach was taken whereby the maximum predicted amine (MEA) and nitrosamine (NDMA) concentrations from both the Proposed Scheme and Keadby 3 assessments were summed and compared to the respective EALs (refer to **Section 6.12**).

### Model Outputs

6.5.32. The processed model outputs comprise concentration data for each pollutant and the respective short term (e.g. hourly, daily) and long term (annual) averaging periods at

[10] For the Proposed Scheme core scenarios, modelling has been completed based on the proprietary amine solvent compounds and associated reaction rate coefficients (see **paragraphs 6.5.21 and 6.5.25**, and **Appendix 6.3**), with outputs treated as MEA and NDMA, respectively, for comparison with the respective EALs (see **paragraphs 6.5.56** and **6.5.57**). However, modelling reported for Keadby 3 used proxy compounds and worst-case assumptions in all reported model scenarios in lieu of the proprietary solvent (paragraph 2.1.6 of Appendix 8C (Keadby Generation Ltd, May 2021)). As such, a cumulative modelling assessment of amine emissions from both proposed developments is not appropriate, given it would not be representative of a realistic cumulative worst-case.

each modelled discrete and gridded receptor location (see **Section 6.8**). These outputs were provided for each of the modelled five years (2016-2020 inclusive), thereby allowing the maximum value at each receptor to be reported over this period. The relevant averaging periods specific to each assessed pollutant are provided in **Table 6.1**.

6.5.33. The model output concentrations for all pollutants, except $PM_{10}$ and $PM_{2.5}$, have been used in the assessment of nutrient nitrogen deposition and acid deposition at identified sensitive habitats (see **Section 6.8**), which has adhered to EA guidance (Environment Agency, 2014). For nitrogen-containing pollutants not included within this guidance (i.e. amines, nitrosamines, nitramines), a deposition velocity equivalent to that for ammonia has been used which, based on relevant research (Matthias Karl, 2009), is considered to be conservative (see **Appendix 6.3**).

6.5.34. Background pollution and nitrogen / acid deposition levels for each relevant compound, where available, have been obtained from national mapping data provided by Defra (Defra, 2022) and APIS (UK Centre for Ecology & Hydrology, 2021) for human and ecological receptors respectively. These are reported in **Section 6.7** below.

6.5.35. The quantified impacts associated with the Process Contribution (PC) (i.e. the pollutant concentration / deposition resulting from the Baseline scenario and the With Proposed Scheme scenario, respectively) and the Predicted Environmental Concentration (PEC) (i.e. the PC plus background concentration / deposition for each scenario) have been assessed in relation to the following standards:

a. Statutory ambient air quality standards for both human and ecological receptors (see **Section 6.2**);
b. Non-statutory environmental assessment levels (EALs) set by the EA (see **Section 6.2**);
c. Non-statutory critical levels and critical loads for ecological receptors, taken from the APIS website (UK Centre for Ecology & Hydrology, 2021) (see **Table 6.11**).

6.5.36. This assessment has accounted for the PC and PEC relating to the With Proposed Scheme scenario in isolation and cumulatively with other projects (as identified in **paragraph 6.5.27**).The PC impact of the With Proposed Scheme scenario represents the change in concentration / deposition between the Baseline scenario and the With Proposed Scheme scenario. For the assessment of cumulative impacts, the PC from the With Proposed Scheme scenario is added to relevant PCs from the qualifying developments identified in **paragraph 6.5.27**.

## ASSESSMENT OF SIGNIFICANCE

### Construction Phase Assessment

6.5.37. The IAQM assessment methodology (IAQM, 2016) recommends that significance criteria are only assigned to the identified risk of dust impacts occurring from a construction activity once appropriate mitigation measures are established. For almost all construction activities, the application of effective mitigation should prevent

any significant effects occurring to sensitive receptors and therefore the residual effect would normally be negligible.

### Operational Phase Assessment

6.5.38. The assessment of potential effects has taken into account the approach provided in the EPUK / IAQM guidance (EPUK & IAQM, 2017), which assists in describing the air quality effects of emissions , in line with best practice for assessing air quality effects relating to planning applications. In addition, EA guidance (Environment Agency, 2021) and IAQM guidance (IAQM, 2019) is referenced with respect to establishing the potential for significant effects on the assessed sensitive ecological receptors.

**Human Receptors**

6.5.39. For long term (annual mean) pollutant concentrations, the EPUK / IAQM guidance (EPUK & IAQM, 2017) recommends that the degree of an impact is described by expressing the magnitude of incremental change in pollution concentration as a proportion of the relevant air quality assessment level (AQAL). This change is then examined in the context of the new total concentration and its relationship with the assessment criterion. This is summarised in **Table 6.9**.

**Table 6.9 - Air Quality Impact Descriptors Relating to Individual Receptors (Human)**

| **Long term average concentration at receptors in assessment year** | **% Change in concentration relative to 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 | Substantial | Substantial |
| 110% or more of AQAL | Moderate | Substantial | Substantial | Substantial |

Notes:

AQAL = Air Quality Assessment Level, which for this assessment relates to the UK Air Quality Strategy objectives and non-statutory EALs for human health as presented in Table 6.1.

Where the %change in concentrations is <0.5%, the change is described as ‘Negligible’ regardless of the concentration.

When defining the concentration as a percentage of the AQAL, ‘without scheme’ (Baseline) concentration should be used where there is a decrease in pollutant concentration and the ‘with scheme’ (Proposed Scheme) concentration where there is an increase.

| Long term average concentration at receptors in assessment year | % Change in concentration relative to AQAL | | | |
|---|---|---|---|---|
| | 1 | 2-5 | 6-10 | >10 |
| Where concentrations increase, the impact is described as adverse, and where it decreases as beneficial. | | | | |

6.5.40. The EPUK / IAQM impact descriptors (**Table 6.9)** are used as the starting point to make a judgement on significance of effects, since other impacts / effects may be important. The EPUK / IAQM guidance (paragraph 7.7) states that the assessment of overall significance should be based on professional judgement, considering several factors, including:

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

6.5.41. The EPUK / IAQM guidance (Section 6) 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 Scheme ('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.

6.5.42. As a precautionary approach, both long-term and short-term average concentrations have been considered with respect to judging likely significant effects as part of this assessment.

6.5.43. For the purposes of assessing cumulative impacts associated in the With Proposed Scheme and Other Projects scenario (as per **paragraph 6.5.27**), all named 'Other Projects' are treated as committed developments. As such, the contributions of these committed developments have been added to the Baseline scenario when assessing impacts at human receptors within the operational phase study area. This approach aligns with EPUK / IAQM guidance.

### Ecological Receptors

6.5.44. Following EA guidance (Environment Agency, 2021), if the change in PC associated with the With Proposed Scheme scenario meets both of the following criteria, impacts are considered to be insignificant and further assessment is not required:

a. The short-term PC is less than 10% of the short-term environmental standard for the ecological receptor; and
b. The long-term PC is less than 1% of the long-term environmental standard for the ecological.

6.5.45. If the above criteria are not met, additional criteria are applied as follows:

a. If the short-term PC exceeds the above screening criteria, significant effects cannot be screened out and further assessment is needed; and
b. If the long-term PC is greater than 1% and the PEC is less than 70% of the long-term environmental standard, the emissions are insignificant, and no further assessment is required; or
c. If the PEC is greater than 70% of the long-term environmental standard, significant effects cannot be screened out and further assessment is needed.

6.5.46. Where it is determined that the impact of the With Proposed Scheme scenario 'alone' is sufficiently large that significant effects cannot be screened out, based on the above criteria, the results of the air quality assessment will be passed to the Proposed Scheme ecologist to use their expertise in determining whether or not there is, in fact, a likely significant effect. The output of this assessment has been reported in the **Chapter 8 (Ecology)** of this ES. This approach aligns with IAQM guidance (IAQM, 2019).

6.5.47. The above criteria are also applied to the assessment of cumulative impacts (i.e. those arising as a result of the With Proposed Scheme scenario with other relevant projects). Unlike the assessment of cumulative impacts at human receptors where all contributions from 'other projects' are treated as committed and part of the 'future baseline', the same projects in the ecological receptor modelling are treated as 'in-combination' for the purposes of assessing cumulative impacts. This means that contributions from the 'other projects' are added to the Proposed Scheme impacts only, with no contributions from these projects being included in the Baseline scenario.

## METHOD OF BASELINE DATA COLLECTION

### Desk Study

6.5.48. The following baseline data sources have been used in the preparation of this Chapter:

a. National pollutant concentration mapping for $NO_x$ and particulate matter, available from the Defra website (Defra, 2022);
b. National pollutant concentration data for ammonia and sulphur dioxide, and deposition mapping for nitrogen and acid, available from the Air Pollution Information System (APIS) (UK Centre for Ecology & Hydrology, 2021);

c. The most recent Local Air Quality Management reporting (2020 and 2021) from Local Authorities including Selby District Council, Doncaster Council, East Riding of Yorkshire Council, North Lincolnshire District Council and Wakefield District Council, including 2019 air quality monitoring from these authorities (pre-COVID travel restrictions), where applicable;

d. UK's national monitoring networks, managed by the EA on behalf of Defra and the Devolved Administrations, with data available from Defra's UK Air Information Resource website (Defra UK AIR, 2022); and

e. Peer reviewed literature focussed on atmospheric chemistry relating to amine reaction schemes, cited accordingly throughout this Chapter and within **Appendix 6.3.**

**Surveys**

6.5.49. No additional project-specific air quality surveys have been undertaken to inform the assessment given the availability of existing data sources (as detailed in **paragraph 6.5.48** above). This approach was outlined in the Applicant's consultation submission to SDC and the EA, dated 11 August 2021.

6.5.50. Whilst the EA did not query this approach in their consultation response, dated 2 November 2021 (as per **Table 6.2**), the EA recommended that the air quality assessment must provide robust evidence that background concentrations are likely to be representative at locations of exposure, which aligns with EA guidance (Environment Agency, 2021). This evidence is provided in **Section 6.7**.

6.5.51. SDC's Section 42 Statutory Consultation letter, dated 10 December 2021, did not query this approach, which is consistent with that reported in Chapter 6 (Air Quality) of the PEIR (WSP, 2021).

**Guidance and Data**

6.5.52. The following guidance documents and data sources have been used during the preparation of this Chapter:

a. Local Air Quality Management Review and Assessment Technical Guidance (Defra, 2018)

b. Guidance on the Assessment of Dust from Demolition and Construction (IAQM, 2016)

c. Land-use Planning & Development Control: Planning for Air Quality (EPUK & IAQM, 2017)

d. Guidance on the assessment of air quality impacts on designated nature conservation sites (IAQM, 2019)

e. Air Pollution Information Service website (UK Centre for Ecology & Hydrology, 2021)

f. Environment Agency: Risk assessments for specific activities, Environmental permits (Environment Agency, 2021)

g. Selby Air Quality: Planning Guidance Note (Selby District Council, 2014)

h. AQMAU recommendations for the assessment and regulation of impacts to air quality from amine-based post-combustion Carbon Capture Plants (Environment Agency, 2021)

i. CERC (2016) ADMS 5 Amine Chemistry User Guide Supplement (CERC, 2016)

j. AQTAG06 Technical guidance on detailed modelled approach for an appropriate assessment for emissions to air (Environment Agency, 2014)

**6.5.53.** A summary of the above documents is provided in **Appendix 6.1 (Air Quality Policy and Legislation)** (document reference 6.3.6.1)**.**

## ASSESSMENT ASSUMPTIONS AND LIMITATIONS

6.5.54. This section outlines the limitations, uncertainties, and assumptions that apply to the air quality assessment reported in this Chapter.

### Baseline Conditions

a. The baseline information that has been collated and used in the assessment (see **paragraph 6.5.48** and **Section 6.7**) has been based on the most up to date information currently available. Where Defra background mapped pollutant data were not available for the operational phase study area, specifically for $SO_2$, HCl, and $NH_3$, ambient monitored data were obtained from suitable monitoring sites, operated by Defra (Defra UK AIR, 2022), for use in the assessment of impacts at human receptors.

b. The assessment of impacts at the identified human and ecological receptors has assumed that there will be no improvement in baseline levels of pollutant concentrations and deposition rates by the proposed opening year (2027), which is a conservative approach as detailed in **Section 6.7**, '**Future Baseline**.'.

c. No additional, project-specific, air quality surveys have been undertaken to inform the assessment given the availability of existing data holdings as outlined above.

d. There are currently no data relating to ambient levels of amines and nitrosamines within the UK, a position acknowledged by the EA (Environment Agency, 2021), with the Scottish Environment Protection Agency's review of amine emissions from Carbon Capture stating that further work is required to develop a reliable method(s) for measurement (Scottish Environment Protection Agency, 2015). Although the absence of background data for these compounds represents a limitation to the assessment of operational phase impacts at human receptors, there are no known sources of amine and / or nitrosamine emissions currently operating within the operational phase study area.

e. As described in **Chapter 2 (Site and Project Description)**, the Applicant has full planning permission for the demolition of the redundant Flue Gas Desulphurisation (FGD) Plant and associated restoration works at Drax Power Station (2020/0994/FULM). The decommissioning and demolition works of Absorber Units 4, 5 and 6 are scheduled to take place prior to the start of the construction of the Proposed Scheme, which has therefore been considered as part of the baseline of the assessment, whilst the demolition of Absorber Units 1, 2 and 3 are assumed to take place following the completion of the Proposed Scheme. The demolition of Units 1, 2 and 3 are assessed in **Chapter 18 (Cumulative Effects)** (document reference 6.1.18).

### Construction Phase Assessment

a. Detailed construction information is not yet available and therefore the assessment reported herein draws upon the experience and assessments undertaken for other similar projects. The assessment assumes that any potential dust-generating activity could occur anywhere within the Order Limits.

b. A conservative approach to the assessment has been taken by assuming that Option 2 will be progressed (see paragraph **6.1.6**), whereby the Carbon Capture Plant associated with Unit 1 and Unit 2 as well as the Common Plant would be constructed at the same time.

c. The construction traffic data used to scope out the assessment of impacts from construction vehicle emissions on local air quality are based on peak construction year movements (see **Table 6.4**). The AADT values are based on an average of the peak daily construction vehicle movements in each month of the relevant year. Therefore, the values presented are conservative, given that the daily average vehicle movements in any month will be lower than the respective peak value.

