Cory Environmental Holdings Limited

CORY DECARBONISATION PROJECT

Air Emissions Risk Assessment

PUBLIC

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1 INTRODUCTION

1.1 PURPOSE OF STUDY

1.1.1. Cory Environmental Holdings Limited (hereafter referred to as Cory) has instructed WSP to undertake an Air Emissions Risk Assessment in support of their application to the Environment Agency (EA) under the Environmental Permitting (England and Wales) Regulations 2016, for a new bespoke environmental permit to operate a Carbon Capture Facility (CCF) in relation to the Cory Decarbonisation Project in Belvedere, London.

1.1.2. This report sets out methodology and results of the detailed dispersion modelling undertaken in support of the permit application to operate the CCF that will be technically connected to Cory's Energy Recovery Facilities (ERF, Riverside 1 and Riverside 2) at Norman Road, Belvedere within the London Borough of Bexley. The operations as a whole will be referred to as the Riverside Campus.

1.1.3. The technology for the CCF is based on Shell's Cansolv CO_2 Capture System.

1.2 THE SITE

1.2.1. The CCF location is shown in Figure A-1, in Appendix A.

1.2.2. The area immediately surrounding the Riverside campus is under mixed use, with distribution centres and light industrial areas to the south and east, the River Thames to the north and Crossness Local Nature Reserve (LNR) to the west.

1.2.3. The wider study area is urban/suburban in nature and the nearest urban development and residential areas, measured from the proposed location for the Stack(s), are:

- South of the Thames
  - Belvedere 600m south
  - Abbey Wood 1.2km south-west
  - Thamesmead 1.6km west
  - Lessness Heath 1.9km south
  - Erith 1.9km south-east
- North of the Thames
  - South Dagenham 2.4km north
  - South Hornchurch 2.4km north-north-east
  - Barking Riverside 2.5km north-west
  - Rainham 2.9km north-east

1.2.4. There are several nature conservation sites in the wider area, including sites declared at local, national and international level.

1.2.5. Further information on potential sensitive receptors for air quality effects is provided in **Section 4.3**.

1.3 EMISSIONS TO AIR

1.3.1. The emissions to air considered in this report will occur via two new Stack(s) at the Site, termed CC1 and CC2 in this report. They will comprise a mix of pollutants generated by the combustion process (waste and those introduced by the amine-based carbon capture process. Details of the chemical species modelled are provided in Appendix B.

1.3.2. There are currently two conventional ERF combustion units on the Riverside Campus. Riverside 1 is currently operational and processes up to 850 kilo-tonnes of waste per annum in three streams. Riverside 2 has been constructed and is undergoing commissioning. It has a permit to process approximately 805 kilo-tonnes of waste per annum in two streams.

1.3.3. The core scenario in this dispersion assessment considers:

- **Full load, continuous operation of Riverside 1 and Riverside with Carbon Capture (termed With Carbon Capture)**
- **Full load, continuous operation of Riverside 1 and Riverside without Carbon Capture (termed Baseline)**

1.3.4. Riverside 1 currently discharges via a single stack containing 3 flues, each with diameter 2.3m. This gives an effective diameter of 3.98m. Riverside 2 will discharge via two stacks, each with diameter 2.2m. The Riverside 1 and 2 stacks are ~90m tall.

1.3.5. With the CCF, emissions will occur from two 100m Stack(s), each with diameter 2.5m.

1.3.6. Appendix F considers the impacts of the operation of the CCF against the current baseline of the operation of Riverside 1 alone. This scenario is considered for ecological receptors only. It is, however, emphasised that full load operation of Riverside 2 will begin imminently and that future operations at the Riverside campus will involve the full load operation of Riverside 1 and 2 as currently permitted.

2 EMISSIONS AND ENVIRONMENTAL STANDARDS

2.1 POLLUTANT EMISSIONS

2.1.1. The post-carbon capture emissions will comprise the existing combustion products plus solvent and degradation[1] products identified by Shell as emissions from the CCF. Table 2-1 lists the modelled emission compounds / compound groups, with further specific details provided in Appendix B.

2.1.2. Ammonia is listed as both a combustion and introduced emission. Ammonia generated by combustion is currently emitted from Riverside 1 and 2 but will largely be removed from the flue gases by gas conditioning prior to the CCF. Ammonia will however be introduced to the post carbon capture flue gas as a degradation product of the amines within the CCF.

2.1.3. The existing permit for the main stacks at Riverside 1 and Riverside 2 also includes dioxins as a controlled emission. However, there is no air quality standard for dioxins and impacts from exposure via the food chain have previously been demonstrated to be negligible. As such, they are not considered in this air emissions risk assessment.

Table 2-1 – Emission compounds for Baseline and With Carbon Capture scenarios

Emission	Notes
Combustion Emissions (Baseline and With Carbon Capture Scenarios)	
Nitrogen Oxides	
Sulphur Dioxide	
Particulate Matter	Assessed as PM_{10} & $PM_{2.5}$
Hydrogen Chloride	
Hydrogen Fluoride	
Particulate Matter	Assessed as PM_{10} & $PM_{2.5}$
Total organic carbon	Assessed as Benzene
Carbon Monoxide	
Ammonia	
Cadmium and Thallium	Assessed as Cadmium
Mercury	
Group 3 metals: Antimony, Arsenic, Copper, Cobalt, Chromium, Nickel, Lead, Manganese, Vanadium	Assessed as Nickel

[1] This is degradation that occurs within the carbon capture plant itself. The degradation of amines in ambient air is considered separately.

Emission	Notes
Emissions Introduced by the CCF (with Carbon Capture Scenario only)	
Amine 1	Secondary Amine
Amine 2	Secondary Amine
Direct Nitrosamine 1	Nitrosamine formed within CCF
Direct Nitrosamine 2	Nitrosamine formed within CCF
Ammonia	Formed with CCF
Aldehydes	Assessed as Formaldehyde
Amides	Assessed as Formamide
Degradant 100	Organic compound formed within CCF
Degradant 101	Organic compound formed within CCF
Degradant 102	Organic compound formed within CCF

2.2 ENVIRONMENTAL STANDARDS

HUMAN HEALTH

2.2.1. Table 2-2 shows the environmental assessment levels for the protection of human health applied to this assessment. They comprise a mix of statutory air quality standards and non-statutory Environmental Assessment Levels (EALs) derived by Environment Agency and, for carbon capture plant emissions for which Environment Agency has not derived EALs, by Shell. These are jointly termed Air Quality Assessment Levels (AQAL).

ECOLOGY

2.2.2. Table 2-3 and Table 2-4 show the environmental assessment levels for the protection of ecology applied to this assessment. They comprise a mix of statutory air quality standards and non-statutory critical levels and critical loads available from the APIS website (www.apis.ac.uk).

Table 2-2 – Environmental standards (AQAL) for the assessment of impacts on human health

Emission	Long Term AQAL (µg/m³)		Short Term AQAL (µg/m³)		Origin
	Standard (µg/m³)	Averaging Period (permitted exceedances per year)	Standard (µg/m³)	Averaging Period (permitted exceedances per year)	
Combustion Emissions (Bioenergy with Carbon Capture and Storage (BECCS) and non-BECCS sources)					
Nitrogen Dioxide	40	Annual	200	Hourly (18)	Air Quality Standards Regulations 2010
Sulphur Dioxide	125	Daily (3)	266 350	15min (35) Hourly (24)	Air Quality (England) Regulations 2000 (as amended) Air Quality Standards Regulations 2010
Hydrogen Chloride			750	Hourly	Non-statutory EAL, derived by Environment Agency
Hydrogen Fluoride	16	Monthly	160	Hourly	Non-statutory EAL, derived by Environment Agency
Particulate Matter (as PM_{10})	40	Annual	50	Daily (35)	Air Quality Standards Regulations 2010
Particulate Matter (as $PM_{2.5}$)	20	Annual			Air Quality Standards Regulations 2010
Benzene	5	Annual			Air Quality Standards Regulations 2010
Carbon Monoxide			10000	8-Hourly	Air Quality Standards Regulations 2010
Ammonia‡	180	Annual	2500	Hourly	Non-statutory EAL, derived by Environment Agency
Cadmium	0.005	Annual			Air Quality Standards Regulations 2010 (target)
Mercury	0.06	Daily	0.6	Hourly	Non-statutory EAL, derived by Environment Agency
Nickel	0.02	Annual			Air Quality Standards Regulations 2010 (target)
Emissions Introduced by the CCF (BECCS only)					
Amine 1	100	Daily	400	Hourly	Non-statutory EAL, derived by EA/Shell†

Emission	Long Term AQAL (µg/m³)		Short Term AQAL (µg/m³)		Origin
	Standard (µg/m³)	Averaging Period (permitted exceedances per year)	Standard (µg/m³)	Averaging Period (permitted exceedances per year)	
Amine 2	15	Daily			Non-statutory EAL, derived by Environment Agency
Direct Nitrosamine 1	0.0002	Annual			Non-statutory EAL, derived by Environment Agency§
Direct Nitrosamine 2	0.0002	Annual			Non-statutory EAL, derived by Environment Agency§
Aldehydes	5	Annual	100	30min	Non-statutory EAL, derived by Environment Agency
Amides	70	Annual			Non-statutory EAL, derived by Shell
Degradant 100	18,100	Annual	362,000	Hourly	Non-statutory EAL, derived by Environment Agency
Degradant 101	47	Annual			Non-statutory EAL, derived by Shell
Degradant 102	680	Annual	10,200	Hourly	Non-statutory EAL, derived by Environment Agency
Pollutants formed by degradation of amines in ambient air					
Nitrosamines	0.0002	Annual			Non-statutory EAL, derived by Environment Agency§
Nitramines	0.0002	Annual			Non-statutory EAL, derived by Environment Agency§

† These EAL were derived by Environment Agency and recommended for use by Shell for this amine

§ This is set at the EAL for Nitrosodimethylamine

‡ Ammonia included both as a combustion related emission and as introduced by the carbon capture plant

Table 2-3 – Environmental standards for the assessment of impacts on sites designated for nature conservation at international and national levels. (Moorland/Forest refer to deposition velocity classes for non-woodland and woodland habitats respectively)

Ecological Site	Critical Levels (µg/m³)			Critical Loads		
	Nitrogen Oxides	Sulphur Dioxide	Ammonia	Most Sensitive Habitat in Study Area	Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (keq/ha/yr) (minimum CL_{minN} | CL_{maxN} | CL_{maxS})
Epping Forest SSSI/SAC	Annual Mean: 30 Daily Mean 75	Annual Mean 10	1	Dry Heaths Fagus woodland	5 – Moorland 10 – Forest	0.571 | 1.584 | 0.87 – Moorland 0.142 | 1.730 | 1.535 - Forest
Ingrebourne Marshes SSSI			1	Rich Fens	15 – Moorland	*Not sensitive*
Inner Thames Marshes SSSI			3	Atlantic mid-upper saltmarsh	10 - Moorland	*Not sensitive*
Oxleas Woodlands SSSI			1	Quercus woodland	15 – Forest	0.357 | 2.72 | 2.363 - Forest
West Thurrock Lagoon and Marshes SSSI			1	Atlantic mid-upper / low–mid saltmarsh	10 - Moorland	*Not sensitive*

Table 2-4 – Environmental standards for the assessment of impacts on sites designated for nature conservation at local level

Ecological Site	Critical Levels (µg/m³)			Critical Loads		
	Nitrogen Oxides	Sulphur Dioxide	Ammonia	Most Sensitive Habitat in Study Area	Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (keq/ha/yr) (minimum CL_{minN} | CL_{maxN} | CL_{maxS})
Lesnes Abbey Woods LNR	Annual Mean: 30 Daily Mean 75	Annual Mean 10	1	Deciduous woodland	10 – Forest	*Not sensitive*
Crossness LNR			1	Reed beds	10 - Moorland	*Not sensitive*
Rainham Marshes LNR			1	Atlantic mid-upper saltmarsh	10 - Moorland	*Not sensitive*

3 BACKGROUND AIR QUALITY

3.1 OVERVIEW

3.1.1. Background air quality within the wider study area is influenced by emissions from the existing Riverside 1 facility, road transport and shipping, and to a lesser extent agricultural practices.

3.1.2. The entire borough of Bexley has been declared an Air Quality Management Area. However, all monitored concentrations of NO_2 have been below the objective (40µg/m^3) since 2018.

3.2 POLLUTANTS RELEVANT TO HUMAN HEALTH

3.2.1. Background pollutant concentrations for pollutants relevant to human health are summarised in Table 3-1. Data are obtained from the mapped data provided by Defra (for NO_2 and particulate matter) and by APIS (for SO_2 and NH_3) at 1km x 1km resolution, and for carbon monoxide, benzene and metals from monitoring at London Marylebone Road and London Westminster.

3.2.2. The Defra data are taken from modelled concentrations for 2025; the APIS data from the 3-year average data for 2020 – 2022 (assumed applicable to 2021). The monitoring data are 2024 annual averages or the latest available.

3.2.3. Taking into account national measures to reduce pollutant emissions in the UK and recent emission trends, these concentrations will be representative of background pollution levels during the early years of operation of the CCF at the Riverside Campus, albeit adopting a somewhat conservative approach. All background pollutant concentrations are well within their respective assessment quality assessment levels (AQAL) set out in Table 2-2.

3.2.4. No relevant background data are available for the remaining pollutants relevant to human health.

Table 3-1 – Background pollutant concentrations relevant to human health (µg/m^3)

Source	Nitrogen Dioxide	Particulate Matter PM_{10}	Particulate Matter $PM_{2.5}$	Sulphur Dioxide	Ammonia	Carbon Monoxide	Benzene	Cadmium	Nickel	Mercury
Defra for 2025	14.0 – 21.1	11.9 – 15.9	7.2 – 8.6	-	-	-	-	-	-	-
APIS for 2021	-	-	-	2.1 – 4.3	0.9 – 1.2	-	-	-	-	-
AURN Monitoring Network 2024§	-	-	-	-	-	175	-	-	-	-
Automatic Hydrocarbon Network§	-	-	-	-	-	-	0.51	-	-	-
Heavy Metals Monitoring Network 2024†	-	-	-	-	-	-	-	0.00010	0.0016	0.01

§ London Marylebone Road for 2024
† Average from London Marylebone Road and London Westminster for 2024 for Cadmium and Nickel; Maximum monthly total vapour and particulate phase mercury from London Westminster 2011 – 2018 (no later data available)

3.3 POLLUTANTS RELEVANT TO ECOLOGICAL RECEPTORS

3.3.1. Background pollutant concentrations and deposition over the nature conservation sites are shown in Table 3-2 and Table 3-3.

3.3.2. Background concentrations of NO_X are elevated but generally within the critical level except in areas of Epping Forest SSSI/SAC, Inner Thames Marshes SSSI and West Thurrock Lagoon and Marshes SSSI near significant pollutant sources such as major roads and shipping on the Thames. Background concentrations of SO_2 are low and within the critical level over all sites.

3.3.3. Background concentrations of ammonia exceed the critical level for all sites except Inner Thames Marshes SSSI where the critical level is 3µg/m^3.

3.3.4. Nitrogen deposition exceeds the critical load over all sites except Ingrebourne Marshes SSSI. Whilst there is a contribution from Riverside 1 in these background levels, the level of exceedance is such that deposition would exceed the critical load whether or not this contribution is excluded from background levels. Therefore, to ensure a conservative assessment no discounting of the Riverside 1 contribution is made in the assessment.

3.3.5. Exceedance of the critical load function for acidity is less widespread than exceedance of the critical load for nitrogen deposition. Exceedances are seen over Epping Forest SAC/SSSI for forest habitats (Table 3-2).

Table 3-2 – Background pollutant concentration and deposition over sites designated for nature conservation at a national and international level. Values in bold exceed either the critical level or critical load.

Ecological Site	Pollutant Concentrations (µg/m^3)			Deposition	
	Nitrogen Oxides	Sulphur Dioxide	Ammonia	Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (keq/ha/yr)§
Epping Forest SSSI/SAC	26.0 – **34.4**	1.8 – 2.3	**1.2**	**13.6 – 14.2** (Moorland) **25.5 – 26.3** (Forest)	1.1 (Moorland) **2.0** (Forest)
Ingrebourne Marshes SSSI	22.0 – 26.5	2.0 – 2.5	1.0 – **1.1**	12.2 – 12.3 (Moorland)	NA
Inner Thames Marshes SSSI	22.3 – **31.6**	2.0 – 4.4	0.9 - 1.1	**12.0 – 12.2** (Moorland)	NA
Oxleas Woodlands SSSI	25.8 – 28.0	1.8 – 2.0	**1.1**	**24.0 – 24.2** (Forest)	1.0
West Thurrock Lagoon and Marshes SSSI	29.2 – **48.5**	2.4 – 3.6	**1.1**	**12.2** (Moorland)	NA

† Limited to area of designated sites within the study area

§ Total acid deposition

Table 3-3 – Background pollutant concentration and deposition over sites designated for nature conservation at a local level. Values in bold exceed either the critical level or critical load

Ecological Site	Pollutant Concentrations (µg/m^3)			Deposition	
	Nitrogen Oxides	Sulphur Dioxide	Ammonia	Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (keq/ha/yr) (N | S)
Lesnes Abbey Woods LNR	26.2	2.2	**1.1**	**23.9**	N/A
Crossness LNR	27.1	2.2	0.9	**12.4**	N/A
Rainham Marshes LNR	**31.6**	3.8	0.9	**12.2**	N/A

3.4 SHORT TERM BACKGROUND CONCENTRATIONS

3.4.1. Short term background concentrations, used in the calculation of total environmental concentrations, are assumed to equate to 2 times the annual mean background concentrations presented above.

4 METHODOLOGY

4.1 MODEL

4.1.1. The dispersion model is ADMS v6.0.0.1. This is a new generation Gaussian plume air dispersion model in which the atmospheric boundary layer properties are characterised by the boundary layer depth and the Monin-Obukhov length.

4.1.2. It is widely used for industrial applications across the UK and in many countries worldwide.

4.2 EMISSION PARAMETERS

4.2.1. The bulk exhaust parameters for the existing combustion units (Riverside 1 and Riverside 2) plus the post carbon capture emission for the 2 carbon capture units are provided in Table 4-1. The parameters represent all streams exiting via the named stacks i.e. pre-carbon capture = A1, A2 and A3 combined for Riverside 1, and A1 and A2 separately in Riverside 2; post carbon capture = all emissions from Riverside 1 and Riverside 2 separately.

Table 4-1 – Exhaust parameters for the pre and post carbon capture stack emissions

Parameter	Baseline (pre–Carbon Capture)			With Carbon Capture	
	Riverside 1	Riverside 2		Riverside 1	Riverside 2
	R1 Permit: A1, A2, A3 Combined	R2-A1 Permit: A1	R2-A2 Permit: A2	CC1 (All streams combined)	CC2 (All streams combined)
Location	549699, 180577	549451, 180746	549465, 180746	549610, 180471	549528, 180480
Stack Height (m)	88	90	90	100	100
Flue Diameter (m)	3.98§	2.2	2.2	2.5	2.5
Flow Rate (Actual, m³/s)	227.3	86.56	86.56	159.05	130.20
Exit Temperature (ºC)	140	120	120	80	80
Exit Velocity (m/s)	18.3	17.9	17.9	32.4	26.5
Oxygen (%, actual)	6.3	5.5	5.5	7.7	6.6
H2O (%, actual)	21.6	20.1	20.1	16.5	16.5
Oxygen (%, dry)8.0	8.0	6.9	6.9	9.2	7.9
Normalised Flow (@6% O2, dry, m³/s)	153.0	68.0	68.0	118.6	121.3

§ Combined diameter of 3 x flues, each with diameter 2.3m

4.2.2. The existing and proposed emission limit values (reference conditions: standard temperature and pressure and 11%O_2, dry) together with calculated mass emission rates are provided in Table 4-2.

4.2.3. In the assessment of impacts against standards identified as 'Short' or 'Long' term AQAL in Table 2-2, emissions are assumed to occur at the rates denoted 'ST' (Short Term) and 'LT' (Long Term) respectively in Table 4-2. This ensures a conservative assessment.

Table 4-2 – Proposed (With Carbon Capture) and Existing (Baseline) Emission Limit Values and equivalent mass emission rates at full load operation. (LT = Long Term, ST = Short Term)

Emission	Concentration (mg/Nm3 @ 11%O2, dry)				Emission Rate (g/s)				
	Baseline		With Carbon Capture		Baseline			With Carbon Capture	
	Riverside 1 (A1, A2, A3)	Riverside 2 (A1, A2)	CC1	CC2	R1	R2-A1	R2-A2	CC1	CC2
Nitrogen Oxides – LT	400	400	Assumed compliance assessed pre-carbon capture and no change to mass emissions in post carbon capture flue gases		61.204	27.216	27.216	61.204	54.432
Nitrogen Oxides – ST	180	75			27.542	5.103	5.103	27.542	10.206
Sulphur Dioxide – LT	200	200			30.602	13.608	13.608	30.602	27.216
Sulphur Dioxide – ST	40	30			6.120	2.041	2.041	6.120	4.082
Particulate Matter - LT	5	5			0.765	0.340	0.340	0.765	0.680
Hydrogen Chloride – ST	60	60			9.181	4.082	4.082	9.181	8.165
Hydrogen Fluoride – ST/LT	8	1			1.224	0.068	0.068	1.224	0.136
TOC (as Benzene) - ST	20	20			3.060	1.361	1.361	3.060	2.722
TOC (as Benzene) - LT	10	10			1.530	0.680	0.680	1.530	1.361
Carbon Monoxide - ST	150	150			22.952	10.206	10.206	22.952	20.412
Carbon Monoxide - LT	50	50			7.651	3.402	3.402	7.651	6.804
Ammonia ST/LT	15	10	10	10	2.295	0.680	0.680	1.186	1.213
Cadmium and Thallium - LT	0.02	0.02	As above, no change to mass emissions in post carbon capture flue gases		0.00306	0.00136	0.00136	0.00306	0.00272
Mercury - ST/LT	0.02	0.02			0.00306	0.00136	0.00136	0.00306	0.00272
Group III Metals - LT	0.3	0.3			0.0459	0.0204	0.0204	0.0459	0.0408

Emission	Concentration (mg/Nm3 @ 11%O2, dry)				Emission Rate (g/s)				
	Baseline		With Carbon Capture		Baseline			With Carbon Capture	
	Riverside 1 (A1, A2, A3)	Riverside 2 (A1, A2)	CC1	CC2	R1	R2-A1	R2-A2	CC1	CC2
Amine 1 - ST§†	No emissions		0.6	0.6	No emissions			0.0712	0.0728
Amine 1 - LT†			0.3	0.3				0.0356	0.0364
Amine 2 - ST§†			0.0024	0.0024				0.000285	0.000291
Amine 2 - LT†			0.0012	0.0012				0.000142	0.000146
Direct Nitrosamine 1 - LT†			0.00017	0.00017				0.0000202	0.0000206
Direct Nitrosamine 2 - LT†			0.0026	0.0026				0.000308	0.000315
Aldehydes - ST§†			2	2				0.237	0.243
Aldehydes - LT†			1	1				0.119	0.121
Amides - LT†			0.023	0.023				0.00273	0.00279
Degradant 100 – LT†			0.081	0.081				0.00961	0.00983
Degradant 101 – LT†			0.032	0.032				0.00380	0.00388
Degradant 102 – LT†			0.29	0.29				0.0344	0.0352
§Short Term ELV set at 2 x Long Term ELV †Appendix B provides further details of the emissions									

4.3 MODEL DOMAIN AND RECEPTORS

4.3.1. The model domain extends a minimum of 15km in all directions from the main Stack(s). Concentrations are modelled within this domain at a resolution of 100m within 5km of the Stack(s) and 250m between 5km and 15km from the Stack(s). The finer, 100m, grid resolution is well within the recommended minimum grid spacing of 1.5 x the stack height (1.5 x 100m = 150m for the CCF; or 1.5 x 88m = 132m for Riverside 1) and ensures that the maximum impacts are well resolved spatially.

4.3.2. Residential properties are ubiquitous throughout the urbanised areas of the model domain. Therefore, rather than identifying specific receptors, results are presented both as a maximum within the model domain and as a maximum within any of the 9 key residential areas within 3km of the Stack(s), namely:

- South of the Thames
  - Belvedere 600m south
  - Abbey Wood 1.2km south-west
  - Thamesmead 1.6km west
  - Lessness Heath 1.9km south
  - Erith 1.9km south-east
- North of the Thames
  - South Dagenham 2.4km north
  - South Hornchurch 2.4km north-north-east
  - Barking Riverside 2.5km north-west
  - Rainham 2.9km north-east

4.3.3. These residential areas are shown in Figure A-2.

4.3.4. The designated ecological sites considered in the assessment conform to the Environment Agency's most stringent distance screening criteria, namely:

- 15km for SACs, SPAs and Ramsar sites
- 15km for SSSI
- 2km for local nature sites (in this case LNRs)

4.3.5. The sites are listed in Table 2-3 and Table 2-4, and shown in Figures A-3.

4.3.6. They comprise

- SAC
  - Epping Forest (and SSSI)
- SSSI
  - Epping Forest (and SAC)
  - Inner Thames Marshes
  - Ingrebourne Marshes
  - Oxleas Woodlands
  - West Thurrock Lagoon and Marshes

- Local Nature Reserves
  - Crossness
  - Rainham Marshes
  - Lesnes Abbey Woods

4.3.7. Ecological receptors are modelled on a grid of receptors of resolution 100m (within 5km of the Stack(s)) or 250m (outside of 5km from the Stack(s)).

4.4 METEOROLOGICAL DATA AND SURFACE CHARACTERISTICS

4.4.1. The model uses 5 years of hourly sequential meteorological data from London City Airport, from 2018 to 2022. Wind roses for the site are shown in Appendix C.

4.4.2. London City Airport lies 6km to the west of the CCF. Both locations are inland sites on the Thames, to the east of the main urban area of London, and in an area of limited terrain influence. As such, the data from the Airport are considered appropriately representation of conditions on Site for dispersion modelling purposes.

4.4.3. The mixed use setting of the power station, with adjacent commercial and light industrial land use, is taken into account in the modelling by setting the surface roughness length to 1.0m. This is the value recommended by the model developers for cities and woodland. The minimum Monin-Obukhov (MO) length scale is set to 100m, the model recommended value for large urban areas. Sensitivity testing was undertaken with decreased and increased roughness length (0.5m, representative of parkland and open suburbia and 1.5m representative of major urban areas), and with minimum MO length reduced to 30m.

4.4.4. The urban setting of the meteorological station was reflected by setting the station roughness length to 0.5m and minimum MO length of 100m.

4.5 BUILDINGS

4.5.1. Buildings influence the dispersion of pollutants by increasing turbulence levels in their wake. The ADMS building module ignores any buildings whose height, H, is less than a fraction 1/α of the source height where

$$\alpha = 1 + 2 \times min\left(1, \left(\frac{W}{H}\right)\right)$$

and W is the crosswind width of the building.

4.5.2. For the Riverside Campus, this implies that any building less than 29m tall will be ignored, irrespective of its crosswind width. The only structures on site over 29m tall are the main housing units for Riverside 1 and Riverside 2 and, in the with carbon capture scenario, the solvent regeneration units. Details are provided in Table 4-3, and shown in the schematic below.

4.5.3. The ADMS ‘main building’ is set to automatic selection (‘Auto’) in the model. However, sensitivity testing shows that this selection has minimal impact on the modelled concentrations in comparison to the selection of either the Riverside 1 or Riverside 2 housing units as the main building.

Table 4-3 – Buildings included within the model

Building	Type	Easting	Northing	Height	Length / Diameter	Width	Angle
Riverside 1	Rectangular	549451	180656	45	86	147	90.4
Riverside 2	Rectangular	549692	180658	50	126	148	90.4
Regen 1	Circular	549521	180455	31.5	5.1	-	-
Regen 2	Circular	549610	180444	31.5	5.1	-	-

4.6 TERRAIN

4.6.1. There are no significant terrain gradients in the study area, defined as large scale slopes in excess of 10% gradient. Therefore, terrain effects are not included within the model.

4.7 CHEMISTRY

NOX TO NO2

4.7.1. To model concentrations of nitrogen dioxide and its subsequent deposition, the following NOx to NO_2 conversion ratio has been used in the post-processing of nitrogen oxides concentrations:

- Annual mean concentrations 0.7
- Hourly mean concentrations 0.35

4.7.2. These are the 'Worse Case' values recommended by Environment Agency.

AMINE CHEMISTRY

4.7.3. For the assessment of amines and nitrosamines from the carbon capture unit, the ADMS Amine Chemistry Module has been used to model the chemical reactions associated with the formation of nitrosamines and nitramines in the atmosphere. Reaction rate coefficients were provided by the carbon capture technology provider (Shell). Information on their derivation was provided in the Environmental Permit Applications for Phillips 66[2].

4.7.4. The mechanisms for the formation of nitrosamines and nitramines in the atmosphere are, as for the degradation within the CCF itself, complex. However, the main initial reaction of amines in the atmosphere is with hydroxyl (OH) radicals and it is this reaction on which the ADMS amine chemistry scheme is based. The formation of nitrosamines and nitramines are attributed to reactions with NO and NO_2, but these degradation products can further degrade in the atmosphere through photo-oxidation and subsequent reaction with oxygen molecules to form imines which are relatively stable and non-toxic compounds.

[2] Modelling nitrosamine and nitramine formation in the atmospheric gas phase photo-oxidation of Cansolv DC103 amine, September 2014, University of Oslo

4.7.5. Primary amines do not form stable nitrosamines, meaning that any such nitrosamines would be rapidly isomerised to the respective imine. However, the potential amine emissions from Shell's Cansolv CO_2 Capture System (DC103) do not include primary amines and therefore all nitrosamines formed by the degradation of these amines are considered in the assessment.

4.7.6. The input parameters used in the modelling are set out in Appendix D.

4.8 SUB-HOURLY AVERAGING PERIODS

4.8.1. Sulphur dioxide and aldehydes have air quality standards that are based on sub-hourly averaging periods i.e. 15-minutes and 30-minutes respectively.

4.8.2. The model has been set up to output sub-hourly average concentrations but, with the meteorological data used for the model being hourly sequential, it is possible that peak concentrations will be underestimated since sub-hourly variations in meteorological conditions may not be fully accounted for.

4.8.3. Therefore, in addition to the direct output from the model, consideration has also been given to the conservative relationships derived by Environment Agency to convert between hourly and sub-hourly average peak concentrations:

- Hourly mean to 30minute mean = 1.3
- Hourly mean to 15minute mean = 1.34

4.9 DEPOSITION

4.9.1. For the Core Scenario, deposition is calculated in post-processing, using a deposition velocity approach, and ignores plume depletion. This is a conservative approach. Sensitivity testing has been undertaken to understand the level of conservatism.

4.9.2. Deposition velocities for non-amine pollutants were taken from AQTAG06.

4.9.3. The deposition velocity for amines has been set to that for ammonia. Karl et al (2014)[3] advised treating amines as ammonia since they are both basic compounds with high solubility.

Table 4-4 – Deposition velocities used in post-processing

Pollutant	Deposition Velocity for Moorland/Short Vegetation (mm/s)	Deposition Velocity for Forest/Tall Vegetation (mm/s)
Nitrogen Dioxide	1.5	3.0
Sulphur Dioxide	12	24
Ammonia	20	30

[3] M. Karl, N. Castell, D. Simpson, S. Solberg, J. Starrfelt , T. Svendby, S.-E. Walker, and R. F. Wright, 2014, Uncertainties in assessing the environmental impact of amine emissions from a CO2 capture plant, *Atmos. Chem. Phys. Discussions*, **14**, 8633-8693

Pollutant	Deposition Velocity for Moorland/Short Vegetation (mm/s)	Deposition Velocity for Forest/Tall Vegetation (mm/s)
Hydrogen Chloride	25	60
Amines	20	30

4.9.4. The factors for the conversion of µg/m^2/s of the individual pollutants including amines to nitrogen deposition in kgN/ha/yr are dependent on the molecular weight and nitrogen content of the specific pollutant. The specific amines are listed in Appendix D.

5 IMPACT ASSESSMENT

5.1 INSIGNIFICANCE CRITERIA

PROCESS CONTRIBUTION (PC) AND PREDICTED ENVIRONMENTAL CONCENTRATION (PEC)

5.1.1. The PC for the CCF is defined as the difference between the ground level concentrations with the proposed CCF and concentrations with future operations without carbon capture i.e.

Carbon Capture Process Contribution =

Ground Level Concentrations from Operations with Carbon Capture (CC1 + CC2)

Minus

Ground Level Concentrations from Future Baseline Operations (R1 + R2-A1+ R2-A2)

5.1.2. This calculation is undertaken on a receptor-by-receptor basis.

5.1.3. The PEC is calculated without discounting baseline operations. This is a slightly conservative approach since it potentially double counts the impacts of Riverside 1. However, it is appropriate since background data will not reflect the detailed spatial distribution of the impacts of Riverside 1 i.e.

PEC with Carbon Capture =

Ground Level Concentrations from Operations with Carbon Capture (CC1 + CC2))

Plus

Background

5.1.4. Following Environment Agency guidance, if impacts meet both of the following criteria, then the impacts can be classed as insignificant:

- the short-term Process Contribution (PC) is less than 10% of the short term AQAL for protected conservation areas
- the long-term PC is less than 1% of the long-term environmental standard for protected conservation areas

5.1.5. If these criteria are exceeded, then the long term Predicted Environmental Concentration (PEC) must be calculated (as PC + Background) and no further analysis is required if:

- the long-term PEC is less than 70% of the long-term environmental standard, and
- the short-term PC is less than 20% of the available headroom, defined as the air quality standard – 2 x background concentrations.

5.1.6. These latter criteria are widely applied, *de facto*, as a second stage insignificance screening (termed 'negligible' impact below).

5.1.7. For this assessment, daily mean impacts are screened for insignificance as long-term impacts. Furthermore, for pollutants associated with the carbon capture process, with the exception of ammonia, the Carbon Capture PCs are identical to the Ground Level Concentrations from Operations with Carbon Capture since there is no equivalent emission in the Baseline scenario.

5.1.8. The insignificance criteria above are applied to human receptors and to ecological receptors designated at international or national level (SAC/SPA/Ramsar/SSSI). For local nature sites, the following insignificance criteria apply:

- the short-term PC is less than 100% of the short-term environmental standard for protected conservation areas
- the long-term PC is less than 100% of the long-term environmental standard for protected conservation areas

5.1.9. There is no requirement set out in Environment Agency guidance to calculate the PEC for local sites.

5.2 PRESENTATION OF RESULTS

5.2.1. Process contributions are presented with the number of decimal places necessary to demonstrate the scale of the impact. This should not be taken to be representative of the accuracy / level of uncertainty in the modelling.

5.2.2. Where the PC or PEC is shown as a percentage of the AQAL, the percentage is shown to 1 decimal place only.

5.2.3. Where short term impacts are presented, the allowed exceedances of the AQAL within the year are discounted from the results, as per the following:

- Hourly Mean NO_2, 18 exceedances allowed, modelled as the 99.79th %ile
- Hourly Mean SO_2, 36 exceedances allowed, modelled as the 99.73rd %ile
- Daily Mean SO_2, 12 exceedances allowed, modelled as the 99.18th %ile
- 15min Mean SO_2, 36 exceedances allowed, modelled as the 99.9th %ile
- Daily Mean PM_{10}, 35 exceedances allowed, modelled as the 90.41st %ile
- All non-statutory EALs, 0 exceedances allowed, modelled as the 100th %ile

5.3 HUMAN HEALTH

NON-AMINE RELATED POLLUTANTS

5.3.1. Table 5-1 shows the maximum Future Baseline and With Carbon Capture contributions to ground level concentrations for all non-amine related pollutants, together with the Carbon Capture PC, taken across the wider study area and all meteorological years. Results for the individual years are provided in Appendix E.

5.3.2. The first point of note is that adding the CCF to the Riverside Campus will **lower** the maximum contribution to ground-level pollutant concentrations, due to combination of the higher stack height and changes to building impacts. However, since the new Stack(s) aren't in the same place as the existing ones, the impact at specific locations can vary: some places may see a slight increase in pollution, while others may see a decrease. This is described in more detail below.

5.3.3. For all pollutants and metrics except 15min mean SO_2, the maximum impacts of the operation of the CCF anywhere within the study area are either insignificant or negligible. That is to say, either:

- the maximum carbon capture PC is less than 1%/10% of any long term/short term AQAL respectively (insignificant), and/or

- for long term metrics, the PEC is less than 70% of the long term EAL or the short-term PC is less than 20% of the short-term headroom[4] (negligible).

5.3.4. For 15minute mean SO_2, the maximum carbon capture PC is just under 30% of the EAL but taking into account the very low background concentrations, there is a negligible risk of exceedance of the AQAL, and no significant effects are likely.

Table 5-2 shows the maximum ground level concentrations and the With Carbon Capture PC over the residential areas identified in Figures A-2. Within residential areas, the PC itself is insignificant for all pollutants except mercury (daily mean) and Group III metals (annual mean), for which the PCs are classed as negligible. Furthermore, since Group III metals are assessed as if all emissions occur as nickel, the modelled impacts are conservative and during operations, impacts are likely to be significantly lower and the PC insignificant.

5.3.5. The spatial distribution of impacts is shown in Figures A-5 – A-16.

- Figure A-5 – Baseline scenario ground level concentrations of hourly mean NO_2
- Figure A-6 – With carbon capture scenario ground level concentrations of hourly mean NO_2
- Figure A-7– With carbon capture scenario ground level concentrations of hourly mean NO_2
- Figure A-8 – Baseline scenario ground level concentrations of annual mean NO_2
- Figure A-9 – With carbon capture scenario ground level concentrations of annual mean NO_2
- Figure A-10– With carbon capture scenario ground level concentrations of annual mean NO_2
- Figure A-11 – Baseline scenario ground level concentrations of 15minute mean SO_2
- Figure A-12 – With carbon capture scenario ground level concentrations of 15minute mean SO_2
- Figure A-13 – With carbon capture scenario ground level concentrations of 15minute mean SO_2
- Figure A-14 – Baseline scenario ground level concentrations of hourly mean SO_2
- Figure A-15– With carbon capture scenario ground level concentrations of hourly mean SO_2
- Figure A-16 – With carbon capture scenario ground level concentrations of hourly mean SO_2

5.3.6. Figure A-5, Figure A-11 and Figure A-14 show that ground level concentrations for metrics with a short averaging period (hourly, 30min, 15min) follow a concentric pattern around the stacks, reflecting the fact that meteorological conditions giving rise to poor dispersion occur under winds from all directions. The general zone of maximum impacts occurs around 400-500m from the stacks. There is also a discrete maximum in concentrations to the south-east of the Riverside 1 housing unit. This is driven by the effects of building downwash.

