# The Keadby 3 Low Carbon Gas Power Station Project

**Document Ref: 6.3**

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**The Keadby 3 (Carbon Capture Equipped Gas Fired Generating Station) Order**

**Land at and in the vicinity of the Keadby Power Station site, Trentside, Keadby, North Lincolnshire**

# Environmental Statement
# Volume II - Appendix 8B: Air Quality - Operational Phase

**The Planning Act 2008**

**The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017**

**Applicant: Keadby Generation Limited**

**Date: May 2021**

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## GLOSSARY

| Abbreviation | Description |
|---|---|
| ADMS | Atmospheric Dispersion Modelling System |
| AOD | Above Ordnance Datum |
| AQAL | Air Quality Assessment Levels |
| AQMA | Air Quality Management Area |
| AQMAU | Environment Agency's Air Quality Modelling Assessment Unit |
| BAT | Best Available Techniques |
| BAT-AEL | Best Available Techniques |
| CCGT | Combined Cycle Gas Turbine |
| DC | Doncaster Council |
| DMRB | Design Manual for Roads and Bridges |
| ERYC | East Riding of Yorkshire Council |
| HRA | Habitats Regulations Assessment |
| IED | Industrial Emissions Directive |
| LCP | Large Combustion Plant |
| LWS | Local Wildlife Site |
| NLC | North Lincolnshire Council |
| SAC | Special Area of Conservation |
| SPA | Special Protection Area |
| SSSI | Site of Special Scientific Interest |

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## ANNEXES



## TABLES

# 1.0 INTRODUCTION

## 1.1 Overview

1.1.1 This Technical Appendix supports **Chapter 8**: Air Quality (ES Volume I – **Application Document Ref. 6.2**) and describes the additional details for the dispersion modelling of point source emissions from the Proposed Development once operational. This assessment considers the likely significant effects on air quality as a result of the CCGT and the carbon capture plant (CCP). For more details about the Proposed Development, refer to **Chapter 4**: The Proposed Development (ES Volume I – **Application Document Ref. 6.2**).

1.1.2 Emissions associated with the operational Proposed Development have the potential to affect human health and sensitive ecosystems, if not appropriately managed. This technical appendix identifies and proposes measures to address the potential impacts and effects of the Proposed Development on air quality during its operational phase.

1.1.3 The magnitude of air quality impacts at sensitive human and ecological receptors has been quantified for pollutants emitted from the main stack(s) associated with the Proposed Development. The impact of emissions on sensitive ecological receptors has been considered in the context of relevant critical levels and critical loads for designated and non-designated ecological sites.

1.1.4 The assessment has considered emissions from the Proposed Development during normal operational conditions. Non routine emissions, such as those which may occur during the commissioning process or other abnormal short-term events would typically only occur on an infrequent basis, would be detected by the process control system and rectified within a short time period and the plant operation will be tightly regulated by the Environment Agency through the Environmental Permit required for the operation of the Proposed Development. For this reason, no detailed consideration of impacts associated with abnormal or emergency events has been included in this assessment. **Chapter 18:** Major Accidents and Disasters (ES Volume I - **Application Document Ref. 6.2**) includes an assessment of the reasonably foreseeable worst-case environmental consequences potentially arising as a result of the Proposed Development.

1.1.5 **Annex A** of this Appendix provides a sensitivity analysis of the model input parameters.

1.1.6 **Annex B** of this Appendix provides an assessment of visible plumes from the absorber stack(s), and also from the preferred cooling technology for the Proposed Development.

1.1.7 **Annex C** of this Appendix details the cumulative impacts of the Proposed Development and other proposed developments that are considered likely to have cumulative impacts.

# 2.0 SCOPE

## 2.1 Operational traffic emissions

2.1.1 No quantitative assessment of traffic emissions during the operational (including maintenance) has been made, as the numbers of additional vehicles associated with the operational phase of the Proposed Development are below the Highways England (HE) Design Manual for Roads and Bridges (DMRB) (HE, 2019) and Institute for Air Quality Management (IAQM) (IAQM, 2017) screening criteria for requiring such assessment. In addition, the predicted impacts for the construction phase traffic emissions show that the effect of additional construction traffic will be not significant at all identified receptors (**Appendix 8A**: Air Quality – Construction Phase, ES Volume II – **Application Document Ref. 6.3**). The number of additional vehicles for the operational phase, including outages required for maintenance, is well below the numbers assessed for the construction phase and therefore it is considered that the effect of operational traffic is also not significant.

## 2.2 Combustion plant and carbon capture emissions

2.2.1 The assessment has considered the impact of the operational process emissions on local air quality, under normal operating conditions, with the CCGT operational and the flue gas being abated by the CCP, operating for 8,760 hours per year, as this represents the-worst case for annual average impacts. The assessment considers impacts in the earliest year in which the Proposed Development is due to commence operation, 2026.

2.2.2 The study area for the operational Proposed Development point source emissions extends up to 15km from the Low Carbon Gas Power Station site, in order to assess the potential impacts on ecological receptors, in line with the Environment Agency risk assessment methodology (Defra and Environment Agency, 2016):

- Special Protection Areas (SPA), Special Areas of Conservation (SAC), Ramsar sites and Sites of Special Scientific Interest (SSSI) within 15km; and
- Local Nature Sites (including ancient woodlands, Local Wildlife Sites (LWS) and National and Local Nature Reserves (NNR and LNR) within 2km.

2.2.3 In terms of human health receptors, impacts from the operational Proposed Development become negligible well within approximately 2km and therefore sensitive receptors for the human health impacts are concentrated within a 2km study area.

2.2.4 The dispersion of emissions from the CCP has been predicted using the latest version of the atmospheric dispersion model ADMS (currently version 5.2.2). The results are presented in both tabular format within this Appendix and as contour plots of predicted ground level process contributions (PC) overlaid on mapping of the surrounding area (**Figures 8.5 – 8.9** in ES Volume III - **Application Document Ref 6.4**).

2.2.5 The dispersion modelling assessment has considered the effects from combustion emissions of oxides of nitrogen ($NO_x$) and carbon monoxide (CO) associated with the operation of the CCGT plant, with consideration also of the impacts from ammonia ($NH_3$) slip (from the Selective Catalytic Reduction (SCR) $NO_x$ abatement system). In addition, emissions of amines and their potential degradation products from the CCP have also been assessed.

2.2.6 Emissions from Large Combustion Plant (LCP) are currently governed by the Industrial Emissions Directive (IED) Directive 2010/75/EU which contains measures relating to the control of emissions, including setting limits on emissions to air from LCP and requires operators to monitor and report emissions.

2.2.7 The Proposed Development would be regulated under the IED and in accordance with the current version of the LCP Best Available Technique (BAT) Reference document (LCP BRef) (European Commission, 2017). The recommendations of the LCP BRef are enforceable through Environmental Permits (H.M. Government, 2016) and the Environment Agency would set specific emission limits in the Environmental Permit issued to the Proposed Development, based on the BAT-associated emission levels (BAT-AEL). There are currently no BAT-AEL relating to the CCP process itself, and the Environment Agency is currently drafting BAT guidance for carbon capture plants. Emissions from the CCP process are therefore based on levels that can be met by plant licensors that need to be achieved to avoid significant adverse effects on receptors.

2.2.8 A comparison has been made between predicted model output concentrations (process contributions), and short-term and long-term Air Quality Assessment Levels (AQAL) as detailed in **Chapter 8**: Air Quality (ES Volume I – **Application Document Ref. 6.2**).

2.2.9 Sensitivity testing of the model to the various model inputs has been carried out and is reported in **Annex A** of this Appendix.

## 2.3 Combined and Cumulative impacts

2.3.1 Cumulative impacts from existing sources of pollution in the area are accounted for in the adoption of site-specific background pollutant concentrations from archive sources and air quality monitoring in close proximity to the Proposed Development Site.

2.3.2 It is recognised, however, that there is a potential impact on local air quality from emission sources which have either received or may receive, planning permission or other consent, but have yet to come into operation. Specifically, the combined impacts with the Keadby 2 Power Station (currently under construction) as well as cumulative effects with other schemes. The impacts of the Keadby 2 Power Station have been modelled and the resulting process contributions have been used to generate a modified background concentration for use within the assessment.

2.3.3 The full list of short-listed cumulative schemes to be considered for the Proposed Development are detailed within **Chapter 19**: Cumulative and Combined Effects (ES Volume I - **Application Document Ref. 6.2**). On the basis of available information, the only other development considered to have potential for cumulative operational impacts is the proposed North Lincolnshire Green Energy Park (PINS Ref. EN010116) (refer to **Figure 19.2** in ES Volume III – **Application Document Ref. 6.4**).

2.3.4 The Energy Park will include a new Energy Recovery Facility (ERF) with a combined heat and power plant with a potential output capacity of up to 100MWe. As such there will be combustion emissions of $NO_x$ and CO, and also $NH_3$ from SCR abatement, which could result in cumulative impacts. The Energy Park is also potentially proposed to include carbon capture in the future, and therefore consideration of the potential for cumulative effects in relation to emissions of amines and amine degradation products is also noted. The potential cumulative impacts are assessed considered further in **Annex C** of this Appendix.

## 2.4 Sources of information

2.4.1 The information that has been used within this assessment includes:

- **Chapter 4**: Proposed Development (ES Volume I – **Application Document Ref. 6.2**);
- data on emissions to atmosphere from the process, taken from IED limits, BAT-AEL values and data provided by licensors of the CCP;
- details on the site layout;
- Ordnance Survey mapping;
- baseline air quality data from published sources and Local Authorities;
- meteorological data supplied by ADM Ltd; and
- data on committed developments presented in **Chapter 19**: Cumulative and Combined Effects (ES Volume I – **Application Document Ref. 6.2**).

# 3.0 METHODOLOGY

## 3.1 Dispersion model selection

3.1.1 The assessment of emissions from the Proposed Development has been undertaken using the advanced dispersion model ADMS (version V5.2.2), supplied by Cambridge Environmental Research Consultants Limited (CERC). ADMS is a modern dispersion model that has an extensive published validation history for use in the UK. This model is well validated and has been extensively used throughout the UK for regulatory purposes (CERC, 2020).

## 3.2 Modelled scenarios

3.2.1 The dispersion modelling undertaken for the assessment of emissions from the operational Proposed Development absorber stack(s) includes:

- emissions from Keadby 2 Power Station have been modelled in isolation and the resulting PCs have been added to existing background concentrations, in order to generate a modified background for use in the assessment;
- modelling of maximum ground-level impacts at a range of release heights for the Proposed Development's main CCP absorber stack (between 100m and 110m AGL), in order to evaluate the effect of increasing the effective release height on dispersion;
- modelling of maximum ground-level impacts at a range of release heights for an alternative licensor's twin stack option[1] for the Proposed Development's main CCP absorber unit (with two stacks up to 74m above ground level (AGL) (76m AoD);
- reporting of impacts at the location of maximum impact for the scenarios assessed, and also at identified human health and sensitive ecological receptors, from the CCP absorber stack at a release height of 105m AGL (107m AOD), as the main reported assessment;
- the location of stack(s) has not been finalised therefore, four assessment scenarios have been modelled, with the absorber stack(s) separately assessed as being located at four corners of a defined area of the Main Site to align with the Work 1C shown in the Works Plan for the CCP (**Application Document Ref. 4.3**), with the worst-case results being reported;
- emissions from the combined cycle gas turbine (CCGT) heat recovery steam generator (HRSG) stack have been considered but are not presented here,

[1] As described in **Chapter 4**: The Proposed Development (ES Volume I – **Application Document Ref. 6.2**), consideration has been given to both a single large absorber and the option of a smaller twin absorber configuration with two stacks up to 74m high in determining worst-case assessments

as initial modelling showed that this will lead to lower impacts than emission from the CCP absorber (detailed in section 3.3); and

- modelling of impacts on a receptor grid and at discrete sensitive human and ecological receptors for all pollutants emitted from the stack.

## 3.3 Model inputs

3.3.1 The general model conditions used in the assessment are summarised in Table 1. Other data used to model the dispersion of emissions is considered below.

**Table 1: General ADMS 5 model inputs**

| Variable | Input |
|---|---|
| Surface roughness at source | 0.2m |
| Surface roughness at meteorological site | 0.2m |
| Receptors | Selected discrete receptors (as **Tables 4** and **Table 5**) |
| | Regular spaced grid |
| Receptor location | X, Y co-ordinates determined by GIS |
| | z (ground level) = 1.5 m for residential receptors |
| | z = 0 m for ecological receptors |
| Source location | X, Y co-ordinates determined by GIS<br>Modelled in the four corners of the CCP Work 1C area (**Application Document Ref. 4.3**) to enable flexibility in design, with the worst-case results reported. |
| Emissions | IED emission limits, BAT-AEL values and data provided by amine solvent licensors |
| Sources | 1 x CCP Absorber Stack for the Proposed Development<br>1 x CCGT Stack for Keadby 2 Power Station |
| Meteorological data | 5 years of meteorological data, Doncaster Robinhood Airport Meteorological Station (2015 - 2019) |
| Terrain data | Not required |
| Buildings that may cause building downwash effects | Keadby 2 Power Station Gas turbine hall, HRSG building and Steam turbine hall.<br>Proposed Development CCP absorber tower. |

## 3.4 Emissions data

3.4.1 During normal operation, the CCP absorber stack(s) would be the primary source of emissions from both the combustion and carbon capture processes associated with the Proposed Development. Emissions from the adjacent Keadby 2 Power Station CCGT stack have also been considered in the assessment, and the resulting impacts have been used to generate a modified background concentration.

