Redmore environmental

Air Quality Assessment

Bridge Farm Biomass Boiler

Client: Abel Energy Ltd

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Executive Summary

Redmore Environmental Ltd was commissioned by Abel Energy Ltd to undertake an Air Quality Assessment in support of a proposed biomass boiler at Bridge Farm, Huntingdon, Cambridgeshire.

The plant has the potential to cause air quality impacts as a result of atmospheric emissions during normal operation. As such, an Air Quality Assessment was undertaken in order to determine baseline conditions and assess potential changes in pollution levels as a result of the installation.

Dispersion modelling was undertaken in order to predict pollutant concentrations at sensitive locations as a result of emissions from the boiler. The results of the assessment indicated that the operation of the installation will not result in exceedences of the relevant air quality standards at any human receptor within the vicinity of the site. As such, impacts are not considered to be significant.

Impacts were also predicted at relevant ecological sites. The results indicated that emissions from the installation would not significantly affect existing conditions at any designation.

Impacts were predicted based on a worst-case assessment scenario of the facility constantly emitting the maximum permitted concentration of each pollutant throughout an entire year. As such, predicted concentrations and deposition rates are likely to overestimate actual impacts.

Table of Contents

1.0 INTRODUCTION

1.1 Background

1.1.1 Redmore Environmental Ltd was commissioned by Abel Energy Ltd to undertake an Air Quality Assessment in support of a proposed biomass boiler at Bridge Farm, Huntingdon, Cambridgeshire.

1.1.2 The plant has the potential to cause air quality impacts as a result of atmospheric emissions during normal operation. As such, an Air Quality Assessment was required in order to determine baseline conditions and assess potential changes in pollution levels as a result of the installation.

1.2 Site Location and Context

1.2.1 Bridge Farm is located off Holme Fen Drove, Huntingdon, at National Grid Reference (NGR): 539000, 276905. Reference should be made to Figure 1 for a map of the site and surrounding area.

1.2.2 It is proposed to install and operate a grade C timber fuelled biomass plant. The heat produced by the installation will be used to dry vegetables, as well as providing heating for offices at Bridge Farm. The installation and associated fuel storage will be housed within a building on the central section of the site. Reference should be made to Figure 2 for a site layout plan.

1.2.3 The operation of the plant may result in atmospheric emissions from the combustion of wood. These have the potential to cause air quality impacts at sensitive locations within the vicinity of the site and have therefore been quantified within this report.

2.0 LEGISLATION AND POLICY

2.1 European Directives

2.1.1 European Union (EU) air quality legislation is provided within Directive 2008/50/EC, which came into force on 11th June 2008. This Directive consolidated previous legislation which was designed to deal with specific pollutants in a consistent manner and provided new Air Quality Limit Values (AQLVs) for particulate matter with an aerodynamic diameter of less than 2.5μm. The consolidated Directives include:

- Directive 1999/30/EC - the First Air Quality "Daughter" Directive - sets ambient AQLVs for nitrogen dioxide (NO_2), oxides of nitrogen (NO_x), sulphur dioxide (SO_2), lead and particulate matter with an aerodynamic diameter of less than 10μm (PM_{10});
- Directive 2000/69/EC - the Second Air Quality "Daughter" Directive - sets ambient AQLVs for benzene and carbon monoxide (CO); and,
- Directive 2002/3/EC - the Third Air Quality "Daughter" Directive - seeks to establish long-term objectives, target values, an alert threshold and an information threshold for concentrations of ozone in ambient air.

2.1.2 The fourth daughter Directive was not included within the consolidation and is described as:

- Directive 2004/107/EC - sets health-based limits on polycyclic aromatic hydrocarbons, cadmium, arsenic, nickel and mercury, for which there is a requirement to reduce exposure to as low as reasonably achievable.

2.2 UK Legislation

2.2.1 The Air Quality Standards Regulations (2010) came into force on 11th June 2010 and transpose EU Directive 2008/50/EC into UK law. AQLVs were published in these regulations for 7 pollutants, as well as Target Values for an additional 5 pollutants.

2.2.2 Part IV of the Environment Act (1995) requires UK government to produce a national Air Quality Strategy (AQS) which contains standards, objectives and measures for improving ambient air quality. The most recent AQS was produced by DEFRA and published in July

2007[1]. The AQS sets out Air Quality Objectives (AQOs) that are maximum ambient pollutant concentrations that are not to be exceeded either without exception or with a permitted number of exceedences over a specified timescale. These are generally in line with the AQLVs, although the requirements for the determination of compliance vary.

2.2.3 Table 1 presents the AQOs for pollutants considered within this assessment.

Table 1 Air Quality Objectives

Pollutant	Air Quality Objective	
	Concentration (μg/m³)	Averaging Period
NO_2	40	Annual mean
	200	1-hour mean, not to be exceeded on more than 18 occasions per annum
SO_2	125	24-hour mean; not to be exceeded more than 3 times per annum
	350	1-hour mean; not to be exceeded more than 24 times per annum
	266	15-minute mean; not to be exceeded more than 35 times per annum
PM_{10}	40	Annual mean
	50	24-hour mean, not to be exceeded on more than 35 occasions per annum
CO	10,000	8-hour running mean

2.2.4 Table 2 presents the critical levels for the protection of vegetation for pollutants considered within this assessment.

Table 2 Critical Levels for the Protection of Vegetation

Pollutant	Critical Level	
	Concentration (μg/m³)	Averaging Period
NO_x	30	Annual mean
	75	24-hour mean

1 The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, DEFRA, 2007.

Pollutant	Critical Level	
	Concentration (µg/m³)	Averaging Period
SO_2	20	Annual mean

2.2.5 Table 3 summarises the advice provided in DEFRA guidance[2] on where the AQOs for pollutants considered within this report apply.

Table 3 Examples of Where the Air Quality Objectives Apply

Averaging Period	Objective Should Apply At	Objective Should Not Apply At
Annual mean	All locations where members of the public might be regularly exposed Building façades of residential properties, schools, hospitals, care homes etc.	Building façades of offices or other places of work where members of the public do not have regular access Hotels, unless people live there as their permanent residence Gardens of residential properties Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term
24-hour mean and 8-hour mean	All locations where the annual mean objective would apply, together with hotels. Gardens of residential properties.	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
1-hour mean	All locations where the annual mean and 24 and 8-hour mean objectives apply. Kerbside sites (for example, pavements of busy shopping streets) Those parts of car parks, bus stations and railway stations etc which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more Any outdoor locations where members of the public might reasonably be expected to spend one hour or longer	Kerbside sites where the public would not be expected to have regular access
15-minute mean	All locations where members of the public might reasonably be exposed for a period of 15 minutes	

2 Local Air Quality Management (TG16), DEFRA, 2016.

2.3 Local Air Quality Management

2.3.1 Under Section 82 of the Environment Act (1995) (Part IV) Local Authorities are required to periodically review and assess air quality within their area of jurisdiction under the system of Local Air Quality Management (LAQM). This review and assessment of air quality involves comparing present and likely future pollutant concentrations against the AQOs. If it is predicted that levels at locations of relevant exposure are likely to be exceeded, the Local Authority is required to declare an Air Quality Management Area (AQMA). For each AQMA the LA is required to produce an Air Quality Action Plan, the objective of which is to reduce pollutant concentrations in pursuit of the AQOs.

2.4 Industrial Pollution Control Legislation

2.4.1 Atmospheric emissions from industry are controlled in the UK through the Environmental Permitting (England and Wales) Regulations (2016). It is understood that the proposed plant will be regulated by the Local Authority as a Part B Installation, in line with the requirements of Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control), referred to as the Industrial Emissions Directive (IED). Amongst conditions of operation will be stated Emission Limit Values (ELVs) for various pollutants produced by the process. Compliance with these conditions must be demonstrated through periodic monitoring requirements, which have been set in order to limit potential impacts in the surrounding area.

2.5 National Planning Policy

2.5.1 The National Planning Policy Framework[3] (NPPF) was published on 27th March 2012 and sets out the Government's core policies and principles with respect to land use planning, including air quality. The document includes the following considerations which are relevant to the proposed development:

> "The planning system should contribute to and enhance the natural and local environment by: [...]

[3] National Planning Policy Framework, Department for Communities and Local Government, 2012.

Preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability"

"Planning policies should sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative impacts on air quality from individual sites in local areas. Planning decisions should ensure that any new development in Air Quality Management Areas is consistent with the local air quality action plan."

2.5.2 The implications of the NPPF have been considered throughout this assessment.

2.6 National Planning Practice Guidance

2.6.1 The National Planning Practice Guidance[4] (NPPG) web-based resource was launched by the Department for Communities and Local Government on 6th March 2014 to support the NPPF and make it more accessible. The air quality pages are summarised under the following headings:

1. Why should planning be concerned about air quality?
2. What is the role of Local Plans with regard to air quality?
3. Are air quality concerns relevant to neighbourhood planning?
4. What information is available about air quality?
5. When could air quality be relevant to a planning decision?
6. Where to start if bringing forward a proposal where air quality could be a concern?
7. How detailed does an air quality assessment need to be?
8. How can an impact on air quality be mitigated?
9. How do considerations about air quality fit into the development management process?

2.6.2 These were reviewed and the relevant guidance considered as necessary throughout the undertaking of this assessment.

[4] http://planningguidance.planningportal.gov.uk.

2.7 Local Planning Policy

2.7.1 The Local Plan is a series of documents that allow Huntingdonshire District Council (HDC) to manage development in the area and set out factors to take into account when deciding planning applications. HDC are currently in the process of developing a new Local Plan, which will replace the existing strategy and help to guide development within the area through to 2036 and beyond.

2.7.2 The existing HDC Core Strategy[5] sets out the strategic spatial planning framework for Huntingdonshire through to 2026 and a range of objectives and policies that form the basis of planning application decisions within the district. A review of the Core Strategy was undertaken in order to identify any planning policies relevant to the assessment. This indicated the following:

> "Policy CS 1: Sustainable Development in Huntingdonshire
>
> All plans, policies and programmes of the Council and its partners, with a spatial element, and all development proposals in Huntingdonshire will contribute to the pursuit of sustainable development.
>
> Reflecting environmental, social and economic issues the following criteria will be used to assess how a development proposal will be expected to achieve the pursuit of sustainable development, including how the proposal would contribute to minimising the impact on and adaptability to climate change. All aspects of the proposal will be considered including the design, implementation and function of development. The criteria are:
>
> […]
>
> Minimising and reducing greenhouse gas emissions, oxides of nitrogen, fine particles and other forms of pollution;
>
> […]"

5 Local Development Framework, Core Strategy, HDC, 2009.

2.7.3 The implications of this policy were taken into consideration throughout the undertaking of the assessment.

2.8 Critical Loads and Levels

2.8.1 A critical load is defined by the UK Air Pollution Information System (APIS)[6] as:

> "A quantitative estimate of exposure to deposition of one or more pollutants, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge. The exceedance of a critical load is defined as the atmospheric deposition of the pollutant above the critical load."

2.8.2 A critical level is defined as:

> "Threshold for direct effects of pollutant concentrations according to current knowledge. Exceedance of a critical level is defined as the atmospheric concentration of the pollutant above the critical level."

2.8.3 A critical load refers to deposition of a pollutant, while a critical level refers to pollutant concentrations in the atmosphere (which usually have direct effects on vegetation or human health).

2.8.4 When pollutant loads (or concentrations) exceed the critical load or level it is considered that there is a risk of harmful effects. The excess over the critical load or level is termed the exceedence. A larger exceedence is often considered to represent a greater risk of damage.

2.8.5 Maps of critical loads and levels and their exceedences have been used to show the potential extent of pollution damage and aid in developing strategies for reducing pollution. Decreasing deposition below the critical load is seen as means for preventing the risk of damage. However, even a decrease in the exceedence may infer that less damage will occur.

[6] UK Air Pollution Information System, www.apis.ac.uk.

2.8.6 Critical loads have been designated within the UK based on the sensitivity of the receiving habitat and have been reviewed for the purpose of this assessment.

3.0 BASELINE

3.1 Introduction

3.1.1 Existing air quality conditions in the vicinity of the site were identified in order to provide a baseline for assessment. These are detailed in the following Sections.