5.3.7. A similar concentric pattern is apparent in the ground level concentrations for short averaging periods in the With Carbon Capture scenario (Figure A-6, Figure A-12 and Figure A-15). However, in this scenario, because of the higher Stack(s), the zone of maximum impacts occurs somewhat further from the Stack(s) (500 – 700m). Furthermore, there is no discrete maximum to the south-east of the Riverside 1 housing, but there is maximum to the north-east of the Riverside 1 housing and a lesser maximum to the north of the Riverside 2 housing – each driven by building downwash effects.

[4] ‘Headroom is defined as the difference between the AQAL and background concentrations (or twice the annual mean background for short term metrics)

5.3.8. In combination, the variation in the building downwash between the Baseline and With Carbon Capture scenarios significantly influences the spatial distribution of the With Carbon Capture PC (Figure A-7, Figure A-13 and Figure A-16). In the immediate vicinity of the Riverside 1 and 2 housing units there are areas of reduced concentrations (negative with Carbon Capture PC). These occur where there were building downwash maxima in the Baseline scenario but not in the With Carbon Capture scenario i.e. to the south-east and north-west of the housings. There are also smaller areas of increased concentrations (positive With Carbon Capture PC) where there were building downwash maxima in the With Carbon Capture scenario. These areas are to the north-east and north of Riverside 1 and Riverside 2 housing units respectively. In the wider study area, including over residential areas, the With Carbon Capture PC is generally negative (but insignificant) to the north-west and south-east of the Stack(s)) and generally positive (but again insignificant) to the north-east and south-west of the Stack(s).

5.3.9. The spatial distribution of annual mean metrics is strongly influenced by the statistics of the hourly meteorological data in each year. Appendix C shows the wind roses for London City Airport 2018 – 2022. The prevailing wind direction is south-westerly and, as a consequence, maximum annual mean ground level concentrations in both the Baseline and With Carbon Capture scenarios occur to the north-east of the Riverside Campus, approximately 1km from the Stack(s). This is illustrated in Figure A-8 and Figure A-9 for NO_2.

5.3.10. There is a secondary maximum to the south-west of the Stack(s), reflecting the secondary prevalence of east-north-easterly winds.

5.3.11. The With Carbon Capture PC is typically negative, but the absolute maximum PC occurs in a small are to the north-east of the Riverside 1 housing unit, influenced by building downwash in the With Carbon Capture scenario.

5.3.12. For all metrics, long and short term, the maximum beneficial and adverse With Carbon Capture PCs occur well away from residential areas, either within the Thames or in the areas of light industry/warehousing to the north and south of the Thames.

5.3.13. Over residential areas, maximum impacts for both short- and long-term metrics occur over Abbey Wood. As set out above, impacts are insignificant for all pollutants other than daily mean mercury concentrations and annual mean concentrations for “other metals” (assessed as Nickel). For these pollutants, the impacts were Negligible.

Table 5-1 – Maximum Baseline and With Carbon Capture contributions to ground level concentration, plus the maximum With Carbon Capture PC (With Carbon Capture minus Baseline). The predicted environmental concentration (PEC) is shown at the point of maximum With Carbon Capture contribution.

Pollutant	Averaging Period	AQAL (µg/m³)	Max Baseline (µg/m³)	Max With Carbon Capture (µg/m³)	Max With Carbon Capture PC (µg/m³)	Max PC as % of EAL	Back-ground (µg/m³)	PEC (µg/m³)	PEC as % of EAL	Insignificant?
Nitrogen Dioxide	Hourly Mean	200	57.24	49.66	29.94	15.0%	42.20	91.86	45.9%	Negligible
	Annual Mean	40	3.24	2.13	0.42	1.0%	21.10	23.23	58.1%	Negligible
Sulphur Dioxide	15minute Mean	266	121.13	114.43	79.57	29.9%	8.60	123.03	46.3%	Negligible
	Hourly Mean	350	80.12	68.79	39.22	11.2%	8.60	77.39	22.1%	Negligible
	Daily Mean	125	6.92	6.35	1.45	1.2%	8.60	14.95	12.0%	Yes
PM10	Daily Mean	50	0.62	0.40	0.10	0.2%	31.80	32.20	64.4%	Yes
	Annual Mean	40	0.20	0.13	0.02	0.1%	15.90	16.03	40.1%	Yes
PM2.5	Annual Mean	10	0.20	0.13	0.02	0.2%	8.60	8.73	87.3%	Yes
Hydrogen Chloride	Hourly Mean	750	42.16	59.40	42.83	5.7%	-	-	-	Yes
Hydrogen Fluoride	Hourly Mean	160	2.28	4.50	3.24	2.0%	-	-	-	Yes
	Annual Mean	16	0.16	0.10	0.02	0.1%	-	-	-	Yes
TOC (as Benzene)	Annual Mean	5	0.46	0.30	0.06	1.1%	0.51	0.81	16.1%	Negligible
Carbon Monoxide	8 Hour Mean	10000	57.04	47.90	27.02	0.3%	175.00	222.90	2.2%	Yes
Ammonia	Hourly Mean	2500	7.06	8.25	5.51	0.2%	2.40	10.65	0.4%	Yes
	Annual Mean	180	0.46	0.21	0.03	<0.1%	1.20	1.41	0.8%	Yes

Pollutant	Averaging Period	AQAL (µg/m³)	Max Baseline (µg/m³)	Max With Carbon Capture (µg/m³)	Max With Carbon Capture PC (µg/m³)	Max PC as % of EAL	Back-ground (µg/m³)	PEC (µg/m³)	PEC as % of EAL	Insignificant?
Cadmium and Thallium	Annual Mean	0.005	0.00078	0.00051	0.000095	1.9%	0.0001	0.00	12.1%	Negligible
Mercury	Hourly Mean	0.6	0.014	0.020	0.014	2.4%	0.02	0.04	6.6%	Yes
	Daily Mean	0.06	0.0067	0.0041	0.0018	3.1%	0.01	0.01	23.5%	Negligible
Other Metals	Annual Mean	0.02	0.0118	0.0076	0.0014	7.1%	0.002	0.01	45.9%	Negligible

Table 5-2 – Maximum Baseline and With Carbon Capture contributions to ground level concentration at residential receptors, plus the maximum With Carbon Capture PC (With Carbon Capture minus Baseline). The predicted environmental concentration (PEC) is shown at the point of maximum With Carbon Capture contribution.

Pollutant	Averaging Period	AQAL (µg/m³)	Max Baseline (µg/m³)	Max With Carbon Capture (µg/m³)	Max With Carbon Capture PC (µg/m³)	Max PC as % of EAL	Back-ground (µg/m³)	PEC (µg/m³)	PEC as % of EAL	Insignificant?
Nitrogen Dioxide	Hourly Mean	200	37.39	37.51	8.45	4.2%	42.20	79.71	39.9%	Yes
	Annual Mean	40	1.06	1.01	0.16	0.4%	21.10	22.11	55.3%	Yes
Sulphur Dioxide	15minute Mean	266	76.80	77.29	19.35	7.3%	8.60	85.89	32.3%	Yes
	Hourly Mean	350	51.98	50.88	12.78	3.7%	8.60	59.48	17.0%	Yes
	Daily Mean	125	3.48	3.37	1.00	0.8%	8.60	11.97	9.6%	Yes
PM10	Daily Mean	50	0.20	0.18	0.06	0.1%	31.80	31.98	64.0%	Yes
	Annual Mean	40	0.06	0.06	0.01	<0.1%	15.90	15.96	39.9%	Yes
PM2.5	Annual Mean	10	0.06	0.06	0.01	0.1%	8.60	8.66	86.6%	Yes
Hydrogen Chloride	Hourly Mean	750	25.08	32.50	11.66	1.6%	-	-	-	Yes
Hydrogen Fluoride	Hourly Mean	160	1.59	2.37	1.07	0.7%	-	-	-	Yes
	Annual Mean	16	0.05	0.05	0.01	<0.1%	-	-	-	Yes

Pollutant	Averaging Period	AQAL (µg/m³)	Max Baseline (µg/m³)	Max With Carbon Capture (µg/m³)	Max With Carbon Capture PC (µg/m³)	Max PC as % of EAL	Back-ground (µg/m³)	PEC (µg/m³)	PEC as % of EAL	Insignificant?
TOC (as Benzene)	Annual Mean	5	0.14	0.13	0.02	0.5%	0.51	0.64	12.9%	Yes
Carbon Monoxide	8 Hour Mean	10000	34.72	32.79	9.65	0.1%	175.00	207.79	2.1%	Yes
Ammonia	Hourly Mean	2500	4.91	4.52	0.47	<0.1%	2.40	6.92	0.3%	Yes
	Annual Mean	180	0.15	0.09	0.00	<0.1%	1.20	1.29	0.7%	Yes
Cadmium and Thallium	Annual Mean	0.005	0.00025	0.00023	0.000041	0.8%	0.00	0.00	6.5%	Yes
Mercury	Hourly Mean	0.6	0.008	0.011	0.004	0.6%	0.02	0.03	5.1%	Yes
	Daily Mean	0.06	0.0028	0.0026	0.0010	1.7%	0.01	0.01	21.0%	Negligible
Other Metals	Annual Mean	0.02	0.0037	0.0034	0.0006	3.1%	0.00	0.01	25.0%	Negligible

AMINES AND DEGRADATION PRODUCTS (NITROSAMINES AND NITRAMINES)

5.3.14. The impacts of amines and degradation products are considered for:

- Direct impacts – the impacts of the emissions of amines and degradation products without consideration of atmospheric chemistry, and
- Indirect impacts – the impacts of the degradation of the amines in ambient air, modelled using the ADMS chemistry module.

5.3.15. For nitrosamines, the direct impacts relate to degradation products formed within the CCF from the degradation of Amine 1 and Amine 2 prior to release to ambient air (termed Direct Nitrosamines 1 and 2 in Table 2-1). Indirect impacts relate to the degradation of these amines in ambient air. There are no direct emissions of nitramines.

Direct Emissions

5.3.16. Table 5-3 shows the maximum With Carbon Capture PC from direct emissions of amines and degradants both as a maximum within the study area and at residential properties. The PC is insignificant for all pollutants and metrics except annual mean direct nitrosamines. Maximum impacts anywhere in the study area are 27.7% of the AQAL for direct nitrosamine 2 (29.5% for total direct nitrosamines), but this occurs over the Thames where there is no potential for long term exposure (Figure A-17). The maximum impact over residential areas is markedly lower at 12.8% of the AQAL. This occurs over Rainham, to the north of the Thames, since this area is downwind of the Riverside campus on the prevailing south-westerly winds. Concentrations in the nearest residential area of Belvedere are lower again at 4.7% of the AQAL.

5.3.17. Further discussion on impacts from nitrosamines is included below.

Table 5-3 – Maximum Process Contribution from direct emissions of amines and degradation products, as a maximum within the study area and as a maximum within residential areas (µg/m^3)

Pollutant		Maximum with Study Area			Maximum over Residential Areas		
		Max With Carbon Capture PC	Max as % of AQAL	Insig-nificant	Max With Carbon Capture PC	Max as % of AQAL	Insig-nificant
Amine 1	Hourly Mean	0.50	0.1%	Yes	0.27	0.1%	Yes
	Daily Mean	0.05	0.1%	Yes	0.03	<0.1%	Yes
Amine 2	Daily Mean	0.00021	<0.1%	Yes	0.00013	<0.1%	Yes
Nitrosamine 1	Annual Mean	0.0000043	2.1%	Likely	0.0000019	0.9%	Yes
Nitrosamine 2	Annual Mean	0.000055	27.7%	Likely	0.000025	12.3%	Likely
Aldehydes	30min Mean	1.91	1.9%	Yes	1.05	1.0%	Yes
	Annual Mean	0.021	0.4%	Yes	0.009	0.2%	Yes
Amides	Annual Mean	0.00048	<0.1%	Yes	0.00021	<0.1%	Yes
Degradant 100	Annual Mean	0.0017	<0.1%	Yes	0.0008	<0.1%	Yes
Degradant 101	Annual Mean	0.00068	<0.1%	Yes	0.00030	<0.1%	Yes
Degradant 102	Annual Mean	0.0062	<0.1%	Yes	0.0027	<0.1%	Yes

Indirect Pollutants

5.3.18. Table 5-4 summaries the contribution of the CCF to ground level concentrations of nitrosamines and nitramines. Note that concentrations are provided in ng/m^3 and that, as shown in Table 2-2, the AQAL is set at 0.2ng/m^3 (0.0002µg/m^3) for all metrics. In addition to indirect impacts, concentrations arising from direct emissions of nitrosamines are also provided. This enables consideration of total nitrosamines and total nitrosamines and nitramines.

5.3.19. The PCs for indirect nitrosamine and nitramine arising from Amine 2 are insignificant everywhere.

5.3.20. The total nitrosamine PC is dominated by the effects of direct emissions of nitrosamine which, as has been noted previously, are assessed as a worst case without taking into account degradation processes.

5.3.21. The spatial distribution of nitrosamine impacts is shown in Figures A-17 – A-21.

- Figure A-17 – With carbon capture scenario ground level concentrations (PC) of direct nitrosamines (Direct Nitrosamine 1 + Direct Nitrosamine 2)
- Figure A-18 – With carbon capture scenario ground level concentrations (PC) of indirect nitrosamines (Indirect Nitrosamine 1+ Nitrosamine 2)
- Figure A-19 – With carbon capture scenario ground level concentrations (PC) of total nitrosamines (Direct plus Indirect, Nitrosamine 1+ Nitrosamine 2)
- Figure A-20 – With carbon capture scenario ground level concentrations (PC) of indirect nitramines (Indirect Nitramine 1+ Nitramine 2)
- Figure A-21 – With carbon capture scenario ground level concentrations (PC) of total nitrosamines and nitramines (Direct plus Indirect, Nitrosamines plus Nitramines))

Table 5-4 – Direct and indirect nitrosamines and nitramines, as a maximum within the study area and as a maximum within residential areas (ng/m^3)

Pollutant	Maximum with Study Area			Maximum over Residential Areas		
	Max With Carbon Capture PC	Max as % of AQAL	Insig-nificant	Max With Carbon Capture PC	Max as % of AQAL	Insig-nificant
Nitrosamine1	0.0194	9.7%	Likely	0.0157	7.9%	Likely
Nitrosamine2	0.000086	0.0%	Yes	0.000070	0.0%	Yes
Total Indirect Nitrosamines	0.0195	9.8%	Likely	0.0158	7.9%	Likely
Direct Nitrosamines	0.0589	29.5%	Likely	0.0257	12.8%	Likely
Total Nitrosamines	0.0736	36.8%	Likely	0.0349	17.5%	Likely
Nitramine1	0.0175	8.7%	Likely	0.0172	8.6%	Likely
Nitramine2	0.000081	0.0%	Yes	0.000079	0.0%	Yes
Total Nitramines	0.0176	8.8%	Likely	0.0173	8.6%	Likely
Total Nitrosamines + Nitramines	0.0844	42.2%	Likely	0.0495	24.8%	Likely

5.3.22. Total indirect nitrosamines (Figure A-18) follow the broad pattern of the prevailing winds with maxima to the north-east and west/southwest of the Stack(s). However, indirect nitrosamines show maximum impacts to the west/south-west of the Stack(s) rather than the north-east seen with the direct emissions. The same effect is seen with the nitramines (Figure A-20).

5.3.23. Notwithstanding this, the total nitrosamines (Figure A-19) and total nitrosamines plus nitramines (Figure A-21) show absolute maximum concentrations within the Thames (dominated by the effects of direct emissions), and maximum concentrations in residential areas occur over Thamesmead and Abbey Wood (due to the influence of indirect impacts under easterly winds).

5.3.24. Maximum concentrations of total nitrosamines, total nitramines and total nitrosamines plus nitramines exceed the 1% insignificance criteria but are all well within the AQAL. At residential properties, total nitrosamines plus nitramines amount to just under 25% of the AQAL.

5.3.25. However, this AQAL is based on the Environment Agency's EAL for N-Nitrosodimethylamine (NDMA). As set out in Appendix B, the toxicity of the process specific nitrosamines is 20 – 40 times less than NDMA (in terms of both mutagenicity and carcinogenicity). Furthermore, nitramines are less than toxic than their counterpart nitrosamines.

5.3.26. Therefore, with the maximum modelled PC in any meteorological year being less than 25% of the AQAL for NDMA, it is highly likely that health effects will be insignificant.

5.4 ECOLOGICAL IMPACTS

5.4.1. This section provides the maximum impacts on sites designated for nature conservation at international/national and local levels. The sites included in the assessment are listed in Table 2-3 and Table 2-4 respectively, with the distance scoping criteria provided in **Section 4.3** and the insignificance criteria provided in **Section 5.1** above.

CRITICAL LEVELS

Nitrogen Oxides

5.4.2. Table 5-5 and Table 5-6 show the maximum modelled contributions and PCs for annual mean nitrogen oxides concentrations and daily mean nitrogen oxides respectively over designated sites across all years.

5.4.3. The With Carbon Capture PC is insignificant over all sites. The PEC exceeds the critical level for annual mean NOx in places, but this is due to impacts from sources other than the Riverside campus. The PEC is within the daily mean NOx critical level everywhere.

5.4.4. Furthermore, all sites experience areas of beneficial PCs (a reduction in concentrations with the CCF) and adverse PCs (an increase with the CCF).

5.4.5. Figures A-22 and Figure A-24 show the spatial distribution of the With Carbon Capture scenario contribution to annual mean and daily mean NOx across the study area for 2020. Maximum concentrations occur over the Thames. The With Carbon Capture PCs are shown in Figure A-23 and Figure A-25.

5.4.6. As seen in the case of pollutants relevant to human health, the maximum PCs (both beneficial and adverse) are concentrated in the immediate vicinity of the Stack(s) and driven by changes in building downwash effects. These effects only influence concentrations over Crossness LNR, where the adverse PC is a maximum of 0.6% of the critical level and the maximum beneficial PC is a maximum of 1.9% of the critical level. Elsewhere across the study area impacts are less than 0.5% of the critical level whether beneficial or adverse.

Sulphur Dioxide

Table 5-7 shows the maximum modelled contributions and PCs for annual mean sulphur dioxide concentrations over designated sites across all years. The PC is insignificant (<1% of the critical level) over all sites.

Ammonia

5.4.7. Table 5-8 shows the maximum modelled contributions and PCs for annual mean ammonia concentrations over designated sites across all years. There are no adverse PCs over any site. The maximum beneficial PC is insignificant (<1% of the critical level) over all sites except Ingrebourne Marshes and Inner Thames Marshes where the PC exceeds 1% beneficial.

5.4.8. Figure A-26 shows the spatial distribution of the ammonia PC for 2020. The only area of adverse impacts is a small area to the north of the Riverside Campus on the banks of the Thames, where there are no nature conservation sites.

Table 5-5 – Maximum contributions and PC for annual mean NOx over sites designated for nature conservation ($\mu g/m^3$)

Site	Desig-nation	Critical Level	Baseline (max)	With Carbon Capture (max)	Max Beneficial PC	Max Adverse PC	Adverse PC as % of CL	PEC at Max Adverse Impact
Epping Forest	SSSI	30	0.074	0.071	-0.003	0.001	0.0%	34.38
Ingrebourne Marshes	SSSI	30	1.316	1.248	-0.070	0.017	0.1%	26.54
Inner Thames Marshes	SSSI	30	1.604	1.730	-0.091	0.180	0.6%	31.74
Oxleas Woodlands	SSSI	30	0.235	0.262	-0.009	0.028	0.1%	27.99
West Thurrock Lagoon and Marshes	SSSI	30	0.199	0.186	-0.014	0.000	0.0%	48.51
Lesnes Abbey Woods	LNR	30	0.306	0.392	0.000	0.086	0.3%	26.33
Crossness	LNR	30	0.645	0.831	-0.574	0.186	0.6%	27.25
Rainham Marshes	LNR	30	1.535	1.691	-0.091	0.178	0.6%	31.74

Table 5-6 – Maximum contributions and PC for daily mean NOx over sites designated for nature conservation ($\mu g/m^3$)

Site	Desig-nation	Critical Level	Baseline (max)	With Carbon Capture (max)	Max Beneficial PC	Max Adverse PC	Adverse PC as % of CL	PEC at Max Adverse Impact
Epping Forest	SSSI	200	1.373	1.248	-0.157	0.110	0.1%	68.87
Ingrebourne Marshes	SSSI	200	6.833	6.849	-0.477	0.537	0.3%	53.58
Inner Thames Marshes	SSSI	200	10.609	11.106	-2.093	1.412	0.7%	64.53
Oxleas Woodlands	SSSI	200	3.449	3.666	-0.251	0.274	0.1%	56.19
West Thurrock Lagoon and Marshes	SSSI	200	2.275	2.228	-0.375	0.082	0.0%	97.10
Lesnes Abbey Woods	LNR	200	5.578	6.942	0.000	1.725	0.9%	54.21
Crossness	LNR	200	23.951	22.359	-21.282	6.902	3.5%	61.02
Rainham Marshes	LNR	200	10.488	11.106	-2.093	1.412	0.7%	64.53

Table 5-7 – Maximum contributions and PC for annual mean SO_2 over sites designated for nature conservation ($\mu g/m^3$)

Site	Designation	CL	Baseline (max)	With Carbon Capture (max)	Max Beneficial PC	Max Adverse PC	Adverse PC as % of CL	PEC at Max Adverse Impact
Epping Forest	SSSI	10	0.021	0.020	-0.002	0.000	0.0%	2.28
Ingrebourne Marshes	SSSI	10	0.374	0.347	-0.029	0.002	0.0%	2.52
Inner Thames Marshes	SSSI	10	0.427	0.470	-0.034	0.055	0.6%	4.41
Oxleas Woodlands	SSSI	10	0.065	0.072	-0.004	0.007	0.1%	1.98
West Thurrock Lagoon and Marshes	SSSI	10	0.056	0.051	-0.005	0.000	0.0%	3.62
Lesnes Abbey Woods	LNR	10	0.084	0.108	-0.003	0.024	0.2%	2.17
Crossness	LNR	10	0.166	0.237	-0.137	0.072	0.7%	2.23
Rainham Marshes	LNR	10	0.408	0.459	-0.034	0.053	0.5%	3.86

Table 5-8 – Maximum contributions and PC for annual mean NH_3 over sites designated for nature conservation ($\mu g/m^3$)

Site	Designation	CL	Baseline (max)	With Carbon Capture (max)	Max Beneficial PC	Max Adverse PC	Adverse PC as % of CL	PEC at Max Adverse Impact
Epping Forest	SSSI	1	0.007	0.005	-0.003	-	-	1.19
Ingrebourne Marshes	SSSI	1	0.133	0.083	-0.050	-	-	1.05
Inner Thames Marshes	SSSI	3	0.153	0.111	-0.046	-	-	1.04
Oxleas Woodlands	SSSI	1	0.023	0.017	-0.006	-	-	1.08
West Thurrock Lagoon and Marshes	SSSI	1	0.020	0.012	-0.008	-	-	1.08
Lesnes Abbey Woods	LNR	1	0.030	0.026	-0.007	-	-	1.08
Crossness	LNR	1	0.060	0.059	-0.053	-	-	0.93
Rainham Marshes	LNR	1	0.146	0.108	-0.046	-	-	0.90

CRITICAL LOADS

Nitrogen Deposition

5.4.9. Table 5-9 shows the maximum modelled contributions and PCs for annual mean nitrogen deposition concentrations over designated sites across all years. There are no adverse PCs over any site. This is a direct result of reduced emissions of ammonia with the carbon capture plant. These reductions are secured as mitigation within the Development Consent Order for the CCF. Specifically, the emission limit value for ammonia in Riverside 1 is reduced from 15mg/Nm^3 in the existing permit to 10mg/Nm^3 post CCF (as shown in Table 4-2 – Proposed (With Carbon Capture) and Existing (Baseline) Emission Limit Values and equivalent mass emission rates at full load operation. (LT = Long Term, ST = Short Term). The maximum beneficial PC is insignificant (<1% of the critical level) over all sites except Ingrebourne Marshes and Inner Thames Marshes where the PC exceeds 1% beneficial.

5.4.10. Figure A-27 shows the spatial distribution of the nitrogen deposition PC for 2020. As for ammonia, the only area of adverse impacts is a small area to the north of the Riverside Campus on the banks of the Thames, where there are no nature conservation sites.

Acid Deposition

5.4.11. Table 5-10 shows the maximum modelled contributions and PCs for annual mean acid deposition concentrations over designated sites across all years. There are no adverse PCs over Epping Forest and an insignificant adverse PC over Oxleas Woodlands. The maximum beneficial PC is insignificant (<1% of the critical level) over all sites.

Table 5-9 - Maximum contributions and PC for nitrogen deposition over sites designated for nature conservation (kgN/ha/yr)

Site	Desig-nation	Depos-ition Type	Critical Load	Baseline (max)	With Carbon Capture (max)	Max Beneficial PC	Max Adverse PC	Adverse PC as % of CL	PEC at Max Adverse Impact
Epping Forest	SSSI	Moorland	5	0.046	0.031	-0.015	-	-	14.59
Epping Forest	SSSI	Forest	10	0.073	0.050	-0.023	-	-	26.62
Ingrebourne Marshes	SSSI	Moorland	15	0.821	0.559	-0.264	-	-	12.17
Oxleas Woodlands	SSSI	Forest	15	0.229	0.188	-0.045	-	-	24.18
Inner Thames Marshes	SSSI	Moorland	10	0.958	0.752	-0.236	-	-	12.20
West Thurrock	SSSI	Moorland	10	0.000	0.000	0.000	-	-	12.22
Crossness	LNR	Moorland	10	0.377	0.390	-0.331	0.013	0.13%	12.41
Lesnes Abbey Woods	LNR	Forest	10	0.296	0.283	-0.048	-	-	23.92
Rainham Marshes	LNR	Moorland	10	0.915	0.734	-0.231	-	-	12.18

Table 5-10 - Maximum contributions and PC for acid deposition over sites designated for nature conservation (keq/ha/yr)

Site	Desig-nation	Depos-ition Type	Critical Load	Baseline (max)	With Carbon Capture (max)	Max Beneficial PC	Max Adverse PC	Adverse Impact as % of CL	PEC at Max Adverse Impact
Epping Forest	SSSI	Moorland	1.584	0.014	0.012	-0.002	0.0%	0.00	1.12
Epping Forest	SSSI	Forest	1.730	0.029	0.025	-0.004	0.0%	0.00	2.03
Oxleas Woodlands	SSSI	Forest	2.720	0.090	0.095	-0.008	0.5%	0.00	1.87

6 SENSITIVITY AND UNCERTAINTY ANALYSIS

6.1 MODEL VALIDATION

6.1.1. The ADMS 6 model has been extensively validated against experimental datasets from field and wind tunnel studies.

6.1.2. Case studies involving simple dispersion of pollutants from stacks over flat terrain, such as the Kincaid, Indianapolis and Prairie Grass studies[5], show reasonable correlation between modelled and observed concentrations. The Kincaid and Indianapolis studies with tall stacks (187m and 84m respectively) are most relevant to the Riverside campus. In these observation campaigns, there was a tendency to underpredict the absolute extreme concentrations whilst representing mean concentrations well – within +/-10% for long term concentrations and within +/-50% for short term concentrations.

6.1.3. The validation of the model with buildings is more challenging. The model performs well in comparison with wind tunnel studies[6], and also in the case of relatively simple real-world buildings[7], generally within a factor of 2. As the complexity of the buildings increases, the prediction of near field concentrations becomes more variable.

6.1.4. In relation to the Riverside campus modelling, the most sensitive receptors i.e. residential properties and sites designated for nature conservation at national and international levels, are located over 500m from the Stack(s) where concentrations are largely uninfluenced by building downwash effects. The buildings are relatively simple structures, with single blocks (housing units) influencing the dispersion from the existing stacks. However, in the areas of downwash, there is very limited potential for exposure of members of the public and the Crossness LNR.

6.2 SENSITIVITY TESTING

6.2.1. The sensitivity testing was undertaken for meteorological years giving some of the highest concentrations i.e. 2019 (for amine chemistry) and 2020 (for non-chemistry metrics), but the overall conclusions are applicable to all years.

METEOROLOGY

6.2.2. The assessment is based on the highest process contribution (for each pollutant and metric individually) over the 5 meteorological years modelled. This is a conservative assumption that, in comparison to typical conditions over the 5 years, equates to an overestimation of maximum impacts (with respect to the 5-year average) by approximately 15% for annual averages, 25% for daily means and 40% for hourly means.

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[5] CERC, 2023, ADMS 6 Flat Terrain Validation: Kincaid, Indianapolis and Prairie Grass
[6] CERC, 2023, ADMS 6 Buildings Validation: Robins and Castro Wind Tunnel Experiments
[7] CERC, 2023, ADMS 6 Buildings Validation: EOCR Study

SURFACE PARAMETERS

6.2.3. The assessment used a roughness length of 1.0m and a minimum Monin-Obukhov length of 100m as surface parameters within the ADMS meteorological module. These values are representative of cities and woodlands.

6.2.4. Sensitivity testing was undertaken for an increased (1.5m – large urban areas) and decreased (0.5m – parkland and open suburbia) surface roughness length, and with the minimum Monin-Obukhov length set to 30m. Results are shown in Table 6-1 for maximum concentrations within the study area of annual mean and hourly mean nitrogen dioxide, 15min mean SO_2 and direct nitrosamines.

6.2.5. Increasing the roughness length increases the maximum ground level concentrations and PCs, whilst decreasing the roughness length decreases the impact.

6.2.6. For maximum ground level concentrations in the study area, the overall sensitivity to the choice of surface parameters is of the order of +/-20%, whilst the With Carbon Capture PC has uncertainty of the order of +/-40% (where a negative percentage indicates a decrease in impact). However, the sensitivity tests demonstrate that the selected 1m roughness length is conservative. The area immediately surrounding the Riverside campus is relatively open and without woodland. Whilst there are buildings in the light industrial area to the east of the site, the majority of area is characterised by suburbia rather than city centre.

6.2.7. There is no sensitivity in the model results to reducing the minimum Monin-Obukhov Length from 100m to 30m.

BUILDING PARAMETERS

6.2.8. The buildings have been entered into the model at their maximum heights. This will tend towards an overestimation of the effects of building downwash.

6.2.9. Notwithstanding this, the ADMS ‘main building’ selection has been set to ‘Auto’, in which the model itself decides on the selection of the main building for the calculation of downwash. The tests undertaken, in which the main building was set to the Riverside 1 housing unit for Riverside 1 and the Riverside 2 housing unit for Riverside 2 showed no sensitivity in the model results.

Table 6-1 – Building and surface parameter sensitivity testing, modelled using meteorological data for 2020

Model Run	Concentrations (ug/m³)				Change to Core Assessment (%)			
	Annual Mean NOx	Hourly Mean Nox	15min SO_2	Direct Nitrosamines	Annual Mean NOx	Hourly Mean Nox	15min SO_2	Direct Nitrosamines
Baseline Scenario Contribution								
Core Modelling	3.24	56.28	121.13	-	-	-	-	-
No Buildings	1.87	36.26	77.34	-	-42%	-36%	-36%	-
Main Building Change	3.24	56.28	121.13	-	0%	0%	0%	-
Reduced Roughness	2.83	59.81	119.23	-	-13%	6%	-2%	-
Increased Roughness	3.48	54.04	131.49	-	8%	-4%	9%	-
Reduced MO Length	3.24	56.28	121.13	-	0%	0%	0%	-
With Carbon Capture Scenario Contribution								
Core Modelling	2.13	46.43	114.43	5.89E-05	-	-	-	-
No Buildings	1.89	36.45	80.98	4.86E-05	-11%	-22%	-29%	-17%
Main Building Change	2.13	46.43	114.43	5.89E-05	0%	0%	0%	0%
Reduced Roughness	1.71	43.94	96.11	4.81E-05	-20%	-5%	-16%	-18%
Increased Roughness	2.42	52.66	134.15	6.64E-05	14%	13%	17%	13%
Reduced MO Length	2.13	46.43	114.43	5.89E-05	0%	0%	0%	0%
With Carbon Capture PC								
Core Modelling	0.35	29.94	79.57	5.89E-05	-	-	-	-
No Buildings	0.39	16.07	39.22	4.86E-05	12%	-46%	-51%	-17%
Main Building Change	0.35	29.94	79.57	5.89E-05	0%	0%	0%	0%
Reduced Roughness	0.21	22.23	59.80	4.81E-05	-40%	-26%	-25%	-18%
Increased Roughness	0.48	34.68	91.67	6.64E-05	38%	16%	15%	13%
Reduced MO Length	0.35	29.94	79.57	5.89E-05	0%	0%	0%	0%

AMINE CHEMISTRY PARAMETERS

6.2.10. The assessment of direct emissions of amines was undertaken as an inherent worst case, since it assumes that no degradation occurs in the atmosphere. However, since the modelled direct impacts of amines are very low, <0.1% of the AQAL, this assumption has no impact on the assessment conclusions. Furthermore, no degradation of directly emitted nitrosamines is assumed, and their assessment is therefore inherently conservative.

6.2.11. Table 6-2 shows the results of the sensitivity testing for the amine chemistry module inputs i.e. parameters relating to the rate of degradation of amines to nitrosamines, nitramines and imines. The sensitivity testing has been undertaken for Amine 1. The specific reaction rates set in the model are shown in Table D2 in Appendix D, and the variation on OH radical in Table B2.

6.2.12. The ADMS chemistry module parameter that has the greatest influence on total nitrosamine and nitramine concentrations is the parameter 'c' that is used to determine the OH radical concentrations across the year. Increasing this parameter, increases the generation of the amine radical in the first step towards the formation of the nitrosamine/nitramine degradants. The value of 'c' set in the model was based on an annual average OH radical concentration of 1.0×10^6 molecules/cm^3. The mapping data provided by CERC (Figure 3.6 in Improving Post-Combustion Carbon Capture Air Quality Risk Assessment Techniques, 2024, CERC) shows that this is likely to be a conservative assessment of the OH radical concentration, implying that the model results will tend towards overestimation.

6.2.13. The kinematic reaction parameters set in the modelling were provided by the technology provider on the basis of solvent specific testing. The parameters were very similar for the related compounds, Amine 1 and Amine 2. The CERC 2024 report provides a range for the parameters for Amine 2 from literature. A sensitivity test was undertaken using data from the CERC report (Details provided in Appendix D). This resulted in greater production of indirect nitrosamines but reduced production of nitramines such that the total production of degradants was reduced.

6.2.14. As noted in the previous section of this report, the With Carbon Capture PC for total nitrosamines is dominated by the impact of direct emissions (Table 5-4), which has been assessed conservatively without consideration of degradation. Placing greatest weight on the solvent specific test parameters provided by the technology provider and taking into account the conservative estimation of the concentration of the OH radical, uncertainty in the amine chemistry model outputs due to input parameter variation is likely to be well within the overall uncertainty in the model outputs, but again with a general tendency towards over-estimation in the results.

Table 6-2 - Maximum amine, nitrosamine and nitramine concentrations in the study area for amine chemistry parameter sensitivity testing, modelled using meteorological data for 2019

Pollutant	Max With Carbon Capture (ng/m^3)			Comparison to Main Case		
	Nitrosamine 1	Nitramine 1	Total Indirect Nitramine and Nitrosamine	Nitrosamine 1	Nitramine 1	Total Indirect Nitramine and Nitrosamine
Main Case	0.0194	0.0174	0.0353			
Reduced 'c'	0.0099	0.0095	0.0186	-49%	-45%	-47%
Increased 'c'	0.0240	0.0210	0.0430	24%	20%	22%
CERC Parameters	0.0327	0.0003	0.0329	68%	-98%	-7%

BASELINE SCENARIO

6.2.15. The assessment of the ‘With Carbon Capture PC’ has been based on consideration of the difference between ground level concentrations in the With Carbon Capture scenario and a Future Baseline scenario of the operation of both Riverside 1 and Riverside 2. This is appropriate since, construction of Riverside 2 is complete, it has a permit to operate and will shortly undergo commissioning.

6.2.16. However, following a request in the EA’s advice on the assessment of impacts on habitats sites, the Applicant has considered an assessment based on comparison of the ground level concentrations in the With Carbon Capture scenario against the current baseline of the operation Riverside 1 alone. This is not a realistic comparison but, none the less, the results of this numerical exercise are set out in Appendix F.

6.2.17. The comparison does not change the overall conclusions that no significant effects are likely with the operation of the CCF. Moreover, the With Carbon Capture PCs presented within Appendix F are well within (less adverse) the envelope of modelled results presented for the Development Consent Order application[8] and accepted by Natural England and unlikely to give rise to significant effects.

6.2.18. Beneficial impacts are limited to Crossness LNR only but the PCs for all metrics are generally within 1% of the critical level/load and insignificant.

6.2.19. Adverse impacts exceed 1% of the critical level for annual mean NOx at Ingrebourne Marshes SSSI and Inner Thames Marshes SSSI. The PEC at the former site is within the critical level and whilst there is a nominal exceedance of the critical level within Inner Thames Marshes, this exceedance is likely to be limited to roadside of the A13

[8] Cory Decarbonisation Project Information, accessed via: https://national-infrastructure-consenting.planninginspectorate.gov.uk/projects/EN010128

(where the PC is negligible) rather than at the point of maximum impact of the CCF[9]. Daily mean NOx PECs are well within the critical level.

6.2.20. The impacts on annual mean SO_2 exceed 1% of the critical level, but the PEC is well within the critical level, and no effects are likely. Ammonia impacts are dominated by agricultural sources and long-range transport but marginally exceed 1% over Ingreborne Marshes if the critical level is assessed to be 1μg/m^3 (for lower plants).

6.2.21. The nitrogen deposition PC over Inner Thames Marshes is 1.1% of the critical load for the most sensitive habitat (saltmarsh)[10]. However, the maximum PC occurs in an area of grazing marsh rather than saltmarsh, with lower sensitivity to atmospheric nitrogen inputs.

OVERALL CONCLUSIONS

6.2.22. Taking into account the overall conservatism built into the model methodology and analysis, i.e. the assumption that emissions are constantly at their emission limit value, and basing impacts on the worst meteorological year, the specification of surface, building and amine chemistry parameters is highly unlikely to significantly influence the assessment conclusions. Indeed, it is likely that impacts tend towards overestimation.