### Operational Phase Assessment

6.5.55. The operational phase air quality assessment has, where possible, adopted a conservative approach by applying the following assumptions to the atmospheric dispersion modelling study:

a. In the core mode scenarios, the non-BECCS Biomass Units at Drax Power Station are assumed to operate at full load for up to 4,000 hours per annum (i.e., a 'mid-merit' operating regime)[2], representing a robust and realistic projection for future baseline operation. The BECCS units are assumed to operate continuously at baseload for all hours of the year. However, further sensitivity model scenarios have been completed, as reported in **Appendix 6.3,** whereby the non-BECCS units also operate continuously at baseload for all hours of the year. This provides an assessment of the 'worst case' emissions profile from the Proposed Scheme;

b. Emissions of pollutants from the Main Stack that are subject to ELVs / BAT-AELs were modelled at the associated emission limit with all operational 'dust' emissions assumed to be in the $PM_{2.5}$ size fraction for particulate matter and therefore included, in total, in both the assessment of $PM_{10}$ and $PM_{2.5}$. All reported modelled concentrations for short-term averaging periods (daily, hourly, sub-hourly) are based on the respective daily average BAT-AELs for each relevant pollutant (see **Appendix 6.3**).;

c. Mass emissions of amines ('Amine 1' and 'Amine 2') in the With Proposed Scheme scenario were modelled at proposed annual and daily average ELVs for all hours of the year (see **Table 6.6**). These proposed ELVs represent emission concentrations that are higher than the reasonable worst-case design emissions given for each amine compound from the technology supplier (MHI).

d. Mass emissions of nitrosamines ('Nitrosamine 1' and 'Nitrosamine 2') in the With Proposed Scheme scenario were modelled based on nominal emission concentrations at baseload operation, as provided by MHI, and represent reasonable worst-case direct emissions. As evidenced in **Appendix 6.4**, the Process Contribution to ground level concentrations of direct nitrosamine emissions is insignificant (<0.1% of the EAL for NDMA). Given the negligible

emissions under baseload operation and the associated insignificant impacts, there is no requirement to propose an annual average ELV for direct nitrosamine emissions.

e. A 70% conversion ratio of $NO_x$ to $NO_2$ in the atmosphere was assumed, based on EA guidance (Environment Agency, 2006);

f. Deposition of amines, nitrosamines, and nitramines from the atmosphere were modelled using a deposition velocity equivalent to that for ammonia (see **Appendix 6.3** for details), which based on relevant research (Karl, 2009), is considered to be conservative;

g. The significance screening of maximum impacts at each designated site was undertaken against minimum recommended critical levels / critical loads, unless otherwise informed by the Proposed Scheme ecologist (see **Table 6.11**);

h. Assessment of maximum impacts for both human and ecological receptors has been undertaken across five years of hourly meteorological data; and

i. In the assessment of cumulative emissions sources, emissions from each source were modelled for each hour of the year, thus providing a worst-case assessment of potential short (sub-hourly, hourly, daily) and long-term (annual) cumulative impacts.

**Amine Chemistry Modelling**

6.5.56. In addition to the above, all amine concentration outputs from the core dispersion model scenarios, which are based on the proprietary amine solvent proposed for use in the BECCS process, have been treated as MEA for comparison with the respective EALs. The modelled maximum hourly mean and daily mean amine (as MEA) concentrations have been derived based on the sum of 'Amine 1' and 'Amine 2' maximum ground level concentrations at each receptor and grid point. This approach is potentially conservative because the 'Amine 1' maximum concentration might occur at a different time (day or hour) to the corresponding 'Amine 2' concentration.

6.5.57. Furthermore, the sum of all nitrosamine and nitramine concentration outputs have been treated as NDMA for comparison with the relevant EAL. This is conservative given that NDMA is considered to be one of the most toxic nitrosamines that has been tested, with nitramines being considered notably less toxic based on preliminary toxicity studies (Gjernes, 2013).

6.5.58. Due to the confidentiality of the proprietary amine solvent, it is not possible to present the equivalent toxicity data relating to the assessed amine and nitrosamine compounds, thus representing a limitation to the assessment. However, further sensitivity testing of the amine chemistry modelling has been undertaken to address and reduce uncertainty, as detailed in **Appendix 6.3** and outlined in **paragraphs 6.5.21** to **6.5.25** and below.

6.5.59. There are a number of input variables that are required to model atmospheric amine chemistry using the ADMS model. The modelling undertaken has utilised specific reaction rate coefficients for the relevant amine compounds, as provided by MHI for the proprietary amine solvent, along with appropriate regional ambient concentration data for $NO_2$ and ozone over a five-year period, and published background hydroxyl

radical data for the UK. However, as acknowledged by the EA (Environment Agency, 2021), there is inherent uncertainty in the amines modelling process, meaning further sensitivity testing of the aforementioned variables was needed as part of the ES.

6.5.60. The sensitivity testing relating to amine chemistry (see **Appendix 6.3**) comprises extensive testing of a range of published reaction rate coefficients relevant to MEA, DMA and NDMA, acting as proxy compounds to 'Amine 1', 'Amine 2' and 'Nitrosamine 1 and 2', respectively. The equivalent reaction rate coefficients for the confidential amine compounds fall within, or are of the same order of magnitude as, the tested range of values applicable to MEA and DMA , therefore reducing the uncertainty in how the proprietary solvent compounds might behave in the atmosphere relative to MEA and DMA. The use of MEA and DMA (NDMA) as proxy compounds has allowed for a direct assessment against the EA's health based EALs for MEA and NDMA.[11]

## 6.6. STUDY AREA

**6.6.1.** For the assessment of impacts during construction and decommissioning, the study area ("the construction phase study area") is limited to the zone within 350 m of the Order Limits or within 50 m of routes used by construction vehicles up to 500 m from the Order Limits. This conforms to the IAQM guidance (IAQM, 2016) and is also conservative in that it assumes that construction works could occur anywhere within the Order Limits and captures all potential vehicle routes within 500 m of the Order Limits (not just the Site entrance). A plan of the construction phase study area is provided in **Figure 6.1.**

6.6.2. The operational phase study area for air quality extends 15 km in all directions from the Main Stack located at Drax Power Station, within the Order Limits (referred to in this Chapter as the 'operational phase study area'). The Main Stack currently releases emissions associated with the existing four biomass units and which will continue to release emissions associated with two biomass units without BECCS and two units with BECCS as part of the Proposed Scheme. The extent of the study area aligns with EA guidance (Environment Agency, 2021) for larger emitters (i.e. over 50 MW output) and is depicted in **Figure 6.2 (Operational Phase Assessment Study Area) (**document reference 6.2.6.2).

## 6.7. BASELINE CONDITIONS

### EXISTING BASELINE

6.7.1. The Proposed Scheme is located in an area where air quality is influenced by emissions from the Drax Power Station, emissions from traffic on the local road

[11] The results of the amine chemistry sensitivity testing, presented in **Appendix 6.4**, do not change the overarching conclusions of the assessment reported in **Sections 6.9, 6.11**, and **6.12**. Whilst varying the amine reaction rates does result in numerical changes to the maximum modelled concentrations, the overall conclusions of the assessment are not significantly affected i.e. no significant effects are likely. Therefore, the uncertainty associated with the amine chemistry modelling methodology does not represent a constraint to the assessment.

network including the M62 motorway, other major power plants including Ferrybridge waste to energy plant (located approximately 18 km to the west), and agricultural practices within the operational phase study area. Whilst air quality is influenced by these local sources, local pollutant concentrations will approach background levels throughout the operational phase study area.

6.7.2. According to the latest Air Quality Annual Status Report (ASR) from SDC (Selby District Council, 2021), based on annual mean 2020 monitoring results, the respective air quality objectives (see **Table 6.1**) were met throughout the District, including the annual mean $NO_2$ objective within the existing AQMA along New Street in Selby Town. However, compliance with the $NO_2$ objective within the AQMA in 2020 was likely to be a consequence of travel restrictions imposed due to the Covid-19 pandemic. As such, SDC has not proposed to amend the size of existing AQMA at this time. The Proposed Scheme lies approximately 6 km to the southeast of the AQMA. SDC does not monitor air quality in the vicinity of the Proposed Scheme.

6.7.3. SDC published an Air Quality Action Plan (AQAP) in 2018 (Selby District Council, 2018) to address air quality issues within its area of jurisdiction. The AQAP identifies the measures intended to result in the '…*greatest and most immediate improvements*…' in Selby's air quality. The main actions of the AQAP under which measures are set, place an emphasis on reducing emissions from road transport, such as alternatives to private vehicle use; freight and delivery management; promoting low emission transport; traffic management; and transport planning and infrastructure.

6.7.4. The operational phase study area also encompasses parts of neighbouring Council areas, namely Doncaster, Wakefield, East Riding of Yorkshire, and North Lincolnshire. A summary of the latest ASR from each of these Councils is provided below:

**a.** According to the 2021 ASR published by Doncaster Council (Doncaster Council, 2021), there are currently seven AQMAs designated due to exceedances of the annual mean $NO_2$ objective, all of which relate to traffic emissions. None of these AQMAs are located within the operational phase study area. However, monitoring within Thorne, located in the southeast of the study area, recorded an annual mean $NO_2$ concentration (38 $\mu g/m^3$) close to the objective (40 $\mu g/m^3$) in 2019 (before the introduction of COVID-19 restrictions). Again, elevated levels of $NO_2$ in this area are attributed to traffic emissions.

**b.** The 2020 ASR published by Wakefield Council (Wakefield Council, 2020) reports the presence of ten AQMAs designated due to exceedances of the annual mean $NO_2$ objective, all of which relate to local road traffic emissions. None of these AQMAs are located within the operational phase study area. Wakefield Council does not undertake any monitoring within the study area.

**c.** The 2021 ASR published by East Riding of Yorkshire Council (East Riding of Yorkshire Council, 2021) confirms that there are no AQMAs designated within East Riding, with air quality reported to be good. The Council does undertake monitoring of $NO_2$ at some locations within the operational phase study area, such as in Goole, Snaith, and Rawcliffe, but 2019 monitoring (pre-COVID-19

restrictions) shows that annual mean $NO_2$ concentrations remained below the respective air quality objective at all locations.

d. The 2020 ASR published by North Lincolnshire Council (North Lincolnshire Council, 2020) confirms that monitoring is ongoing within the Scunthorpe AQMA, which was designated due to exceedances of the 24-hour $PM_{10}$ objective, attributed to the integrated iron and steel works within Scunthorpe. This AQMA is not located within the study area and North Lincolnshire does not undertake any monitoring within the study area.

6.7.5. Background pollutant concentrations are available from the national maps provided on the Defra website (Defra, 2022), where background concentrations of those pollutants included within the Air Quality Strategy (see **Section 6.2)** have been mapped at a grid resolution of 1x1 km for the whole of the UK. Projected concentrations are available for all years between 2018 and 2030.

6.7.6. Given the low population density, absence of urban centres, and prevalence of agricultural land within the area surrounding the Order Limits, existing air quality within the context of Air Quality Strategy statutory objectives can be characterised based on background air pollution data published by Defra. As such, no site-specific air quality monitoring was undertaken.

6.7.7. The background mapped concentrations for $NO_x$, $NO_2$, and $PM_{10}$ and other pollutants are summarised in **Table 6.10** for a base year of 2021, which account for the contribution of existing industrial processes in the vicinity of the Proposed Scheme, including the Drax Power Station itself. The data, therefore, are conservative for use as background concentrations for the assessment of impacts on human health, given that the operational phase assessment will effectively result in 'double-counting' of background contributions from the Site.

6.7.8. The background concentrations for each pollutant are modelled to be demonstrably below the respective air quality standards in 2021.

**Table 6.10 - Defra Background Annual Mean Pollutant Concentrations Based on Operational Phase Study Area for 2021 Baseline Year**

| **Statistic** | **2021 annual mean background (µg/m$^3$)** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **$NO_x$** | **$NO_2$** | **$SO_2$(1)** | **$PM_{10}$** | **$PM_{2.5}$(2)** | **HCl(3)** | **$NH_3$(3)** |
| Minimum | 7.0 | 5.5 | - | 11.0 | 6.7 | - | - |
| Maximum | 18.2 | 13.5 | 20.5 | 17.6 | 10.6 | 2.4 | 1.6 |
| Average | 9.6 | 7.5 | 1.8 | 14.1 | 7.8 | 1.3 | 0.8 |
| Air Quality Standard / EAL | 30 | 40 | 350 | 40 | 25 | 750 | 180 |
| Notes: | | | | | | | |

| Statistic | 2021 annual mean background (µg/m$^3$) | | | | | | |
|---|---|---|---|---|---|---|---|
| | $NO_x$ | $NO_2$ | $SO_2$[(1)] | $PM_{10}$ | $PM_{2.5}$[(2)] | HCl[(3)] | $NH_3$[(3)] |

[(1)] In the absence of Defra background data for 2021, data based on 2018 hourly monitored data at Defra's AURN site at Hull Freetown has been used. Maximum value corresponds to maximum hourly observation. Compared to 1-hour mean Objective. Year 2018 chosen based on comparison of data from years 2017-2020 inclusive, with 2018 representing year with highest maximum hourly concentration.

[(2)] Emissions of $PM_{2.5}$ and $PM_{10}$ are included in assessment at the same emission rate, based on the ELV for 'dust'.

[(3)] Based on maximum monthly measured data in 2020 at Defra's UK eutrophying and acidifying network (UKEAP) monitoring site at Ladybower, Peak District (EAL for HCL based on hourly limit, EAL for $NH_3$ based on annual mean). Monitored values were shown to be comparable to equivalent data available for earlier years (2017-2019 inclusive), indicating no discernible impact of the Covid-19 pandemic on data from this monitoring station.

6.7.9. Background annual mean concentrations of $NO_x$, $SO_2$, and $NH_3$ at ecological receptors (see **Section 6.8**), in addition to annual mean acid and nitrogen (N) deposition rates, were taken from the APIS website (UK Centre for Ecology & Hydrology, 2021) and are based on a three year mean (2017-2019), which represents the latest available data at the time of writing. A summary of the background concentrations and deposition levels at the identified ecological receptors, along with the respective critical levels (concentration) and critical loads (deposition), is presented in **Table 6.11**.

6.7.10. Both $NO_X$ and $SO_2$ concentrations are within the relevant critical levels across all sites, noting that the maximum background levels for $NO_x$ within the Humber Estuary SAC / SPA are reported by APIS (UK Centre for Ecology & Hydrology, 2021) to exceed the 30 µg/m$^3$ benchmark. However, there are no areas of exceedance within the portion of the Humber Estuary located inside the operational phase study area. The maximum background annual mean $NO_x$ concentration applicable to the Humber Estuary SAC / SPA within the study area, as given by Defra background maps data (Defra, 2022), is 12.2 µg/m$^3$, which is well below the critical level.

6.7.11. Background $NH_3$ concentrations are more likely to exceed the critical level where lower plants (e.g. bryophytes and lichens, with a critical level of 1µg/m$^3$) are present, such as over Thorne Moore, Lower Derwent Valley and Skipwith Common designated sites, compared to where higher plants are present (i.e. plants having vascular tissues, with a critical level of 3 µg/m$^3$).