3.2 Local Air Quality Management

3.2.1 As required by the Environment Act (1995), HDC has undertaken review and assessment of air quality within their area of jurisdiction. This process has indicated that annual mean concentrations of NO_2 are above the relevant AQO within the district. As such, four AQMAs have been declared. These are described as follows:

- Brampton AQMA - An area encompassing properties at Wood View, Nursery Cottages, Thrapston Road, Bliss Close and Flamsteed Drive close to the A14 in Brampton and Hinchingbrooke;
- Hemingford to Fenstanton (A14) AQMA - An area encompassing a number of properties either side of the A14 between Hemingford and Fenstanton;
- Huntingdon AQMA - An area encompassing the southern part of the town centre, bounded largely by the A141 to the west, A14 to the south and the river to the east; and,
- St Neots AQMA - An area encompassing the junction of the High Street, St Neots, with New Street and South Street.

3.2.2 The closest designation to the development, the Hemingford to Fenstanton (A14) AQMA, is located approximately 11.2km south-west of the site. It is considered unlikely the proposals would cause air quality impacts over a distance of this magnitude. As such, the AQMAs have not been considered further in the context of the assessment.

3.2.3 HDC has concluded that concentrations of all other pollutants considered within the AQS are currently below the relevant AQOs. As such, no further AQMAs have been designated.

3.3 Air Quality Monitoring

3.3.1 Monitoring of pollutant concentrations is undertaken by HDC using continuous and periodic methods throughout their area of jurisdiction. However, the closest monitor to the development is situated approximately 9.1km south-west of the site within the town of St Ives. Due to the distance between the monitoring location and the development, it is not considered likely that similar pollution levels would occur at the two positions. As such, this source of data has not been considered further in the context of the assessment.

3.4 Background Pollutant Concentrations

3.4.1 Predictions of background pollutant concentrations on a 1km by 1km grid basis have been produced by DEFRA for the entire of the UK to assist Local Authorities in their Review and Assessment of air quality. The site is located in grid square NGR: 538500, 276500. Data for this location was downloaded from the DEFRA website[7] for the purpose of the assessment and is summarised in Table 4.

Table 4 Background Pollutant Concentration Predictions

Pollutant	Predicted Background Pollutant Concentration (μg/m^3)
NO_2	9.19
SO_2	2.58
PM_{10}	15.86
CO	248

3.4.2 It should be noted that concentrations of NO_2 and PM_{10} are predicted for 2017 and SO_2 and CO for 2001. These were the most recent predictions available from DEFRA at the time of assessment and are therefore considered to provide a reasonable representation of background concentrations in the vicinity of the site.

[7] https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html.

4.0 METHODOLOGY

4.1 Introduction

4.1.1 Emissions associated with the combustion of wood within the biomass plant have the potential to cause increases in pollutant concentrations in the vicinity of the site. These have been quantified through dispersion modelling in accordance with the methodology outlined in the following Sections.

4.1.2 The plant will have a rated installation capacity of 3MW and it is estimated that the boiler will be operational for approximately 8,000-hours per annum. To provide a worst-case assessment of potential impact at nearby receptor locations, an extended schedule has been considered as part of the modelling. This assumes continuous operation of the plant for 24-hours per day, Monday to Sunday inclusive.

4.2 Dispersion Model

4.2.1 Dispersion modelling was undertaken using ADMS-5.2 (v5.2.1.0), which is developed by Cambridge Environmental Research Consultants (CERC) Ltd. ADMS-5 is a short-range dispersion modelling software package that simulates a wide range of buoyant and passive releases to atmosphere. It is a new generation model utilising boundary layer height and Monin-Obukhov length to describe the atmospheric boundary layer and a skewed Gaussian concentration distribution to calculate dispersion under convective conditions.

4.2.2 The model utilises hourly meteorological data to define conditions for plume rise, transport and diffusion. It estimates the concentration for each source and receptor combination for each hour of input meteorology, and calculates user-selected long-term and short-term averages.

4.3 Modelling Scenarios

4.3.1 The scenarios considered in the modelling assessment are summarised in Table 5.

Table 5 Assessment Scenarios

Parameter	Modelled As	
	Short Term	Long Term
NO_2	99.8th percentile (%ile) 1-hour mean	Annual mean
NO_x	24-hour mean	Annual mean
SO_2	99.9th %ile 15-minute mean	Annual mean
	99.7th %ile 1-hour mean	
	99.2nd %ile 24-hour mean	
PM_{10}	90.4th %ile 24-hour mean	Annual mean
CO	8-hour rolling mean	-
Nitrogen deposition	-	Annual deposition
Acid deposition	-	Annual deposition

4.3.2 Some short-term air quality criteria are framed in terms of the number of occasions in a calendar year on which the concentration should not be exceeded. As such, the %iles shown in Table 5 were selected to represent the relationship between the permitted number of exceedences of short-period concentrations and the number of periods within a calendar year.

4.3.3 Predicted pollutant concentrations were summarised in the following formats:

- Process contribution (PC) - Predicted pollutant level as a result of emissions from the facility only; and,
- Predicted environmental concentration (PEC) - Total predicted pollutant level as a result of emissions from the facility and the existing baseline.

4.3.4 Predicted ground level pollutant concentrations and deposition rates were compared with the relevant AQOs, Critical Levels and Critical Loads. These criteria are collectively referred to as Environmental Quality Standards (EQSs).

4.4 Assessment Area

4.4.1 The assessment area was defined based on the facility location, anticipated pollutant dispersion patterns and the positioning of sensitive receptors. Ambient concentrations were predicted over NGR: 537960, 275810 to 540360, 278210. One Cartesian grid with a resolution of 20m was used within the model to produce data suitable for contour plotting using the Surfer software package.

4.4.2 Reference should be made to Figure 3 for a graphical representation of the assessment grid extents.

4.5 Sensitive Receptors

4.5.1 A sensitive receptor is defined as any location which may be affected by changes in air quality. These have been defined for human and ecological receptors in the following Sections.

Sensitive Human Receptors

4.5.2 A desk-top study was undertaken in order to identify any sensitive human receptor locations in the vicinity of the site that required specific consideration during the assessment. These are summarised in Table 6.

Table 6 Sensitive Human Receptor Locations

Receptor		NGR (m)	
		X	Y
R1	Bridge Farm	538946.0	276892.4
R2	Residential - Ash Drove	538989.4	276689.4
R3	Commercial - Earith Lakes Fisheries	538728.9	276523.8
R4	Commercial - Fenland Fisheries	539266.2	275979.8
R5	Residential - Medlands Farm	539836.6	278060.9
R6	Residential - Holme Fenland Drove	538231.6	276332.1

4.5.3 Reference should be made to Figure 4 for a graphical representation of the sensitive receptor locations.

Ecological Receptors

4.5.4 Atmospheric emissions from the facility also have the potential to impact on receptors of ecological sensitivity within the vicinity of the site. The Conservation of Habitats and Species Regulations (2010) and subsequent amendments require competent authorities to review applications and consents that have the potential to impact on ecological designations. A study was therefore undertaken to identify the following sites of ecological or nature conservation importance:

- Special Areas of Conservation (SACs), Special Protection Areas (SPAs) or Ramsar sites within 10km of the facility; and,
- Sites of Special Scientific Interest (SSSI), National Nature Reserves, Local Nature Reserves (LNRs) and ancient woodland within 2km of the facility.

4.5.5 The study was completed using the Multi-Agency Geographic Information for the Countryside (MAGIC) web-based interactive mapping service[8] which draws together information on key environmental schemes and designations. This indicated the following ecological designations:

- Ouse Washes Ramsar site;
- Ouse Washes SSSI;
- Ouse Washes SAC; and,
- Ouse Washes SPA.

4.5.6 For the purpose of the modelling assessment discrete receptors were placed at the closest point of each designation to the facility to ensure the maximum potential impact was predicted. These are summarised in Table 7.

8 Multi-Agency Geographic Information for the Countryside, www.magic.gov.uk.

Table 7 Ecological Receptor Locations

Receptor		Designation	NGR (m)	
			X	Y
E1	Ouse Washes	Ramsar, SSSI, SPA, SAC	539589.1	275976.8
E2	Ouse Washes	Ramsar, SSSI, SPA, SAC	539820.9	276297.0
E3	Ouse Washes	Ramsar, SSSI, SPA, SAC	540052.8	276613.5
E4	Ouse Washes	Ramsar, SSSI, SPA, SAC	540341.7	276999.9

4.5.7 Reference should be made to Figure 5 for a map of the ecological receptor locations.

4.5.8 Critical loads have been designated within the UK based on the sensitivity and relevant features of the receiving habitat. A review of the APIS[9] and MAGIC websites, as well as the relevant site designations and publicly available information, were undertaken in order to identify the most suitable habitat description and associated critical load for the area of each designation considered within the assessment.

4.5.9 The habitat types identified within the designations are presented in Table 8.

Table 8 Ecological Designation Habitat Types

Designation	Feature	APIS Habitat
Ouse Washes Ramsar	Wet Grassland	-[(a)]
Ouse Washes SSSI	Neutral grassland (Agrostis stolonifera - Alopecurus geniculatus grassland)	Low and medium altitude hay meadows
	Neutral grassland (Festuca rubra - Agrostis stolonifera - Potentilla anserina grassland)	Low and medium altitude hay meadows
	Vascular plant assemblage	-[(b)]
	Anas acuta - Pintail	Littoral sediment - pioneer, low-mid, mid-upper saltmarshes. Standing open water and canals

9 http://www.apis.ac.uk/.

Designation	Feature	APIS Habitat
	Anas clypeata - Shoveler	Neutral grassland - low and medium altitude hay meadows
	Anas crecca - Teal	Littoral sediment - pioneer, low-mid, mid-upper saltmarshes. Standing open water and canals
	Anas penelope - Wigeon	Littoral sediment - pioneer, low-mid, mid-upper saltmarshes. Standing open water and canals
	Anas platyrhynchos - Mallard	Littoral sediment - pioneer, low-mid, mid-upper saltmarshes. Standing open water and canals
	Anas querquedula - Garganey	Neutral grassland - low and medium altitude hay meadows
	Philomachus pugnax - Ruff	Littoral sediment - pioneer, low-mid, mid-upper saltmarshes. Neutral grassland - low and medium altitude hay meadows
	Anas strepera - Gadwall	Standing open water and canals
	Aythya ferina - Pochard	Standing open water and canals
	Aythya fuligula - Tufted Duck	Standing open water and canals
	Cygnus columbianus bewickii - Bewick's Swan	-[b]
	Cygnus cygnus - Whooper Swan	Improved grassland. Standing open water and canals
	Cygnus olor - Mute Swan	Standing open water and canals
	Fulica atra - Coot	Standing open water and canals
	Lowland damp grasslands	-[b]
	Variety of breeding bird species	-[b]
Ouse Washes SAC	Cobitis taenia - Spined loach	Rivers and streams
Ouse Washes SPA	Gallinago gallinago (Europe - breeding) - Common snipe	Bogs - raised blanket bogs. Acid grassland - non-mediterranean dry acid and neutral closed grassland. Neutral grassland - low and medium altitude hay meadows

Designation	Feature	APIS Habitat
	Circus cyaneus - Hen harrier	Dwarf shrub heath - northern wet heath: Calluna-dominated wet heath (upland moorland). Fen, marsh and swamp - rich fens. Littoral sediment - pioneer, low-mid, mid-upper saltmarshes
	Tadorna tadorna (North-western Europe) - Common shelduck	Littoral sediment - pioneer, low-mid, mid-upper saltmarshes. Improved grassland
	Anas penelope (Western Siberia/North-western/North-eastern Europe) - Eurasian wigeon	Littoral sediment - pioneer, low-mid, mid-upper saltmarshes. Standing open water and canals
	Anas crecca (North-western Europe) - Eurasian teal	Littoral sediment - pioneer, low-mid, mid-upper saltmarshes. Standing open water and canals
	Anas acuta (North-western Europe) - Northern pintail	Littoral sediment - pioneer, low-mid, mid-upper saltmarshes. Standing open water and canals
	Anas querquedula (Western Siberia/Europe/Western Africa) - Garganey	Neutral grassland - low and medium altitude hay meadows
	Anas clypeata (North-western/Central Europe) - Northern shoveler (	Neutral grassland - low and medium altitude hay meadows. Standing open water and canals
	Aythya ferina (North-western/North-eastern Europe) - Common pochard	Littoral sediment - pioneer, low-mid, mid-upper saltmarshes. Standing open water and canals
	Aythya fuligula (North-western Europe) - Tufted duck	Littoral sediment - pioneer, low-mid, mid-upper saltmarshes. Standing open water and canals
	Haematopus ostralegus (Europe & Northern/Western Africa) - Eurasian oystercatcher	Littoral sediment - pioneer, low-mid, mid-upper saltmarshes. Standing open water and canals. Neutral grassland - low and medium altitude hay meadows. Rivers and streams
	Vanellus vanellus (Europe - breeding) - Northern lapwing	Neutral grassland - low and medium altitude hay meadows. Rivers and streams
	Philomachus pugnax (Western Africa - wintering) - Ruff	Littoral sediment - pioneer, low-mid, mid-upper saltmarshes. Standing open water and canals. Neutral grassland - low and medium altitude hay meadows
	Limosa limosa limosa (Western Europe/W Africa) - Black-tailed godwit	Neutral grassland - low and medium altitude hay meadows.