3.4.2 In addition, there would be an additional stack associated with Proposed Development's CCGT unit, which would only be operational when the Proposed Development is operating in an unabated mode (i.e. combustion emissions only, with no carbon capture taking place) as described in **Chapter 4**: The Proposed Development (ES Volume I – **Application Document Ref. 6.2**).

3.4.3 The combustion emissions ($NO_x$ and CO, including $NH_3$ from the SCR) associated with these two modes of operation would be subject to the same emission limits when directed through the absorber stack as through the HRSG stack, and therefore the associated release rates would be comparable. The unabated emissions from the CCGT plant only, however, would be released at a higher temperature (approximately 75ºC compared with temperatures up to 60ºC for the CCP) and therefore have improved thermal buoyancy, and consequentially dispersion, resulting in a level of impact that is no worse than for the carbon capture mode of operation. Initial modelling showed that emissions from the HRSG stack will lead to lower impacts than emissions from the CCP absorber; therefore, these results have not been presented.

3.4.4 When the plant is operating with carbon capture, there are additional emissions of amines and potentially their degradation compounds (nitrosamines and nitramines, collectively referred to as N-amines). The carbon capture mode of operation therefore has been assessed as representing the worst-case mode of operation in terms of the resulting predicted impacts, due to the additional species emitted and the lower release temperature, resulting in reduced thermal buoyancy of the release. The assessment of amine degradation products is presented in Technical **Appendix 8C**: Air Quality Assessment of Amine Degradation Products (ES Volume II – **Application Document Ref. 6.3**).

3.4.5 The main reported emissions for the Proposed Development have therefore been modelled based on the single larger CCP absorber stack. This stack has been evaluated for a range of stack heights but based on the predicted results, a stack height of 105m AGL (107.6m AOD) with an internal stack diameter of 6.8m. It is considered that 105m AGL is the appropriate stack height that would result in not significant impacts at human health receptors and would limit significant effects reported at ecological receptors, with the current conservative model input parameters and therefore has been used in the assessment. The physical properties of the assessed emission sources are shown in Table 2 and are illustrated in **Figure 8.4** (ES Volume III – **Application Document Ref. 6.4**). These are based on the worst-case emission data provided by CCGT equipment suppliers and CCP licensors, in order to ensure that a conservative assessment has been carried out.

**Table 2: Emissions inventory**

| Parameter | Unit | Keadby 2 Power Station HRSG stack | Proposed Development CCP absorber stack |
|---|---|---|---|
| Stack position | (NGR) m | 482670, 411606 | 482104, 412084[1]<br>481820, 412158<br>481799, 411884<br>482213, 411884 |
| Stack release height (AGL) | m | 75 | 105 |
| Effective internal stack diameter | m | 8 | 6.8 |
| Flue temperature | °C | 74.1 | 60.0 |
| Flue $H_2O$ content | % | 10.2 | 7.4 |
| Flue $O_2$ content (dry) | % | 11.4 | 11.1 |
| Stack gas exit velocity | m/s | 20.5 | 24.3 |
| Stack flow (actual) | $Am^3/s$ | 1,030 | 856.4 |
| Stack flow at reference conditions (STP, dry, 15% $O_2$) | $Nm^3/s$ | 1,162 | 1,080 |
| [1] In line with the Rochdale Envelope approach, the layout is subject to change and therefore the modelling carried out has considered a range of stack locations within the Main Site (Proposed PCC Site), with the worst-case results being reported. | | | |

3.4.6 The modelled pollutant emission rates (in grams per second (g/s)) have been calculated by multiplying the emission concentration by the volumetric flow rate at normalised reference conditions. The emission limits assumed to apply to the Proposed Development are shown in Table 3.

3.4.7 In order to optimise the rate of carbon capture, emission concentrations of $NO_x$ are required to be no higher than the BAT-AEL range provided in the Large Combustion Plant BRef (10 - 30 mg/Nm$^3$ as a yearly average and 15 - 40 mg/Nm$^3$ as a daily average). Whilst it is recognised that some additional $NO_x$ may be formed in the CCP itself, there would also be control of $NO_x$ through the proposed SCR unit and removal of further $NO_x$ from the CCP through reaction with amine.

3.4.8 $NO_x$ has therefore been modelled at the upper end of the yearly BAT-AEL range for annual average impacts and at the upper end of the daily BAT-AEL range for hourly average impacts. It is considered that this represents the worst-case $NO_x$ emissions; in practice the emission is likely to be lower than these concentrations, as it is desirable to reduce the NOx emissions entering the inlet of the CCP.

3.4.9 A $NO_x$ abatement system such as SCR may be required to achieve the required $NO_x$ emission on inlet to the CCP. SCR reduces $NO_x$ concentrations by spraying urea (or other forms of $NH_3$) into the flue gas and therefore has the potential to result in ‘ammonia slip’ with a resulting emission of $NH_3$. Emissions of $NH_3$ have therefore also been included in the assessment.

3.4.10 In addition, depending on the amine solution used, ammonia can result as a degradation product during the carbon capture process itself. As there is uncertainty in the level of potential ammonia emission, the design for the CCP may include provision for an acid wash to remove ammonia from the absorber stack gas, if required. Emissions of $NH_3$ have therefore been assessed at a concentration considered to be achievable through the use of acid wash abatement (1 mg/Nm$^3$).

3.4.11 Depending on the final CCGT and solvent selection, acid wash may not be required to control ammonia emissions from the CCP. Alternatively, other design parameters may be applied to ensure that the impacts associated with any ammonia emission are acceptable at ecological receptors (such as additional reheat, or a taller stack, although the stack height would remain within the parameters assessed under the Rochdale Envelope, presented in Table 4.1 in **Chapter 4**: The Proposed Development (ES Volume I – **Application Document Ref. 6.2**).

3.4.12 The carbon capture process is likely to utilise a proprietary amine solvent to remove the carbon dioxide from the combustion emission. Emissions of ‘amine slip’ can therefore also result.

3.4.13 There are a number of licensors with proprietary amine solutions available for use in carbon capture systems, however at this stage of the development the final licensor has not been selected. Each licensor’s proprietary amine solution is likely to contain a different amine or mix of amines and therefore in order to consider this in the assessment, the potential amine release has been assessed at the maximum concentration provided by all the potential licensors and has been assessed as monoethanolamine (MEA), since this is the only amine species that has a published EAL.

3.4.14 It is also known that amines degrade into nitrosamines and nitramines (collectively referred to as N-amines) both within the carbon capture process itself and also in the environment following release, and therefore this has also been considered in the assessment. Depending on the amine solvent, other degradation products, such as acetaldehyde, formaldehyde and ketones may be formed, and therefore these have also been included at the maximum value obtained from all the licensors under consideration.

3.4.15 Due to the complexity of the N-amines atmospheric degradation processes that occur following release, the assessment of N-amines is described in Technical **Appendix 8C**: Air Quality Assessment of Amine Degradation Products (ES Volume II – **Application Document Ref. 6.3**).

3.4.16 The assessment has assumed that the Proposed Development would operate at continuous design load (8,760 hours per year). No time-based variation in emissions has therefore been accounted for within the model. The Keadby 2 Power Station has also been assumed to be operational for 8,760 hours per year for the purpose of generating the modified background concentrations.

**Table 3: Emission concentrations and the assessed emission rates**

| Pollutant | Keadby 2 Power Station | | Proposed Development CCP absorber stack | |
|---|---|---|---|---|
| | Emission concentration ($mg/Nm^3$) | Emission rate (g/s) | Emission concentration ($mg/Nm^3$) | Emission rate (g/s) |
| Oxides of Nitrogen ($NO_x$ (as $NO_2$)) | 34 | 39.5 | 30 | 32.4 |
| Carbon Monoxide (CO) | 100 | 116.2 | 100 | 108.0 |
| Ammonia ($NH_3$) | 3.8 | 4.4 | 1.0 | 1.1 |
| Amines | - | | 5.5 | 5.9 |
| Acetaldehyde | - | - | 5.3 | 5.7 |
| Formaldehyde | - | - | 0.5 | 0.5 |
| Ketones | - | - | 5.0 | 5.4 |

## 3.5 Modelled domain – discrete receptors

Sensitive human receptors

3.5.1 The modelling has predicted concentrations of the pollutants relevant to human health at the maximum location anywhere and at discrete air quality sensitive receptors, as listed in Table 4. The locations of these receptors are also shown in **Figure 8.1** (ES Volume III – **Application Document Ref. 6.4**). The receptors are selected to be representative of residential dwellings and recreational areas in the area around the Proposed Development. (OR = Operational Receptor).

For human health receptors, concentrations have been predicted at a height of 1.5m.

**Table 4: Human health receptor locations**

| Receptor I.D. | Receptor description | Grid reference | | Distance and direction from the operational Main Site |
|---|---|---|---|---|
| | | X | Y | |
| OR1 | Holly House | 483036 | 411882 | 810m north-east |
| OR2 | 1 Trent Side, Keadby | 483368 | 411284 | 1.3km south-east |
| OR3 | North Pilfrey Farm | 480853 | 411403 | 990m south-west |
| OR4 | Keadby Grange | 481565 | 410909 | 990m south |
| OR5 | Pharon-Ville - Gunness | 484057 | 411661 | 1.8km east |
| OR6 | Boskeydyke Farm, Amcotts | 483860 | 413348 | 2.0km north-east |
| OR7 | Grange Cottage, Gunness | 484708 | 412315 | 2.5km north-east |
| OR8 | Pilfrey Farm | 480769 | 409994 | 2.1km south-west |
| OR9 | Thorne Village | 469571 | 412678 | 12.2km west |
| OR10 | Vazon Bridge House[1] | 482507 | 411501 | 475m south |
| OR11 | North Moor Farm | 482875 | 412621 | 790m north-west |

1 Taken to also be representative of Roe Farm and the Scunthorpe Sea Cadets receptors.

Sensitive ecological receptors

3.5.2 In accordance with the Environment Agency's air emissions risk assessment guidance (Defra and Environment Agency, 2016), the impacts associated with emissions from the Proposed Development on statutory sensitive ecological sites has been quantified. The assessment considers European designated sites (Special Areas of Conservation (SAC), Special Protection Areas (SPA) and Ramsar sites) and Sites of Special Scientific Interest (SSSI) within 15km of the operational Proposed Development, as recommended by the Environment Agency's risk assessment guidance for "large emitters". The most notable of these sites is the Humber Estuary Ramsar, SPA and SSSI, which is adjacent to the Water Connection Corridor of the Proposed Development Site but over 1.3km from the Main Site.

3.5.3 In additional, LWS within 2km of the Proposed Development have also been included in the assessment.

3.5.4 Ground-level concentrations of the modelled pollutants relevant to sensitive ecological receptors have been predicted at locations listed in Table 5. The locations of these receptors are also shown in **Figure 8.2** (ES Volume III – **Application Document Ref. 6.4**). The location reported for each ecology site is the point closest to the Proposed Development, taken to be representative of the worst-case.

**Table 5: Ecological receptor locations**

| I.D. | Receptor description | Designation | Grid reference | | Distance and direction from the operational Main Site |
|---|---|---|---|---|---|
| | | | X | Y | |
| OE1 | Humber Estuary | Ramsar, SAC, SSSI | 483573 | 411823 | 1.3km east |
| OE2 | Humber Estuary | Ramsar, SAC, SSSI | 483612 | 412068 | 1.4km east |
| OE3 | Humber Estuary | Ramsar, SAC, SSSI | 483723 | 412323 | 1.5km east |
| OE4 | Humber Estuary | Ramsar, SAC, SSSI | 483817 | 412556 | 1.6km east |
| OE5 | Humber Estuary | Ramsar, SAC, SSSI | 483951 | 412817 | 1.8km east |
| OE6 | Crowle Borrow Pits | SSSI | 479102 | 410825 | 2.9km west |
| OE7 | Hatfield Chase Ditches | SSSI | 478769 | 410293 | 3.4km south-west |
| OE8 | Eastoft Meadow | SSSI | 478772 | 414311 | 3.7km north-west |
| OE9 | Belshaw | SSSI | 476961 | 406079 | 7.7km south-west |
| OE10 | Thorne Moor | SAC, SPA and SSSI | 475934 | 414720 | 6.3km north-west |
| OE11 | Epworth Turbary | SSSI | 475690 | 404195 | 9.8km south-west |
| OE12 | Risby Warren | SSSI | 491180 | 413564 | 9.1km east |
| OE13 | Hatfield Moor | SAC, SPA and SSSI | 471828 | 408178 | 10.4km west |

| I.D. | Receptor description | Designation | Grid reference | | Distance and direction from the operational Main Site |
|---|---|---|---|---|---|
| | | | X | Y | |
| OE14 | Messingham Heath | SSSI | 487748 | 403574 | 9.9km south-east |
| OE15 | Tuetoes Hills | SSSI | 484361 | 401698 | 10.4km south |
| OE16 | Haxey Turbary | SSSI | 475107 | 401866 | 11.9km south-west |
| OE17 | Rush Furlong | SSSI | 478141 | 400564 | 11.9km south |
| OE18 | Hewson's Field | SSSI | 478493 | 399614 | 12.7km south |
| OE19 | Messingham Sand Quarry | SSSI | 491394 | 404065 | 12.0km south-east |
| OE20 | Manton and Twigmoor | SSSI | 492895 | 405918 | 12.2km south-east |
| OE21 | Scotton and Laughton Forest Ponds | SSSI | 485863 | 399966 | 12.4km south |
| OE22 | Broughton Far Wood | SSSI | 495776 | 410821 | 13.6km east |
| OE23 | Broughton Alder Wood | SSSI | 495914 | 409994 | 13.9km east |
| OE24 | Scotton Beck Field | SSSI | 487885 | 399177 | 13.9km south-east |
| OE25 | Scotton Common | SSSI | 486951 | 398641 | 14.1km south |
| OE26 | Laughton Common | SSSI | 483534 | 397224 | 14.7km south |
| OE27 | Stainforth and Keadby Canal Corridor | LWS | 482055 | 411529 | 330m south |
| OE28 | Keadby Wetland | LWS | 482773 | 411433 | 695m east |
| OE29 | Keadby Wet Grassland | LWS | 482785 | 411409 | 710m east |
| OE30 | Three Rivers | LWS | 482956 | 411068 | 1.1km south-east |
| OE31 | Ash Tip | N/A | 481797 | 412068 | Adjacent to west |

| I.D. | Receptor description | Designation | Grid reference | | Distance and direction from the operational Main Site |
|---|---|---|---|---|---|
| | | | X | Y | |
| OE32 | Humber Estuary (at Blacktoft Sands) | Ramsar, SAC, SPA and SSSI | 486210 | 421275 | 10.3km north-east |

Modelled domain – receptor grid

3.5.5 Emissions from the Proposed Development absorber stack has been modelled on a receptor grid that is 4km by 4km centred on the area containing the CCP. The grid spacing is 44m, which is considered appropriate for a 105m stack.