6.7.12. The relevant background nitrogen and acid deposition levels within the operational phase study area exceed the respective critical loads stated in **Table 6.11** for all identified designated sites with the exception of Eskamhorn Meadows SSSI (nitrogen and acid deposition) and Went Ings Meadows SSSI (acid deposition only).

**Table 6.11 - Background Annual Mean Pollutant Concentrations and Deposition Levels at Ecological Receptors included in Operational Phase Assessment**

| Ecological Receptor | $NO_x$ (µg/m$^3$) | $SO_2$ (µg/m$^3$) | $NH_3$ (µg/m$^3$) | N Deposition (kgN/ha/yr)[1] | | Acid Deposition (Keq/ha/yr)[2] | |
|---|---|---|---|---|---|---|---|
| | | | | Background | Critical Load | Background | Critical Load |
| Thorne Moor SAC | 13.2 | 1.3 | 2.6 | 21.3 | 5 | 1.73 | 0.462 |
| Thorne & Hatfield Moors SPA | 13.2 | 1.3 | 2.6 | 21.3 | 10 | Species within broad habitat not sensitive to acid deposition [3] | |
| Thorne, Crowle and Goole Moors SSSI | 13.2 | 1.3 | 2.6 | 21.3 | 5 | 1.73 | 0.462 |
| Lower Derwent Valley SAC | 8.2 – 9.9 | 1.1 – 1.7 | 4.6 | 30.2 | 20 | 2.40 | 0.643 |
| Lower Derwent Valley SPA | | | | | 20 | No expected negative impact on species due to impacts on the species' broad habitat [3] | |
| Lower Derwent Valley Ramsar | | | | | 20 | | |
| River Derwent SAC | 11.9 | 3.9 | 4.6 | 14.8 | n/a | No sensitive habitats [3] | |
| Skipwith Common SAC | 9.8 | 1.4 | 2.6 | 21.1 | 10 | 1.73 | 0.802 |
| Skipwith Common SSSI | | | | | 10 | | |
| Humber Estuary SAC | 12.2 | 7.5 | 3.6 | 28.9 | 20 | No expected negative impact on species due to impacts on the species' broad habitat (SPA) [3]<br>No sensitive habitats (SAC & SSSI) [3] | |
| Humber Estuary SPA | | | | | 20 | | |
| Humber Estuary SSSI | | | | | 20 | | |
| Breighton Meadows SSSI | 9.9 | 1.7 | 3.1 | 23.5 | 20 | 1.92 | 0.643 |
| Eskamhorn Meadows SSSI | 11.4 | 1.3 | 2.4 | 20.0 | 20 | 1.64 | 2.00 |
| Derwent Ings SSSI | 9.8 | 1.7 | 4.6 | 30.2 | 20 | 2.40 | 0.643 |
| Barn Hill Meadows SSSI | 12.9 | 1.8 | 2.3 | 20.4 | 20 | 1.69 | 0.633 |
| Burr Closes SSSI | 10.5 | 1.2 | 2.5 | 20.6 | 20 | 1.68 | 1.248 |
| Went Ings Meadows SSSI | 12.1 | 1.3 | 2.4 | 19.4 | 15 | 1.59 | 2.008 |
| Critical Level (µg/m$^3$) | 30 | 20 | 1-3 | | | | |

Notes:

| Ecological Receptor | $NO_x$ (µg/m$^3$) | $SO_2$ (µg/m$^3$) | $NH_3$ (µg/m$^3$) | N Deposition (kgN/ha/yr)[1] | | Acid Deposition (Keq/ha/yr)[2] | |
|---|---|---|---|---|---|---|---|
| | | | | Background | Critical Load | Background | Critical Load |

[1] – Nitrogen (N) deposition presented as average mass deposition (kgN) per hectare (ha) per year (yr). Critical load represents the lower limit of the respective critical load range for the most sensitive feature within the designated site regardless of if it exists within the operational study area, which represents a precautionary approach with reference to IAQM guidance (IAQM, 2019). However, where applicable, an appropriate critical load and / or critical level has been provided by the Proposed Scheme ecologist based on specialist knowledge of the relevant sensitive features located within the designated site inside the operational study area. This also aligns with IAQM guidance, which states that specialist knowledge can be applied to provide a critical load in place of the precautionary lower limit based on all sensitive features within the designated site.

[2] – Acidification caused by deposition of nitrogen (N) and sulphur (S) presented as kilo equivalents of H+ ions (keq) per hectare per year. Background and critical load values presented based on sum of N and S. Critical load represents the lower limit of the respective critical load range for the most sensitive feature within the designated site.

[3] – Applicable to all areas of respective designated sites within operational phase study area. See Appendix 5 (document reference 6.8.3.5) of the Habitats Regulations Assessment (HRA).

## FUTURE BASELINE

6.7.13. It is expected that, should the Proposed Scheme not proceed, the baseline local air quality conditions within the study area in relation to local air quality would likely remain unchanged or would slightly improve (i.e. ambient pollutant concentrations would reduce). Any improvement would be predominantly related to the expected reduction in vehicle emissions as older, more polluting vehicles are replaced by cleaner vehicles.

6.7.14. **Table 6.12** presents future modelled pollutant concentrations in 2027 and 2029, which represent the respective opening years for Biomass Unit 2 and Unit 1 with BECCS. These data demonstrate an expected improvement in pollutant concentrations compared to existing (2021) baseline concentrations as reported in **Table 6.10**.

6.7.15. The mapped reductions in pollutant concentrations have not been applied within the air quality assessment. Whilst this approach assumes no improvement in future baseline air quality, thereby providing a conservative assessment, it has limited material impact on the outcome of the assessment since both current and future pollutant concentrations are well within the air quality standards.

6.7.16. With respect to future baseline conditions at ecological receptors, IAQM (IAQM, 2019) guidance states that '…*the air quality specialist may choose to assume no change in future baseline concentrations or deposition rates, where there is no evidence to indicate that they may decrease in value*…'. The latest forecasts produced by the Joint Nature Conservation Council (JNCC), under the Nitrogen Futures project (JNCC, October 2020), include multiple scenarios for future emissions including a 'Business As Usual' scenario, in which only policies that have already been adopted or implemented are considered. This was the most conservative scenario assessed and the conclusion was that total nitrogen deposition over the UK is expected to decrease by 13.6% between 2017 and 2030, with emissions of $NO_x$ reducing by 34% over the same period, and emissions of $NH_3$ remaining near-unchanged (a 1% increase).

6.7.17. Although ambient levels of $NO_x$ and rates of nitrogen deposition are expected to reduce throughout the study area, a conservative approach has been adopted for the assessment whereby no change in baseline conditions has been assumed for all ecological receptors.

**Table 6.12 - Defra Background Annual Mean Pollutant Concentrations Based on Operational Phase Study Area for Future Baseline 2027 and 2029**

| Statistic | $NO_x$ (µg/m$^3$) | | $NO_2$ (µg/m$^3$) | | $PM_{10}$ (µg/m$^3$) | | $PM_{2.5}$ (µg/m$^3$) | |
|---|---|---|---|---|---|---|---|---|
| | 2027 | 2029 | 2027 | 2029 | 2027 | 2029 | 2027 | 2029 |
| Minimum | 6.0 | 5.9 | 4.8 | 4.7 | 10.6 | 10.6 | 6.4 | 6.4 |

| Statistic | $NO_x$ (µg/m$^3$) | | $NO_2$ (µg/m$^3$) | | $PM_{10}$ (µg/m$^3$) | | $PM_{2.5}$ (µg/m$^3$) | |
|---|---|---|---|---|---|---|---|---|
| | 2027 | 2029 | 2027 | 2029 | 2027 | 2029 | 2027 | 2029 |
| Maximum | 14.5 | 14.0 | 10.9 | 10.5 | 17.0 | 17.0 | 10.1 | 10.0 |
| Average | 8.1 | 7.9 | 6.4 | 6.2 | 13.6 | 13.6 | 7.4 | 7.4 |
| AQ Standard | 30 | | 40 | | 40 | | 25 | |

## 6.8. SENSITIVE RECEPTORS

6.8.1. Different study areas are defined for the construction and operational phases, as detailed in **Section 6.6**, within which the associated sensitive receptors have been identified.

6.8.2. The construction phase assessment has considered human receptors within the defined construction phase study area (see **Section 6.6**), which may be classified as 'high sensitivity' (e.g. residential dwellings), 'medium sensitivity' (e.g. parks and places of work), or 'low sensitivity' (e.g. playing fields, farmland, footpaths) with reference to Section 7.3 of the IAQM construction dust guidance (IAQM, 2016).

6.8.3. The IAQM guidance requires that the construction assessment considers ecological receptors within 50 m of the Order Limits or 50 m of the routes used by construction vehicles up to 500 m from the Drax Power Station Site entrance. Through consultation with the Proposed Scheme ecologist, it was identified that there is functionally-linked land (i.e., land outside a designated European Site, but used by European Site qualifying interests) within 50 m of the Order Limits (north of the Drax Power Station Wood Yard), which is associated with a number of ecological receptors[12].

6.8.4. Although the operational phase study area, encompassing 15 km in all directions from the Main Stack (see **Section 6.6** and **Figure 6.2**), is largely under agricultural use, sensitive human receptors are ubiquitous and the assessment of operational impacts assumes that the potential for exposure to impacts, at human receptors of high sensitivity, exists throughout the area and impacts on health will be assessed with reference to the maximum concentrations anywhere within the 30 km x 30 km study area.

6.8.5. As such and given the scale of the operational phase study area, it is not necessary to list all potential human receptors for air quality impacts. However, for illustrative purposes, properties representing sensitive human receptors have been included in

[12] Specifically, this land could be used by bird species and / or otter that are qualifying features of Derwent Valley SAC, Lower Derwent Valley SAC, Lower Derwent Valley SPA, Lower Derwent Valley Ramsar, Humber Estuary SPA, and Humber Estuary Ramsar.

proximity to the Order Limits and further afield within the operational study area, including areas where the UK's Air Quality Strategy statutory objectives are being exceeded (e.g. Selby AQMA) or are close to exceeding (e.g. Thorne, Doncaster) and villages downwind of the Main Stack on the prevailing wind direction (south-westerly).

6.8.6. Human receptors in proximity to the Site will be largely unaffected by operational impacts. This is because, given the height of the Main Stack (259 m above ground level, agl), the emitted pollutants will not mix down to ground level in the immediate vicinity of the Proposed Scheme and impacts will be negligible. Rather, maximum ground level impacts will occur at distances over 7 km from the Proposed Scheme.

6.8.7. The locations of the illustrative discrete receptors included in the assessment of operational phase impacts are summarised in **Table 6.13** and depicted in **Figure 6.3 (Modelled Discrete Human Receptors)** (document reference 6.2.6.3). All receptors were modelled at 1.5 m agl to be representative of breathing height.

**Table 6.13 - Discrete Sensitive Human Receptor Locations Included in Operational Phase Air Quality Assessment**

| Receptor ID | X, Y Grid Reference (m) | Location |
|---|---|---|
| 1 | 466848, 428488 | Foreman's Cottage |
| 2 | 466681, 426392 | East Yorkshire Caravan Salvage |
| 3 | 466440, 426327 | Drax Sport's and Social Club |
| 4 | 467290, 427162 | Wren Hall |
| 5 | 467759, 428000 | 3 Pear Tree Ave |
| 6 | 465346, 426160 | Crange Cottages |
| 7 | 467077, 428276 | Drax Abbey Farm |
| 8 | 467609, 426745 | Read School |
| 9 | 467524, 428124 | Old Lodge |
| 10 | 461665, 432401 | Selby AQMA |
| 11 | 474370, 423841 | Goole |
| 12 | 467492, 430550 | Hemingbrough |
| 13 | 468367, 422845 | Rawcliffe |
| 14 | 464405, 422188 | Snaith |

| Receptor ID | X, Y Grid Reference (m) | Location |
|---|---|---|
| 15 | 459008, 423234 | Hensall |
| 16 | 466349, 432349 | Cliffe |
| 17 | 470967, 433904 | Breighton |
| 18 | 471016, 431474 | Wressle |
| 19 | 479718, 429869 | Eastrington |
| 20 | 470943, 439787 | Ellerton |
| 21 | 475464, 437453 | Foggathorpe |
| 22 | 463554, 433977 | Barlby |
| 23 | 461998, 437720 | Riccall |
| 24 | 457696, 431036 | Thorpe Willoughby |
| 25 | 453369, 425275 | Kellingley |
| 26 | 469485, 415893 | Moorends |
| 27 | 468707, 413584 | Thorne |
| 28 | 477214, 422091 | Swine Fleet |
| 29 | 459057, 418081 | Balne |
| 30 | 456165, 421046 | Whitley |
| 31 | 464575, 428678 | Barlow |
| 32 | 468099, 428435 | Long Drax |
| 33 | 467637, 426345 | Drax |
| 34 | 469387, 424716 | Newland |
| 35 | 464866, 424206 | Carlton |
| 36 | 464976, 426107 | Camblesforth |
| 37 | 459362, 428539 | Burn |

| Receptor ID | X, Y Grid Reference (m) | Location |
|---|---|---|
| 38 | 460601, 424975 | Temple Hirst |
| 39 | 457380, 437726 | Cawood |
| 40 | 454617, 434848 | Biggin |
| 41 | 475309, 428488 | Howden |
| 42 | 474791, 431049 | Brind |
| 43 | 468012, 433355 | South Duffield |
| 44 | 472425, 436425 | Highfield |
| 45 | 474472, 434890 | Willitoft |

6.8.8. With reference to EA guidance (Environment Agency, 2021), the following ecological receptors were identified within the operational phase study area:

a. Special Protection Areas (SPAs), Special Areas of Conservation (SACs), Ramsar Sites (protected wetlands) and Sites of Special Scientific Interest (SSSIs) within a 15 km radius of the Main Stack.
b. Local Nature sites within 2 km of the Main Stack (National and Local Nature Reserves, Ancient Woodland).

6.8.9. The sensitive ecological receptors identified in **Table 6.14** meet these EA criteria within the operational study area and were modelled at 0.5 m agl at a resolution of between 100 m to 200 m to capture the maximum modelled impacts for the purposes of the ES.

6.8.10. In assessing potential air quality impacts at each of the identified sensitive ecological receptors (see **Sections 6.9 – 6.12**), the whole of the part of each designated site that is within the operational phase study area has been considered, thereby assuming that the relevant sensitive feature(s) could be present anywhere within the area of the Site that falls within the study area.