Designation	Feature	APIS Habitat
	Tringa totanus (Eastern Atlantic - wintering) - Common redshank	Littoral sediment - pioneer, low-mid, mid-upper saltmarshes. Standing open water and canals. Neutral grassland - low and medium altitude hay meadows. Improved grassland
	Phalacrocorax carbo (North-western Europe) - Great cormorant	Standing open water and canals
	Cygnus olor (Britain) - Mute swan	Standing open water and canals
	Cygnus columbianus bewickii (Western Siberia/North-eastern & North-western Europe) - Tundra swan	Standing open water and canals. Improved grassland
	Cygnus cygnus (Iceland/UK/Ireland) - Whooper swan	Standing open water and canals. Improved grassland
	Anas strepera (North-western Europe) - Gadwall	Standing open water and canals
	Anas platyrhynchos (North-western Europe) - Mallard	Standing open water and canals
	Gallinula chloropus (Europe/Northern Africa) - Common moorhen	Standing open water and canals
	Fulica atra (North-western Europe - wintering) - Common coot	Standing open water and canals

NOTE: (a) APIS does not provide information on Ramar sites.

NOTE: (b) No habitat is assigned for this feature.

4.5.10 The critical loads for nitrogen deposition at the designations are presented in Table 9. It should be noted that the values specified for each designation correspond to the range assigned by APIS to the feature that is considered to be the most sensitive to nitrogen deposition. The lowest critical loads reported for the designations were then selected for use in the modelling in order to provide a worst-case assessment of nitrogen deposition. These values are highlighted in **bold**.

Table 9 Critical Loads - Nitrogen Deposition

Receptors	Designation	Feature	Nitrogen Critical Load (kgN/ha/yr)	
			Low	High
E1, E2, E2, E3, E4	Ouse Washes SSSI	Neutral grassland	20	30
	Ouse Washes SAC	Spined loach	-[a]	-[a]
	Ouse Washes SPA	Common snipe	**5**	**10**

NOTE: (a) No critical load has been assigned for this feature.

4.5.11 The critical loads for acid deposition at the designations are presented in Table 10. Similarly to nitrogen deposition, the values specified for each designation correspond to the range assigned by APIS to the feature that is considered to be the most sensitive to acid deposition. The critical loads which resulted in the maximum PC and PEC at the receptors was then selected for use in the modelling in order to provide a worst-case assessment of acid deposition rates. These values are highlighted in **bold**.

Table 10 Critical Loads - Acid Deposition

Receptors	Designation	Feature	Acid Critical Load (keq/ha/yr)		
			CLMaxS	CLMinN	CLMaxN
E1, E2, E2, E3, E4	Ouse Washes SSSI	Neutral grassland	0.156	0.223	0.522
	Ouse Washes SAC	Spined loach	-[a]	-[a]	-[a]
	Ouse Washes SPA	Common snipe	**0.155**	**0.321**	**0.475**

NOTE: (a) No critical load has been assigned for this feature.

4.5.12 Background pollutant concentrations and deposition rates at each ecological receptor location were obtained from the APIS website using the 'site relevant critical loads' function and are summarised in Table 11. The maximum values reported for all designations were then selected for use in the modelling to provide a worst case assessment of baseline conditions. These values are highlighted in **bold**.

Table 11 Baseline Pollution Levels

Receptor	Designation	Baseline Deposition Rate			Baseline NO_x Concentration ($\mu g/m^3$)
		Nitrogen (kgN/ha/yr)	Acid (keq/ha/yr)		
			Nitrogen	Sulphur	
E1, E2, E3, E4	Ouse Washes SSSI	**18.9**	**1.35**	**0.20**	**15.01**
	Ouse Washes SAC	9.24	1.35	0.20	15.01
	Ouse Washes SPA	**18.9**	**1.35**	**0.20**	**15.01**

4.6 Process Conditions

4.6.1 A summary of the model inputs used in the assessment is provided in Table 12. These were obtained from Abel Energy Ltd.

Table 12 Process Conditions

Parameter	Unit	Value
Stack position	NGR	539006.5, 279896.1
Stack height	m	10
Stack diameter	m	0.6
Exhaust gas temperature	°C	150
Exhaust gas flow rate	m^3/hr	7,800
Exhaust gas flow rate	Nm^3/hr	5,034
Exhaust gas efflux velocity	m/s	7.66

4.7 Emissions

4.7.1 The biomass plant will comply with the relevant ELVs for exhaust gas pollutant concentrations specified within the IED. These are shown in Table 13.

Table 13 Pollutant Emission Concentrations

Pollutant	Pollutant Emission Concentration (mg/m^3)	
NO_x	Daily average	200
	Half hourly average	400
SO_2	Daily average	50
	Half hourly average	200
PM_{10}	Daily average	10
	Half hourly average	30
CO	Daily average	50
	Half hourly average	100

4.7.2 The pollutant mass emission rates for use in the assessment were derived from the concentrations shown in Table 13 and the flow rate shown in Table 12. These are summarised in Table 14. This represents a conservative assessment approach with emissions from the boiler assumed to be the maximum permitted.

4.7.3 It should be noted that specific emission rates were calculated based on a comparison of the ELV averaging periods and the relevant EQSs. For pollutants with an EQS averaging period of 24-hours or more, the daily average ELV was utilised to calculated mass emissions. For pollutants with an EQS averaging period of less than 24-hours, the half hourly average ELV was utilised.

Table 14 Pollutant Mass Emission Rates

Pollutant	Assessment Scenario	Pollutant Mass Emission Rate (g/s)
NO_x	Annual Mean	0.280
	99.8^{th} %ile 1-hour mean	0.559
SO_2	Annual mean	0.070
	99.2^{nd} %ile 24-hour mean	0.070
	99.7^{th} %ile 1-hour mean	0.280
	99.9^{th} %ile 15-minute mean	0.280
PM_{10}	Annual Mean	0.014

Pollutant	Assessment Scenario	Pollutant Mass Emission Rate (g/s)
	90.4th %ile 24-hour mean	0.014
CO	8-hour rolling mean	0.140

4.7.4 Emissions were assumed to be constant, with the plant in operation 24-hours per day, 365-days per year. This is considered to be a worst-case assessment scenario as plant shut-down or periods of reduced work load are not reflected in the modelled emissions.

4.8 NO_x to NO_2 Conversion

4.8.1 Emissions of total NO_x from combustion processes are predominantly in the form of nitric oxide (NO). Excess oxygen in the combustion gases and further atmospheric reactions cause the oxidation of NO to NO_2. Comparisons of ambient NO and NO_2 concentrations in the vicinity of point sources in recent years has indicated that it is unlikely that more than 30% of the NO_x is present at ground level as NO_2.

4.8.2 Ambient NO_x concentrations were predicted through dispersion modelling. Concentrations of NO_2 shown in the results section assume 70% conversion from NO_x to NO_2 for annual means and 35% conversion for 1-hour concentrations, based upon Environment Agency (EA) guidance[10].

4.9 Building Effects

4.9.1 The dispersion of substances released from elevated sources can be influenced by the presence of buildings close to the emission point. Structures can interrupt the wind flows and cause significantly higher ground-level concentrations close to the source than would arise in the absence of the buildings.

4.9.2 Analysis of the site layout indicated that a number of structures should be included within the model in order to take account of effects on pollutant dispersion. Building input geometries are shown in Table 15.

10 Conversion Ratios for NO_x and NO_2, EA, undated.

Table 15 Building Geometries

Building	NGR (m)		Height (m)	Length (m)	Width (m)	Angle (°)
	X	Y				
Building 1	538990.5	276866.0	8.1	23.2	33.0	159.7
Building 2	539002.4	276901.6	9.0	36.5	79.3	160.7
Building 3	538952.5	276953.9	9.0	25.2	33.8	161.7
Building 4	539009.7	276960.1	9.0	25.5	32.6	160.3

4.10 Meteorological Data

4.10.1 Meteorological data used in the assessment was taken from Mildenhall meteorological station over the period 1st January 2010 to 31st December 2014 (inclusive). Mildenhall observation station is located at NGR: 568952, 276984, which is approximately 30km south-east of the facility. It is anticipated that conditions would be reasonably similar over a distance of this magnitude. The data was therefore considered suitable for an assessment of this nature.

4.10.2 All meteorological files used in the assessment were provided by Atmospheric Dispersion Modelling Ltd, which is an established distributor of data within the UK. Reference should be made to Figure 6 for wind roses of utilised meteorological records.

4.11 Roughness Length

4.11.1 A roughness length (z_0) of 0.3m was used within the model to describe the dispersion extents. This value of z_0 is considered appropriate for the morphology of the area and is suggested within ADMS-5 as being suitable for 'agricultural areas (max)'.

4.11.2 A z_0 of 0.5m was used within the model to describe the meteorological site. This value of z_0 is considered appropriate for the morphology of the area and is suggested within ADMS-5 as being suitable for 'parkland, open suburbia'.

4.12 Monin-Obukhov Length

4.12.1 The Monin-Obukhov length provides a measure of the stability of the atmosphere. A minimum Monin-Obukhov length of 1m was used within the model to represent the dispersion extents. This is the default value and is suggested within ADMS-5 as being suitable for 'rural areas'.

4.12.2 A minimum Monin-Obukhov length of 10m was used in the dispersion modelling study to represent the meteorological measurement site. This value is considered appropriate for the nature of the area and is suggested within ADMS-5 as being suitable for 'small towns <50,000'.

4.13 Terrain Data

4.13.1 Inclusion of terrain data is recommended within the ADMS-5 user guide if the gradient within a modelling area varies by more than 10% (1 in 10). Assessment of changes in elevation throughout the modelling extents using Google Earth indicated the maximum gradient was 3.7%. As such, terrain data was not included within the model.

4.14 Nitrogen Deposition

4.14.1 Nitrogen deposition rates were calculated using the conversion factors provided within EA document 'Technical Guidance on Detailed Modelling approach for an Appropriate Assessment for Emissions to Air AQTAG 06'[11]. Predicted pollutant concentrations were multiplied by the relevant deposition velocity and conversion factor to calculate the speciated dry deposition flux. The conversion factors used for the determination of nitrogen deposition are presented within Table 16.

[11] Technical Guidance on Detailed Modelling approach for an Appropriate Assessment for Emissions to Air AQTAG 06, EA, 2014.

Table 16 Conversion Factors to Determine Dry Deposition Flux for Nitrogen Deposition

Pollutant	Deposition Velocity (m/s)		Conversion Factor (μg/m²/s to kg/ha/yr of pollutant species)
	Grassland	Forest	
NO_2	0.0015	0.003	95.9

4.14.2 The relevant deposition velocity for each ecological receptor was selected from Table 16 based on the vegetation type present within the designation.

4.15 Acid Deposition

4.15.1 Acid deposition occurs as a result of NO_2 and SO_2. Predicted ground level pollutant concentrations of all these species were converted to kilo-equivalent ion depositions (keq/ha/yr) for comparison with the critical load for acid deposition at each of the identified ecological receptors. The conversion to units of equivalents, a measure of the potential acidifying effect of a species, was undertaken using the standard conversion factors shown in Table 17.

Table 17 Conversion Factors to Determine Dry Deposition Flux for Acid Deposition

Pollutant	Deposition Velocity (m/s)		Conversion Factor (μg/m²/s to keq/ha/yr of pollutant species)
	Grassland	Forest	
NO_2	0.0015	0.003	6.84
SO_2	0.012	0.024	9.84

4.15.2 The PC and PEC proportion of the EQS were calculated using the tool available on the APIS website[12].

4.16 Background Concentrations

4.16.1 The background values predicted by DEFRA were utilised to represent existing concentrations in the area in lieu of local monitoring data.

12 http://www.apis.ac.uk/.

4.16.2 It is not possible to add short-term peak baseline and process concentrations. This is because the conditions which give rise to peak ground-level concentrations of substances emitted from an elevated source at a particular location and time are likely to be different to the conditions which give rise to peak concentrations due to emissions from other sources. This point is addressed in in EA guidance 'Air emissions risk assessment for your environmental permit'[13], which advises that an estimate of the maximum combined pollutant concentration can be obtained by adding the maximum predicted short-term concentration due to emissions from the source to twice the annual mean baseline concentration. This approach was adopted throughout the assessment.

