Contents

Plates

Tables

ANNEXES

8B. Air Quality – Operational Assessment

8B.1. Overview

8B.1.1. This Technical Appendix supports **ES Volume I Chapter 8**: Air Quality (**Application Document 6.2**) and describes the additional details for the assessment of emissions from the Proposed Development once operational. This assessment considers the potential for air quality effects from operational traffic and the likely significant effects on air quality as a result of the emissions from the combined cycle gas turbine (CCGT). For more details about the Proposed Development, refer to **ES Volume I Chapter 4**: The Proposed Development (**Application Document 6.2**).

8B.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.

8B.1.3. The magnitude of air quality impacts at sensitive human and ecological receptors has been quantified through detailed dispersion modelling for pollutants emitted from the main stack 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.

8B.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. **ES Volume I Chapter 19**: Major Accidents and Disasters (**Application Document 6.2**) includes an assessment of the reasonably foreseeable worst-case environmental

consequences potentially arising as a result of the Proposed Development.

8B.1.5. **Annex ~~A~~ 1** of this Appendix provides a sensitivity analysis of the dispersion model input parameters.

8B.1.6. **Annex ~~B~~ 2** of this Appendix provides an assessment of visible plumes from the preferred cooling technology for the Proposed Development.

~~8B.1.6.~~8B.1.7. **Annex 3** of this Appendix provides an assessment of potential cumulative impacts of identified short-listed schemes with the Proposed Development.

8B.2. Scope

Operational traffic emissions

8B.2.1. Once operational, up to circa 50 permanent operational roles would be created. Conservatively assuming a car occupancy of one, this could equate to an additional circa 50 cars accessing the Proposed Development Site per day (i.e. 100 Light Duty Vehicles (LDV) [1] movements per day).

8B.2.2. There would also be additional 15 Heavy Duty Vehicles (HDV)[2] per week generated by deliveries associated with day-to-day operations and maintenance of plant/ equipment.

8B.2.3. The screening of operational traffic data has been undertaken using the approach set out in the IAQM/EPUK Land Use and Planning guidance (IAQM, 2017). The Proposed Development is located 6.3km west of the nearest Air Quality Management Area (AQMA) (Scunthorpe AQMA) and therefore it is not expected that this AQMA will be impacted by the Proposed Development. The following IAQM criteria therefore apply:

- A change of more than 500 Annual Average Daily Traffic (AADT) LDV movements; and
- A change of more than 100 AADT HDV movements.

8B.2.4. No quantitative assessment of traffic emissions during the operation of the Proposed Development has been made, as the numbers of additional vehicles associated with the operational phase of the Proposed Development are well below the 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 (**ES Volume II Appendix 8A**: Air Quality – Construction Assessment, **Application Document 6.3**). The number of additional vehicles for the operational phase, including outages required for maintenance, is well below the numbers assessed for the

[1] Vehicles <3.5t in weight

[2] Vehicles >3.5t in weight

construction phase and therefore it is considered that the effect of operational traffic is also not significant.

Combustion plant emissions

8B.2.5. The assessment has considered the impact of the operational process emissions on local air quality, under normal operating conditions, with the CCGT operational for 8,760 hours per year, as this represents the-worst case for annual average impacts. Routine maintenance activities would mean that the CCGT would never actually operate for 8,760 hours per year. The assessment considers impacts in the earliest year in which the Proposed Development is due to commence operation, 2030.

8B.2.6. As detailed in **ES Volume I Chapter 4**: The Proposed Development (**Application Document 6.2**), there may be a period at the start of operation when the required hydrogen supply infrastructure may not be available, in which case the Proposed Development would also need to be able to operate using 100% natural gas or blends of hydrogen and natural gas until such time as a commercially viable and reliable hydrogen supply becomes available to the Site.

8B.2.7. As such, emissions from the Proposed Development have been assessed based on two operational scenarios: 100% natural gas and 100% hydrogen. It is considered that these two scenarios represent the full range of potential impacts that could occur from the Proposed Development, and that impacts associated with any interim operation on blends of natural gas and hydrogen would fall within this range.

8B.2.8. The study area for the operational Proposed Development point source emissions extends up to 15km from the operational 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.

8B.2.9. In terms of human health receptors, impacts from the operational Proposed Development become negligible within approximately 2km and

therefore sensitive receptors for the human health impacts are concentrated within a 2km study area.

8B.2.10. The dispersion of emissions from the Proposed Development's stack has been predicted using the latest version of the atmospheric dispersion model ADMS (currently ADMS version 6.0.2.5). 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 (**ES Volume III Figures 8.6 – 8.10** in **Application Document 6.4**).

8B.2.11. The dispersion modelling assessment has considered the effects from combustion emissions of oxides of nitrogen (NOx) and carbon monoxide (CO) (only applicable when firing on 100% natural gas or natural gas and hydrogen blends) 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 that may be required to ensure that NOx emissions are compliant with the relevant emission limits. There are no other pollutant emissions from the operational CCGT plant.

8B.2.12. Emissions from gas fired 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.

8B.2.13. When firing on natural gas, 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) LCP (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).

8B.2.14. The combustion of 100% hydrogen in a gas turbine will result in a reduction in the normalised flue gas volume (at 0°C, 1 atmosphere, dry gas and 15% O_2) compared with natural gas by approximately 27%. This is due to the fundamental difference in combustion chemistry of the respective fuels and inherent gas turbine design characteristics with respect to high excess air. This means that for the same BAT-AEL, the mass pollutant release when the CCGT is fired on natural gas would be higher than when fired on hydrogen. To achieve parity between the mass

pollutant release rates for the two fuels, the ELVs for hydrogen firing therefore need to be increased.

8B.2.15. As an emerging technology, there are no BAT-AELs for hydrogen-fired CCGTs included within the LCP BRef or BATc. However, the Environment Agency has developed Guidance on Emerging Technologies (GET): Hydrogen Combustion: comply with emission limit values (Environment Agency 2024), where a NOx ELV of 68.5 mg/Nm^3 for CCGTs firing 100% hydrogen is proposed, which is a factor of 1.37 higher than the IED NOx ELV of 50 mg/Nm^3. This will result in equivalent mass release rates of NOx between the two fuels based on the IED ELV.

8B.2.16. The relevant BAT-AELs and GET ELVs have been modelled for the two operational scenarios assessed.

8B.2.17. Sensitivity testing of the model to the various model inputs has been carried out and is reported in **Annex ~~A~~ 1** of this Appendix.

Combined and cumulative impacts

8B.2.18. 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, including the operational Keadby 1 Power Station. However, as the Keadby 2 Power Station only became commercially operational in March 2023, it is considered that this will not be included in the baseline monitoring data available for the study area. As such emissions from the Keadby 2 Power Station have been modelled and added to the baseline data to provide a “modified baseline” including the Keadby 2 process contributions (PC).

8B.2.19. It is considered that this would in fact overestimate the background contributions from Keadby 2, given that the assessment assumes emissions occur 8,760 hours per year at the emission limit values, when actual operation is less than this, and the actual emission concentrations are below the limit values used in the assessment, especially in the case of ammonia.

8B.2.20. It is also recognised 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.

8B.2.21. The full list of short-listed cumulative schemes to be considered for the Proposed Development are detailed ~~and assessed~~ within **ES Volume I Chapter 21**: Cumulative and Combined Effects (**Application Document 6.2**). There are no short-listed schemes with close proximity to the

Proposed Development with significant sources of combustion gases that ~~require~~ would enable an assessment of cumulative impacts through dispersion modelling~~, and therefore no further consideration of these schemes is carried out in this Chapter~~. The assessment of cumulative effect with any short-listed schemes which have the potential for cumulative impacts is therefore carried out qualitatively and is provided in Annex 3.

Sources of information

~~8B.2.21.~~8B.2.22. The information that has been used within this assessment includes:

- **ES Volume I Chapter 4**: Proposed Development (**Application Document 6.2**);
- data on emissions to atmosphere from the process, taken from IED limits, BAT-AEL values, GET and data provided by CCGT Original Equipment Manufacturers (OEMs);
- details on the site layout;
- Ordnance Survey mapping;
- baseline air quality data from published sources and Local Authorities; and
- meteorological data supplied by ADM Ltd.

8B.3. Methodology

Dispersion model selection

8B.3.1. The assessment of emissions from the Proposed Development has been undertaken using the advanced dispersion model ADMS, 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 has been extensively used throughout the UK for regulatory purposes (CERC, 2020).

Modelled scenarios

8B.3.2. The dispersion modelling undertaken for the assessment of emissions from the operational Proposed Development stack includes:

- Modified Baseline Modelling - 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;
- Stack Height Modelling - modelling of maximum ground-level impacts at a range of release heights for the Proposed Development's CCGT stack

(between 70m and 100m above ground level (AGL)), in order to evaluate the effect of increasing the effective release height on the dispersion of emissions;

- Proposed Development 100% Hydrogen Firing - modelling emissions from the CCGT when firing on 100% hydrogen at a release height of 85m AGL (87.8m above ordnance datum (AOD)) and processing the results on a receptor grid and at discrete sensitive human and ecological receptors for all pollutants emitted from the stack;
- Proposed Development 100% Natural Gas Firing - modelling emissions from the CCGT when firing on 100% Natural Gas at a release height of 85m AGL (88m above ordnance datum (AOD)), and processing the results on a receptor grid and at discrete sensitive human and ecological receptors for all pollutants emitted from the stack;
- Reporting of the impacts for the CCGT firing scenario that results in the highest impacts of each pollutant modelled, at the worst case human health receptor and at all ecological receptors.

Model inputs

8B.3.3. The general model conditions used in the assessment are summarised in Table 8B.1.

Table 8B.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 8B.4** and **Table 8B.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
Emissions	IED emission limits, BAT-AELs and GET values and data provided by OEMs – see Section 8B.3.4.
Sources	1 x CCGT Stack for Keadby 2 Power Station 1 x CCGT Stack for the Proposed Development

Variable	Input
Meteorological data	5 years of meteorological data, Doncaster Robinhood Airport Meteorological Station (2018 - 2022)
Terrain data	Not required
Buildings that may cause building downwash effects	Keadby 2 Power Station gas turbine hall, HRSG building and steam turbine hall. Proposed Development gas turbine hall, HRSG building and steam turbine hall.

Emissions data

8B.3.4. During normal operation, the CCGT stack would be the primary source of emissions from the combustion process 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.

8B.3.5. It is considered that 85m AGL is the appropriate stack height that would result in not significant impacts at human health receptors for natural gas and hydrogen firing 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 8B.2 and are illustrated in **ES Volume III Figure 8.4:** Operational Study Area – Modelled Buildings (**Application Document 6.4**).

Table 8B.2: Emissions inventory

Parameter	Unit	Keadby 2 Power Station HRSG stack	Proposed Development	
			100% Natural Gas Firing	100% Hydrogen Firing
Stack position	(NGR) m	482720, 411640	482064, 411945	
Stack release height (AGL)	m	75	85	
Internal stack diameter	m	8.0	8.4	
Flue temperature	°C	80	75.0	75.0
Flue H_2O content	%	11.8	10.1	16.0

Parameter	Unit	Keadby 2 Power Station HRSG stack	Proposed Development	
			100% Natural Gas Firing	100% Hydrogen Firing
Flue O_2 content (dry)	%	9.8	11.5	13.8
Stack gas exit velocity	m/s	20.7	19.1	19.7
Stack flow (actual)	Am^3/s	1,040	1,058	1,091
Stack flow at normalised conditions (STP, dry, 15% O_2)	Nm^3/s	1,129	1,176	860
STP = Standard temperature and pressure (0°C, 1 atmosphere (101.325 kilopascals))				

8B.3.1. It is recognised that the actual stack location has not been fixed, however it is considered that should the stack be located within 30m of its assessed location, the effect on the assessment results would not change the assessment outcome, considering all the worst-case assumptions that have been applied in the assessment.

8B.3.2. For 100% firing on natural gas, emission concentrations of NOx 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). Where a CCGT has an electrical efficiency greater than 55% (as will be the case for the Proposed Development) a correction factor can be applied to these BAT-AELs to increase the BAT-AEL to compensate for the slightly higher emission concentrations that result from improved efficiencies.