6.8.11. All key sensitive ecological receptor locations are shown on **Figure 2.1 (Environmental Constraints)**.

### Table 6.14 - Sensitive Ecological Receptor Locations Included in Operational Phase Air Quality Assessment

| Site Name | Designation | Distance and Orientation from Main Stack (km) |
|---|---|---|
| River Derwent | SAC and SSSI | 2.2 km northeast |
| Lower Derwent Valley | SAC, SPA, Ramsar, NNR (1) | 6.4 km northeast |
| Humber Estuary | SAC, SPA, SSSI | 7.2 km east |
| Skipwith Common | SAC and SSSI | 9.4 km north |
| Thorne Moor | SAC | 10.1 km southeast |
| Thorne and Hatfield Moors | SPA | 10.1 km southeast |
| Thorne, Crowle and Goole Moors | SSSI | 10.1 km southeast |
| Eskamhorn Meadows | SSSI | 3.3 km south-southeast |
| Breighton Meadows | SSSI | 6.4 km northeast |
| Barn Hill Meadows | SSSI | 6.8 km east |
| Derwent Ings | SSSI | 8.6 km north-northeast |
| Went Ings Meadows | SSSI | 8.8 km south |
| Burr Closes | SSSI | 9.3 km northwest |
| Disused Railway Embankment | SINC (2) | 0.6 km east |
| Brockholes | SINC | 0.7 km southeast |
| Meadow East of Orchard Farm | SINC | 1.2 km west |
| Cobble Croft Wood | SINC | 1.4 km west |
| Common Plantation | SINC | 1.4 km west |
| Hagg Green Lane | SINC | 1.7 km north |

| Site Name | Designation | Distance and Orientation from Main Stack (km) |
|---|---|---|
| Sand Pitt Wood and Barffs Close Plantation | SINC | 1.9 km west |
| Barmby-on-the-Marsh | LWS (3) | 1.3 km east |
| Barmby Pond | LWS | 1.9 km northwest |

Notes:

(1) Results reported for Lower Derwent Valley SAC in this Chapter are equally applicable to the Lower Derwent Valley National Nature Reserve (NNR)

(2) Site of Importance for Nature Conservation (SINC)

(3) Local Wildlife Site (LWS)

## 6.9. PRELIMINARY ASSESSMENT OF LIKELY IMPACTS AND EFFECTS

6.9.1. This section details the preliminary assessment of significant effects taking account of primary mitigation, as described in **Chapter 2 (Site and Project Description)** but in the absence of secondary mitigation. Secondary mitigation for the Proposed Scheme is described in **Section 6.10** below.

### CONSTRUCTION AND DECOMMISSIONING PHASES

6.9.2. The likely significant effects for air quality associated with the construction and decommissioning phases are set out below.

#### Dust Impacts

6.9.3. A summary of the qualitative dust assessment findings is provided below. **Appendix 6.2** provides details of the assessment approach and associated findings, which was completed with reference to the relevant IAQM guidance (IAQM, 2016).

6.9.4. There are human and ecological receptors located within the defined construction phase study area (see **Section 6.6**). As such, the risk of dust impacts from the construction and decommissioning phases cannot be screened out.

6.9.5. Overall, the potential dust emission magnitude from each of the following four different dust and $PM_{10}$ sources is classed as ‘large’, based on the following:

a. Demolition:
   i. No demolition works are proposed as part of the Proposed Scheme construction, but some structures are likely to undergo demolition during the decommissioning phase. For the purposes of this assessment, a conservative approach has been adopted that assumes some demolition

activities will occur over 20 m above ground level and that the total volume of buildings demolished would be in excess of 50,000 $m^3$, including the disturbance of dusty materials (e.g., concrete).

b. Earthworks:
   i. The total area within the Order Limits encompasses more than 10,000 $m^2$ and the soil type is potentially dusty (clay); it is assumed that there will be more than 10 earth-moving vehicles active during peak earthwork activities; and, it is assumed that more than 100,000 tonnes of material will be moved in total.

c. Construction:
   i. It is assumed that the total volume of all buildings to be constructed will exceed 100,000 $m^3$.

d. Trackout:
   i. There will be in excess of 50 heavy duty vehicle (HDV) movements per day during peaks, and it is assumed there will be more than 100 m of unpaved roads used within the Site.

6.9.6. The sensitivity of the area to dust soiling, human health, and ecological effects was established based on identifying the number of properties and receptors located within discrete distance bands from the Order Limits. The distance bands are set at 20 m, 50 m, 100 m, and 350 m from the Order Limits, as depicted in **Figure 6.1 (Construction Phase Assessment Study Area),** which also details the Proposed Scheme construction laydown areas.

6.9.7. Wind roses from the meteorological data used for the dispersion modelling of operational phase impacts are provided in **Appendix 6.3 (Atmospheric Dispersion Modelling)**. They show that the prevailing wind direction is from the southwest. Therefore, receptors located to the northeast of the Order Limits are more likely to be affected by dust and particulate matter emitted and re-suspended during the construction phase. Under low wind speed conditions, it is likely that the majority of dust would be deposited in the area immediately surrounding the source.

6.9.8. There is functionally-linked land[12] within 50 m of the Order Limits (specifically to the north of the Drax Power Station Wood Yard). As such, the receptor sensitivity of this area is classified as ‘high’ as per the IAQM criteria for ecological receptors.

6.9.9. With respect to dust soiling and human health, the Proposed Habitat Provision Areas are located inside the Order Limits within 20 m of Drax Abbey Farm and within 50 m of Foreman’s Cottage, although the potential for dust generation from activities within these areas is anticipated to be negligible. However, by conservatively assuming that any construction activity, aside from demolition[13], could occur anywhere within the Order Limits (see **Figure 6.1**), additional sensitive receptors within 100 m of the Order Limits would include Drax Sports and Social Club and the East Yorkshire

[13] Any demolition activities would be focussed within the centre of the Site and during decommissioning only.

Caravan Salvage, with the Old Lodge and residential receptors adjacent to Adamson Court and Hales Lane within 350 m.

6.9.10. Given the low background annual mean $PM_{10}$ concentrations within the construction phase study area (see **Table 6.10**), the IAQM guideline criteria (see **Appendix 6.2**) have been used to determine that the sensitivity of the above properties is 'medium' for dust soiling effects and 'low' for human health ($PM_{10}$) effects for all relevant construction activities.

6.9.11. By combining the dust emissions magnitude ('large') with the sensitivity of the area, the risk of construction dust effects without mitigation applied is assessed to be *low risk* for human health effects, *medium risk* for dust soiling, and *medium risk* for ecological effects. Given that the dust emission magnitude is assessed as 'large', there is some potential for temporary, moderate adverse effects. These effects are most likely to occur when earthworks and construction activities are being undertaken in the eastern, northern, and southern areas of the Site, due to the proximity of residential properties and functionally-linked land to designated ecological receptors.

6.9.12. The assessed risk rating has been used to determine the appropriate prevention and mitigation measures, with reference to IAQM guidance (IAQM, 2016), that should be applied via the implementation of a CEMP. A **Register of Environmental Actions and Commitments (REAC)** has been produced for the Proposed Scheme (document reference 6.5). The **REAC** contains the mitigation to be secured by requirements in the DCO, and would include a requirement for a CEMP to be produced for the Proposed Scheme. These measures are summarised in **Section 6.10**, with a comprehensive list provided in **Appendix 6.2**.

### OPERATIONAL PHASE

6.9.13. The likely significant effects for air quality for the operational phase are set out below and focus on the results of core model scenarios (Baseline and With Proposed Scheme), as detailed in **paragraph 6.5.15 (Section 6.5)**.

6.9.14. The air quality impacts of the installation of CCS on a combustion unit are as follows:

**a.** Emissions of small quantities of amines and nitrosamines;

**b.** A potential decrease in emissions of all other pollutants ($NO_X$, $SO_2$, $NH_3$, HCl) due to a reduction in the volume of exhaust gas (without a change in emission limit);

**c.** A reduction in the temperature of the exhaust gases due to heat extracted during the CCS process and subsequent reduction in plume buoyancy.

6.9.15. The combined impact of these changes results in a net low level of increase in ground level concentrations of the emitted pollutants and a net low level of increase in the deposition of nitrogen and acid to ecological receptors. These impacts are illustrated by the sensitivity test undertaken based on the worst case emissions profile (as per **paragraph 6.5.16**), with the results set out in **Appendix 6.4** (human receptors) and **Appendix 6.5** (ecological receptors) which, in essence, directly

compares the current, permitted operations against the proposed future permitted operations with CCS installed on the basis of the same operational load profile.

6.9.16. However, in the With Proposed Scheme scenario, it is likely that the CCS-enabled units would be brought into operation more frequently than non-CCS units; with such a load profile being within what is already consented at Drax Power Station. To fully reflect this possibility, the core modelled scenarios (as per **paragraph 6.5.15**) completed for this assessment have additionally considered the impact of that increased load profile.

6.9.17. The effect of the increased load for the CCS-enabled units increases the potential adverse impacts to receptors over and above those which result purely from the changed emissions characteristics. Therefore, to ensure a conservative assessment, the focus of the results presented in this Chapter is the mid-merit scenario in which the likely future load profiles of the various combustion units on Site are appropriately represented as:

a. **Baseline**: 4 x non-CCS units operating at baseload for 4,000 hours per year;
b. **With Proposed Scheme**: 2 x CCS units operating at baseload for 8,760 hours (all year) 2 x non-CCS units operating at baseload for4,000 hours per year.

6.9.18. The core model scenario results, presented in this Chapter and in **Appendices 6.4 and 6.5**, therefore represent the worst likely impacts, and reflect the combined effects of load profile change and Proposed Scheme-driven emissions changes. The impacts of the installation of CCS alone, without a load change, are covered by the results of the worst case emissions profile sensitivity test (**Appendices 6.4 and 6.5**) and show lower impacts.

6.9.19. The results of the cumulative impact assessment are analysed in **Section 6.12**.

### Potential Effects on Human Receptors

6.9.20. Detailed atmospheric dispersion modelling has been undertaken to model the air quality impacts associated with the With Proposed Scheme scenario at a number of discrete sensitive receptors and across a defined receptor grid (as outlined in **Section 6.6**).

6.9.21. The modelled grid maximum concentrations for each pollutant and relevant averaging period, based on modelling across five years of meteorological data (2016-2020), are presented in **Table 6.15**.

6.9.22. The results of the assessment at each discrete receptor and for each pollutant are presented in **Tables 1.2 to 1.9** in **Appendix 6.4**. Pollutant contour plots, depicting the spatial distribution of modelled With Proposed Scheme maximum impacts across the operational phase study area, are presented for $NO_2$, amine (as MEA), and

nitrosamine (as NDMA) concentrations[14] in **Figures 6.4 to 6.8** (document reference 6.2.6.4 – 6.2.6.8) inclusive for the respective averaging periods.

**Table 6.15 - Modelled Maximum Pollutant Concentrations within Study Area presented as Percentage of Relevant AQALs**

| Pollutant | Averaging Period | Maximum Concentration (µg/m$^3$) | | | Impact as % of AQAL |
|---|---|---|---|---|---|
| | | Baseline(1) | With Scheme(2) | Max Impact(3) | |
| $NO_2$ | Annual | 0.06 | 0.13 | 0.09 | 0.22% |
| | Hourly | 4.05 | 4.31 | 2.44 | 1.22% |
| $PM_{10}$ | Annual | 0.01 | 0.01 | 0.01 | 0.02% |
| | Daily (5) | 0.08 | 0.08 | 0.05 | 0.10% |
| $PM_{2.5}$ | Annual | 0.01 | 0.01 | 0.01 | 0.04% |
| $SO_2$ (5) | 15-minute | 26.83 | 26.27 | 13.70 (4) | 5.15% |
| | Hourly | 10.97 | 11.61 | 6.99 | 2.00% |
| | Daily | 3.20 | 3.70 | 1.63 | 1.31% |
| HCl | Hourly (5) | 0.69 | 0.74 | 0.41 | 0.05% |
| $NH_3$ | Annual | 0.01 | 0.01 | 0.01 | <0.01% |
| | Hourly (5) | 0.58 | 0.62 | 0.35 | 0.01% |
| MEA | Hourly (5) | 0.00 | 0.24 | 0.24 | 0.06% |
| | Daily (5) | 0.00 | 0.06 | 0.06 | 0.06% |
| NDMA | Annual | 0.00 | 0.02 | 0.02 | 8.65% |

(1) Baseline scenario (mid-merit operating regime)

(2) With Proposed Scheme scenario (2 x BECCS Units at continuous baseload operation; 2 x non-BECCS Units at mid-merit operating regime)

[14] Based on modelling using reaction rate coefficients specific to the amines and nitrosamines associated with the proprietary amine solvent proposed for use in the BECCS process, as part of the Proposed Scheme, provided by the BECCS technology supplier (MHI).

| Pollutant | Averaging Period | Maximum Concentration (µg/m$^3$) | | | Impact as % of AQAL |
|---|---|---|---|---|---|
| | | Baseline[(1)] | With Scheme[(2)] | Max Impact[(3)] | |

[(3)] The maximum impact is the maximum difference between Baseline and With Proposed Scheme concentrations, and may not coincide with the specific geographic point at which the maximum value occurs in each modelled scenario.

[(4)] The maximum PC in the 'With Scheme' scenario has decreased relative to 'Baseline'. However, because of the change in location of point of maximum impact between the two scenarios, some locations experience an increase in concentrations and this is the maximum increase at any point within the study area.

[(5)] Results scaled (increased) according to corresponding daily average BAT-AEL / proposed permit daily average ELVs for amines.

6.9.23. The modelled impacts for all assessed pollutants are below 1% of the relevant AQALs, with the exception of the hourly mean $NO_2$, hourly mean $SO_2$, and annual mean nitrosamine (as NDMA), where the maximum modelled impacts equate to 1.2% ($NO_2$), 2.4% ($SO_2$) and 8.7% (NDMA) of the respective AQALs. For hourly mean $NO_2$ and $SO_2$, the maximum impact corresponds to a 'negligible' magnitude of change and for NDMA, the maximum impact corresponds to a 'slight adverse' magnitude of change within the context of the significance criteria presented in **Table 6.9**. For all other assessed pollutants and averaging periods, the maximum modelled impacts are classified as 'negligible'[15].

6.9.24. As such, emissions in the With Proposed Scheme scenario will not result in significant air quality effects at human receptors.

**Sensitivity Test: Worst Case Emissions Profile**

6.9.25. The sensitivity testing completed and detailed in **Appendix 6.3** (technical approach) and **Appendix 6.4** (results in **Tables 1.13 to 1.20**), which considers the worst-case emissions profile for both the Baseline and With Proposed Scheme scenarios (as per **paragraph 6.5.16**), does not affect the outcome of the results reported above, such that emissions in the With Proposed Scheme scenario would still not result in significant air quality effects at human receptors.

6.9.26. For instance, the maximum annual mean $NO_2$ Process Contribution in the Baseline scenario (0.14 µg/m$^3$) notably increases under a worst-case operating profile relative to the core modelling Baseline scenario (0.06 µg/m$^3$), with only a marginal increase in the With Scheme scenario (0.15 µg/m$^3$) compared to the core modelling (0.13 µg/m$^3$). This is a function of all four biomass units in the Baseline scenario switching from 'mid-merit' operation (full load for 4,000 hours per year) to continuous operation

[15] This is also applicable to the maximum $PM_{2.5}$ impact within the context of the proposed national annual mean target currently under consultation (10 µg/m$^3$). The maximum modelled impact corresponds to 0.1% of the proposed annual mean target.