4.17 Assessment Criteria

Human Receptors

4.17.1 EA guidance 'Air emissions risk assessment for your environmental permit'[14] states that PCs can be screened as insignificant if they meet the following criteria:

- The short-term PC is less than 10% of the short-term environmental standard; and,
- The long-term PC is less than 1% of the long-term environmental standard.

4.17.2 If these criteria are exceeded the following guidance is provided on when whether PECs can be screened as insignificant:

- The short-term PC is less than 20% of the short-term environmental standards minus twice the long-term background concentration; and,
- The long-term PEC is less than 70% of the long-term environmental standards.

4.17.3 Predicted PCs and PECs have been compared to the relevant EQSs and the criteria stated above.

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13 https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit.

14 https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit.

Ecological Receptors

4.17.4 EA guidance 'Air emissions risk assessment for your environmental permit'[15] states that PCs at SPAs, SACs, Ramsar sites or SSSIs can be screened as insignificant if they meet the following criteria:

- The short-term PC is less than 10% of the short-term environmental standard for protected conservation areas; and,
- The long-term PC is less than 1% of the long-term environmental standard for protected conservation areas.

4.18 Modelling Uncertainty

4.18.1 Uncertainty in dispersion modelling predictions can be associated with a variety of factors, including:

- Model uncertainty - due to model limitations;
- Data uncertainty - due to errors in input data, including emission estimates, operational procedures, land use characteristics and meteorology; and,
- Variability - randomness of measurements used.

4.18.2 Potential uncertainties in the model results were minimised as far as practicable and worst-case inputs used in order to provide a robust assessment. This included the following:

- Choice of model - ADMS-5 is a commonly used atmospheric dispersion model and results have been verified through a number of studies to ensure predictions are as accurate as possible;
- Meteorological data - Modelling was undertaken using five meteorological data sets from a local observation site to take account of conditions within the vicinity of the site;
- Plant operating conditions - Operational parameters for the biomass plant were supplied by Abel Energy Ltd, based on the performance specifications. As such, these are considered to be representative of likely operating conditions;

15 https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit.

- Emission rates - Emission rates were calculated based on relevant ELVs for the proposed plant supplied by Abel Energy Ltd. As such, these are considered to be representative of anticipated emissions;
- Background concentrations - Background pollutant levels were obtained from the DEFRA mapping study;
- Receptor locations - A Cartesian Grid was included in the model in order to provide suitable data for contour plotting. Receptor points were also included at sensitive locations to provide additional consideration of these areas; and,
- Variability - All model inputs were as accurate as possible and worst-case conditions were considered as necessary in order to ensure a robust assessment of potential pollutant concentrations.

4.18.3 Results were considered in the context of the relevant EQSs. It is considered that the use of the stated measures to reduce uncertainty and the use of worst-case assumptions when necessary has resulted in model accuracy of an acceptable level.

5.0 ASSESSMENT

5.1 Introduction

5.1.1 Dispersion modelling was undertaken with the inputs described in Section 4.0. The results are summarised in the following Sections.

5.2 Maximum Pollutant Concentrations

5.2.1 The maximum predicted pollutant concentrations at any point within the assessment extents for any meteorological data set are summarised in Table 18.

Table 18 Maximum Predicted Pollutant Concentrations

Pollutant	Averaging Period	EQS (µg/m³)	PC (µg/m³)	PC Proportion of AQO (%)	PEC (µg/m³)	PEC Proportion of AQO (%)
NO_2	Annual	40	14.00	35.01	23.19	57.98
	99.8th %ile 1-hour	200	82.84	41.22	100.81	50.41
SO_2	99.2nd %ile 24-hour	125	15.54	12.43	20.60	16.48
	99.7th %ile 1-hour	350	105.53	30.15	110.59	31.60
	99.9th %ile 15-minute	266	139.65	52.50	144.71	54.40
PM_{10}	Annual	40	1.00	2.50	16.86	42.15
	90.4th %ile 24-hour	50	1.89	3.78	33.61	67.22
CO	Rolling 8-hour	10,000	80.21	0.80	328.21	0.32

5.2.2 As indicated in Table 18, there are no predicted exceedences of any EQS at any location for any pollutant or averaging period of interest.

5.2.3 Reference should be made to Figure 7 to Figure 14 for graphical representations of predicted pollutant concentrations, inclusive of background, throughout the assessment extents. It should be noted that the data shown in the Figures are predictions from the meteorological data set which resulted in the maximum pollutant concentration for that species. For example, the maximum annual mean NO_2 concentration was predicted using the 2010 meteorological data set. As such, the contours shown in Figure 7 were produced from the 2010 model outputs.

5.3 Human Receptors

5.3.1 Predicted concentrations of each pollutant at the human sensitive receptor locations identified in Table 6 are summarised in the following Sections.

Nitrogen Dioxide

5.3.2 Predicted annual mean NO_2 concentrations, inclusive of background levels, are summarised in Table 19.

Table 19 Predicted Annual Mean NO_2 Concentrations

Receptor	Predicted Annual Mean NO_2 Concentration (µg/m³)				
	2010	2011	2012	2013	2014
R1	10.55	10.57	10.63	10.94	10.72
R2	10.05	9.61	9.65	9.78	9.75
R3	9.44	9.32	9.31	9.41	9.35
R4	9.27	9.23	9.24	9.25	9.24
R5	9.24	9.26	9.27	9.25	9.26
R6	9.26	9.24	9.23	9.26	9.24

5.3.3 As indicated in Table 19, predicted NO_2 concentrations were below the annual mean EQS of 40µg/m³ at all sensitive receptor locations for all meteorological data sets.

5.3.4 Maximum predicted annual mean NO_2 concentrations at the receptor locations are summarised in Table 20. Reference should be made to Figure 7 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 20 Maximum Predicted Annual Mean NO_2 Concentrations

Receptor		Predicted Annual Mean NO_2 Concentration (µg/m³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
R1	Bridge Farm	1.75	10.94	4.37	27.35
R2	Residential - Ash Drove	0.86	10.05	2.15	25.13
R3	Earith Lakes Fisheries	0.25	9.44	0.63	23.60
R4	Fenland Fisheries	0.08	9.27	0.19	23.16
R5	Medlands Farm	0.08	9.27	0.20	23.18
R6	Holme Fenland Drove	0.07	9.26	0.17	23.15

5.3.5 As indicated in Table 20, all PECs were below 70% of the EQS. As such, predicted effects on annual mean NO_2 concentrations are not considered to be significant in accordance with the stated criteria.

5.3.6 Predicted 99.8th %ile 1-hour mean NO_2 concentrations, inclusive of background levels, are summarised in Table 21.

Table 21 Predicted 99.8th %ile 1-hour Mean NO_2 Concentrations

Receptor	Predicted 99.8th %ile 1-hour Mean NO_2 Concentration (µg/m³)				
	2010	2011	2012	2013	2014
R1	54.63	54.63	54.94	54.78	55.11
R2	32.68	31.41	31.68	32.31	32.35
R3	24.81	23.91	24.01	24.80	24.45
R4	21.94	20.58	20.68	21.61	21.74
R5	21.15	20.96	21.21	21.43	21.22
R6	22.03	21.33	21.12	21.17	20.64

5.3.7 As indicated in Table 21, predicted NO_2 concentrations were well below the 1-hour mean EQS of 200µg/m³ at all sensitive receptor locations for all meteorological data sets.

5.3.8 Maximum predicted 99.8th %ile 1-hour mean NO_2 concentrations at the receptor locations are summarised in Table 22. Reference should be made to Figure 8 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 22 Maximum Predicted 99.8th %ile 1-hour Mean NO_2 Concentrations

Receptor		Maximum Predicted 99.8th %ile 1-hour Mean NO_2 Concentration (µg/m³)		PC Proportion of EQS Headroom(%)(a)
		PC	PEC	
R1	Bridge Farm	36.73	55.11	20.22
R2	Residential - Ash Drove	14.30	32.68	7.88
R3	Earith Lakes Fisheries	6.43	24.81	3.54
R4	Fenland Fisheries	3.56	21.94	1.96
R5	Medlands Farm	3.05	21.43	1.68
R6	Holme Fenland Drove	3.65	22.03	2.01

NOTE (a) PC proportion of EQS minus twice the long-term background concentration.

5.3.9 As indicated in Table 22, the PC proportion of the EQS minus twice the long-term background concentration was below 20% at all sensitive locations with the exception of R1, which represents Bridge Farm. At this location, the maximum predicted PC marginally exceeded the relevant criteria. However, the PEC at this position was well within the 1-hour mean EQS and as a result, predicted effects on short term NO_2 concentrations are not considered to be significant.

Sulphur Dioxide

5.3.10 Predicted 99.2nd %ile 24-hour mean SO_2 concentrations, inclusive of background levels, are summarised in Table 23.

Table 23 Predicted 99.2nd %ile 24-hour Mean SO_2 Concentrations

Receptor	Predicted 99.2nd %ile 24-hour Mean SO_2 Concentration (µg/m³)				
	2010	2011	2012	2013	2014
R1	11.56	12.32	13.60	12.74	12.99

Receptor	Predicted 99.2nd %ile 24-hour Mean SO_2 Concentration (µg/m³)				
	2010	2011	2012	2013	2014
R2	7.44	7.01	7.21	7.03	7.17
R3	5.78	5.70	5.66	5.73	5.73
R4	5.30	5.26	5.25	5.33	5.25
R5	5.19	5.21	5.20	5.19	5.23
R6	5.33	5.31	5.27	5.28	5.28

5.3.11 As indicated in Table 23, predicted SO_2 concentrations were well below the 24-hour mean EQS of 125µg/m³ at all sensitive receptor locations for all meteorological data sets.

5.3.12 Maximum predicted 99.2nd %ile 24-hour mean SO_2 concentrations at the receptor locations are summarised in Table 24. Reference should be made to Figure 9 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 24 Maximum Predicted 99.2nd %ile 24-hour Mean SO_2 Concentrations

Receptor		Maximum Predicted 99.2nd %ile 24-hour Mean SO_2 Concentration (µg/m³)		PC Proportion of EQS Headroom(%)[a]
		PC	PEC	
R1	Bridge Farm	8.54	13.60	7.12
R2	Residential - Ash Drove	2.38	7.44	1.99
R3	Earith Lakes Fisheries	0.72	5.78	0.60
R4	Fenland Fisheries	0.27	5.33	0.22
R5	Medlands Farm	0.17	5.23	0.14
R6	Holme Fenland Drove	0.27	5.33	0.22

NOTE (a) PC proportion of EQS minus twice the long-term background concentration.

5.3.13 As indicated in Table 24, the PC proportion of the EQS minus twice the long-term background concentration was below 20% at all receptor locations. As such, predicted effects on 24-hour mean SO_2 concentrations are not considered to be significant in accordance with the stated criteria.

5.3.14 Predicted 99.7th %ile 1-hour mean SO_2 concentrations, inclusive of background levels, are summarised in Table 25.

Table 25 Predicted 99.7th %ile 1-hour Mean SO_2 Concentrations

Receptor	Predicted 99.7th %ile 1-hour Mean SO_2 Concentration (µg/m³)				
	2010	2011	2012	2013	2014
R1	56.57	56.47	56.67	56.49	57.18
R2	25.03	23.08	23.40	24.40	24.08
R3	13.18	12.12	11.29	13.12	13.03
R4	9.40	7.93	7.97	9.09	9.49
R5	8.26	8.25	8.61	8.67	8.38
R6	8.69	8.16	7.59	8.30	8.06

5.3.15 As indicated in Table 25, predicted SO_2 concentrations were well below the 1-hour mean EQS of 350µg/m³ at all sensitive receptor locations for all meteorological data sets.

5.3.16 Maximum predicted 99.7th %ile 1-hour mean SO_2 concentrations at the receptor locations are summarised in Table 26. Reference should be made to Figure 10 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 26 Maximum Predicted 99.7th %ile 1-hour Mean SO_2 Concentrations

Receptor		Maximum Predicted 99.7th %ile 1-hour Mean SO_2 Concentration (µg/m³)		PC Proportion of EQS Headroom(%)(a)
		PC	PEC	
R1	Bridge Farm	52.12	57.18	15.11
R2	Residential - Ash Drove	19.97	25.03	5.79
R3	Earith Lakes Fisheries	8.12	13.18	2.35
R4	Fenland Fisheries	4.43	9.49	1.28
R5	Medlands Farm	3.61	8.67	1.05
R6	Holme Fenland Drove	3.63	8.69	1.05

NOTE (a) PC proportion of EQS minus twice the long-term background concentration.

