The Drax Power (Generating Stations) Order

Land at, and in the vicinity of, Drax Power Station, near Selby, North Yorkshire

Environmental Statement
Appendix 6.3 - Air Dispersion Modelling

The Planning Act 2008
The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 – Regulation 5(2)(a)

Drax Power Limited

Drax Repower Project

Applicant: DRAX POWER LIMITED
Date: May 2018
Document Ref: 6.2.6.3
PINS Ref: EN010091

Appendix 6.3: Air Dispersion Modelling

6.3 Air Dispersion Model

6.3.1. Atmospheric dispersion modelling was performed using the Cambridge Environmental Research Consultants (CERC) Air Dispersion Modelling Software (ADMS 5.2.1). This model uses detailed information regarding the pollutant releases, local building effects and local meteorological conditions to predict pollution concentrations at specific locations selected by the user. The model has been validated against both field studies and wind tunnel studies of dispersion and is widely used for air quality impact assessment in the UK. The modelling inputs and assumptions used are detailed in the following paragraphs.

Stack Parameters

6.3.2. The stack parameters used in the dispersion modelling are detailed in Tables A6.3.1 to A6.3.3.

6.3.3. The emission data for the Proposed Scheme have been derived from the manufacturer's technical specification whilst having regard for the 2017 BAT Conclusions for Large Combustion Plant (Document 2017/1442/EU).

6.3.4. The emission concentrations used for the existing biomass and coal units are in line with the 2017 BAT Conclusions as are the CO emission concentrations for all scenarios considered.

6.3.5. The NO_X emission concentrations for Units X and Y with combustion control to provide Low NOx emissions are in line with IED limits (50 mg/Nm^3) but potentially exceed the BAT Conclusion associated emission levels (BAT-AELs).

6.3.6. The NO_X emission concentrations for Units X and Y with NOX Abatement (indicative SCR) are in line with the BAT-AELs (30 mg/Nm^3 as an annual average, 40 mg/Nm^3 as a daily average). Emission concentrations for NH_3 for Units X and Y with SCR represent the anticipated emission concentrations and have been based, in discussion with Drax, on the achievable limits (1mg/Nm^3 at 15% O_2, dry). The proposed annual emissions cap for ammonia for the Proposed Scheme is 120 tonnes/year for Unit X and Unit Y (total across both units).

6.3.7. Units X and Y can operate in either combined cycle model (CCGT) or open cycle (OCGT). The bulk exhaust gas parameters (flow, temperature etc.) are the same whether or not additional NOx abatement is used.

6.3.8. Unit X and Unit Y each comprise 2 combustion units, capable of operating in CCGT or OCGT. CCGT and OCGT have separate stacks and, therefore, each unit has 4 associated stacks.

6.3.9. The existing units forming part of the Drax Power Station discharge through the 259 m main stack, and are modelled as a single source. For the Future Baseline this comprises 2 coal units and 4 biomass units; for the Proposed Scheme this is reduced to the 4 biomass units.

6.3.10. Boilers are required at the Gas Receiving Facility to ensure that the gas supply to the generating stations meets required parameters (temperature and pressure). The boilers will operate at varying load dependent on the gas supply to the GRF. The boilers have been sized on the basis of historic gas supply data and on this basis it is estimated that the boilers will operate at an average of 65% load throughout the year.

6.3.11. Emissions for the Eggborough Power Plant were taken from their Environmental Statement. Data for the combined cycle turbines are provided, as in the ES for that project, for operation with and without the use of SCR. As for the Proposed Project, emissions without SCR meet the limits set in the IED; emissions with SCR meet the requirements of the latest BAT-AELs.

Table A.3-1 - Emission parameters for the Power Station Site. Emissions are provided per combustion unit (Unit X = 2 combustion units; Unit Y = 2 combustion units)

Parameter	Gas Generating Stations			Existing Units	
	CCGT – Low NOx	CCGT – NOX Abatement	OCGT	Coal Unit	Biomass Unit
Discharge Height (m)	120	120	120	259	259
Flue Exit Diameter (m)	8[a]	8[a]	11[a]	11/13.9[b]	11/13.9[b]
Discharge Temperature (°C)	92	92	682	90	144
Flow Rate (m^3/s)[b]	1044	1044	2730	776	993
Flow Rate (Nm^3/s, dry, reference O_2[c])	1119	1119	1045	572	573
NO_X Concentration (mg/Nm^3) – Long Term	50	30	50	150	150
NO_X Emission Rate (g/s) -– Long Term	55.9	33.6	52.3	85.8	85.8
NO_X Concentration (mg/Nm^3) – Short Term	50	40	50	150	150
NO_X Emission Rate (g/s) - Short Term	55.9	44.7	52.3	85.8	91.6
NH_3 Concentration (mg/Nm^3)	n/a	1	n/a	10	10
NH_3 Emission Rate (g/s)	n/a	1.1	n/a	5.7	
CO Concentration (mg/Nm^3)	100	100	100	n/a	n/a
CO Emission Rate (g/s)	111.9	111.9	111.9	n/a	n/a
SO_2 Concentration (mg/Nm^3)	n/a	n/a	n/a	130	100
SO_2 Emission Rate (g/s)	n/a	n/a	n/a	74.3	57.3
PM_{10} Concentration (mg/Nm^3)	n/a	n/a	n/a	8	10
PM_{10} Emission Rate (g/s)	n/a	n/a	n/a	4.6	5.7