(full load for 8,760 hours per year), resulting in more pollutants being emitted and thus more pronounced changes in annual mean concentrations relative to the With Proposed Scheme scenario, where operation changes from 'mid-merit' to continuous full load at the two non-BECCS biomass units only (BECCS units already assumed to operate at continuous full load in core modelling scenario).

6.9.27. As a consequence, the maximum annual mean $NO_2$ impact in the Proposed Scheme (0.03 µg/m$^3$) scenario decreases slightly under the worst-case emissions profile scenario relative to the core modelling (0.09 µg/m$^3$). This is evident for all modelled pollutants in the sensitivity test results, whereby the majority of modelled Baseline concentrations increase, whilst the With Proposed Scheme scenario concentrations remain largely unchanged or reduce slightly. Therefore, the maximum impacts are reported to decrease at the majority of receptors relative to the core modelling equivalents.

**Sensitivity Test: Amine Chemistry Modelling**

6.9.28. The sensitivity testing completed in relation to amine chemistry modelling for the With Proposed Scheme scenario is detailed in **Appendix 6.3** (technical approach) and **Appendix 6.4** (results in **Tables 1.21 and 1.22**).

6.9.29. The maximum hourly (0.10 µg/m$^3$) and daily mean (0.02 µg/m$^3$) MEA concentrations from the sensitivity tests were modelled to be equivalent to the concentrations reported for the proprietary amine solvent (0.10 µg/m$^3$ and 0.02 µg/m$^3$ respectively), when modelling an identical mass emission rate for amines in all tests.

6.9.30. The maximum annual mean NDMA concentrations reported from the sensitivity tests (0.03 ng/m$^3$) was modelled to be 67% higher than the equivalent concentration reported for the proprietary amine solvent (0.02 ng/m$^3$). However, the maximum concentration from the sensitivity tests still remains well below the annual mean EAL for NDMA, equating to 14% of the EAL.

6.9.31. Therefore, the results of the sensitivity testing do not affect the outcome of the core assessment results, such that emissions in the With Proposed Scheme scenario would still not result in significant air quality effects at human receptors in terms of amine (MEA) and nitrosamine (NDMA) concentrations.

## Potential Effects on Ecological Receptors

6.9.32. The contributions in the With Proposed Scheme scenario to air pollution are presented as maximum ground level concentrations and deposition levels at the identified designated sites. The PC of the With Proposed Scheme scenario represents the change in concentration / deposition between the Baseline scenario and With Proposed Scheme scenario.

6.9.33. The below sub-sections focus on the results associated with internationally and nationally designated habitat sites, where relevant. Detailed tables of results relating to each ecological receptor in the Baseline and With Proposed Scheme scenarios, including locally designated habitat sites, are presented in **Appendix 6.5**.

**Oxides of Nitrogen ($NO_x$), Ammonia ($NH_3$), and Sulphur Dioxide ($SO_2$)**

6.9.34. The modelled maximum PC and PEC concentrations relating to the relevant averaging periods for $NO_x$, $NH_3$, and $SO_2$ at each designated site, based on five years of meteorological data (2016-2020), are presented in **Tables 1.1 to 1.4** of **Appendix 6.5**. Concentrations are presented for both the Baseline and With Proposed Scheme scenarios.

6.9.35. The spatial distributions of the modelled With Proposed Scheme scenario maximum concentration impacts for $NO_x$, $NH_3$, and $SO_2$ across the operational phase study area are depicted in **Figures 6.9 to 6.11** (document reference 6.2.6.9 – 6.2.6.11), respectively.

6.9.36. Using the significance screening criteria presented in **paragraph 6.5.44** for ecological receptors, the impacts of operation in the With Proposed Scheme scenario alone on annual mean $NO_x$, annual mean $NH_3$, and annual mean $SO_2$ concentrations are classified as insignificant (≤1% of the critical level) at all designated sites. Similarly, the modelled maximum daily mean $NO_x$ concentration impacts are well below 10% of the critical level, meaning the modelled impacts are classified as insignificant.

6.9.37. Therefore, emissions of $NO_x$, $NH_3$, and $SO_2$ in the With Proposed Scheme scenario alone will not result in significant air quality effects at the assessed ecological receptors.

**Nitrogen Deposition**

6.1.1. The modelled maximum PC and PEC annual nitrogen deposition rates at each designated site, based on five years of meteorological data (2016-2020), are presented in **Table 1.5** of **Appendix 6.5**. The spatial distribution of modelled With Proposed Scheme scenario maximum impacts for annual nitrogen deposition rates across the operational phase study area is depicted in **Figure 6.12** (document reference 6.2.6.12).

6.9.38. Using the significance screening criteria presented in **paragraph 6.5.44** for ecological receptors, the impacts of operation in the With Proposed Scheme scenario alone on annual nitrogen deposition rates are classified as insignificant (≤1% of the critical level) at all designated sites.

6.9.39. Therefore, contributions to nitrogen deposition associated with emissions in the With Proposed Scheme scenario alone will not result in significant air quality effects at the assessed ecological receptors.

**Acid Deposition**

6.9.40. The modelled maximum PC and PEC annual acid deposition rates at each designated site, based on five years of meteorological data (2016-2020), are presented in **Table 6.16**. The spatial distribution of modelled With Proposed Scheme scenario maximum impacts for annual acid deposition rates across the operational phase study area is depicted in **Figure 6.13**.

6.9.41. The modelled PC from the With Proposed Scheme scenario operation is above 1% of the respective critical load at sensitive habitats within the Lower Derwent Valley SAC (2.0%), Thorne Moor SAC and Thorne, Crowle, and Goole Moors SSSI (1.3%), as well as at sensitive habitats within SSSI designations at Breighton Meadows (2.0%), Derwent Ings (1.6%), and Barn Hill Meadows (1.6%). Given that background levels of acid deposition at the relevant sensitive habitats within these designated sites already exceed their respective critical loads, the associated Proposed Scheme PECs exceed the screening criterion (i.e. PEC >70% of critical level).

6.9.42. Therefore, significant effects relating to acid deposition at the aforementioned designated sites cannot be screened out when considering the impacts of emissions from the With Proposed Scheme scenario alone. For acid deposition, contributions attributed to the With Proposed Scheme scenario are a small proportion of the existing background levels of deposition at the affected designated sites. That is to say that the risk of exceedance of critical loads or the level of exceedance of the critical load, is wholly dependent on the existing deposition levels and would not be affected by the Proposed Scheme.

6.9.43. Notwithstanding, mitigation relating to the control of emissions from the Main Stack has been considered to address the potential for adverse effects (see **Section 6.10**).

6.9.44. The PC annual acid deposition rates at all other international, national, and local designated sites included in the assessment are below the 1% criterion and, therefore, emissions from the With Proposed Scheme scenario alone will not result in significant air quality effects at those sites.

**Table 6.16 - Modelled Maximum Operational Phase Impacts at Ecological Receptors for Annual Acid Deposition**

| Receptor | Critical Load (keq/ha/yr) | Max *Ba*seline PEC[(1)] (keq/ha/yr) | Max *With Scheme* PEC[(1)] (keq/ha/yr) | Max PC (Impact) (keq/ha/yr) | Max PC as % of CL | Max *With Scheme* PEC as % of CL |
|---|---|---|---|---|---|---|
| Thorne Moor SAC | 0.462 | 1.74 | 1.74 | 0.01 | 1.3% | 376.9% |
| Thorne Moor SSSI[(2)] | 0.462 | 1.74 | 1.74 | 0.01 | 1.3% | 376.9% |
| Lower Derwent Valley SAC | 0.643 | 2.41 | 2.42 | 0.01 | 2.0% | 376.8% |
| Skipwith Common SAC | 0.802 | 1.73 | 1.73 | 0.00 | 0.5% | 216.0% |
| Skipwith Common SSSI | 0.802 | 1.73 | 1.73 | 0.00 | 0.5% | 216.0% |
| Breighton Meadows SSSI | 0.643 | 1.93 | 1.94 | 0.01 | 2.0% | 302.2% |
| Eskamhorn Meadows SSSI | 1.998 | 1.64 | 1.64 | 0.00 | 0.2% | 82.2% |
| Derwent Ings SSSI | 0.643 | 2.41 | 2.42 | 0.01 | 1.6% | 376.4% |
| Went Ings SSSI | 2.008 | 1.59 | 1.60 | 0.00 | 0.2% | 79.6% |
| Barn Hill Meadows SSSI | 0.633 | 1.69 | 1.70 | 0.01 | 1.6% | 269.3% |
| Burr Closes SSSI | 1.248 | 1.68 | 1.69 | 0.00 | 0.4% | 135.2% |

Notes: All deposition rates rounded to two decimal places (2 d.p.). Maximum values based on results modelled using five years of meteorological data (2016-2020). Results presented only for the sites that are assigned an acid deposition critical load.

(1) Including maximum background acid deposition (N+S) as reported by APIS (see Table 6.11).

(2) Thorne, Crowle, and Goole Moors SSSI

**Sensitivity Test: Worst Case Emissions Profile**

6.9.45. The sensitivity testing completed and detailed in **Appendix 6.3** (technical approach) and **Appendix 6.5** (results in **Tables 1.19 to 1.24**), which considers the worst-case emissions profile for both the Baseline and With Proposed Scheme scenarios (as per **paragraph 6.5.16**), does not affect the outcome of the results reported above.

6.9.46. For all pollutant concentrations and deposition rates, it is evident that the modelled maximum PC impacts attributed to the With Proposed Scheme scenario are lower at all receptors relative to the core model scenarios. This is a function of all four biomass units in the Baseline scenario switching from mid-merit operation (full load for 4,000 hours per year) to continuous operation (full load for 8,760 hours per year), resulting in more pollutants being emitted and thus more pronounced changes (increases) in concentrations / deposition rates relative to the With Proposed Scheme scenario. In the With Proposed Scheme scenario, operation changes from mid-merit to continuous full load at the two non-CCS biomass units only (CCS units already assumed to operate at continuous full load in core modelling scenario), meaning the changes (increases and decreases) in concentrations / deposition rates are relatively small compared to the Baseline.

6.9.47. As a consequence, the maximum modelled impacts of the Proposed Scheme decrease at all receptors under the worst-case emissions profile scenario relative to the core modelling. Whilst some modelled maximum PEC concentrations do increase under worst case emissions in both the Baseline and With Proposed Scheme scenarios, there are no material changes relative to the core modelling equivalents, meaning that the respective assessment significance criteria are not exceeded.

## 6.10. DESIGN, MITIGATION AND ENHANCEMENT MEASURES

6.10.1. This section sets out the design, mitigation and enhancement measures which are likely to be required to avoid, prevent, reduce or, if possible, offset any identified significant adverse effects on the environment.

### MITIGATION

#### Construction Phase

6.10.2. As outlined in IAQM guidance (IAQM, 2016), the application of effective mitigation should prevent any significant effects occurring and therefore the residual effect will normally be insignificant.

6.10.3. The qualitative dust risk assessment reported in **Section 6.9** and **Appendix 6.2** has been used to inform the appropriate mitigation measures required to prevent significant effects and are included in the **REAC** (document reference 6.5) for the Proposed Scheme. The **REAC** contains mitigation measures which would be secured by requirements in the DCO and would include a requirement for a Construction Environmental Management (CEMP) to be produced for the Proposed Scheme. A comprehensive list of the respective mitigation measures, commensurate

to the identified *low* to *medium risk* of impacts, is provided in **Appendix 6.2** and summarised as follows:

**Site Management**

a. All dust and air quality complaints would be recorded, and causes identified. Appropriate remedial action would be taken in a timely manner.

**Monitoring**

a. When there is a risk of dust from construction activities, daily on-site and off-site inspections will be undertaken to monitor compliance with the relevant CEMP. Inspections would be recorded, and the inspection log made available to the local authority, as required.
b. The frequency of Site inspections would be increased when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.

**Preparing and Maintaining the Site**

a. The Site layout would be planned so that machinery and dust causing activities are located away from receptors, as far as is practicable.
b. Where practicable, solid screens or barriers would be erected around dusty activities and material stockpiles on site. Specifically, hoarding at a height of 2.4 m agl around areas within the Drax Power Station Site and East Construction Laydown Area would be specified for the Proposed Scheme.
c. Where practicable, stockpiles would be covered, seeded, or fenced to prevent wind whipping.

**Operating Vehicle / Machinery and Sustainable Travel**

a. All vehicle operators would switch off engines when stationary - no idling vehicles.
b. The use of diesel- or petrol-powered generators would be avoided and mains electricity or battery powered equipment used where practicable.

**Operations**

a. An adequate water supply on the Site for effective dust / particulate matter suppression / mitigation would be made available, using non-potable water where possible and appropriate.
b. Drop heights from loading or handling equipment would be minimised and fine water sprays used on such equipment as appropriate.

**Measures Specific to Earthworks**

a. Earthworks and exposed areas / soil stockpiles would be revegetated to stabilise surfaces as soon as practicable.
b. Where practicable, windbreak netting / screening would be positioned around material stockpiles and vehicle loading / unloading areas, as well as exposed excavation and material handling operations, to provide a physical barrier between the Site and the surroundings. Specifically, hoarding at a height of 2.4 m agl around areas within the Drax Power Station Site and East Construction Laydown Area would be specified for the Proposed Scheme.

c. Where practicable, stockpiles of soils and materials would be located as far as possible from sensitive properties, taking account of the prevailing wind direction.
d. During dry or windy weather, material stockpiles and exposed surfaces would be dampened down using a water spray to minimise the potential for wind pick-up.

**Measures Specific to Construction**

a. All construction plant and equipment would be maintained in good working order and not left running when not in use.

**Measures Specific to Trackout.**

a. Water-assisted dust sweeper(s) would be used on the access and local roads, to remove, as necessary, any material tracked out of the Site.
b. Vehicles entering and leaving sites would be covered to prevent escape of materials during transport.
c. A wheel washing system would be implemented (with rumble grids to dislodge accumulated dust and mud prior to leaving the Site where reasonably practicable).

6.10.4. An Outline Construction Traffic Management Plan (CTMP) (Appendix 5.1 of Volume 3 (document reference 6.2.5.1)) and Framework Construction Worker Travel Plan (CWTP) (Appendix 5.2 of Volume 3 (document reference 6.2.5.2)) have been prepared to manage the impacts associated with construction worker traffic HDV movements, and Abnormal Indivisible Loads (AIL).