5.3.17 As indicated in Table 26, the PC proportion of the EQS minus twice the long-term background concentration was below 20% at all receptor locations. As such, predicted effects on 1-hour mean SO_2 concentrations are not considered to be significant in accordance with the stated guidance.

5.3.18 Predicted 99.9th %ile 15-minute mean SO_2 concentrations, inclusive of background levels, are summarised in Table 27.

Table 27 Predicted 99.9th %ile 15-minute Mean SO_2 Concentrations

Receptor	Predicted 99.9th %ile 15-minute Mean SO_2 Concentration (µg/m³)				
	2010	2011	2012	2013	2014
R1	58.69	58.50	59.13	58.80	59.28
R2	30.42	28.07	28.89	30.42	29.66
R3	25.40	18.88	16.35	19.59	19.01
R4	14.91	12.06	11.77	14.41	13.74
R5	12.83	12.07	12.35	12.64	12.68
R6	15.24	14.54	14.99	12.63	11.38

5.3.19 As indicated in Table 27, predicted SO_2 concentrations were well below the 15-minute mean EQS of 266µg/m³ at all sensitive receptor locations for all meteorological data sets.

5.3.20 Maximum predicted 99.9th %ile 15-minute mean SO_2 concentrations at the receptor locations are summarised in Table 28. Reference should be made to Figure 11 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 28 Maximum Predicted 99.9th %ile 15-minute Mean SO_2 Concentrations

Receptor		Maximum Predicted 99.9th %ile 15-minute Mean SO_2 Concentration (µg/m³)		PC Proportion of EQS Headroom(%)(a)
		PC	PEC	
R1	Bridge Farm	54.22	59.28	20.78
R2	Residential - Ash Drove	25.36	30.42	9.72
R3	Earith Lakes Fisheries	20.34	25.40	7.79

Receptor		Maximum Predicted 99.9th %ile 15-minute Mean SO_2 Concentration (μg/m³)		PC Proportion of EQS Headroom(%)[(a)]
		PC	PEC	
R4	Fenland Fisheries	9.85	14.91	3.77
R5	Medlands Farm	7.77	12.83	2.98
R6	Holme Fenland Drove	10.18	15.24	3.90

NOTE (a) PC proportion of EQS minus twice the long-term background concentration.

5.3.21 As indicated in Table 28, the PC proportion of the EQS minus twice the long-term background concentration was below 20% at all sensitive locations, with the exception of R1, which represents Bridge Farm. At this location, the predicted PC marginally exceeded the relevant criteria. However, the maximum PEC was well within the 15-minute mean EQS and as a result, predicted effects on short term SO_2 concentrations are not considered to be significant.

Particulate Matter

5.3.22 Predicted annual mean PM_{10} concentrations, inclusive of background levels, are summarised in Table 29.

Table 29 Predicted Annual Mean PM_{10} Concentrations

Receptor	Predicted Annual Mean PM_{10} Concentration (μg/m³)				
	2010	2011	2012	2013	2014
R1	15.957	15.959	15.963	15.985	15.969
R2	15.922	15.890	15.893	15.902	15.900
R3	15.878	15.869	15.869	15.876	15.871
R4	15.865	15.863	15.863	15.865	15.864
R5	15.864	15.865	15.866	15.865	15.865
R6	15.865	15.863	15.863	15.865	15.864

5.3.23 As indicated in Table 29, predicted PM_{10} concentrations were below the annual mean EQS of 40μg/m³ at all sensitive receptor locations for all meteorological data sets.

5.3.24 Maximum predicted annual mean PM_{10} concentrations at the receptor locations are summarised in Table 30. Reference should be made to Figure 12 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 30 Maximum Predicted Annual Mean PM_{10} Concentrations

Receptor		Predicted Annual Mean PM_{10} Concentration (μg/m^3)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
R1	Bridge Farm	0.125	15.985	0.313	39.963
R2	Residential - Ash Drove	0.062	15.922	0.154	39.804
R3	Earith Lakes Fisheries	0.018	15.878	0.045	39.695
R4	Fenland Fisheries	0.005	15.865	0.013	39.663
R5	Medlands Farm	0.006	15.866	0.015	39.665
R6	Holme Fenland Drove	0.005	15.865	0.012	39.662

5.3.25 As indicated in Table 30, all PCs were below 1% of the EQS. As such, predicted effects on annual mean PM_{10} concentrations are not considered to be significant in accordance with the stated criteria.

5.3.26 Predicted 90.4th %ile 24-hour mean PM_{10} concentrations, inclusive of background levels, are summarised in Table 31.

Table 31 Predicted 90.4th %ile 24-hour Mean PM_{10} Concentrations

Receptor	Predicted 90.4th %ile 24-hour Mean PM_{10} Concentration (μg/m^3)				
	2010	2011	2012	2013	2014
R1	32.182	32.000	32.056	32.214	32.174
R2	31.938	31.841	31.826	31.863	31.873
R3	31.790	31.749	31.753	31.792	31.766
R4	31.740	31.730	31.735	31.736	31.736
R5	31.733	31.735	31.737	31.733	31.734
R6	31.737	31.733	31.732	31.740	31.735

5.3.27 As indicated in Table 31, predicted PM_{10} concentrations were well below the 24-hour mean EQS of 50µg/m³ at all sensitive receptor locations for all meteorological data sets.

5.3.28 Maximum predicted 90.4th %ile 24-hour mean PM_{10} concentrations at the receptor locations are summarised in Table 32. Reference should be made to Figure 13 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 32 Maximum Predicted 90.4th %ile 24-hour Mean PM_{10} Concentrations

Receptor		Maximum Predicted 90.4th %ile 24-hour Mean PM_{10} Concentration (µg/m³)		PC Proportion of EQS Headroom(%)[a]
		PC	PEC	
R1	Bridge Farm	0.494	32.214	2.702
R2	Residential - Ash Drove	0.218	31.938	1.190
R3	Earith Lakes Fisheries	0.072	31.792	0.391
R4	Fenland Fisheries	0.020	31.740	0.108
R5	Medlands Farm	0.017	31.737	0.091
R6	Holme Fenland Drove	0.020	31.740	0.111

NOTE (a) PC proportion of EQS minus twice the long-term background concentration.

5.3.29 As indicated in Table 32, the PC proportion of the EQS minus twice the long-term background concentration was below 20% at all sensitive locations. As such, predicted effects on 24-hour mean PM_{10} concentrations are not considered to be significant in accordance with the stated criteria.

Carbon Monoxide

5.3.30 Predicted 8-hour rolling mean CO concentrations, inclusive of background levels, are summarised in Table 33.

Table 33 Predicted 8-hour Rolling Mean CO Concentrations

Receptor	Predicted 8-hour Rolling Mean CO Concentration (μg/m³)				
	2010	2011	2012	2013	2014
R1	522.53	518.41	521.26	521.02	519.44
R2	504.27	504.91	503.47	505.09	502.99
R3	499.58	499.45	499.89	498.72	500.24
R4	498.27	497.65	497.74	497.60	496.99
R5	497.44	497.12	497.88	497.21	496.96
R6	498.92	499.76	498.72	497.61	498.58

5.3.31 As indicated in Table 33, predicted CO concentrations were well below the 8-hour rolling mean EQS of 10,000μg/m³ at all sensitive receptor locations for all meteorological data sets.

5.3.32 Maximum predicted 8-hour rolling mean CO concentrations at the receptor locations are summarised in Table 34. Reference should be made to Figure 14 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 34 Maximum Predicted 8-hour Rolling Mean CO Concentrations

Receptor		Maximum Predicted 8-hour Rolling Mean CO Concentration (μg/m³)		PC Proportion of EQS Headroom(%)[(a)]
		PC	PEC	
R1	Bridge Farm	26.53	522.53	0.28
R2	Residential - Ash Drove	9.09	505.09	0.10
R3	Earith Lakes Fisheries	4.24	500.24	0.04
R4	Fenland Fisheries	2.27	498.27	0.02
R5	Medlands Farm	1.88	497.88	0.02
R6	Holme Fenland Drove	3.76	499.76	0.04

NOTE (a) PC proportion of EQS minus twice the long-term background concentration.

5.3.33 As indicated in Table 34, the PC proportion of the EQS minus twice the long-term background concentration was below 20% at all sensitive locations. As such, predicted effects on 8-hour rolling mean CO concentrations are not considered to be significant.

5.4 Ecological Receptors

Nitrogen Oxides

5.4.1 Predicted annual mean NO_x concentrations, inclusive of background levels, are summarised in Table 35 .

Table 35 Predicted Annual Mean NO_x Concentrations

Receptor	Predicted Annual Mean NO_x Concentration (µg/m³)				
	2010	2011	2012	2013	2014
E1	15.11	15.07	15.09	15.09	15.07
E2	15.11	15.07	15.08	15.09	15.06
E3	15.11	15.08	15.09	15.08	15.07
E4	15.10	15.08	15.09	15.07	15.07

5.4.2 As indicated in Table 35, predicted NO_x concentrations were well below the annual mean EQS of 30µg/m³ at all sensitive receptor locations for all meteorological data sets.

5.4.3 Maximum predicted annual mean NO_x concentrations at the ecological receptors are summarised in Table 36.

Table 36 Maximum Predicted Annual Mean NO_x Concentrations

Receptor		Predicted Annual Mean NO_x Concentration (µg/m³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
E1	Ouse Washes Ramsar, SSSI, SAC, SPA	0.10	15.11	0.34	50.37
E2	Ouse Washes Ramsar, SSSI, SAC, SPA	0.10	15.11	0.32	50.35
E3	Ouse Washes Ramsar, SSSI, SAC, SPA	0.10	15.11	0.32	50.36

Receptor		Predicted Annual Mean NO_x Concentration (µg/m^3)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
E4	Ouse Washes Ramsar, SSSI, SAC, SPA	0.09	15.10	0.29	50.32

5.4.4 As shown in Table 36, PCs were below 1% of the EQS at all ecological receptors for all meteorological data sets. As such, predicted effects on annual mean NO_x concentrations are not considered to be significant in accordance with the stated criteria.

5.4.5 Predicted 24-hour mean NO_x concentrations, inclusive of background levels, are summarised in Table 37.

Table 37 Predicted 24-hour Mean NO_x Concentrations

Receptor	Predicted 24-hour Mean NO_x Concentration (µg/m^3)				
	2010	2011	2012	2013	2014
E1	31.28	31.17	31.38	31.52	31.00
E2	31.08	30.96	30.96	31.09	30.89
E3	31.00	30.75	30.77	30.74	30.72
E4	31.01	30.46	31.12	30.62	30.47

5.4.6 As indicated in Table 37, predicted NO_x concentrations were well below the 24-hour mean EQS of 75µg/m^3 at all ecological receptors for all meteorological data sets.

5.4.7 Maximum predicted 24-hour mean NO_x concentrations at the ecological receptors are summarised in Table 38.

Table 38 Maximum Predicted 24-hour Mean NO_x Concentrations

Receptor		Predicted 24-hour Mean NO_x Concentration (µg/m^3)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
E1	Ouse Washes Ramsar, SSSI, SAC, SPA	1.50	42.02	2.00	42.02

Receptor		Predicted 24-hour Mean NO_x Concentration (μg/m³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
E2	Ouse Washes Ramsar, SSSI, SAC, SPA	1.07	41.46	1.43	41.46
E3	Ouse Washes Ramsar, SSSI, SAC, SPA	0.98	41.33	1.30	41.33
E4	Ouse Washes Ramsar, SSSI, SAC, SPA	1.10	41.49	1.46	41.49

5.4.8 As shown in Table 39, PCs were below 10% of the EQS at all ecological receptors for all meteorological data sets. As such, predicted effects on 24-hour mean NO_x concentrations are not considered to be significant in accordance with the stated criteria.

Sulphur Dioxide

5.4.9 Predicted annual mean SO_2 concentrations, inclusive of background levels, are summarised in Table 39.

Table 39 Predicted Annual Mean SO_2 Concentrations

Receptor	Predicted Annual Mean SO_2 Concentration (μg/m³)				
	2010	2011	2012	2013	2014
E1	0.025	0.015	0.019	0.020	0.015
E2	0.024	0.014	0.018	0.019	0.012
E3	0.024	0.017	0.019	0.018	0.015
E4	0.022	0.016	0.020	0.015	0.015

5.4.10 As indicated in Table 39, predicted SO_2 concentrations were well below the annual mean EQS of 20μg/m³ at all ecological receptors for all meteorological data sets

5.4.11 Maximum predicted annual mean SO_2 concentrations at the ecological receptor locations are summarised in Table 40.