[9] The maximum impact over Inner Thames Marshes presented in Appendix F is 1.7% of the critical level for annual mean NOx and the PEC at this location is 32.08μg/m^3. In a written response to Natural England for the DCO (Appendix A: Applicant's Response to Natural England Air Quality Position Letter, February 2005), the equivalent impact and PEC were 2.4% of the critical level and 34.98μg/m^3 respectively. The impacts presented here are, therefore, within the envelope agreed by Natural England as not significant.

[10] The maximum impact on nitrogen deposition over Inner Thames Marshes presented in Appendix F is 0.11kgN/ha/yr. In a written response to Natural England for the DCO (Appendix A: Applicant's Response to Natural England Air Quality Position Letter, February 2005), the equivalent impact agreed by Natural England as not significant was 0.16kgN/ha/yr. The impacts presented here are, therefore, within the envelope agreed by Natural England as not significant.

7 CONCLUSIONS

7.1 HUMAN HEALTH

COMBUSTION-RELATED POLLUTANTS

7.1.1. The With Carbon Capture PC for existing combustion-related pollutants including nitrogen dioxide, sulphur dioxide, particulate matter, hydrogen chloride, hydrogen fluoride, ammonia and metals is **insignificant** or classed as **negligible** due to the PEC being well within the AQAL.

7.1.2. This conclusion is robust since the assessment has tended to overestimate impacts and the conclusions hold even if overall model uncertainty is taken into account (from general model uncertainty up to +/-50% for short term metrics and +/-10% for long term metrics).

CARBON-CAPTURE RELATED POLLUTANTS

7.1.3. The With Carbon Capture PC for direct emissions of amines, aldehydes, amides and other degradants except nitrosamines is **insignificant**. This conclusion is robust since taking account of overall model uncertainty (+/-50%, driven by overall model uncertainty), the process contribution will remain insignificant for all metrics.

7.1.4. The process contributions to concentrations of nitrosamines and nitramines in the Core Scenario do not screen as insignificant, and the maximum modelled contribution with amines at their emission limit value is approximately 18% of the EAL for nitrosamines and 9% of the EAL for nitramines in residential receptor areas. However, the concentrations will not exceed the EAL even if uncertainty of +/-70% (driven by kinetic reaction parameter uncertainty) is taken into account and/or if the impact is assessed as nitrosamines and nitramines separately or combined.

7.1.5. Moreover, the EAL has been set conservatively at the EAL for one of the most toxic nitrosamines (NDMA) and the proposed ELV takes account of potential short-term fluctuations in emissions and hence is likely to overestimate typical (average) emissions. Therefore, taking into account the likely underestimation of nitrosamine and nitramine degradation/removal processes in the ADMS chemistry module, this is an **acceptable** maximum impact within the wider study area and health effects are likely to be insignificant.

7.2 ECOLOGY

CRITICAL LEVELS

7.2.1. The With Carbon Capture PC for concentrations of NOx and SO_2 over sites designated for nature conservation is **insignificant** where any adverse impacts occur, and also beneficial in places. The conclusion is robust since taking a conservative view of overall model uncertainty of +/-10% (with the upper limit driven by long term concentration model uncertainty) together with the many conservative assumptions in the modelling, the PC would remain insignificant.

7.2.2. The process contribution to concentrations of ammonia is beneficial over all sites, but any effects are unlikely to be measurable since total concentrations are dominated by emissions from agriculture and long-range transport.

CRITICAL LOADS

7.2.3. The process contribution to nitrogen and acid deposition is **insignificant** over all designated sites where any adverse impacts occur, and also beneficial in places. This is driven by the beneficial impacts on ammonia concentrations. Taking into account uncertainty (+/-10% driven by model uncertainty) and overall conservative assumptions in the modelling, this conclusion is robust.

7.3 CONCLUSIONS

7.3.1. The overall conclusions of the air dispersion modelling are that **no significant effects are likely** on either human health or local habitats.

Appendix A

FIGURES

Public

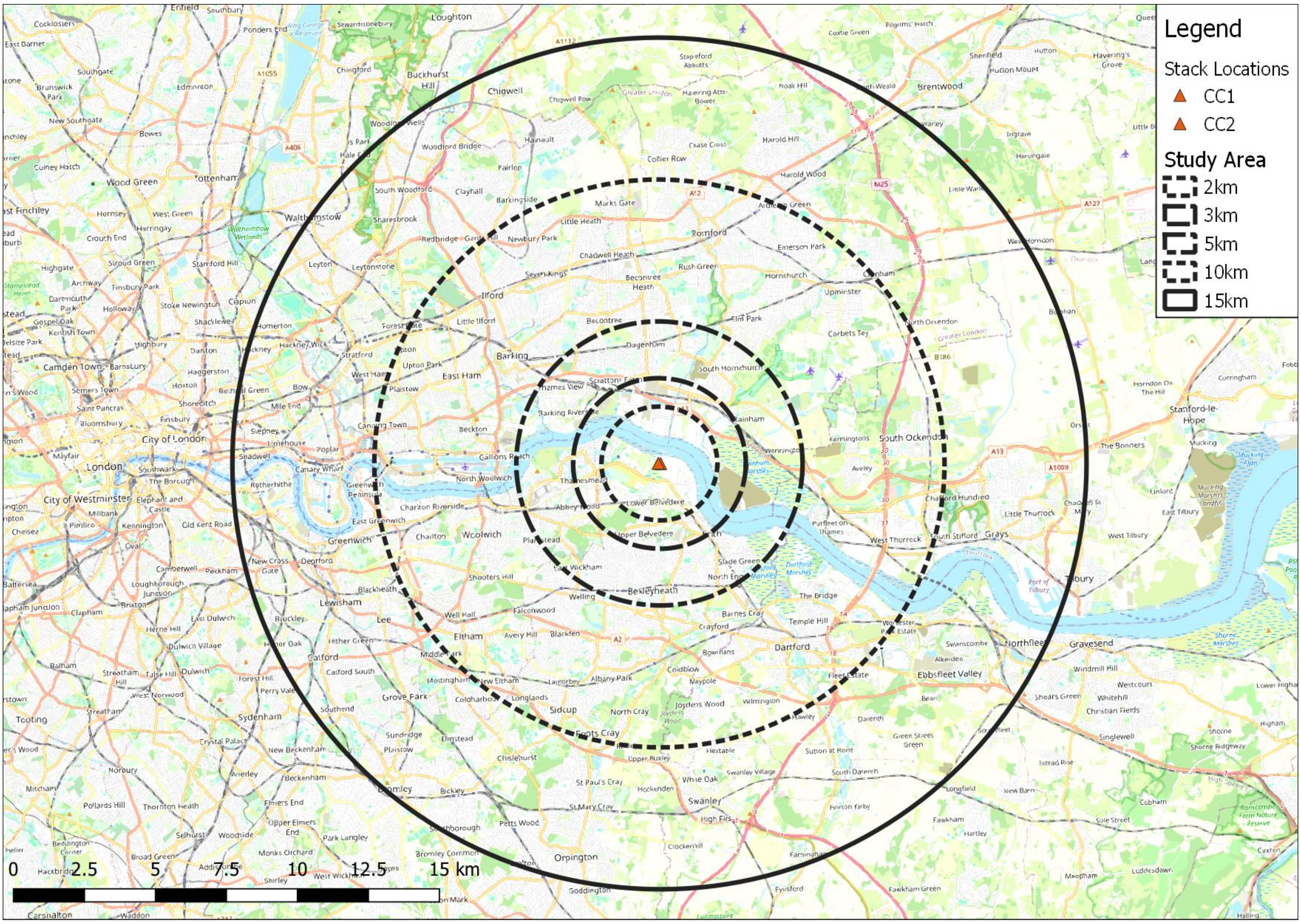


Figure A-1 - Site setting and study area. The CCF Stack(s) are shown as a red filled triangles. Dotted lines show the distance from the CCF Stack(s).

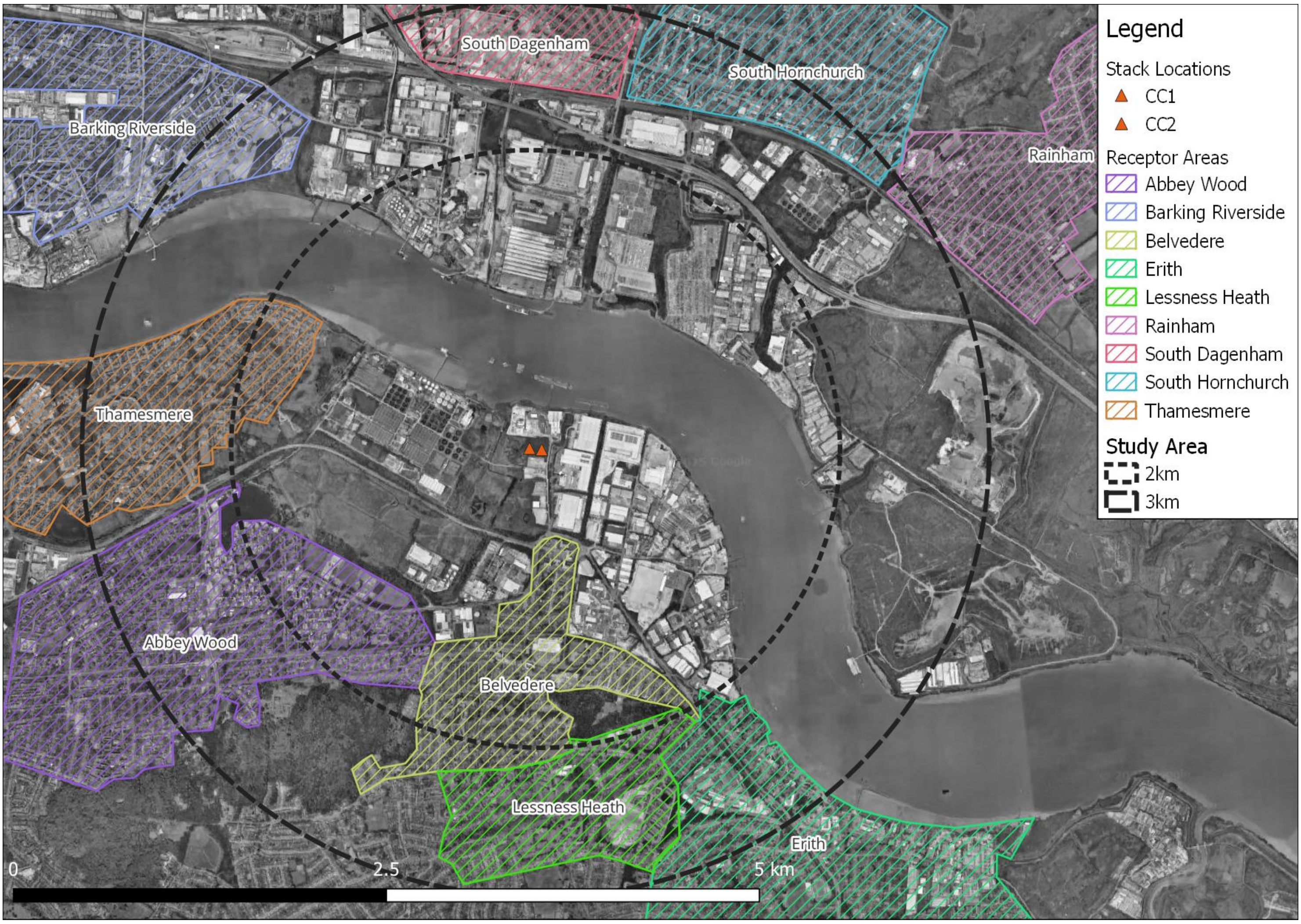


Figure A-2 - Illustrative key residential areas (receptors for chronic human health effects) within 3km of the Stack(s). The CCF Stack(s) are shown as a red filled triangles.

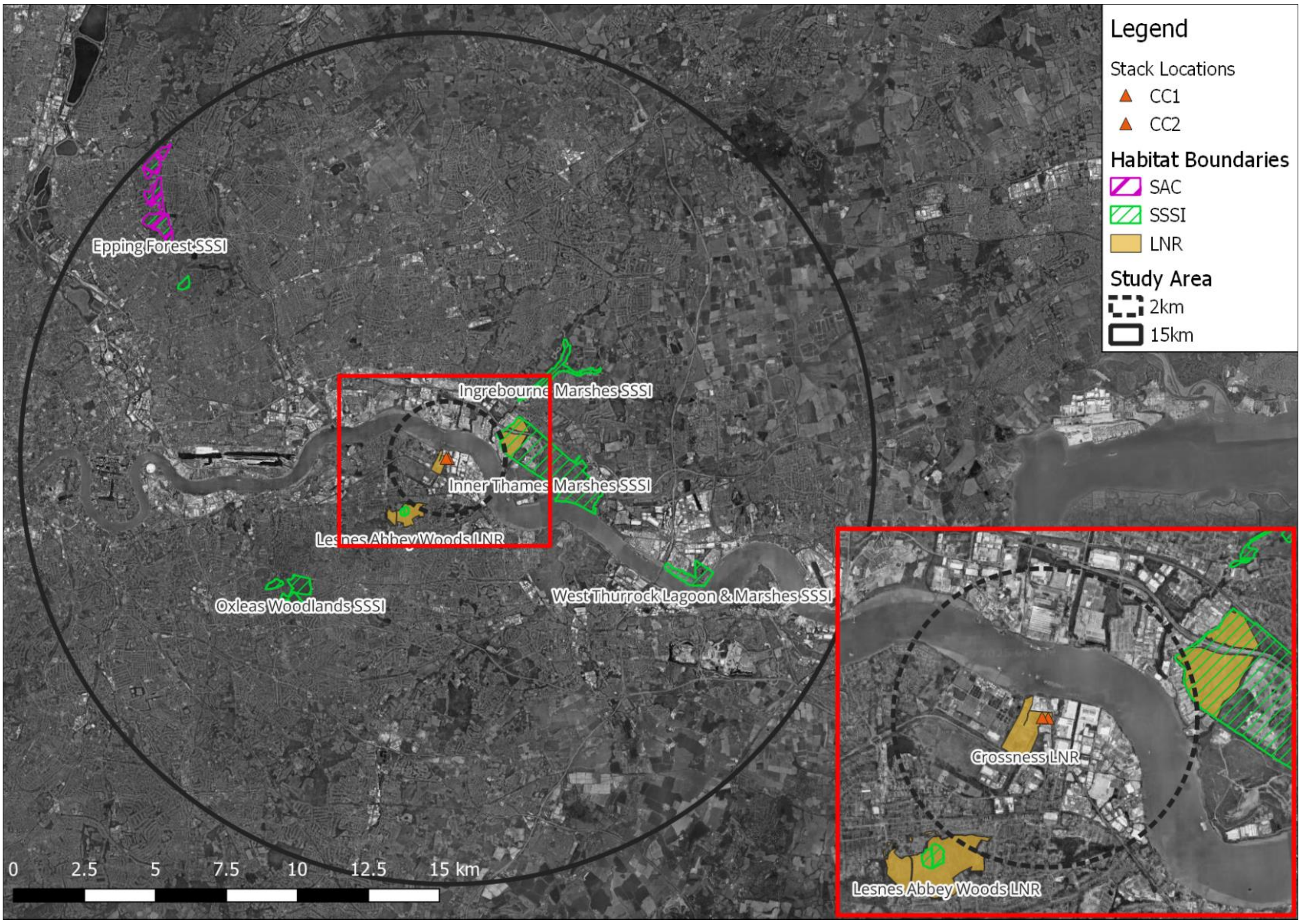


Figure A-3 – Ecological sites included in the modelling.

Figure A-4 – Buildings and Stack(s), as modelled.

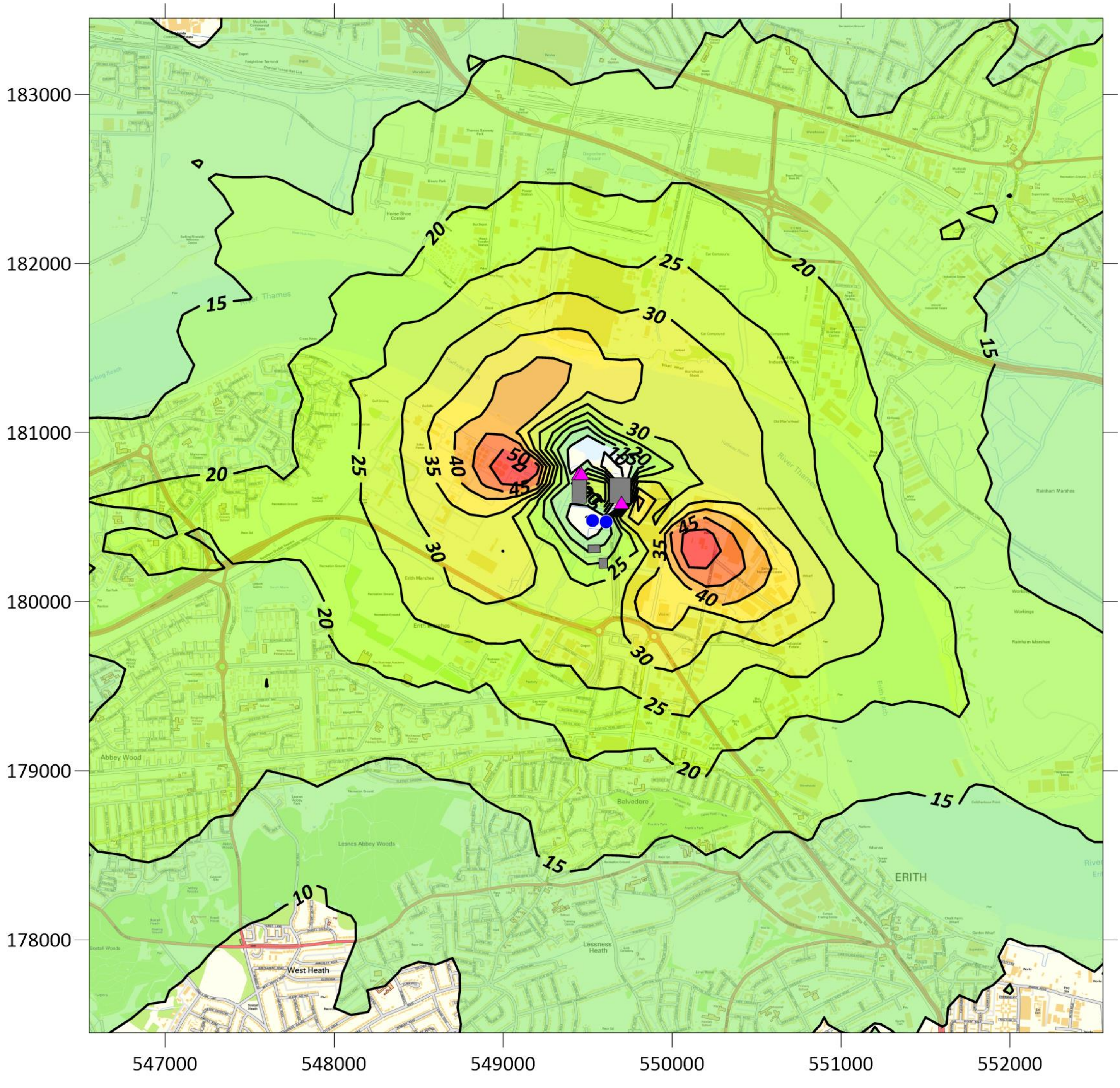


Figure A-5 – Baseline scenario contribution to ground level concentrations of hourly mean nitrogen dioxide, modelled using meteorological data from 2020. Contour interval: 5µg/m³ (2.5% of AQAL)

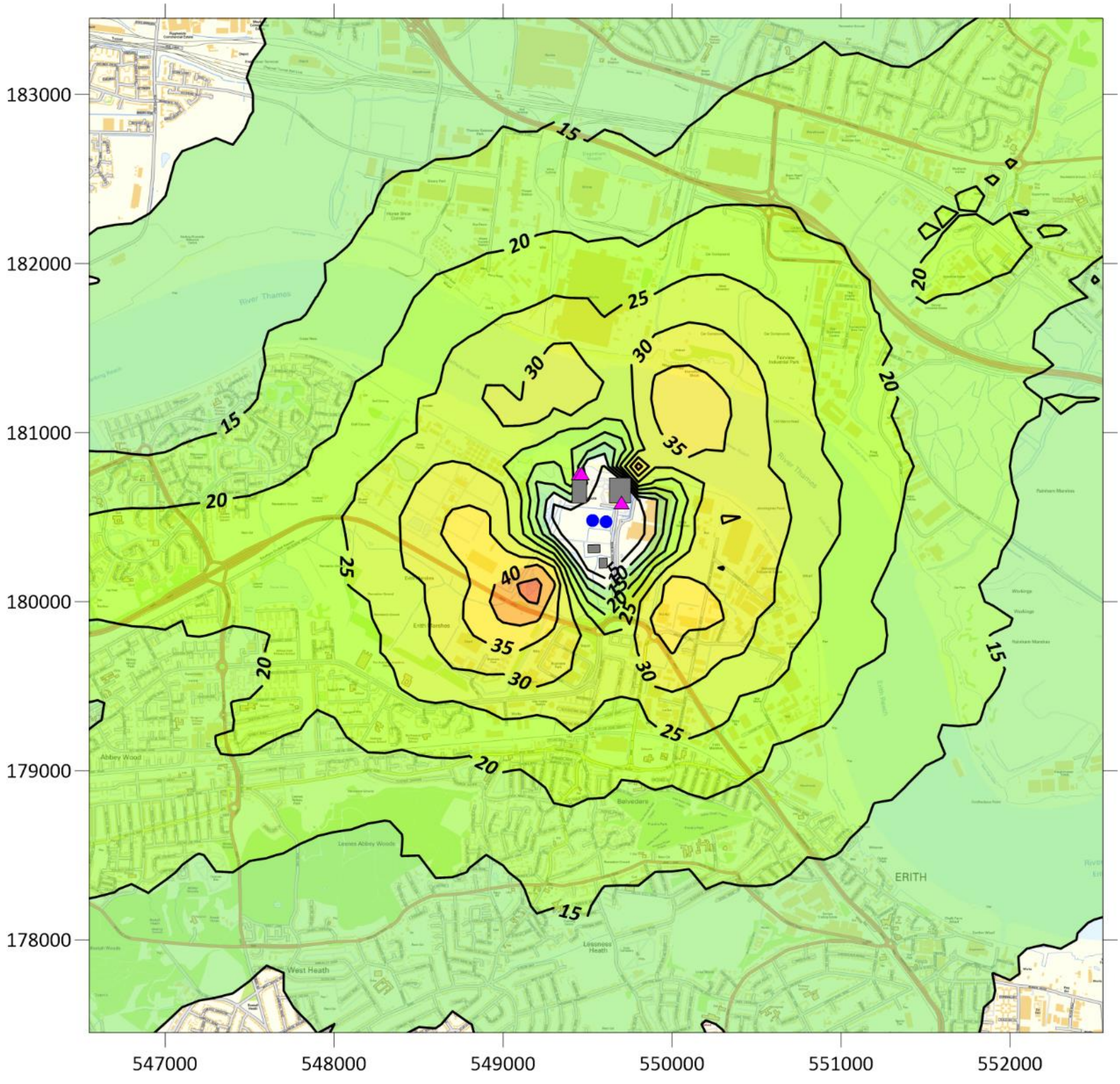


Figure A-6 – With Carbon Capture scenario contribution to ground level concentrations of hourly mean nitrogen dioxide, modelled using meteorological data from 2020. Contour interval: 5µg/m^3 (2.5% of AQAL)

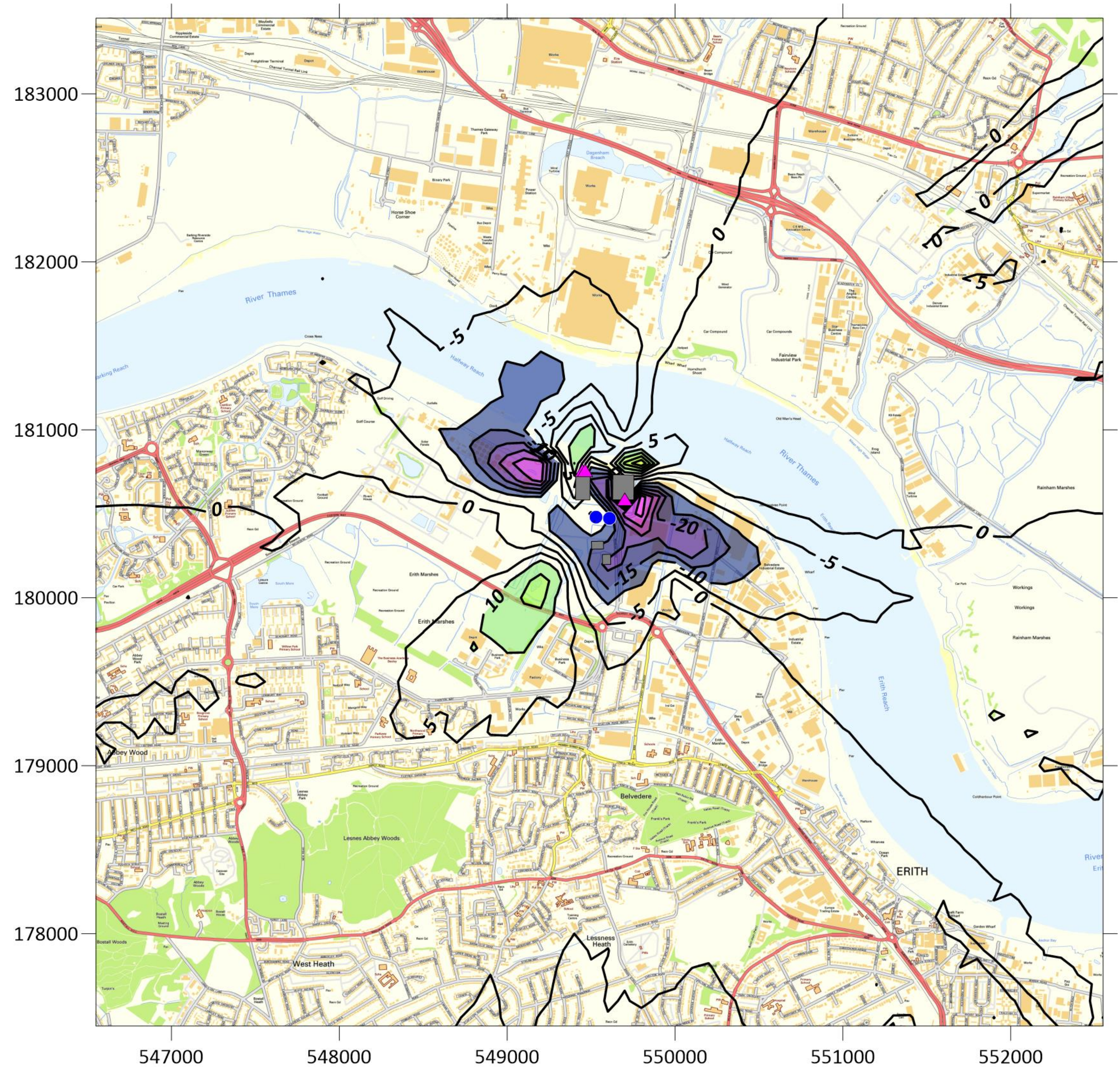


Figure A-7 - With Carbon Capture PC for hourly mean nitrogen dioxide, modelled using meteorological data from 2020. Contour interval: 5µg/m³ (2.5% of AQAL)

wsp

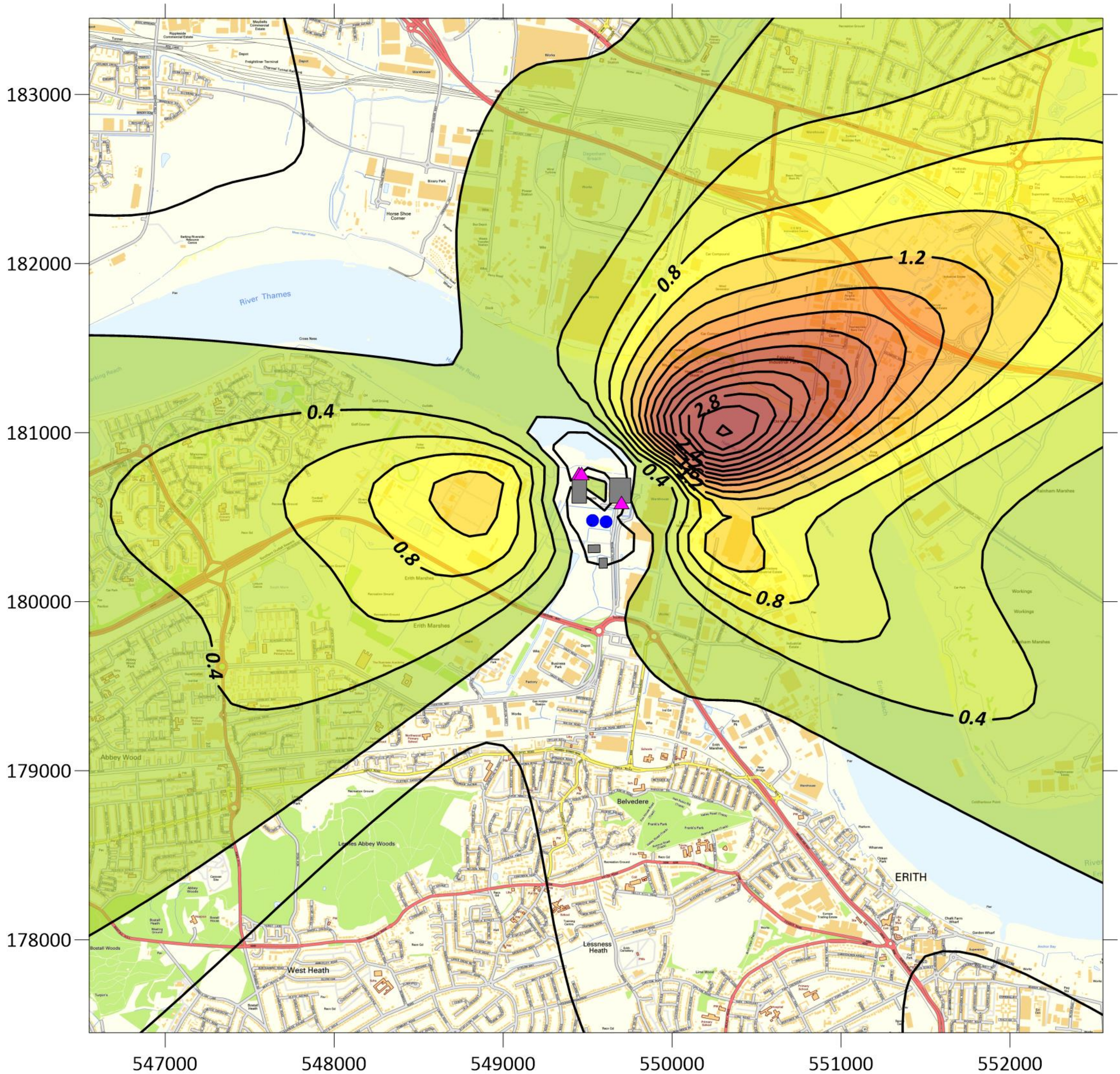


Figure A-8 – Baseline scenario contribution to ground level concentrations of annual mean nitrogen dioxide, modelled using meteorological data from 2020. Contour interval: 0.2µg/m³ (0.5% of AQAL)

wsp

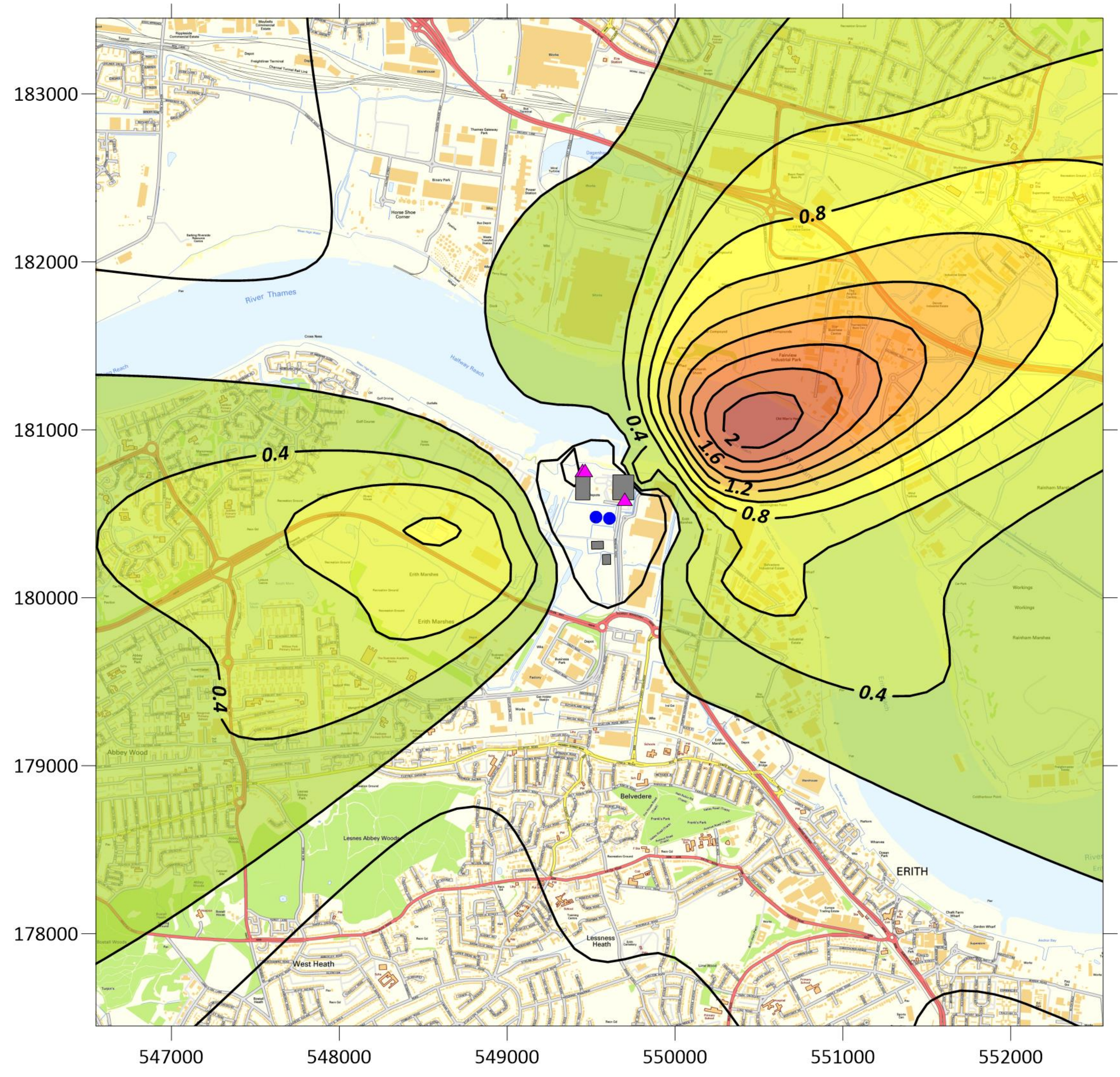


Figure A-9 – With Carbon Capture scenario contribution to ground level concentrations of annual mean nitrogen dioxide, modelled using meteorological data from 2020. Contour interval: 0.2µg/m³ (0.5% of AQAL)

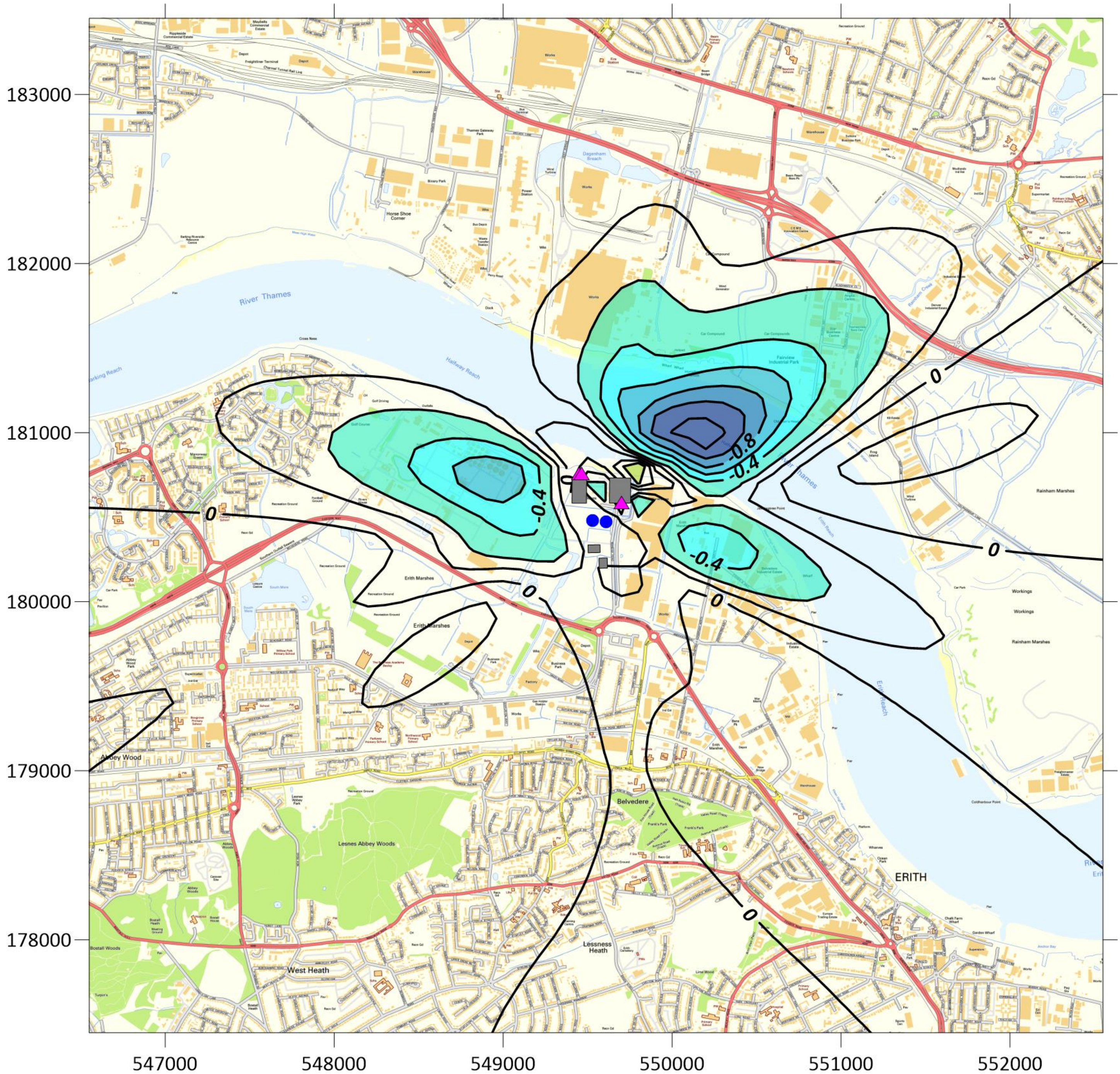


Figure A-10 - With Carbon Capture scenario PC for ground level concentrations of annual mean nitrogen dioxide, modelled using meteorological data from 2020. Contour interval: 0.2µg/m³ (0.5% of AQAL)