6.10.5. The **CTMP** includes details of the HDV access routes and construction traffic management measures to ensure that heavy construction traffic does not pass along sensitive roads within the study area. The **CTMP** also identifies that large-scale vehicle movements associated with the delivery and removal of materials should be timed to avoid peak hours on the local road network, where practicable.

6.10.6. The **CWTP** includes details of the travel plan measures to be implemented to minimise the number of vehicle movements associated with construction workers, with the focus on encouraging car sharing and the use of contractor mini-buses. The proposed strategy to minimising construction worker vehicle trips reflects the location of the Site and is considered achievable and realistic.

## Operational Phase

6.10.7. The assessment of impacts in the With Proposed Scheme scenario alone identified that significant effects at habitats sensitive to acid deposition could not be screened out at Lower Derwent Valley SAC, Thorne Moor SAC, Thorne, Crowle, and Goole Moors SSSI, and further SSSI designations at Breighton Meadows, Derwent Ings, and Barn Hill Meadows.

6.10.8. To reduce these potential impacts relating to acid deposition, a review of the post combustion CCS releases was undertaken. This resulted in the following changes to the Main Stack emissions parameters being applied to the With Proposed Scheme scenario:

a. Reduce $SO_2$ emissions by 40%, applied to the CCS Biomass Units

b. Increase exit temperature of flue gases from the CCS Units from 80ºC to 103ºC.

6.10.9. The purpose of these measures is to increase buoyancy in the flue gases leaving the Main Stack, thereby improving dispersion of all pollutants, and to reduce the concentration of $SO_2$ being emitted, thus mitigating the With Proposed Scheme scenario contribution to acid deposition at the identified sensitive habitats.

6.10.10. The above changes to the emissions parameters were applied to the atmospheric dispersion modelling for the With Proposed Scheme scenario and the relevant revised flue emissions parameters are presented in **Table 6.17** (all other parameters remain unchanged from those presented in **Table 6.7**). These parameters would be secured through the environmental permitting process.

**Table 6.17 - Revised Combined Flue Emissions Parameters applied to Dispersion Modelling of With Proposed Scheme Scenario (Including Mitigation)**

| Parameter | With Proposed Scheme Scenario | |
|---|---|---|
| | Design (1) | Mitigation |
| Discharge Temp (°C) | 116.8 | 125.3 (2) |
| Exit velocity (m/s) | 33.5 | 34.3 |
| Vol. flow ($Am^3/s$) | 3,370 | 3,445 |
| $SO_2$ emission rate (g/s) | 203.4 | 167.9 (3) |

(1) As per Table 6.7

(2) Combined (CCS and Non-CCS Units) exit temperature resulting from increased exit temperature (103ºC) applied to two CCS Units only

(3) 40% reduction applied to BAT-AEL $SO_2$ exit concentration (CCS Units only)

6.10.11. The revised dispersion modelling, taking account of the above mitigation, has focussed on the impacts to acid deposition at the identified sensitive ecological receptors within the operational phase study area. Whilst the changes to the emissions parameters would impact the modelled results for all pollutants at human and ecological receptors – with any impacts likely to be beneficial (but not significant) as a consequence of increasing the Main Stack exit temperature[16] – there would be no material change to the outcomes of the assessment presented in **Section 6.9**.

6.10.12. As such, the results of the revised modelling have only been presented and analysed with respect to acid deposition, as presented in **Table 6.18**. The spatial distribution

[16] The impacts of the proposed mitigation on pollutant concentrations / nitrogen deposition at all relevant ecological receptors are tabulated within **Appendix 6.3. T**he spatial distribution of modelled maximum impacts for annual mean $SO_2$ concentrations across the operational phase study area are presented in **Figure 6.14**.

of modelled With Proposed Scheme scenario maximum impacts for annual acid deposition rates, with mitigation applied, is depicted in **Figure 6.15**.

6.10.13. The modelled results demonstrate that the proposed mitigation reduces the maximum impacts on acid deposition at all relevant designated sites when compared to the pre-mitigation equivalent results. With respect to the significance screening criteria presented in **paragraph 6.5.44**, the maximum impacts of the With Proposed Scheme scenario alone at Thorne Moor SAC, Thorne, Crowle, and Goole Moors SSSI, and Derwent Ings SSSI have been reduced to below the 1% criterion.

6.10.14. The mitigation has also had the effect of reducing the modelled level of exceedance at Lower Derwent Valley SAC and the SSSIs at Breighton Meadows and Barn Hill Meadows, such that the impact of the With Proposed Scheme scenario alone is now 1.1% of the respective critical load at each of these sites, representing marginal exceedances of the 1% criterion.

**Table 6.18 - Modelled Maximum Operational Phase Impacts at Ecological Receptors for Annual Acid Deposition (Without versus With Mitigation Applied)**

| Receptor | Critical Load (keq/ha/yr) | Max PC (Impact) – No Mitigation (keq/ha/yr) | Max PC (Impact) – With Mitigation (keq/ha/yr) | Max PC as % of CL – No Mitigation | Max PC as % of CL – With Mitigation |
|---|---|---|---|---|---|
| Thorne Moor SAC | 0.462 | 0.01 | 0.01 | 1.3% | 0.7% |
| Thorne Moor SSSI[(1)] | 0.462 | 0.01 | 0.01 | 1.3% | 0.7% |
| Lower Derwent Valley SAC | 0.643 | 0.01 | 0.01 | 2.0% | 1.1% |
| Skipwith Common SAC | 0.802 | 0.00 | 0.01 | 0.5% | 0.3% |
| Skipwith Common SSSI | 0.802 | 0.00 | 0.01 | 0.5% | 0.3% |
| Breighton Meadows SSSI | 0.643 | 0.01 | 0.01 | 2.0% | 1.1% |
| Eskamhorn Meadows SSSI | 1.998 | 0.00 | 0.00 | 0.2% | 0.1% |
| Derwent Ings SSSI | 0.643 | 0.01 | 0.01 | 1.6% | 0.9% |
| Went Ings SSSI | 2.008 | 0.00 | 0.00 | 0.2% | 0.1% |
| Barn Hill Meadows SSSI | 0.633 | 0.01 | 0.01 | 1.6% | 1.1% |
| Burr Closes SSSI | 1.248 | 0.00 | 0.00 | 0.4% | 0.2% |

Notes: All deposition rates rounded to two decimal places (2 d.p.). Maximum values based on results modelled using five years of meteorological data (2016-2020). Results presented only for the sites that are assigned an acid deposition critical load.

[(1)] Thorne, Crowle, and Goole Moors SSSI

### OPPORTUNITIES FOR ENVIRONMENTAL ENHANCEMENT

6.10.15. There are no opportunities for environmental enhancement associated with the air quality assessment completed for the Proposed Scheme.

## 6.11. ASSESSMENT OF LIKELY SIGNIFICANT EFFECTS

6.11.1. This section details the assessment of significant effects taking account of the secondary and tertiary mitigation detailed in **Section 6.10** above.

### CONSTRUCTION AND DECOMMISSIONING PHASES

6.11.2. With the application of the mitigation measures outlined in **Section 6.10**, detailed in **Appendix 6.2**, and included in the **REAC** for the Proposed Scheme, construction phase activities will have **no significant effect** on local air quality.

### OPERATIONAL PHASE

#### Likely Effects on Human Receptors

6.11.3. As reported in **Section 6.9**, the modelled impacts attributed to emissions from the With Proposed Scheme scenario were classified as, at worst, 'slight adverse' with reference to the assessment significance criteria (**Table 6.9**). The outcomes of this assessment will not be materially affected by the implementation of the proposed mitigation, as reported in **Section 6.10**.

6.11.4. With respect to the decision-making considerations included in NPS EN-1 (BEIS, 2011) (see **paragraphs 6.2.27 and 6.2.28**), the Proposed Scheme would not lead to a deterioration in air quality within the study area where air quality already breaches relevant national air quality limits (i.e., the Selby AQMA). In addition, no substantial changes in air quality levels are expected within the operational phase study area and the Proposed Scheme would not result in any non-compliances with relevant statutory limits or exceedances EALs set for the protection of human health.

6.11.5. Therefore, the operational phase of the With Proposed Scheme scenario alone will have **no significant effect** on local air quality with respect to human health.

#### Likely Effects on Ecological Receptors

6.11.6. With the exception of acid deposition, modelling of emissions associated with the operation of the With Proposed Scheme scenario alone has demonstrated that the relevant assessment significance criteria (see **paragraph 6.5.44**) for all other pollutant and deposition species will not be exceeded at all designated sites. This conclusion applies to the modelled results both without and with the proposed mitigation reported in **Section 6.10**.

6.11.7. Therefore, the operational phase of the With Proposed Scheme scenario alone will have **no significant effect** on air quality at all international, national, and local designated sites with respect to $NO_x$, $NH_3$, and $SO_2$ concentrations, and nitrogen deposition rates.

6.11.8. With the application of the proposed mitigation reported in **Section 6.10**, the 1% significance screening criterion in relation to impacts on acid deposition is marginally exceeded at Lower Derwent Valley SAC, Breighton Meadows SSSI and Barn Hill Meadows SSSI. As such, potential significant effects on sensitive habitats within these sites cannot be screened out. The results of the air quality modelling at these sites were passed to the Proposed Scheme ecologist to determine whether or not there is a likely significant effect. The outcomes of this analysis are reported in **Chapter 8** (**Ecology**).

6.11.9. With respect to the decision making considerations included in NPS EN-1 (BEIS, 2011) (see **paragraphs 6.2.27 and 6.2.28**), the With Proposed Scheme scenario alone has the potential to lead to a deterioration in air quality within the aforementioned designated sites in terms of acid deposition impacts, where the respective critical loads for acid deposition are already exceeded without the modelled Proposed Scheme contributions (see **Chapter 8 (Ecology)** for assessment of likely significant effects). For all other assessed pollutants and relevant designated sites, no substantial changes in air quality levels are expected within the operational phase study area and the Proposed Scheme alone will not result in any new exceedances of relevant critical levels or critical loads.

## 6.12. CUMULATIVE EFFECTS

6.12.1. The potential for significant cumulative effects has been assessed in relation to the construction phase (relevant other projects identified below) and operational phase of the Proposed Scheme (relevant other projects identified in **paragraph 6.5.27**).

### CONSTRUCTION PHASE

6.12.2. There are a number of other projects located within 1 km of the Proposed Scheme for which there could be a temporal overlap in construction activities, identified as:

**a.** Scotland to England Green Link 2 Project (planning reference: 2021/0450/SCP);
**b.** Development of a Horticultural Facility for indoor farming and agri-tech, Camblesforth (planning reference: 2021/0120/FULM);
**c.** Barlow Ash Mound, Drax (planning reference: NY/2022/0027/SCO);
**d.** Development of an energy storage facility, Drax (planning reference: 2020/1357/FULM);
**e.** Development of a battery storage facility, Drax (planning reference: 2021/1089/FULM); and
**f.** National Grid Humber Low Carbon Pipeline.

6.12.3. Although there is potential for the cumulative generation of dust emissions associated with temporal overlap of any of the above projects with the Proposed Scheme construction, each project would require appropriate environmental management measures to be implemented in the form of a CEMP (or similar) to ensure that there are no significant effects on local air quality.

6.12.4. Therefore, provided that each project applies appropriate mitigation measures via a CEMP (or similar), there will be **no significant cumulative effects**.

## OPERATIONAL PHASE

### Potential Effects on Human Receptors

6.12.5. Detailed atmospheric dispersion modelling has been undertaken to model the cumulative air quality impacts associated with the operational phase of the With Proposed Scheme and Other Projects scenario as outlined in **Section 6.5**.

6.12.6. The modelled grid maximum annual mean concentrations for each pollutant ($NO_2$, $NH_3$, and $PM_{10}$/$PM_{2.5}$), based on modelling across five years of meteorological data (2016-2020), are presented in **Table 6.19**.

6.12.7. Results relating to all relevant pollutants and modelled discrete receptors are presented in **Tables 1.10 to 1.12** of **Appendix 6.4**. The spatial distribution of modelled With Proposed Scheme maximum cumulative impacts across the operational phase study area for annual mean $NO_2$ is presented in **Figure 6.16**.

**Table 6.19 - Modelled Maximum Cumulative Pollutant Concentrations within Study Area presented as Percentage of Relevant AQALs**

| Pollutant | Averaging Period | Maximum Concentration (µg/m$^3$) | | | Impact as % of AQAL |
|---|---|---|---|---|---|
| | | Baseline[(1)] | Cumulative | Max Impact [(2)] | |
| $NO_2$ | Annual | 9.96 | 10.01 | 0.05 | 0.32% |
| $PM_{10}$ | Annual | 0.006 | 0.012 | 0.006 | 0.03% |
| $PM_{2.5}$ | Annual | 0.006 | 0.012 | 0.006 | 0.06% |
| $NH_3$ | Annual | 0.026 | 0.030 | 0.004 | 0.01% |

(1) Baseline for Drax Power Station represented by 'mid-merit' operating regime.

(2) The maximum impact is the maximum difference between Baseline & Other Projects and Cumulative (Baseline & Other Projects & Proposed Scheme) concentrations, and may not coincide with the specific geographic point at which the maximum value occurs in each modelled scenario.

6.12.8. The modelled maximum cumulative impacts for all assessed pollutants are below 1% of the relevant AQALs, equating to negligible air quality impacts at all receptors within the operational phase study area. As such, cumulative emissions from the With Proposed Scheme scenario and other projects would have **no significant effect** on local air quality with respect to human health. The outcomes of this assessment would not be materially affected by the implementation of the proposed mitigation, as reported in **Section 6.10,** With Proposed Scheme scenario

**Amines & Nitrosamines**

6.12.9. As detailed in **paragraphs 6.5.30 and 6.5.31**, a quantitative modelling assessment of cumulative impacts for amine and nitrosamine concentrations was not considered appropriate. However, to provide a qualitative and conservative judgement on potential cumulative impacts, the maximum modelled PC concentrations from both the Proposed Scheme and Keadby 3 (Keadby Generation Ltd, May 2021) project were summed, as follows:

**Amine (as MEA) cumulative maximum 1-hour mean PC (µg/m$^3$)**
*= 0.24 (Proposed Scheme) + 25.2 (Keadby 3)* = **25.44 µg/m$^3$**

**Amine (as MEA) cumulative maximum 24-hour mean PC (µg/m$^3$)**
*= 0.06 (Proposed Scheme) + 0.22 (Keadby 3)* = **0.28 µg/m$^3$**

**Nitrosamine (as NDMA) cumulative maximum annual mean PC (ng/m$^3$)**
*= 0.017 (Proposed Scheme) + 0.064 (Keadby 3)* = **0.081 ng/m$^3$**

6.12.10. The EALs for MEA and NDMA are not exceeded, with the maximum cumulative values representing 6.4% of the 1-hour mean EAL for MEA (400 µg/m$^3$), 0.3% of the 24-hour mean EAL for MEA (100 µg/m$^3$), and 40.5% of the annual mean EAL for NDMA (0.2 ng/m$^3$), respectively.