Table 40 Maximum Predicted Annual Mean SO_2 Concentrations

Receptor		Predicted Annual Mean SO_2 Concentration (μg/m³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
E1	Ouse Washes Ramsar, SSSI, SAC, SPA	0.03	2.61	0.13	13.03
E2	Ouse Washes Ramsar, SSSI, SAC, SPA	0.02	2.60	0.12	13.02
E3	Ouse Washes Ramsar, SSSI, SAC, SPA	0.02	2.60	0.12	13.02
E4	Ouse Washes Ramsar, SSSI, SAC, SPA	0.02	2.60	0.11	13.01

5.4.12 As shown in Table 40, PCs were below 1% of the EQS at all ecological receptor locations. As such, predicted effects on annual mean SO_2 concentrations are not considered to be significant in accordance with the stated criteria.

Nitrogen Deposition

5.4.13 Maximum predicted annual mean nitrogen deposition rates at the ecological receptor locations are summarised in Table 41.

Table 41 Predicted Annual Nitrogen Deposition Rates

Receptor		Predicted Annual Nitrogen Deposition Rate (kgN/ha/yr)		Proportion of EQS (%)			
		PC	PEC	Low EQS		High EQS	
				PC	PEC	PC	PEC
E1	Ouse Washes SSSI, SAC, SPA	0.01	18.91	0.20	378.20	0.10	189.10
E2	Ouse Washes SSSI, SAC, SPA	0.01	18.91	0.19	378.19	0.10	189.10
E3	Ouse Washes SSSI, SAC, SPA	0.01	18.91	0.20	378.20	0.10	189.10
E4	Ouse Washes SSSI, SAC, SPA	0.01	18.91	0.20	378.20	0.10	189.10

5.4.14 As shown in Table 41, PCs were below 1% of the EQSs at all locations. As such, predicted effects on annual nitrogen deposition are not considered to be significant in accordance with the stated criteria.

5.4.15 It should be noted that PECs are predicted to exceed the relevant EQSs at the receptor locations as a base condition.

Acid Deposition

5.4.16 Predicted annual acid deposition rates are summarised in Table 42. These include contributions from NO_2 and SO_2.

Table 42 Predicted Annual Acid Deposition Rates

Receptor		Predicted Annual Acid Deposition Rate (keq/ha/yr)		Proportion of EQS (%)	
		S	N	PC	PEC
E1	Ouse Washes SSSI, SAC, SPA	0.0030	0.0007	0.0	326.3
E2	Ouse Washes SSSI, SAC, SPA	0.0028	0.0007	0.0	326.3
E3	Ouse Washes SSSI, SAC, SPA	0.0029	0.0007	0.0	326.3
E4	Ouse Washes SSSI, SAC, SPA	0.0029	0.0007	0.0	326.3

5.4.17 As shown in Table 42, PCs were below 1% of the EQS at all locations. As such, predicted effects on annual acid deposition are not considered to be significant in accordance with the stated criteria.

5.4.18 It should be noted that PECs are predicted to exceed the relevant EQSs at all ecological receptor locations as a base condition.

6.0 CONCLUSION

6.1.1 Redmore Environmental Ltd was commissioned by Abel Energy Ltd to undertake an Air Quality Assessment in support of a proposed biomass boiler at Bridge Farm, Huntingdon, Cambridgeshire.

6.1.2 The plant has the potential to cause air quality impacts as a result of atmospheric emissions during normal operation. As such, an Air Quality Assessment was undertaken in order to determine baseline conditions and assess potential changes in pollution levels as a result of the installation.

6.1.3 Dispersion modelling of a number of pollutants was undertaken using ADMS-5. Impacts at sensitive receptors were quantified and the results compared with the relevant EQSs.

6.1.4 The results of the assessment indicated that the operation of the plant will not result in exceedences of the relevant EQSs at any human receptor location within the vicinity of the site. As such, impacts are not considered to be significant.

6.1.5 Impacts were also predicted at relevant ecological sites. The results indicated that emissions from the installation would not significantly affect existing conditions at any designation.

6.1.6 Impacts were predicted based on a worst-case assessment scenario of the facility constantly emitting the maximum permitted concentration of each pollutant throughout an entire year. As such, predicted concentrations and deposition rates are likely to overestimate actual impacts.

7.0 ABBREVIATIONS

APIS	Air Pollution Information System
AQLV	Air Quality Limit Value
AQMA	Air Quality Management Area
AQO	Air Quality Objective
AQS	Air Quality Strategy
CERC	Cambridge Environmental Research Consultants
CO	Carbon monoxide
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency
ELV	Emission Limit Value
EQS	Environmental Quality Standards
HDC	Huntingdonshire District Council
IED	Industrial Emissions Directive
EU	European Union
LAQM	Local Air Quality Management
LWS	Local Wildlife Site
LNR	Local Nature Reserve
MAGIC	Multi-Agency Geographic Information for the Countryside
NGR	National Grid Reference
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
PC	Process Contribution
PEC	Predicted Environmental Concentration
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10µm
SAC	Special Areas of Conservation
SO_2	Sulphur dioxide
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
z_0	Roughness length
%ile	Percentile

Figures

Legend

Site Boundary

Title

Figure 1 - Site Location

Project

Air Quality Assessment -
Bridge Farm Biomass Boiler

Project Reference

1778

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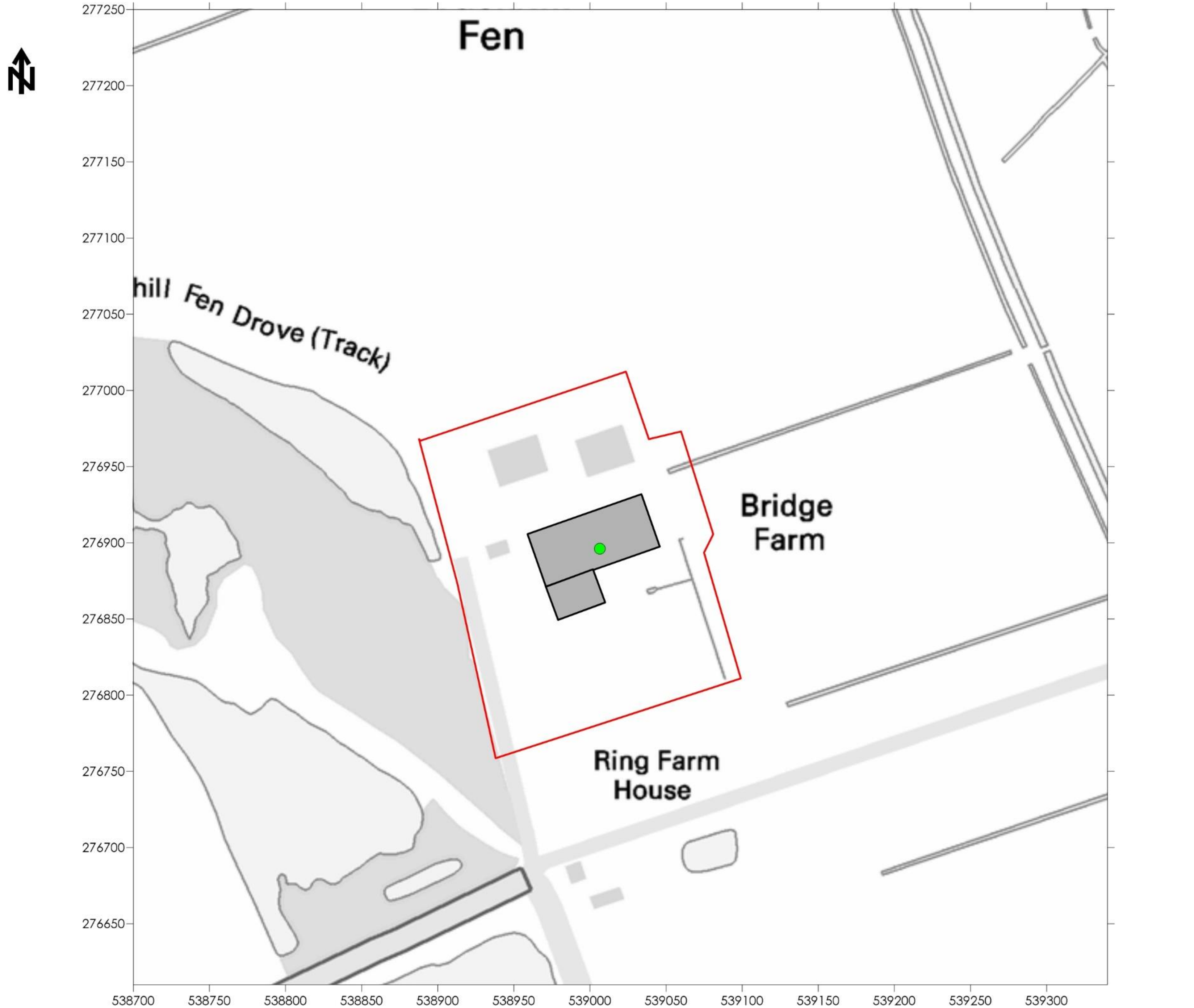

Title
Figure 2 - Site Layout

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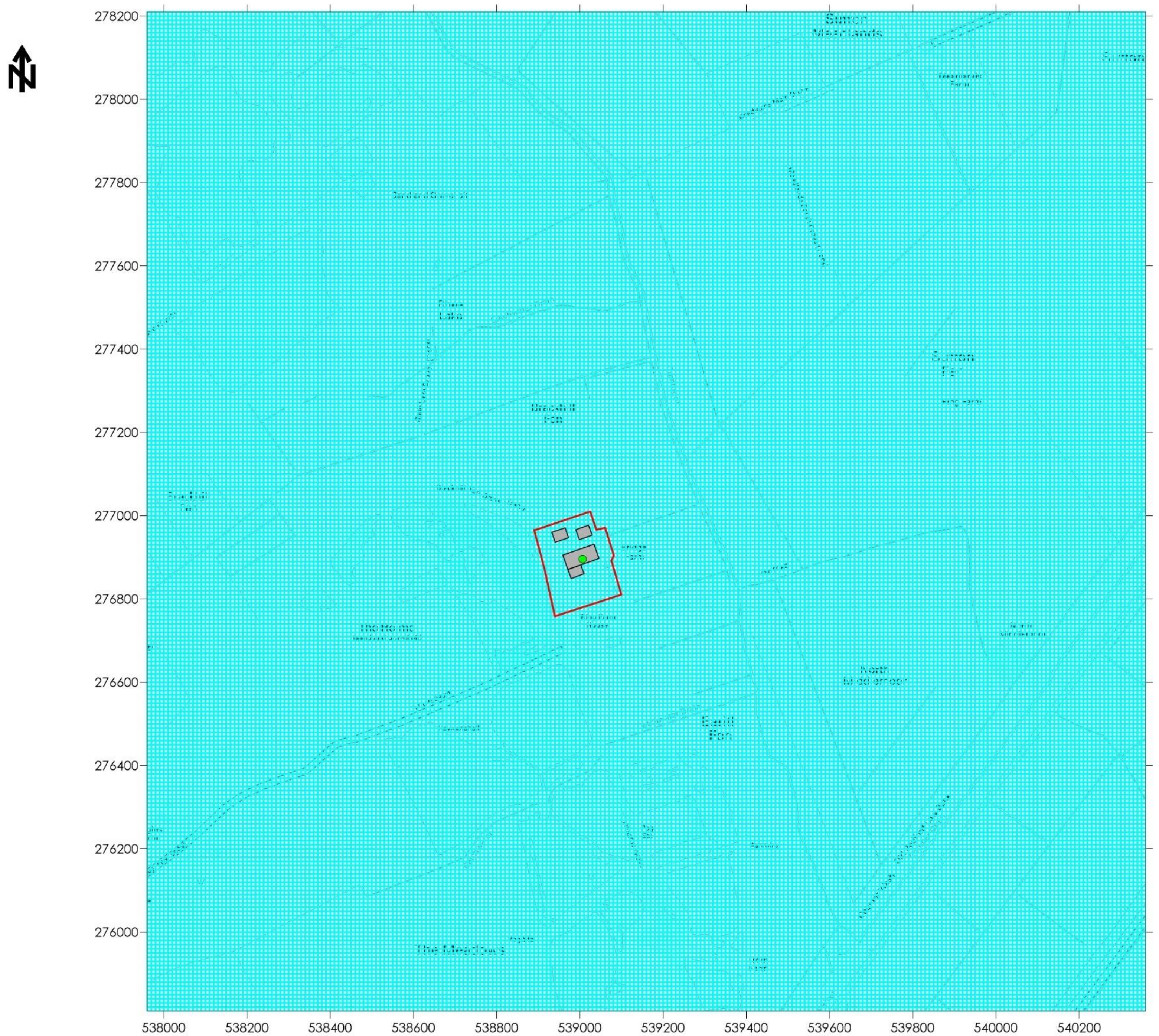