Parameter	Gas Generating Stations			Existing Units	
	CCGT – Low NOx	CCGT – NOX Abatement	OCGT	Coal Unit	Biomass Unit
HCl Concentration (mg/Nm^3)	n/a	n/a	n/a	10	10
HCl Emission Rate (g/s)	n/a	n/a	n/a	2.9	2.9

[a] Equivalent diameter for 2 combustion units
[b] Equivalent diameter for 4 units with Proposed Scheme / 6 units with Existing Drax Power Station Complex
[c] Reference conditions 15% oxygen, dry, 273.1K, 1atm for Gas Generating Stations; 6% oxygen, dry for Existing Drax Power Station Complex

Table A.3-2 Emission parameters for the Gas Receiving Facility. Emissions are provided per unit (estimated)

Parameter	Gas Receiving Facility boilers
Number of Units	12
Discharge Location	466806, 427274
Discharge Height (m)	10
Flue Exit Diameter (m)	0.5 (for 3 x units)
Discharge Temperature (ºC)	40
Flow Rate (m^3/s)[b]	0.244
Flow Rate (Nm^3/s, dry, reference O_2[a])	0.213
NO_X Concentration (mg/kgh)	31
NO_X Emission Rate (g/s)	0.005167

Table A.3-3 - Emission parameters for the Eggborough and Thorpe Marsh Generating Stations. Emissions are provided per unit. (Thorpe Marsh parameters are per single discharge point, 2 CCGTs)

Parameter	Eggborough			Thorpe Marsh
	CCGT – no SCR	CCGT – with SCR	OCGT	CCGT – no SCR
Number of Units	3	3	1	1

Parameter	Eggborough			Thorpe Marsh
	CCGT – no SCR	CCGT – with SCR	OCGT	CCGT – no SCR
Discharge Location	457600, 423935	457600, 423935	457520, 423950	460560, 409830
Discharge Height (m)	90	90	45	70
Flue Exit Diameter (mm)	8	8	8	11.3
Discharge Temperature (ºC)	75	75	579	78
Flow Rate (m^3/s)[b]	1200	1200	1800	2086
Flow Rate (Nm^3/s, dry, reference O_2[a])	1150	1150	650	2093
NO_X Concentration (mg/Nm^3)	50	33	50	50
NO_X Emission Rate (g/s)	57.5	38.0	32.5	104.6
CO Concentration (mg/Nm^3)	100	100	100	100
CO Emission Rate (g/s)	115.0	115.0	65	209.3
[a] Reference conditions 15% oxygen, dry, 273.1K, 1 atm				

Building Downwash

6.3.12. The dispersion model takes into account the effects of building downwash of pollutants. Downwash is the enhanced turbulent mixing of pollutants in the lee of buildings which can result in high pollutant concentrations in the wake of the building. The principal building in terms of downwash for the new units will be the existing cooling tower (referenced as CT04A in the model). This has been included in all model runs at a height of 114 m (above local ground level), with a diameter of 95.6 m located north to north-east of the new stacks. The building layout for the Proposed Project used in the model is shown in Insert A6.3.1 and the building dimensions are presented in Tables A6.3.4 to A6.3.5.

Table A.3-4 - Building the Power Station Site and GRF

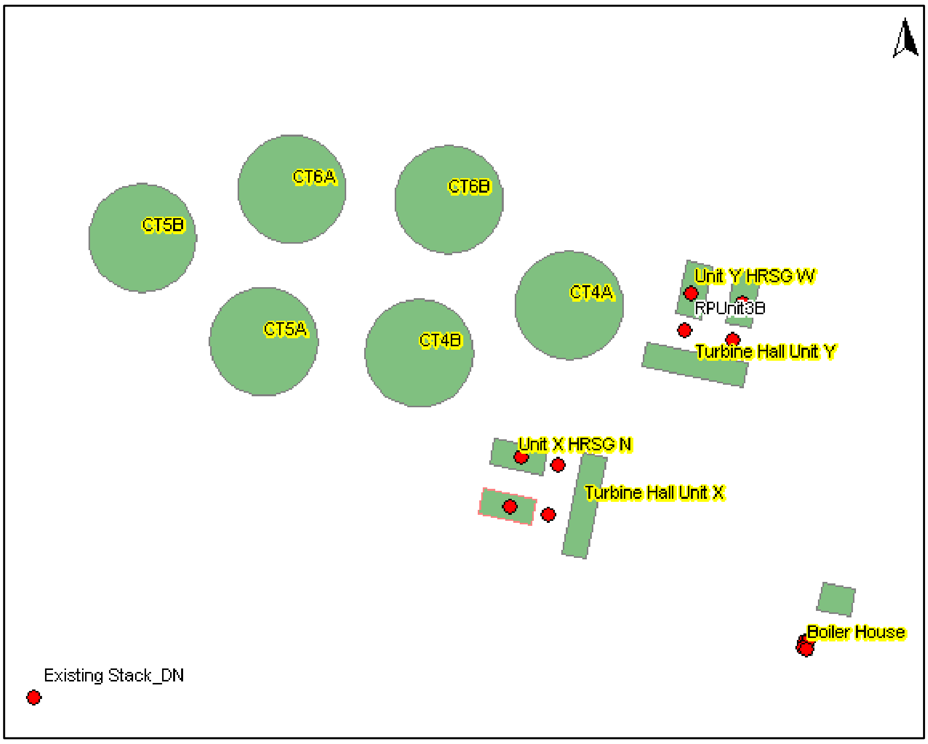
Name	Shape	X (m)	Y (m)	Height (m)	Length (m) / Diameter (m)	Width (m)	Angle (Degrees)
New01	Rectangular	466591	427390	37.	16	39	11.66
New02	Rectangular	466600	427433	37	16	39	11.66
New03	Rectangular	466695	427583	37	39.	16	11.66
New04	Rectangular	466738	427574	37	39	16	11.66