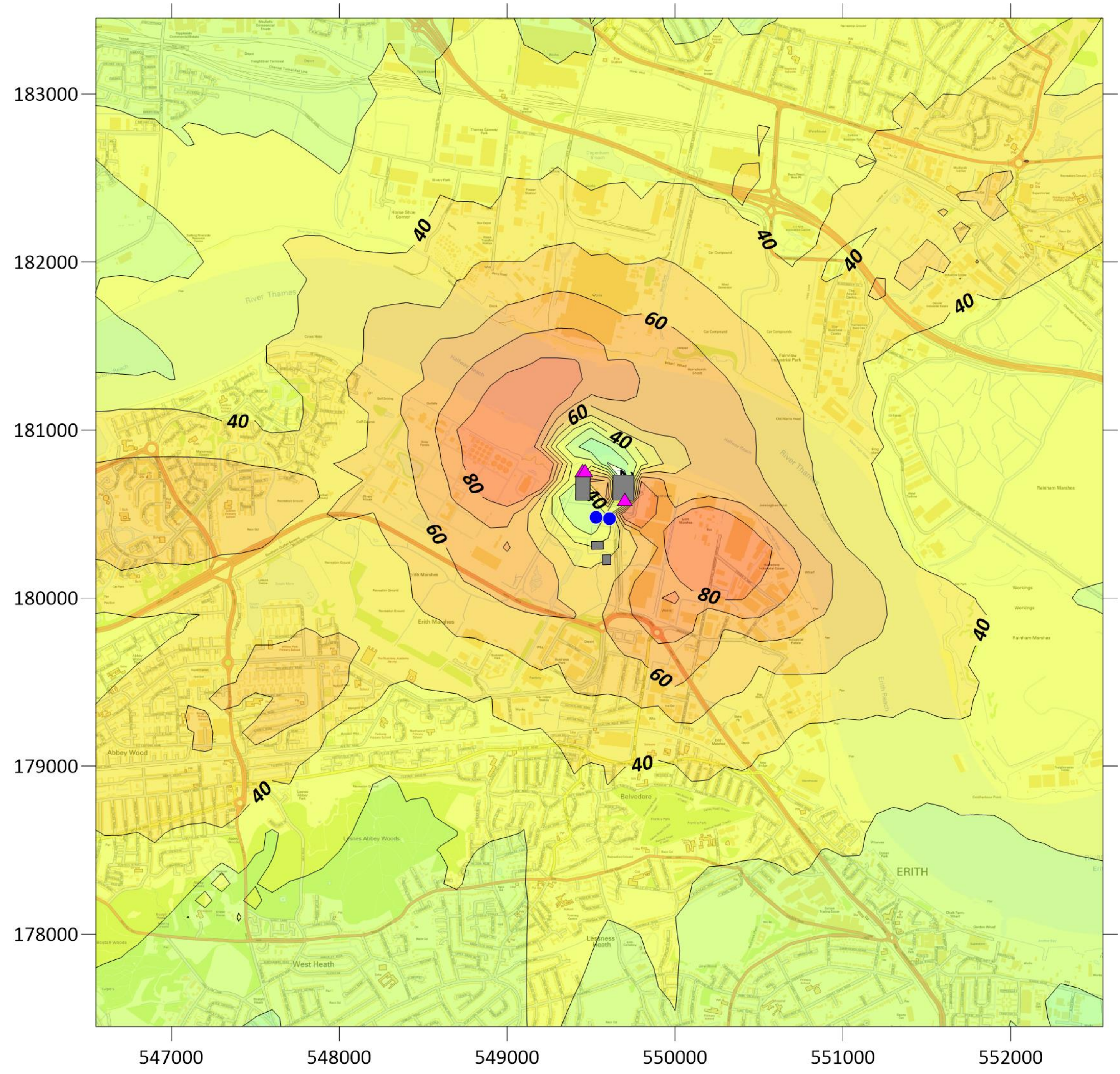


Figure A-11 –Baseline scenario contribution to ground level concentrations of 15minute mean sulphur dioxide, modelled using meteorological data from 2020. Contour interval: 10µg/m³ (3.7% of AQAL)

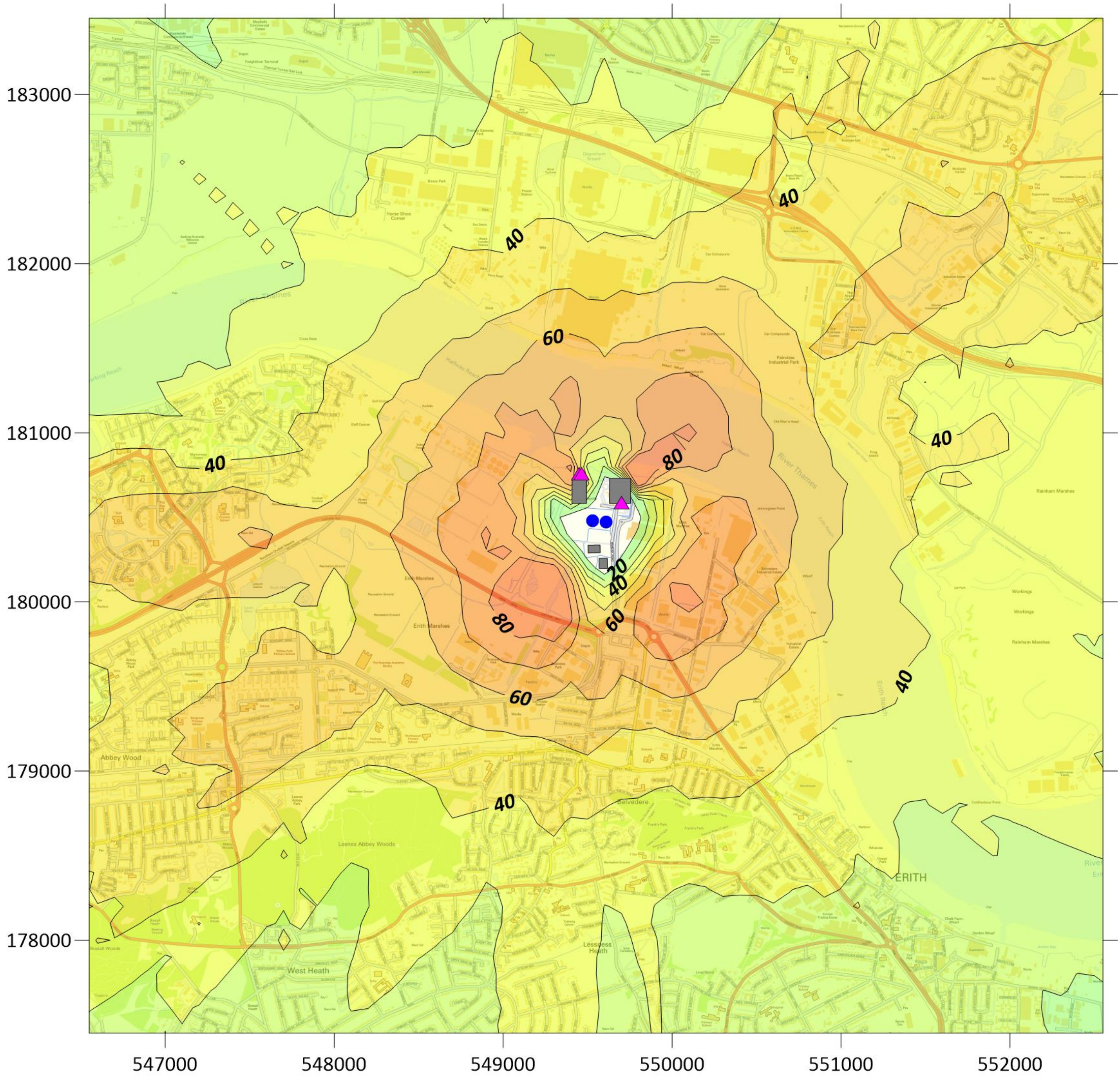


Figure A-12 – With Carbon Capture scenario contribution to ground level concentrations of 15minute mean sulphur dioxide, modelled using meteorological data from 2020. Contour interval: 10µg/m³ (3.7% of AQAL)

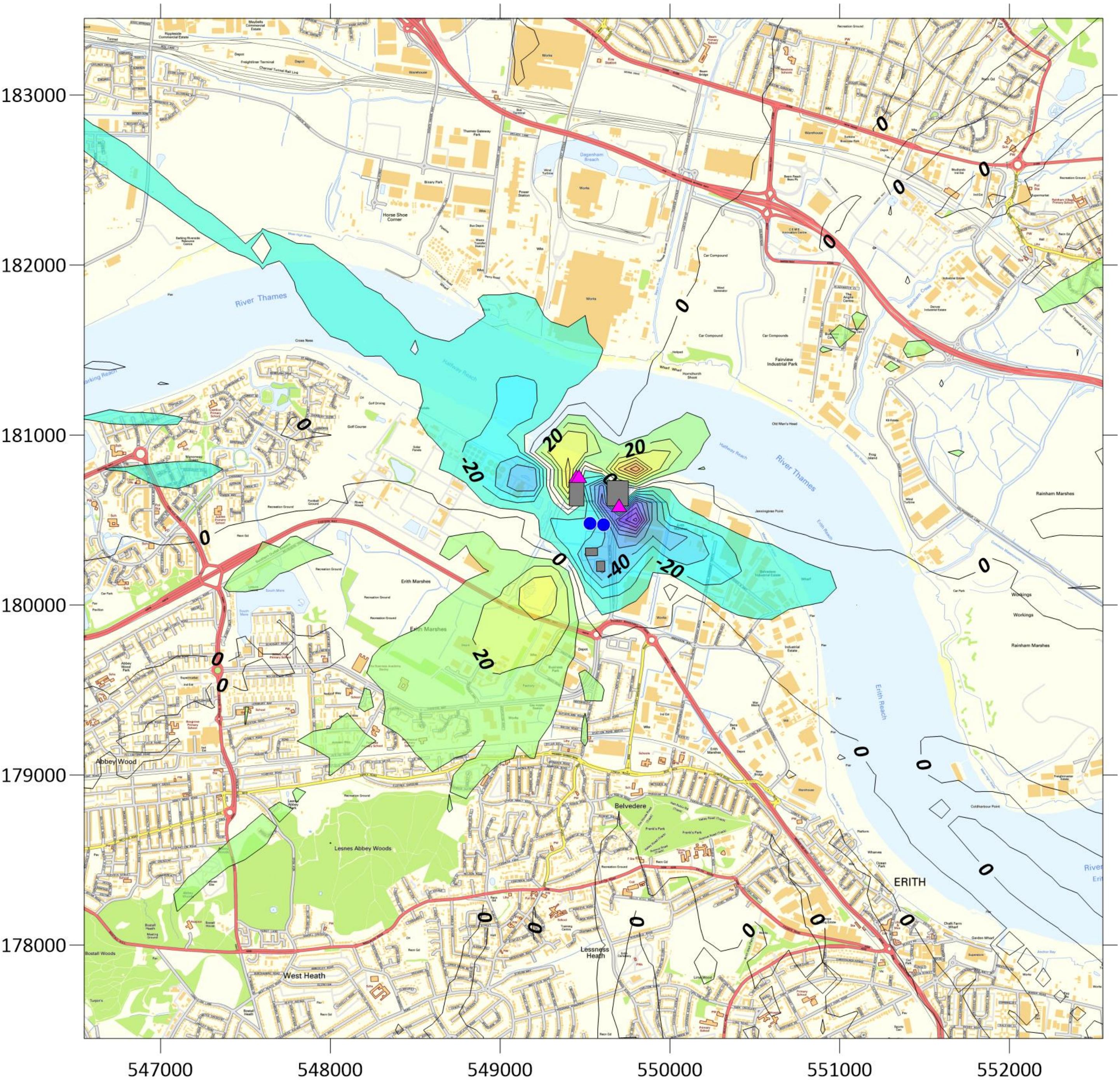


Figure A-13 – With Carbon Capture PC for ground level concentrations of 15minute mean sulphur dioxide, modelled using meteorological data from 2020. Contour interval: 10μg/m³ (3.7% of AQAL)

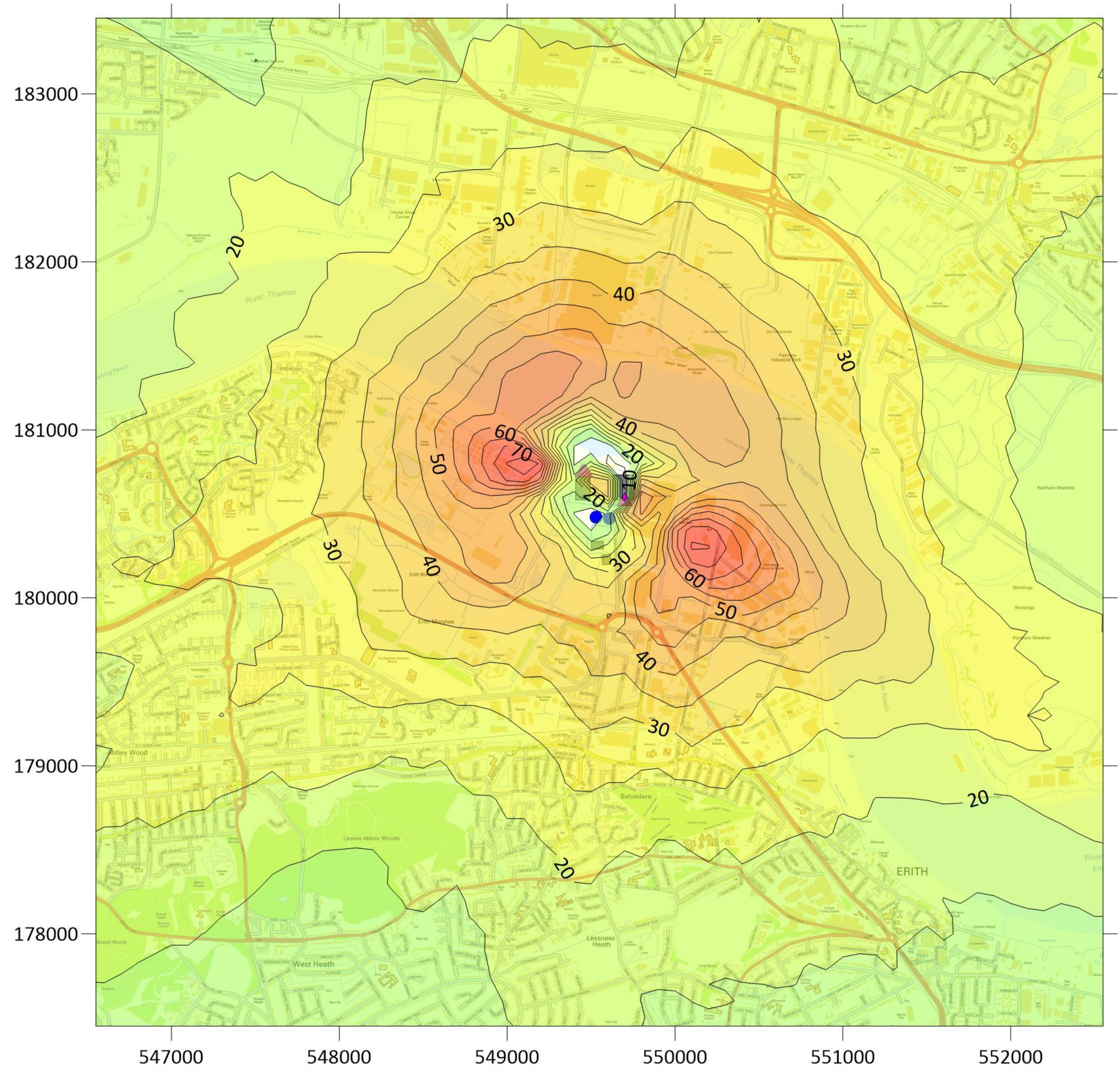


Figure A-14 –Baseline scenario contribution to ground level concentrations of hourly mean sulphur dioxide, modelled using meteorological data from 2020. Contour interval: 10µg/m^3 (3.7% of AQAL)

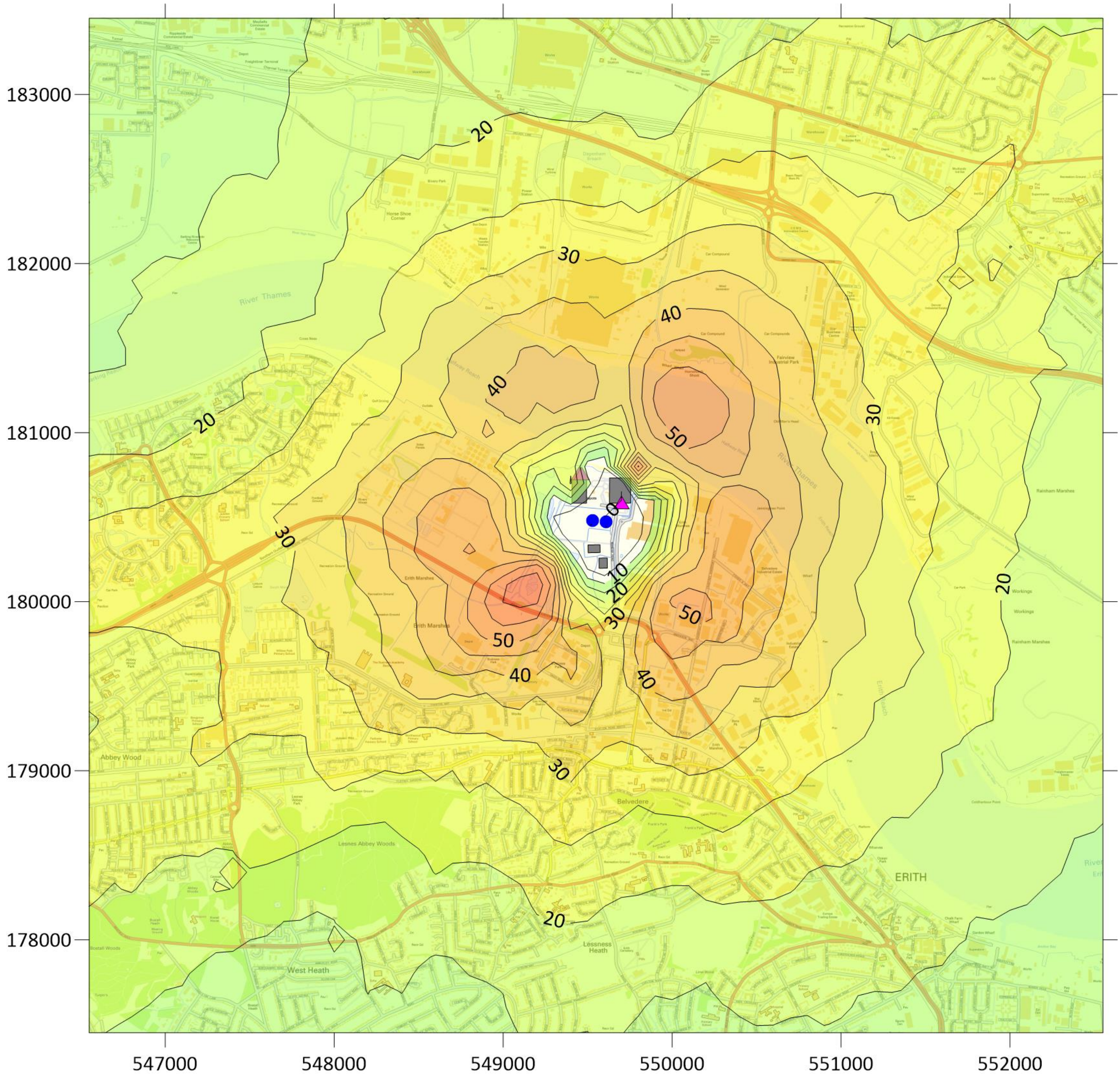


Figure A-15 – With Carbon Capture scenario contribution to ground level concentrations of hourly mean sulphur dioxide, modelled using meteorological data from 2020. Contour interval: 10µg/m³ (3.7% of AQAL)

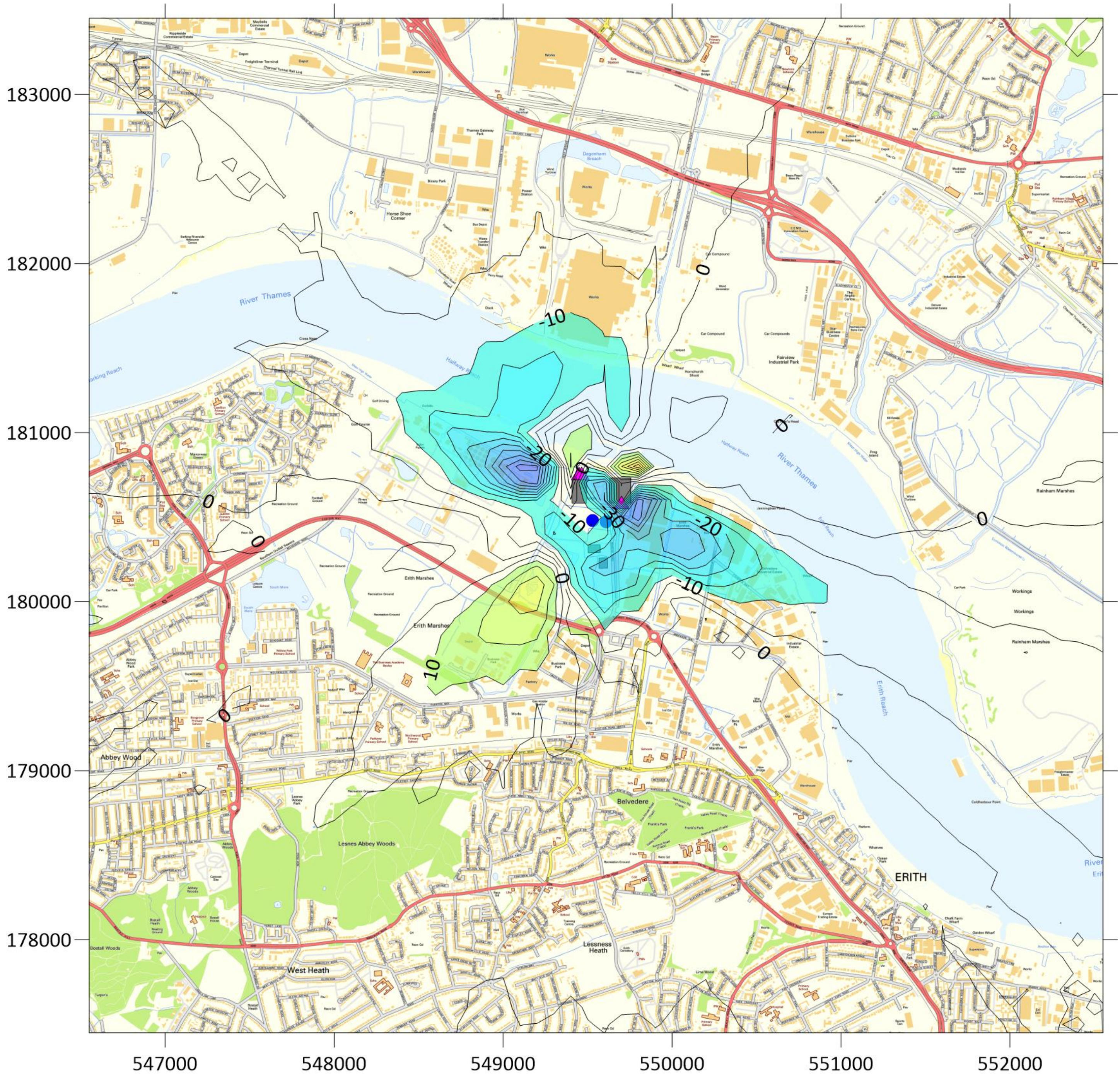


Figure A-16 – With Carbon Capture PC for ground level concentrations of hourly mean sulphur dioxide, modelled using meteorological data from 2020. Contour interval: 10µg/m³ (3.7% of AQAL)

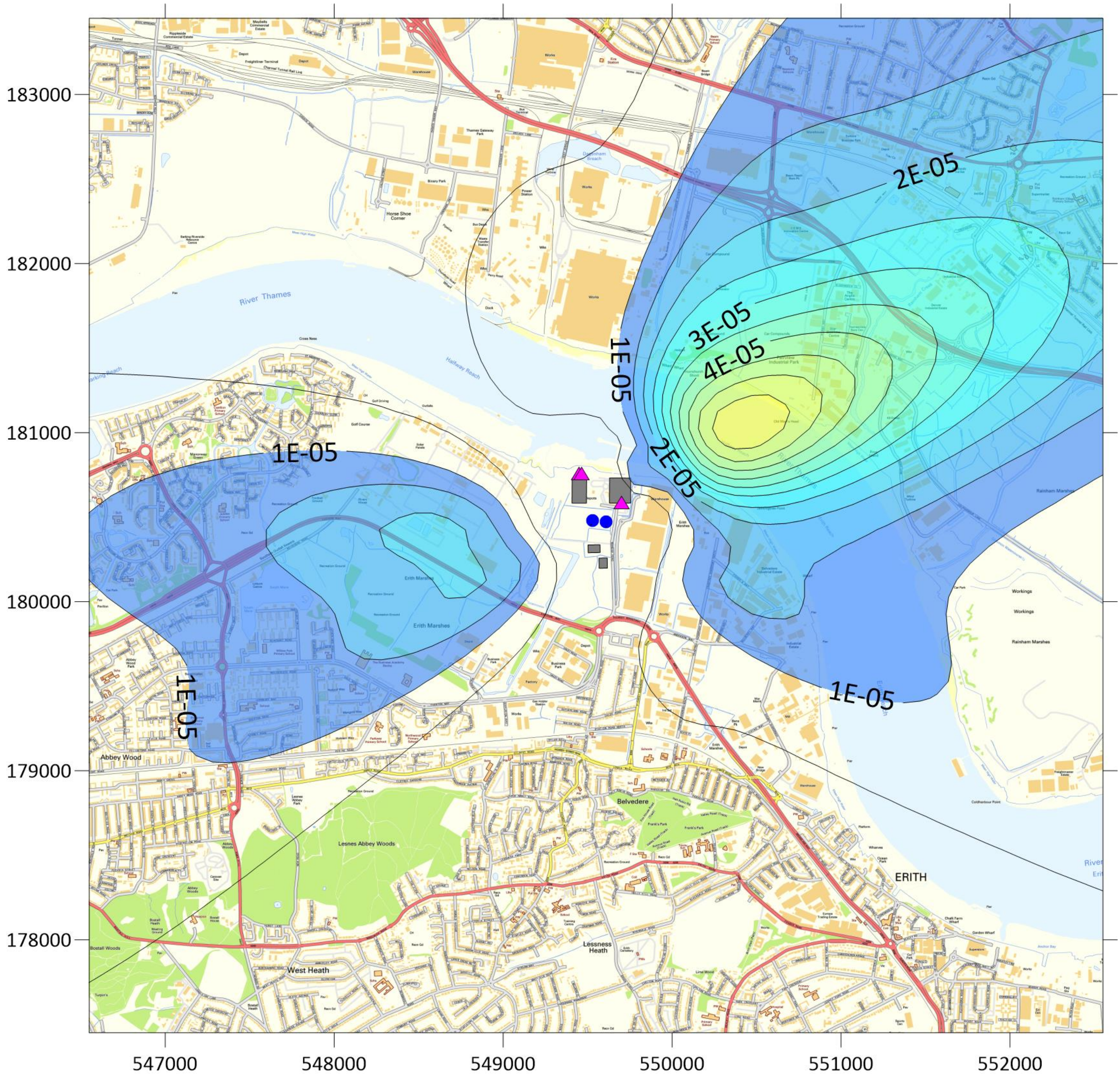


Figure A-17 – With Carbon Capture PC for ground level concentrations of annual mean direct nitrosamines, modelled using meteorological data from 2020. Contour interval: 5 x 10^{-6}µg/m^3 (0.005ng/m3, 2.5% of AQAL)

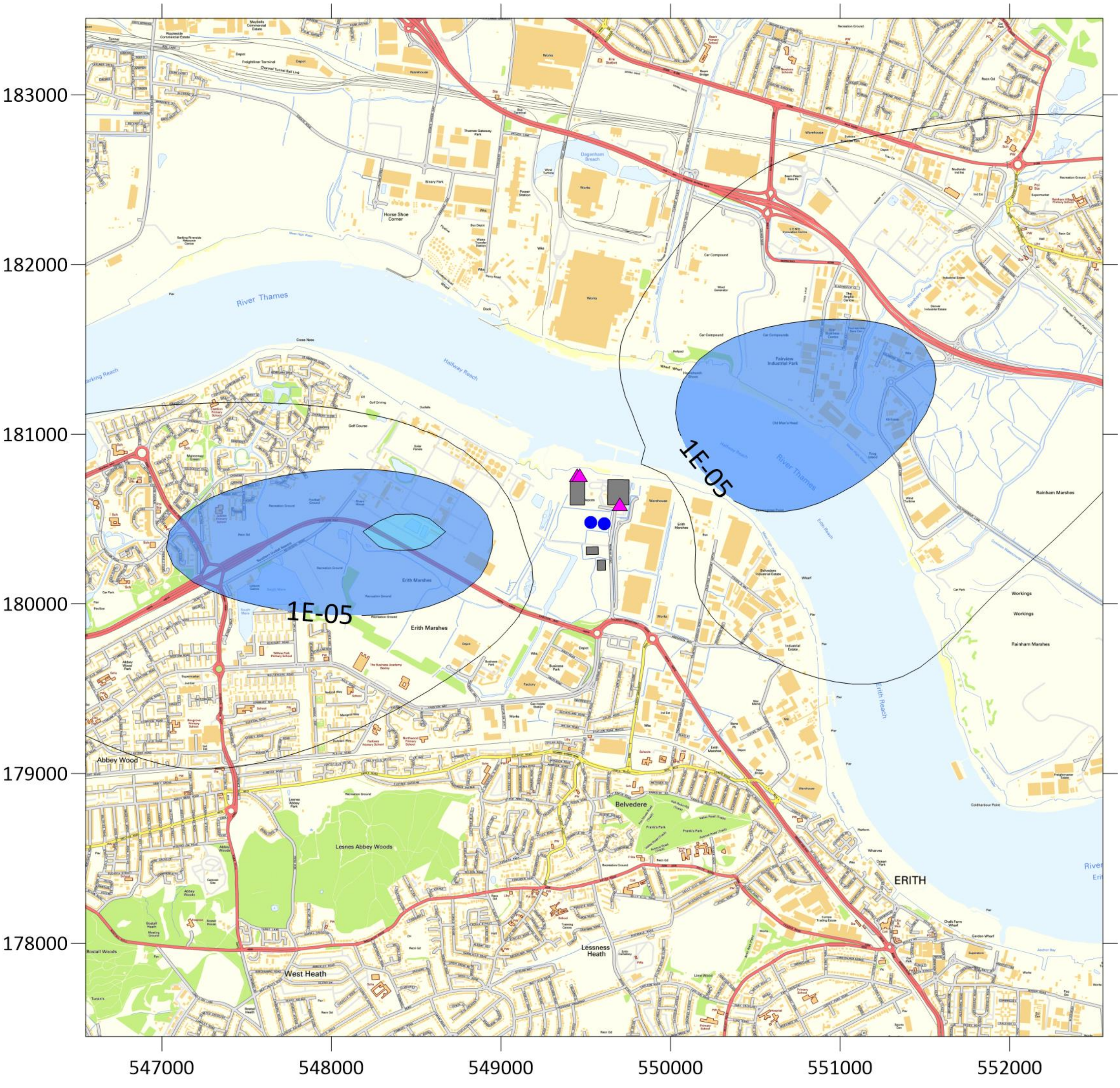


Figure A-18 – With Carbon Capture PC for ground level concentrations of annual mean indirect nitrosamines, modelled using meteorological data from 2020 and the ADMS amine chemistry module. Contour interval: 5 x 10^{-6}µg/m^3 (0.005ng/m3, 2.5% of AQAL)

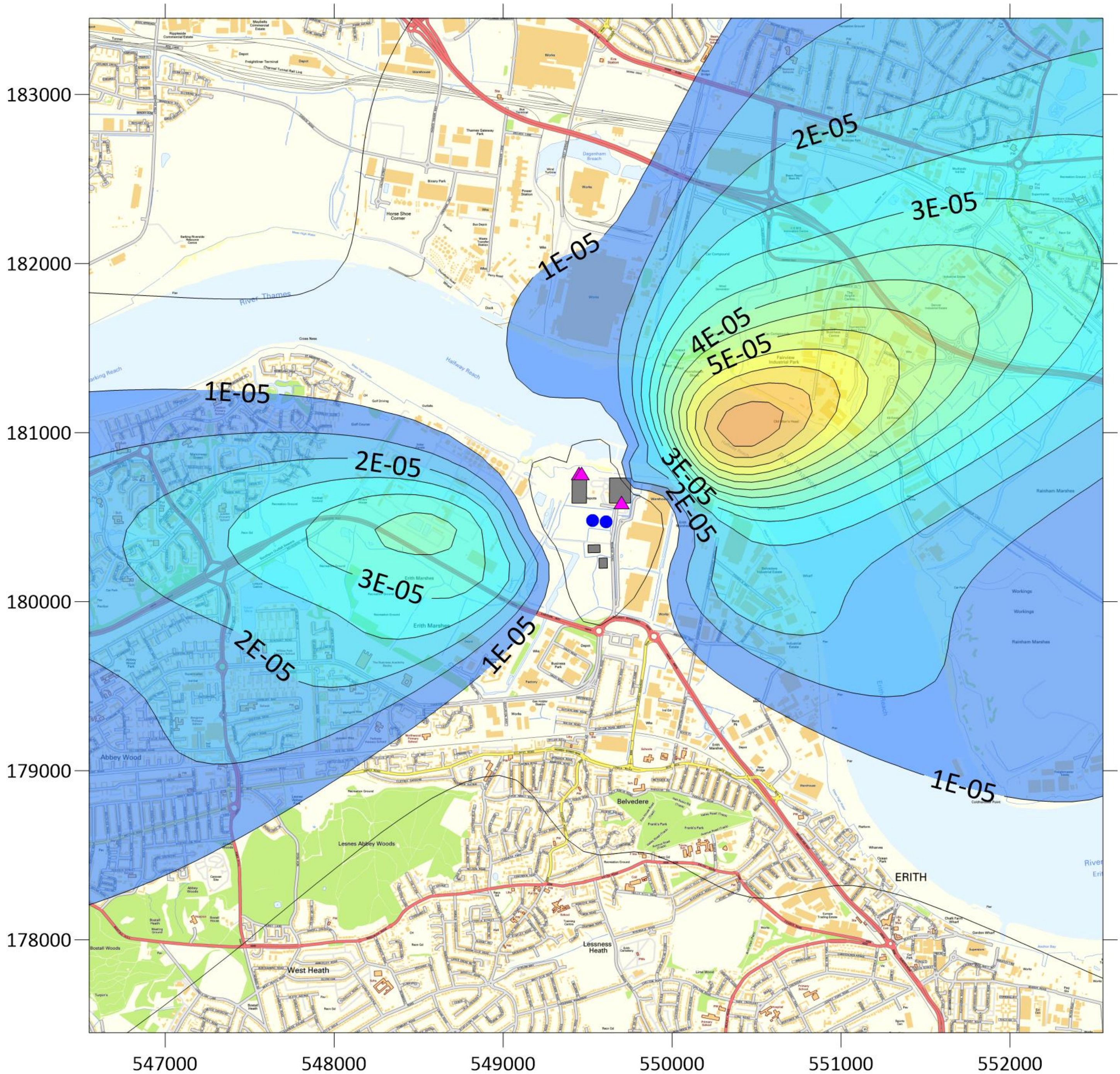


Figure A-19 – With Carbon Capture PC for ground level concentrations of annual mean total nitrosamines (direct and indirect), modelled using meteorological data from 2020 and, for indirect nitrosamines, the ADMS amine chemistry module. Contour interval: 5 x 10^{-6}µg/m^3 (0.005ng/m3, 2.5% of AQAL)