8B.3.3. NOx has 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.

8B.3.4. For 100% hydrogen firing, the GET details applying a correction factor of 1.37 to the ELVs provided in the IED, which for NOx is 50 mg/Nm^3. As such, the emission concentrations of NOx during 100% hydrogen firing will be required to be no higher than 68.5mg/Nm^3 as an annual average.

8B.3.5. For all emissions modelling, it is considered that modelling at these maximum values represents the worst-case impacts; in practice, emission

concentrations are likely to be lower than permitted Emission Limits concentrations.

8B.3.6. A NOx abatement system such as SCR may be required to achieve the required NOx emission concentrations for the Proposed Development. SCR reduces NO_x concentrations by spraying NH_3 into the flue gas and therefore will result in 'ammonia slip' with a resulting emission of NH_3. Emissions of NH_3 have therefore also been included in the assessment at a concentration of 3mg/Nm^3. It should be noted that if SCR is required, emissions of NH_3 would likely be less than 3mg/Nm^3, which has been demonstrated by the operation of Keadby 2, which to-date has measured annual emissions of NH_3 below 1mg/Nm^3 compared to the permitted emission limit of 3.8mg/m^3. It is therefore considered that the presented assessment in terms of NH_3 emissions and nitrogen deposition impacts is very much worst case.

8B.3.7. The modelled pollutant emission rates (in grams per second (g/s)) have been calculated by multiplying the relevant 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 8B.3.

8B.3.8. 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 8B.3: Emission concentrations and the assessed emission rates

Pollutant	Keadby 2 Power Station		Proposed Development CCGT stack			
	Emission conc^{n} (mg/Nm^3)	Emission rate (g/s)	Natural gas emission conc^{n} (mg/Nm^3)	Natural gas emission rate (g/s)	Hydrogen emission conc^{n} (mg/Nm^3)	Hydrogen emission rate (g/s)
Oxides of Nitrogen (NO_x (as NO_2))	34 (annual average)[1] 45 (daily average)[2]	38.5 (annual average) 51.2 (daily average)	34 (annual average)[1] 45 (daily average)[2]	40.1 (annual average) 53.4 (daily average)	68.5	58.9
Carbon Monoxide (CO)	100	112.9	100	117.6	Not applicable	
Ammonia (NH_3)	3.8	4.3	3.0	3.5	3.0	2.6

[1] Correction factor applied to the BAT-AEL based on 30 × 61/55 – (assuming 61% net electrical efficiency)

[2] Correction factor applied to the BAT-AEL based on 40 × 61/55 – (assuming 61% net electrical efficiency)

Modelled domain – discrete receptors

Sensitive human receptors

8B.3.9. 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 8B.4. The locations of these receptors are also shown in **ES Volume III Figure 8.1:** Operational Study Area – Human Health Receptors (**Application Document 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 8B.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	483035	411880	780m north-east
OR2	1 Trent Side, Keadby	483370	411285	1.2km south-east
OR3	North Pilfrey Farm	480855	411405	990m south-west
OR4	Keadby Grange	481565	410910	900m south
OR5	Pharon-Ville - Gunness	484060	411660	1.8km east
OR6	Boskeydyke Farm, Amcotts	483860	413350	2.0km north-east
OR7	Grange Cottage, Gunness	484710	412315	2.5km north-east
OR8	Pilfrey Farm	480770	409995	2.1km south-west
OR9	Thorne Village	469570	412680	12.2km west
OR10	Vazon Bridge House[1]	482510	411500	455m south
OR11	North Moor Farm	482875	412620	740m north-west
OR12	Trent Road	483400	411620	1km east

[1] Taken to also be representative Scunthorpe Sea Cadets.

Sensitive ecological receptors

8B.3.10. In accordance with the Environment Agency's 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.

8B.3.11. In additional, LWS within 2km of the Proposed Development have also been included in the assessment.

8B.3.12. Ground-level concentrations of the modelled pollutants relevant to sensitive ecological receptors have been predicted at locations listed in Table 8B.5. The locations of these receptors are also shown in **ES Volume III Figure 8.2:** Operational Study Area – Ecological Receptors (**Application Document 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 8B.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 south-west

I.D.	Receptor description	Designation	Grid reference		Distance and direction from the operational Main Site
			X	Y	
OE7	Hatfield Chase Ditches	SSSI	478769	410293	3.3km south-west
OE8	Eastoft Meadow	SSSI	478772	414311	3.6km 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
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

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

Modelled domain – receptor grid

8B.3.13. Emissions from the Proposed Development CCGT stack have been modelled on a receptor grid that is 4km by 4km centred on the stack. The grid spacing is 44m, which is considered appropriate for a 85m stack.

8B.3.14. In addition, the receptors detailed in Tables 8B.4 and 8B.5 have been included as specified points within the model and therefore are unaffected by grid spacing.

8B.3.15. In order to produce isopleths for ecological receptors, a larger grid has also been used.

Meteorological data

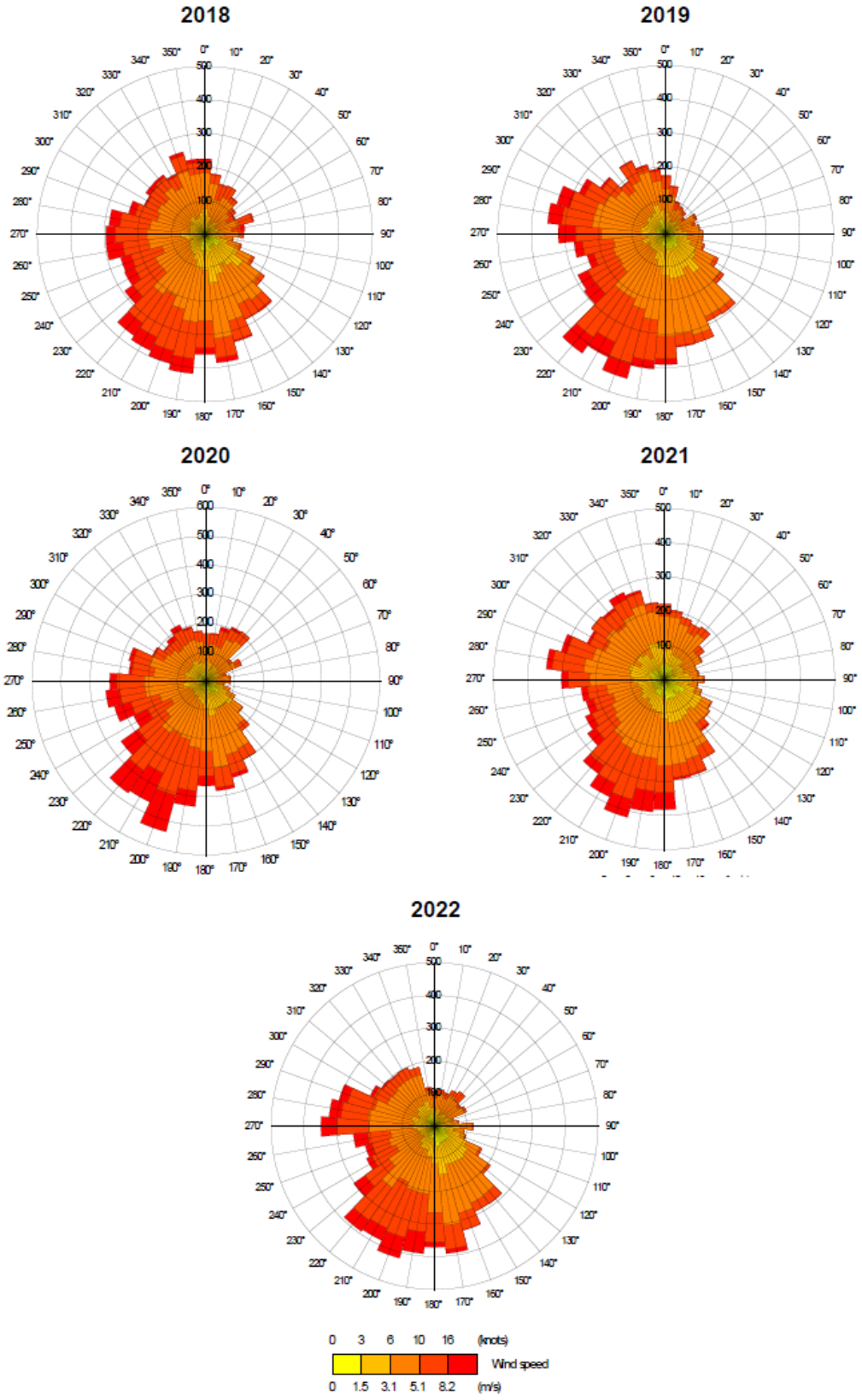
8B.3.16. Actual measured hourly-sequential meteorological data is available for input into dispersion models, and it is important to select data as representative as possible for the site that will be modelled. This is usually achieved by selecting a meteorological station as close to the site as possible, although other stations may be used if the local terrain and

conditions vary considerably, or if the station does not provide sufficient data.

8B.3.17. 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.

8B.3.18. The modelling for this assessment has utilised 5 years of meteorological data for the period 2018 – 2022. Wind roses for each of the years within this period are shown in **Plate 8B.1**.

Plate 8B.1: Wind roses for Doncaster Robin Hood Airport, 2018 to 2022



Building downwash effects

8B.3.19. 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.

8B.3.20. 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 8B.6. A plan showing the buildings layout used in the ADMS simulation is illustrated in **ES Volume III Figure 8.4**: Air Quality, Operational study area, Modelled Buildings (**Application Document Ref. 6.4**).

8B.3.21. The dimensions of the buildings included in the model are the maximum measurements that could potentially be required (as defined in the Rochdale Envelope) and have been provided by the Design Engineers.

Table 8B.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	482720	411640	40	26	46	92
Keadby 2 Power Station GT	482720	411676	30	47	20	92
Keadby 2 Power Station Building	482660	411640	30	46	46	91
Keadby Next Generation HRSG	482105	411925	58	74	33	91
Keadby Next Generation GT	482150	411920	32	23	53	91
Keadby Next Generation Power Station Building	482105	411980	39	61	58	91

Terrain

8B.3.22. 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.

8B.3.23. Site-specific terrain data has not been used in the model, as there are no potentially significant changes in gradient within the study area.

NOx to NO_2 conversion

8B.3.24. 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.

8B.3.25. 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.

Calculation of deposition at sensitive ecological receptors

8B.3.26. 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

(National Highways, 2020) (IAQM, 2020), which takes into account variations in the deposition mechanisms for different types of habitat.

8B.3.27. The conversion rates and factors used in the assessment are shown in Table 8B.7.

Table 8B.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)
NOx as NO_2	0.0015	0.003	96	6.84
NH_3	0.02	0.03	259.7	18.5

Specialised model treatments

8B.3.28. 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.

8B.4. Baseline Air Quality

Overview

8B.4.1. 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.

Air Quality Management Areas

8B.4.2. 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.

8B.4.3. 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.

Local authority monitoring data

8B.4.4. NLC undertook automatic monitoring for NO_2 at 6 sites within their administrative area in 2022 and undertook diffuse on tube monitoring at 24 locations.

8B.4.5. 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 2022 at CM1 monitor was 13µg/m^3 and at CM3 it was also 13µg/m^3.

8B.4.6. 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 20 - 24µg/m^3, well below the annual AQAL of 40µg/m^3.

8B.4.7. 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, and therefore that they are not representative of background concentrations in the vicinity.

Defra background data

8B.4.8. Defra's 2021-based background maps are available at a 1x1 km resolution for the UK for 2021 and are projected forward to the year 2040. These projections of pollution concentrations across England are available for NO_2 and NOx.

8B.4.9. Background concentrations for NOx and NO_2 from the Defra 20121-based background maps are presented for the year 2018 in Table 8B.8. 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 2021 using the Defra published year adjustment factors.

8B.4.10. Data for 2021 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 NOx 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 earliest potential opening year of the Proposed Development (2030), is considered to represent a conservative approach, and is in line with advice from the Environment Agency on similar projects.