Name	Shape	X (m)	Y (m)	Height (m)	Length (m) / Diameter (m)	Width (m)	Angle (Degrees)
CT4A	Circular	466597	427572	114	96	n/a	n/a
CT4B	Circular	466464	427530	114	96	n/a	n/a
CT5A	Circular	466327	427540	114	96	n/a	n/a
CT5B	Circular	466219	427631	114	96	n/a	n/a
CT6A	Circular	466351	427675	114	96	n/a	n/a
CT6B	Circular	466490	427665	114.00	95.60	n/a	n/a
GRF	Rectangular	466807	427395	3.5	14	14	12

Table A.3-5 Building Parameters for Eggborough.

Name	Shape	X (m)	Y (m)	Height (m)	Length (m) / Diameter (m)	Width (m)	Angle (Degrees)
EG HRSG 1	Rectangular	457586	423822	50	63	28	119
EG TurbineH1	Rectangular	457650	423794	30	76	76	119
EG HRSG 2	Rectangular	457637	423913	50	63	28	119
EG TurbineH2	Rectangular	457702	423886	30	76	76	119
EG HRSG 3	Rectangular	457687	424004	50	63	28	119
EG TurbineH3	Rectangular	457751	423977	30	76	76	119
EG Peak P	Rectangular	457541	423986	30	64	102	119
EG Black S	Rectangular	457500	423910	30	35	54	119

Diagram - A6.3-1 - Power Station SITE and GRF Building Layout



Meteorological Data

6.3.13. The model has utilised hourly sequential meteorological data from RAF Waddington, for five years from 2012 to 2016. The site lies 69 km to the south of the Power Station Site. Both the location of the Power Station Site and RAF Waddington are inland sites, to the east of England (and east of the Peak District) in areas of limited terrain influence. As such, the data from the RAF station are considered appropriate for the assessment.

6.3.14. The open setting of the Power Station Site with relatively sparse development in the vicinity, is taken into account in the modelling by setting the surface roughness length to 0.3 m. This is the value recommended by the model developers for agricultural areas (with long vegetation).

6.3.15. The wind roses for 2012 to 2013 are provided at the end of this Appendix. The predominant winds are south-westerly in all years.

Model Domain

6.3.16. A coarse model domain that extends 30 km x 30 km centred on the Power Station Site was used to produce the isopleths. A finer grid (100 m resolution), which is well within the recommended minimum grid spacing of 1.5 times the stack height (1.5 x 120 m = 180 m), was used in the stack sensitivity assessment. A series of fine grids over the ecological designated sites, with 100 m resolution, were also used to predict pollutant concentrations over the designations.

Terrain

6.3.17. Terrain was not included in the modelling since there are no significant gradients in the study area.

Atmospheric Chemistry

6.3.18. Emissions of NO_X from combustion sources include both nitrogen dioxide NO_2 and nitric oxide (NO), with the majority being in the form of NO. In ambient air, NO is oxidised to form NO_2, and it is NO_2 which has the more significant health impacts. For this assessment, the conversion of NO to NO_2 has been estimated using the worst case assumptions set out in the EA guidance, namely that

- For the assessment of long term (annual mean) impacts, at receptors 70% of NO_X is NO_2
- For the assessment of short term (hourly mean) impacts, at receptors 35% of NO_X is NO_2.

6.3.19. The oxidation of NO to NO_2 is not, however, an instantaneous process and, where the maximum impacts occur within a few hundred metres of the stacks (as will be shown to be the case for the Power Station Site), the EA worst case assumptions are very conservative.

Deposition

6.3.20. The deposition of nitrogen and sulphur is modelled using a deposition velocity approach, where the surface flux of pollutants is modelled by multiplying the ground level concentration by a pollutant specific deposition velocity. The velocity used in the assessment of nitrogen deposition from NO_2 was 1.5 mm/s for short vegetation and 3.0mm/s for tall vegetation, and that for ammonia was 20 mm/s for short vegetation and 30 mm/s for tall vegetation.

6.3.21. Deposition was calculated in post-processing i.e. by multiplying the annual mean concentration of nitrogen dioxide or ammonia by the deposition velocity.

6.3.22. As deposition occurs, the exhaust gas plumes are depleted slightly of material. This was accounted for in the model using the in-built dry deposition facility but setting the deposition velocity for nitrogen oxides to 1mm/s (accounting for the fact that 70% of the plume is assumed to be nitrogen dioxide which deposits with a velocity of 1.5 mm/s; 1mm/s ≈ 0.7 x 1.5mm/s) and the deposition velocity for ammonia to 10mm/s. The latter takes account of the observation that over managed habitats, such as the agricultural land between the project site and the designated sites, the ammonia compensation point can be sufficiently high as to ensure there is two way exchange of ammonia between surface and atmosphere. Over the designated habitats sites, the compensation point is very low and, as such, it is not possible to take account of both reduced plume depletion over agricultural land and high deposition over un-managed or semi-natural habitats. The two stage approach to modelling deposition is a pragmatic but approximate approach to capturing the effects of plume depletion. The deposition velocity for nitrogen dioxide is relatively low, and plume depletion amounts to less than 2% over the study area; for ammonia, the modelled plume depletion amounts to around 5% at 5km and up to 15% at 15 km from the release points.