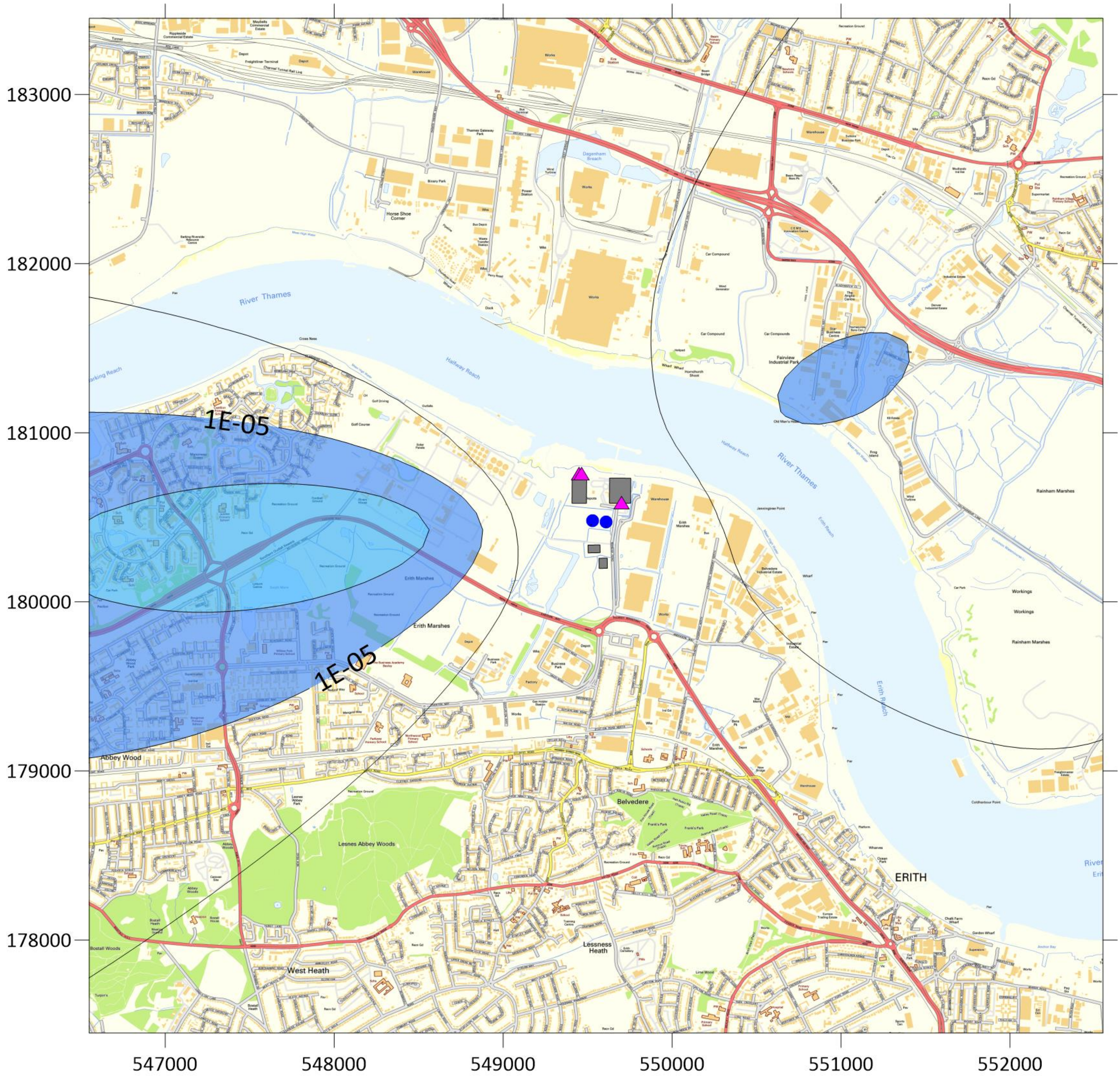


Figure A-20 – With Carbon Capture PC for ground level concentrations of annual mean indirect nitramines, modelled using meteorological data from 2020 and the ADMS amine chemistry module. Contour interval: 5×10^{-6}µg/m^3 (0.005ng/m3, 2.5% of AQAL)

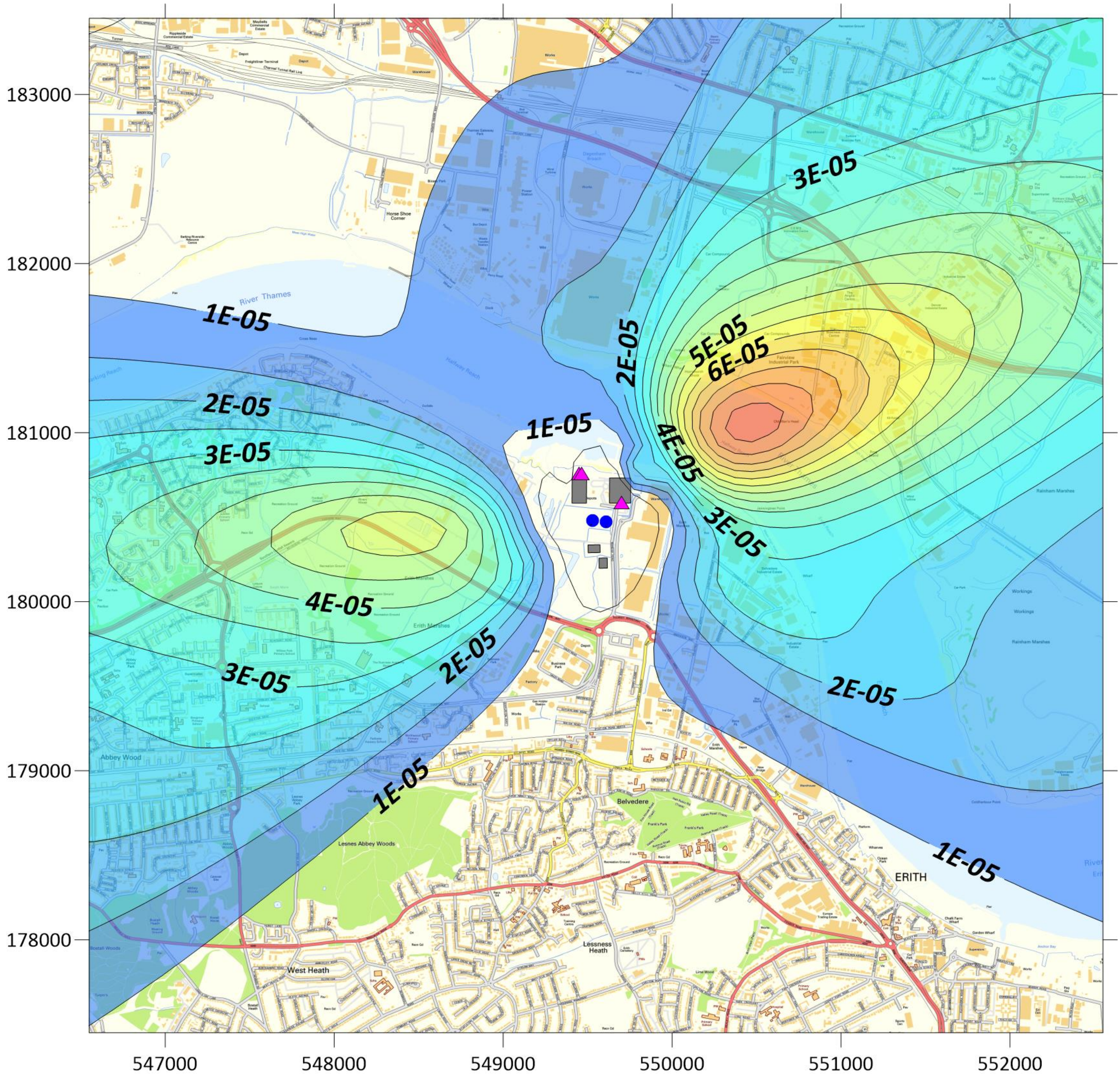


Figure A-21 – With Carbon Capture PC for ground level concentrations of annual mean total nitrosamines and nitramines (direct and indirect), modelled using meteorological data from 2020 and, for indirect nitrosamines and nitramines, the ADMS amine chemistry module. Contour interval: 5 x 10^{-6}µg/m^{3} (0.005ng/m3, 2.5% of AQAL)

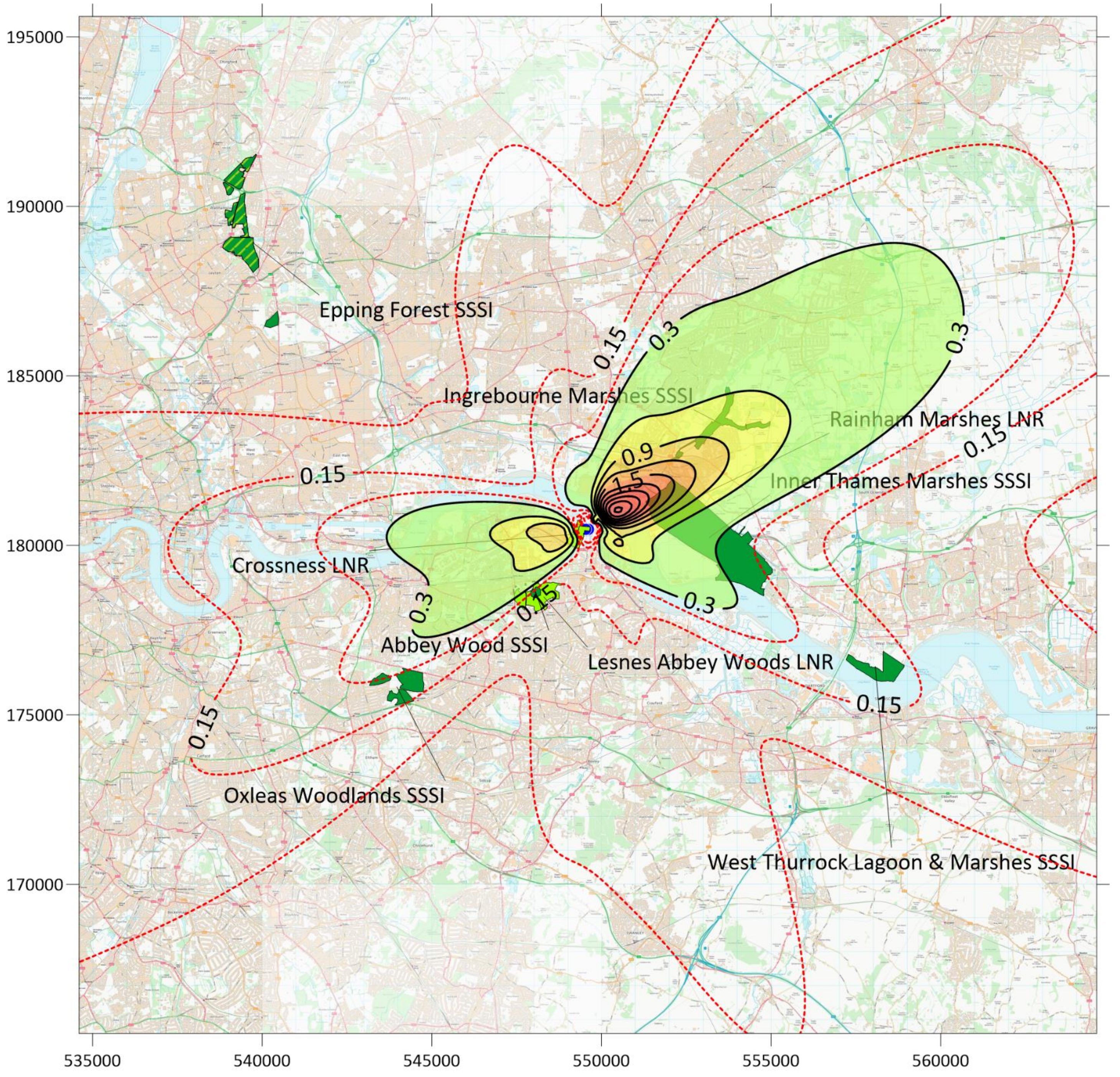


Figure A-22 – With Carbon Capture contribution to ground level concentrations of annual mean nitrogen oxides. Contour interval: 0.3µg/m³ above 0.3µg/m³ (1% of AQAL, solid contours) and 0.075µg/m³ below 0.3µg/m³ (0.25% of AQAL, red dashed contours).

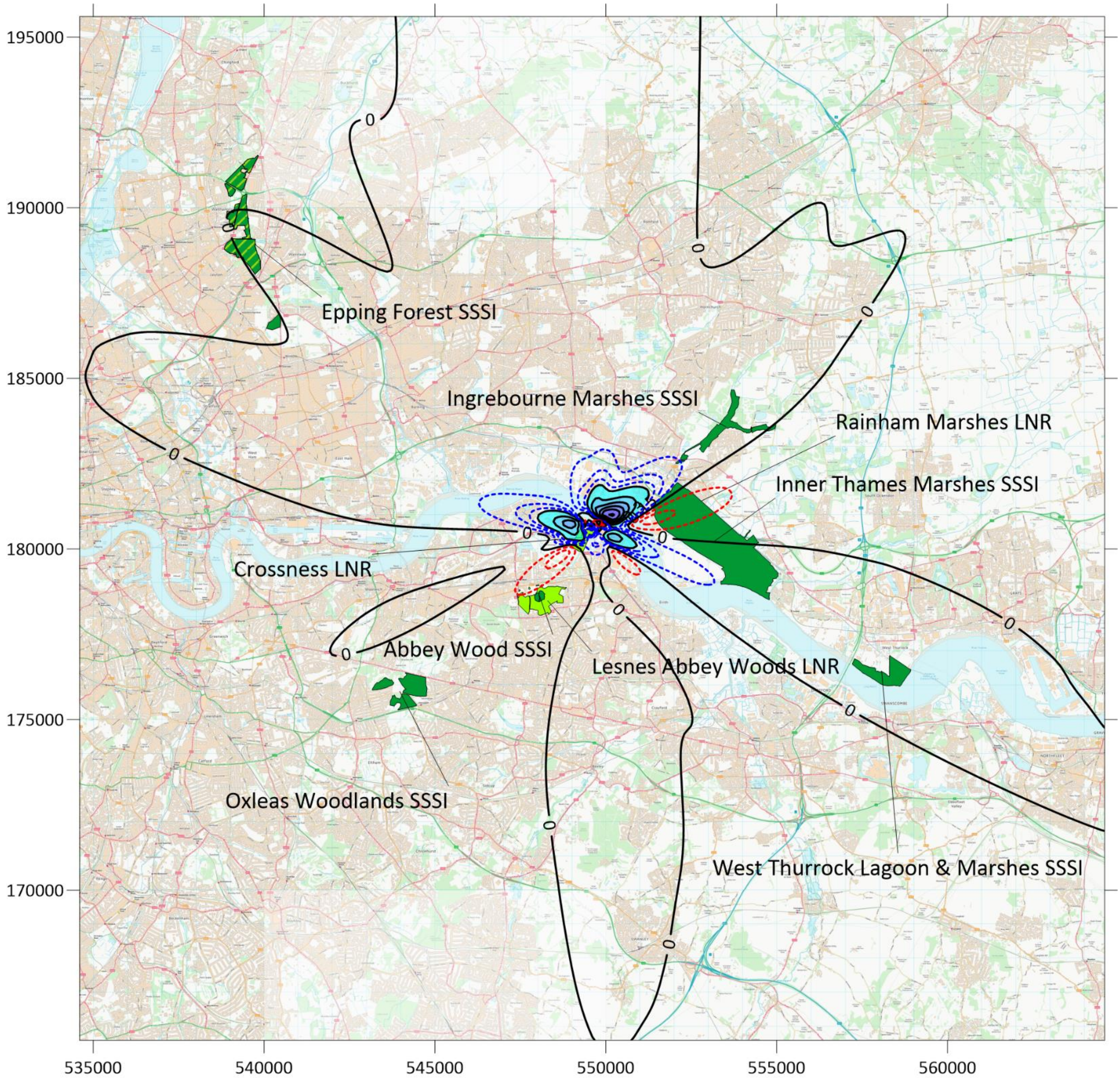


Figure A-23 – With Carbon Capture PC for annual mean nitrogen oxides. Contour interval: 0.3µg/m³ above/ below 0.3/-0.3µg/m³ (1% of AQAL, solid contours) and 0.075µg/m³ between -0.3µg/m³ and 0.3µg/m³ (0.25% of AQAL, red dashed contours for concentrations above zero, blue dashed contours for concentrations below zero).

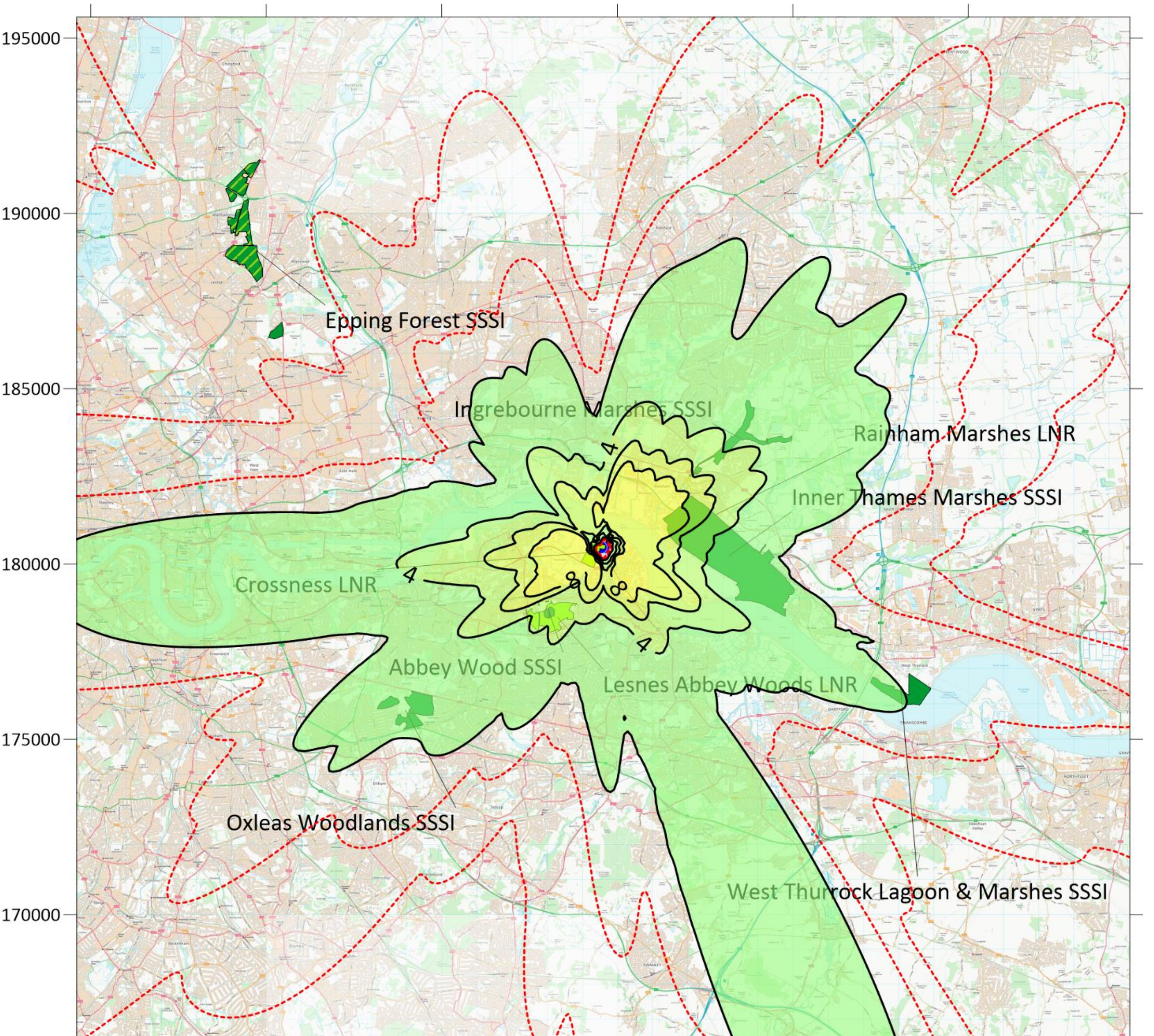


Figure A-24 – With Carbon Capture contribution to ground level concentrations of daily mean nitrogen oxides. Contour interval: 2µg/m^3 above 2µg/m^3 (1% of AQAL, solid contours) and 0.5µg/m^3 below 2µg/m^3 (0.25% of AQAL, red dashed contours).

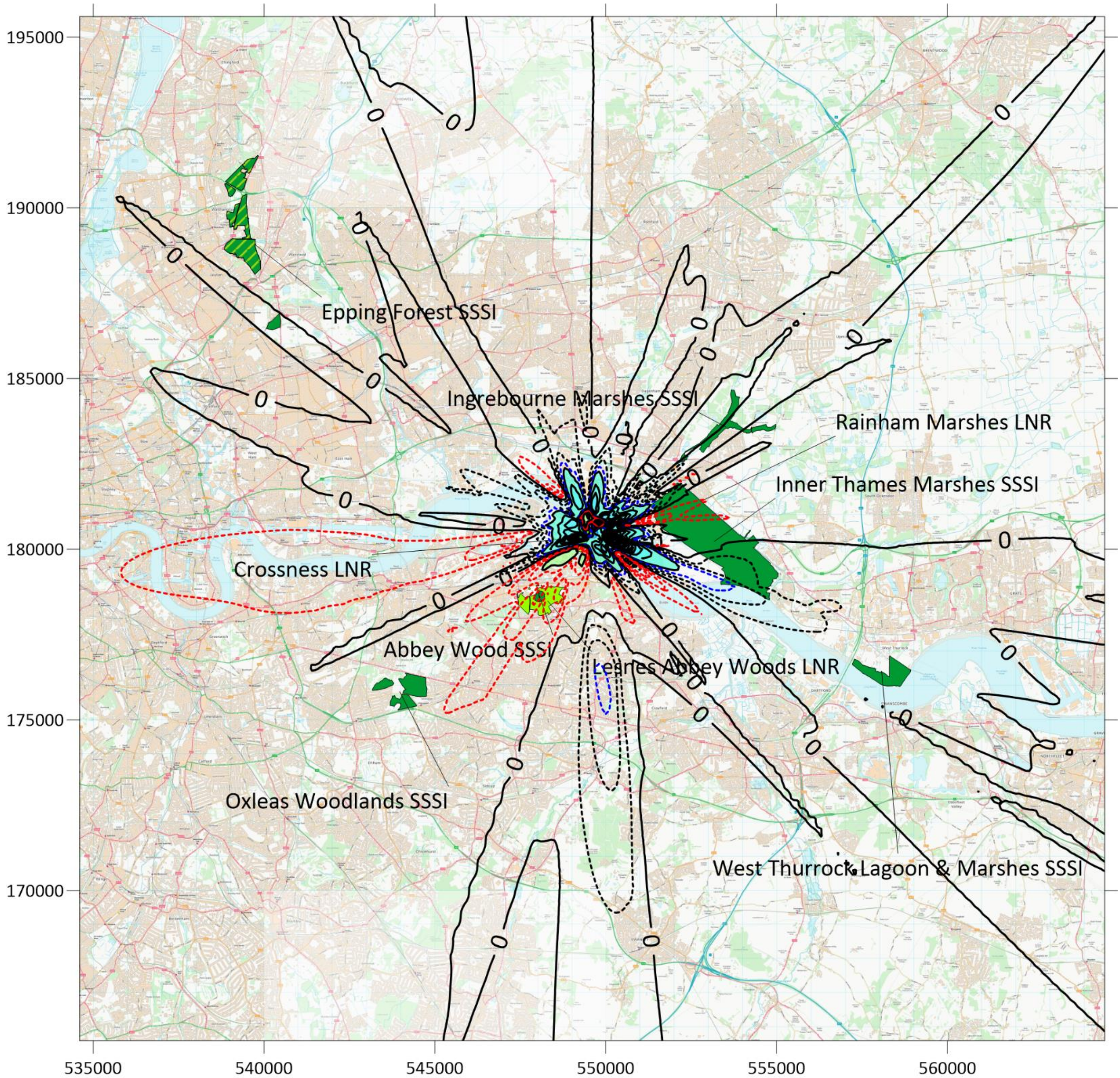


Figure A-25 – With Carbon Capture PC for daily mean nitrogen oxides. Contour interval: 2µg/m³ above/ below 2/-2µg/m³ (1% of AQAL, solid contours) and 0.5µg/m³ between -2µg/m³ and 2µg/m³ (0.25% of AQAL, red dashed contours for concentrations above zero, blue dashed contours for concentrations below zero).

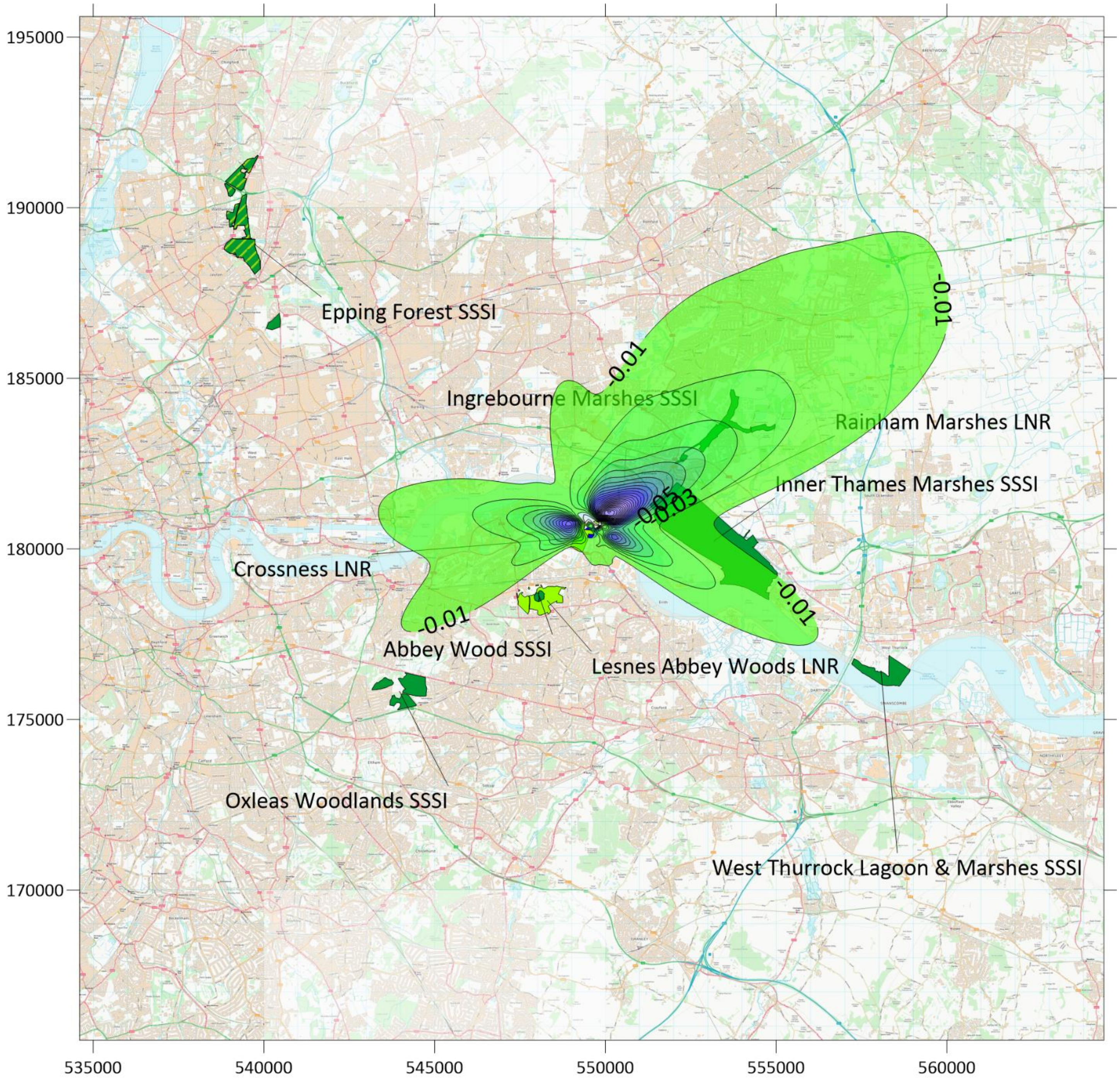


Figure A-26 – With Carbon Capture PC for annual mean ammonia. Contour interval: 0.01µg/m³ (1% of AQAL)

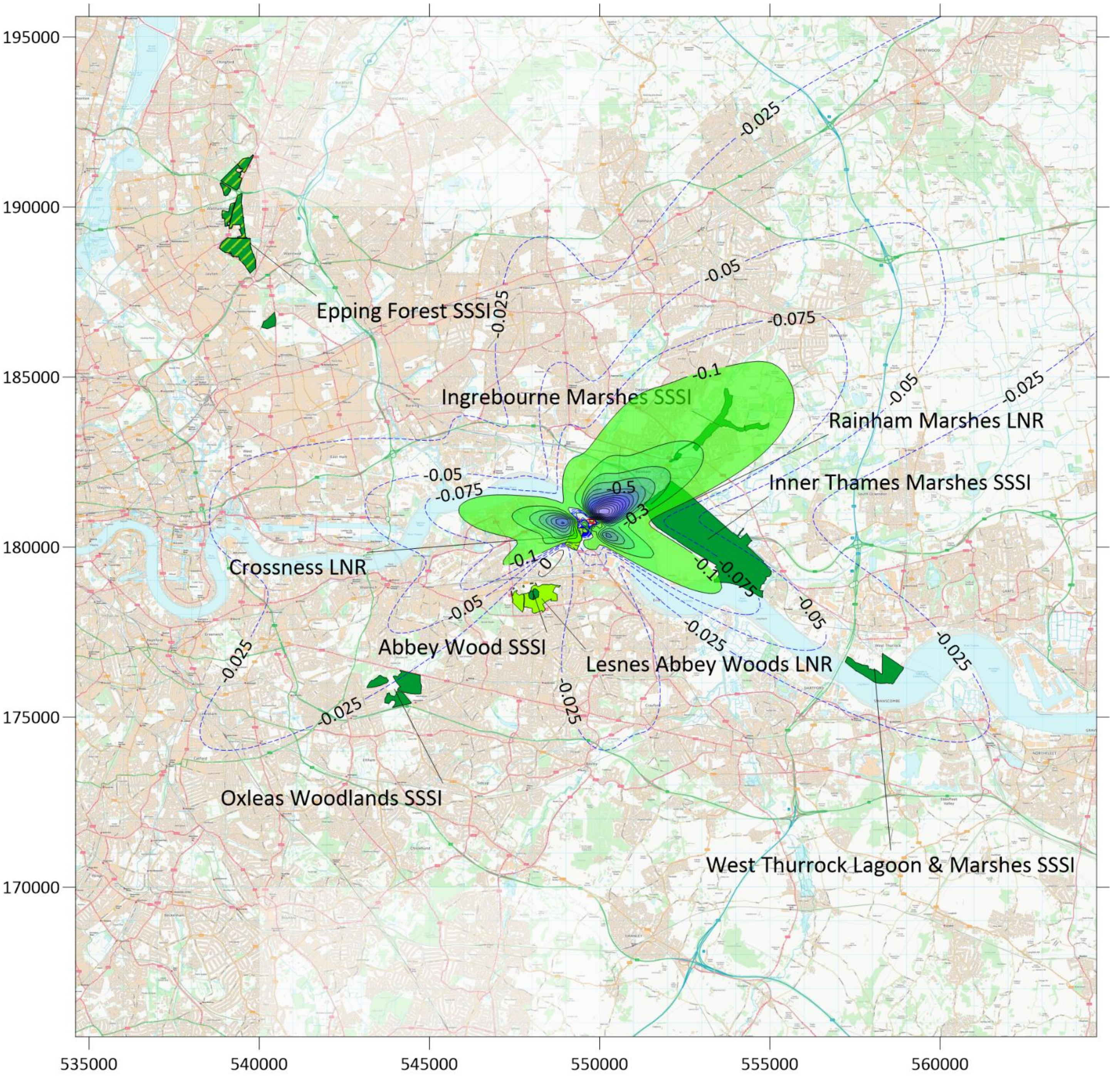


Figure A-27 – With Carbon Capture PC for annual mean nitrogen deposition. Contour interval: 0.1µg/m³ above/below 1/-1µg/m³ (1% of AQAL, solid contours) and 0.025µg/m³ between -1µg/m³ and 1µg/m³ (0.25% of AQAL, red dashed contours for concentrations above zero, blue dashed contours for concentrations below zero).

Appendix B

SPECIATED EMISSIONS FROM CARBON CAPTURE

Public

The table overleaf provides the speciated emissions from the proposed CCF, including the proposed Emission Limit Values. Following sections of the Appendix provide the toxicological data for the emissions.

All emission compound and emissions information provided by Shell (August 2025).

Table B-1 – Speciated emissions from carbon capture

Generic Identifier	Specific Compound	CAS Number	Typical Emission Concentration (mg/Nm^3, @11%O_2, dry)	Proposed Long Term ELV (µg/m^3)	Notes on assessment and Environmental Assessment Levels (EALs)
Amine 1	1-Piperazineethanol	103-76-4	0.21	0.30	See below for recommended EAL
Amine 2	Piperazine	110-85-0	0.0008	0.0012	See below for recommended EAL
Amine 3	1,4-Piperazinediethanol	122-96-3	Below Limit of Detection	None proposed	Emissions are unlikely since the amine is a minor component of the solvent and has low volatility. Not likely to be emitted. Given conservatism between typical emissions and proposed ELVs for Amine 1 and Amine 2, it is not considered necessary to model Amine 3 emissions.
Direct Nitrosamine A	4-Nitroso-1-piperazineethanol	48121-20-6	0.00012	0.00017	See below for recommended EAL
Direct Nitrosamine B	1-nitrosopiperazine	5632-47-3	0.0018	0.0026	See below for recommended EAL
Aldehydes	Formaldehyde		0.01	1	Assessed as formaldehyde as a worst case based on Environment Agency EALs
	Acetaldehyde		0.21		
Amides	4-(2-Hydroxyethyl) piperazin-2-one	23936-04-1	0.007	0.023	Total amides assessed as formamide as a worst case. See below for derivation of EAL
	Piperazin-2-one	5625-67-2			
	1-formyl-4-(2-hydroxyethyl) piperazine	25209-64-7	0.008		
	1-formylpiperazine	7755-92-2			
Degradant 100	Acetone		0.054	0.080	EAL available from Environment Agency
Degradant 101	Ethanol		0.022	0.032	EAL available from Environment Agency
Degradant 102	Acetonitrile		0.19	0.29	EAL available from Environment Agency
N/A	Mono ethanolamine		Below Limit of Detection	None proposed	Given conservatism between typical emissions and proposed ELVs for Amine 1 and Amine 2, it is not considered necessary to model MEA emissions.

Derivation of EAL (Information provided by Shell)

The Environment Agency have set Environmental Assessment Levels for, *inter alia*, mono ethanolamine (MEA) and piperazine. For Amines, therefore, the following information relates to the setting of EAL for Amine 1 and Amine 3.

Furthermore, Environment Agency have set an Environmental Assessment Level for the nitrosamine N-nitrosodimethylamine (NDMA). Environment Agency state that "NDMA is one of the most potent nitrosamines [in terms of carcinogenic potential]" and also state that NDMA is one of the most widely studied of the nitrosamines, recognizing that toxicology data for other nitrosamines is scarce, particularly for carcinogenic potential.

Cansolv DC-103 Amines

Table B-1 above lists the direct amine emissions expected from the Cansolv DC-103 solvent. These amines are structural analogues, consisting of a heterocyclic di-amine (Amine 2), with an alkanol group substitution on one (Amine 1) or both (Amine 3) amine functions.

Amine 1 has low vapor pressure and is considered to be a strong ocular and skin irritant.

Amine 2 has low vapor pressure and is considered to be a strong ocular and skin irritant. It is classified for respiratory sensitization and reproductive toxicity.

Amine 3 is a minor component of the DC-103 solvent with low volatility and is generally not detected at stack. DC-103 amine 3 is an amine with low vapor pressure and is considered to be a strong ocular and skin irritant.

Evaluation

Due to their common active group (the amine group), the overall toxicity of all aliphatic amines is similar, with some potency differences depending on the aliphatic parts. Based on a review of the toxicological properties of alkanol-amines, cyclic amines and aliphatic amines, supplemented with modelling of the structure-activity relationship, the following can be summarized regarding the toxicity of these compounds in the human body:

- Amines are metabolized by oxidation into the corresponding aldehydes, a process accompanied by the release of ammonia. The aldehydes are then metabolized into carboxylic acids and, ultimately, into CO_2 (that is subsequently exhaled).
- Aliphatic amines and alkanolamines are of relatively low acute toxicity, with LD50 levels (Lethal Dose for 50% of the test animals) in the order of grams per kilogram bodyweight. The cyclic amines have a lower threshold of toxicity (LD50 levels in the order of 100s of milligrams per kilogram bodyweight) but are still of relatively low acute toxicity.
- Except for tertiary amines, the range of aliphatic amines, alkanolamines, as well as cyclic amines are to some degree corrosive or highly irritating to the skin, eyes and/or respiratory tract.
- With the exception of piperazine, amines are not skin or respiratory sensitizers.
- Overall, amines are not mutagenic or carcinogenic and, with exception of piperazine, amines are not expected to affect human development or reproduction.

Overall, amines will pose minimal risk to members of the general public. However, due to their corrosive properties risk management measures need to be in place for workers. Table B-2 sets out a summary of the available toxicological data for the Cansolv DC-103 amines and, for reference, MEA.

The main amine present in the absorber emission is Amine 1. Based on available data, all DC-103 amines are expected to be of low systemic toxicity with no alerts for carcinogenicity, mutagenicity or reproductive toxicity. Like mono ethanolamine (MEA), the main effect would be local irritation.

It should be noted that all chemicals imported to the UK are subject to the UK REACH regulation. It is anticipated that additional information will be generated for the REACH registration of Amine 1. This will include longer-term repeated dose studies that will confirm a NOAEL and can be used to substantiate the current EAL derivation. The current EAL derivation however is considered to be conservative and based on inhalation effects from MEA. Due to the low vapor pressure of Amine 1 compared to MEA, exposure levels are estimated to be well below the EAL, and this has been demonstrated by the dispersion modelling carried out for the project.

Analysis of the No Observed Adverse Effect Levels (NOAEL) of the DC-103 amines and MEA, support that there is no concern for systemic toxicity from the DC-103 amines. The NOAEL for Amine 3 is 1,000 mg/kg bw/d for systemic effects, which is above the systemic NOAEL of MEA of 300 mg/kg bw/d.

To date, a NOAEL has not been derived for Amine 1, however based on structural similarity with Amine 2 and Amine 3, Amine 1 is expected to have a systemic NOAEL of the same order of magnitude. Given that the NOAELs for Amine 3 (and Amine 2, 627 mg/kg bw/d) are higher than that derived for MEA, it is reasonable to assume that for systemic effects, the EAL derived for MEA would represent a worst-case, and that the EAL protective for systemic effects from exposure to MEA, should also be protective for systemic effects of all three of the DC-103 amines.

Amines 1 and 3 have the same local irritating effects as MEA. It is therefore reasonable to assume that the EAL protective for local irritating effects from exposure to MEA, should also be protective for local irritating effects of DC-103 amines.

For Amine 2, additional effects due to respiratory sensitization are taken into account and the EAL derived by the Environment Agency is applied for this assessment.