Legend

Site Boundary

Building

Boiler Stack

Output Grid

Title

Figure 3 - ADMS-5 Inputs

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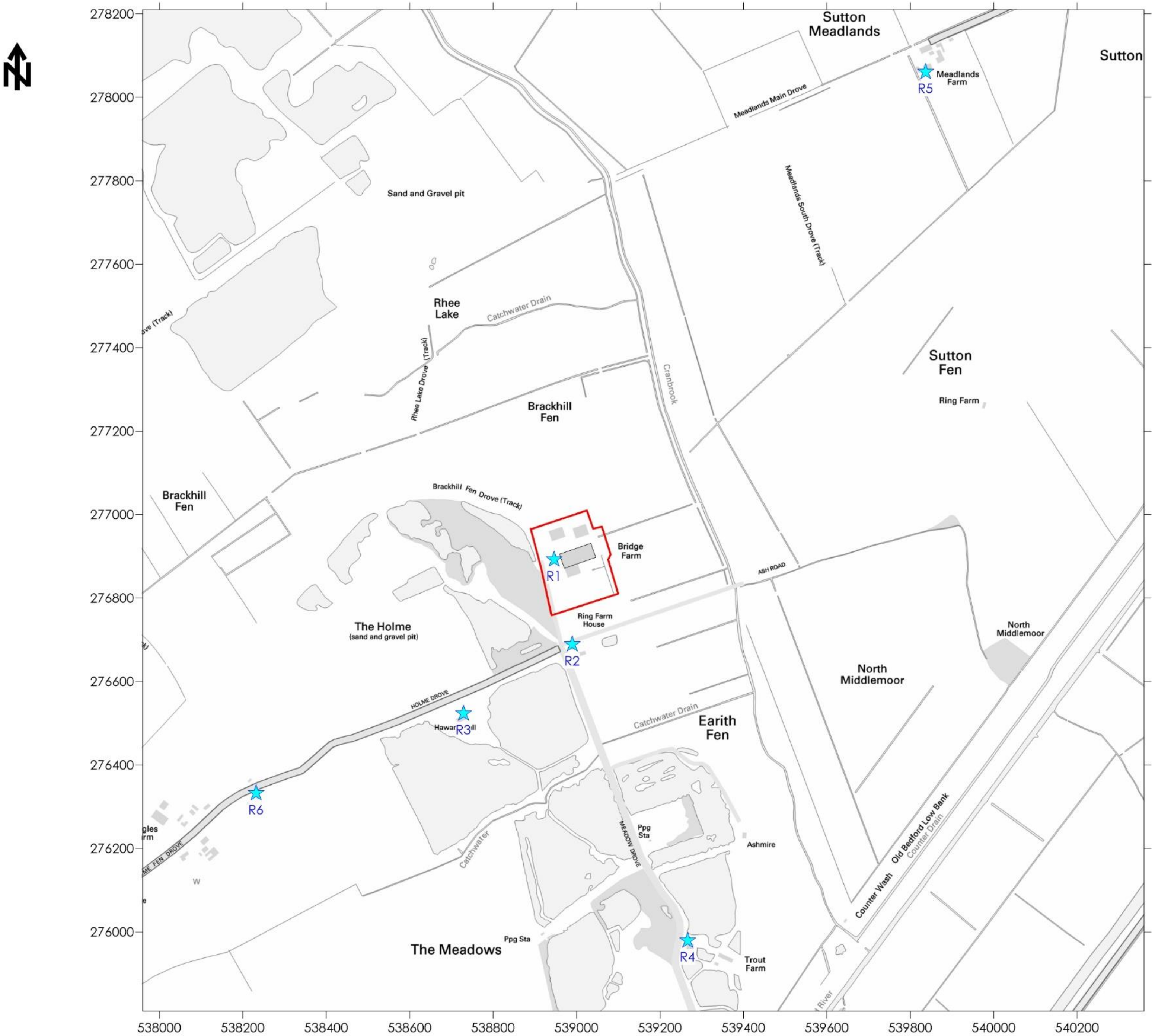

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Site Boundary

Sensitive Receptor Location

Title

Figure 4 - Human Receptor Locations

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Site Boundary

Ouse Washes Ramsar site, SSSI, SPA and SAC

Ecological Receptor

Title

Figure 5 - Ecological Receptor Locations

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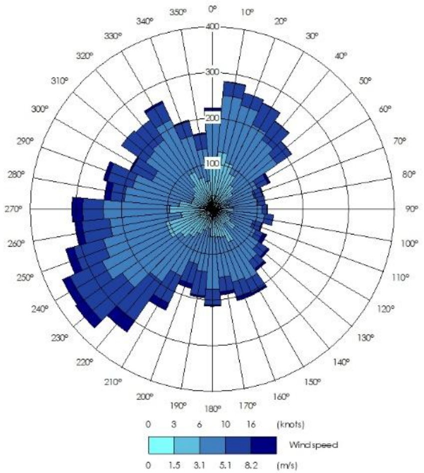
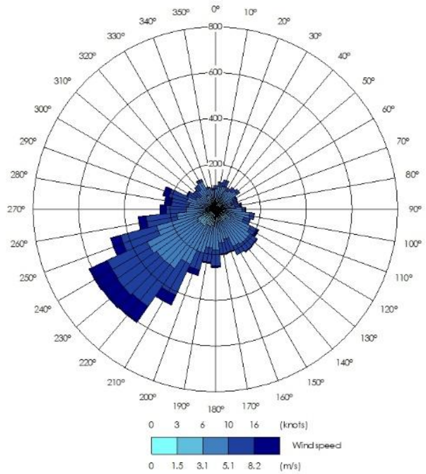
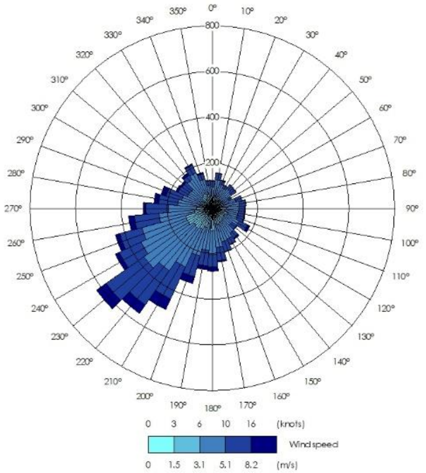


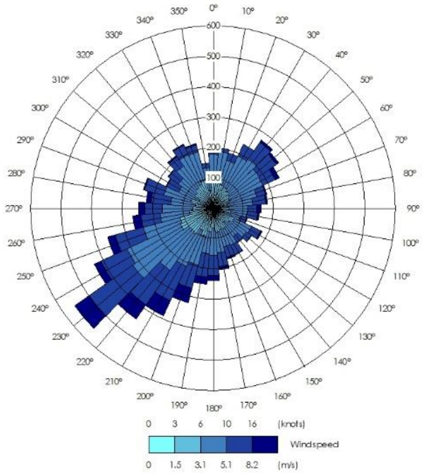
2010 Meteorological Data



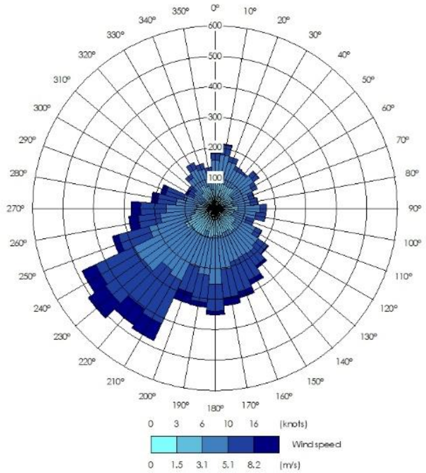
2011 Meteorological Data



2012 Meteorological Data



2013 Meteorological Data



2014 Meteorological Data

Title

Figure 6 - Wind Roses of 2010 to 2014 Mildenhall Meteorological Data

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Legend

Predicted Annual Mean NO_2 Concentration (µg/m³)

22
20
18
16
14
12
10

Title

Figure 7 - Predicted Annual Mean NO_2 Concentrations (µg/m³) 2011 Meteorological Data

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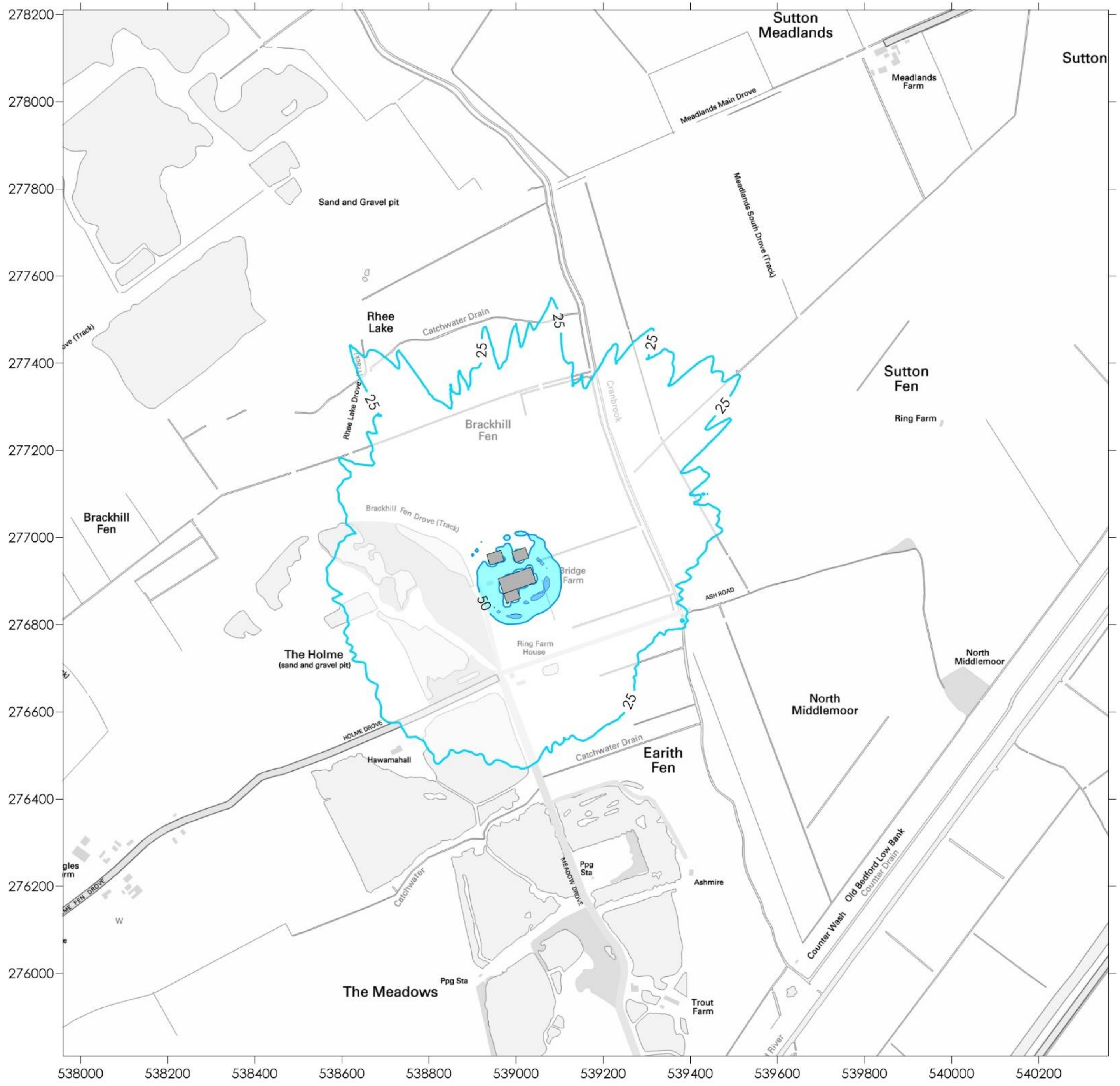

Legend

Predicted 99.8th%ile 1-hour Mean NO_2 Concentration ($\mu g/m^3$)

100
75
50
25

Title

Figure 8 - Predicted 99.8th%ile 1-hour Mean NO_2 Concentrations ($\mu g/m^3$) 2014 Meteorological Data