Emission Scenarios

6.3.23. The scenarios modelled are detailed in Table A6.3.4.

6.3.24. The Do Nothing scenario represents emissions from the Existing Power Station Complex and assumes that 2 coal units and 4 biomass units will be in operation in the future. All future year scenarios with the Proposed Scheme (A1, A2, B, C, D) assume that the 2 coal units are replaced with gas generating stations Units X and Y operating either in OCGT or CCGT mode but include the impacts of 4 x biomass units.

6.3.25. Scenarios A1 and A2 represent the Proposed Scheme with the Gas Generating Stations operating continuously in either combined cycle (A1) or open cycle (A2) without the use of NOx abatement.

6.3.26. Scenario B assumes that the Proposed Scheme operates with NOx abatement (and associated ammonia slip from SCR). In addition, the scenario assumes that the total ammonia released from the gas generating stations is equal to or less than 120 tonnes per year. This is achieved by operating the Proposed Scheme in open cycle mode for 1500 hours and the remainder of the year in combined cycle. Impacts for this scenario are calculated in post processing by scaling the long term outputs from continuous operation of the plant with SCR in CCGT and OCGT modes by the operating hours. Short term impacts are taken to be the worst of either full time operation in CCGT or OCGT since it is assumed that CCGT and OCGT operation would not occur within the same hourly period.

6.3.27. The boilers in the Gas Receiving Facility are assumed to operate continuously at 65% load in all future scenarios (A to D).

6.3.28. Scenario A1 is the worst realistic case without NOx abatement through SCR; Scenario B is the worst realistic case with NOx abatement via SCR.

6.3.29. Scenarios C and D are the cumulative emissions scenarios. The Eggborough Power Station CCGT plant has the potential to operate with and without SCR (depending on planning and permit application outcomes). It has been assumed that if the Drax CCGT operates without SCR i.e. that a decision is made at national level to exempt the power stations from the requirements of the BAT –AELs, then so will the Eggborough Station. And, as a result, two cumulative scenarios were assessed. For Eggborough Power Station, the model (following the ES) is assumed to operate in in CCGT mode 8000 hours per year and 1500 hours per year in OCGT mode. Information on the Eggborough Power Station was extracted from its DCO application (Ref. 6.27 to 6.29). The Thorpe Marsh Power Station inputs were extracted from its planning application documentation (Ref. 6.30). Scenario C mirrors scenario A1 for the process alone; Scenario D mirrors Scenario B and, as such, includes for a ceiling of 120 tonnes / annum on ammonia emissions.

Table A6.3-4 - Air Quality Assessment Scenarios

Scenario	Existing Power Station	Gas Generating Stations Unit X & Y	Gas Receiving Facility	Eggborough Power Station	Thorpe Marsh Power Station
Do Nothing	2 Coal units + 4	-	-	-	-

	Biomass units				
Proposed Scheme					
Scenario A1	4 Biomass units	4 Gas Turbines in CCGT mode	12 boilers	-	-
Scenario A2	4 Biomass units	4 Gas Turbines in OCGT mode	12 boilers	-	-
Scenario B	4 Biomass units	4 Gas Turbines, with NOx abatement and ammonia ceiling	12 boilers	-	-
Cumulative Effects					
Scenario C	4 Biomass units	4 Gas Turbines in CCGT mode	12 boilers	Without SCR	Without SCR
Scenario D	4 Biomass units	4 Gas Turbines, with NOx abatement and ammonia ceiling	12 boilers	With SCR	Without SCR

STACK HEIGHT SENSITIVITY ASSESSMENT

6.3.30. A stack height sensitivity testing was undertaken to determine an appropriate stack height for the new Units. The assessment is presented in Appendix 6.3 using the emissions data set out in Appendix 6.4 and meteorological data from 2015. This year will be shown to give near maximum ground level impacts of all years tested (2012 – 2016).

6.3.31. Dispersion model runs were undertaken for various stack heights between 70m and 140m with a model grid resolution of 100m. The critical metrics for determining the stack height were:

- The long term NO_2 PC and PEC are below the 1% and 70% of objective respectively.
- The short term NO_2 PC and PEC are below the 10% and 20% of objective respectively

6.3.32. Table A6.3-5 and the associated figure (Insert A6.3-2) show the results of the stack height sensitivity testing. Significant benefits are seen as the stack height increases from 70m to 120m, as the impacts of building downwash reduce. Beyond this height, whilst benefits are still seen with increasing stack height, the rate of reduction in impacts progressively decreases. By 120m, the maximum PEC of NO_2 anywhere on the grid is less than 70% of the annual mean objective but above 20% of the PEC for the hourly mean objective. However hourly PEC are still well below the 200µg/m^3 objective and whilst the PC for annual mean NO_2 is 4% at 120m further increases in stack height do not produce corresponding decreases in the PC.