Table B-2 – Available toxicology data for Cansolv DC-103 amines and MEA

Amine	Irritation§	Sensitization§	Geno-toxicity§	NOAEL (mg/kg bw/day)	NOAEC (mg/m^3)	STEL (mg/m^3)	OEL or DNEL (mg/m^3)
MEA	H314	Not classified	Negative	300	10	7.6	2.5 0.28* 0.18**
Amine 1	H315 H318 No clinical signs after exposure to saturated vapours	Not classified	Negative	N/A	***	N/A	N/A
Amine 2	H314	H334 H317	Negative	627	N/A	0.3	0.1
Amine 3	H318	N/A	Negative	1000	***	N/A	N/A

§ Coding follows the Global Harmonized System Code for hazards
* General population DNEL local effects
** General population DNEL systemic effects
*** Due to the low vapor pressure, it is unlikely that the substance will be available as a vapor.
NOAEL = No Observed Adverse Effect Level; NOAEC = No Observed Adverse Effect Concentration; STEL = Short Term Exposure Limit; OEL = Occupational Exposure Limit; DNEL = Derived No-Effect Level

Summary EALs Amines

In summary, based on the absence of significant systemic toxicity and similar local effects (irritation) the proposed EALs for the DC-103 amines are those provided by Environment Agency for MEA i.e. 400µg/m^3 and 100µg/m^3 for short-term (hourly) and long-term (daily) exposure, respectively. For Amine 2, a more stringent EAL of 15µg/m^3 is taken directly from Environment Agency guidance.

Nitrosamines

The carbon capture process may emit nitrosamines formed by the degradation of Amine 1 and Amine 2, termed Direct Nitrosamines A and B in Table B-1 above.

The Environment Agency EAL for NDMA is 0.2ng/m^3, based on a Dose Level (BMDL10) of 0.023mg/m^3. The EA state: "NDMA is one of the most potent nitrosamines [in terms of carcinogenic potential]" and also state that NDMA is one of the most widely studied of the nitrosamines, recognizing that toxicology data for other nitrosamines is scarce, particularly for carcinogenic potential.

Direct Nitrosamine A has no carcinogenic data currently available. Direct Nitrosamine B has been studied for carcinogenic potential, and it has been demonstrated to be 45 times less potent than NDMA.

The mutagenic potency of Direct Nitrosamine A, Direct Nitrosamine B and NDMA (as a positive control) have been investigated in a modified Ames test (Plewa et al. University of Illinois 2013), using bacterial strains sensitive to nitrosamines. The mutagenic potency of Direct Nitrosamine A was found to be 2,000 times less than that of NDMA, and the mutagenic potency of Direct Nitrosamine B was found to be 50 times less than that of NDMA.

An overview of data is presented in Table B-3.

Table B-3 – Mutagenic and carcinogenic potency of NDMA and the Cansolv DC-103 nitrosamines

Nitrosamine	Mutagenic potency (µmol)$^{-1}$	Carcinogenic potency based on animal data (mmol/m^3)$^{-1}$	EAL (ng/m^3) annual mean
NDMA	1	300	0.2
DC-103 nitrosamine 1	0.043	N/A	0.2 proposed
DC-103 nitrosamine 2	0.001	6.6	0.2 proposed

Summary EALs Nitrosamines

NDMA is one of the best-studied nitrosamines, and also one of the nitrosamines with the highest carcinogenic potential. Based on the available data, EA have derived an EAL of 0.2ng/m^3 (annual mean). Based on available data on the mutagenic and carcinogenic potency of DC-103 nitrosamines and NDMA, it is expected that NDMA is the most potent mutagen and carcinogen. Hence, the EAL for NDMA of 0.2 ng/m^3 (annual mean) will serve as a very conservative EAL for DC-103 nitrosamines.

Amides

The carbon capture process may emit amides formed by the degradation of Amine 1 and Amine 2, as set out in Table B-1 above.

Little toxicological data is available and is summarised below. In addition, the amides have been modelled using RespiraTox which uses a Quantitative Structure-Activity Relationship (QSAR) tool to correlate a chemical's molecular structure with its biological activity and human respiratory irritancy potential.

Table B-4 – Summary toxicological data for emitted amides

Amide	Toxicology	Recommendation
4-(2-Hydroxyethyl) piperazin-2-one (Amide HEP)§	Based on 3rd party report, classed as: H302 Acute Toxicity Category 4 (Oral) H315 Skin corrosion/irritation (Category 2) H319 Eye irritation (Category 2) H335 Specific target organ toxicity (single exposure respiratory irritation) (Category 3)	Read across from Amine 1 based on respiratory irritation as critical end point based on 89% similarity to amine 1 in RespiraTox: LT EAL: 100µg/m^3 ST EAL: 400µg/m^3
Piperazin-2-one (Amide piperazine) †	ECHA website classifies as: H315 Skin corrosion/irritation (Category 1B) H317 Skin sensitivity (Category 1) H318 Eye damage (Category 1) H319 Eye irritation (Category 2 / 2B) H335 Specific target organ toxicity (single exposure respiratory irritation) (Category 3)	Read across from Amine 1 & MEA based on respiratory irritation as critical end point based on 78% similarity to amine 1 in RespiraTox: LT EAL: 100µg/m^3 ST EAL: 400µg/m^3 83% similarity to Amine 2 is in the context of predicting respiratory irritation and not sensitisation, for which there is no indication
1-formyl-4-(2-hydroxyethyl) piperazine (Formamide HEP) §	No specific data, but based on 3rd party report, classed as: H315 Skin corrosion/irritation (Category 2) H319 Serious eye damage/ eye irritation (Category 2) H335 Specific target organ toxicity (single exposure respiratory irritation) (Category 3)	Read across from Amine 1 & MEA based on respiratory irritation as critical end point based on 85% similarity to amine 1, 62% similarity to MEA in RespiraTox: LT EAL: 100µg/m^3 ST EAL: 400µg/m^3
1-formylpiperazine (Formamide piperazine) ‡	Based on 3rd party notification, classed as H302 Acute Toxicity Category 4 (Oral) H315 Skin corrosion/irritation (Category 2) H318 Serious eye damage/eye irritation (Category 1) H335 Specific target organ toxicity (single exposure respiratory irritation) (Category 3)	Read across from Amine 1 based on respiratory irritation as critical end point based on 83% similarity to amine 1 in RespiraTox: LT EAL: 100µg/m^3 ST EAL: 400µg/m^3 85% similarity to Amine 2 is in the context of predicting respiratory irritation and not sensitisation, for which there is no indication

§ https://static.cymitquimica.com/products/AN/pdf/sds-AG003JZY.pdf
† https://echa.europa.eu/brief-profile/-/briefprofile/100.157.367
‡ https://www.echa.europa.eu/es/web/guest/information-on-chemicals/cl-inventory-database/-/discli/notification-details/106023/625780

Shell have also developed an EAL for Formamide using the Environment Agency's methodology for deriving EALs and carcinogenicity data.

The NOAEL for formamide is 20mg/kg-bw/day via the oral route. Converting this oral route NOAEL to an inhalation route, assuming 70kg and breathing at a rate of 20m^3/day, 20 mg/kg bw/day = 70 mg/m^3. Applying the following recommended uncertainty factors - 10 for inter-species variation, 10 inter-individual variation and 10 for the severity of effect, the recommended long term EAL for formamide is 70/1000 = 0.07 mg/m^3 = 70µg/m^3. No short term EAL is recommended due to its chronic toxicity.

Based on all of the above data, an EAL of 70µg/m^3 as an annual mean has been applied to all amides.

Ethanol

Shell has derived an EAL for Ethanol following the same methodology as that applied to NDMA by Environment Agency.

Shell quote a 10% Benchmark Dose Level ($BMDL_{10}$) for Ethanol as 1400mg/kg-bw/day, which on conversion to a concentration in air for the inhalation route equates to 4900mg/m^3. Adjusting this concentration for continuous exposure by multiplying by (4/7) days and (4/13) hours gives a final concentration (termed Point of Departure) of 466.7mg/m^3. Applying a conservative margin of safety (by dividing by 10,000), leaves a long term EAL of 0.047mg/m^3 = 47µg/m^3.

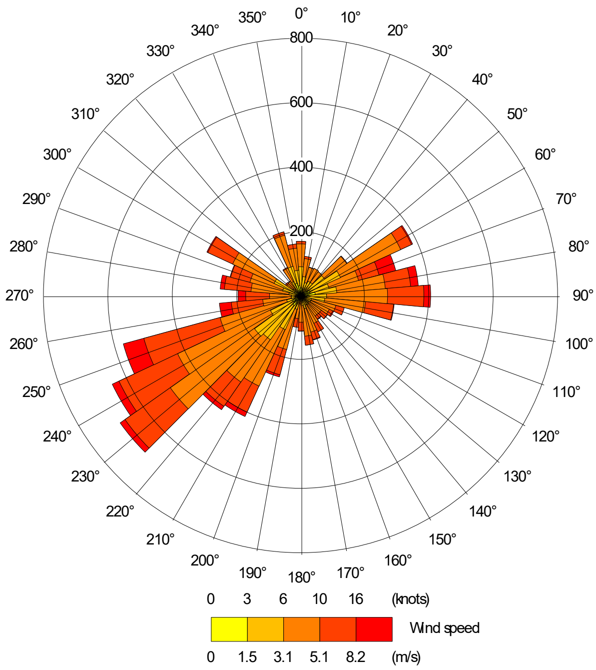
Appendix C

WIND ROSES

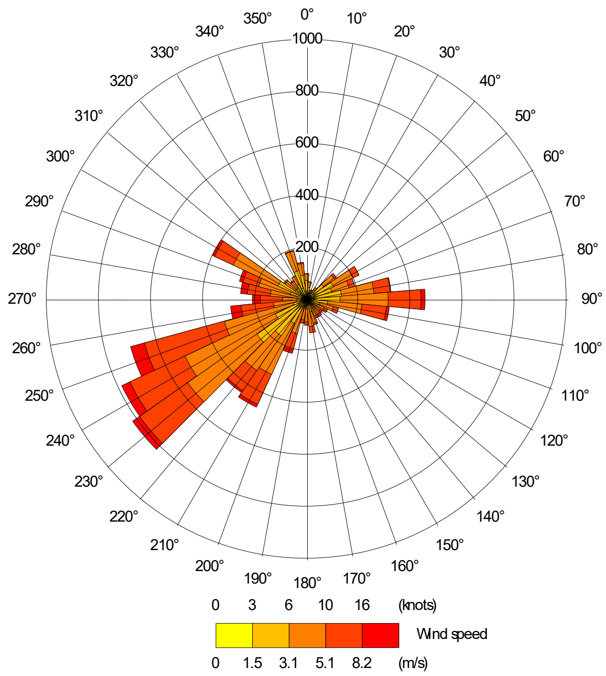
Public

London City Airport Wind Roses

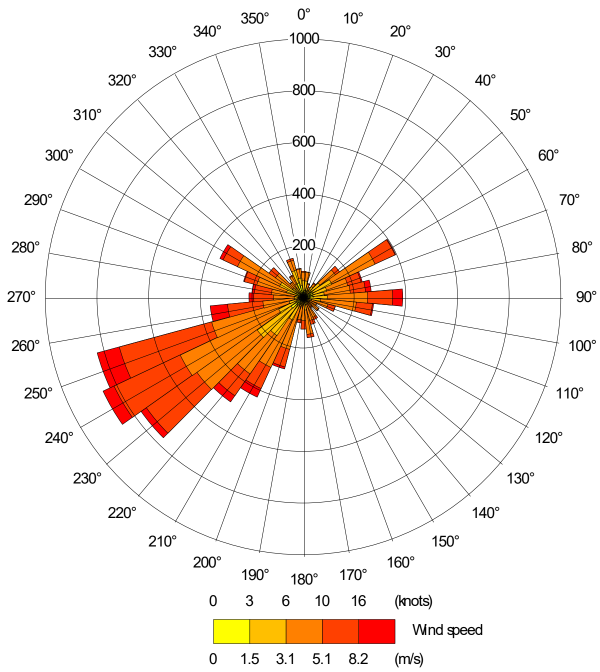
2018



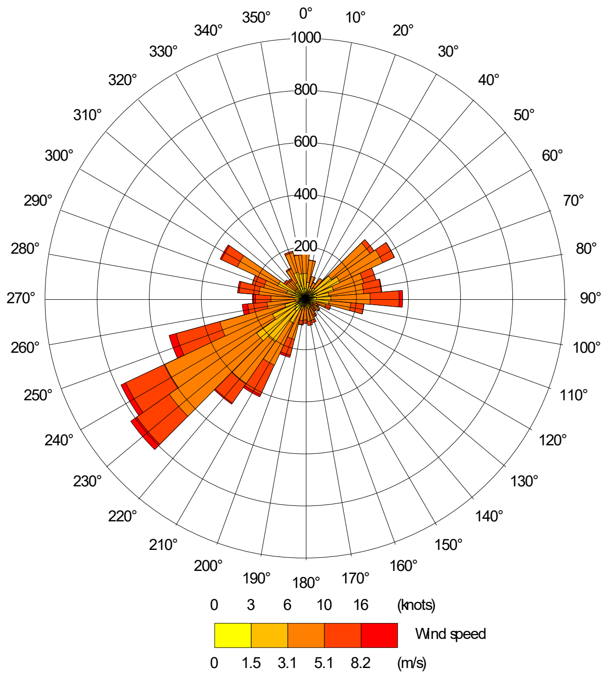
2019



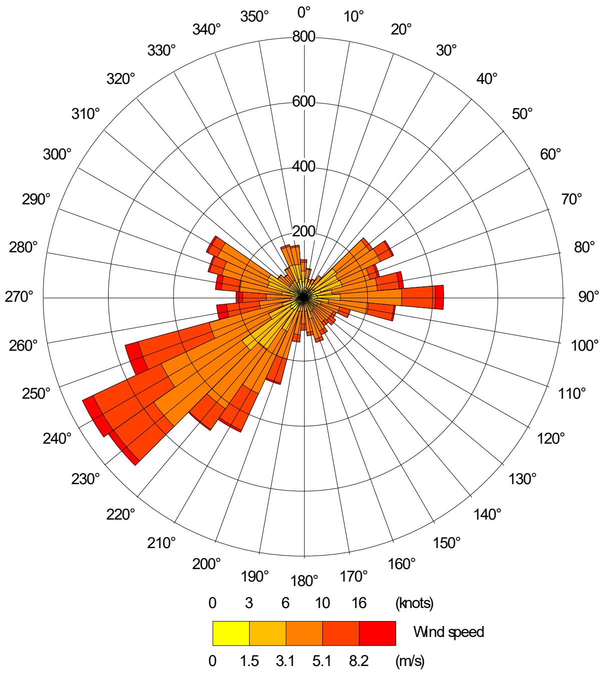
2020



2021



2022



0°
10°
20°
30°
40°
50°
60°
70°
80°
90°
100°
110°
120°
130°
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170°
180°
190°
200°
210°
220°
230°
240°
250°
260°
270°
280°
290°
300°
310°
320°
330°
340°
350°
200
400
600
800
0 3 6 10 16 (knots)
Wind speed
0 1.5 3.1 5.1 8.2 (m/s)

Appendix D

AMINE CHEMISTRY MODULE PARAMETERS

Table D-1 – Overarching amine chemistry modelling input parameters and rationale

Parameter	Value	Notes
Amine emissions	Table 4-2 and Appendix D for emissions at proposed short- and long-term emission limit values	ELV proposed on the basis of speciated emissions provided by Shell; 2 amine species modelled Impacts assessed as direct emissions with no degradation (worst case).
Direct nitrosamine emissions	Table 4-2 and Appendix D for speciated emissions at proposed long term emission limit values	ELV proposed on the basis of speciated emissions provided by Shell; 2 nitrosamine species modelled. Species differ from those formed from the degradation of amine emissions in ambient air Impacts assessed as direct emissions with no additional degradation (worst case).
Direct nitramine emissions		Shell advised that no direct emissions of nitramines are likely
NOx emission	Table 4-2	Emissions assumed to be at ELV at all times with 5% of NO_X emissions as NO_2. A sensitivity test was undertaken with 10% of NOx emissions as NO_2.
Amine reaction rate constants	Table D-2 Sensitivity test parameters also provided Table D-2	Data provided by Shell from University of Oslo study of the degradation of Cansolv DC103 amines[2].
Constant, c, for OH concentration calculations	1.038×10^{-3} to $1/363 \times 10^{-3}$ s	Calculated using CERC recommended relationship between annual average jNO_2, O_3 and OH concentrations for each met year.

Parameter	Value	Notes
		Annual mean OH concentration is $1x10^{6}$ molecules/cm^{3} ($4.0x10^{-5}$ ppb) taken from mapping provided by CERC (Figure 3.6 in Improving Post-Combustion Carbon Capture Air Quality Risk Assessment Techniques, 2024, CERC) O_3 concentration annual average from London Bloomsbury AURN station for each meteorological year. Sensitivity tests undertaken for annual mean OH concentrations of $0.5x10^{6}$molecules/cm^{3} and $1.25x10^{6}$molecules/cm^{3}. Range taken from mapped OH concentrations within study area.
Background NOx/NO_2/O_3 concentrations	Year specific, hourly concentrations	Data taken from London Bloomsbury AURN site for 2018 - 2022. This is one of the closest sites to the Riverside campus recording NO_X (NO and NO_2) and O_3. Testing undertaken using Thurrock AURN site for the Cory Decarbonisation DCO demonstrated that London Bloomsbury was more conservative.

Table D-2 – Amine specific reaction rate constants (ppb/s) and rationale

Amine	k1	k2	k3	k4a	k4	k1a/k1	J/JNO$_2$	Notes
Amine 1	6.25	$1.25x10^{-9}$	$1.35x10^{-2}$	$7.95x10^{-3}$	$7.95x10^{-3}$	0.17	0.34	Data provided by Shell based on solvent specific University of Oslo study.
Amine 2	5.95	$1.25x10^{-9}$	$1.35x10^{-2}$	$7.95x10^{-3}$	$7.95x10^{-3}$	0.18	0.34	
Amine 1 Sensitivity Test	6.67 Average of all values	$4.63e^{-11}$ Average of all values	1.80 Max of values	$7.95x10^{-3}$ No change since represent-tative	$7.95x10^{-3}$ No change since represent-tative	0.09 Average of values excluding highest outlier	0.32 CERC recommen-dation	Parameters taken from CERC Report for piperazine (Improving Post-Combustion Carbon Capture Air Quality Risk Assessment Techniques, 2024, CERC)

Appendix E

MODEL RESULTS

Table E-1 – Maximum with Carbon Capture Scenario contribution to ground level concentrations anywhere within the study area (μg/m³).

Pollutant	Averaging Period	AQAL (ug/m3)	With Carbon Capture 2018	With Carbon Capture 2019	With Carbon Capture 2020	With Carbon Capture 2021	With Carbon Capture 2022	Max over 5 years
Nitrogen Dioxide	Hourly Mean	200	48.32	42.98	46.43	48.60	49.66	49.66
	Annual Mean	40	1.66	1.94	2.13	1.69	1.68	2.13
Sulphur Dioxide	15minute Mean	266	101.05	97.83	114.43	99.95	105.28	114.43
	Hourly Mean	350	66.28	56.02	63.99	68.30	68.79	68.79
	Daily Mean	125	4.58	5.12	5.26	6.35	4.70	6.35
PM10	Daily Mean	50	0.32	0.40	0.38	0.32	0.34	0.40
	Annual Mean	40	0.10	0.12	0.13	0.10	0.10	0.13
PM2.5	Annual Mean	10	0.10	0.12	0.13	0.10	0.10	0.13
Hydrogen Chloride	Hourly Mean	750	43.91	47.29	37.50	31.76	59.40	59.40
Hydrogen Fluoride	Hourly Mean	160	2.94	3.24	3.04	2.37	4.50	4.50
	Annual Mean	16	0.08	0.09	0.10	0.08	0.08	0.10
TOC (as Benzene)	Annual Mean	5	0.23	0.27	0.30	0.24	0.24	0.30
Carbon Monoxide	8 Hour Mean	10000	37.85	39.48	41.70	47.90	46.03	47.90
Ammonia	Hourly Mean	2500	6.16	6.62	5.22	4.48	8.25	8.25
	Annual Mean	180	0.17	0.20	0.21	0.17	0.17	0.21
Cadmium and Thallium	Annual Mean	0.005	0.00040	0.00046	0.00051	0.00040	0.00040	0.00051
Mercury	Hourly Mean	0.6	0.015	0.016	0.012	0.011	0.020	0.02
	Daily Mean	0.06	0.0036	0.0038	0.0038	0.0041	0.0040	0.00
Other Metals	Annual Mean	0.02	0.0059	0.0070	0.0076	0.0060	0.0060	0.01
Amine1	Hourly Mean	400	0.37	0.40	0.31	0.27	0.50	0.50
	Daily Mean	100	0.045	0.048	0.048	0.052	0.049	0.052
Amine2	Daily Mean	15	0.00018	0.00019	0.00019	0.00021	0.00020	0.00021
Direct Nitros1	Annual Mean	0.0002	0.0000033	0.0000039	0.0000043	0.0000034	0.0000034	0.0000043
Direct Nitros2	Annual Mean	0.0002	0.0000434	0.0000507	0.0000553	0.0000441	0.0000441	0.0000553
Aldehydes	30minute Mean	100	1.43	1.54	1.21	1.04	1.91	1.91
	Annual Mean	5	0.02	0.02	0.02	0.02	0.02	0.02
Amides	Annual Mean	70	0.00038	0.00044	0.00048	0.00038	0.00038	0.00048

DEG100	Annual Mean	860	0.0014	0.0016	0.0017	0.0014	0.0014	0.0017
DEG101	Annual Mean	47	0.00053	0.00062	0.00068	0.00054	0.00054	0.00068
DEG102	Annual Mean	50	0.0048	0.0057	0.0062	0.0049	0.0049	0.0062

Table E-2 – Maximum with Carbon Capture Process Contribution anywhere within the study area (µg/m³).

Pollutant	Averaging Period	AQAL (ug/m3)	Max PC 2018	Max PC 2019	Max PC 2020	Max PC 2021	Max PC 2022	Max over 5 years
Nitrogen Dioxide	Hourly Mean	200	23.14	29.75	29.94	21.16	29.56	29.94
	Annual Mean	40	0.32	0.42	0.35	0.36	0.35	0.42
Sulphur Dioxide	15minute Mean	266	71.79	66.80	79.57	51.97	65.15	79.57
	Hourly Mean	350	31.12	34.77	39.22	29.40	29.66	39.22
	Daily Mean	125	1.08	1.29	1.45	1.42	1.26	1.45
PM10	Daily Mean	50	0.07	0.10	0.06	0.09	0.07	0.10
	Annual Mean	40	0.02	0.02	0.02	0.02	0.02	0.02
PM2.5	Annual Mean	10	0.02	0.02	0.02	0.02	0.02	0.02
Hydrogen Chloride	Hourly Mean	750	28.72	32.73	22.07	18.00	42.83	42.83
Hydrogen Fluoride	Hourly Mean	160	2.31	2.62	2.02	1.48	3.24	3.24
	Annual Mean	16	0.02	0.02	0.02	0.02	0.02	0.02
TOC (as Benzene)	Annual Mean	5	0.04	0.06	0.04	0.05	0.04	0.06
Carbon Monoxide	8 Hour Mean	10000	22.47	19.29	17.94	19.03	27.02	27.02
Ammonia	Hourly Mean	2500	3.63	4.19	2.73	2.33	5.51	5.51
	Annual Mean	180	0.02	0.03	0.02	0.03	0.02	0.03
Cadmium and Thallium	Annual Mean	0.005	0.00007	0.00009	0.00007	0.00008	0.00007	0.00009
Mercury	Hourly Mean	0.6	0.010	0.011	0.007	0.006	0.014	0.01
	Daily Mean	0.06	0.0012	0.0012	0.0012	0.0018	0.0012	0.00
Other Metals	Annual Mean	0.02	0.0010	0.0014	0.0011	0.0012	0.0011	0.00
Amine1	Hourly Mean	400	0.37	0.40	0.31	0.27	0.50	0.50
	Daily Mean	100	0.045	0.048	0.048	0.052	0.049	0.052
Amine2	Daily Mean	15	0.00018	0.00019	0.00019	0.00021	0.00020	0.00021
Direct Nitros1	Annual Mean	0.0002	0.0000033	0.0000039	0.0000043	0.0000034	0.0000034	0.0000043
Direct Nitros2	Annual Mean	0.0002	0.0000434	0.0000507	0.0000553	0.0000441	0.0000441	0.0000553
Aldehydes	30minute Mean	100	1.43	1.54	1.21	1.04	1.91	1.91
	Annual Mean	5	0.02	0.02	0.02	0.02	0.02	0.02
Amides	Annual Mean	70	0.00038	0.00044	0.00048	0.00038	0.00038	0.00048
DEG100	Annual Mean	860	0.0014	0.0016	0.0017	0.0014	0.0014	0.0017
DEG101	Annual Mean	47	0.00053	0.00062	0.00068	0.00054	0.00054	0.00068
DEG102	Annual Mean	50	0.0048	0.0057	0.0062	0.0049	0.0049	0.0062

Table E-3 – Maximum with Carbon Capture Scenario contribution to ground level concentrations in Barking Riverside residential area (µg/m³).

Pollutant	Averaging Period	AQAL (ug/m3)	With Carbon Capture 2018	With Carbon Capture 2019	With Carbon Capture 2020	With Carbon Capture 2021	With Carbon Capture 2022	Max over 5 years
Nitrogen Dioxide	Hourly Mean	200	13.93	13.19	12.90	13.03	14.53	14.53
	Annual Mean	40	0.15	0.12	0.11	0.10	0.16	0.16
Sulphur Dioxide	15minute Mean	266	101.05	97.83	114.43	99.95	105.28	114.43
	Hourly Mean	350	66.28	56.02	63.99	68.30	68.79	68.79
	Daily Mean	125	4.58	5.12	5.26	6.35	4.70	6.35
PM10	Daily Mean	50	0.32	0.40	0.38	0.32	0.34	0.40
	Annual Mean	40	0.10	0.12	0.13	0.10	0.10	0.13
PM2.5	Annual Mean	10	0.10	0.12	0.13	0.10	0.10	0.13
Hydrogen Chloride	Hourly Mean	750	43.91	47.29	37.50	31.76	59.40	59.40
Hydrogen Fluoride	Hourly Mean	160	2.94	3.24	3.04	2.37	4.50	4.50
	Annual Mean	16	0.08	0.09	0.10	0.08	0.08	0.10
TOC (as Benzene)	Annual Mean	5	0.23	0.27	0.30	0.24	0.24	0.30
Carbon Monoxide	8 Hour Mean	10000	37.85	39.48	41.70	47.90	46.03	47.90
Ammonia	Hourly Mean	2500	6.16	6.62	5.22	4.48	8.25	8.25
	Annual Mean	180	0.17	0.20	0.21	0.17	0.17	0.21
Cadmium and Thallium	Annual Mean	0.005	0.00040	0.00046	0.00051	0.00040	0.00040	0.00051
Mercury	Hourly Mean	0.6	0.015	0.016	0.012	0.011	0.020	0.02
	Daily Mean	0.06	0.0036	0.0038	0.0038	0.0041	0.0040	0.00
Other Metals	Annual Mean	0.02	0.0059	0.0070	0.0076	0.0060	0.0060	0.01
Amine1	Hourly Mean	400	0.37	0.40	0.31	0.27	0.50	0.50
	Daily Mean	100	0.045	0.048	0.048	0.052	0.049	0.052
Amine2	Daily Mean	15	0.00018	0.00019	0.00019	0.00021	0.00020	0.00021
Direct Nitros1	Annual Mean	0.0002	0.0000033	0.0000039	0.0000043	0.0000034	0.0000034	0.0000043
Direct Nitros2	Annual Mean	0.0002	0.0000434	0.0000507	0.0000553	0.0000441	0.0000441	0.0000553
Aldehydes	30minute Mean	100	1.43	1.54	1.21	1.04	1.91	1.91
	Annual Mean	5	0.02	0.02	0.02	0.02	0.02	0.02
Amides	Annual Mean	70	0.00038	0.00044	0.00048	0.00038	0.00038	0.00048
DEG100	Annual Mean	860	0.0014	0.0016	0.0017	0.0014	0.0014	0.0017
DEG101	Annual Mean	47	0.00053	0.00062	0.00068	0.00054	0.00054	0.00068
DEG102	Annual Mean	50	0.0048	0.0057	0.0062	0.0049	0.0049	0.0062

Table E-4 – Maximum with Carbon Capture Process Contribution in Barking Riverside residential area (µg/m^3).

Pollutant	Averaging Period	AQAL (ug/m3)	Max With Carbon Capture PC 2018	Max With Carbon Capture PC 2019	Max With Carbon Capture PC 2020	Max With Carbon Capture PC 2021	Max With Carbon Capture PC 2022	Max over 5 years
Nitrogen Dioxide	Hourly Mean	200	-0.72	-0.65	-0.38	-0.50	-1.60	-0.38
	Annual Mean	40	-0.01	-0.01	0.00	-0.01	-0.01	0.00
Sulphur Dioxide	15minute Mean	266	5.33	-1.66	-1.23	0.47	1.70	5.33
	Hourly Mean	350	-1.36	-0.93	-0.48	-0.77	-1.72	-0.48
	Daily Mean	125	0.01	0.02	0.07	0.01	-0.03	0.07
PM10	Daily Mean	50	0.00	0.00	0.00	0.00	0.00	0.00
	Annual Mean	40	0.00	0.00	0.00	0.00	0.00	0.00
PM2.5	Annual Mean	10	0.00	0.00	0.00	0.00	0.00	0.00
Hydrogen Chloride	Hourly Mean	750	0.91	3.77	3.26	1.86	4.18	4.18
Hydrogen Fluoride	Hourly Mean	160	0.25	0.49	0.45	0.19	0.51	0.51
	Annual Mean	16	0.00	0.00	0.00	0.00	0.00	0.00
TOC (as Benzene)	Annual Mean	5	0.00	0.00	0.00	0.00	0.00	0.00
Carbon Monoxide	8 Hour Mean	10000	0.19	0.50	0.92	0.71	0.18	0.92
Ammonia	Hourly Mean	2500	-0.41	0.08	-0.33	-0.49	0.03	0.08
	Annual Mean	180	-0.01	-0.01	0.00	0.00	-0.01	0.00
Cadmium and Thallium	Annual Mean	0.005	-0.00001	-0.00001	0.00000	0.00000	-0.00001	0.00000
Mercury	Hourly Mean	0.6	0.000	0.001	0.001	0.001	0.001	0.00
	Daily Mean	0.06	0.0000	0.0000	0.0001	0.0000	0.0000	0.00
Other Metals	Annual Mean	0.02	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001	0.00
Amine1	Hourly Mean	400	0.12	0.14	0.16	0.14	0.15	0.16
	Daily Mean	100	0.010	0.006	0.010	0.007	0.009	0.010
Amine2	Daily Mean	15	0.00004	0.00003	0.00004	0.00003	0.00004	0.00004
Direct Nitros1	Annual Mean	0.0002	0.0000003	0.0000002	0.0000002	0.0000002	0.0000003	0.0000003
Direct Nitros2	Annual Mean	0.0002	0.0000036	0.0000030	0.0000026	0.0000024	0.0000037	0.0000037
Aldehydes	30minute Mean	100	0.47	0.54	0.61	0.56	0.58	0.61
	Annual Mean	5	0.00	0.00	0.00	0.00	0.00	0.00
Amides	Annual Mean	70	0.00003	0.00003	0.00002	0.00002	0.00003	0.00003
DEG100	Annual Mean	860	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
DEG101	Annual Mean	47	0.00004	0.00004	0.00003	0.00003	0.00005	0.00005
DEG102	Annual Mean	50	0.0004	0.0003	0.0003	0.0003	0.0004	0.0004

Table E-5 – Maximum with Carbon Capture Scenario contribution to ground level concentrations in Thamesmead residential area (µg/m³).

Pollutant	Averaging Period	AQAL (ug/m3)	With Carbon Capture 2018	With Carbon Capture 2019	With Carbon Capture 2020	With Carbon Capture 2021	With Carbon Capture 2022	Max over 5 years
Nitrogen Dioxide	Hourly Mean	200	24.62	26.77	23.10	21.17	26.23	26.77
	Annual Mean	40	0.60	0.64	0.54	0.53	0.59	0.64
Sulphur Dioxide	15minute Mean	266	101.05	97.83	114.43	99.95	105.28	114.43
	Hourly Mean	350	66.28	56.02	63.99	68.30	68.79	68.79
	Daily Mean	125	4.58	5.12	5.26	6.35	4.70	6.35
PM10	Daily Mean	50	0.32	0.40	0.38	0.32	0.34	0.40
	Annual Mean	40	0.10	0.12	0.13	0.10	0.10	0.13
PM2.5	Annual Mean	10	0.10	0.12	0.13	0.10	0.10	0.13
Hydrogen Chloride	Hourly Mean	750	43.91	47.29	37.50	31.76	59.40	59.40
Hydrogen Fluoride	Hourly Mean	160	2.94	3.24	3.04	2.37	4.50	4.50
	Annual Mean	16	0.08	0.09	0.10	0.08	0.08	0.10
TOC (as Benzene)	Annual Mean	5	0.23	0.27	0.30	0.24	0.24	0.30
Carbon Monoxide	8 Hour Mean	10000	37.85	39.48	41.70	47.90	46.03	47.90
Ammonia	Hourly Mean	2500	6.16	6.62	5.22	4.48	8.25	8.25
	Annual Mean	180	0.17	0.20	0.21	0.17	0.17	0.21
Cadmium and Thallium	Annual Mean	0.005	0.00040	0.00046	0.00051	0.00040	0.00040	0.00051
Mercury	Hourly Mean	0.6	0.015	0.016	0.012	0.011	0.020	0.02
	Daily Mean	0.06	0.0036	0.0038	0.0038	0.0041	0.0040	0.00
Other Metals	Annual Mean	0.02	0.0059	0.0070	0.0076	0.0060	0.0060	0.01
Amine1	Hourly Mean	400	0.37	0.40	0.31	0.27	0.50	0.50
	Daily Mean	100	0.045	0.048	0.048	0.052	0.049	0.052
Amine2	Daily Mean	15	0.00018	0.00019	0.00019	0.00021	0.00020	0.00021
Direct Nitros1	Annual Mean	0.0002	0.0000033	0.0000039	0.0000043	0.0000034	0.0000034	0.0000043
Direct Nitros2	Annual Mean	0.0002	0.0000434	0.0000507	0.0000553	0.0000441	0.0000441	0.0000553
Aldehydes	30minute Mean	100	1.43	1.54	1.21	1.04	1.91	1.91
	Annual Mean	5	0.02	0.02	0.02	0.02	0.02	0.02
Amides	Annual Mean	70	0.00038	0.00044	0.00048	0.00038	0.00038	0.00048
DEG100	Annual Mean	860	0.0014	0.0016	0.0017	0.0014	0.0014	0.0017
DEG101	Annual Mean	47	0.00053	0.00062	0.00068	0.00054	0.00054	0.00068
DEG102	Annual Mean	50	0.0048	0.0057	0.0062	0.0049	0.0049	0.0062

Table E-6 – Maximum with Carbon Capture Process Contribution in Thamesmead residential area (µg/m³).

Pollutant	Averaging Period	AQAL (ug/m3)	Max With Carbon Capture PC 2018	Max With Carbon Capture PC 2019	Max With Carbon Capture PC 2020	Max With Carbon Capture PC 2021	Max With Carbon Capture PC 2022	Max over 5 years
Nitrogen Dioxide	Hourly Mean	200	2.01	1.70	3.67	3.55	1.35	3.67
	Annual Mean	40	0.03	0.07	0.04	0.03	0.04	0.07
Sulphur Dioxide	15minute Mean	266	5.43	5.74	7.74	6.71	4.59	7.74
	Hourly Mean	350	2.04	1.84	4.28	5.00	2.52	5.00
	Daily Mean	125	0.17	0.17	0.22	0.19	0.11	0.22
PM10	Daily Mean	50	0.01	0.03	0.01	0.02	0.02	0.03
	Annual Mean	40	0.00	0.00	0.00	0.00	0.00	0.00
PM2.5	Annual Mean	10	0.00	0.00	0.00	0.00	0.00	0.00
Hydrogen Chloride	Hourly Mean	750	3.05	3.64	8.70	5.18	8.46	8.70
Hydrogen Fluoride	Hourly Mean	160	0.40	0.63	0.90	0.58	0.90	0.90
	Annual Mean	16	0.00	0.00	0.00	0.00	0.00	0.00
TOC (as Benzene)	Annual Mean	5	0.00	0.01	0.00	0.00	0.00	0.01
Carbon Monoxide	8 Hour Mean	10000	1.09	2.21	5.13	3.04	1.23	5.13
Ammonia	Hourly Mean	2500	-0.44	-0.42	0.25	-0.38	0.07	0.25
	Annual Mean	180	-0.02	-0.02	-0.01	-0.02	-0.02	-0.01
Cadmium and Thallium	Annual Mean	0.005	0.00000	0.00001	0.00000	0.00000	0.00000	0.00001
Mercury	Hourly Mean	0.6	0.001	0.001	0.003	0.002	0.003	0.00
	Daily Mean	0.06	0.0001	0.0001	0.0002	0.0000	0.0002	0.00
Other Metals	Annual Mean	0.02	0.0000	0.0002	0.0001	0.0000	0.0000	0.00
Amine1	Hourly Mean	400	0.18	0.19	0.23	0.22	0.23	0.23
	Daily Mean	100	0.016	0.016	0.015	0.016	0.018	0.018
Amine2	Daily Mean	15	0.00006	0.00007	0.00006	0.00006	0.00007	0.00007
Direct Nitros1	Annual Mean	0.0002	0.0000011	0.0000012	0.0000010	0.0000010	0.0000011	0.0000012
Direct Nitros2	Annual Mean	0.0002	0.0000146	0.0000154	0.0000130	0.0000127	0.0000143	0.0000154
Aldehydes	30minute Mean	100	0.70	0.72	0.89	0.84	0.90	0.90
	Annual Mean	5	0.01	0.01	0.01	0.00	0.01	0.01
Amides	Annual Mean	70	0.00013	0.00013	0.00011	0.00011	0.00012	0.00013
DEG100	Annual Mean	860	0.0005	0.0005	0.0004	0.0004	0.0004	0.0005
DEG101	Annual Mean	47	0.00018	0.00019	0.00016	0.00016	0.00018	0.00019
DEG102	Annual Mean	50	0.0016	0.0017	0.0015	0.0014	0.0016	0.0017

Table E-7 – Maximum with Carbon Capture Scenario contribution to ground level concentrations in Abbey Wood residential area (µg/m^3).