8B.4.11. A review of the background map concentrations over the study area for human health receptors shows that the concentrations presented in Table 8B.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 6.7µg/m^3), however to enable a worst case assessment, the maximum value from receptors in the vicinity of the Proposed Development has been used. The additional contribution from the Keadby 2 power station is also shown, together with the modified background concentration for use in the assessment.

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

Pollutant	Defra Background concentration (µg/m^3)	Keadby 2 Process Contribution (µg/m^3)	K2 Modified Background concentration (µg/m^3)
NOx	8.44	0.99	9.43

Pollutant	Defra Background concentration ($\mu g/m^3$)	Keadby 2 Process Contribution ($\mu g/m^3$)	K2 Modified Background concentration ($\mu g/m^3$)
NO_2	6.64	0.69	7.33
CO	114.6	142.6	257.2

Ecological site background data

8B.4.12. The NOx 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 8B.9, together with the modelled PCs from the Keadby 2 power station (shown in parenthesis), and the modified background concentrations.

Table 8B.9: APIS background data NO_x and NH_3 (2020 – 2022 data) and K2 modified background concentrations

Receptor I.D.	Ecology site	APIS Backgrounds		K2 Modified Background concentration ($\mu g/m^3$)	
		NOx ($\mu g/m^3$)	NH_3 ($\mu g/m^3$)	NOx ($\mu g/m^3$)	NH_3 ($\mu g/m^3$)
OE1-5	Humber Estuary	8.7	1.9	(0.7) 9.3	(0.07) 2.0
OE6	Crowle Borrow Pits	8.7	1.8	(0.1) 8.7	(0.01) 1.8
OE7	Hatfield Chase Ditches	8.8	1.8	(0.1) 8.9	(0.01) 1.8
OE8	Eastoft Meadow	7.8	1.9	(0.1) 7.8	(0.01) 1.9
OE9	Belshaw	7.8	1.7	(0.1) 7.8	(0.01) 1.7
OE10	Thorne Moor	7.8	1.7	(0.1) 7.9	(0.01) 1.7
OE11	Epworth Turbary	7.7	1.6	(0.1) 7.8	(0.01) 1.6
OE12	Risby Warren	11.1	1.9	(0.1) 11.3	(0.01) 1.9
OE13	Hatfield Moor	8.5	1.5	(0.0) 8.5	(0.00) 1.5
OE14	Messingham Heath	8.1	2.1	(0.1) 8.2	(0.01) 2.1
OE15	Tuetoes Hills	7.6	2.0	(0.1) 7.7	(0.01) 2.0
OE16	Haxey Turbary	7.6	1.5	(0.1) 7.7	(0.01) 1.5
OE17	Rush Furlong	7.5	1.6	(0.1) 7.6	(0.01) 1.6
OE18	Hewsons Field	7.6	1.6	(0.1) 7.7	(0.01) 1.6

Receptor I.D.	Ecology site	APIS Backgrounds		K2 Modified Background concentration (µg/m^3)	
		NOx (µg/m^3)	NH_3 (µg/m^3)	NOx (µg/m^3)	NH_3 (µg/m^3)
OE19	Messingham Sand Quarry	8.2	2.1	(0.1) 8.3	(0.01) 2.1
OE20	Manton and Twigmoor	8.6	2.1	(0.1) 8.7	(0.01) 2.1
OE21	Scotton and Laughton Forest Ponds	7.7	1.9	(0.1) 7.8	(0.01) 1.9
OE22	Broughton Far Wood	9.8	2.3	(0.1) 9.9	(0.01) 2.3
OE23	Broughton Alder Wood	9.9	2.3	(0.1) 10.0	(0.01) 2.3
OE24	Scotton Beck Field	8.0	2.1	(0.1) 8.1	(0.01) 2.1
OE25	Scotton Common	8.0	1.9	(0.1) 8.0	(0.01) 1.9
OE26	Laughton Common	7.5	1.7	(0.1) 7.6	(0.01) 1.7
OE27	Stainforth and Keadby Canal Corridor	8.8	1.9	(0.0) 8.8	(0.00) 1.9
OE28	Keadby Wetland	8.8	1.9	(0.0) 8.8	(0.00) 1.9
OE29	Keadby Wet Grassland	8.8	1.9	(0.0) 8.8	(0.00) 1.9
OE30	Three Rivers	8.9	1.9	(0.2) 9.1	(0.03) 1.9
OE31	Ash Tip	8.6	1.9	(0.1) 8.7	(0.01) 1.9
OE32	Humber Estuary (at Blacktoft Sands)	9.5	1.7	(0.2) 9.7	(0.02) 1.7

8B.4.13. In addition, the APIS website provides information on the relevant critical load ranges for the assessment of depositional impacts, as well as background nitrogen deposition and acid deposition loads. The background data is presented in Table 8B.10, and the relevant critical load classes and ranges are shown in the results Tables 8B.16 and 8B.17. Where woodland and forest habitats are specified, the higher background deposition concentrations relating to such habitats have been used, with

the background for all other habitat types being taken as those for short vegetation.

8B.4.14. Table 8B.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 8B.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	16.0	1.15	0.16	(0.45) 16.4	(0.032) 1.182
OE6	28.3 woodland 14.8 others	2.02	0.17	(0.09) 28.4 (0.06) 14.9	(0.007) 2.027
OE7	No comparable habitat with established critical load estimate available[1]				
OE8	14.6	1.04	0.13	(0.05) 14.6	(0.004) 1.044
OE9	No Critical Load Assigned				
OE10	27.0 woodland 14.1 other	1.91 1.00	0.16 0.12	(0.06) 27.0 (0.04) 14.1	(0.004) 1.914 (0.003) 1.003
OE11	13.5	0.96	0.12	(0.04) 13.5	(0.003) 0.963
OE12	17.4	1.24	0.2	(0.08) 17.5	(0.006) 1.246
OE13	25.0 woodland 13.0 other	1.79 0.93	0.16 0.12	(0.04) 25.0 (0.03) 13.0	(0.003) 1.793 (0.002) 0.932
OE14	16.9	No acidity critical loads		(0.07) 17.0	NA
OE15	15.3	No acidity critical loads		(0.05) 15.4	NA
OE16	13.2	0.95	0.12	(0.04) 13.3	(0.003) 0.953
OE17	13.6	0.97	0.12	(0.04) 13.7	(0.003) 0.973
OE18	13.6	0.97	0.12	(0.04) 13.6	(0.003) 0.973
OE19	32.6 woodland 17.4 other	2.33 N/A	0.18 N/A	(0.08) 32.7 (0.05) 17.5	(0.006) 2.336
OE20	33.2 woodland 17.7 other	2.37	0.18	(0.07) 33.3 (0.04)17.8	(0.006) 2.376
OE21	30.0 woodland	2.13	0.16	(0.08) 30.0	(0.005) 2.085

Receptor I.D.	APIS Backgrounds			K2 Modified Background concentration (µg/m³)	
	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)
	15.8 other	1.12	0.12	(0.05) 15.8	(0.003) 1.093
OE22	35.6 woodland	2.54	0.23	(0.09) 35.7	(0.006) 2.546
	19.0 other	1.36	0.18	(0.06) 19.1	(0.004) 1.364
OE23	Designated feature/ feature habitat not sensitive to eutrophication				
OE24	16.6	No acidity critical loads		(0.05) 16.7	N/A
OE25	16.1	1.15	0.12	(0.05) 16.2	(0.004) 1.154
OE26	14.7	1.02	0.12	(0.04) 14.7	(0.003) 1.023
OE27	15.5	1.11	0.15	(0.00) 15.5	(0.002) 1.112
OE28	29.5	2.11	0.19	(0.03) 29.5	(0.001) 2.111
OE29	No comparable habitat with established critical load estimate available				
OE30	16.0	1.14	0.15	(0.12) 16.1	(0.008) 1.148
OE31	15.3	1.09	0.14	(0.06) 15.4	(0.001) 1.091
OE32	14.7	Not sensitive to acid deposition		(0.11) 14.8	N/A

[1] The aquatic species present at Hatfield Chase Ditches are rooted within the watercourse and therefore an approach for aquatic habitats is considered appropriate, rather than assessing this habitat as Rich fens. Aquatic species are not affected by N deposition to foliage, and freshwater environments are typically phosphorus limited and therefore it is the availability of phosphorus which dictates the growth response of freshwater vegetation and thus eutrophication. The emergents named on the SSSI citation as typical to dominant are all species of eutrophic lowland watercourses.

Summary of background air quality

8B.4.15. 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 8B.8.

8B.4.16. The background NOx 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 8B.9 and 8B.10.

8B.4.17. 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.

8B.4.18. 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 earliest opening year of 2030.

8B.5. Operational Emissions Modelling Results

Evaluation of stack height

8B.5.1. 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.

8B.5.2. The emissions from the operational Proposed Development occur from a stack adjacent to the HRSG Building. The HRSG building has been included in the model at a maximum height of 58m AGL.

8B.5.3. The CCGT stack has been modelled at heights between 70m and 100m, at 5m increments for the hydrogen firing scenario, as this was found to lead to the worst case impacts for NO_2 and NOx and will be the long term mode of operation.

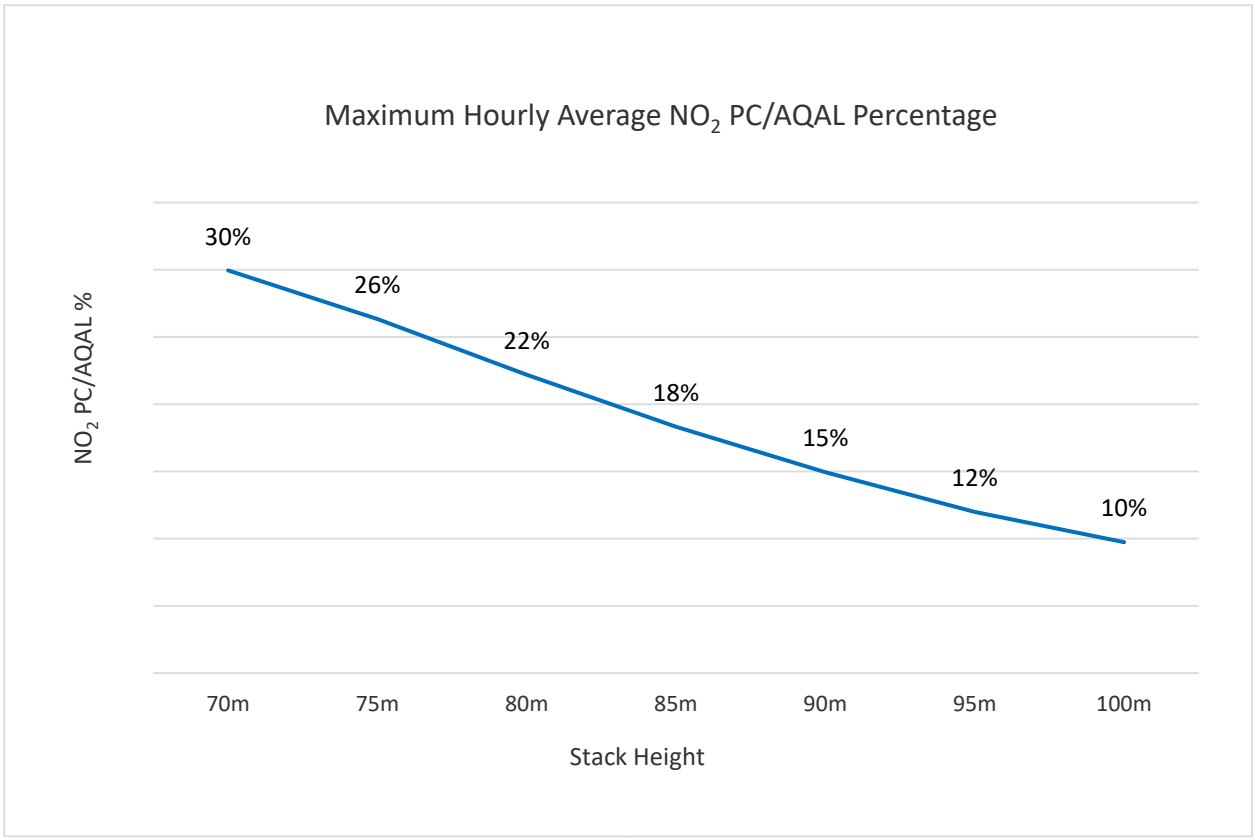
8B.5.4. A graph showing the percentage PC against the relevant AQAL for the maximum annual mean and maximum 1-hour NO_2 concentrations is presented in **Plate 8B.2**. The purpose of the graph is to evaluate the optimum release height in terms of the dispersion of pollutants which would occur, against 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.