6.3.33. As noted in Chapter 4 (Consideration of Alternatives) stack heights of greater than 120 m are not structurally possible with the proposed vertical Heat Recovery Steam Generators

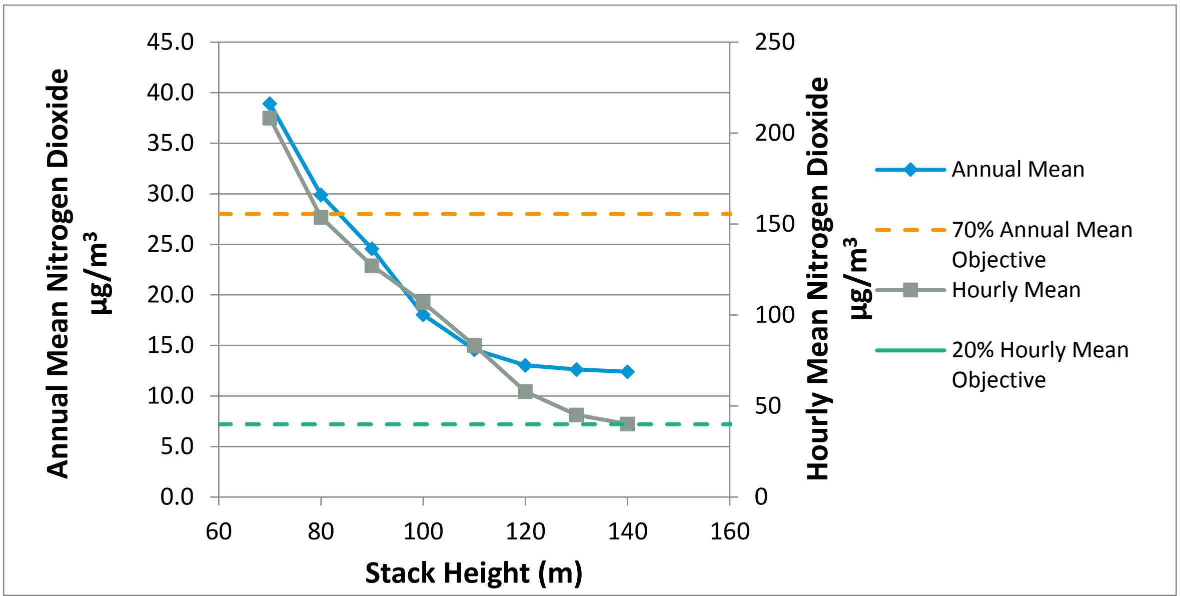
(HRSGs). The alternative horizontal HRSGs that would be required for greater stack heights are not considered viable for the Proposed Scheme as there is insufficient space for them.

6.3.34. Therefore potential impacts from emissions of NO_2 with a stack of 120m are considered negligible and the recommended minimum stack height was set to 120m.

Table A6.3-5 - Stack height sensitivity testing results

Stack Height	Maximum NO_2 Impacts in Study Area							
	Annual Mean (40µg/m^3)				Hourly Mean (200 µg/m^3)			
	PC	% Obj.	PEC	% Obj.	PC	% Obj.	PEC	% Obj.
70	28.0	70%	38.9	97%	186.6	93%	208	104%
80	19.0	47%	29.9	75%	131.9	66%	154	77%
90	13.7	34%	24.6	61%	105.4	53%	127	64%
100	7.1	18%	18.0	45%	85.1	43%	107	53%
110	3.7	9%	14.6	36%	61.5	31%	83	42%
120	2.1	5%	13.0	33%	36.1	18%	58	29%
130	1.7	4%	12.6	32%	23.4	12%	45	23%
140	1.5	4%	12.4	31%	18.4	9%	40	20%

Diagram 6.3-1 - Stack height sensitivity testing



MODEL RESULTS

IMPACTS ON HUMAN RECEPTORS

6.3.35. The following tables show the PC for all pollutants assessed for impacts on human health and, where those impacts could give rise to significant effects (NOx and NO_2), the PEC.

6.3.36. A comparison of impacts between the Do Nothing Scenario and Scenarios A to D demonstrates that the Proposed Project results in an overall increase in ground level concentrations of NOx and NO_2 (and potentially NH_3).

6.3.37. A comparison of impacts between Scenario A1 and Scenario A2 shows that impacts on ground level pollutant concentrations and deposition levels are lower with operation in open cycle than in combined cycle. This is due to the greater plume dispersion with more buoyant open cycle exhaust gas plume.

6.3.38. A comparison of impacts between Scenario A and Scenario B shows that nitrogen oxides / NO_2 concentrations are higher if SCR is not employed, but that total pollutant concentrations remain well within the objectives whatever the method of NOx emissions control.

6.3.39. A comparison of impacts between Scenarios A and C, and Scenarios B and D show that the contributions of the cumulative processes (Thorpe Marsh and Eggborough) are of similar magnitude to the impacts of the Proposed Scheme on human receptors.

Table A6.3-6 - Maximum operational impacts at human receptors – Annual mean NO_2

Receptor	Annual Mean NO_2 Objective: 40µg/m^3						
	Back-ground	Do Nothing	Scenario A1	Scenario A2	Scenario B	Scenario C	Scenario D
Process Contribution							
Foreman's Cottage	8.5	0.00	1.17	0.07	0.60	1.58	0.90
East Yorkshire Caravan	10.9	0.00	0.21	0.02	0.11	0.59	0.39
Drax Sport's and Social Club	10.9	0.00	0.46	0.03	0.24	0.85	0.52
Wren Hall	8.8	0.00	0.17	0.07	0.11	0.61	0.43
3 Pear Tree Avenue	8.5	0.01	1.57	0.06	0.80	2.01	1.12
Crange Cottages	9.4	0.00	0.45	0.04	0.23	0.83	0.50
Drax Abbey Farm	8.5	0.00	1.18	0.04	0.60	1.64	0.93
Read School	9.2	0.00	0.23	0.02	0.12	0.65	0.43
Predicted Environmental Concentration							
Foreman's Cottage	8.5	8.50	9.67	8.57	9.10	10.08	9.40
East Yorkshire Caravan	10.9	10.90	11.11	10.92	11.01	11.49	11.29
Drax Sport's and Social Club	10.9	10.90	11.36	10.93	11.14	11.75	11.42
Wren Hall	8.8	8.80	8.97	8.87	8.91	9.41	9.23
3 Pear Tree Avenue	8.5	8.51	10.07	8.56	9.30	10.51	9.62
Crange Cottages	9.4	9.40	9.85	9.44	9.63	10.23	9.90
Drax Abbey Farm	8.5	8.50	9.68	8.54	9.10	10.14	9.43
Read School	9.2	9.20	9.43	9.22	9.32	9.85	9.63