3.5.6 In addition, the receptors detailed in Tables 4 and 5 have been included as specified points within the model and therefore are unaffected by grid spacing.

3.5.7 In order to produce isopleths for ecological receptors, a larger grid with variable grid spacing has been used, this included an inner grid extending 500m at a resolution of 25m x 25m. A middle grid extending from 500m to 5,000m at a resolution of 50m x 50m. An outer grid extending from 5,000m to 15,000m at a resolution of 250m x 250m.

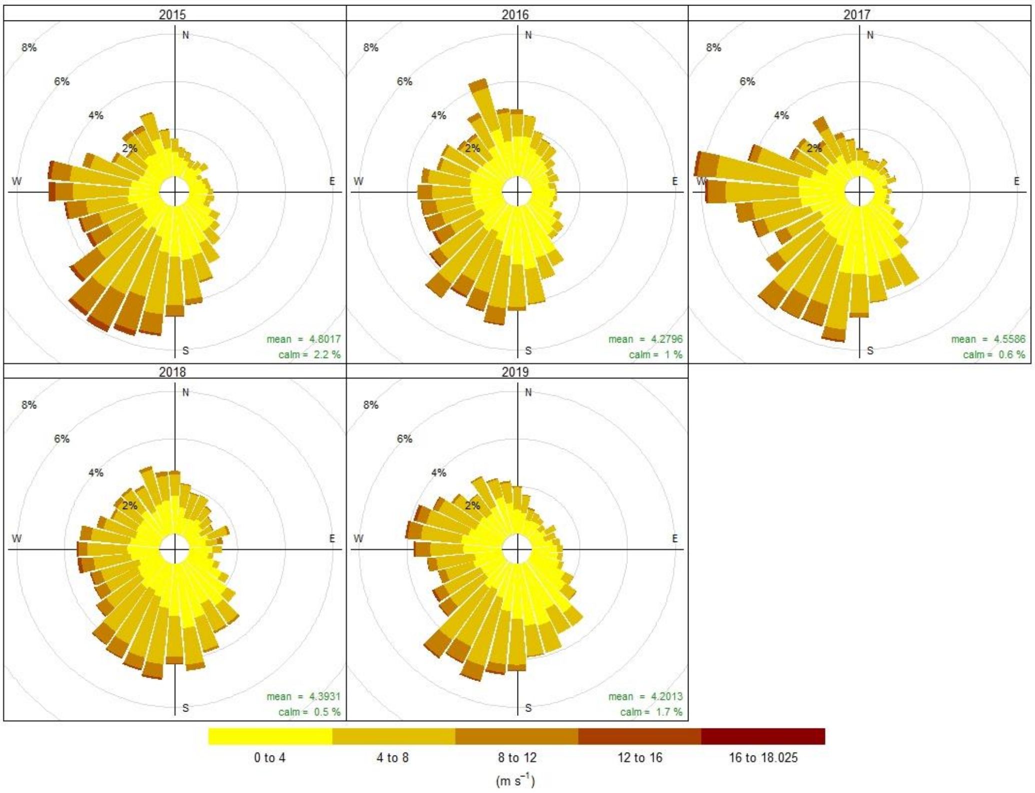
## 3.6 Meteorological data

3.6.1 Actual measured hourly-sequential meteorological data is available for input into dispersion models, and it is important to select data as representative as possible for the site that will be modelled. This is usually achieved by selecting a meteorological station as close to the site as possible, although other stations may be used if the local terrain and conditions vary considerably, or if the station does not provide sufficient data.

3.6.2 The meteorological site that was selected for the assessment is Doncaster Robin Hood Airport, located approximately 21km south-west of the Proposed Development Site, at a flat airfield in a principally agricultural area. A surface roughness of 0.2m (representative of an agricultural area) has been selected for the meteorological site within the model.

3.6.3 The modelling for this assessment has utilised 5 years of meteorological data for the period 2015 – 2019. Wind roses for each of the years within this period are shown in **Plate 1**.

**Plate 1: Wind roses for Doncaster Robin Hood Airport, 2015 to 2019**




## 3.7 Building downwash effects

3.7.1 The buildings that make up the Proposed Development have the potential to affect the dispersion of emissions from the operational process stack. The ADMS buildings effect module has therefore been used to incorporate building downwash effects as part of the model set up. Buildings greater than one-third of the range of the stack height modelled have been included within the modelling assessment.

3.7.2 Buildings associated with the Proposed Development that have been considered to be of sufficient height and volume to potentially impact on the dispersion of emission stacks are shown in Table 6. Model sensitivity testing showed that the only building to affect the predicted impacts from the CCP absorber stack, was the absorber building itself. A plan showing the buildings layout used in the ADMS simulation is illustrated in **Figure 8.4**: Air Quality, Operational study area, Modelled Buildings (ES Volume III – **Application Document Ref. 6.4**).

3.7.3 The absorber building has been included in the model in all four corners of the CCP Works 1C area (**Application Document Ref. 4.3**), as described above for the stack location. The modelled locations are shown in Table 6 and a plan showing the building layout used in the ADMS simulation is illustrated in **Figure 8.4** (ES Volume III – **Application Document Ref. 6.4**). The dimensions of the absorber are the maximum measurements that could potentially be required (as defined in the Rochdale Envelope) and have been provided by the Design Engineers. Keadby 2 buildings have been included within the model with the parameters that were assessed at Planning/ Permitting stage for that Development.

**Table 6: Buildings incorporated into the modelling assessment**

| Building | Building centre grid reference (x, y) | | Height (m) | Length (m) | Width (m) | Angle (°) |
|---|---|---|---|---|---|---|
| Keadby 2 Power Station HRSG | 482676 | 411630 | 40 | 26.15 | 46.17 | 104 |
| Keadby 2 Power Station GT | 482699 | 411676 | 30 | 47.3 | 19.9 | 104 |
| Keadby 2 Power Station Building | 482630 | 411659 | 30 | 45.8 | 45.7 | 104 |
| Proposed Development Absorber | 481204 | 412084 | 90[1] | 13 | 40 | 0 |
| | 481820 | 412158 | | | | |
| | 481799 | 411884 | | | | |
| | 428213 | 411884 | | | | |

[1] The full height of the absorber tower is 99m, however the top 16m of the tower is formed from a sloping transition piece that tapers the footprint of the absorber building to the stack bottom, and as such the absorber height in the model has been reduced by half of the height of the transition piece to take account of the fact that this will reduce the downwash effects of the absorber building on the emission.

## 3.8 Terrain

3.8.1 The local area immediate to the Proposed Development is flat agricultural land, with the urban area of Scunthorpe (including the industrial area on the east side) approximately 4.1km to the east. The Proposed Development is situated near to the River Trent and River Humber. A surface roughness of 0.2m, corresponding to the minimum value associated with the terrain type, has therefore been selected to represent the local terrain.

3.8.2 Site-specific terrain data has not been used in the model, as there are no potentially significant changes in gradient within the study area.

## 3.9 $NO_x$ To $NO_2$ conversion

3.9.1 Emissions of NOx from industrial point sources are typically dominated by nitric oxide (NO), with emissions from combustion sources typically in the ratio of nitric oxide to nitrogen dioxide of 9:1. However, it is nitrogen dioxide that has specified environmental standards due to its potential impact on human health. In the ambient air, nitric oxide is oxidised to nitrogen dioxide by the ozone present, and the rate of oxidation is dependent on the relative concentrations of nitric oxide and ozone in the ambient air.

3.9.2 For the purposes of detailed modelling, and in accordance with Environment Agency technical guidance it is assumed that 70% of nitric oxide emitted from the stack is oxidised to nitrogen dioxide in the long term and 35% of the emitted nitric oxide is oxidised to nitrogen dioxide in the local vicinity of the Proposed Development Site in the short-term.

## 3.10 Calculation of deposition at sensitive ecological receptors

3.10.1 The deposition of nutrient nitrogen and acid at sensitive ecological receptors has been calculated using the modelled process contributions (PC) predicted at the receptor points. The deposition rates are determined using conversion rates and factors contained within published guidance (Highways England, 2019) (IAQM, 2020), which takes into account variations in the deposition mechanisms for different types of habitat.

3.10.2 The conversion rates and factors used in the assessment are shown in Table 7.

**Table 7: Conversion factors – Calculation of Nutrient Nitrogen and Acid Deposition**

| Pollutant | Deposition velocity grassland (m/s) | Deposition velocity woodland (m/s) | Deposition Conversion factors | |
|---|---|---|---|---|
| | | | Nutrient Nitrogen ($\mu g/m^3/s$ to kg/ha/yr) | Acid ($\mu g/m^3/s$ to keq/ha/yr) |
| $NO_x$ as $NO_2$ | 0.0015 | 0.003 | 96 | 6.84 |
| $NH_3$ | 0.02 | 0.03 | 259.7 | 18.5 |

## 3.11 Specialised model treatments

3.11.1 Emissions have been modelled such that they are not subject to dry and wet deposition or depleted through chemical reactions. The assumption of continuity of mass is likely to result in an over-estimation of impacts at receptors, and therefore is considered to be conservative.

# 4.0 BASELINE AIR QUALITY

## 4.1 Overview

4.1.1 This section presents the information used to evaluate the background and baseline ambient air quality in the area surrounding the Proposed Development. The following steps have been taken in the determination of background values:

- identification of Air Quality Management Areas (AQMA);
- review of North Lincolnshire Council (NLC) ambient monitoring data;
- review of data from Defra's background mapping database;
- review of background data and site relevant critical loads from the APIS website;
- modelling of the Keadby 2 power station emissions and adding the resulting PCs to the existing background concentrations, in order to provide a modified baseline for the assessment.

## 4.2 Air Quality Management Areas

4.2.1 NLC has declared a single AQMA within their administrative area (6.2km east of the Proposed Development Site), for the exceedance of the 24-hour mean $PM_{10}$ AQAL (50µg/m$^3$ not to be exceeded more than 35 times within a year). As the AQMA has not been declared for the pollutant species emitted from the operational Proposed Development, it would not be impacted by the emissions from it.

4.2.2 The study area includes small parts of the administrative areas of Doncaster Council (DC) and East Riding of Yorkshire Council (ERYC). DC has declared AQMA for $NO_2$ within their administrative area, but none are within the study area for residential receptors; the closest being over 10km from the Proposed Development Site. As the AQMA are upwind of the operational Proposed Development, and based on the isopleth modelling results, it would not be impacted by the emissions from it.

## 4.3 Local authority monitoring data

4.3.1 NLC undertook automatic monitoring for $NO_2$ at 3 sites within their administrative area in 2018 and undertook diffusion tube monitoring at 22 locations.

4.3.2 The nearest automatic monitors are located approximately 7.5km from the Proposed Development Site; CM1 (Scunthorpe Town AURN) and CM3 (Low Santon). The annual mean for $NO_2$ for 2018 at CM1 monitor was 18µg/m$^3$ and at CM3 it was 20µg/m$^3$.

4.3.3 The nearest $NO_2$ diffusion tube monitoring locations to the Proposed Development are approximately 4.5km to the east, located on Doncaster Road

(DT3 and DT4) and Scotter Road (DT2, near junction with Doncaster Road). Doncaster Road is a major road from the A18 and M181 into the centre of Scunthorpe. Annual mean concentrations of $NO_2$ at these locations range between 19 - 24µg/m$^3$, well below the annual AQAL of 40µg/m$^3$.

4.3.4 Given that these monitoring locations are closer to, or within, more populated/ urbanised areas than the area surrounding the Proposed Development site, it is considered that the background concentrations of $NO_2$ would be higher than those in the immediate vicinity of the Proposed Development.