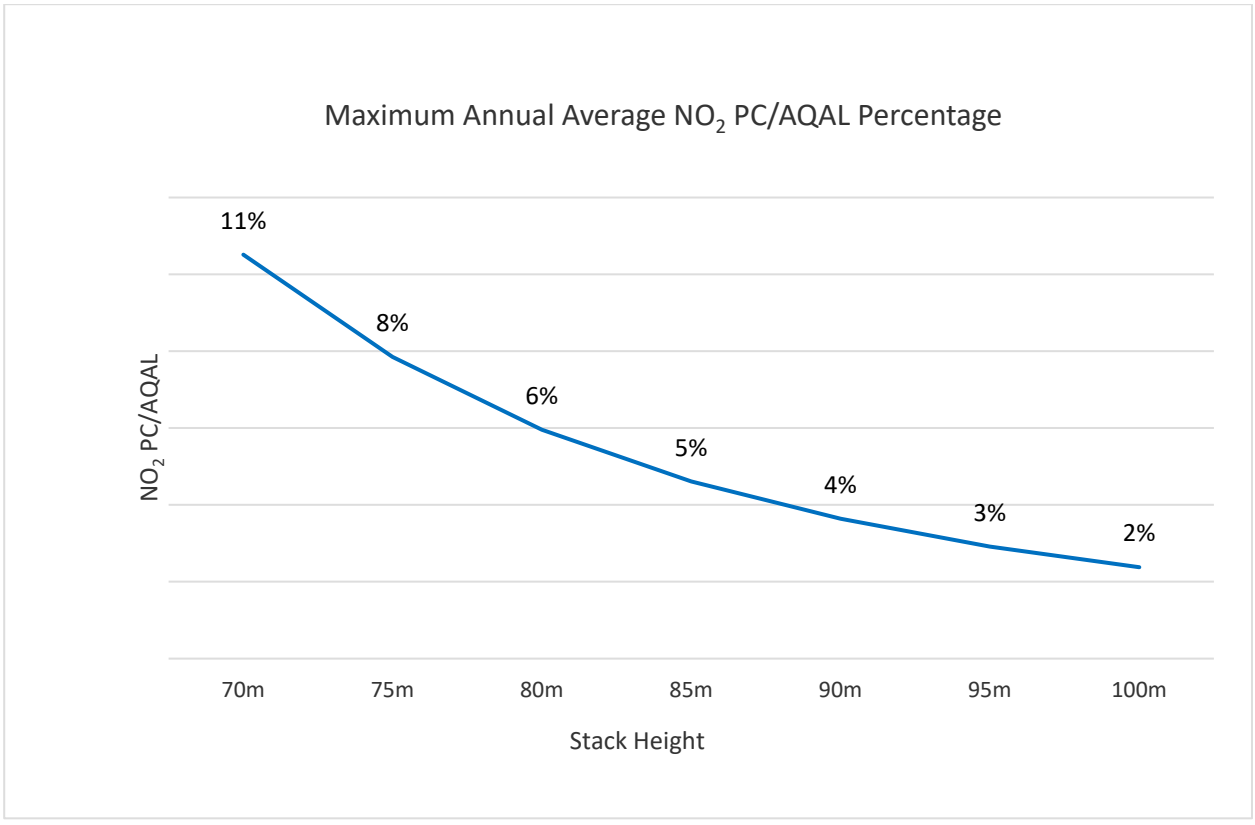
8B.5.5. Analysis of the curves shows that there is no obvious "elbow" to the curve, however after a stack height of 85m the reduction in the impacts becomes

less pronounced with each 5m increase. The reported results are therefore based on an 85m AGL stack.

~~8B.5.5.~~8B.5.6. Any change in the stack height that may result after further detailed design of the Proposed Development would be remodelled to ensure that the predicted impacts remain in accordance with the predicted impacts presented in this assessment at all receptors.

Plate 8B.2: Stack Height Determination (Hydrogen Firing)





Human Health Receptor Results

Nitrogen dioxide emissions

~~8B.5.6.~~8B.5.7. 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 8B.11. The results shown represent the highest (worst-case) result from all five years of the meteorological data used in the model for the operating scenario that resulted in the highest impacts at receptors (100% hydrogen firing).

~~8B.5.7.~~8B.5.8. The maximum predicted annual mean NO_2 concentration that occurs anywhere within the study area as a result of the Proposed Development is 1.8µg/m^3, which represents 4.6% of the annual mean AQAL. This occurs approximately 700m to the northeast of the stack associated with the operational Proposed Development. The annual mean NO_2 predicted environmental concentration (PEC) (i.e. the PC + the K2 modified background concentration) is 9.2µg/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.

~~8B.5.8.~~8B.5.9. The discrete receptor most affected by emissions from the Proposed Development is receptor OR11 Northmoor Farm, with a predicted annual mean NO_2 PC of 1.3µg/m^3, representing 3.3% of the AQAL. With the background concentration, the PEC represents 20% of the AQAL, and therefore is considered to be well below the PEC and an exceedance of the AQAL as a result of the operation of the Proposed Development. The significance of the predicted change in annual mean NO_2 concentrations is discussed in **ES Volume I Chapter 8**: Air Quality (**Application Document Ref. 6.2**).

Table 8B.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	1.8	4.6%	7.3	9.2	23%
OR1		0.7	1.7%	6.8	7.4	19%
OR2		0.4	1.0%	6.9	7.3	18%
OR3		0.3	0.7%	6.5	6.8	17%
OR4		0.3	0.8%	6.2	6.6	16%
OR5		0.4	1.1%	7.6	8.0	20%

Receptor	AQAL (µg/m^3)	PC (µg/m^3)	PC/AQAL %	Modified Background Concentration (BC) (µg/m^3)	PEC (µg/m^3)	PEC/ AQAL %
OR6		0.5	1.4%	6.7	7.2	18%
OR7		0.3	0.8%	7.1	7.4	19%
OR8		0.2	0.5%	6.4	6.6	16%
OR9		0.03	0.1%	8.2	8.3	21%
OR10		0.2	0.5%	6.6	6.8	17%
OR11		1.3	3.3%	6.6	7.9	20%
OR12		0.5	1.4%	7.0	7.5	19%

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

~~8B.5.9.~~8B.5.10. The maximum predicted hourly mean NO_2 concentration (as the 99.79th percentile of hourly averages) that occurs anywhere within the study area as a result of the Proposed Development is 36.6µg/m^3, and this occurs approximately 500m northeast of the stack associated with the operational Proposed Development. The PEC (i.e. the PC + the Keadby 2 modified background concentration) is 51.3µg/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.

~~8B.5.10.~~8B.5.11. 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 17.8µg/m^3, representing 9% of the AQAL.

Table 8B.12: Predicted change in hourly mean NO_2 concentrations (as the 99.79th Percentile of Hourly Averages)

Receptor	AQAL (µg/m^3)	PC (µg/m^3)	PC/AQAL %	Modified BC (µg/m^3)	PEC (µg/m^3)	PEC/ AQAL %
Max anywhere	200	36.6	18%	14.7	51.3	26%
OR1		14.5	7%	13.5	28.1	14%
OR2		9.5	5%	13.7	23.3	12%
OR3		11.8	6%	13.0	24.8	12%
OR4		12.8	6%	12.5	25.2	13%

Receptor	AQAL (µg/m^3)	PC (µg/m^3)	PC/AQAL %	Modified BC (µg/m^3)	PEC (µg/m^3)	PEC/ AQAL %
OR5		6.9	3%	15.1	22.1	11%
OR6		7.7	4%	13.4	21.1	11%
OR7		5.2	3%	14.2	19.4	10%
OR8		5.8	3%	12.7	18.5	9%
OR9		1.7	1%	16.5	18.2	9%
OR10		13.2	7%	13.3	26.5	13%
OR11		17.8	9%	13.2	31.0	15%
OR12		10.3	5%	14.0	24.2	12%

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

Carbon monoxide emissions

~~8B.5.11.~~8B.5.12. Carbon monoxide emissions are only released if the Proposed Development is fired on Natural Gas. If required to operate on 100% Natural Gas, the maximum hourly and 8-hour running mean PC that occur anywhere as a result of the Proposed Development represent 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 Keadby 2 modified background concentrations in the study area, the PEC is 6% or less of the relevant AQAL for both averaging periods. The results at individual receptors have therefore not been presented.

Ammonia emissions

~~8B.5.12.~~8B.5.13. The maximum annual and hourly average PCs of ammonia occur when firing on 100% Natural Gas, due to the higher mass release rate that results from this mode of operation. The predicted PCs that occur anywhere as a result of the Proposed Development represent less than 1% of the relevant AQALs 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 hourly PEC remains less than 1% of the relevant AQAL, and the annual average PEC is only 1.5% of the relevant AQAL. As the maximum impacts can be considered insignificant, the results at individual receptors have not been presented.

Ecological Receptor Results

~~8B.5.13.~~8B.5.14. The results of the dispersion modelling of predicted impacts on sensitive ecological receptors are presented in Table 8B.14 to Table 8B.17. The tables set out the predicted PC compared to the atmospheric

concentrations of NOx and NH_3 and also nutrient nitrogen and acid deposition.

~~8B.5.14.~~8B.5.15. 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.

~~8B.5.15.~~8B.5.16. 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.

~~8B.5.16.~~8B.5.17. The effect of atmospheric NOx concentrations, nitrogen deposition rates and acid deposition rates on the modelled SAC and SPA receptor locations is considered in detail in the report to inform the **Habitats Regulations Assessment Appropriate Assessment Report** (HRA) (**Application Document Ref. 5.2**). Further discussion on the significance of the impact on nationally ~~sensitive~~ designated ecological receptors is provided in **ES Volume I Chapter 11**: Biodiversity and Nature Conservation (**Application Document Ref. 6.2**).

Oxides of nitrogen emissions – Critical Levels

~~8B.5.17.~~8B.5.18. The assessment results show that the predicted annual average and daily average NOx impacts are below the criteria for insignificance at the majority of the ecological receptors assessed for the operating scenario that resulted in the highest impacts at receptors (100% hydrogen firing).

~~8B.5.18.~~8B.5.19. PCs of more than 1% of the annual average critical level for NOx occur at the adjacent Humber Estuary SAC and SSSI and Ramsar, Keadby Wetland LWS, Keadby Wet grassland LWS and Three Rivers LWS, however in combination with the K2 modified background concentrations, all sites are well below 70% of the critical level threshold for insignificance, therefore no exceedances of the annual critical level are predicted.

~~8B.5.19.~~8B.5.20. The daily critical level is below the 10% screening threshold for insignificance at all the statutory designated sites except for the Humber Estuary SAC and SSSI and the Crowle Borrow Pits SSSI. In combination

with the K2 modified background concentration at the Humber Estuary, the impacts are 41% of the daily critical level and at Crowle Borrow Pits the PEC is 29% of the daily Critical Level and therefore indicate that no exceedance of the daily critical level is predicted at these sites as a result of the operational Proposed Development.

~~8B.5.20.~~8B.5.21. Four of the LWS have impacts over the 10% daily critical level, however again with the K2 modified 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.

~~8B.5.21.~~8B.5.22. 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.