Table A6.3-7 - Maximum operational impacts at human receptors – Hourly mean NO_2

Receptor	Hourly Mean NO_2 Objective: 200µg/m^3						
	Back-ground	Do Nothing	Scenario A1	Scenario A2	Scenario B	Scenario C	Scenario D
Process Contribution							
Foreman's Cottage	17.0	0.1	21.3	5.4	17.1	21.7	17.4
East Yorkshire Caravan	21.8	0.0	14.2	0.8	11.3	14.2	11.3
Drax Sport's and Social Club	21.8	0.0	22.5	1.2	18.0	22.5	18.0
Wren Hall	17.6	0.1	5.2	1.1	4.2	6.5	4.5
3 Pear Tree Avenue	17.0	0.3	20.4	1.7	16.3	22.2	17.6
Crange Cottages	18.8	0.1	14.0	2.0	11.2	14.0	11.2
Drax Abbey Farm	17.0	0.2	21.0	1.4	16.8	21.1	16.9
Read School	18.4	0.2	9.3	0.7	7.5	9.3	7.5
Predicted Environmental Concentration							
Foreman's Cottage	17.0	17.1	38.3	22.4	34.1	38.7	34.4
East Yorkshire Caravan	21.8	21.8	36.0	22.6	33.1	36.0	33.1
Drax Sport's and Social Club	21.8	21.8	44.3	23.0	39.8	44.3	39.8
Wren Hall	17.6	17.7	22.8	18.7	21.8	24.1	22.1
3 Pear Tree Avenue	17.0	17.3	37.4	18.7	33.3	39.2	34.6
Crange Cottages	18.8	18.9	32.8	20.8	30.0	32.8	30.0
Drax Abbey Farm	17.0	17.2	38.0	18.4	33.8	38.1	33.9
Read School	18.4	18.6	27.7	19.1	25.9	27.7	25.9

Table A6.3-7 - Maximum operational impacts at human receptors – 8 Hourly mean CO

Receptor	8 Hour CO Objective: 10,000µg/m^3						
	Back-ground	Do Nothing	Scenario A1	Scenario A2	Scenario B	Scenario C	Scenario D
Process Contribution							
Foreman's Cottage	200	0.4	120	55	120	122	122
East Yorkshire Caravan	200	0.2	72	18	72	72	72
Drax Sport's and Social Club	200	0.2	132	18	132	132	132
Wren Hall	200	0.3	32	23	32	44	44
3 Pear Tree Avenue	200	0.6	112	12	112	123	123
Crange Cottages	200	0.3	83	20	83	83	83
Drax Abbey Farm	200	0.4	109	10	109	110	110
Read School	200	1.0	50	5	50	50	50
Predicted Environmental Concentration							
Foreman's Cottage	200	200.2	272.2	217.7	272.2	272.2	272.2
East Yorkshire Caravan	200	200.2	332.1	218.2	332.1	332.1	332.1
Drax Sport's and Social Club	200	200.3	232.4	222.9	232.4	243.9	243.9
Wren Hall	200	200.6	312.0	211.8	312.0	323.2	323.2
3 Pear Tree Avenue	200	200.3	283.4	220.3	283.4	283.4	283.4
Crange Cottages	200	200.4	308.6	209.8	308.6	309.5	309.5
Drax Abbey Farm	200	201.0	249.8	205.3	249.8	249.8	249.8
Read School	200	200.6	268.2	208.0	268.2	276.4	276.4

Table A6.3-8 - Maximum operational impacts at human receptors – 15min mean SO_2

Receptor	15min SO_2 Objective: 266µg/m^3						
	Back-ground	Do Nothing	Scenario A1	Scenario A2	Scenario B	Scenario C	Scenario D
Process Contribution							
Foreman's Cottage	Not required	0.25	0.18	0.18	0.18	0.18	0.18
East Yorkshire Caravan		0.06	0.06	0.06	0.06	0.06	0.06
Drax Sport's and Social Club		0.04	0.04	0.04	0.04	0.04	0.04
Wren Hall		0.23	0.14	0.14	0.14	0.14	0.14
3 Pear Tree Avenue		0.74	0.55	0.55	0.55	0.55	0.55
Crange Cottages		0.18	0.15	0.15	0.15	0.15	0.15
Drax Abbey Farm		0.38	0.26	0.26	0.26	0.26	0.26
Read School		0.35	0.27	0.27	0.27	0.27	0.27

Table A6.3-9 - Maximum operational impacts at human receptors – Hourly mean SO_2

Receptor	Hourly Mean SO_2 Objective: 350µg/m^3						
	Back-ground	Do Nothing	Scenario A1	Scenario A2	Scenario B	Scenario C	Scenario D
Process Contribution							
Foreman's Cottage	Not required	0.18	0.13	0.13	0.13	0.13	0.13
East Yorkshire Caravan		0.04	0.05	0.05	0.05	0.05	0.05
Drax Sport's and Social Club		0.03	0.03	0.03	0.03	0.03	0.03