## 4.4 Defra background data

4.4.1 Defra's 2018-based background maps are available at a 1x1 km resolution for the UK for 2018 and are projected forward to the year 2030. These projections of pollution concentrations across England are available for $NO_2$ and $NO_x$.

4.4.2 Background concentrations from the Defra 2018-based background maps are presented for the year 2018 in Table 8, and have been taken for the grid square in which the operational Proposed Development is located (482500,411500) for $NO_x$ and $NO_2$.

4.4.3 Background concentrations for CO are not available for the most recent Defra maps, but data for 2001-based background concentrations are available and this has been adjusted for 2018 using the Defra published year adjustment factors.

4.4.4 Data for 2018 has been presented for the assessment to represent a conservative approach, as the typical trend shown in the Defra background mapping is that over the projected time period, concentrations of $NO_2$ and $NO_x$ are shown to be decreasing. This corresponds to a reduction over time of vehicle emissions as newer, cleaner vehicles replace older ones. Therefore, assuming no reduction occurs until the opening year of the Proposed Development (2026), is considered to represent a conservative approach, and is in line with advice from the Environment Agency on similar projects.

4.4.5 A review of the background map concentrations over the study area for human health receptors shows that the concentrations presented in Table 8 for the Proposed Development Site location are also representative of the background concentrations at the receptor locations (the average $NO_2$ concentration in the grid squares with identified receptors was 9.1µg/m$^3$). The additional contribution from the Keadby 2 power station is also shown, together with the modified background concentration for use in the assessment

**Table 8: Defra background concentrations (NGR 482500,411500) and K2 modified background concentrations**

| Pollutant | Defra Background concentration (µg/m³) | Keadby 2 Process Contribution (µg/m³) | K2 Modified Background concentration (µg/m³) |
|---|---|---|---|
| $NO_x$ | 12.5 | 0.75 | 13.3 |
| $NO_2$ | 9.5 | 0.52 | 10.0 |
| CO | 111.8 | 161.8 | 273.6 |

4.4.6 There is no background monitoring data for the other trace species emitted from the Proposed Development (amines, N-amines). N-amine levels are likely to be below the limit of detection of any monitoring technique currently available for these species.

## 4.5 Ecological site background data

4.5.1 The $NO_x$ and $NH_3$ background concentrations for designated SAC, SPA and SSSI sites are available from the APIS website. The average concentrations present at the relevant habitat receptor sites are presented in Table 9, together with the modelled PCs from the Keadby 2 power station (shown in parenthesis), and the modified background concentrations.

**Table 9: APIS background data $NO_x$ and $NH_3$ (2017 – 2019 data) and K2 modified background concentrations**

| Receptor I.D. | Ecology site | APIS Backgrounds | | K2 Modified Background concentration (µg/m³) | |
|---|---|---|---|---|---|
| | | $NO_X$ (µg/m³) | $NH_3$ (µg/m³) | $NO_X$ (µg/m³) | $NH_3$ (µg/m³) |
| OE1-5 | Humber Estuary | 13.0 | 2.3 | (0.7) 13.7 | (0.08) 2.4 |
| OE6 | Crowle Borrow Pits | 13.2 | 2.6 | (0.1) 13.3 | (0.01) 2.6 |
| OE7 | Hatfield Chase Ditches | 13.2 | 2.6 | (0.1) 13.3 | (0.01) 2.6 |
| OE8 | Eastoft Meadow | 11.0 | 2.6 | (0.1) 11.1 | (0.01) 2.6 |
| OE9 | Belshaw | 10.8 | 2.6 | (0.1) 10.9 | (0.01) 2.6 |
| OE10 | Thorne Moor | 11.2 | 2.6 | (0.0) 11.2 | (0.01) 2.6 |
| OE11 | Epworth Turbary | 10.6 | 2.2 | (0.0) 10.6 | (0.00) 2.2 |
| OE12 | Risby Warren | 14.7 | 3.2 | (0.1) 14.8 | (0.01) 3.2 |
| OE13 | Hatfield Moor | 11.7 | 2.4 | (0.0) 11.7 | (0.00) 2.4 |

| Receptor I.D. | Ecology site | APIS Backgrounds | | K2 Modified Background concentration (µg/m³) | |
|---|---|---|---|---|---|
| | | $NO_X$ (µg/m³) | $NH_3$ (µg/m³) | $NO_X$ (µg/m³) | $NH_3$ (µg/m³) |
| OE14 | Messingham Heath | 11.0 | 3.3 | (0.1) 11.1 | (0.01) 3.3 |
| OE15 | Tuetoes Hills | 10.3 | 2.4 | (0.1) 10.4 | (0.01) 2.4 |
| OE16 | Haxey Turbary | 10.6 | 2.2 | (0.0) 10.6 | (0.00) 2.2 |
| OE17 | Rush Furlong | 10.3 | 2.2 | (0.0) 10.4 | (0.01) 2.2 |
| OE18 | Hewsons Field | 10.5 | 2.2 | (0.0) 10.5 | (0.01) 2.2 |
| OE19 | Messingham Sand Quarry | 12.3 | 2.8 | (0.1) 12.3 | (0.01) 2.8 |
| OE20 | Manton and Twigmoor | 12.0 | 2.7 | (0.1) 12.1 | (0.01) 2.7 |
| OE21 | Scotton and Laughton Forest Ponds | 10.5 | 2.6 | (0.1) 10.6 | (0.01) 2.6 |
| OE22 | Broughton Far Wood | 13.4 | 3.0 | (0.1) 13.5 | (0.01) 3.0 |
| OE23 | Broughton Alder Wood | 13.5 | 4.2 | (0.1) 13.6 | (0.01) 4.2 |
| OE24 | Scotton Beck Field | 11.0 | 2.6 | (0.1) 11.0 | (0.01) 2.6 |
| OE25 | Scotton Common | 11.0 | 2.6 | (0.1) 11.0 | (0.01) 2.6 |
| OE26 | Laughton Common | 10.2 | 2.0 | (0.1) 10.3 | (0.01) 2.0 |
| OE27 | Stainforth and Keadby Canal Corridor | 13.5 | 2.3 | (0.0) 13.5 | (0.00) 2.3 |
| OE28 | Keadby Wetland | 13.5 | 2.3 | (0.0) 13.5 | (0.00) 2.3 |
| OE29 | Keadby Wet Grassland | 13.5 | 2.3 | (0.0) 13.5 | (0.00) 2.3 |
| OE30 | Three Rivers | 13.0 | 2.3 | (0.2) 13.3 | (0.03) 2.3 |
| OE31 | Ash Tip | 13.0 | 2.3 | (0.1) 13.2 | (0.01) 2.3 |
| OE32 | Humber Estuary (at Blacktoft Sands) | 12.9 | 1.9 | (0.2) 13.1 | (0.02) 1.9 |

4.5.2 In addition, the APIS website provides information on the relevant critical loads for the assessment of depositional impacts, as well as background nitrogen deposition and acid deposition loads. The background data is presented in Table 10, and the relevant critical load classes and ranges are shown in the results Tables 16 and 17. Table 10 also shows the modelled PCs from the Keadby 2 power station (shown in parenthesis), and the modified background concentrations (N.B. only the Nitrogen acid deposition baseline has been modified as there are no emissions of sulphur species).

**Table 10: APIS Background deposition information**

| Receptor I.D. | APIS Backgrounds | | | K2 Modified Background concentration (µg/m$^3$) | |
|---|---|---|---|---|---|
| | N-Deposition (kg N/Ha/Yr) | Acid Deposition | | N-Deposition (kg N/Ha/Yr) | Acid Deposition |
| | | (Keq N/Ha/Yr) | (Keq S/Ha/Yr) | | (Keq N/Ha/Yr) |
| OE1-5 | 19.7 | 1.4 | 0.2 | (0.48) 20.2 | (0.03) 1.4 |
| OE6 | 36.5 | 2.6 | 0.3 | (0.06) 36.6 | (0.03) 2.6 |
| OE7 | 21.3 | 1.5 | 0.2 | (0.06) 21.3 | (0.00) 1.5 |
| OE8 | 21.3 | 1.5 | 0.2 | (0.05) 21.3 | (0.00) 1.5 |
| OE9 | 21.6 | 1.5 | 0.2 | (0.03) 21.6 | (0.00) 1.5 |
| OE10 | 21.3 | 1.5 | 0.2 | (0.03) 21.3 | (0.00) 1.5 |
| OE11 | 18.9 | 1.4 | 0.2 | (0.03) 18.9 | (0.00) 1.4 |
| OE12 | 26.0 | 1.9 | 0.4 | (0.09) 26.1 | (0.00) 1.9 |
| OE13 | 20.9 | 1.5 | 0.2 | (0.03) 20.9 | (0.00) 1.5 |
| OE14 | 24.5 | 1.8 | 0.2 | (0.06) 24.6 | (0.00) 1.8 |
| OE15 | 19.7 | 1.4 | 0.2 | (0.06) 19.8 | (0.00) 1.4 |
| OE16 | 18.9 | 1.4 | 0.2 | (0.03) 18.9 | (0.00) 1.4 |
| OE17 | 18.9 | 1.4 | 0.2 | (0.03) 18.9 | (0.00) 1.4 |
| OE18 | 18.5 | 1.3 | 0.2 | (0.03) 18.5 | (0.00) 1.3 |
| OE19 | 38.4 | 2.7 | 0.3 | (0.05) 38.4 | (0.00) 2.7 |
| OE20 | 22.7 | 1.6 | 0.3 | (0.06) 22.7 | (0.00) 1.6 |
| OE21 | 21.1 | 1.5 | 0.2 | (0.06) 21.2 | (0.00) 1.5 |
| OE22 | 41.9 | 3.0 | 0.3 | (0.08) 41.9 | (0.00) 3.0 |
| OE23 | 51.7 | 3.7 | 0.3 | (0.08) 51.7 | (0.00) 3.7 |
| OE24 | 21.1 | 1.5 | 0.2 | (0.06) 21.2 | (0.00) 1.5 |
| OE25 | 21.1 | 1.5 | 0.2 | (0.06) 21.2 | (0.00) 1.5 |
| OE26 | 17.6 | 1.3 | 0.2 | (0.04) 17.7 | (0.00) 1.3 |

| Receptor I.D. | APIS Backgrounds | | | K2 Modified Background concentration (µg/m$^3$) | |
|---|---|---|---|---|---|
| | N-Deposition (kg N/Ha/Yr) | Acid Deposition | | N-Deposition (kg N/Ha/Yr) | Acid Deposition |
| | | (Keq N/Ha/Yr) | (Keq S/Ha/Yr) | | (Keq N/Ha/Yr) |
| OE27 | 19.7 | 1.4 | 0.2 | (0.00) 19.7 | (0.03) 1.4 |
| OE28 | 33.7 | 2.4 | 0.3 | (0.02) 33.8 | (0.03) 2.4 |
| OE29 | 19.7 | 1.4 | 0.2 | (0.01) 19.7 | (0.03) 1.4 |
| OE30 | 19.7 | 1.4 | 0.2 | (0.17) 19.9 | (0.03) 1.4 |
| OE31 | 19.7 | 1.4 | 0.2 | (0.07) 19.8 | (0.03) 1.4 |
| OE32 | 18.1 | 1.3 | 0.2 | (0.11) 18.7 | (0.03) 1.3 |

## 4.6 Summary of background air quality

4.6.1 For human health receptors, the background concentrations for $NO_2$, and CO have been taken from the Defra background mapping and modified with the contribution from the Keadby 2 power station, as presented in Table 8Table 8: Defra background concentrations (NGR 482500,411500).

4.6.2 The background $NO_x$ and $NH_3$ concentrations for ecological receptors were sourced from APIS using the specific location for the relevant ecological receptors and modified with the contribution from the Keadby 2 power station, as detailed in Tables 9 and 10**.**

4.6.3 Where no short-term concentrations are available, short-term background concentrations have been calculated by multiplying the selected annual mean background concentration by a factor of two, in accordance with the Environment Agency Risk Assessment methodology.

4.6.4 In order to represent a conservative approach, it has been assumed that background concentrations of $NO_2$ would not decrease in future years. Therefore, the current background concentrations have been assumed to apply to the projected opening year of 2026.