Table 8B.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	0.81	2.7%	9.4	10.2	34%	75	16.4	22%	14.0	30.4	41%
OE6	Crowle Borrow Pits SSSI		0.18	0.6%	8.7	8.9	30%		8.9	12%	13.1	22.0	29%
OE7	Hatfield Chase Ditches SSSI		0.15	0.5%	8.9	9.0	30%		7.4	10%	13.3	20.7	28%
OE8	Eastoft Meadow SSSI		0.13	0.4%	7.8	7.9	26%		3.4	4%	11.7	15.1	20%
OE9	Belshaw SSSI		0.13	0.4%	7.8	8.0	27%		2.8	4%	11.8	14.5	19%
OE10	Thorne Moor SAC		0.08	0.3%	7.9	7.9	26%		2.4	3%	11.8	14.2	19%
OE11	Epworth Turbary SSSI		0.11	0.4%	7.8	7.9	26%		2.4	3%	11.7	14.0	19%
OE12	Risby Warren SSSI		0.16	0.5%	11.3	11.4	38%		2.0	3%	16.9	18.9	25%
OE13	Hatfield Moor SAC		0.06	0.2%	8.5	8.6	29%		1.8	2%	12.8	14.6	19%
OE14	Messingham Heath SSSI		0.13	0.4%	8.2	8.3	28%		2.0	3%	12.3	14.3	19%
OE15	Tuetoes Hills SSSI		0.11	0.4%	7.7	7.8	26%		1.6	2%	11.5	13.1	17%
OE16	Haxey Turbary SSSI		0.09	0.3%	7.7	7.8	26%		2.2	3%	11.5	13.7	18%
OE17	Rush Furlong SSSI		0.10	0.3%	7.6	7.7	26%		1.7	2%	11.4	13.1	17%
OE18	Hewsons Field SSSI		0.09	0.3%	7.7	7.8	26%		1.6	2%	11.5	13.2	18%

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		0.11	0.4%	8.3	8.4	28%		1.4	2%	12.4	13.9	18%
OE20	Manton and Twigmoor SSSI		0.12	0.4%	8.7	8.8	29%		1.9	2%	13.0	14.9	20%
OE21	Scotton and Laughton Forest Ponds SSSI		0.11	0.4%	7.8	7.9	26%		1.5	2%	11.7	13.2	18%
OE22	Broughton Far Wood SSSI		0.12	0.4%	9.9	10.0	33%		1.2	2%	14.8	16.1	21%
OE23	Broughton Alder Wood SSSI		0.12	0.4%	10.0	10.1	34%		1.3	2%	15.0	16.3	22%
OE24	Scotton Beck Fields SSSI		0.10	0.3%	8.1	8.2	27%		1.5	2%	12.1	13.5	18%
OE25	Scotton Common SSSI		0.10	0.3%	8.0	8.1	27%		1.4	2%	12.0	13.4	18%
OE26	Laughton Common SSSI		0.08	0.3%	7.6	7.7	26%		1.1	2%	11.4	12.5	17%
OE27	Stainforth and Keadby Canal Corridor LWS		0.30	1.0%	8.8	9.1	30%		22.3	30%	13.2	35.5	47%
OE28	Keadby Wetland LWS		0.57	1.9%	8.8	9.4	31%		24.9	33%	13.2	38.1	51%
OE29	Keadby Wet Grassland LWS		0.46	1.5%	8.8	9.3	31%		22.8	30%	13.2	36.0	48%
OE30	Three Rivers LWS		0.38	1.3%	9.1	9.4	31%		11.4	15%	13.6	25.0	33%

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
OE31	Ash tip		0.09	0.3%	8.7	8.8	29%		11.5	15%	13.0	24.6	33%
OE32	Humber Estuary (at Blacktoft Sands) Ramsar, SAC, SPA and SSSI		0.23	0.8%	9.7	9.9	33%		1.9	3%	14.5	16.4	22%

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

Ammonia – Critical Levels

8B.5.23. The assessment results show that the predicted annual average NH_3 impacts at all the ecological receptors for the worst case operating scenario (100% Natural Gas firing) are below the criteria for insignificance (≤1% of the critical level) for all but two habitat receptors and therefore can be considered insignificant where this is the case. When combined with the K2 modified background concentrations, the impacts at the Humber Estuary SSSI, SAC and Ramsar and the Keadby Wetland LWS are both less than 70% of the critical level and therefore can be considered to be insignificant.

8B.5.24. For a number of receptors (OE7, OE22 and OE23) the results have been presented against the critical levels for both higher plants and bryophytes and lichens. Whilst it is recognised that APIS states that the lower critical level is applicable at these sites, previous detailed study of these areas for the Keadby 3 DCO highlighted that although bryophytes were present, they were not considered to be an integral part of the SSSI feature. It is therefore considered appropriate that the critical level of 3ug/m^3 can be used for detailed assessment at these receptors.

8B.5.25. The NH_3 levels at Risby Warren SSSI represents 1% of the lower Critical Level value for NH_3, however, the background level is already 191% of the lower Critical Level value, with the PC adding negligibly to this. The APIS website indicates that most ammonia emissions come from agricultural sources, and this is likely to be the prevailing source at Risby Warren given it is surrounded by arable cultivation. Industrial sources within Scunthorpe, which is closer to the SSSI than the Proposed Development, are also likely to be substantive contributors to the NH_3 received at the SSSI. Until these more significant sources of NH_3 are addressed, it is considered that NH_3 concentrations are not likely to fall sufficiently to allow recolonisation by lichens and bryophytes at this site. It is therefore considered that the effects of NH_3 from the Proposed Development are not significant.

~~8B.5.22.~~8B.5.26. Further interpretation of the significance of these results, is provided in ~~the main **ES Volume I Chapter 8**: Air Quality and in~~ **ES**

Volume I Chapter 11: Biodiversity and Nature Conservation (**Application Document Ref. 6.2**).

Table 8B.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	0.05	1.7%	1.96	2.01	67%
OE6	Crowle Borrow Pits SSSI	3 1	0.01	0.4% 1.1%	1.81	1.82	61% 182%
OE7	Hatfield Chase Ditches SSSI	3	0.01	0.3%	1.81	1.82	61%
OE8	Eastoft Meadow SSSI	3	0.01	0.3%	1.91	1.92	64%
OE9	Belshaw SSSI	3	0.01	0.3%	1.71	1.72	57%
OE10	Thorne Moor SAC	1	0.01	0.5%	1.71	1.71	171%
OE11	Epworth Turbary SSSI	1	0.01	0.7%	1.61	1.61	161%
OE12	Risby Warren SSSI	1	0.01	1.0%	1.91	1.92	192%
OE13	Hatfield Moor SAC	1	0.004	0.4%	1.50	1.51	151%
OE14	Messingham Heath SSSI	1	0.01	0.8%	2.11	2.12	212%
OE15	Tuetoes Hills SSSI	1	0.01	0.7%	2.01	2.02	202%
OE16	Haxey Turbary SSSI	1	0.01	0.6%	1.51	1.51	151%
OE17	Rush Furlong SSSI	3	0.01	0.2%	1.61	1.61	54%
OE18	Hewsons Field SSSI	3	0.01	0.2%	1.61	1.61	54%
OE19	Messingham Sand Quarry SSSI	1	0.01	0.2%	2.11	2.12	71%
OE20	Manton and Twigmoor SSSI	1	0.01	0.7%	2.11	2.12	212%
OE21	Scotton and Laughton Forest Ponds SSSI	1	0.01	0.7%	1.91	1.91	191%
OE22	Broughton Far Wood SSSI	3 1	0.01	0.3% 0.8%	2.31	2.32	77% 232%
OE23	Broughton Alder Wood SSSI	3 1	0.01	0.2% 0.7%	2.31	2.32	77% 232%
OE24	Scotton Beck Fields SSSI	1	0.01	0.6%	2.11	2.11	211%
OE25	Scotton Common SSSI	1	0.01	0.6%	1.91	1.91	191%
OE26	Laughton Common SSSI	1	0.005	0.5%	1.71	1.71	171%
OE27	Stainforth and Keadby Canal Corridor LWS	3	0.02	0.6%	1.90	1.92	64%
OE28	Keadby Wetland LWS	3	0.04	1.2%	1.90	1.94	65%
OE29	Keadby Wet Grassland LWS	3	0.03	1.0%	1.90	1.93	64%

Receptor ID	Site Name	Annual Average (µg/m^3)					
		CL	PC	PC % of CL	Modified BC	PEC	PEC % of CL
OE30	Three Rivers LWS	3	0.02	0.8%	1.92	1.94	65%
OE31	Ash tip	1	0.007	0.7%	1.91	1.92	192%
OE32	Humber Estuary (at Blacktoft Sands) Ramsar, SPA, SAC and SSSI	3	0.01	0.5%	1.72	1.73	58%

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

Nitrogen deposition – Critical Loads

~~8B.5.23.~~8B.5.27. Critical Load ranges account for the variation in ecosystem response across the whole of Europe (CEH and APIS). The assessment has used the lower end of the relevant Critical Load range at each receptor to ensure a conservative assessment is carried out.

~~8B.5.24.~~8B.5.28. The Environment Agency ~~and Natural England have agreed~~consider 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[3]). Natural England, require the consideration of in-combination impacts of other consented schemes, when considering the 1% threshold.

~~8B.5.25.~~8B.5.29. The majority of sites have impacts that can be screened as being insignificant as they are less than 1% of the lower end of the Critical Load range for the worst case operating scenario (100% natural gas firing).

~~8B.5.26.~~ ~~Although t~~The Humber Estuary locations OE1 – OE5 show a PC representing ~~1.6~~3.2% of the lower Critical Load range applied to the assessment for the worst gas firing scenario. ~~, i~~It should be noted however, that the ~~pioneer~~ Atlantic, upper to mid salt marsh habitat type used in the assessment ~~for which the SAC is designated for~~ is not considered to be present at these locations, with only very narrow stands of common reed on the banks of the River Trent at the high water line. Adjacent to this at low tide there are exposed marginal mudflats in the

[3] 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

river. The vegetation closest to the Proposed Development is therefore considered to be transitional reedbed. If rich fen is assumed as a best fit proxy habitat for transitional reaed bed a higher Critical Load of 15kg N/ha/yr could be used. Against this Critical Load, the PC would represent 2.1%, however it is still considered that this Critical Load is over precautionary for the habitat that is present. The potential impact of nitrogen deposition on rich fen relates to its role as a fertiliser that promotes the growth of tall, robust vascular plant species including grasses such as common reed, at the expense of more sensitive species. As the existing habitat is already dominated by such grasses, the small quantity of nitrogen deposition from the Proposed Development is considered unlikely to further affect the composition of the habitat. Further detail and justification of this conclusion is provided in the **Habitats Regulations Assessment Appropriate Assessment Report** (HRA) **(Application Document Ref. 5.2)**

~~8B.5.27. The SAC qualifying saltmarsh is specifically "Salicornia and other annuals colonising mud and sand" which is a pioneer community that would occur within the main Humber Estuary area. The community of relevance is therefore only considered to occur at the estuary proper[4], at the mouth of the River Trent. This is closer to the location of the Humber receptor OE32, which has a PC of 0.10kg N/ha/yr, which represents 0.5% of the Pioneer salt marshes lower Critical Load and therefore would be screened as being insignificant.~~

~~8B.5.28.~~8B.5.30. The Broadleaved deciduous woodland habitat type at the Crowle Borrow Pits receptor OE6 has a PC representing 1.1% of the lower Critical Load value for the worst case operating scenario (100% natural gas firing). Against the upper end of the Critical Load range the PC would represent 0.7%.

~~8B.5.29.~~8B.5.31. For the 100% hydrogen firing scenario, which will be the main mode of operation once hydrogen becomes available to the site, the PC reduces to represent 1.0% of the lower Critical Load value. The background deposition at the site is already 284% of the lower Critical Load value.

~~8B.5.30.~~8B.5.32. The woodland at Crowle Borrow Pit is currently in an unfavourable condition, due to ash dieback and lack of regeneration of trees, which are factors that are likely to be unrelated to N deposition. In addition, the

~~[4] Mapping showing the location of the relevant saltmarsh habitat can be found https://environment.data.gov.uk/explore/6da82900-d465-11e4-8cc3-f0def148f590?download=true – the relevant community is coloured red.~~

woodland is floodplain wet woodland and the identified ground flora is already, and likely naturally, eutrophic in character. It is therefore considered that the 1.1% increase associated with the natural gas firing scenario, would be unlikely to impact the unfavourable condition of the site, given the very high background nitrogen deposition at the site. Additionally, air quality is not an identified pressure on this site.