Pollutant	Averaging Period	AQAL (ug/m3)	With Carbon Capture 2018	With Carbon Capture 2019	With Carbon Capture 2020	With Carbon Capture 2021	With Carbon Capture 2022	Max over 5 years
Nitrogen Dioxide	Hourly Mean	200	28.49	28.12	27.19	28.61	31.05	31.05
	Annual Mean	40	0.67	0.64	0.58	0.64	0.61	0.64
Sulphur Dioxide	15minute Mean	266	101.05	97.83	114.43	99.95	105.28	114.43
	Hourly Mean	350	66.28	56.02	63.99	68.30	68.79	68.79
	Daily Mean	125	4.58	5.12	5.26	6.35	4.70	6.35
PM10	Daily Mean	50	0.32	0.40	0.38	0.32	0.34	0.40
	Annual Mean	40	0.10	0.12	0.13	0.10	0.10	0.13
PM2.5	Annual Mean	10	0.10	0.12	0.13	0.10	0.10	0.13
Hydrogen Chloride	Hourly Mean	750	43.91	47.29	37.50	31.76	59.40	59.40
Hydrogen Fluoride	Hourly Mean	160	2.94	3.24	3.04	2.37	4.50	4.50
	Annual Mean	16	0.08	0.09	0.10	0.08	0.08	0.10
TOC (as Benzene)	Annual Mean	5	0.23	0.27	0.30	0.24	0.24	0.30
Carbon Monoxide	8 Hour Mean	10000	37.85	39.48	41.70	47.90	46.03	47.90
Ammonia	Hourly Mean	2500	6.16	6.62	5.22	4.48	8.25	8.25
	Annual Mean	180	0.17	0.20	0.21	0.17	0.17	0.21
Cadmium and Thallium	Annual Mean	0.005	0.00040	0.00046	0.00051	0.00040	0.00040	0.00051
Mercury	Hourly Mean	0.6	0.015	0.016	0.012	0.011	0.020	0.02
	Daily Mean	0.06	0.0036	0.0038	0.0038	0.0041	0.0040	0.00
Other Metals	Annual Mean	0.02	0.0059	0.0070	0.0076	0.0060	0.0060	0.01
Amine1	Hourly Mean	400	0.37	0.40	0.31	0.27	0.50	0.50
	Daily Mean	100	0.045	0.048	0.048	0.052	0.049	0.052
Amine2	Daily Mean	15	0.00018	0.00019	0.00019	0.00021	0.00020	0.00021
Direct Nitros1	Annual Mean	0.0002	0.0000033	0.0000039	0.0000043	0.0000034	0.0000034	0.0000043
Direct Nitros2	Annual Mean	0.0002	0.0000434	0.0000507	0.0000553	0.0000441	0.0000441	0.0000553
Aldehydes	30minute Mean	100	1.43	1.54	1.21	1.04	1.91	1.91
	Annual Mean	5	0.02	0.02	0.02	0.02	0.02	0.02
Amides	Annual Mean	70	0.00038	0.00044	0.00048	0.00038	0.00038	0.00048
DEG100	Annual Mean	860	0.0014	0.0016	0.0017	0.0014	0.0014	0.0017
DEG101	Annual Mean	47	0.00053	0.00062	0.00068	0.00054	0.00054	0.00068
DEG102	Annual Mean	50	0.0048	0.0057	0.0062	0.0049	0.0049	0.0062

Table E-8 – Maximum with Carbon Capture Process Contribution in Abbey Wood residential area ($\mu g/m^3$).

Pollutant	Averaging Period	AQAL (ug/m3)	Max With Carbon Capture PC 2018	Max With Carbon Capture PC 2019	Max With Carbon Capture PC 2020	Max With Carbon Capture PC 2021	Max With Carbon Capture PC 2022	Max over 5 years
Nitrogen Dioxide	Hourly Mean	200	7.39	7.85	7.46	8.45	7.68	8.45
	Annual Mean	40	0.13	0.09	0.12	0.16	0.13	0.16
Sulphur Dioxide	15minute Mean	266	16.81	15.73	15.35	16.46	19.35	19.35
	Hourly Mean	350	10.37	10.96	11.00	12.78	11.33	12.78
	Daily Mean	125	0.54	1.00	0.89	0.90	0.77	1.00
PM10	Daily Mean	50	0.06	0.03	0.03	0.05	0.03	0.06
	Annual Mean	40	0.01	0.01	0.01	0.01	0.01	0.01
PM2.5	Annual Mean	10	0.01	0.01	0.01	0.01	0.01	0.01
Hydrogen Chloride	Hourly Mean	750	5.67	7.31	11.66	9.99	7.01	11.66
Hydrogen Fluoride	Hourly Mean	160	0.60	0.49	1.03	1.07	0.91	1.07
	Annual Mean	16	0.01	0.01	0.00	0.01	0.01	0.01
TOC (as Benzene)	Annual Mean	5	0.02	0.01	0.02	0.02	0.02	0.02
Carbon Monoxide	8 Hour Mean	10000	6.36	9.65	8.08	7.34	5.58	9.65
Ammonia	Hourly Mean	2500	-0.03	0.19	0.45	0.40	0.40	0.45
	Annual Mean	180	0.00	0.00	0.00	0.00	0.00	0.00
Cadmium and Thallium	Annual Mean	0.005	0.00003	0.00002	0.00003	0.00004	0.00003	0.00004
Mercury	Hourly Mean	0.6	0.002	0.002	0.004	0.003	0.002	0.00
	Daily Mean	0.06	0.0007	0.0007	0.0006	0.0010	0.0006	0.00
Other Metals	Annual Mean	0.02	0.0005	0.0003	0.0005	0.0006	0.0005	0.00
Amine1	Hourly Mean	400	0.20	0.22	0.27	0.23	0.22	0.27
	Daily Mean	100	0.029	0.027	0.028	0.033	0.024	0.033
Amine2	Daily Mean	15	0.00012	0.00011	0.00011	0.00013	0.00010	0.00013
Direct Nitros1	Annual Mean	0.0002	0.0000013	0.0000012	0.0000011	0.0000013	0.0000011	0.0000013
Direct Nitros2	Annual Mean	0.0002	0.0000167	0.0000154	0.0000147	0.0000165	0.0000147	0.0000167
Aldehydes	30minute Mean	100	0.76	0.84	1.05	0.89	0.87	1.05
	Annual Mean	5	0.01	0.01	0.01	0.01	0.01	0.01
Amides	Annual Mean	70	0.00015	0.00013	0.00013	0.00014	0.00013	0.00015
DEG100	Annual Mean	860	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
DEG101	Annual Mean	47	0.00021	0.00019	0.00018	0.00020	0.00018	0.00021
DEG102	Annual Mean	50	0.0019	0.0017	0.0016	0.0018	0.0016	0.0019

Table E-9 – Maximum with Carbon Capture Scenario contribution to ground level concentrations Belvedere residential area (µg/m^3).

Pollutant	Averaging Period	AQAL (ug/m3)	With Carbon Capture 2018	With Carbon Capture 2019	With Carbon Capture 2020	With Carbon Capture 2021	With Carbon Capture 2022	Max over 5 years
Nitrogen Dioxide	Hourly Mean	200	36.53	37.51	31.30	36.42	33.35	37.51
	Annual Mean	40	0.34	0.26	0.17	0.29	0.26	0.29
Sulphur Dioxide	15minute Mean	266	101.05	97.83	114.43	99.95	105.28	114.43
	Hourly Mean	350	66.28	56.02	63.99	68.30	68.79	68.79
	Daily Mean	125	4.58	5.12	5.26	6.35	4.70	6.35
PM10	Daily Mean	50	0.32	0.40	0.38	0.32	0.34	0.40
	Annual Mean	40	0.10	0.12	0.13	0.10	0.10	0.13
PM2.5	Annual Mean	10	0.10	0.12	0.13	0.10	0.10	0.13
Hydrogen Chloride	Hourly Mean	750	43.91	47.29	37.50	31.76	59.40	59.40
Hydrogen Fluoride	Hourly Mean	160	2.94	3.24	3.04	2.37	4.50	4.50
	Annual Mean	16	0.08	0.09	0.10	0.08	0.08	0.10
TOC (as Benzene)	Annual Mean	5	0.23	0.27	0.30	0.24	0.24	0.30
Carbon Monoxide	8 Hour Mean	10000	37.85	39.48	41.70	47.90	46.03	47.90
Ammonia	Hourly Mean	2500	6.16	6.62	5.22	4.48	8.25	8.25
	Annual Mean	180	0.17	0.20	0.21	0.17	0.17	0.21
Cadmium and Thallium	Annual Mean	0.005	0.00040	0.00046	0.00051	0.00040	0.00040	0.00051
Mercury	Hourly Mean	0.6	0.015	0.016	0.012	0.011	0.020	0.02
	Daily Mean	0.06	0.0036	0.0038	0.0038	0.0041	0.0040	0.00
Other Metals	Annual Mean	0.02	0.0059	0.0070	0.0076	0.0060	0.0060	0.01
Amine1	Hourly Mean	400	0.37	0.40	0.31	0.27	0.50	0.50
	Daily Mean	100	0.045	0.048	0.048	0.052	0.049	0.052
Amine2	Daily Mean	15	0.00018	0.00019	0.00019	0.00021	0.00020	0.00021
Direct Nitros1	Annual Mean	0.0002	0.0000033	0.0000039	0.0000043	0.0000034	0.0000034	0.0000043
Direct Nitros2	Annual Mean	0.0002	0.0000434	0.0000507	0.0000553	0.0000441	0.0000441	0.0000553
Aldehydes	30minute Mean	100	1.43	1.54	1.21	1.04	1.91	1.91
	Annual Mean	5	0.02	0.02	0.02	0.02	0.02	0.02
Amides	Annual Mean	70	0.00038	0.00044	0.00048	0.00038	0.00038	0.00048
DEG100	Annual Mean	860	0.0014	0.0016	0.0017	0.0014	0.0014	0.0017
DEG101	Annual Mean	47	0.00053	0.00062	0.00068	0.00054	0.00054	0.00068
DEG102	Annual Mean	50	0.0048	0.0057	0.0062	0.0049	0.0049	0.0062

Table E-10 – Maximum with Carbon Capture Process Contribution in Belvedere residential area (µg/m^3).

Pollutant	Averaging Period	AQAL (ug/m3)	Max With Carbon Capture PC 2018	Max With Carbon Capture PC 2019	Max With Carbon Capture PC 2020	Max With Carbon Capture PC 2021	Max With Carbon Capture PC 2022	Max over 5 years
Nitrogen Dioxide	Hourly Mean	200	5.44	5.49	4.66	4.85	6.29	6.29
	Annual Mean	40	0.04	0.02	0.02	0.02	0.03	0.04
Sulphur Dioxide	15minute Mean	266	11.33	12.39	10.91	10.75	14.87	14.87
	Hourly Mean	350	7.72	9.19	6.60	6.77	9.21	9.21
	Daily Mean	125	0.29	0.44	0.30	0.19	0.24	0.44
PM10	Daily Mean	50	0.02	0.00	0.01	0.02	0.01	0.02
	Annual Mean	40	0.00	0.00	0.00	0.00	0.00	0.00
PM2.5	Annual Mean	10	0.00	0.00	0.00	0.00	0.00	0.00
Hydrogen Chloride	Hourly Mean	750	6.44	5.05	8.45	5.41	5.57	8.45
Hydrogen Fluoride	Hourly Mean	160	1.01	0.66	0.99	0.42	0.68	1.01
	Annual Mean	16	0.00	0.00	0.00	0.00	0.00	0.00
TOC (as Benzene)	Annual Mean	5	0.00	0.00	0.00	0.00	0.00	0.00
Carbon Monoxide	8 Hour Mean	10000	3.48	5.37	3.91	2.40	3.22	5.37
Ammonia	Hourly Mean	2500	-0.20	-0.05	0.47	-0.07	-0.27	0.47
	Annual Mean	180	0.00	0.00	0.00	0.00	0.00	0.00
Cadmium and Thallium	Annual Mean	0.005	0.00000	0.00000	0.00000	0.00000	0.00001	0.00001
Mercury	Hourly Mean	0.6	0.002	0.002	0.003	0.002	0.002	0.00
	Daily Mean	0.06	0.0001	0.0002	0.0002	0.0001	0.0002	0.00
Other Metals	Annual Mean	0.02	0.0001	0.0000	0.0000	0.0000	0.0001	0.00
Amine1	Hourly Mean	400	0.26	0.21	0.18	0.18	0.21	0.26
	Daily Mean	100	0.022	0.024	0.017	0.020	0.016	0.024
Amine2	Daily Mean	15	0.00009	0.00010	0.00007	0.00008	0.00006	0.00010
Direct Nitros1	Annual Mean	0.0002	0.0000007	0.0000005	0.0000004	0.0000006	0.0000005	0.0000007
Direct Nitros2	Annual Mean	0.0002	0.0000087	0.0000069	0.0000047	0.0000076	0.0000067	0.0000087
Aldehydes	30minute Mean	100	1.00	0.81	0.68	0.68	0.82	1.00
	Annual Mean	5	0.00	0.00	0.00	0.00	0.00	0.00
Amides	Annual Mean	70	0.00008	0.00006	0.00004	0.00007	0.00006	0.00008
DEG100	Annual Mean	860	0.0003	0.0002	0.0001	0.0002	0.0002	0.0003
DEG101	Annual Mean	47	0.00011	0.00009	0.00006	0.00009	0.00008	0.00011
DEG102	Annual Mean	50	0.0010	0.0008	0.0005	0.0009	0.0008	0.0010

Table E-11 – Maximum with Carbon Capture Scenario contribution to ground level concentrations within South Dagenham residential area (µg/m³).

Pollutant	Averaging Period	AQAL (ug/m3)	With Carbon Capture 2018	With Carbon Capture 2019	With Carbon Capture 2020	With Carbon Capture 2021	With Carbon Capture 2022	Max over 5 years
Nitrogen Dioxide	Hourly Mean	200	15.03	14.08	14.25	14.66	14.97	14.97
	Annual Mean	40	0.30	0.27	0.31	0.26	0.34	0.34
Sulphur Dioxide	15minute Mean	266	101.05	97.83	114.43	99.95	105.28	114.43
	Hourly Mean	350	66.28	56.02	63.99	68.30	68.79	68.79
	Daily Mean	125	4.58	5.12	5.26	6.35	4.70	6.35
PM10	Daily Mean	50	0.32	0.40	0.38	0.32	0.34	0.40
	Annual Mean	40	0.10	0.12	0.13	0.10	0.10	0.13
PM2.5	Annual Mean	10	0.10	0.12	0.13	0.10	0.10	0.13
Hydrogen Chloride	Hourly Mean	750	43.91	47.29	37.50	31.76	59.40	59.40
Hydrogen Fluoride	Hourly Mean	160	2.94	3.24	3.04	2.37	4.50	4.50
	Annual Mean	16	0.08	0.09	0.10	0.08	0.08	0.10
TOC (as Benzene)	Annual Mean	5	0.23	0.27	0.30	0.24	0.24	0.30
Carbon Monoxide	8 Hour Mean	10000	37.85	39.48	41.70	47.90	46.03	47.90
Ammonia	Hourly Mean	2500	6.16	6.62	5.22	4.48	8.25	8.25
	Annual Mean	180	0.17	0.20	0.21	0.17	0.17	0.21
Cadmium and Thallium	Annual Mean	0.005	0.00040	0.00046	0.00051	0.00040	0.00040	0.00051
Mercury	Hourly Mean	0.6	0.015	0.016	0.012	0.011	0.020	0.02
	Daily Mean	0.06	0.0036	0.0038	0.0038	0.0041	0.0040	0.00
Other Metals	Annual Mean	0.02	0.0059	0.0070	0.0076	0.0060	0.0060	0.01
Amine1	Hourly Mean	400	0.37	0.40	0.31	0.27	0.50	0.50
	Daily Mean	100	0.045	0.048	0.048	0.052	0.049	0.052
Amine2	Daily Mean	15	0.00018	0.00019	0.00019	0.00021	0.00020	0.00021
Direct Nitros1	Annual Mean	0.0002	0.0000033	0.0000039	0.0000043	0.0000034	0.0000034	0.0000043
Direct Nitros2	Annual Mean	0.0002	0.0000434	0.0000507	0.0000553	0.0000441	0.0000441	0.0000553
Aldehydes	30minute Mean	100	1.43	1.54	1.21	1.04	1.91	1.91
	Annual Mean	5	0.02	0.02	0.02	0.02	0.02	0.02
Amides	Annual Mean	70	0.00038	0.00044	0.00048	0.00038	0.00038	0.00048
DEG100	Annual Mean	860	0.0014	0.0016	0.0017	0.0014	0.0014	0.0017
DEG101	Annual Mean	47	0.00053	0.00062	0.00068	0.00054	0.00054	0.00068
DEG102	Annual Mean	50	0.0048	0.0057	0.0062	0.0049	0.0049	0.0062

Table E-12 – Maximum with Carbon Capture Process Contribution anywhere in South Dagenham residential area (µg/m³).

Pollutant	Averaging Period	AQAL (ug/m3)	Max With Carbon Capture PC 2018	Max With Carbon Capture PC 2019	Max With Carbon Capture PC 2020	Max With Carbon Capture PC 2021	Max With Carbon Capture PC 2022	Max over 5 years
Nitrogen Dioxide	Hourly Mean	200	-1.07	-1.02	-1.44	-0.95	-0.74	-0.74
	Annual Mean	40	-0.03	-0.02	-0.03	-0.02	-0.02	-0.02
Sulphur Dioxide	15minute Mean	266	2.87	-0.84	0.57	-1.79	2.60	2.87
	Hourly Mean	350	-1.46	-1.54	-2.18	-1.42	-1.18	-1.18
	Daily Mean	125	-0.08	-0.11	-0.02	-0.02	-0.05	-0.02
PM10	Daily Mean	50	-0.01	0.00	-0.01	0.00	0.00	0.00
	Annual Mean	40	0.00	0.00	0.00	0.00	0.00	0.00
PM2.5	Annual Mean	10	0.00	0.00	0.00	0.00	0.00	0.00
Hydrogen Chloride	Hourly Mean	750	1.32	1.57	0.37	2.76	1.60	2.76
Hydrogen Fluoride	Hourly Mean	160	0.45	0.20	0.31	0.32	0.44	0.45
	Annual Mean	16	0.00	0.00	0.00	0.00	0.00	0.00
TOC (as Benzene)	Annual Mean	5	-0.01	0.00	-0.01	0.00	0.00	0.00
Carbon Monoxide	8 Hour Mean	10000	-0.38	-0.24	-0.30	2.66	0.69	2.66
Ammonia	Hourly Mean	2500	-0.44	-0.17	-0.86	-0.20	-0.41	-0.17
	Annual Mean	180	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Cadmium and Thallium	Annual Mean	0.005	-0.00001	-0.00001	-0.00001	-0.00001	-0.00001	-0.00001
Mercury	Hourly Mean	0.6	0.000	0.001	0.000	0.001	0.001	0.00
	Daily Mean	0.06	-0.0001	-0.0001	0.0000	0.0000	0.0000	0.00
Other Metals	Annual Mean	0.02	-0.0002	-0.0001	-0.0002	-0.0001	-0.0001	0.00
Amine1	Hourly Mean	400	0.16	0.13	0.17	0.15	0.18	0.18
	Daily Mean	100	0.012	0.013	0.014	0.009	0.010	0.014
Amine2	Daily Mean	15	0.00005	0.00005	0.00005	0.00003	0.00004	0.00005
Direct Nitros1	Annual Mean	0.0002	0.0000006	0.0000005	0.0000006	0.0000005	0.0000006	0.0000006
Direct Nitros2	Annual Mean	0.0002	0.0000072	0.0000066	0.0000074	0.0000061	0.0000081	0.0000081
Aldehydes	30minute Mean	100	0.63	0.50	0.66	0.58	0.69	0.69
	Annual Mean	5	0.00	0.00	0.00	0.00	0.00	0.00
Amides	Annual Mean	70	0.00006	0.00006	0.00006	0.00005	0.00007	0.00007
DEG100	Annual Mean	860	0.0002	0.0002	0.0002	0.0002	0.0003	0.0003
DEG101	Annual Mean	47	0.00009	0.00008	0.00009	0.00008	0.00010	0.00010
DEG102	Annual Mean	50	0.0008	0.0007	0.0008	0.0007	0.0009	0.0009

Table E-13 – Maximum with Carbon Capture Scenario contribution to ground level concentrations within Lessness Heath residential area (µg/m³).

Pollutant	Averaging Period	AQAL (ug/m3)	With Carbon Capture 2018	With Carbon Capture 2019	With Carbon Capture 2020	With Carbon Capture 2021	With Carbon Capture 2022	Max over 5 years
Nitrogen Dioxide	Hourly Mean	200	19.12	19.44	18.29	18.73	19.51	19.51
	Annual Mean	40	0.24	0.20	0.14	0.24	0.20	0.24
Sulphur Dioxide	15minute Mean	266	101.05	97.83	114.43	99.95	105.28	114.43
	Hourly Mean	350	66.28	56.02	63.99	68.30	68.79	68.79
	Daily Mean	125	4.58	5.12	5.26	6.35	4.70	6.35
PM10	Daily Mean	50	0.32	0.40	0.38	0.32	0.34	0.40
	Annual Mean	40	0.10	0.12	0.13	0.10	0.10	0.13
PM2.5	Annual Mean	10	0.10	0.12	0.13	0.10	0.10	0.13
Hydrogen Chloride	Hourly Mean	750	43.91	47.29	37.50	31.76	59.40	59.40
Hydrogen Fluoride	Hourly Mean	160	2.94	3.24	3.04	2.37	4.50	4.50
	Annual Mean	16	0.08	0.09	0.10	0.08	0.08	0.10
TOC (as Benzene)	Annual Mean	5	0.23	0.27	0.30	0.24	0.24	0.30
Carbon Monoxide	8 Hour Mean	10000	37.85	39.48	41.70	47.90	46.03	47.90
Ammonia	Hourly Mean	2500	6.16	6.62	5.22	4.48	8.25	8.25
	Annual Mean	180	0.17	0.20	0.21	0.17	0.17	0.21
Cadmium and Thallium	Annual Mean	0.005	0.00040	0.00046	0.00051	0.00040	0.00040	0.00051
Mercury	Hourly Mean	0.6	0.015	0.016	0.012	0.011	0.020	0.02
	Daily Mean	0.06	0.0036	0.0038	0.0038	0.0041	0.0040	0.00
Other Metals	Annual Mean	0.02	0.0059	0.0070	0.0076	0.0060	0.0060	0.01
Amine1	Hourly Mean	400	0.37	0.40	0.31	0.27	0.50	0.50
	Daily Mean	100	0.045	0.048	0.048	0.052	0.049	0.052
Amine2	Daily Mean	15	0.00018	0.00019	0.00019	0.00021	0.00020	0.00021
Direct Nitros1	Annual Mean	0.0002	0.0000033	0.0000039	0.0000043	0.0000034	0.0000034	0.0000043
Direct Nitros2	Annual Mean	0.0002	0.0000434	0.0000507	0.0000553	0.0000441	0.0000441	0.0000553
Aldehydes	30minute Mean	100	1.43	1.54	1.21	1.04	1.91	1.91
	Annual Mean	5	0.02	0.02	0.02	0.02	0.02	0.02
Amides	Annual Mean	70	0.00038	0.00044	0.00048	0.00038	0.00038	0.00048
DEG100	Annual Mean	860	0.0014	0.0016	0.0017	0.0014	0.0014	0.0017
DEG101	Annual Mean	47	0.00053	0.00062	0.00068	0.00054	0.00054	0.00068
DEG102	Annual Mean	50	0.0048	0.0057	0.0062	0.0049	0.0049	0.0062

Table E-14 – Maximum with Carbon Capture Process Contribution in Lessness Heath residential area (µg/m^3).

Pollutant	Averaging Period	AQAL (ug/m3)	Max With Carbon Capture PC 2018	Max With Carbon Capture PC 2019	Max With Carbon Capture PC 2020	Max With Carbon Capture PC 2021	Max With Carbon Capture PC 2022	Max over 5 years
Nitrogen Dioxide	Hourly Mean	200	2.35	2.33	2.39	1.60	2.55	2.55
	Annual Mean	40	0.01	0.01	0.01	0.00	0.01	0.01
Sulphur Dioxide	15minute Mean	266	6.60	5.86	7.53	6.01	9.76	9.76
	Hourly Mean	350	3.00	3.20	3.35	2.15	3.66	3.66
	Daily Mean	125	0.09	0.14	0.18	0.17	0.06	0.18
PM10	Daily Mean	50	0.00	0.00	0.00	0.01	0.00	0.01
	Annual Mean	40	0.00	0.00	0.00	0.00	0.00	0.00
PM2.5	Annual Mean	10	0.00	0.00	0.00	0.00	0.00	0.00
Hydrogen Chloride	Hourly Mean	750	6.35	4.83	2.56	2.34	5.26	6.35
Hydrogen Fluoride	Hourly Mean	160	0.93	0.64	0.40	0.43	0.66	0.93
	Annual Mean	16	0.00	0.00	0.00	0.00	0.00	0.00
TOC (as Benzene)	Annual Mean	5	0.00	0.00	0.00	0.00	0.00	0.00
Carbon Monoxide	8 Hour Mean	10000	1.97	2.75	1.46	1.68	1.85	2.75
Ammonia	Hourly Mean	2500	-0.10	-0.02	-0.25	-0.55	-0.26	-0.02
	Annual Mean	180	-0.01	0.00	0.00	-0.01	0.00	0.00
Cadmium and Thallium	Annual Mean	0.005	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Mercury	Hourly Mean	0.6	0.002	0.002	0.001	0.001	0.002	0.00
	Daily Mean	0.06	0.0001	0.0001	0.0001	0.0000	0.0000	0.00
Other Metals	Annual Mean	0.02	0.0000	0.0000	0.0000	0.0000	0.0000	0.00
Amine1	Hourly Mean	400	0.23	0.18	0.15	0.15	0.20	0.23
	Daily Mean	100	0.014	0.012	0.014	0.012	0.011	0.014
Amine2	Daily Mean	15	0.00005	0.00005	0.00006	0.00005	0.00005	0.00006
Direct Nitros1	Annual Mean	0.0002	0.0000005	0.0000004	0.0000003	0.0000004	0.0000004	0.0000005
Direct Nitros2	Annual Mean	0.0002	0.0000060	0.0000050	0.0000036	0.0000058	0.0000050	0.0000060
Aldehydes	30minute Mean	100	0.88	0.70	0.57	0.59	0.78	0.88
	Annual Mean	5	0.00	0.00	0.00	0.00	0.00	0.00
Amides	Annual Mean	70	0.00005	0.00004	0.00003	0.00005	0.00004	0.00005
DEG100	Annual Mean	860	0.0002	0.0002	0.0001	0.0002	0.0002	0.0002
DEG101	Annual Mean	47	0.00007	0.00006	0.00004	0.00007	0.00006	0.00007
DEG102	Annual Mean	50	0.0007	0.0006	0.0004	0.0007	0.0006	0.0007

Table E-15 – Maximum with Carbon Capture Scenario contribution to ground level concentrations within South Hornchurch residential area (µg/m^3).

Pollutant	Averaging Period	AQAL (ug/m3)	With Carbon Capture 2018	With Carbon Capture 2019	With Carbon Capture 2020	With Carbon Capture 2021	With Carbon Capture 2022	Max over 5 years
Nitrogen Dioxide	Hourly Mean	200	17.88	18.47	20.54	22.31	21.78	22.31
	Annual Mean	40	0.78	0.94	0.93	0.91	0.85	0.94
Sulphur Dioxide	15minute Mean	266	101.05	97.83	114.43	99.95	105.28	114.43
	Hourly Mean	350	66.28	56.02	63.99	68.30	68.79	68.79
	Daily Mean	125	4.58	5.12	5.26	6.35	4.70	6.35
PM10	Daily Mean	50	0.32	0.40	0.38	0.32	0.34	0.40
	Annual Mean	40	0.10	0.12	0.13	0.10	0.10	0.13
PM2.5	Annual Mean	10	0.10	0.12	0.13	0.10	0.10	0.13
Hydrogen Chloride	Hourly Mean	750	43.91	47.29	37.50	31.76	59.40	59.40
Hydrogen Fluoride	Hourly Mean	160	2.94	3.24	3.04	2.37	4.50	4.50
	Annual Mean	16	0.08	0.09	0.10	0.08	0.08	0.10
TOC (as Benzene)	Annual Mean	5	0.23	0.27	0.30	0.24	0.24	0.30
Carbon Monoxide	8 Hour Mean	10000	37.85	39.48	41.70	47.90	46.03	47.90
Ammonia	Hourly Mean	2500	6.16	6.62	5.22	4.48	8.25	8.25
	Annual Mean	180	0.17	0.20	0.21	0.17	0.17	0.21
Cadmium and Thallium	Annual Mean	0.005	0.00040	0.00046	0.00051	0.00040	0.00040	0.00051
Mercury	Hourly Mean	0.6	0.015	0.016	0.012	0.011	0.020	0.02
	Daily Mean	0.06	0.0036	0.0038	0.0038	0.0041	0.0040	0.00
Other Metals	Annual Mean	0.02	0.0059	0.0070	0.0076	0.0060	0.0060	0.01
Amine1	Hourly Mean	400	0.37	0.40	0.31	0.27	0.50	0.50
	Daily Mean	100	0.045	0.048	0.048	0.052	0.049	0.052
Amine2	Daily Mean	15	0.00018	0.00019	0.00019	0.00021	0.00020	0.00021
Direct Nitros1	Annual Mean	0.0002	0.0000033	0.0000039	0.0000043	0.0000034	0.0000034	0.0000043
Direct Nitros2	Annual Mean	0.0002	0.0000434	0.0000507	0.0000553	0.0000441	0.0000441	0.0000553
Aldehydes	30minute Mean	100	1.43	1.54	1.21	1.04	1.91	1.91
	Annual Mean	5	0.02	0.02	0.02	0.02	0.02	0.02
Amides	Annual Mean	70	0.00038	0.00044	0.00048	0.00038	0.00038	0.00048
DEG100	Annual Mean	860	0.0014	0.0016	0.0017	0.0014	0.0014	0.0017
DEG101	Annual Mean	47	0.00053	0.00062	0.00068	0.00054	0.00054	0.00068
DEG102	Annual Mean	50	0.0048	0.0057	0.0062	0.0049	0.0049	0.0062

Table E-16 – Maximum with Carbon Capture Process Contribution in South Hornchurch residential area (µg/m³).

Pollutant	Averaging Period	AQAL (ug/m3)	Max With Carbon Capture PC 2018	Max With Carbon Capture PC 2019	Max With Carbon Capture PC 2020	Max With Carbon Capture PC 2021	Max With Carbon Capture PC 2022	Max over 5 years
Nitrogen Dioxide	Hourly Mean	200	2.76	3.17	3.05	3.98	4.13	4.13
	Annual Mean	40	-0.01	-0.01	-0.01	-0.02	-0.01	-0.01
Sulphur Dioxide	15minute Mean	266	12.85	7.88	7.99	9.41	7.51	12.85
	Hourly Mean	350	4.13	4.46	4.10	6.11	4.44	6.11
	Daily Mean	125	0.11	0.13	0.13	0.18	0.12	0.18
PM10	Daily Mean	50	0.00	0.00	0.00	0.00	0.00	0.00
	Annual Mean	40	0.00	0.00	0.00	0.00	0.00	0.00
PM2.5	Annual Mean	10	0.00	0.00	0.00	0.00	0.00	0.00
Hydrogen Chloride	Hourly Mean	750	3.86	3.81	3.79	3.69	2.47	3.86
Hydrogen Fluoride	Hourly Mean	160	0.57	0.48	0.44	0.40	0.29	0.57
	Annual Mean	16	0.00	0.00	0.00	0.00	0.00	0.00
TOC (as Benzene)	Annual Mean	5	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Carbon Monoxide	8 Hour Mean	10000	2.40	1.48	1.21	2.38	2.08	2.40
Ammonia	Hourly Mean	2500	-0.33	-0.33	-0.46	-0.35	-0.48	-0.33
	Annual Mean	180	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
Cadmium and Thallium	Annual Mean	0.005	-0.00001	-0.00001	-0.00001	-0.00001	-0.00001	-0.00001
Mercury	Hourly Mean	0.6	0.001	0.001	0.001	0.001	0.001	0.00
	Daily Mean	0.06	0.0001	0.0001	0.0001	0.0002	0.0001	0.00
Other Metals	Annual Mean	0.02	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	0.00
Amine1	Hourly Mean	400	0.18	0.16	0.17	0.17	0.17	0.18
	Daily Mean	100	0.016	0.015	0.016	0.017	0.016	0.017
Amine2	Daily Mean	15	0.00006	0.00006	0.00006	0.00007	0.00006	0.00007
Direct Nitros1	Annual Mean	0.0002	0.0000015	0.0000018	0.0000018	0.0000018	0.0000016	0.0000018
Direct Nitros2	Annual Mean	0.0002	0.0000196	0.0000236	0.0000231	0.0000228	0.0000213	0.0000236
Aldehydes	30minute Mean	100	0.69	0.62	0.65	0.68	0.66	0.69
	Annual Mean	5	0.01	0.01	0.01	0.01	0.01	0.01
Amides	Annual Mean	70	0.00017	0.00020	0.00020	0.00020	0.00018	0.00020
DEG100	Annual Mean	860	0.0006	0.0007	0.0007	0.0007	0.0007	0.0007
DEG101	Annual Mean	47	0.00024	0.00029	0.00028	0.00028	0.00026	0.00029
DEG102	Annual Mean	50	0.0022	0.0026	0.0026	0.0025	0.0024	0.0026

Table E-17 – Maximum with Carbon Capture Scenario contribution to ground level concentrations within Erith residential area (µg/m^3).

Pollutant	Averaging Period	AQAL (ug/m3)	With Carbon Capture 2018	With Carbon Capture 2019	With Carbon Capture 2020	With Carbon Capture 2021	With Carbon Capture 2022	Max over 5 years
Nitrogen Dioxide	Hourly Mean	200	17.66	17.74	17.93	18.41	19.29	19.29
	Annual Mean	40	0.20	0.19	0.16	0.22	0.18	0.22
Sulphur Dioxide	15minute Mean	266	101.05	97.83	114.43	99.95	105.28	114.43
	Hourly Mean	350	66.28	56.02	63.99	68.30	68.79	68.79
	Daily Mean	125	4.58	5.12	5.26	6.35	4.70	6.35
PM10	Daily Mean	50	0.32	0.40	0.38	0.32	0.34	0.40
	Annual Mean	40	0.10	0.12	0.13	0.10	0.10	0.13
PM2.5	Annual Mean	10	0.10	0.12	0.13	0.10	0.10	0.13
Hydrogen Chloride	Hourly Mean	750	43.91	47.29	37.50	31.76	59.40	59.40
Hydrogen Fluoride	Hourly Mean	160	2.94	3.24	3.04	2.37	4.50	4.50
	Annual Mean	16	0.08	0.09	0.10	0.08	0.08	0.10
TOC (as Benzene)	Annual Mean	5	0.23	0.27	0.30	0.24	0.24	0.30
Carbon Monoxide	8 Hour Mean	10000	37.85	39.48	41.70	47.90	46.03	47.90
Ammonia	Hourly Mean	2500	6.16	6.62	5.22	4.48	8.25	8.25
	Annual Mean	180	0.17	0.20	0.21	0.17	0.17	0.21
Cadmium and Thallium	Annual Mean	0.005	0.00040	0.00046	0.00051	0.00040	0.00040	0.00051
Mercury	Hourly Mean	0.6	0.015	0.016	0.012	0.011	0.020	0.02
	Daily Mean	0.06	0.0036	0.0038	0.0038	0.0041	0.0040	0.00
Other Metals	Annual Mean	0.02	0.0059	0.0070	0.0076	0.0060	0.0060	0.01
Amine1	Hourly Mean	400	0.37	0.40	0.31	0.27	0.50	0.50
	Daily Mean	100	0.045	0.048	0.048	0.052	0.049	0.052
Amine2	Daily Mean	15	0.00018	0.00019	0.00019	0.00021	0.00020	0.00021
Direct Nitros1	Annual Mean	0.0002	0.0000033	0.0000039	0.0000043	0.0000034	0.0000034	0.0000043
Direct Nitros2	Annual Mean	0.0002	0.0000434	0.0000507	0.0000553	0.0000441	0.0000441	0.0000553
Aldehydes	30minute Mean	100	1.43	1.54	1.21	1.04	1.91	1.91
	Annual Mean	5	0.02	0.02	0.02	0.02	0.02	0.02
Amides	Annual Mean	70	0.00038	0.00044	0.00048	0.00038	0.00038	0.00048
DEG100	Annual Mean	860	0.0014	0.0016	0.0017	0.0014	0.0014	0.0017
DEG101	Annual Mean	47	0.00053	0.00062	0.00068	0.00054	0.00054	0.00068
DEG102	Annual Mean	50	0.0048	0.0057	0.0062	0.0049	0.0049	0.0062

Table E-18 – Maximum with Carbon Capture Process Contribution in Erith residential area (µg/m³).