6.12.11. Within the context of the significance criteria presented in **Table 6.9**, these maximum cumulative impacts equate to 'slight adverse' for the MEA 1-hour averaging period, 'negligible' for the MEA 24-hour averaging period, and 'moderate adverse' for annual mean NDMA.

6.12.12. However, given the conservatism applicable to the above values, including the worst-case assumption that maximum concentrations from both schemes would occur at the same location and time anywhere within the operational phase study area, and that values from both schemes represent the sum of nitramine and nitrosamine concentrations (see **paragraph 6.5.54**), the cumulative impact on amines and nitrosamines is considered to be **not significant**.

## Potential Effects on Ecological Receptors

6.12.13. The cumulative contributions in the With Proposed Scheme scenario alongside other projects to air pollution are presented as maximum ground level concentrations and deposition levels at the identified designated sites, both before and after the proposed mitigation is applied as per **Section 6.10**. The cumulative PC of the With Proposed Scheme scenario and other projects represents the change in concentration / deposition between the Baseline scenario and With Proposed Scheme and Other Projects scenario.

6.12.14. The below sub-sections focus on the results associated with internationally and nationally designated habitat sites, specifically where the assessment significance criteria are exceeded. Detailed tables of results relating to each ecological receptor

in the Baseline and With Proposed Scheme and Other Projects scenarios, including locally designated habitat sites, are presented in **Appendix 6.5**.

**Oxides of Nitrogen ($NO_x$) and Sulphur Dioxide ($SO_2$)**

6.12.15. The modelled maximum cumulative PC and PEC concentrations relating to annual mean $NO_x$ and $SO_2$ at each designated site, based on five years of meteorological data (2016-2020), are presented in **Tables 1.13 and 1.16** of **Appendix 6.5.** The spatial distributions of the modelled With Proposed Scheme scenario maximum cumulative concentration impacts for $NO_x$ and $SO_2$ are depicted in **Figures 6.17 and 6.19** (document reference 6.2.6.17 – 6.2.6.19), respectively

6.12.16. Using the significance screening criteria presented in **paragraph 6.5.44**, the cumulative operational impacts on annual mean $SO_2$ are classified as insignificant (≤1% of the critical level) at all designated sites. Similarly, whilst the maximum cumulative $NO_x$ PC impacts are predicted to be above 1% of the annual mean critical level at all receptors, the maximum PECs at all designated sites are below 70% of the critical level. As such, the modelled cumulative impacts are classified as insignificant.

6.12.17. The maximum cumulative impacts on daily mean $NO_x$ concentrations do not exceed the 10% significance screening criterion within any of the identified designated sites, except for the Humber Estuary SAC/SPA/SSSI, where the maximum impact equates to 22% of the critical level. However, the contribution from the Proposed Scheme to this impact equates to 0.5% of the critical level and the corresponding maximum cumulative PEC remains well below the critical level. Therefore, the modelled cumulative impacts are classified as insignificant at all receptors in terms of daily mean $NO_x$ concentrations.

6.12.18. The above summary applies equally to the pre- and post-mitigation (see **Section 6.10**) cumulative air quality modelling results. Therefore, cumulative emissions of $NO_x$ and $SO_2$ from the With Proposed Scheme scenario & Other Projects scenario will have **no significant effect** on air quality at all assessed designated sites.

**Ammonia ($NH_3$)**

6.12.19. The modelled maximum cumulative PC and PEC concentrations relating to annual mean $NH_3$ at each designated site, based on five years of meteorological data (2016-2020), are presented in **Table 6.20**. Concentrations are presented for both the Baseline and With Proposed Scheme and Other Projects scenarios. The spatial distribution of the modelled With Proposed Scheme scenario maximum cumulative concentration impacts for $NH_3$ is depicted in **Figure 6.18**.

6.12.20. Using the significance screening criteria, the cumulative operational impacts on annual mean $NH_3$ are classified as insignificant (≤1% of the critical level) at all designated sites except for Thorne Moor SAC, Thorne & Hatfield Moors SPA, Thorne, Crowle, and Goole Moors SSSI. At these designated sites, the modelled maximum cumulative PC impact, which equates to 1.1% of the respective critical level, marginally exceeds the 1% significance screening criterion and the maximum

PEC exceeds the critical level. This applies equally to the pre- and post-mitigation (see **Section 6.10**) cumulative air quality modelling results.

6.12.21. Therefore, the results of the $NH_3$ cumulative impact assessment at the above designated sites were passed to the Proposed Scheme ecologist to determine whether or not there is a likely significant effect. The outcomes of this analysis are reported in **Chapter 8** (**Ecology**).

6.12.22. The cumulative emissions of $NH_3$ from the With Proposed Scheme and Other Projects scenario will have **no significant effect** on air quality at all of the other assessed designated sites.

**Table 6.20 - Modelled Maximum Cumulative Impacts at Ecological Receptors for Annual Mean $NH_3$ (Without Mitigation applied to Proposed Scheme)**

| Receptor | Critical Level (µg/m$^3$) | Max *Ba*seline PEC[(1)] (µg/m$^3$) | Max *Cumulative* PEC[(1)] (µg/m$^3$) | Max PC (Impact) (µg/m$^3$)[(2)] | Max PC as % of CL[(2)] | Max *Cumulative* PEC as % of CL[(2)] |
|---|---|---|---|---|---|---|
| River Derwent SAC | 3 | 4.57 | 4.58 | 0.01 | 0.3% | 152.8% |
| Thorne Moor SAC/SPA/SSSI[(3)] | 1 | 2.59 | 2.60 | 0.01 | 1.1% | 260.3% |
| Lower Derwent Valley SAC/SPA | 3 | 4.57 | 4.58 | 0.01 | 0.3% | 152.8% |
| Skipwith Common SAC/SSSI | 1 | 2.58 | 2.59 | 0.00 | 0.4% | 258.6% |
| Humber Estuary SAC/SPA/SSSI | 3 | 3.58 | 3.59 | 0.01 | 0.4% | 119.8% |
| Breighton Meadows SSSI | 3 | 3.08 | 3.09 | 0.01 | 0.3% | 103.1% |
| Eskamhorn Meadows SSSI | 3 | 2.40 | 2.41 | 0.01 | 0.2% | 80.2% |
| Derwent Ings SSSI | 3 | 4.57 | 4.58 | 0.01 | 0.3% | 152.7% |
| Went Ings SSSI | 3 | 2.35 | 2.36 | 0.01 | 0.2% | 78.6% |
| Barn Hill Meadows SSSI | 3 | 2.32 | 2.33 | 0.01 | 0.3% | 77.7% |
| Burr Closes SSSI | 3 | 2.50 | 2.51 | 0.00 | 0.2% | 83.5% |

Notes: All concentrations rounded to two decimal places (2 d.p.). Maximum values based on results modelled using five years of meteorological data (2016-2020).

(1) Including maximum background concentration as reported by APIS (see Table 6.11)

(2) No material changes to modelled results when mitigation (as per Section 6.10) applied to Proposed Scheme

(3) **Thorne Moor SAC, Thorne & Hatfield Moors SPA, Thorne, Crowle, and Goole Moors SSSI**

### Nitrogen Deposition

6.12.23. The modelled maximum cumulative PC and PEC annual nitrogen deposition rates at each designated site, based on five years of meteorological data (2016-2020), are presented in **Table 6.21**. Deposition rates are presented for both the Baseline and With Proposed Scheme and Other Projects scenarios. The spatial distribution of the modelled With Proposed Scheme scenario maximum cumulative nitrogen deposition impacts is depicted in **Figure 6.20**.

6.12.24. Using the significance screening criteria, the cumulative operational impacts on annual nitrogen deposition are classified as insignificant (≤1% of the critical level) at all designated sites except for Thorne Moor SAC and Thorne, Crowle, and Goole Moors SSSI. At these sites, the modelled maximum cumulative PC impact, which equates to 1.8% of the respective critical level, exceeds the 1% significance screening criterion the maximum PEC exceeds the relevant critical load. This applies equally to the pre- and post-mitigation (see **Section 6.10**) cumulative air quality modelling results, although the magnitude of exceedance reduces slightly (to 1.7% of the critical load) when mitigation is applied.

6.12.25. The results of the cumulative impacts modelling at the locally designated sites has identified that the 1% significance criterion is exceeded at six[17] of the nine sites included in the assessment (see Table 1.17, **Appendix 6.5**). Furthermore, nitrogen deposition at each of these local sites already exceeds the critical load.

6.12.26. Therefore, the results of the nitrogen deposition cumulative impact assessment at Thorne Moor SAC and Thorne, Crowle, and Goole Moors SSSI, and at the identified locally designated sites[17], were passed to the Proposed Scheme ecologist to determine whether or not there is a likely significant effect. The outcomes of this analysis are reported in **Chapter 8** (**Ecology**).

6.12.27. The cumulative emissions of nitrogen deposition from the With Proposed Scheme and Other Projects scenario will have **no significant effect** on air quality at all of the other assessed designated sites.

[17] 1% criterion exceeded at Common Plantation SINC; Disused Railway Embankment SINC; Barmby-on-the-Marsh LWS; Cobble Croft Wood SINC; Hagg Green Lane SINC; and Sand Pit Wood and Barffs Close Plantation SINC.

**Table 6.21 - Modelled Maximum Cumulative Impacts at Ecological Receptors for Annual Nitrogen Deposition (Without Mitigation applied to Proposed Scheme)**

| Receptor | Critical Load (µg/m$^3$) | Max *Bas*eline PEC[(1)] (kgN/ha/yr) | Max *Cumulative* PEC[(1)] (kgN/ha/yr) | Max PC (Impact) (kgN/ha/yr)[(2)] | Max PC as % of CL[(2)] | Max *Cumulative* PEC as % of CL[(2)] |
|---|---|---|---|---|---|---|
| Thorne Moor SAC/SSSI[(3)] | 5 | 21.32 | 21.41 | 0.09 | 1.8% | 428.1% |
| Thorne Moor SPA[(3)] | 10 | 21.32 | 21.41 | 0.09 | 0.9% | 214.1% |
| Lower Derwent Valley SAC/SPA | 20 | 30.25 | 30.36 | 0.11 | 0.6% | 151.8% |
| Skipwith Common SAC/SSSI | 10 | 21.13 | 21.20 | 0.07 | 0.7% | 212.0% |
| Humber Estuary SAC/SPA/SSSI | 20 | 28.89 | 28.98 | 0.09 | 0.5% | 144.9% |
| Breighton Meadows SSSI | 20 | 23.53 | 23.64 | 0.11 | 0.6% | 118.2% |
| Eskamhorn Meadows SSSI | 10 | 19.96 | 20.03 | 0.07 | 0.7% | 200.3% |
| Derwent Ings SSSI | 20 | 30.25 | 30.35 | 0.10 | 0.5% | 151.7% |
| Went Ings SSSI | 15 | 19.39 | 19.45 | 0.06 | 0.4% | 129.7% |
| Barn Hill Meadows SSSI | 20 | 20.45 | 20.54 | 0.09 | 0.5% | 102.7% |
| Burr Closes SSSI | 20 | 20.65 | 20.70 | 0.05 | 0.3% | 103.5% |

Notes: All depositions rounded to two decimal places (2 d.p.). Maximum values based on results modelled using five years of meteorological data (2016-2020). Results presented only for the sites that are assigned a nitrogen deposition critical load.

(1) Including maximum background deposition as reported by APIS (see Table 6.11)

(2) No material changes to modelled results when mitigation (as per Section 6.10) applied to Proposed Scheme. *Max PC as % of CL* at Thorne Moor SAC/SSSI reduces to 1.7%.

**(3)** Thorne Moor SAC, Thorne, Crowle, and Goole Moors SSSI, Thorne & Hatfield Moors SPA

### Acid Deposition

6.12.28. The modelled maximum cumulative PC and PEC annual acid deposition rates at each designated site, based on five years of meteorological data (2016-2020), are presented in **Table 6.22.** Deposition rates are presented for both the Baseline and With Proposed Scheme and Other Projects scenarios (pre- and post-mitigation). The spatial distribution of the modelled With Proposed Scheme scenario maximum cumulative acid deposition impacts is depicted in **Figure 6.21**.

6.12.29. Using the significance screening criteria, the maximum cumulative PC impacts on annual acid deposition, without mitigation applied, exceed the 1% criterion at Thorne Moor SAC, Thorne, Crowle, and Goole Moors SSSI, Lower Derwent Valley SAC, Skipwith Common SAC and SSSI, and at the SSSIs designated at Breighton Meadows, Derwent Ings, and Barn Hill Meadows. Given the level of existing levels of depositions at these sites, the maximum PEC exceeds the respective critical loads.

6.12.30. With mitigation applied, the maximum cumulative PC impacts reduce to below the 1% criterion at Skipwith Common SAC and SSSI, but remain above 1% of the relevant critical loads at all other sites that exceeded the criterion in the pre-mitigation scenario.

6.12.31. Therefore, the results of the acid deposition cumulative impact assessment were passed to the Proposed Scheme ecologist to determine whether or not there is a likely significant effect. The outcomes of this analysis are reported in **Chapter 8** (**Ecology**).

6.12.32. The cumulative emissions of nitrogen deposition from the With Proposed Scheme & Other Projects scenario will have **no significant effect** on air quality at the SSSIs designated at Eskamhorn Meadows, Went Ings, and Burr Closes, in addition to all locally designated sites.

6.12.33. Overall, with respect to the decision making considerations included in NPS EN-1 (BEIS, 2011) (see **paragraphs 6.2.27 and 6.2.28**), emissions from the Proposed Scheme and other assessed projects have the potential to lead to a cumulative deterioration in air quality within a number of designated sites in terms of $NH_3$ concentration, nitrogen deposition, and acid deposition impacts. In all cases, the respective critical level for $NH_3$ and critical loads for nitrogen and acid deposition are already exceeded without the modelled Proposed Scheme and other projects contributions (see **Chapter 8 (Ecology)** for assessment of likely significant effects).

6.12.34. For all other assessed pollutants and relevant designated sites, no substantial changes in air quality levels are expected within the operational phase study area and emissions from the Proposed Scheme and other projects would not result in any new exceedances of relevant critical levels or critical loads.