8B.5.33. The only other site that has a PC that represents more than 1% of the lower Critical Load is Risby Warren (OE12) at 1.31%. Against the upper Critical Load for the Inland sanddrift and dune with siliceous grassland habitat type, the PC would represent 0.4% and therefore would be significantly less than the 1% screening criteria. For the hydrogen firing scenario, the PC ~~remains as~~reduce to 1.1% of the lower Critical Load.

8B.5.34. The impacts at Risby Warren have also been assessed against the slightly higher Critical Load for Lowland to montane, dry to mesic grassland. Against this Critical Load the worst case impacts are 1%.

~~8B.5.31.~~8B.5.35. The background deposition at Risby Warren is already 350% of the lower Critical Load value (and 291% of the Critical Load for Lowland to montane) and therefore it is highly unlikely the predicted additional deposition from the Proposed Development would impact the site further, given that it represents only 0.3% of the existing deposition.

~~8B.5.32.~~8B.5.36. Although N deposition is recognised as a barrier to recovery of the designated interest (lichen heath/ acid grassland) a significant reduction would be required to recover the interest feature, and in these terms the impacts associated with the Proposed Development could be considered inconsequential.

~~8B.5.33.~~8B.5.37. As stated previously, emissions of NH_3 are only as a result of SCR abatement, which may not be needed in order to meet the BAT-AELs and GET ELVs, depending on the final CCGT selection. If SCR were needed, it is likely that the actual annual emissions would be less than 3mg/Nm^3, which has been demonstrated by the operation of Keadby 2, which to-date has measured annual emissions of NH_3 below 1mg/Nm^3 compared to the permitted emission limit of 3.8mg/Nm^3. However, it is unlikely that an Original Equipment Manufacturer would guarantee that such low emissions could be achieved, especially in the light of the early development of hydrogen technology.

~~8B.5.34.~~8B.5.38. Due to the higher conversion factors for nitrogen deposition for NH_3 compared to NO_2, even very small changes in NH_3 emission concentrations can have a large effect on nitrogen deposition. For example, if an annual NH_3 emission concentration of 2mg/Nm^3 was achieved, nitrogen deposition impacts at Crowle Barrow Pits (OE6) and

Risby Warren (OE12) would be reduced to 0.8% and 0.6% of the relevant Critical Loads respectively. Likewise, if annual operational hours were modelled as 8,000 rather than 8,760 the impacts at both sites would reduce to 1.0% and 0.8% of the respective Critical Loads. Although it would not be proposed to restrict operating hours to less than 8,760 hours per year, this does not represent a realistic operational scenario, as the Proposed Development will need to undergo maintenance outages and is also likely to operate as a dispatchable plant. The point being made is that even, a slight reduction in annual operational hours would reduce the nitrogen deposition impacts to a level that could be considered insignificant.

~~8B.5.35.~~8B.5.39. It is therefore considered that the presented assessment in terms of NH_3 emissions and nitrogen deposition impacts is very much worst case.

~~8B.5.36.~~8B.5.40. The acid deposition at all sites is less than the 1% threshold and therefore can be considered to be insignificant.

~~8B.5.37.~~8B.5.41. Further interpretation of the significance of the nitrogen deposition results is provided in **ES Volume I Chapter 11**: Biodiversity and Nature Conservation (**Application Document Ref. 6.2**).

Table 8B.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	16.4	~~Pioneer~~ Atlantic upper-mid saltmarsh	10~~20~~	0.32	3.2~~1.6~~%	16.7	167~~84~~%
			Rich fen	15		2.1%		111%
			Pioneer saltmarsh	20		1.6%		84%
OE6	Crowle Borrow Pits SSSI	28.4	Broad-leaved, mixed and yew woodland	10	0.11	1.1%	28.5	285%
		14.9	Rich fens	15	0.07	0.5%	14.9	100%
OE7	Hatfield Chase Ditches SSSI	No comparable habitat with established critical load estimate available						
OE8	Eastoft Meadow SSSI	14.6	Low and medium altitude hay meadows	10	0.05	0.5%	14.7	147%
OE9	Belshaw SSSI	No critical loads assigned						
OE10	Thorne Moor SAC/ SPA/ SSSI	14.1	Raised and blanket bogs	5	0.04	0.7%	14.2	283%
		27.0	Temperate mountain Picea forest, Temperate	10	0.05	0.5%	27.1	271%

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
			mountain Abies forest					
OE11	Epworth Turbary SSSI	13.5	Raised and blanket bogs	5	0.04	0.9%	13.6	272%
OE12	Risby Warren SSSI	17.5	Inland sanddrift and dune with siliceous grassland	5	0.06	1.3%	17.5	351%
			Lowland to montane, dry to mesic grassland	6		1.0%		295%
OE13	Hatfield Moor SAC/ SPA/ SSSI	13.0	Raised and blanket bogs	5	0.02	0.5%	13.1	261%
		25.0	Temperate mountain Picea forest, Temperate mountain Abies forest	10	0.04	0.4%	25.1	251%
OE14	Messingham Heath SSSI	17.0	Non-mediterranean dry acid and neutral closed grassland	6	0.05	0.9%	17.0	284%
OE15	Tuetoes Hills SSSI	15.4	Inland sanddrift and dune with siliceous grassland	5	0.04	0.9%	15.4	309%

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
OE16	Haxey Turbary SSSI	13.3	Raised and blanket bogs	5	0.04	0.7%	13.3	266%
OE17	Rush Furlong SSSI	13.7	Low and medium altitude hay meadows	10	0.04	0.4%	13.7	137%
OE18	Hewsons Field SSSI	13.6	Low and medium altitude hay meadows	10	0.04	0.4%	13.6	136%
OE19	Messingham Sand Quarry SSSI	32.7	Broadleaved deciduous woodland	10	0.07	0.7%	32.7	327%
		17.5	Rich fens	15	0.04	0.3%	17.5	117%
OE20	Manton and Twigmoor SSSI	33.3	Broadleaved deciduous woodland	10	0.07	0.7%	33.3	333%
		17.8	Inland sanddrift and dune with siliceous grassland	5	0.05	0.9%	17.8	356%
OE21	Scotton and Laughton Forest Ponds SSSI	30.0	Broadleaved deciduous woodland	10	0.07	0.7%	30.1	301%

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
		15.8	Valley mires, poor fens and transition mires	5	0.04	0.8%	15.9	317%
OE22	Broughton Far Wood SSSI	35.7	Carpinus and Quercus mesic deciduous forest	15	0.08	0.5%	35.8	238%
		19.1	Semi-dry Perennial calcareous grassland (basic meadow steppe).	10	0.05	0.5%	19.1	191%
OE23	Broughton Alder Wood SSSI	Designated feature/ feature habitat not sensitive to eutrophication						
OE24	Scotton Beck Fields SSSI	16.7	Dry heath	5	0.04	0.8%	16.7	334%
OE25	Scotton Common SSSI	16.2	Dry heath	5	0.04	0.8%	16.2	324%
OE26	Laughton Common SSSI	14.7	Dry heath	5	0.03	0.7%	14.8	296%
OE27	Stainforth and Keadby Canal Corridor LWS	15.5	Neutral grassland	20	0.13	0.7%	15.6	78%
OE28	Keadby Wetland LWS	29.5	Broadleaved deciduous woodland	10	0.40	4.0%	29.9	299%

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
OE29	Keadby Wet Grassland LWS	15.5	Coastal and floodplain grazing marsh	20	0.20	1.0%	15.7	79%
OE30	Three Rivers LWS	16.2	Neutral grassland	20	0.16	0.8%	16.3	81%
OE31	Ash tip	15.4	Acid grassland	10	0.04	0.4%	15.4	154%
OE32	Humber Estuary at Blacktoft Sands (Ramsar, SAC, SPA and SSSI)	14.8	Atlantic upper-mid saltmarsh	10	0.10	1.0%	14.9	149%
			Rich Fens	15		0.6%		99%

Table 8B.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	Min CL Min N: 0.856 Min CL Max N: 4.856 Min CL Max S: 4.00	N: 1.182 S: 0.16	Calcareous grassland (using base cation)	27.6%	0.023	0.4%	28.2%
OE6	Crowle Borrow Pits SSSI	Min CL Min N: 0.142 Min CL Max N: 10.908 Min CL Max S: 10.766	N: 2.027 S: 0.17	Unmanaged Broadleaved/ Coniferous Woodland	20.2%	0.008	0.1%	20.3%
OE7	Hatfield Chase Ditches SSSI	Not sensitive to acidity						
OE8	Eastoft Meadow SSSI	Min CL Min N: 1.071 Min CL Max N: 5.071 Min CL Max S: 4.000	N: 1.044 S: 0.13	Calcareous grassland (using base cation)	3.3%	0.003	0.0%	3.3%
OE9	Belshaw SSSI	No critical load assigned						
OE10	Thorne Moor SAC	Min CL Min N: 0.142 Min CL Max N: 0.498 Min CL Max S: 0.213	N: 1.924 S: 0.16	Unmanaged Broadleaved/ Coniferous Woodland	418.5%	0.004	0.8%	419.3%

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
OE11	Epworth Turbary SSSI	Min CL Min N: 0.321 Min CL Max N: 0.478 Min CL Max S: 0.157	N: 0.963 S: 0.12	Bogs	226.6%	0.003	0.4%	227.0%
OE12	Risby Warren SSSI	Min CL Min N: 0.856 Min CL Max N: 4.856 Min CL Max S: 4.000	N: 1.246 S: 0.20	Acid grassland	29.8%	0.004	0.1%	29.9%
OE13	Hatfield Moor SAC	Min CL Min N: 0.285 Min CL Max N: 0.475 Min CL Max S: 0.154	N: 1.813 S: 0.16	Unmanaged Broadleaved/ Coniferous Woodland	386.9%	0.003	0.6%	387.5%
OE14	Messingham Heath SSSI	No acidity critical loads available for this site						
OE15	Tuetoes Hills SSSI	No critical loads assigned						
OE16	Haxey Turbary SSSI	Min CL Min N: 0.321 Min CL Max N: 0.477 Min CL Max S: 0.156	N: 0.953 S: 0.12	Bogs	224.9%	0.003	0.6%	225.6%
OE17	Rush Furlong SSSI	Min CL Min N: 1.071 Min CL Max N: 5.071 Min CL Max S: 4.000	N: 0.973 S: 0.12	Calcareous grassland (using base cation)	3.0%	0.003	0.0%	3.0%

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
OE18	Hewsons Field SSSI	Min CL Min N: 1.071 Min CL Max N: 5.071 Min CL Max S: 4.00	N: 0.973 S: 0.12	Calcareous grassland (using base cation)	3.0%	0.003	0.0%	3.0%
OE19	Messingham Sand Quarry SSSI	Min CL Min N: 0.142 Min CL Max N: 1.214 Min CL Max S: 1.016	N: 2.336 S: 0.18	Unmanaged Broadleaved/ Coniferous Woodland	207.2%	0.005	0.4%	207.7%
OE20	Manton and Twigmoor SSSI	Min CL Min N: 0.142 Min CL Max N: 1.002 Min CL Max S: 0.717	N: 2.376 S: 0.18	Unmanaged Broadleaved/ Coniferous Woodland	255.1%	0.005	0.5%	255.6%
OE21	Scotton and Laughton Forest Ponds SSSI	Min CL Min N: 0.321 Min CL Max N: 0.484 Min CL Max S: 0.163	N: 1.1.093 S: 0.12	Bogs	250.6%	0.003	0.6%	251.2%
OE22	Broughton Far Wood SSSI	Min CL Min N: 0.285 Min CL Max N: 0.989 Min CL Max S: 0.704	N: 2.546 S: 0.23	Unmanaged Broadleaved/ Coniferous Woodland	280.7%	0.005	0.5%	281.2%
OE23	Broughton Alder Wood SSSI	No critical loads assigned						

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	No critical load assigned						
OE25	Scotton Common SSSI	Min CL Min N: 1.035 Min CL Max N: 1.225 Min CL Max S: 0.19	N: 1.154 S: 0.12	Dwarf shrub heath	103.7%	0.003	0.8%	104.5%
OE26	Laughton Common SSSI	Min CL Min N: 0.892 Min CL Max N: 5.002 Min CL Max S: 4.11	N: 1.023 S: 0.12	Dwarf shrub heath	22.8%	0.002	0.2%	23.0%
OE27	Stainforth and Keadby Canal Corridor LWS	Min CL Min N: 0.856 Min CL Max N: 4.856 Min CL Max S: 4.000	N: 1.112 S: 0.15	Neutral grassland	25.9%	0.009	0.2%	26.2%
OE28	Keadby Wetland LWS	Min CL Min N: 0.142 Min CL Max N: 10.923 Min CL Max S: 10.781	N: 2.111 S: 0.19	Unmanaged Broadleaved/ Coniferous Woodland	21.1%	0.028	0.3%	21.3%
OE29	Keadby Wet Grassland LWS	No comparable critical load class for which the CL function is calculated.						