# 5.0 OPERATIONAL EMISSIONS MODELLING RESULTS

## 5.1 Evaluation of stack height

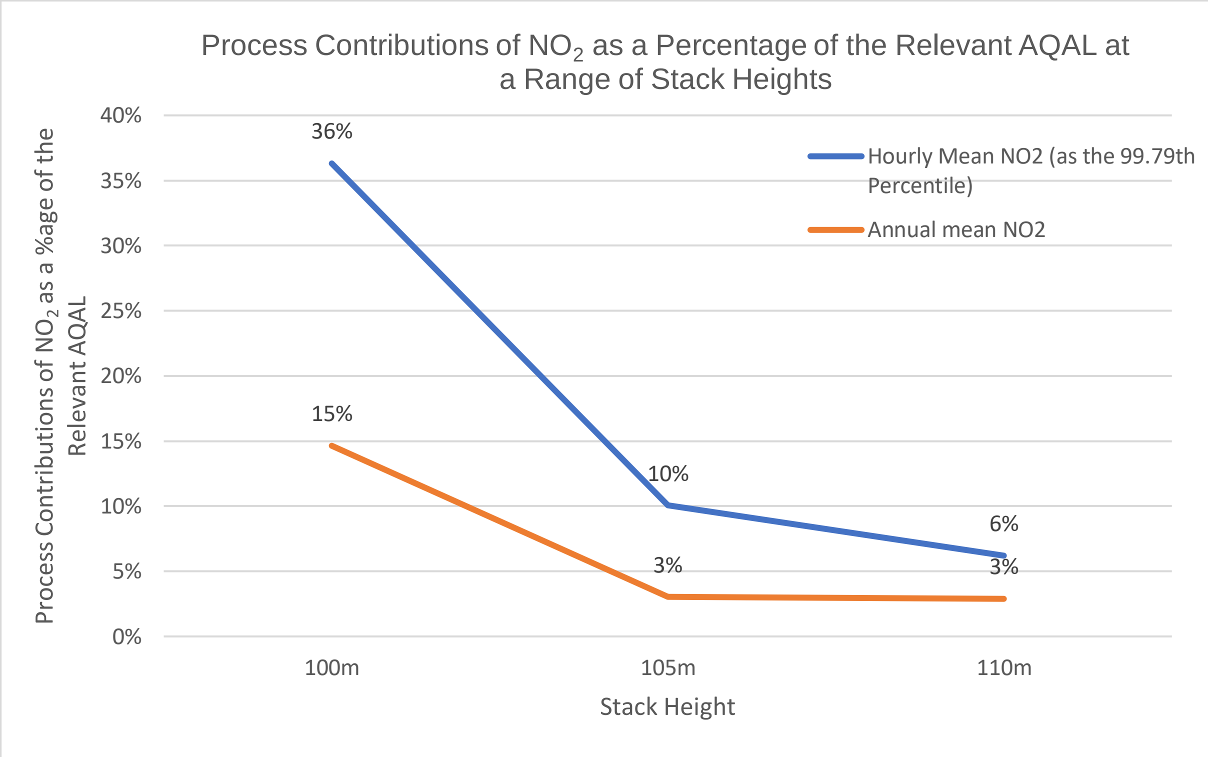
5.1.1 The selection of an appropriate stack release height requires a number of factors to be taken into account, the most important of which is the need to balance a release height sufficient to achieve adequate dispersion of pollutants against other constraints such as the visual impact of tall stacks.

5.1.2 The emissions from the CCP occur from a stack on top of the absorber building. The absorber building itself has been included in the model at a height of 91m AGL. The top 16m of the absorber building consists of a sloped transition piece that tapers the footprint of the absorber building to the stack bottom, and as such the absorber height in the model has been reduced by half of the height of the transition piece to take account of the fact that this tapering will reduce the downwash effects of the absorber building on the emission.

5.1.3 Given the already tall height of the absorber building, the stack has been modelled at heights between 100m and 110m, at 5m increments. A graph showing the percentage PC against the relevant AQAL for the annual mean and maximum 1-hour $NO_2$ concentrations is presented in **Plate 2**. The purpose of the graph is to evaluate the optimum release height in terms of the dispersion of pollutants which would occur, against the visual constraints of further increases in release height, with the 'elbow' of the resulting curve showing where the reductions in ground level concentrations become disproportionate to the increasing height, regarded as the stack height that represents BAT for the emission source.

5.1.4 Analysis of the curves shows that the benefit of the incremental increase in release heights between 100m and 105m are relatively pronounced. At heights above 105m, the air quality benefit of increasing release height further is reduced, especially for annual average impacts. The reported results are therefore based on a 105m stack.

### Plate 2: Stack Height Determination




## 5.2 Human Health Receptor Results

Nitrogen dioxide emissions

5.2.1 The predicted change in annual mean $NO_2$ concentrations at the identified human health receptors occurring during the operation of the Proposed Development, are presented in Table 11. The results shown represent the highest (worst-case) result from all five years of the meteorological data used in the model.

5.2.2 The maximum predicted annual mean $NO_2$ concentration that occurs anywhere within the study area as a result of the Proposed Development is 0.8µg/m$^3$, which represents 2% of the annual mean AQAL. This occurs just to the north of the operational Proposed Development. The annual mean $NO_2$ predicted environmental concentration (PEC) (i.e. the PC + the existing background concentration) is 10.9µg/m$^3$ and therefore is well below the annual mean $NO_2$ AQAL of 40µg/m$^3$. $NO_2$ emissions from the Proposed Development are therefore not predicted to lead to a risk of the annual mean AQAL being exceeded anywhere within the study area.

5.2.3 The discrete receptor most affected by emissions from the Proposed Development is receptor OR11 Northmoor Farm, with a predicted annual mean $NO_2$ concentration of 0.7µg/m$^3$, also representing 1.8% of the AQAL.

5.2.4 The significance of the predicted change in annual mean $NO_2$ concentrations is discussed in **Chapter 8**: Air Quality (ES Volume I – **Application Document Ref. 6.2**).

**Table 11: Predicted change in annual mean $NO_2$ concentrations**

| Receptor | AQAL (µg/m$^3$) | PC (µg/m$^3$) | PC/AQAL % | Modified Background Concentration (BC) (µg/m$^3$) | PEC (µg/m$^3$) | PEC/ AQAL % |
|---|---|---|---|---|---|---|
| Max anywhere | 40 | 0.8 | 2.0% | 10.0 | 10.9 | 27% |
| OR1 | | 0.3 | 0.8% | 9.8 | 10.1 | 25% |
| OR2 | | 0.2 | 0.6% | 9.8 | 10.0 | 25% |
| OR3 | | 0.1 | 0.3% | 9.8 | 9.9 | 25% |
| OR4 | | 0.1 | 0.3% | 9.1 | 9.3 | 23% |
| OR5 | | 0.3 | 0.8% | 9.9 | 10.3 | 26% |
| OR6 | | 0.4 | 0.9% | 8.9 | 9.3 | 23% |
| OR7 | | 0.2 | 0.6% | 9.9 | 10.1 | 25% |
| OR8 | | 0.1 | 0.3% | 9.4 | 9.5 | 24% |
| OR9 | | 0.02 | 0.0% | 11.9 | 11.9 | 30% |
| OR10 | | 0.2 | 0.4% | 10.0 | 10.2 | 26% |
| OR11 | | 0.7 | 1.8% | 9.1 | 9.8 | 25% |

PC = Process Contribution, AQAL = Air Quality Assessment Level, BC = Background Concentration, PEC = Predicted Environmental Concentration

5.2.5 The maximum predicted hourly mean $NO_2$ concentration (as the 99.79$^{th}$ percentile of hourly averages) that occurs anywhere within the study area as a result of the Proposed Development is 24.6µg/m$^3$, and this occurs again just to the north of the operational Proposed Development. The PEC (i.e. the PC + the existing background concentration) is 43.6µg/m$^3$ and is therefore well below the hourly mean $NO_2$ AQAL of 200µg/m$^3$. $NO_2$ emissions from the Proposed Development are therefore not predicted to lead to a risk of the hourly mean air quality standard being exceeded anywhere within the study area.

5.2.6 The discrete receptor most affected by the short-term emissions from the Proposed Development is receptor OR11 North Moor Farm, with a predicted hourly mean $NO_2$ concentration as a result of the Proposed Development of 9.2µg/m$^3$, representing 5% of the AQAL.

**Table 12: Predicted change in hourly mean $NO_2$ concentrations (as the 99.79th Percentile of Hourly Averages)**

| Receptor | AQAL ($\mu g/m^3$) | PC ($\mu g/m^3$) | PC/AQAL % | Modified BC ($\mu g/m^3$) | PEC ($\mu g/m^3$) | PEC/AQAL % |
|---|---|---|---|---|---|---|
| Max anywhere | 200 | 24.6 | 12% | 20.0 | 43.6 | 22% |
| OR1 | | 7.1 | 4% | 19.6 | 26.7 | 13% |
| OR2 | | 6.5 | 3% | 19.6 | 26.1 | 13% |
| OR3 | | 5.6 | 3% | 19.5 | 25.1 | 13% |
| OR4 | | 6.6 | 3% | 18.3 | 24.8 | 12% |
| OR5 | | 5.0 | 2% | 19.9 | 24.8 | 12% |
| OR6 | | 4.8 | 2% | 17.9 | 22.6 | 11% |
| OR7 | | 3.7 | 2% | 19.7 | 23.5 | 12% |
| OR8 | | 4.6 | 2% | 18.9 | 23.4 | 12% |
| OR9 | | 1.1 | 1% | 23.7 | 24.9 | 12% |
| OR10 | | 8.2 | 4% | 20.1 | 28.2 | 14% |
| OR11 | | 9.2 | 5% | 18.2 | 27.4 | 14% |

PC = Process Contribution, AQAL = Air Quality Assessment Level, BC = Background Concentration, PEC = Predicted Environmental Concentration

Carbon monoxide emissions

5.2.7 The maximum hourly and 8-hour running mean PC that occur anywhere as a result of the Proposed Development represent less than 2% of the relevant AQAL and therefore can be considered to be insignificant/ negligible at all receptor locations, being less than 10% of both the AQAL. In addition, when added to the background concentrations in the study area, the PEC remains less than 7% of the relevant AQAL for both averaging periods. The results at individual receptors have therefore not been presented.

Ammonia emissions

5.2.8 The annual and hourly average PC of ammonia that occur anywhere as a result of the Proposed Development represent less than 1% of the relevant AQAL and therefore can be considered to be insignificant/ negligible at all receptor locations. In addition, when added to the background concentrations in the study area, the PEC remains less than 1% of the relevant AQAL for both averaging periods. The results at individual receptors have therefore not been presented.

Amine emissions

5.2.9 The annual average PC of amines that occurs anywhere as a result of the Proposed Development represent less than 1% of the relevant AQAL for MEA at all locations and therefore can be considered to be insignificant/ negligible. The results at individual receptors have therefore not been presented.

5.2.10 The hourly average concentration at the maximum impacted location represents 6% of the AQAL for MEA, and therefore can also be considered to be insignificant/ negligible. The results at individual receptors have therefore not been presented.

Other potential degradation products emissions

5.2.11 The annual average PCs of other degradation products (formaldehyde, acetaldehyde and ketones) that occurs anywhere as a result of the Proposed Development represents less than 1% of the relevant AQAL at all locations and therefore can be considered to be insignificant/ negligible. The results at individual receptors have therefore not been presented.

5.2.12 The hourly average concentrations of these species at the maximum impacted location represent less than 10% of the relevant AQAL, and therefore can also be considered to be insignificant/ negligible. The results at individual receptors have therefore not been presented.

## 5.3 Ecological Receptor Results

5.3.1 The results of the dispersion modelling of predicted impacts on sensitive ecological receptors are presented in Table 14 to Table 16. The tables set out the predicted PC compared to the atmospheric concentrations of $NO_x$ and $NH_3$ and also nutrient nitrogen and acid deposition.

5.3.2 Specific significance criteria relating to impacts on sensitive designated ecological receptors are set out within the Environment Agency air emissions risk assessment guidance. The impact of stack emissions can be regarded as insignificant at sites with statutory designations if:

- the long-term PC is less than 1% of the critical level, or if greater than 1% then the PEC is less than 70% of the critical level; and
- the short-term PC is less than 10% of the critical level.

5.3.3 The impact of stack emissions can be regarded as insignificant at sites of local importance if:

- the long-term PC is less than 100% of the critical level; and
- the short-term PC is less than 100% of the critical level.

5.3.4 The effect of atmospheric $NO_x$ concentrations, nitrogen deposition rates and acid deposition rates on the modelled receptor locations is considered in detail in the report to inform the Habitats Regulations Assessment Screening Report (HRA) (**Application Document Ref 5.12**). Further discussion on the significance of the impact on sensitive ecological receptors is provided in **Chapter 11**: Biodiversity and Nature Conservation (ES Volume I – **Application Document Ref. 6.2**).

Oxides of nitrogen emissions – Critical Levels

5.3.5 The assessment results show that the predicted annual average and daily average $NO_x$ impacts are below the criteria for insignificance at the majority of the ecological receptors assessed.

5.3.6 PCs of more than 1% of the annual average critical level for $NO_x$ occur at the adjacent Humber Estuary SAC and SSSI and Ramsar, Keadby Wetland LWS, Keadby Wet grassland and Three Rivers LWS, however in combination with the background concentrations, all sites are less than 70% of the critical level threshold for insignificance, therefore no exceedances of the annual critical level are predicted.

5.3.7 The daily critical level is below the 10% screening threshold for insignificance at all the statutory designated sites except for the Humber Estuary. In combination with the background concentration at the Humber Estuary, the impacts are 41% of the daily critical level and therefore indicate that no exceedance of the daily critical level is predicted.

5.3.8 Four of the LWS have impacts over the 10% daily critical level, however again with the background concentrations taken into account, the impacts are well below the daily critical level at all these sites, and therefore no exceedance of the daily critical level is predicted at any non-statutory nature conservation site.

5.3.9 Due to the worst-case assumptions used in the assessment, it is considered that the predicted impacts are conservative and that an exceedance of the critical level is unlikely to occur as a result of the emissions from the operational Proposed Development.

Ammonia – Critical Levels

5.3.10 The assessment results show that the predicted annual average $NH_3$ impacts at all the ecological receptors are below the criteria for insignificance (<1% of the critical level) and therefore can be considered insignificant

5.3.11 Further interpretation of the significance of these results, is provided in the main **Chapter 8**: Air Quality and in **Chapter 11**: Biodiversity and Nature Conservation (ES Volume I – **Application Document Ref. 6.2**).