Wren Hall		0.17	0.11	0.11	0.11	0.11	0.11
3 Pear Tree Avenue		0.55	0.41	0.41	0.41	0.41	0.41
Crange Cottages		0.13	0.11	0.11	0.11	0.11	0.11
Drax Abbey Farm		0.28	0.19	0.19	0.19	0.19	0.19
Read School		0.26	0.20	0.20	0.20	0.20	0.20

Table A6.3-10 Maximum operational impacts at human receptors – 24 hour mean SO_2

Receptor	24hr Mean SO_2 Objective: 125µg/m^3						
	Back-ground	Do Nothing	Scenario A1	Scenario A2	Scenario B	Scenario C	Scenario D
Process Contribution							
Foreman's Cottage	Not Required	0.04	0.04	0.040	0.040	0.040	0.040
East Yorkshire Caravan		0.03	0.04	0.042	0.042	0.042	0.042
Drax Sport's and Social Club		0.01	0.01	0.015	0.015	0.015	0.015
Wren Hall		0.06	0.03	0.029	0.029	0.029	0.029
3 Pear Tree Avenue		0.16	0.10	0.096	0.096	0.096	0.096
Crange Cottages		0.04	0.03	0.032	0.032	0.032	0.032
Drax Abbey Farm		0.08	0.06	0.062	0.062	0.062	0.062
Read School		0.06	0.06	0.059	0.059	0.059	0.059

Table A6.3-11 - Maximum operational impacts at human receptors – Daily mean PM_{10}

Receptor	24 hr PM_{10} Objective: 50µg/m^3						
	Back-ground	Do Nothing	Scenario A1	Scenario A2	Scenario B	Scenario C	Scenario D
Process Contribution							
Foreman's Cottage	Not Required	0.00023	0.00026	0.00026	0.00026	0.00026	0.00026
East Yorkshire Caravan		0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
Drax Sport's and Social Club		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Wren Hall		0.00010	0.00011	0.00011	0.00011	0.00011	0.00011
3 Pear Tree Avenue		0.00124	0.00110	0.00110	0.00110	0.00110	0.00110
Crange Cottages		0.00004	0.00004	0.00004	0.00004	0.00004	0.00004
Drax Abbey Farm		0.00041	0.00036	0.00036	0.00036	0.00036	0.00036
Read School		0.00038	0.00037	0.00037	0.00037	0.00037	0.00037

Table A6.3-12 - Maximum operational impacts at human receptors – Annual mean PM_{10}

Receptor	Annual mean PM_{10} Objective: 40µg/m^3						
	Back-ground	Do Nothing	Scenario A1	Scenario A2	Scenario B	Scenario C	Scenario D
Process Contribution							
Foreman's Cottage	Not Required	0.00017	0.00000	0.00000	0.00000	0.00000	0.00000
East Yorkshire Caravan		0.00004	0.00002	0.00002	0.00002	0.00002	0.00002
Drax Sport's and Social Club		0.00004	0.00001	0.00001	0.00001	0.00001	0.00001
Wren Hall		0.00013	-0.00001	-0.00001	-0.00001	-0.00001	-0.00001

3 Pear Tree Avenue		0.00053	-0.00001	-0.00001	-0.00001	-0.00001	-0.00001
Crange Cottages		0.00011	0.00001	0.00001	0.00001	0.00001	0.00001
Drax Abbey Farm		0.00026	-0.00002	-0.00002	-0.00002	-0.00002	-0.00002
Read School		0.00026	0.00000	0.00000	0.00000	0.00000	0.00000

Table A6.3-13 - Maximum operational impacts at human receptors – Hourly mean HCl

Receptor	Hourly mean HCl Assessment Level: 750µg/m^3						
	Back-ground	Do Nothing	Scenario A1	Scenario A2	Scenario B	Scenario C	Scenario D
Process Contribution							
Foreman's Cottage	Not Required	0.052	0.052	0.052	0.052	0.052	0.052
East Yorkshire Caravan		0.031	0.038	0.038	0.038	0.038	0.038
Drax Sport's and Social Club		0.033	0.037	0.037	0.037	0.037	0.037
Wren Hall		0.071	0.079	0.079	0.079	0.079	0.079
3 Pear Tree Avenue		0.125	0.086	0.086	0.086	0.086	0.086
Crange Cottages		0.063	0.058	0.058	0.058	0.058	0.058
Drax Abbey Farm		0.048	0.053	0.053	0.053	0.053	0.053
Read School		0.110	0.078	0.078	0.078	0.078	0.078

IMPACTS ON ECOLOGICAL RECEPTORS

6.3.41. The impacts modelled under worst case scenarios (A1, B, C and D) are set out in the main chapter. For completeness, we report only the open cycle results in this appendix.