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
OE30	Three Rivers LWS	Min CL Min N: 0.856 Min CL Max N: 4.856 Min CL Max S: 4.000	N: 1.14 S: 0.15	Neutral grassland	26.8%	0.013	0.2%	27.0%
OE31	Ash tip	Min CL Min N: 0.223 Min CL Max N: 4.303 Min CL Max S: 4.08	N: 1.09 S: 0.15	Acid grassland	28.6%	0.002	0%	28.6%
OE32	Humber Estuary at Blacktoft Sands (Ramsar, SAC, SPA and SSSI)	Fen, Marsh and Swamp - Not sensitive to acidity						

8B.6. Assessment Limitations and Assumptions

8B.6.1. This section outlines the potential limitations associated with the dispersion modelling assessment. Where assumptions have been made, this is also detailed here.

8B.6.2. 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.

8B.6.3. In order to minimise the likelihood of under-estimating the PC to ground level concentrations from the operational Proposed Developments 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 be operational based on market conditions and require routine maintenance periods meaning that actual operation would be less than this;
- the operational Proposed Development has been assumed to operate at 100% load, however this will not always be the case;
- the modelling predictions are based on the use of five full years of meteorological data from Doncaster Robin Hood meteorological station for the years 2018 to 2022 inclusive, with the highest result being reported for all years assessed, other years therefore result in lower impacts;
- 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;
- emission concentrations for the process are calculated based on the use of IED limits, BAT-AEL or GET concentrations; in practice annual average rates would be below this to enable continued compliance with Environmental Permit requirements (H.M. Government, 2016), this is especially considered to be the case for NH_3, as detailed in Paragraph 8B.3.6.

8B.7. Conclusions

8B.7.1. 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.

8B.7.2. An evaluation of the release height for the main stack has shown that a release height of 85m 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.

8B.7.3. Emissions from the Proposed Development's 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.

8B.7.4. 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 NOx.

8B.7.5. Impacts of NH_3 are not significant at all designated ecological sites.

8B.7.6. Depositional impacts of nutrient nitrogen and acid are considered not to result in significant impacts. Further interpretation and discussion of these impacts and effects is provided in **ES Volume I Chapter 11**: Biodiversity and Nature Conservation (**Application Document Ref. 6.2**) and the **HRA Appropriate Assessment Report** (**Application Document Ref. 5.2**).

8B.8. References

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Annex 1 Sensitivity Testing of Model Inputs

Contents

Tables

8B1. Sensitivity Testing of Model Inputs

8B1.1.1. 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 8B1.1 as the percentage of maximum reported values in Tables 8B.11, 8B.12 and 8B.13 above.

Table 8B1.1: Point Source Dispersion Model Sensitivity Analysis

Model Input Variable	Human Health Receptor		Ecological Receptor	
	Short-term	Long-term	Short-term	Long-term
Reported Results (µg/m^3)	17.8	1.3	24.9	0.81
Meteorological data (5-year min-max)	92%	54%	21%	60%
Surface roughness representation (0.3m)	96%	100%	96%	103%
Surface roughness representation (0.1m)	107%	100%	105%	95%

8B1.1.2. The main uncertainty associated with the model is considered to be the meteorological data, with the lowest NO_2 process contribution resulting in a PC that is 92% of the hourly mean NO_2 result at the worst-case human health receptor; this is equivalent to an overall uncertainty at the worst-affected receptor of -1.4 µg/m^3 (or -0.7% of the relevant AQAL).

8B1.1.3. The lowest annual average NO_2 process contribution was 54%, equivalent to an overall uncertainty at the worst-affected receptor of -0.6 µg/m^3 (or -1.5% of the relevant AQAL).

8B1.1.4. 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 to see the effects of varying the surface roughness between 0.3m and 0.1m.

Annex 2 Assessment of visible plumes from the HYBRID cooling towers

Contents

Tables

8B2. Sensitivity Testing of Model Inputs

8B2.1.1. There is 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 **ES Volume I Chapter 14**: Landscape and Visual and **ES Volume I Chapter 15**: Cultural Heritage (**Application Document Ref 6.2**).

8B2.1.2. The indicative cooling infrastructure design shows 16 cooling cells positioned in a single block, 2 cells wide and 8 cells in length. The potential for visible plumes to occur from the cooling cells has therefore been modelled as shown in **Table 8B2.1**.

Table 8B2.1 Cooling Cell Visible Plume Model Inputs

Parameter	Wet Cooling System
Number of vents	16
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

8B2.1.3. The results for the cooling tower modelling are shown in **Table 8B2.2.** Although the results indicate that a short visible plume may be present for up to 24% of the time once the Proposed Development becomes operational, the average length of visible plumes is less than 1m, with a maximum length of 241m predicted for only one year of the meteorological data.

Table 8B2.2: Cooling Cell Visible Plumes

Met Year	Percentage of Time Plume Is Visible	Longest Visible Plume Length (m)	Average Visible Plume Length (m)
2018	20.8%	216m	<1m
2019	20.3%	63m	<1m
2020	22.7%	53m	<1m
2021	24.2%	241m	<1m
2022	18.4%	65m	<1m

Annex 3 In-combination Assessment

Contents

Tables

8B3. In-combination Assessment

8B3.1.1. As detailed in Appendix 8B, there are no short-listed schemes with close proximity to the Proposed Development with significant sources of combustion gases that would enable an assessment of cumulative impacts through dispersion modelling. The assessment of cumulative effect with any short-listed schemes which have the potential for cumulative impacts has therefore been carried out qualitatively based on information available from planning applications available for those developments.

8B3.1.2. The assessment of in-combination effects is inherently complex and over precautionary as it assumes that all proposed schemes will proceed in the timescales set out in the original applications, whereas in reality, a number of the schemes will not proceed to construction at all, and others may proceed but in a different form to that originally proposed. Furthermore, the timescales of the majority of proposed schemes are also likely to vary from those originally set out in planning documents.

8B3.1.3. It is also the case that individual assessments are carried out with numerous conservative assumptions included, such as the maximum emission flow rates and concentrations, and assuming continuous operation, whereas actual operation will involve periods of reduced loads (and therefore flow rates), emission concentrations that are below the assessed emission limit values (otherwise operators would be at constant risk of breaching their permit conditions) and outages due to maintenance activities.

8B3.1.4. Therefore, although the assessment of in-combination effects is a requirement of the EIA, the assessment should be viewed in light of these factors.

8B3.1.5. For the initial longlist of developments to inform the assessment a range of criteria were adopted including:

- NSIPs within 15km;
- Major developments (as defined by Section 2 of the Town and Country Planning (Development Management Procedure) (England) Order 2015) within 5km;
- EIA screening requests within 5km;
- Marine licence activities or development within 5km; and,
- Non-major development within 1km (other development which does not meet the criteria for major development).

8B3.1.6. The above search criteria would have included any development which met these criteria including agricultural developments. As no agricultural developments were identified which met the above criteria they were not included in the assessment as their scale would mean no cumulative effects would be likely to occur.

8B3.1.7. The short list of schemes which were assessed to have potential in-combination impacts are provided in Table 8B3.1.

Table 8B3.1 Shortlisted schemes considered for in-combination impacts

Scheme ID	Scheme
1	Humber Carbon Capture Pipeline DCO EN0710003
2	North Lincolnshire Green Energy Park DCON010116
4	Tween Bridge Solar Farm DCO EN010148
5	North Humber to High Marnham DCO EN020034
21	Moors Solar Farm PA/SCR/2021/8
22	Pilfrey Solar Farm PA/SCR/2021/7
33	Scunthorpe Electric Arc Furnace PA/2024/123

8B3.1.8. Tween Bridge Solar Farm DCO and North Humber to High Marnham DCO are 9km west and 5km north respectively of the Proposed Development, and therefore any in-combination effects with construction traffic would not occur. Construction traffic impacts from Moors Solar Farm and Pilfrey Solar farm were scoped out of their planning assessments, and therefore again it is considered very unlikely that in-combination effects would occur with the Proposed Development.

8B3.1.9. The Humber Carbon Capture Pipeline DCO, Tween Bridge Solar Farm DCO, North Humber to High Marnham DCO, Moors Solar Farm and Pilfry Solar Farm have been excluded from the assessment of cumulative air quality effects on the basis that there will be no operational impacts from these schemes that could have cumulative impacts with the Proposed Development.

8B3.1.10. Whilst cumulative impacts with the Scunthorpe Electric Arc Furnace (EAF) PA/2024/123 are considered, there is currently uncertainty over whether this scheme will proceed and any timescales associated with it. However, it is considered that on the whole, the operation of the EAF will result in a decrease in the mass emissions of NOx from the British Steel site over

existing operations, which will lead to a reduction in the predicted impacts at ecological receptors. It is therefore considered that there would be no in-combination impacts with the Proposed Development.

8B3.1.11. The only scheme considered to have the potential to result in in-combination impacts is the Lincolnshire Green Energy Park DCO. The application for the North Lincolnshire Green Energy Park considered the cumulative impacts with the proposed Keadby 3 scheme, which the Proposed Development is an alternative for. The only potential for cumulative likely significant effects identified were for ammonia and nitrogen deposition at the Risby Warren SSSI, and therefore it is reasonable to assume that this would remain the case for the Proposed Development.

8B3.1.12. Risby Warren is approximately 5.1km to the east of the North Lincolnshire Green Energy Park and approximately 9.1km east of the Proposed Development.

8B3.1.13. The predicted Process Contribution of ammonia at Risby Warren for the Proposed Development represents 1.0% of the critical level. The North Lincolnshire Green Energy Park predicted a PC 0.7% for the reasonable operating case assessment. It should be noted that emissions of ammonia only occur as a result of the SCR abatement required for both schemes to meet the BAT-AELs for NOx. For the Proposed Development, the requirement for SCR will depend on the final CCGT selection, and some CCGT Original Equipment Manufacturers have indicated this may not be required. If SCR were needed, it is likely that the actual annual emissions would be less than the 3mg/Nm^3 assessed in the model, which has been demonstrated by the operation of Keadby 2, which to date has measured annual emissions of NH_3 below 1mg/Nm^3 compared to the permitted emission limit of 3.8mg/Nm^3. If emission concentrations were <1mg/Nm^3, the actual impacts from the Proposed Development would be 0.3% of the critical level.

8B3.1.14. Likewise for the Lincolnshire Green Energy Park, an ammonia emission of 10mg/Nm^3 was assessed, however it is considered that 5mg/Nm^3 is likely to be achievable for modern Energy from Waste plant as an annual average. This would therefore halve the impacts of that scheme on Risby Warren. As a result, it is considered that the actual in-combination impacts are likely to be <1% of the critical level for ammonia at Risby Warren.