Nitrogen deposition – Critical Loads

5.3.12 The Environment Agency and Natural England have agreed that depositional impacts that are below 1% of the relevant critical load for a site can be regarded as insignificant. Guidance from the IAQM clarifies that the 1% threshold is not intended to be precise to a set number of decimal places but to the nearest whole number (paragraph 5.5.2.6 of Institute of Air Quality Management, 2020[2]).

5.3.13 The majority of sites have impacts that can be screened as being insignificant as they are less than 1% of the critical load, or where this is not the case, the PC together with the background concentration do not exceed the critical load.

5.3.14 Further interpretation of the significance of these results is provided in **Chapter 11**: Biodiversity and Nature Conservation (ES Volume I – **Application Document Ref. 6.2**).

[2] Institute of Air Quality Management (2020). *A Guide to the Assessment of Air Quality Impacts on Designated Nature Conservation Sites, Version 1.1* [Online]. Available from: https://iaqm.co.uk/text/guidance/air-quality-impacts-on-nature-sites-2020.pdf

**Table 13: $NO_x$ Dispersion modelling results for ecological receptors**

| Receptor ID | Site Name | Annual average (µg/m³) | | | | | | 24-hour average (µg/m³) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CL | PC | PC % of CL | Modified BC | PEC | PEC % of CL | CL | PC | PC % of CL | Modified BC | PEC | PEC % of CL |
| OE1-5 | Humber Estuary Ramsar/ SAC/ SSSI | 30 | 0.49 | 1.6% | 13.7 | 14.23 | 47% | 75 | 9.9 | 13% | 20.6 | 30.5 | 41% |
| OE6 | Crowle Borrow Pits SSSI | | 0.10 | 0.3% | 13.3 | 13.36 | 45% | | 5.7 | 8% | 19.9 | 25.6 | 34% |
| OE7 | Hatfield Chase Ditches SSSI | | 0.08 | 0.3% | 13.3 | 13.34 | 44% | | 4.5 | 6% | 19.9 | 24.3 | 32% |
| OE8 | Eastoft Meadow SSSI | | 0.08 | 0.3% | 11.0 | 11.11 | 37% | | 2.9 | 4% | 16.6 | 19.4 | 26% |
| OE9 | Belshaw SSSI | | 0.05 | 0.2% | 10.9 | 10.92 | 36% | | 1.3 | 2% | 16.3 | 17.6 | 24% |
| OE10 | Thorne Moor SAC | | 0.05 | 0.2% | 11.2 | 11.25 | 38% | | 1.7 | 2% | 16.8 | 18.6 | 25% |
| OE11 | Epworth Turbary SSSI | | 0.04 | 0.1% | 10.7 | 10.72 | 36% | | 1.0 | 1% | 16.0 | 17.1 | 23% |
| OE12 | Risby Warren SSSI | | 0.10 | 0.3% | 14.8 | 14.91 | 50% | | 1.1 | 2% | 22.2 | 23.4 | 31% |
| OE13 | Hatfield Moor SAC | | 0.03 | 0.1% | 11.7 | 11.78 | 39% | | 1.4 | 2% | 17.6 | 19.1 | 25% |
| OE14 | Messingham Heath SSSI | | 0.06 | 0.2% | 11.1 | 11.11 | 37% | | 1.7 | 2% | 16.6 | 18.2 | 24% |
| OE15 | Tuetoes Hills SSSI | | 0.08 | 0.3% | 10.4 | 10.46 | 35% | | 2.3 | 3% | 15.6 | 17.9 | 24% |
| OE16 | Haxey Turbary SSSI | | 0.03 | 0.1% | 10.6 | 10.62 | 35% | | 0.9 | 1% | 15.9 | 16.8 | 22% |
| OE17 | Rush Furlong SSSI | | 0.04 | 0.1% | 10.4 | 10.41 | 35% | | 1.3 | 2% | 15.6 | 16.8 | 22% |
| OE18 | Hewsons Field SSSI | | 0.04 | 0.1% | 10.5 | 10.57 | 35% | | 1.0 | 1% | 15.8 | 16.8 | 22% |

| Receptor ID | Site Name | Annual average (µg/m³) | | | | | | 24-hour average (µg/m³) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CL | PC | PC % of CL | Modified BC | PEC | PEC % of CL | CL | PC | PC % of CL | Modified BC | PEC | PEC % of CL |
| OE19 | Messingham Sand Quarry SSSI | | 0.05 | 0.2% | 12.3 | 12.38 | 41% | | 1.0 | 1% | 18.5 | 19.5 | 26% |
| OE20 | Manton and Twigmoor SSSI | | 0.06 | 0.2% | 12.1 | 12.11 | 40% | | 1.8 | 2% | 18.1 | 19.8 | 26% |
| OE21 | Scotton and Laughton Forest Ponds SSSI | | 0.07 | 0.2% | 10.6 | 10.64 | 35% | | 2.7 | 4% | 15.9 | 18.5 | 25% |
| OE22 | Broughton Far Wood SSSI | | 0.09 | 0.3% | 13.5 | 13.60 | 45% | | 0.9 | 1% | 20.3 | 21.2 | 28% |
| OE23 | Broughton Alder Wood SSSI | | 0.09 | 0.3% | 13.6 | 13.67 | 46% | | 0.9 | 1% | 20.4 | 21.3 | 28% |
| OE24 | Scotton Beck Fields SSSI | | 0.06 | 0.2% | 11.0 | 11.10 | 37% | | 1.2 | 2% | 16.6 | 17.7 | 24% |
| OE25 | Scotton Common SSSI | | 0.07 | 0.2% | 11.0 | 11.09 | 37% | | 2.3 | 3% | 16.5 | 18.8 | 25% |
| OE26 | Laughton Common SSSI | | 0.05 | 0.2% | 10.3 | 10.34 | 34% | | 1.1 | 1% | 15.4 | 16.5 | 22% |
| OE27 | Stainforth and Keadby Canal Corridor LWS | | 0.27 | 0.9% | 13.5 | 13.76 | 46% | | 13.1 | 17% | 20.2 | 33.3 | 44% |
| OE28 | Keadby Wetland LWS | | 0.37 | 1.2% | 13.5 | 13.90 | 46% | | 12.8 | 17% | 20.3 | 33.1 | 44% |
| OE29 | Keadby Wet Grassland LWS | | 0.32 | 1.1% | 13.5 | 13.82 | 46% | | 12.2 | 16% | 20.2 | 32.4 | 43% |
| OE30 | Three Rivers LWS | | 0.25 | 0.8% | 13.3 | 13.53 | 45% | | 10.3 | 14% | 19.9 | 30.2 | 40% |

| Receptor ID | Site Name | Annual average (µg/m$^3$) | | | | | | 24-hour average (µg/m$^3$) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CL | PC | PC % of CL | Modified BC | PEC | PEC % of CL | CL | PC | PC % of CL | Modified BC | PEC | PEC % of CL |
| OE31 | Ash tip | | 0.02 | 0.1% | 13.2 | 13.20 | 44% | | 1.7 | 2% | 19.8 | 21.5 | 29% |
| OE32 | Humber Estuary (at Blacktoft Sands) Ramsar, SAC, SPA and SSSI | | 0.13 | 0.4% | 13.1 | 13.19 | 44% | | 1.4 | 2% | 19.6 | 21.0 | 28% |
| CL = Critical Level, PC = Process Contribution, BC = Background Concentration, PEC = Predicted Environmental Concentration | | | | | | | | | | | | | |

**Table 14: Dispersion modelling results for ecological receptors – $NH_3$**

| Receptor ID | Site Name | Annual Average (µg/m3) | | | | | |
|---|---|---|---|---|---|---|---|
| | | CL | PC | PC % of CL | Modified BC | PEC | PEC % of CL |
| OE1-5 | Humber Estuary SSSI, SAC, Ramsar | 3 | 0.02 | 0.5% | 2.36 | 2.38 | 79% |
| OE6 | Crowle Borrow Pits SSSI | 3 | 0.003 | 0.1% | 2.60 | 2.60 | 87% |
| OE7 | Hatfield Chase Ditches SSSI | No features listed | | | | | |
| OE8 | Eastoft Meadow SSSI | 3 | 0.003 | 0.1% | 2.60 | 2.60 | 87% |
| OE9 | Belshaw SSSI | 3 | 0.002 | 0.1% | 2.64 | 2.64 | 88% |
| OE10 | Thorne Moor SAC | 1 | 0.002 | 0.2% | 2.60 | 2.60 | 260% |
| OE11 | Epworth Turbary SSSI | 1 | 0.001 | 0.1% | 2.19 | 2.20 | 220% |
| OE12 | Risby Warren SSSI | 1 | 0.003 | 0.3% | 3.23 | 3.24 | 324% |
| OE13 | Hatfield Moor SAC | 1 | 0.001 | 0.1% | 2.39 | 2.40 | 240% |
| OE14 | Messingham Heath SSSI | 1 | 0.002 | 0.2% | 3.27 | 3.27 | 327% |
| OE15 | Tuetoes Hills SSSI | 1 | 0.003 | 0.3% | 2.41 | 2.41 | 241% |
| OE16 | Haxey Turbary SSSI | 1 | 0.001 | 0.1% | 2.19 | 2.20 | 220% |
| OE17 | Rush Furlong SSSI | 3 | 0.001 | 0.0% | 2.20 | 2.20 | 73% |
| OE18 | Hewsons Field SSSI | 3 | 0.001 | 0.0% | 2.24 | 2.24 | 75% |
| OE19 | Messingham Sand Quarry SSSI | 1 | 0.002 | 0.2% | 2.78 | 2.78 | 278% |
| OE20 | Manton and Twigmoor SSSI | 1 | 0.002 | 0.2% | 2.69 | 2.69 | 269% |
| OE21 | Scotton and Laughton Forest Ponds SSSI | 1 | 0.002 | 0.2% | 2.58 | 2.58 | 258% |

| Receptor ID | Site Name | Annual Average (µg/m3) | | | | | |
|---|---|---|---|---|---|---|---|
| | | CL | PC | PC % of CL | Modified BC | PEC | PEC % of CL |
| OE22 | Broughton Far Wood SSSI | 3 | 0.003 | 0.1% | 3.02 | 3.03 | 101% |
| OE23 | Broughton Alder Wood SSSI | 3 | 0.003 | 0.1% | 4.17 | 4.18 | 139% |
| OE24 | Scotton Beck Fields SSSI | 1 | 0.002 | 0.2% | 2.58 | 2.58 | 258% |
| OE25 | Scotton Common SSSI | 1 | 0.002 | 0.2% | 2.58 | 2.58 | 258% |
| OE26 | Laughton Common SSSI | 1 | 0.002 | 0.2% | 1.97 | 1.97 | 197% |
| OE27 | Stainforth and Keadby Canal Corridor LWS | 3 | 0.009 | 0.3% | 2.28 | 2.29 | 76% |
| OE28 | Keadby Wetland LWS | 3 | 0.012 | 0.4% | 2.28 | 2.30 | 77% |
| OE29 | Keadby Wet Grassland LWS | 3 | 0.012 | 0.4% | 2.28 | 2.29 | 76% |
| OE30 | Three Rivers LWS | 3 | 0.008 | 0.3% | 2.31 | 2.32 | 77% |
| OE31 | Ash tip | 1 | 0.001 | 0.1% | 2.29 | 2.29 | 229% |
| OE32 | Humber Estuary (at Blacktoft Sands) Ramsar, SPA, SAC and SSSI | 3 | 0.004 | 0.1% | 1.89 | 1.91 | 64% |

CL = Critical Level, PC = Process Contribution, BC = Background Concentration, PEC = Predicted Environmental Concentration