Table A6.3-14 - Maximum operational impact at ecological receptors – annual mean NH_3

Receptor	Critical Level	Back-ground ($\mu g/m^3$)	PC ($\mu g/m^3$)	PC as % of Obj.	PEC ($\mu g/m^3$)	PEC as % of Obj.
Scenario A2 – Open cycle operation with low NOx emissions (50mg/m^3)						
River Derwent SAC/SSSI	3	2.76	0.00	0%	2.76	92%
Lower Derwent SAC	3	2.81	0.00	0%	2.81	94%
Breighton Meadows SSSI	3	2.81	0.00	0%	2.81	94%
Derwent Ings SSSI	3	2.76	0.00	0%	2.76	92%
Thorne Moor SAC/SPA	1	2.39	0.00	0%	2.39	239%
Skipwith Common SAC	1	2.42	0.00	0%	2.42	242%
Humber Est. SAC/SPA	3	2.92	0.00	0%	2.92	97%
Eskamhorn SSSI	3	2.14	0.00	0%	2.14	71%
Brockholes SINC	3	2.23	0.00	0%	2.23	74%
Orchard Farm SINC	3	2.24	0.00	0%	2.24	75%

Table A6.3-15 - Maximum operational impact at ecological receptors – annual mean NO_x

Receptor	Critical Level	Back-ground ($\mu g/m^3$)	PC ($\mu g/m^3$)	PC as % of Obj.	PEC ($\mu g/m^3$)	PEC as % of Obj.
Scenario A2 – Open cycle operation with low NOx emissions (50mg/m^3)						
River Derwent SAC/SSSI	30	16.26	0.23	0.77%	16.49	55%
Lower Derwent SAC	30	15.32	0.21	0.70%	15.53	52%
Breighton Meadows SSSI	30	15.28	0.21	0.70%	15.49	52%
Derwent Ings SSSI	30	15.32	0.12	0.38%	15.44	51%
Thorne Moor SAC/SPA	30	18.56	0.06	0.20%	18.62	62%
Skipwith Common SAC	30	14.75	0.05	0.16%	14.80	49%
Humber Est. SAC/SPA	30	23.19	0.10	0.34%	23.29	78%

Receptor	Critical Level	Back-ground ($\mu g/m^3$)	PC ($\mu g/m^3$)	PC as % of Obj.	PEC ($\mu g/m^3$)	PEC as % of Obj.
Eskamhorn SSSI	30	16.49	0.03	0.10%	16.52	55%
Brockholes SINC	30	17.8	0.02	0.08%	17.82	59%
Orchard Farm SINC	30	17.9	0.03	0.09%	17.93	60%

Table A6.3-16 - Maximum operational impact at ecological receptors – daily mean NO_X

Receptor	Critical Level	Back-ground ($\mu g/m^3$)	PC ($\mu g/m^3$)	PC as % of Obj.	PEC ($\mu g/m^3$)	PEC as % of Obj.
Scenario A2 – Open cycle operation with low NOx emissions (50mg/m³)						
River Derwent SAC/SSSI	75	32.5	13.6	18%	46.1	61%
Lower Derwent SAC	75	30.6	12.5	17%	43.2	58%
Breighton Meadows SSSI	75	30.6	12.5	17%	43.1	57%
Derwent Ings SSSI	75	30.6	5.3	7%	36.0	48%
Thorne Moor SAC/SPA	75	37.1	4.3	6%	41.4	55%
Skipwith Common SAC	75	29.5	3.8	5%	33.3	44%
Humber Est. SAC/SPA	75	46.4	5.5	7%	51.9	69%
Eskamhorn SSSI	75	33.0	3.7	5%	36.6	49%
Brockholes SINC	75	35.6	2.3	3%	37.9	51%
Orchard Farm SINC	75	35.8	2.7	4%	38.5	51%

Table A6.3-17 - Maximum operational impact at ecological receptors – nitrogen deposition

Receptor	Critical Load	Back-ground (kgN/ha/yr)	PC (kgN/ha/yr)	PC as % of CL	PEC (kgN/ha/yr)	PEC as % of CL
Scenario A2 – Open cycle operation with low NOx emissions (50mg/m^3)						
River Derwent SAC/SSSI	No critical load set					
Lower Derwent SAC	20	21.0	0.01	0.1%	21.0	105%
Breighton Meadows SSSI	20	21.0	0.01	0.1%	21.0	105%
Derwent Ings SSSI	20	20.9	0.00	0.0%	20.9	104%
Thorne Moor SAC/SPA	5	19.2	0.00	0.1%	19.2	384%
Skipwith Common SAC	10	19.2	0.00	0.0%	19.2	192%
Humber Est. SAC/SPA	20	20.7	0.01	0.0%	20.7	104%
Eskamhorn SSSI	20	17.9	0.00	0.0%	17.9	90%
Brockholes SINC	10	18.5	0.00	0.0%	18.5	185%
Orchard Farm SINC	10	19.2	0.00	0.0%	19.2	192%

Table A6.3-18 - Maximum operational impact at ecological receptors –acid deposition

Receptor	Critical Load	Back-ground (keq/ha/yr)	PC (keq/ha/yr)	PC as % of CL	PEC (keq/ha/yr)	PEC as % of CL
Scenario A2 – Open cycle operation with low NOx emissions (50mg/m^3)						
River Derwent SAC/SSSI	No critical load set					
Lower Derwent SAC	4.856	1.5	0.001	0.0%	1.50	31%
Breighton Meadows SSSI	4.856	1.5	0.001	0.0%	1.50	31%
Derwent Ings SSSI	4.856	1.49	0.000	0.0%	1.49	31%
Thorne Moor SAC/SPA	0.462	1.37	0.000	0.1%	1.37	297%
Skipwith Common SAC	0.820	1.37	0.000	0.0%	1.37	167%
Humber Est. SAC/SPA	Not sensitive					
Eskamhorn SSSI	1.998	1.28	0.000	0.0%	1.28	64%
Brockholes SINC	Not sensitive					
Orchard Farm SINC	5.071	1.37	0.000	0.0%	1.37	27%