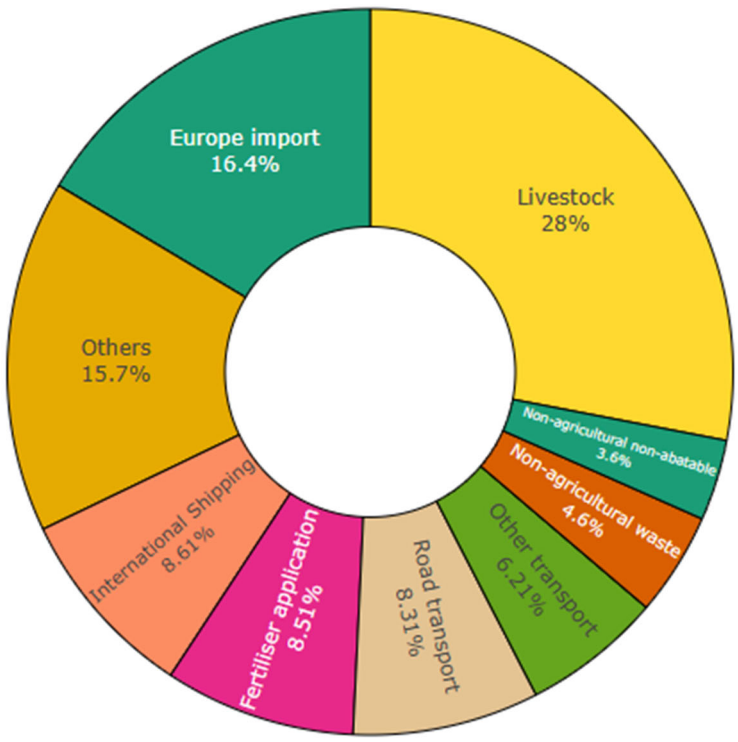
8B3.1.15. In terms of the nitrogen deposition impacts, the predicted Process Contribution of nitrogen deposition at Risby Warren for the Proposed Development represents 1.3% of the critical load. The North Lincolnshire Green Energy Park predicted a PC 0.8% for the reasonable operating

case assessment. The cumulative impact with the Proposed Development therefore increases to 2.1% of the critical load.

8B3.1.16. The predicted impacts of nitrogen deposition from the Proposed Development are dominated by the modelled emissions of ammonia, due to its significantly higher deposition rate than NO_2. Therefore, as stated in paragraph 8B3.1.13, if actual annual average emissions of ammonia were <1mg/Nm^3, the contribution to nitrogen deposition from the Proposed Development would reduce to 0.6% of the Critical Load, and likewise the North Lincolnshire Green Energy Park impacts would significantly reduce if the annual average NH_3 emission was half of that assessed.

8B3.1.17. Additionally, it is important to consider the nitrogen contributions from the Proposed Development and Lincolnshire Green Energy Park with reference to the background nitrogen deposition. Figure 8B3.1 shows the existing local contributions to nitrogen deposition at Risby Warren. It is clear that the contribution from livestock and fertiliser application is larger than any other source and contributes 4.71kg N/ha/yr on its own. This contribution is 94% of the critical load, compared to the Proposed Developments worst case modelled PC of 1.3%.

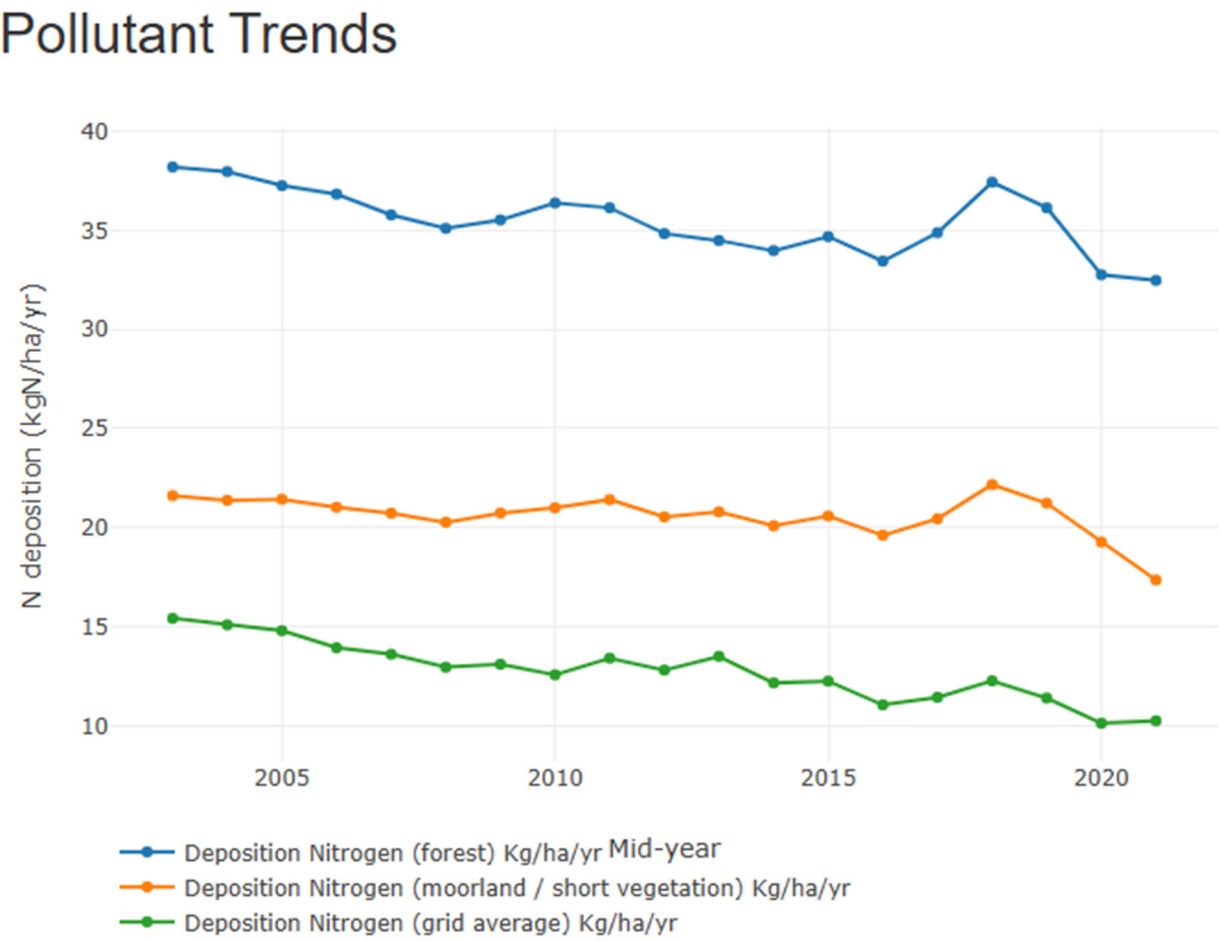
Figure 8B3.1 Local contributions to Nitrogen deposition at Risby Warren (Kg N/ha/yr) from UK sources



8B3.1.18. Additionally, historic nitrogen deposition for Risby Warren is shown in Figure 8B3.2. It can be seen that between 2003 and 2017 nitrogen deposition for short vegetation remains between 20 – 21.5 kg N/ha/yr, an interannual variance of 1.5kg N/ha/yr, which is considered to represent natural variation due to the impacts of meteorological conditions.

8B3.1.19. In 2018 a peak of 22.16 kg N/ha/yr was observed prior to a marked reduction in 2021 to 17.34 kg N/ha/yr (a reduction of 4.81 kg N/ha/yr, which represent 96% of the lower critical load on its own). It is not clear what the cause of this significant reduction is attributed to, however it is considered that such a significant reduction must have been due to a substantial change in one of the major contributors to overall deposition.

Figure 8B3.2 Trends in Nitrogen deposition Risby Warren



8B3.1.20. The worst case predicted contribution from the Proposed Development of 0.063 kg N/ha/yr and the Lincolnshire Green Energy Park contribution of 0.12 kg N/ha/yr represents a very small proportion of the nitrogen deposition at Risby Warren (0.18kg N/ha/yr in total or 1% of the background concentration of 17.3 kg N/ha/yr), and indeed the 1.5kg N/h/yr

interannual variance that occurs naturally due to meteorological conditions.

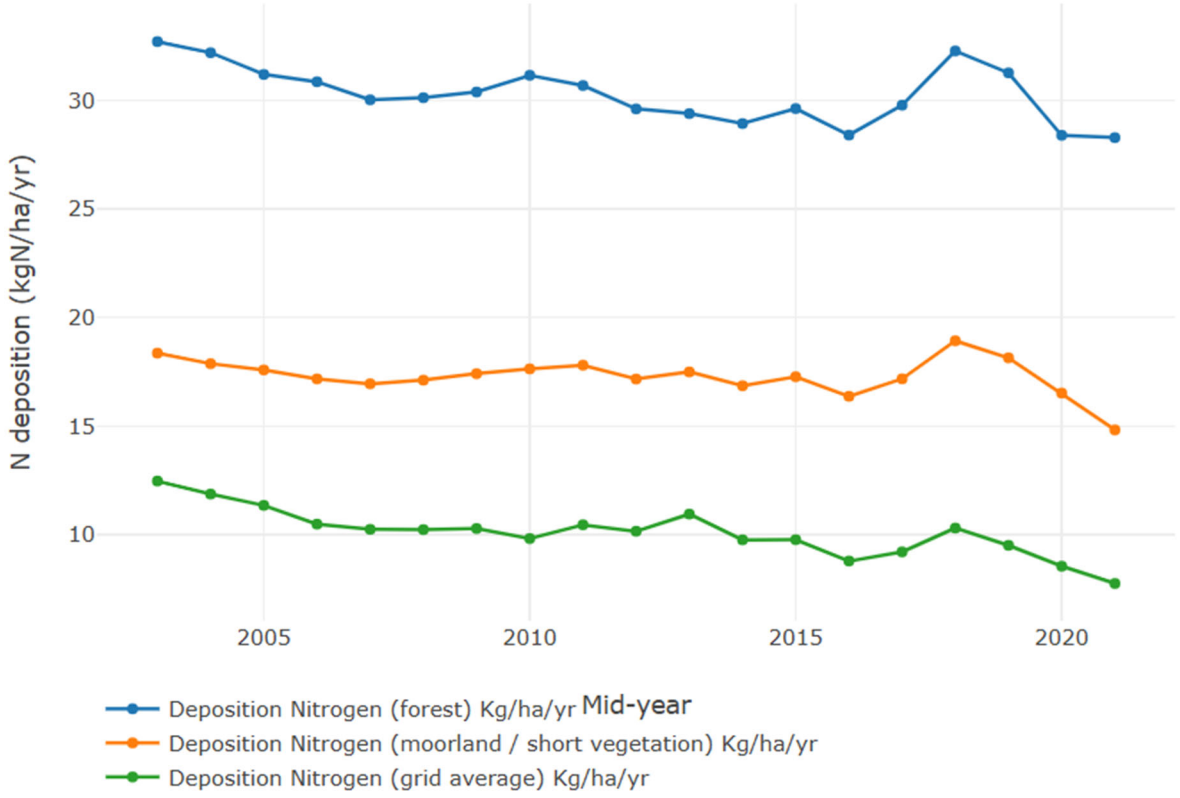
8B3.1.21. It is therefore considered that the in-combination nitrogen deposition impacts are unlikely to result in significant effects at the Risby Warren receptor.

8B3.1.22. It is recognised that Natural England have questioned whether in-combination impacts of acid deposition on the Humber Estuary would lead to Likely Significant Effects (LSE), however on revising the APIS information on the receptor it is noted that the only habitat that is sensitive to acid deposition is the coastal dune grassland feature, which does not occur on the estuary or the River Trent, with the closest occurrence of this type of habitat being at Cleethorpes, which is over 40km to the east of the Proposed Development. It is therefore considered that there would be no (LSE) at this receptor from the Proposed Development in-combination with other schemes.

8B3.1.23. The Proposed Development's contribution to nitrogen deposition at Crowle Borrow Pits was predicted to be 1.1% of the relevant critical load for the Broad-leaved, mixed and yew woodland habitat present. The process contribution from the Lincolnshire Green Energy Park was predicted to be 0.2%. In-combination this equates to a potential increase of 1.3% of the nitrogen deposition against the lower end of the critical load, but compared to the background concentration already present at that location the in-combination process contributions represent less than 0.5% of the existing deposition. Again, given the conservatism in the assessment assumptions over the emission concentrations of ammonia assessed, it is considered

that the actual impacts will be less than those presented in the assessment, and therefore it is considered that there would be no LSE.

Figure 8B3.3 Trends in Nitrogen deposition Crowle Barrow Pits



8B3.1.24. Further detail on the in-combination assessment is provided in **ES Volume I Chapter 21**: Cumulative and Combined Effects (**Application Document 6.2**).