**Table 15: Dispersion modelling results for ecological receptors – Nutrient nitrogen deposition (Kg N/Ha/Yr)**

| Receptor ID | Site name | Modified Background nitrogen deposition (kg N/ha/yr) | Most stringent Critical Load class applicable for the site | Lower value of applicable Critical Load range | PC (kg N/ha/yr) | PC % Critical Load | PEC (kg N/ha/yr) | PEC % Critical Load |
|---|---|---|---|---|---|---|---|---|
| OE1-5 | Humber Estuary Ramsar, SSSI, SAC | 20.2 | Pioneer, Low-mid, mid-upper saltmarshes | 20 | 0.13 | 0.7% | 20.4 | 102% |
| OE6 | Crowle Borrow Pits SSSI | 36.6 | Broad-leaved, mixed and yew woodland | 10 | 0.05 | 0.5% | 36.6 | 366% |
| OE7 | Hatfield Chase Ditches SSSI | No features listed in APIS | | | | | | |
| OE8 | Eastoft Meadow SSSI | 21.3 | Neutral grassland | 20 | 0.02 | 0.1% | 21.4 | 107% |
| OE9 | Belshaw SSSI | No critical loads assigned for the features present | | | | | | |
| OE10 | Thorne Moor SAC | 21.3 | Degraded Raised Bogs | 5 | 0.01 | 0.2% | 21.3 | 426% |
| OE11 | Epworth Turbary SSSI | 18.9 | Raised and blanket bogs | 5 | 0.01 | 0.2% | 18.9 | 379% |
| OE12 | Risby Warren SSSI | 26.1 | Acid Grassland | 8 | 0.03 | 0.3% | 26.2 | 327% |
| OE13 | Hatfield Moor SSSI | 20.9 | Raised and blanket bogs | 5 | 0.01 | 0.2% | 20.9 | 418% |

| Receptor ID | Site name | Modified Background nitrogen deposition (kg N/ha/yr) | Most stringent Critical Load class applicable for the site | Lower value of applicable Critical Load range | PC (kg N/ha/yr) | PC % Critical Load | PEC (kg N/ha/yr) | PEC % Critical Load |
|---|---|---|---|---|---|---|---|---|
| OE14 | Messingham Heath SSSI | 24.6 | Acid Grassland | 8 | 0.02 | 0.2% | 24.6 | 307% |
| OE15 | Tuetoes Hills SSSI | 19.8 | Acid Grassland | 8 | 0.02 | 0.3% | 19.8 | 248% |
| OE16 | Haxey Turbary SSSI | 18.9 | Raised and blanket bogs | 5 | 0.01 | 0.2% | 18.9 | 379% |
| OE17 | Rush Furlong SSSI | 18.9 | Neutral Grassland | 20 | 0.01 | 0.1% | 18.9 | 95% |
| OE18 | Hewsons Field SSSI | 18.5 | Neutral Grassland | 20 | 0.01 | 0.1% | 18.5 | 93% |
| OE19 | Messingham Sand Quarry SSSI | 38.4 | Broadleaved deciduous woodland | 10 | 0.02 | 0.2% | 38.4 | 384% |
| OE20 | Manton and Twigmoor SSSI | 22.7 | Acid Grassland | 8 | 0.02 | 0.2% | 22.8 | 284% |
| OE21 | Scotton and Laughton Forest Ponds SSSI | 21.2 | Fen, Marsh and Swamp (assumed) | 10 | 0.02 | 0.2% | 21.2 | 212% |
| OE22 | Broughton Far Wood SSSI | 41.9 | Broad-leaved, mixed and yew woodland | 15 | 0.04 | 0.3% | 42.0 | 280% |
| OE23 | Broughton Alder Wood SSSI | Broad-leafed, mixed and yew woodland – Not sensitive to nitrogen deposition | | | | | | |

| Receptor ID | Site name | Modified Background nitrogen deposition (kg N/ha/yr) | Most stringent Critical Load class applicable for the site | Lower value of applicable Critical Load range | PC (kg N/ha/yr) | PC % Critical Load | PEC (kg N/ha/yr) | PEC % Critical Load |
|---|---|---|---|---|---|---|---|---|
| OE24 | Scotton Beck Fields SSSI | 21.2 | Acid Grassland | 10 | 0.02 | 0.2% | 21.2 | 212% |
| OE25 | Scotton Common SSSI | 21.2 | Dwarf Shrub Heath | 10 | 0.02 | 0.2% | 21.2 | 212% |
| OE26 | Laughton Common SSSI | 17.7 | Acid grasslands | 8 | 0.01 | 0.2% | 17.7 | 221% |
| OE27 | Stainforth and Keadby Canal Corridor LWS | 19.7 | Neutral grassland | 20 | 0.07 | 0.4% | 19.8 | 99% |
| OE28 | Keadby Wetland LWS | 33.8 | Broadleaved deciduous woodland | 10 | 0.17 | 1.7% | 33.9 | 339% |
| OE29 | Keadby Wet Grassland LWS | 19.7 | Coastal and floodplain grazing marsh | 20 | 0.09 | 0.4% | 19.8 | 99% |
| OE30 | Three Rivers LWS | 19.9 | Coastal and floodplain grazing marsh | 20 | 0.07 | 0.3% | 20.0 | 100% |
| OE31 | Ash tip | 19.8 | Acid grassland | 10 | 0.01 | 0.1% | 19.8 | 198% |
| OE32 | Humber Estuary at Blacktoft Sands | 18.2 | Rich Fens | 15 | 0.04 | 0.2% | 18.2 | 121% |

| Receptor ID | Site name | Modified Background nitrogen deposition (kg N/ha/yr) | Most stringent Critical Load class applicable for the site | Lower value of applicable Critical Load range | PC (kg N/ha/yr) | PC % Critical Load | PEC (kg N/ha/yr) | PEC % Critical Load |
|---|---|---|---|---|---|---|---|---|
| | (Ramsar, SAC, SPA and SSSI) | | | | | | | |

**Table 16: Dispersion modelling results for ecological receptors – Acid deposition (Keq/Ha/Yr)**

| Receptor ID | Site name | Acid deposition | | | | PC acid deposition (keq/ha/yr) | | |
|---|---|---|---|---|---|---|---|---|
| | | Critical Load (keq/ha/yr) | Modified Baseline (keq/ha/yr) | Lowest Critical Load class applicable | Modified Baseline % of Critical Load | PC | PC % of Critical Load | PEC% of Critical Load |
| OE1-5 | Humber Estuary Ramsar/ SAC/ SSSI | Fen, marsh and swamp – not sensitive to acidity | | | | | | |
| OE6 | Crowle Borrow Pits SSSI | Min CL Min N: 0.142<br>Min CL Max N: 2.694<br>Min CL Max S: 2.337 | N: 2.6<br>S: 0.25 | Unmanaged Broadleaved/ Coniferous Woodland | 107% | 0.003 | 0.0% | 107% |
| OE7 | Hatfield Chase Ditches SSSI | No features listed in APIS | | | | | | |
| OE8 | Eastoft Meadow SSSI | Min CL Min N: 0.438<br>Min CL Max N: 2.008<br>Min CL Max S: 1.57 | N: 1.5<br>S: 0.2 | Acid grassland | 86% | 0.002 | 0.0% | 86% |
| OE9 | Belshaw SSSI | No critical loads assigned for the features present | | | | | | |

| Receptor ID | Site name | Acid deposition | | | | PC acid deposition (keq/ha/yr) | | |
|---|---|---|---|---|---|---|---|---|
| | | Critical Load (keq/ha/yr) | Modified Baseline (keq/ha/yr) | Lowest Critical Load class applicable | Modified Baseline % of Critical Load | PC | PC % of Critical Load | PEC% of Critical Load |
| OE10 | Thorne Moor SAC | Min CL Min N: 0.321<br>Min CL Max N: 0.462<br>Min CL Max S: 0.141 | N: 1.5<br>S: 0.2 | Bogs | 374% | 0.001 | 0.0% | 374% |
| OE11 | Epworth Turbary SSSI | Min CL Min N: 0.321<br>Min CL Max N: 0.478<br>Min CL Max S: 0.157 | N: 1.4<br>S: 0.2 | Bogs | 362% | 0.001 | 0.0% | 362% |
| OE12 | Risby Warren SSSI | Min CL Min N: 0.223<br>Min CL Max N: 0.858<br>Min CL Max S: 0.42 | N: 1.9<br>S: 0.4 | Acid grassland | 262% | 0.002 | 0.0% | 262% |
| OE13 | Hatfield Moor SAC | Min CL Min N: 0.321 | N: 1.5<br>S: 0.2 | Bogs | 356% | 0.001 | 0.0% | 356% |

| Receptor ID | Site name | Acid deposition | | | | PC acid deposition (keq/ha/yr) | | |
|---|---|---|---|---|---|---|---|---|
| | | Critical Load (keq/ha/yr) | Modified Baseline (keq/ha/yr) | Lowest Critical Load class applicable | Modified Baseline % of Critical Load | PC | PC % of Critical Load | PEC% of Critical Load |
| | | Min CL Max N: 0.475<br>Min CL Max S: 0.154 | | | | | | |
| OE14 | Messingham Heath SSSI | Min CL Min N: 0.366<br>Min CL Max N: 0.556<br>Min CL Max S: 0.19 | N: 1.8<br>S: 0.2 | Acid grassland | 356% | 0.001 | 0.0% | 356% |
| OE15 | Tuetoes Hills SSSI | Min CL Min N: 0.366<br>Min CL Max N: 0.556<br>Min CL Max S: 0.20 | N: 1.4<br>S: 0.2 | Acid grassland | 288% | 0.001 | 0.0% | 288% |
| OE16 | Haxey Turbary SSSI | Min CL Min N: 0.321<br>Min CL Max N: 0.477 | N: 1.4<br>S: 0.2 | Bogs | 323% | 0.001 | 0.0% | 323% |

| Receptor ID | Site name | Acid deposition | | | | PC acid deposition (keq/ha/yr) | | |
|---|---|---|---|---|---|---|---|---|
| | | Critical Load (keq/ha/yr) | Modified Baseline (keq/ha/yr) | Lowest Critical Load class applicable | Modified Baseline % of Critical Load | PC | PC % of Critical Load | PEC% of Critical Load |
| | | Min CL Max S: 0.156 | | | | | | |
| OE17 | Rush Furlong SSSI | Min CL Min N: 0.295<br>Min CL Max N: 2.028<br>Min CL Max S: 1.59 | N: 1.4<br>S: 0.2 | Acid grassland | 76% | 0.001 | 0.0% | 76% |
| OE18 | Hewsons Field SSSI | Min CL Min N: 0.438<br>Min CL Max N: 2.048<br>Min CL Max S: 1.61 | N: 1.3<br>S: 0.2 | Acid grassland | 74% | 0.001 | 0.0% | 74% |
| OE19 | Messingham Sand Quarry SSSI | Min CL Min N: 0.142<br>Min CL Max N: 1.214<br>Min CL Max S: 1.016 | N: 2.7<br>S: 0.3 | Unmanaged Broadleaved/ Coniferous Woodland | 247% | 0.002 | 0.0% | 247% |

| Receptor ID | Site name | Acid deposition | | | | PC acid deposition (keq/ha/yr) | | |
|---|---|---|---|---|---|---|---|---|
| | | Critical Load (keq/ha/yr) | Modified Baseline (keq/ha/yr) | Lowest Critical Load class applicable | Modified Baseline % of Critical Load | PC | PC % of Critical Load | PEC% of Critical Load |
| OE20 | Manton and Twigmoor SSSI | Min CL Min N: 0.223<br>Min CL Max N: 0.556<br>Min CL Max S: 0.19 | N: 1.6<br>S: 0.3 | Acid grassland | 338% | 0.001 | 0.0% | 338% |
| OE21 | Scotton and Laughton Forest Ponds SSSI | Min CL Min N: 0.321<br>Min CL Max N: 0.484<br>Min CL Max S: 0.163 | N: 1.5<br>S: 0.2 | Bogs | 355% | 0.001 | 0.0% | 355% |
| OE22 | Broughton Far Wood SSSI | Min CL Min N: 0.285<br>Min CL Max N: 0.989<br>Min CL Max S: 0.704 | N: 3.0<br>S: 0.3 | Unmanaged Broadleaved/ Coniferous Woodland | 337% | 0.003 | 0.0% | 337% |
| OE23 | Broughton Alder Wood SSSI | Broad-leafed, mixed and yew woodland – Not sensitive to acidity | | | | | | |

| Receptor ID | Site name | Acid deposition | | | | PC acid deposition (keq/ha/yr) | | |
|---|---|---|---|---|---|---|---|---|
| | | Critical Load (keq/ha/yr) | Modified Baseline (keq/ha/yr) | Lowest Critical Load class applicable | Modified Baseline % of Critical Load | PC | PC % of Critical Load | PEC% of Critical Load |
| OE24 | Scotton Beck Fields SSSI | Min CL Min N: 0.366<br>Min CL Max N: 0.556<br>Min CL Max S: 0.19 | N: 1.5<br>S: 0.2 | Acid grassland | 311% | 0.001 | 0.0% | 311% |
| OE25 | Scotton Common SSSI | Min CL Min N: 1.035<br>Min CL Max N: 1.225<br>Min CL Max S: 0.19 | N: 1.5<br>S: 0.2 | Dwarf shrub heath | 141% | 0.001 | 0.0% | 141% |
| OE26 | Laughton Common SSSI | Min CL Min N: 0.223<br>Min CL Max N: 0.576<br>Min CL Max S: 0.21 | N: 1.3<br>S: 0.2 | Acid grassland | 254% | 0.001 | 0.0% | 254% |
| OE27 | Stainforth and Keadby Canal Corridor LWS | No information available | | | | | | |

| Receptor ID | Site name | Acid deposition | | | | PC acid deposition (keq/ha/yr) | | |
|---|---|---|---|---|---|---|---|---|
| | | Critical Load (keq/ha/yr) | Modified Baseline (keq/ha/yr) | Lowest Critical Load class applicable | Modified Baseline % of Critical Load | PC | PC % of Critical Load | PEC% of Critical Load |
| OE28 | Keadby Wetland LWS | No information available | | | | | | |
| OE29 | Keadby Wet Grassland LWS | No information available | | | | | | |
| OE30 | Three Rivers LWS | No information available | | | | | | |
| OE31 | Ash tip | No information available | | | | | | |
| OE32 | Humber Estuary at Blacktoft Sands (Ramsar, SAC, SPA and SSSI) | Fen, Marsh and Swamp - Not sensitive to acidity | | | | | | |

# 6.0 ASSESSMENT LIMITATIONS AND ASSUMPTIONS

6.1.1 This section outlines the potential limitations associated with the dispersion modelling assessment. Where assumptions have been made, this is also detailed here.

6.1.2 The greatest uncertainty associated with any dispersion modelling assessment arises through the inherent uncertainty of the dispersion modelling process itself. Nevertheless, the use of dispersion modelling is a widely applied and accepted approach for the prediction of impacts from industrial sources.