**Table 6.22 - Modelled Maximum Cumulative Impacts at Ecological Receptors for Annual Acid Deposition (Without and With Mitigation applied to Proposed Scheme)**

| Receptor | Critical Load (keq/ha/yr) | Max *Baseline* PEC[1] (keq/ha/yr) | Max *Cumulative* PEC[1] (keq/ha/yr) | | Max PC (Impact) (keq/ha/yr) | | Max PC as % of CL | | Max *Cumulative* PEC as % of CL | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Pre [2] | Post [3] | Pre [2] | Post [3] | Pre [2] | Post[3] | Pre [2] | Post [3] |
| Thorne Moor SAC | 0.462 | 1.74 | 1.75 | 1.75 | 0.01 | 0.01 | 2.3 | 1.9 | 378.0 | 377.5 |
| Thorne Moor SSSI [4] | 0.462 | 1.74 | 1.75 | 1.75 | 0.01 | 0.01 | 2.3 | 1.9 | 378.0 | 377.5 |
| Lower Derwent Valley SAC | 0.643 | 2.41 | 2.43 | 2.42 | 0.02 | 0.01 | 2.7 | 1.8 | 377.5 | 376.7 |
| Skipwith Common SAC | 0.802 | 1.73 | 1.74 | 1.73 | 0.01 | 0.01 | 1.1 | 0.8 | 216.5 | 216.2 |
| Skipwith Common SSSI | 0.802 | 1.73 | 1.74 | 1.73 | 0.01 | 0.01 | 1.1 | 0.8 | 216.5 | 216.2 |
| Breighton Meadows SSSI | 0.643 | 1.93 | 1.95 | 1.94 | 0.02 | 0.01 | 2.7 | 1.8 | 302.9 | 302.0 |
| Eskamhorn Meadows SSSI | 1.998 | 1.64 | 1.65 | 1.64 | 0.01 | 0.01 | 0.4 | 0.3 | 82.4 | 82.3 |
| Derwent Ings SSSI | 0.643 | 2.41 | 2.43 | 2.42 | 0.01 | 0.01 | 2.3 | 1.6 | 377.1 | 376.4 |
| Went Ings SSSI | 2.008 | 1.59 | 1.60 | 1.60 | 0.01 | 0.01 | 0.4 | 0.3 | 79.8 | 79.7 |
| Barn Hill Meadows SSSI | 0.633 | 1.69 | 1.71 | 1.71 | 0.02 | 0.01 | 2.4 | 1.9 | 270.1 | 269.6 |
| Burr Closes SSSI | 1.248 | 1.68 | 1.69 | 1.69 | 0.01 | 0.01 | 0.6 | 0.4 | 135.4 | 135.2 |

Notes: All deposition rates rounded to two decimal places (2 d.p.). Maximum values based on results modelled using five years of meteorological data (2016-2020). Results presented only for the sites that are assigned an acid deposition critical load.

[1] Including maximum background acid deposition (N+S) as reported by APIS (see Table 6.11)

[2] Modelled results before any mitigation applied to Proposed Scheme Main Stack

[3] Modelled results after mitigation applied to Proposed Scheme Main Stack (as per Section 6.10)

**[4] Thorne, Crowle, and Goole Moors SSSI**

## 6.13. IN-COMBINATION CLIMATE CHANGE IMPACTS

6.13.1. The in-combination climate change impact assessment considers the extent to which climate change may alter the effects which have already been identified within this chapter.

6.13.2. The effects that have been considered within this chapter have been assessed against likely climate hazards, as set out within **Chapter 14 (Climate Change Resilience)** (document reference 6.1.14), and the effects identified are not anticipated to change as a result of these hazards.

## 6.14. MONITORING

### BASELINE AND OPERATIONAL AMBIENT AMINE COMPOUNDS MONITORING

6.14.1. There are currently no data relating to ambient levels of amines and nitrosamines within the UK, a position acknowledged by the EA (Environment Agency, 2021), with the Scottish Environment Protection Agency's review of amine emissions from Carbon Capture stating that further work is required to develop a reliable method(s) for measurement (Scottish Environment Protection Agency, 2015).

6.14.2. As acknowledged in **paragraph 6.5.54 (Assessment Assumption and Limitations),** the absence of background data for amine and nitrosamine compounds represents a limitation to the assessment of operational phase impacts at human receptors. However, there are no known sources of amine and / or nitrosamine emissions currently operating within the operational phase study area.

6.14.3. An approach to establishing baseline monitoring for amines and nitrosamines as part of the Proposed Scheme, in-combination with other emitters in the region, should form part of the environmental permitting process and through ongoing engagement with the Environment Agency and other relevant stakeholders.

**Table 6.23 - Summary of Air Quality Effects**

| Receptor | Potential Effects | Additional Mitigation | Residual Effects |
|---|---|---|---|
| Receptors identified within construction phase study area (see **Section 6.9**) | Dust deposition on sensitive properties and increase in ambient $PM_{10}$ levels at human receptors resulting from emissions associated with Proposed Scheme construction and decommissioning phase activities. | Application of mitigation measures as detailed within **Section 6.10** and **Appendix 6.2.** | **Negligible (not significant)**<br>T / D / ST |
| Receptors identified within construction phase study area (see **Section 6.9**) | Cumulative dust deposition impacts on sensitive properties and increases in ambient $PM_{10}$ levels at human receptors resulting from cumulative emissions associated with temporal overlap of Proposed Scheme construction activities with activities associated with other projects identified in **paragraph 6.12.2**. | Application of appropriate mitigation measures detailed in each individual project's CEMP (or similar document outlining dust prevention / mitigation measures), which will be required as part of planning approval before construction commences. | **Negligible (not significant)**<br>T / D / ST |
| Human receptors located within the operational phase study area (see **Section 6.6**) | Increase in ambient pollutant concentrations associated with operational phase emissions from the With Proposed Scheme scenario alone and cumulatively with other projects (as per **Section 6.5**). | None required. | **Negligible (not significant)**<br>P / D & I / LT |
| Ecological receptors within the operational phase study area (**see Section 6.6).** Specifically; Lower Derwent Valley SAC, Thorne Moor SAC, Thorne, Crowle, and Goole Moors SSSI, and SSSIs at Breighton Meadows, Derwent Ings, and Barn Hill Meadows | Assessment significance screening criteria were exceeded in relation to acid deposition impacts at the named ecological receptors resulting from operational phase pollutant emissions from the With Proposed Scheme scenario alone.<br>Therefore, potential for significant effects cannot be screened out. | Reduce potential impacts relating to acid deposition by applying operational changes to the Main Stack emissions parameters in the With Proposed Scheme scenario:<br>- Reduce $SO_2$ emissions by 30%, applied to all four Biomass Units<br>- Increase exit temperature of flue gases from the BECCS Units from 80ºC to 103ºC. | Marginal exceedances of the assessment significance screening criteria remained post-mitigation at Lower Derwent Valley SAC and the SSSIs at Breighton Meadows and Barn Hill Meadows. Therefore, the results of the air quality modelling were passed to the Proposed Scheme ecologist to determine whether or not there is a likely significant effect. The outcomes of this analysis are reported in **Chapter 8 (Ecology)**. |
| All ecological receptors within the operational phase study area (see **Section 6.6**) | Increase in ambient levels of $NO_x$, $NH_3$, and $SO_2$ concentrations, and nitrogen deposition rates at ecological receptors associated with operational phase pollutant emissions from the With Proposed Scheme scenario alone. | None required. Implementation of Main Stack emissions mitigation (see above) relating to acid deposition does not have a material impact on reported results for these pollutants and nitrogen deposition (not significant). | **Negligible (not significant)**<br>P / D & I / LT |
| Thorne Moor SAC, Thorne & Hatfield Moors SPA, Thorne, Crowle, and Goole Moors SSSI | Increase in ambient levels of $NH_3$ associated with cumulative operational phase pollutant emissions from the With Proposed Scheme scenario and other projects (as per **Section 6.5**).<br>Significance screening criteria are marginally exceeded, thus potential for significant effects cannot be screened out. | The results of the air quality modelling were passed to the Proposed Scheme ecologist to determine whether or not there is a likely significant effect. The outcomes of this analysis are reported in **Chapter 8 (Ecology)**. | |
| Thorne Moor SAC, Thorne, Crowle, and Goole Moors SSSI, and locally designated sites[17] | Increase in nitrogen deposition rates associated with cumulative operational phase pollutant emissions from | The results of the air quality modelling were passed to the Proposed Scheme ecologist to determine whether or not there is a likely significant effect. The outcomes of this analysis are reported in **Chapter 8 (Ecology)**. | |

| Receptor | Potential Effects | Additional Mitigation | Residual Effects |
|---|---|---|---|
| | the With Proposed Scheme scenario and other projects (as per **Section 6.5**).<br>Significance screening criteria are exceeded, thus potential for significant effects cannot be screened out. | | |
| Thorne Moor SAC, Thorne, Crowle, and Goole Moors SSSI, Lower Derwent Valley SAC, and SSSIs designated at Breighton Meadows, Derwent Ings, and Barn Hill Meadows | Increase in acid deposition rates associated with cumulative operational phase pollutant emissions from the P With Proposed Scheme scenario and other projects (as per **Section 6.5**).<br>Significance screening criteria are exceeded, thus potential for significant effects cannot be screened out. | The results of the air quality modelling were passed to the Proposed Scheme ecologist to determine whether or not there is a likely significant effect. The outcomes of this analysis are reported in **Chapter 8 (Ecology)**. | |
| All ecological receptors within the operational phase study area (see **Section 6.6**) | Increase in ambient levels of $NO_x$ and $SO_2$ concentrations at ecological receptors associated with cumulative operational phase pollutant emissions from the With Proposed Scheme scenario and other projects (as per **Section 6.5**). | None required. Implementation of Proposed Scheme mitigation (as per Section 0) does not have material impact on reported cumulative results for these pollutants. | **Negligible (not significant)**<br>P / D / LT |

Key to table:

**P/T = Permanent or Temporary, D/I = Direct or Indirect, ST/MT/LT = Short Term, Medium Term or Long Term, N/A = Not Applicable**

# REFERENCES


BEIS. (2011, June). *National Policy Statement for Renewable Energy Infrastructure (EN-3).* Retrieved from https://www.gov.uk/government/publications/national-policy-statements-for-energy-infrastructure

BEIS. (2011, July). *Overarching National Policy Statement for Energy (EN-1).* Retrieved from https://www.gov.uk/government/publications/national-policy-statements-for-energy-infrastructure

BEIS. (2011). *Overarching National Policy Statement for Energy (EN-1).*

BH EnergyGap (Doncaster) Limited. (June 2020). *Doncaster ERF: Air Quality Assessment (Appendix 5.1 of Environmental Statement).* Retrieved from https://pad.doncaster.gov.uk/NPSPublicDocs/00865016.pdf

CERC. (2016). *ADMS 5 Amine Chemistry Supplement User Guide.*

Council of the European Union. (2010). *Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control).* Retrieved from http://eur-lex.europa.eu/

Defra. (2018). *Local Air Quality Management Technical Guidance (TG16).* London: Defra.

Defra. (2022). *Background mapping data for local authorities 2018*. Retrieved Sept 24, 2021, from https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018

Defra UK AIR. (2022). *UK AIR Data Selector*. Retrieved from https://uk-air.defra.gov.uk/data/data_selector

Dept. for Environment Food and Rural Affairs. (2007). *The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Volumes 1 and 2).* London: Defra.

Doncaster Council. (2020). *2020 Air Quality Annual Status Report.*

Doncaster Council. (2021). *2021 Air Quality Annual Status Report.*

East Riding of Yorkshire Council. (2021). *2021 Air Quality Annual Status Report.*

Eggborough Power Ltd. (2017). *Chapter 8 - Air Quality, Environmental Statement Vol. 1.* Retrieved from https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010081/EN010081-000645-6.2.8%20-%20ES%20Chapter%208%20-%20Final%20-%20May%202017.pdf

Environment Agency. (2006). *Environment Agency's advice note for conversion ratios for NOx and NO2.* Retrieved from https://webarchive.nationalarchives.gov.uk/ukgwa/20140328084622/http:/www.environment-agency.gov.uk/static/documents/Conversion_ratios_for__NOx_and_NO2_.pdf

Environment Agency. (2014). *Technical guidance on detailed modelling approach for an appropriate assessment for emissions to air AQTAG06.*

Environment Agency. (2021, Sept 3). *Air emissions risk assessment for your environmental permit*. Retrieved Sept 22, 2021, from https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit

Environment Agency. (2021). *AQMAU recommendations for the assessment and regulation of impacts to air quality from amine-based post-combustion carbon capture plants.*

Environmental Protection UK & Institute of Air Quality Management. (2017). *Land-Use Planning & Development Control: Planning for Air Quality.* London: EPUK & IAQM.

EPUK & IAQM. (2017). *Land-Use Planning & Development Control: Planning For Air Quality.*

European Commission. (2017). *Commission Implementing Decision (EU) 2017/1442 of 31 July 2017 establishing best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for large combustion plants.*

Gjernes, E. I. (2013). Health and environmental impact of amine based post combustion CO2 capture. *Energy Procedia Volume 37*, 735-742.

IAQM. (2016). *Guidance on the Assessment of Dust from Demolition and Construction v1.1.*

IAQM. (2019). *A guide to the assessment of air quality impacts on designated nature conservation sites.*

JNCC. (October 2020). *Report No 665: Nitrogen Futures.*

Karl, M. B. (2009). *Worst Case Studies on Amine Emissions from CO2 Capture Plants.*

Keadby Generation Ltd. (May 2021). *Environmental Statement - Volume 2 - Appendix 8C - Air Quality Assessment of Amine Degradation Products.* Retrieved from https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010114/EN010114-000282-K3%20-%20Document%206.3.7%20-%20ES%20Appendix%208C%20Air%20Quality%20Assessment%20of%20Amine%20Degradation%20Products.pdf

Keadby Generation Ltd. (May 2021). *Environmental Statement - Volume II - Appendix 8B: Air Quality - Operational Phase.*

Ministry of Housing, C. &. (2019, November 1). *Planning Practice Guidance: Air Quality*. Retrieved from https://www.gov.uk/guidance/air-quality--3

Ministry of Housing, Communities & Local Government. (2021). *National Planning Policy Framework.*

North Lincolnshire Council. (2020). *2020 Air Quality Annual Status Report.*

Scottish Environment Protection Agency. (2015). *Review of amine emissions from carbon capture systems.*

Selby District Council. (2013). *Selby District Core Strategy Local Plan.*

Selby District Council. (2014). *Air Quality Planning Guidance Note.*

Selby District Council. (2018). *Selby District Council Air Quality Action Plan.*

Selby District Council. (2021). *2021 Air Quality Annual Status Report.*

Selby District Council. (2021). *Local Plan Preferred Options Consultation 2021.*

UK Centre for Ecology & Hydrology. (2021). *Air Pollution Information System*. Retrieved Sept 22, 2021, from http://www.apis.ac.uk/srcl

Wakefield Council. (2020). *2020 Air Quality Annual Status Report.*

WSP. (2021). *Preliminary Environmental Information Report - Vol. 1 - Chapter 2 Site and Project Description.*

WSP. (2021). *Preliminary Environmental Information Report - Vol. 1 - Chapter 6 Air Quality.*