Pollutant	Averaging Period	AQAL (ug/m3)	Max With Carbon Capture PC 2018	Max With Carbon Capture PC 2019	Max With Carbon Capture PC 2020	Max With Carbon Capture PC 2021	Max With Carbon Capture PC 2022	Max over 5 years
Nitrogen Dioxide	Hourly Mean	200	2.23	2.99	2.16	2.19	2.89	2.99
	Annual Mean	40	0.01	0.01	0.02	0.01	0.01	0.02
Sulphur Dioxide	15minute Mean	266	6.30	6.70	4.84	12.60	8.11	12.60
	Hourly Mean	350	2.87	4.25	2.94	2.74	3.43	4.25
	Daily Mean	125	0.04	0.08	0.18	0.08	0.17	0.18
PM10	Daily Mean	50	0.00	0.01	0.01	0.01	0.00	0.01
	Annual Mean	40	0.00	0.00	0.00	0.00	0.00	0.00
PM2.5	Annual Mean	10	0.00	0.00	0.00	0.00	0.00	0.00
Hydrogen Chloride	Hourly Mean	750	4.98	4.87	3.89	3.70	4.36	4.98
Hydrogen Fluoride	Hourly Mean	160	0.75	0.61	0.59	0.53	0.45	0.75
	Annual Mean	16	0.00	0.00	0.00	0.00	0.00	0.00
TOC (as Benzene)	Annual Mean	5	0.00	0.00	0.00	0.00	0.00	0.00
Carbon Monoxide	8 Hour Mean	10000	2.34	1.93	1.15	2.73	1.76	2.73
Ammonia	Hourly Mean	2500	-0.16	-0.11	-0.30	-0.25	-0.22	-0.11
	Annual Mean	180	0.00	0.00	0.00	0.00	0.00	0.00
Cadmium and Thallium	Annual Mean	0.005	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Mercury	Hourly Mean	0.6	0.002	0.002	0.001	0.001	0.001	0.00
	Daily Mean	0.06	0.0001	0.0000	0.0001	0.0000	0.0001	0.00
Other Metals	Annual Mean	0.02	0.0000	0.0000	0.0000	0.0000	0.0000	0.00
Amine1	Hourly Mean	400	0.20	0.18	0.16	0.15	0.17	0.20
	Daily Mean	100	0.010	0.010	0.014	0.010	0.011	0.014
Amine2	Daily Mean	15	0.00004	0.00004	0.00005	0.00004	0.00004	0.00005
Direct Nitros1	Annual Mean	0.0002	0.0000004	0.0000004	0.0000003	0.0000004	0.0000003	0.0000004
Direct Nitros2	Annual Mean	0.0002	0.0000051	0.0000047	0.0000037	0.0000054	0.0000045	0.0000054
Aldehydes	30minute Mean	100	0.78	0.71	0.63	0.58	0.67	0.78
	Annual Mean	5	0.00	0.00	0.00	0.00	0.00	0.00
Amides	Annual Mean	70	0.00004	0.00004	0.00003	0.00005	0.00004	0.00005
DEG100	Annual Mean	860	0.0002	0.0001	0.0001	0.0002	0.0001	0.0002
DEG101	Annual Mean	47	0.00006	0.00006	0.00005	0.00007	0.00006	0.00007
DEG102	Annual Mean	50	0.0006	0.0005	0.0004	0.0006	0.0005	0.0006

Table E-19 – Maximum with Carbon Capture Scenario contribution to ground level concentrations in Rainham residential area (µg/m^3).

Pollutant	Averaging Period	AQAL (ug/m3)	With Carbon Capture 2018	With Carbon Capture 2019	With Carbon Capture 2020	With Carbon Capture 2021	With Carbon Capture 2022	Max over 5 years
Nitrogen Dioxide	Hourly Mean	200	16.78	17.51	20.53	21.58	20.23	21.58
	Annual Mean	40	0.79	0.96	1.01	0.90	0.86	1.01
Sulphur Dioxide	15minute Mean	266	101.05	97.83	114.43	99.95	105.28	114.43
	Hourly Mean	350	66.28	56.02	63.99	68.30	68.79	68.79
	Daily Mean	125	4.58	5.12	5.26	6.35	4.70	6.35
PM10	Daily Mean	50	0.32	0.40	0.38	0.32	0.34	0.40
	Annual Mean	40	0.10	0.12	0.13	0.10	0.10	0.13
PM2.5	Annual Mean	10	0.10	0.12	0.13	0.10	0.10	0.13
Hydrogen Chloride	Hourly Mean	750	43.91	47.29	37.50	31.76	59.40	59.40
Hydrogen Fluoride	Hourly Mean	160	2.94	3.24	3.04	2.37	4.50	4.50
	Annual Mean	16	0.08	0.09	0.10	0.08	0.08	0.10
TOC (as Benzene)	Annual Mean	5	0.23	0.27	0.30	0.24	0.24	0.30
Carbon Monoxide	8 Hour Mean	10000	37.85	39.48	41.70	47.90	46.03	47.90
Ammonia	Hourly Mean	2500	6.16	6.62	5.22	4.48	8.25	8.25
	Annual Mean	180	0.17	0.20	0.21	0.17	0.17	0.21
Cadmium and Thallium	Annual Mean	0.005	0.00040	0.00046	0.00051	0.00040	0.00040	0.00051
Mercury	Hourly Mean	0.6	0.015	0.016	0.012	0.011	0.020	0.02
	Daily Mean	0.06	0.0036	0.0038	0.0038	0.0041	0.0040	0.00
Other Metals	Annual Mean	0.02	0.0059	0.0070	0.0076	0.0060	0.0060	0.01
Amine1	Hourly Mean	400	0.37	0.40	0.31	0.27	0.50	0.50
	Daily Mean	100	0.045	0.048	0.048	0.052	0.049	0.052
Amine2	Daily Mean	15	0.00018	0.00019	0.00019	0.00021	0.00020	0.00021
Direct Nitros1	Annual Mean	0.0002	0.0000033	0.0000039	0.0000043	0.0000034	0.0000034	0.0000043
Direct Nitros2	Annual Mean	0.0002	0.0000434	0.0000507	0.0000553	0.0000441	0.0000441	0.0000553
Aldehydes	30minute Mean	100	1.43	1.54	1.21	1.04	1.91	1.91
	Annual Mean	5	0.02	0.02	0.02	0.02	0.02	0.02
Amides	Annual Mean	70	0.00038	0.00044	0.00048	0.00038	0.00038	0.00048
DEG100	Annual Mean	860	0.0014	0.0016	0.0017	0.0014	0.0014	0.0017
DEG101	Annual Mean	47	0.00053	0.00062	0.00068	0.00054	0.00054	0.00068
DEG102	Annual Mean	50	0.0048	0.0057	0.0062	0.0049	0.0049	0.0062

Table E-20 – Maximum with Carbon Capture Process Contribution in Rainham residential area (µg/m³).

Nitrogen Dioxide	Hourly Mean	200	3.12	3.30	5.06	4.83	4.26	5.06
	Annual Mean	40	0.06	0.07	0.07	0.06	0.06	0.07
Sulphur Dioxide	15minute Mean	266	7.18	9.01	13.77	7.21	8.16	13.77
	Hourly Mean	350	2.70	2.98	5.04	5.68	5.11	5.68
	Daily Mean	125	0.22	0.22	0.21	0.17	0.19	0.22
PM10	Daily Mean	50	0.01	0.01	0.02	0.02	0.01	0.02
	Annual Mean	40	0.00	0.00	0.00	0.00	0.00	0.00
PM2.5	Annual Mean	10	0.00	0.00	0.00	0.00	0.00	0.00
Hydrogen Chloride	Hourly Mean	750	3.90	4.01	2.65	2.80	2.70	4.01
Hydrogen Fluoride	Hourly Mean	160	0.41	0.32	0.42	0.37	0.27	0.42
	Annual Mean	16	0.00	0.00	0.00	0.00	0.00	0.00
TOC (as Benzene)	Annual Mean	5	0.01	0.01	0.01	0.01	0.01	0.01
Carbon Monoxide	8 Hour Mean	10000	1.86	1.60	2.18	1.39	1.39	2.18
Ammonia	Hourly Mean	2500	-0.26	-0.21	-0.34	-0.45	-0.41	-0.21
	Annual Mean	180	-0.01	-0.01	-0.02	-0.01	-0.01	-0.01
Cadmium and Thallium	Annual Mean	0.005	0.00001	0.00002	0.00002	0.00001	0.00001	0.00002
Mercury	Hourly Mean	0.6	0.001	0.001	0.001	0.001	0.001	0.00
	Daily Mean	0.06	0.0001	0.0001	0.0001	0.0001	0.0001	0.00
Other Metals	Annual Mean	0.02	0.0002	0.0003	0.0002	0.0002	0.0002	0.00
Amine1	Hourly Mean	400	0.15	0.14	0.14	0.14	0.15	0.15
	Daily Mean	100	0.015	0.015	0.015	0.014	0.015	0.015
Amine2	Daily Mean	15	0.00006	0.00006	0.00006	0.00005	0.00006	0.00006
Direct Nitros1	Annual Mean	0.0002	0.0000015	0.0000018	0.0000019	0.0000017	0.0000016	0.0000019
Direct Nitros2	Annual Mean	0.0002	0.0000195	0.0000239	0.0000246	0.0000224	0.0000213	0.0000246
Aldehydes	30minute Mean	100	0.59	0.54	0.54	0.55	0.57	0.59
	Annual Mean	5	0.01	0.01	0.01	0.01	0.01	0.01
Amides	Annual Mean	70	0.00017	0.00021	0.00021	0.00019	0.00018	0.00021
DEG100	Annual Mean	860	0.0006	0.0007	0.0008	0.0007	0.0007	0.0008
DEG101	Annual Mean	47	0.00024	0.00029	0.00030	0.00028	0.00026	0.00030
DEG102	Annual Mean	50	0.0022	0.0027	0.0027	0.0025	0.0024	0.0027

Table E-21 – Modelled with Carbon Capture PC for nitrosamines and nitramines anywhere within the study area (ng/m^3)

Pollutant	Max 2018	Max 2019	Max 2020	Max 2021	Max 2022	Max over 5 years
Nitrosamine1	0.0160	0.0194	0.0156	0.0171	0.0135	0.0194
Nitrosamine2	0.000071	0.000086	0.000069	0.000076	0.000060	0.000086
Total Indirect Nitrosamines	0.0161	0.0195	0.0157	0.0172	0.0135	0.0195
Direct Nitrosamines	0.0462	0.0541	0.0589	0.0470	0.0470	0.0589
Total Nitrosamines	0.0623	0.0736	0.0733	0.0634	0.0603	0.0736
Nitramine1	0.0152	0.0174	0.0175	0.0159	0.0111	0.0175
Nitramine2	0.000070	0.000080	0.000081	0.000073	0.000051	0.000081
Total Nitramines	0.0153	0.0175	0.0176	0.0160	0.0112	0.0176
Total Nitrosamines + Nitramines	0.0738	0.0844	0.0826	0.0736	0.0691	0.0844

Table E-22 – Modelled with Carbon Capture PC for nitrosamines and nitramines in any residential area (ng/m^3)

Pollutant	Max 2018	Max 2019	Max 2020	Max 2021	Max 2022	Max over 5 years
Nitrosamine1	0.0119	0.0157	0.0114	0.0119	0.0100	0.0157
Nitrosamine2	0.000053	0.000070	0.000051	0.000053	0.000044	0.000070
Total Indirect Nitrosamines	0.0119	0.0158	0.0115	0.0120	0.0100	0.0158
Direct Nitrosamines	0.0209	0.0254	0.0257	0.0243	0.0227	0.0257
Total Nitrosamines	0.0290	0.0349	0.0326	0.0330	0.0296	0.0349
Nitramine1	0.0148	0.0172	0.0170	0.0155	0.0110	0.0172
Nitramine2	0.000068	0.000079	0.000078	0.000071	0.000051	0.000079
Total Nitramines	0.0148	0.0173	0.0171	0.0155	0.0111	0.0173
Total Nitrosamines + Nitramines	0.0433	0.0495	0.0424	0.0433	0.0386	0.0495

Table E-23 – Modelled with Carbon Capture PC for nitrosamines and nitramines in Barking Riverside residential area (ng/m^3)

Pollutant	Max 2018	Max 2019	Max 2020	Max 2021	Max 2022	Max over 5 years
Nitrosamine1	0.0030	0.0027	0.0018	0.0021	0.0025	0.0030
Nitrosamine2	0.000013	0.000012	0.000008	0.000009	0.000011	0.000013
Total Indirect Nitrosamines	0.0030	0.0027	0.0018	0.0021	0.0025	0.0030
Direct Nitrosamines	0.0039	0.0032	0.0028	0.0023	0.0040	0.0040
Total Nitrosamines	0.0068	0.0059	0.0045	0.0044	0.0065	0.0068
Nitramine1	0.0058	0.0040	0.0043	0.0049	0.0042	0.0058
Nitramine2	0.000027	0.000018	0.000020	0.000023	0.000019	0.000027
Total Nitramines	0.0058	0.0040	0.0043	0.0049	0.0042	0.0058
Total Nitrosamines + Nitramines	0.0123	0.0099	0.0086	0.0094	0.0105	0.0123

Table E-24 – Modelled with Carbon Capture PC for nitrosamines and nitramines in Thamesmead residential area (ng/m^3)

Pollutant	Max 2018	Max 2019	Max 2020	Max 2021	Max 2022	Max over 5 years
Nitrosamine1	0.0114	0.0151	0.0114	0.0118	0.0094	0.0151
Nitrosamine2	0.000050	0.000067	0.000051	0.000052	0.000042	0.000067
Total Indirect Nitrosamines	0.0114	0.0152	0.0115	0.0119	0.0094	0.0152
Direct Nitrosamines	0.0156	0.0164	0.0139	0.0136	0.0153	0.0164
Total Nitrosamines	0.0270	0.0316	0.0253	0.0254	0.0247	0.0316
Nitramine1	0.0147	0.0172	0.0170	0.0155	0.0108	0.0172
Nitramine2	0.000068	0.000079	0.000078	0.000071	0.000050	0.000079
Total Nitramines	0.0147	0.0173	0.0171	0.0155	0.0109	0.0173
Total Nitrosamines + Nitramines	0.0418	0.0486	0.0424	0.0410	0.0354	0.0486

Table E-25 – Modelled with Carbon Capture PC for nitrosamines and nitramines in Abbey Wood residential area (ng/m³)

Pollutant	Max 2018	Max 2019	Max 2020	Max 2021	Max 2022	Max over 5 years
Nitrosamine1	0.0119	0.0157	0.0113	0.0119	0.0100	0.0157
Nitrosamine2	0.000053	0.000070	0.000050	0.000053	0.000044	0.000070
Total Indirect Nitrosamines	0.0119	0.0158	0.0114	0.0120	0.0100	0.0158
Direct Nitrosamines	0.0178	0.0165	0.0156	0.0176	0.0156	0.0178
Total Nitrosamines	0.0285	0.0323	0.0253	0.0268	0.0257	0.0323
Nitramine1	0.0148	0.0172	0.0168	0.0151	0.0110	0.0172
Nitramine2	0.000068	0.000079	0.000078	0.000070	0.000051	0.000079
Total Nitramines	0.0148	0.0173	0.0169	0.0152	0.0111	0.0173
Total Nitrosamines + Nitramines	0.0433	0.0495	0.0422	0.0415	0.0368	0.0495

Table E-26 – Modelled with Carbon Capture PC for nitrosamines and nitramines in South Dagenham residential area (ng/m³)

Pollutant	Max 2018	Max 2019	Max 2020	Max 2021	Max 2022	Max over 5 years
Nitrosamine1	0.0036	0.0042	0.0030	0.0037	0.0046	0.0046
Nitrosamine2	0.000016	0.000019	0.000013	0.000017	0.000020	0.000020
Total Indirect Nitrosamines	0.0036	0.0043	0.0030	0.0038	0.0046	0.0046
Direct Nitrosamines	0.0077	0.0070	0.0079	0.0065	0.0086	0.0086
Total Nitrosamines	0.0113	0.0113	0.0109	0.0103	0.0132	0.0132
Nitramine1	0.0051	0.0051	0.0043	0.0044	0.0058	0.0058
Nitramine2	0.000023	0.000023	0.000020	0.000020	0.000027	0.000027
Total Nitramines	0.0051	0.0051	0.0043	0.0044	0.0059	0.0059
Total Nitrosamines + Nitramines	0.0164	0.0164	0.0152	0.0147	0.0191	0.0191

Table E-27 – Modelled with Carbon Capture PC for nitrosamines and nitramines in Lessness residential area (ng/m^3)

Pollutant	Max 2018	Max 2019	Max 2020	Max 2021	Max 2022	Max over 5 years
Nitrosamine1	0.0050	0.0044	0.0021	0.0040	0.0030	0.0050
Nitrosamine2	0.000022	0.000019	0.000009	0.000018	0.000013	0.000022
Total Indirect Nitrosamines	0.0050	0.0044	0.0021	0.0040	0.0030	0.0050
Direct Nitrosamines	0.0064	0.0053	0.0038	0.0062	0.0053	0.0064
Total Nitrosamines	0.0114	0.0097	0.0059	0.0102	0.0083	0.0114
Nitramine1	0.0055	0.0040	0.0026	0.0044	0.0029	0.0055
Nitramine2	0.000025	0.000018	0.000012	0.000020	0.000013	0.000025
Total Nitramines	0.0056	0.0040	0.0026	0.0044	0.0029	0.0056
Total Nitrosamines + Nitramines	0.0169	0.0136	0.0081	0.0146	0.0112	0.0169

Table E-28 – Modelled with Carbon Capture PC for nitrosamines and nitramines in South Hornchurch residential area (ng/m^3)

Pollutant	Max 2018	Max 2019	Max 2020	Max 2021	Max 2022	Max over 5 years
Nitrosamine1	0.0081	0.0094	0.0067	0.0087	0.0069	0.0094
Nitrosamine2	0.000036	0.000042	0.000030	0.000039	0.000030	0.000042
Total Indirect Nitrosamines	0.0081	0.0094	0.0067	0.0087	0.0069	0.0094
Direct Nitrosamines	0.0209	0.0251	0.0247	0.0243	0.0227	0.0251
Total Nitrosamines	0.0290	0.0345	0.0314	0.0330	0.0296	0.0345
Nitramine1	0.0107	0.0101	0.0086	0.0103	0.0088	0.0107
Nitramine2	0.000049	0.000046	0.000040	0.000047	0.000041	0.000049
Total Nitramines	0.0107	0.0101	0.0086	0.0104	0.0089	0.0107
Total Nitrosamines + Nitramines	0.0398	0.0446	0.0400	0.0433	0.0385	0.0446

Table E-29 – Modelled with Carbon Capture PC for nitrosamines and nitramines in Erith residential area (ng/m^3)

Pollutant	Max 2018	Max 2019	Max 2020	Max 2021	Max 2022	Max over 5 years
Nitrosamine1	0.0043	0.0042	0.0023	0.0039	0.0028	0.0043
Nitrosamine2	0.000019	0.000019	0.000010	0.000017	0.000012	0.000019
Total Indirect Nitrosamines	0.0044	0.0042	0.0023	0.0039	0.0028	0.0044
Direct Nitrosamines	0.0054	0.0050	0.0040	0.0057	0.0048	0.0057
Total Nitrosamines	0.0097	0.0092	0.0063	0.0095	0.0076	0.0097
Nitramine1	0.0052	0.0039	0.0031	0.0044	0.0034	0.0052
Nitramine2	0.000024	0.000018	0.000014	0.000020	0.000016	0.000024
Total Nitramines	0.0053	0.0040	0.0031	0.0044	0.0034	0.0053
Total Nitrosamines + Nitramines	0.0150	0.0131	0.0089	0.0139	0.0105	0.0150

Table E-30 – Modelled with Carbon Capture PC for nitrosamines and nitramines in Rainham residential area (ng/m^3)

Pollutant	Max 2018	Max 2019	Max 2020	Max 2021	Max 2022	Max over 5 years
Nitrosamine1	0.0081	0.0095	0.0070	0.0087	0.0068	0.0095
Nitrosamine2	0.000036	0.000042	0.000031	0.000039	0.000030	0.000042
Total Indirect Nitrosamines	0.0081	0.0095	0.0070	0.0088	0.0069	0.0095
Direct Nitrosamines	0.0208	0.0254	0.0257	0.0239	0.0227	0.0257
Total Nitrosamines	0.0290	0.0349	0.0326	0.0326	0.0296	0.0349
Nitramine1	0.0107	0.0102	0.0088	0.0105	0.0090	0.0107
Nitramine2	0.000049	0.000047	0.000040	0.000048	0.000041	0.000049
Total Nitramines	0.0108	0.0103	0.0088	0.0105	0.0090	0.0108
Total Nitrosamines + Nitramines	0.0397	0.0452	0.0414	0.0431	0.0386	0.0452

Table E-31 – Modelled with Carbon Capture PC for nitrosamines and nitramines in Belvedere residential area (ng/m^3)

Pollutant	Max 2018	Max 2019	Max 2020	Max 2021	Max 2022	Max over 5 years
Nitrosamine1	0.0063	0.0050	0.0026	0.0049	0.0034	0.0063
Nitrosamine2	0.000028	0.000022	0.000011	0.000022	0.000015	0.000028
Total Indirect Nitrosamines	0.0063	0.0050	0.0026	0.0049	0.0035	0.0063
Direct Nitrosamines	0.0093	0.0074	0.0050	0.0081	0.0072	0.0093
Total Nitrosamines	0.0156	0.0123	0.0075	0.0131	0.0106	0.0156
Nitramine1	0.0056	0.0039	0.0028	0.0044	0.0029	0.0056
Nitramine2	0.000026	0.000018	0.000013	0.000020	0.000013	0.000026
Total Nitramines	0.0056	0.0039	0.0028	0.0045	0.0029	0.0056
Total Nitrosamines + Nitramines	0.0205	0.0152	0.0093	0.0166	0.0127	0.0205

Table E-32 - Modelled concentrations and process contribution to Annual Mean Nitrogen Oxides (µg/m³)

Ecological Site	Designation	Baseline Scenario (µg/m³)					With Carbon Capture (µg/m³)				
		2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
Epping Forest	SSSI	0.07	0.06	0.05	0.05	0.07	0.07	0.05	0.05	0.05	0.07
Ingrebourne Marshes	SSSI	1.05	1.29	1.32	1.19	1.15	1.02	1.24	1.25	1.17	1.11
Inner Thames Marshes	SSSI	1.19	1.29	1.60	1.07	1.17	1.29	1.43	1.73	1.17	1.28
Oxleas Woodlands	SSSI	0.17	0.13	0.16	0.24	0.20	0.19	0.14	0.18	0.26	0.22
West Thurrock Lagoon and Marshes	SSSI	0.15	0.20	0.18	0.17	0.18	0.14	0.19	0.17	0.16	0.17
Lesnes Abbey Woods	LNR	0.24	0.13	0.19	0.31	0.25	0.30	0.18	0.24	0.39	0.32
Crossness	LNR	0.64	0.27	0.59	0.64	0.51	0.60	0.33	0.58	0.83	0.66
Rainham Marshes	LNR	1.16	1.25	1.54	1.04	1.15	1.28	1.38	1.69	1.14	1.25

Ecological Site	Designation	With Carbon Capture PC (µg/m³)				
		2018	2019	2020	2021	2022
Epping Forest	SSSI	0.00	0.00	0.00	0.00	0.00
Ingrebourne Marshes	SSSI	0.01	0.01	0.00	0.02	0.01
Inner Thames Marshes	SSSI	0.12	0.14	0.18	0.10	0.11
Oxleas Woodlands	SSSI	0.02	0.02	0.02	0.03	0.02
West Thurrock Lagoon and Marshes	SSSI	0.00	-0.01	0.00	0.00	0.00
Lesnes Abbey Woods	LNR	0.06	0.04	0.05	0.09	0.07
Crossness	LNR	0.09	0.06	0.08	0.19	0.16
Rainham Marshes	LNR	0.12	0.14	0.18	0.10	0.11

Table E-33 - Modelled concentrations and process contribution to Daily Mean Nitrogen Oxides (µg/m³)

Ecological Site	Designation	Baseline Scenario (µg/m³)					With Carbon Capture (µg/m³)				
		2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
Epping Forest	SSSI	1.37	0.78	0.98	0.93	1.34	1.22	0.75	1.00	1.00	1.25
Ingrebourne Marshes	SSSI	6.29	6.74	6.83	6.19	6.64	6.54	6.58	6.51	6.29	6.85
Inner Thames Marshes	SSSI	8.27	9.86	10.61	8.02	9.16	8.68	8.68	11.11	8.21	9.56
Oxleas Woodlands	SSSI	1.99	2.71	2.22	3.45	2.69	2.11	3.00	2.39	3.67	2.89
West Thurrock Lagoon and Marshes	SSSI	2.24	2.45	2.06	2.27	2.06	2.19	2.51	2.02	2.23	1.74
Lesnes Abbey Woods	LNR	5.57	3.29	3.76	5.58	3.49	6.89	4.26	5.41	6.94	4.37
Crossness	LNR	23.95	10.48	19.15	15.46	12.88	11.61	12.84	15.67	22.36	15.16
Rainham Marshes	LNR	8.02	9.39	10.49	8.02	8.86	8.68	8.68	11.11	8.21	9.56

Ecological Site	Designation	Maximum Impact (µg/m³)				
		2018	2019	2020	2021	2022
Epping Forest	0.034	0.03	0.07	0.06	0.11	0.02
Ingrebourne Marshes	0.396	0.40	0.14	0.33	0.54	0.42
Inner Thames Marshes	0.935	0.94	0.86	1.36	1.41	0.99
Oxleas Woodlands	0.124	0.12	0.30	0.24	0.22	0.27
West Thurrock Lagoon and Marshes	0.070	0.07	0.08	0.01	-0.01	-0.25
Lesnes Abbey Woods	1.725	1.73	1.14	1.67	1.59	1.19
Crossness	2.582	2.58	2.43	2.48	6.90	5.45
Rainham Marshes	0.828	0.83	0.86	1.36	1.41	0.97

Table E-34 - Modelled concentrations and process contribution to Annual Mean Sulphur Dioxide (µg/m³)

Ecological Site	Designation	Baseline Scenario (µg/m³)					With Carbon Capture (µg/m³)				
		2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
Epping Forest	SSSI	0.019	0.015	0.014	0.013	0.021	0.018	0.014	0.013	0.012	0.020
Ingrebourne Marshes	SSSI	0.296	0.367	0.374	0.342	0.324	0.280	0.347	0.346	0.330	0.307
Inner Thames Marshes	SSSI	0.317	0.346	0.427	0.292	0.314	0.349	0.389	0.470	0.322	0.345
Oxleas Woodlands	SSSI	0.048	0.033	0.044	0.065	0.055	0.053	0.036	0.049	0.072	0.061
West Thurrock Lagoon and Marshes	SSSI	0.042	0.056	0.050	0.048	0.050	0.039	0.051	0.046	0.044	0.047
Lesnes Abbey Woods	LNR	0.067	0.035	0.052	0.084	0.069	0.082	0.046	0.067	0.108	0.088
Crossness	LNR	0.157	0.071	0.143	0.166	0.132	0.175	0.088	0.164	0.237	0.187
Rainham Marshes	LNR	0.310	0.340	0.408	0.288	0.308	0.345	0.376	0.459	0.313	0.338

Ecological Site	Designation	With Carbon Capture PC (µg/m³)				
		2018	2019	2020	2021	2022
Epping Forest	0.000	0.000	0.000	0.000	0.000	0.000
Ingrebourne Marshes	0.000	0.000	0.002	-0.002	0.002	0.001
Inner Thames Marshes	0.034	0.034	0.045	0.055	0.030	0.031
Oxleas Woodlands	0.005	0.005	0.004	0.005	0.007	0.006
West Thurrock Lagoon and Marshes	-0.001	-0.001	-0.003	-0.002	-0.002	-0.002
Lesnes Abbey Woods	0.015	0.015	0.011	0.015	0.024	0.019
Crossness	0.028	0.028	0.019	0.034	0.072	0.055
Rainham Marshes	0.034	0.034	0.045	0.053	0.030	0.031

Table E-35 - Modelled concentrations and process contribution to Annual Mean Ammonia (µg/m³)

Crossness	Designation	Baseline Scenario (µg/m³)					With Carbon Capture (µg/m³)				
		2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
Ingrebourne Marshes	SSSI	0.106	0.130	0.133	0.120	0.115	0.068	0.083	0.083	0.079	0.074
Inner Thames Marshes	SSSI	0.114	0.124	0.153	0.104	0.113	0.083	0.091	0.111	0.075	0.082
Oxleas Woodlands	SSSI	0.017	0.013	0.016	0.023	0.020	0.013	0.009	0.012	0.017	0.015
West Thurrock Lagoon and Marshes	SSSI	0.015	0.020	0.018	0.017	0.018	0.009	0.012	0.011	0.010	0.011
Lesnes Abbey Woods	LNR	0.024	0.013	0.019	0.030	0.025	0.020	0.012	0.016	0.026	0.021
Crossness	LNR	0.057	0.026	0.053	0.060	0.048	0.042	0.023	0.039	0.059	0.046
Rainham Marshes	LNR	0.112	0.121	0.146	0.102	0.111	0.082	0.088	0.108	0.073	0.080

Ecological Site	Designation	With Carbon Capture PC (µg/m³)				
		2018	2019	2020	2021	2022
Ingrebourne Marshes	-0.019	-0.019	-0.023	-0.024	-0.021	-0.020
Inner Thames Marshes	-0.010	-0.010	-0.010	-0.009	-0.010	-0.012
Oxleas Woodlands	-0.003	-0.003	-0.002	-0.002	-0.003	-0.003
West Thurrock Lagoon and Marshes	-0.004	-0.004	-0.006	-0.006	-0.005	-0.006
Lesnes Abbey Woods	-0.004	-0.004	-0.001	-0.002	-0.003	-0.003
Crossness	-0.008	-0.008	-0.003	-0.006	-0.001	-0.002
Rainham Marshes	-0.015	-0.015	-0.014	-0.014	-0.015	-0.016

Table E-36 - Modelled deposition and process contribution to Nitrogen Deposition (kgN/ha/yr)

Ecological Site	Designation	Baseline Scenario (kgN/ha/yr)					With Carbon Capture Scenario (kgN/ha/yr)				
		2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
Epping Forest (Moorland)	SSSI	0.042	0.034	0.031	0.030	0.046	0.029	0.023	0.021	0.020	0.031
Epping Forest (Forest)	SSSI	0.066	0.054	0.048	0.048	0.073	0.046	0.037	0.034	0.033	0.050
Ingrebourne Marshes	SSSI	0.654	0.803	0.821	0.743	0.714	0.456	0.559	0.558	0.528	0.498
Oxleas Woodlands	SSSI	0.168	0.123	0.153	0.229	0.193	0.137	0.103	0.126	0.188	0.160
Inner Thames Marshes	SSSI	0.713	0.772	0.958	0.646	0.707	0.562	0.620	0.752	0.511	0.555
West Thurrock	SSSI	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crossness	LNR	0.362	0.160	0.333	0.377	0.301	0.281	0.150	0.264	0.390	0.307
Lesnes Abbey Woods	LNR	0.235	0.131	0.183	0.296	0.242	0.213	0.129	0.175	0.283	0.230
Rainham Marshes	LNR	0.699	0.755	0.915	0.634	0.692	0.554	0.599	0.734	0.496	0.544

Ecological Site	Designation	With Carbon Capture PC (kgN/ha/yr)				
		2018	2019	2020	2021	2022
Epping Forest (Moorland)	-0.006	-0.006	-0.005	-0.004	-0.005	-0.007
Epping Forest (Forest)	-0.009	-0.009	-0.007	-0.006	-0.007	-0.011
Ingrebourne Marshes	-0.096	-0.096	-0.116	-0.126	-0.107	-0.103
Oxleas Woodlands	-0.022	-0.022	-0.012	-0.015	-0.023	-0.021
Inner Thames Marshes	-0.052	-0.052	-0.050	-0.044	-0.054	-0.060
West Thurrock	0.000	0.000	0.000	0.000	0.000	0.000
Crossness	-0.032	-0.032	-0.010	-0.023	0.013	0.008
Lesnes Abbey Woods	-0.021	-0.021	-0.002	-0.006	-0.007	-0.007
Rainham Marshes	-0.067	-0.067	-0.062	-0.064	-0.068	-0.072

Table E-37 - Modelled deposition and process contribution to Acid Deposition (keq/ha/yr)

Ecological Site	Designation	Baseline Scenario (keq/ha/yr)					With Carbon Capture Scenario (keq/ha/yr)				
		2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
Epping Forest (Moorland)	SSSI	0.012	0.010	0.009	0.009	0.014	0.011	0.008	0.008	0.008	0.012
Epping Forest (Forest)	SSSI	0.026	0.022	0.020	0.019	0.029	0.023	0.018	0.017	0.016	0.025
Oxleas Woodlands	SSSI	0.066	0.048	0.060	0.090	0.077	0.069	0.051	0.064	0.095	0.081

Ecological Site	Designation	With Carbon Capture PC (keq/ha/yr)				
		2018	2019	2020	2021	2022
Epping Forest	-0.001	-0.001	0.000	0.000	0.000	-0.001
Epping Forest	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
Oxleas Woodlands	0.003	0.003	0.004	0.004	0.005	0.005

Appendix F

ASSESSMENT AGAINST CURRENT BASELINE

Table F-1 - Modelled maximum Baseline, with Carbon Capture, and PCs for annual mean NOx concentrations (µg/m^3).

Site	Desig-nation	Critical Level	Baseline (max)	With Carbon Capture (max)	Max Beneficial PC	Max Adverse PC	Adverse PC as % of CL	PEC at Max Adverse Impact
Epping Forest	SSSI	30	0.047	0.071		0.024	0.1%	34.40
Ingrebourne Marshes	SSSI	30	0.860	1.248		0.408	1.4%	26.93
Inner Thames Marshes	SSSI	30	1.209	1.730		0.525	1.7%	32.08
Oxleas Woodlands	SSSI	30	0.161	0.262		0.101	0.3%	28.06
West Thurrock Lagoon and Marshes	SSSI	30	0.126	0.186		0.064	0.2%	48.57
Lesnes Abbey Woods	LNR	30	0.212	0.392		0.180	0.6%	26.42
Crossness	LNR	30	0.572	0.831	-0.503	0.314	1.0%	27.37
Rainham Marshes	LNR	30	1.167	1.691		0.525	1.7%	32.08

Table F-2 - Modelled maximum Baseline, with Carbon Capture, and PCs for daily mean NOx concentrations (µg/m^3).

Site	Desig-nation	Critical Level	Baseline (max)	With Carbon Capture (max)	Max Beneficial PC	Max Adverse PC	Adverse PC as % of CL	PEC at Max Adverse Impact
Epping Forest	SSSI	200	0.861	1.248		0.462	0.2%	69.22
Ingrebourne Marshes	SSSI	200	4.783	6.849		2.598	1.3%	55.64
Inner Thames Marshes	SSSI	200	8.295	11.106		3.365	1.7%	66.48
Oxleas Woodlands	SSSI	200	2.407	3.666		1.258	0.6%	57.18
West Thurrock Lagoon and Marshes	SSSI	200	1.631	2.507		0.876	0.4%	97.90
Lesnes Abbey Woods	LNR	200	4.031	6.942		3.465	1.7%	55.94
Crossness	LNR	200	23.951	22.359	-21.282	7.997	4.0%	62.12
Rainham Marshes	LNR	200	8.295	11.106		3.365	1.7%	66.48

Table F-3 - Modelled maximum Baseline, with Carbon Capture, and PCs for annual mean NH_3 concentrations (μg/m^3).

Site	Desig-nation	Critical Level	Baseline (max)	With Carbon Capture (max)	Max Beneficial Impact	Max Adverse Impact	Adverse Impact as % of CL	PEC at Max Adverse Impact
Epping Forest	SSSI	1	0.004	0.005		0.001	0.1%	1.19
Ingrebourne Marshes	SSSI	1	0.072	0.083		0.015	1.5%	1.09
Inner Thames Marshes	SSSI	3	0.101	0.111		0.012	0.4%	1.06
Oxleas Woodlands	SSSI	1	0.013	0.017		0.004	0.4%	1.08
West Thurrock Lagoon and Marshes	SSSI	1	0.010	0.012		0.002	0.2%	1.08
Lesnes Abbey Woods	LNR	1	0.018	0.026		0.008	0.8%	1.09
Crossness	LNR	1	0.048	0.059	-0.043	0.016	1.6%	0.95
Rainham Marshes	LNR	1	0.097	0.108		0.012	1.2%	0.92

Table F-4 - Modelled maximum Baseline, with Carbon Capture, and PCs for annual mean SO_2 concentrations (μg/m^3).

Site	Desig-nation	Critical Level	Baseline (max)	With Carbon Capture (max)	Max Beneficial Impact	Max Adverse Impact	Adverse Impact as % of CL	PEC at Max Adverse Impact
Epping Forest	SSSI	10	0.011	0.020		0.009	0.1%	2.29
Ingrebourne Marshes	SSSI	10	0.191	0.347		0.161	1.6%	2.68
Inner Thames Marshes	SSSI	10	0.268	0.470		0.201	2.0%	4.55
Oxleas Woodlands	SSSI	10	0.035	0.072		0.036	0.4%	2.01
West Thurrock Lagoon and Marshes	SSSI	10	0.028	0.051		0.024	0.2%	3.64
Lesnes Abbey Woods	LNR	10	0.047	0.108		0.061	0.6%	2.21
Crossness	LNR	10	0.127	0.237	-0.108	0.123	1.2%	2.28
Rainham Marshes	LNR	10	0.259	0.459		0.199	2.0%	4.01

Table F-5 - Modelled maximum Baseline, with Carbon Capture, and PCs for annual mean Nitrogen Deposition rates (kg N/ha/yr).

Site	Desig-nation	Depos-ition Type	Critical Load	Baseline (max)	With Carbon Capture (max)	Max Beneficial PC	Max Adverse PC	Adverse PC as % of CL	PEC at Max Adverse Impact
Epping Forest	SSSI	Moorland	5.000	0.025	0.031		0.006	0.1%	14.60
Epping Forest	SSSI	Forest	10.000	0.040	0.050		0.010	0.1%	26.64
Ingrebourne Marshes	SSSI	Moorland	15.000	0.459	0.559		0.121	0.8%	12.39
Oxleas Woodlands	SSSI	Forest	15.000	0.137	0.188		0.051	0.3%	24.24
Inner Thames Marshes	SSSI	Moorland	10.000	0.645	0.752		0.115	1.1%	12.35
West Thurrock	SSSI	Moorland	10.000	0.000	0.000		0.000	0.0%	12.22
Crossness	LNR	Moorland	10.000	0.305	0.390	-0.275	0.114	1.1%	12.51
Lesnes Abbey Woods	LNR	Forest	10.000	0.181	0.283		0.102	1.0%	24.02
Rainham Marshes	LNR	Moorland	10.000	0.623	0.734		0.113	1.1%	12.35

Table F-6 - Modelled maximum Baseline, with Carbon Capture, and PCs for annual mean Acid Deposition rates (keq/ha/yr).

Site	Desig-nation	Depos-ition Type	Critical Load	Baseline (max)	With Carbon Capture (max)	Max Beneficial Impact	Max Adverse Impact	Adverse Impact as % of CL	PEC at Max Adverse Impact
Epping Forest	SSSI	Moorland	1.584	0.006	0.012		0.005	0.3%	1.13
Epping Forest	SSSI	Forest	1.730	0.013	0.025		0.012	0.7%	2.04
Oxleas Woodlands	SSSI	Forest	2.720	0.046	0.095		0.049	1.8%	1.91

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