6.1.3 In order to minimise the likelihood of under-estimating the PC to ground level concentrations from the absorber stack, the following conservative assumptions have been made within the assessment:

- the operational Proposed Development has been assumed to operate on a continuous basis i.e. for 8,760 hour per year, although in practice the plant would require routine maintenance periods;
- the modelling predictions are based on the use of five full years of meteorological data from Doncaster Robin Hood meteorological station for the years 2015 to 2019 inclusive, with the highest result being reported for all years assessed;
- the largest possible building sizes within the Rochdale Envelope have been included in the assessment; therefore, the stack height represents the highest required to achieve the impacts presented in this assessment;
- the stack has been located in all four corners of the CCP Work area (1C) (**Application Document Ref. 4.3**), and the worst-case receptor results reported; and,
- emission concentrations for the process are calculated based on the use of IED limits, BAT-AEL concentrations, or licensor maximum envisaged emission rates from licensors; in practice annual average rates would be below this to enable continued compliance with Environmental Permit requirements (H.M. Government, 2016).

6.1.4 The following assumptions have been made in the preparation of the assessment:

- 70% $NO_x$ to $NO_2$ conversion rate has been assumed in predicting the long-term PC, and 35% for the short-term PC respectively;
- ammonia emissions have been assessed based on a concentration of 1mg/Nm$^3$, which may need an acid wash abatement step after the water wash to enable this to be achieved; and separately, and
- heating has been considered for the absorber stack gases to improve dispersion and reduce plume visibility; an assessment of visible plumes is included in **Annex B**.

# 7.0 CONCLUSIONS

7.1.1 This report has assessed the impact on local air quality of the operation of the Proposed Development. The assessment has used the dispersion model ADMS to predict the increases in pollutant species released from the operational Proposed Development to the local study area.

7.1.2 An evaluation of the release height for the main stack has shown that a release height of 105m above ground level is capable of mitigating the short-term and long-term impacts of emissions to an acceptable level, with regard to existing air quality and ambient air quality standards at human health receptors. This is based on the assumption that the absorber tower is at a height of up to 99m. Should the height of the tower be reduced, the stack height could also be lowered, as the down wash effects would be reduced, enabling a lower stack to have the same level of predicted impact as presented in this assessment.

7.1.3 Emissions from the absorber stack would result in small increases in ground-level concentrations of the modelled pollutants. Taking into account available information on background concentrations within the modelled domain, predicted operational concentrations of the modelled pollutants would be within current environmental standards for the protection of human health.

7.1.4 The modelling of impacts at designated ecological sites (SAC/ Ramsar / SPA and SSSI) has predicted that emissions would give rise to no significant effects with regard to increases in atmospheric concentrations of $NO_x$.

7.1.5 Impacts of $NH_3$ are not significant at all designated ecological sites.

7.1.6 Depositional impacts of nutrient nitrogen and acid are considered to be not significant. Further interpretation and discussion of these impacts and effects is provided in **Chapter 11**: Biodiversity and Nature Conservation (ES Volume I – **Application Document Ref. 6.2**) and the HRA Screening Report (**Application Document Ref. 5.12**).

# 8.0 REFERENCES

Cambridge Environmental Research Consultants (CERC) (2020). *Model Validation* (online) [Accessed 02/06/2020]. Available online: https://www.cerc.co.uk/environmental-software/model-validation.html

Department for Environment, Food & Rural Affairs and Environment Agency (2016). *Air emissions risk assessment for your environmental permit* (online). [Accessed 04/09/2020]. Available from: https://www.gov.uk/government/collections/risk-assessments-for-specific-activities-environmental-permits

ERM (2019). Keadby Power Station – Environmental Permit Variation Application Air Quality Impact Assessment and Habitat Regulations Assessment. Available from Annex C Air Quality Impact Assessment and Habitat Regulations Assessment.pdf (environment-agency.gov.uk)

European Commission (2010). *Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control (Recast)).*

European Commission (E.C.) (2017) *Best available techniques Reference document for Large Combustion Plants* (online). [Accessed 04/09/2020]. Available from: https://eippcb.jrc.ec.europa.eu/sites/default/files/2019-11/JRC_107769_LCPBref_2017.pdf

H.M. Government (2016) The Environmental Permitting (England and Wales) Regulations 2016 (SI 2016 No. 1154), the Stationary Office. Available online: https://www.legislation.gov.uk/uksi/2016/1154/contents/made

Highways England (2019) *Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 1, LA 105 Air Quality.* Available online: https://www.standardsforhighways.co.uk/dmrb/search/10191621-07df-44a3-892e-c1d5c7a28d90

Institute of Air Quality Management (2020) *A guide to the assessment of air quality impacts on designated nature conservation sites, v1.1,* May 2020. Available online: https://iaqm.co.uk/text/guidance/air-quality-impacts-on-nature-sites-2020.pdf

# ANNEX A SENSITIVITY TESTING OF MODEL INPUTS

A.1.1 The maximum predicted concentrations of $NO_2$ at the worst-affected human health receptors and $NO_x$ at the worst-affected statutory designated ecological receptor associated with the variable input parameters, are presented in Table A1 as the percentage of maximum reported values in Tables 11, 12 and 13 above.

**Table A1: Point Source Dispersion Model Sensitivity Analysis**

| Model Input Variable | Human Health Receptor | | Ecological Receptor | |
|---|---|---|---|---|
| | Short-term | Long-term | Short-term | Long-term |
| Meteorological data (5-year min-max) | 74% | 59% | 55% | 63% |
| Stack and absorber position | 82% | 72% | 82% | 95% |
| Surface roughness representation (0.3m) | 87% | 154% | 106% | 104% |
| Surface roughness representation (0.1m) | 92% | 89% | 90% | 94% |

A.1.2 The main uncertainty associated with the model is considered to be the meteorological data, with a $NO_2$ process contribution variation of 74% in the hourly mean $NO_2$ results; this is equivalent to an overall uncertainty at the worst-affected receptor of -3.6 µg/m$^3$ (or -2% of the relevant AQAL).

A.1.3 The annual average $NO_2$ process contribution varies by 59%, equivalent to an overall uncertainty at the worst-affected receptor of -0.5 µg/m$^3$ (or -1% of the relevant AQAL).

A.1.4 The position of the absorber and stack has a less marked effect on the predicted process contributions than the meteorological data.

A.1.5 The surface roughness representation in the main model has been assessed at 0.2m, representative of the lowest surface roughness associated with agricultural land. This is consistent with modelling carried out for the Keadby 2 Power Station Section 36 Consent and Environmental Permit application, and therefore is considered to be the most appropriate surface roughness to represent the Proposed Development Site. The surface roughness has been varied and it was found that a higher surface roughness (0.3m), on the whole resulted in higher impacts at the worst case receptor, however for receptors further away from the source, the impacts would be reduced over those reported in the main assessment.

A.1.6 The lower surface roughness of 0.1m resulted in lower impacts.

## ANNEX B ASSESSMENT OF VISIBLE PLUMES FROM THE ABSORBER STACK AND HYBRID COOLING TOWERS

B.1.1 Due to the initial water content of the emission from the absorber stack, and the relatively low temperature of the release, there is potential for the plume released from the stack to be visible. The ADMS module can assess the potential for visible plumes to form, based on the initial water content of the release, and the humidity of the ambient air.

B.1.2 The plume from a stack is described by the model developers as being "visible" when liquid water is present in the plume above a critical threshold of 0.002kg/kg.

B.1.3 The original version of the Environment Agency H1 Risk Assessment Guidance published in 2003 included a methodology for the assessment of the impacts of visible plumes, however this guidance is now superseded. Nevertheless, an assessment has been carried out so that the outputs can be reported and discussed in **Chapter 14**: Landscape and Visual and **Chapter 15**: Cultural Heritage (ES Volume I - **Application Document Ref. 6.2**).

B.1.4 The ADMS model set up is identical to that used for the main assessment of pollutant emission, except for the selection of plume visibility in the model set-up and the input of initial water content in the plume. The initial water vapour mixing ratio of the plume is 0.036 kg/kg (mass of water vapour per unit mass of dry release at the stack). ADMS 5 defines the plume to be 'visible' at a particular downwind distance if the ambient humidity at the plume centreline is below 98%, above which it is considered the plume would be indistinguishable from clouds. All other model inputs are identical to those detailed for the main assessment.

B.1.5 The results from the model are shown in Table B1 assuming an emission at 60°C. The results show that the plumes are predicted to be visible for 3% of the time, with average plumes only being very short (<4m). Occasional longer plumes are predicted (up to 632m), however these are predicted to occur for less than 1% of the time.

### Table B1: Visible Plumes from the Absorber with a 60°C Release

| Met Year | Percentage of Time Plume is Visible | Longest Visible Plume Length | Average Visible Plume Length (m) | Percentage of Year Visible Plume is Over 105m |
|---|---|---|---|---|
| 2015 | 3% | 632m | 3.4m | 1.1% |
| 2016 | 3% | 475m | 1.9m | 0.6% |
| 2017 | 3% | 441m | 2.7m | 1.0% |
| 2018 | 3% | 537m | 3.3m | 1.0% |
| 2019 | 3% | 487m | 1.3m | 0.4% |

B.2.1 In addition to the potential for visible plumes to occur from the absorber stack, there is also potential for visible plumes to occur from the hybrid cooling towers, recognising that these are plume abated to reduce the potential for visible plumes to form. However, an assessment of the potential for visible plumes to form has been carried out to inform the assessment in **Chapter 14**: Landscape and Visual and **Chapter 15**: Cultural Heritage (ES Volume I - **Application Document Ref. 6.2**).

B.2.2 The indicative cooling infrastructure design (refer to **Application Document Ref. 4.7**) shows 22 cooling cells positioned in a single block, 2 cells wide and 11 cells in length. The potential for visible plumes to occur from the cooling cells has therefore been modelled as shown in Table B2.

### Table B2: Cooling Cell Visible Plume Model Inputs

| Parameter | Wet Cooling System |
|---|---|
| Number of vents | 22 |
| Release height (m) | 20 |
| Vent diameter (m) | 12 |
| Flow rate per vent | 1,050 kg/s |
| Water ratio (kg/kg, dry) | 0.0064 |
| Temperature (°C) | Ambient |

B.2.3 The results for the cooling tower modelling are shown in Table B3. Although the results indicate that a short visible plume may be present for up to 26% of the time once the Proposed Development becomes operational, only two of the five years of meteorological data used in the assessment resulted in plumes greater than 1m.

**Table B3: Cooling Cell Visible Plumes**

| Met Year | Percentage of Time Plume Is Visible | Longest Visible Plume Length (m) | Average Visible Plume Length (m) |
|---|---|---|---|
| 2015 | 18.9% | <1m | <1m |
| 2016 | 26.2% | <1m | <1m |
| 2017 | 20.0% | <1m | <1m |
| 2018 | 20.5% | 63m | <1m |
| 2019 | 20.3% | 25m | <1m |

## ANNEX C ASSESSMENT OF CUMULATIVE IMPACTS

D.1.1 This Annex provides an assessment of the operational cumulative impacts from the Proposed Development and other industrial emission sources in the vicinity of the Proposed Development Site.

D.1.2 Cumulative impacts from existing sources of pollution in the area are accounted for in the adoption of site-specific background pollutant concentrations from archive sources and use of available baseline air quality monitoring in close proximity to the Proposed Development site.

D.1.3 It is recognised, however, that there is a potential impact on local air quality from emission sources which have either received or are may soon receive planning permission or consent but have yet to come into operation. Those that are relevant for consideration due to their air quality impacts are considered to be limited to the adjacent Keadby 2 power station (incorporated into the main assessment) and a single proposed nationally significant infrastructure project (NSIP) - North Lincolnshire Green Energy Park which was notified to PINS in May 2019 and reached Scoping Stage (Scoping Opinion published December 2020). This comprises circa 600ha of development including 760,000 tonnes per annum energy from waste (EfW) (circa 100MW) and associated development. The development is proposed to be located at and around Flixborough Port on the eastern bank of the tidal River Trent.

D.1.4 The site has road, rail and water links. The associated development includes (but is not limited to):

- carbon dioxide capture plant;
- offices, business centre and visitor centre;
- expansion of the riverside wharf to 420m;
- renewable energy storage (hydrogen, battery storage and steam storage);
- a new railhead and reinstatement of 6km of railway;
- an access road;
- polymer production facility;
- concrete block manufacturing facility;
- incinerator bottom ash (IBA) and flue gas treatment (FGTr) facility;
- hydrogen production;
- back-up heat and power generation to be fuelled by hydrogen;
- natural gas, hydrogen and bio methane above ground installations (AGI) and infrastructure;
- electric vehicle and hydrogen refuelling for vehicles; and

- a heat, cooling, hydrogen gas, carbon dioxide and renewable power off take/ export.

D.1.5 Given the early stage (scoping) of this NSIP, limited data is available to enable a quantitative assessment of any likely cumulative impacts. It is noted that PINS has advised the applicant of the need to take the Proposed Development into account in its assessment of cumulative effects. Based upon the timeline advised to PINS, initial information on cumulative effects may accompany the statutory consultation on the energy park, understood to be planned for Q2 2021, with a final assessment of cumulative effects which takes into account the Proposed Development and other relevant developments to be published on submission of their DCO application, currently expected in Q4 2021.

D.1.6 No further assessment has therefore been undertaken here, as no published data yet exists on which an assessment could be based. Consequently, the cumulative effects of the Proposed Development will need to be considered in the cumulative assessment for North Lincolnshire Green Energy Park.