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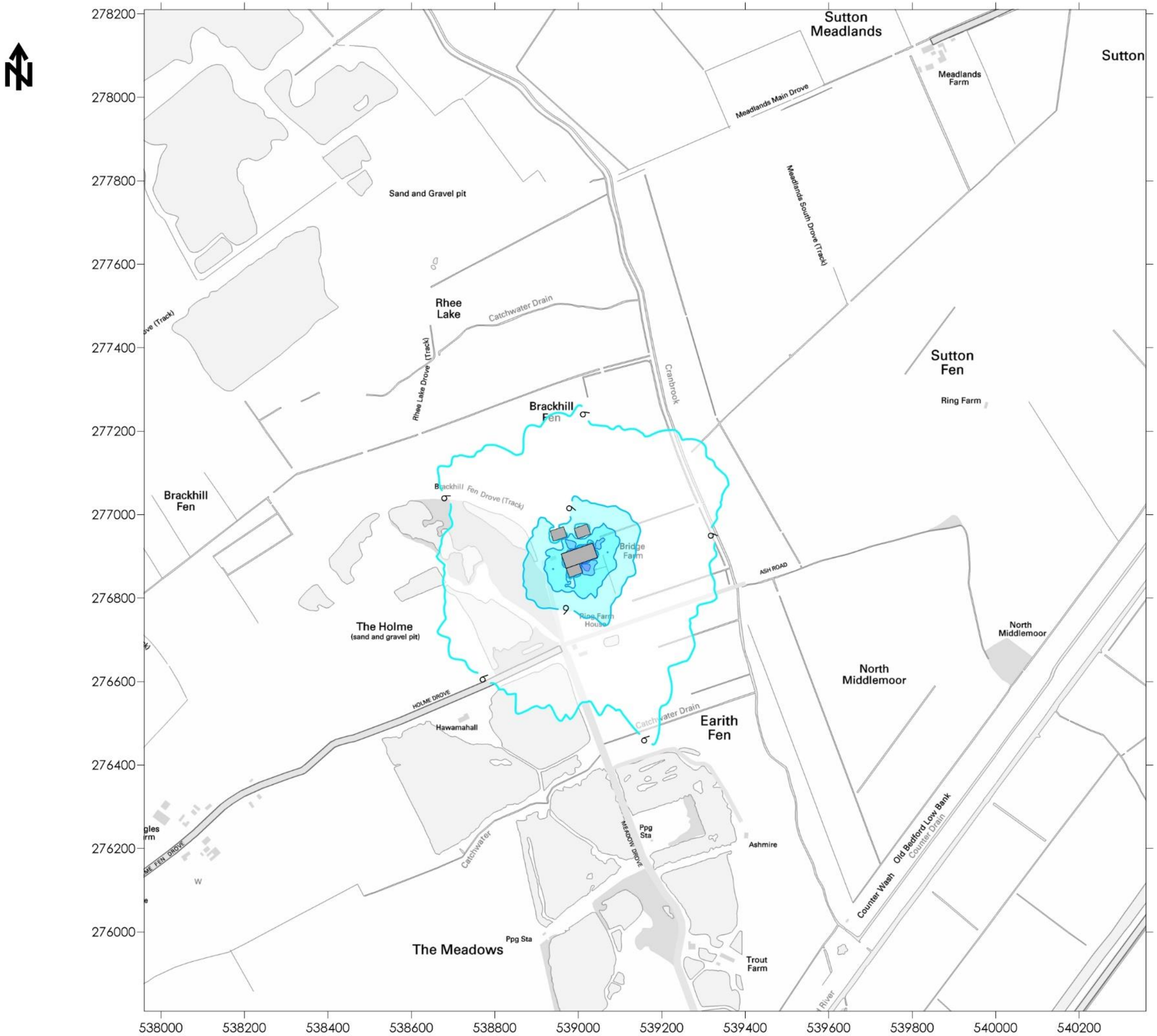

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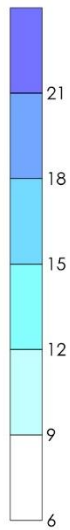

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Figure 9 - Predicted 99.2nd%ile 24-hour Mean SO_2 Concentrations (µg/m³) 2013 Meteorological Data

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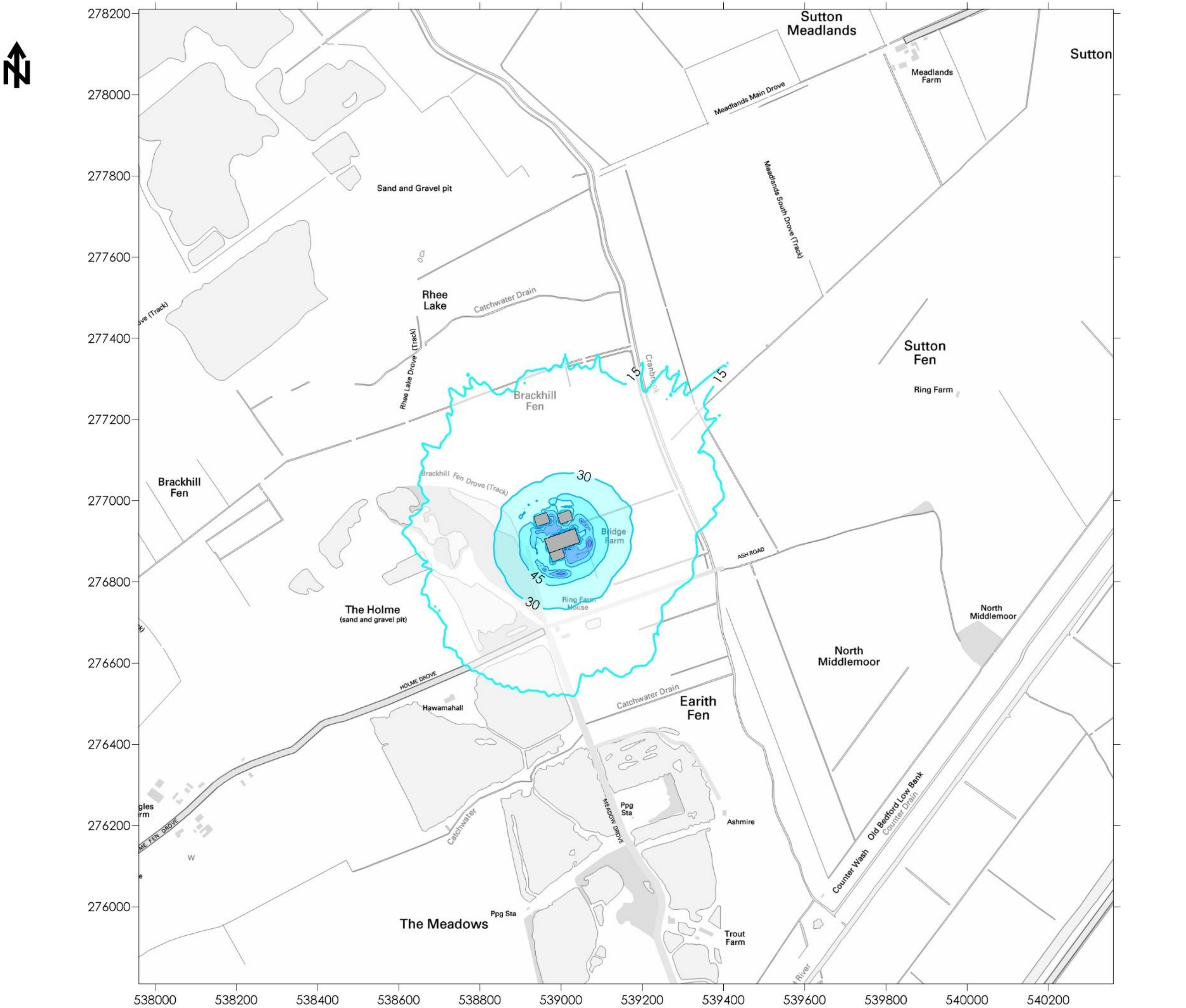

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Predicted 90.7th%ile 1-hour Mean SO_2 Concentration (μg/m³)

90
75
60
45
30
15

Title

Figure 10 - Predicted 90.7th%ile 1-hour Mean SO_2 Concentrations (μg/m³) 2014 Meteorological Data

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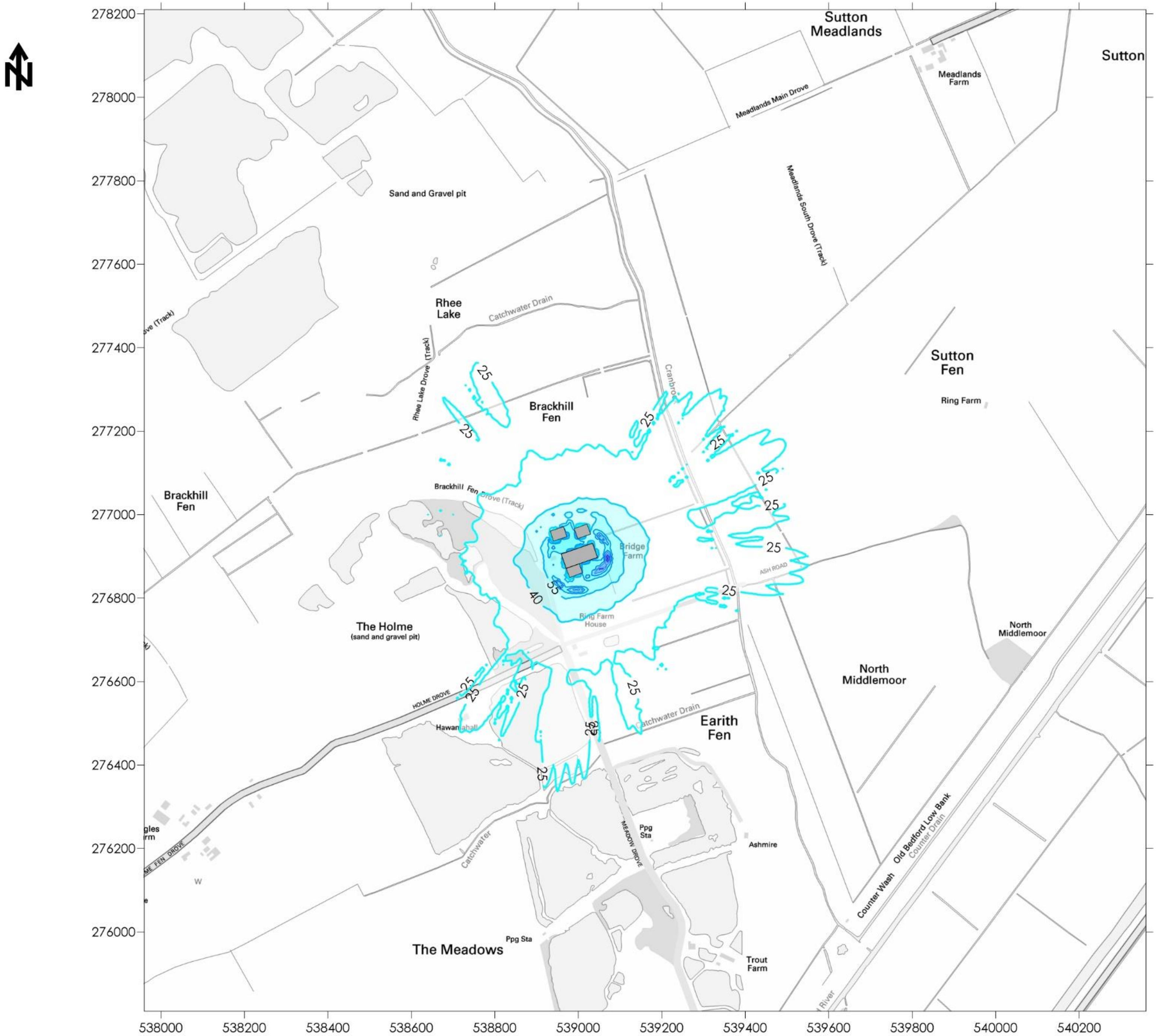

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Predicted 99.9th%ile 15-minute Mean SO_2 Concentration (µg/m³)

130
115
100
85
70
55
40
25

Title

Figure 11 - Predicted 99.9th%ile 15-minute Mean SO_2 Concentrations (µg/m³) 2010 Meteorological Data

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Legend

Predicted Annual Mean PM_{10} Concentration (µg/m^3)

16.9
16.7
16.5
16.3
16.1
15.9

Title

Figure 12 - Predicted Annual Mean PM_{10} Concentrations (µg/m^3) 2010 Meteorological Data

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Predicted 90.4th%ile 24-hour Mean PM_{10} Concentration (µg/m³)

33.5

33

32.5

32

Title

Figure 13 - Predicted 90.4th%ile 24-hour Mean PM_{10} Concentrations (µg/m³) 2010 Meteorological Data

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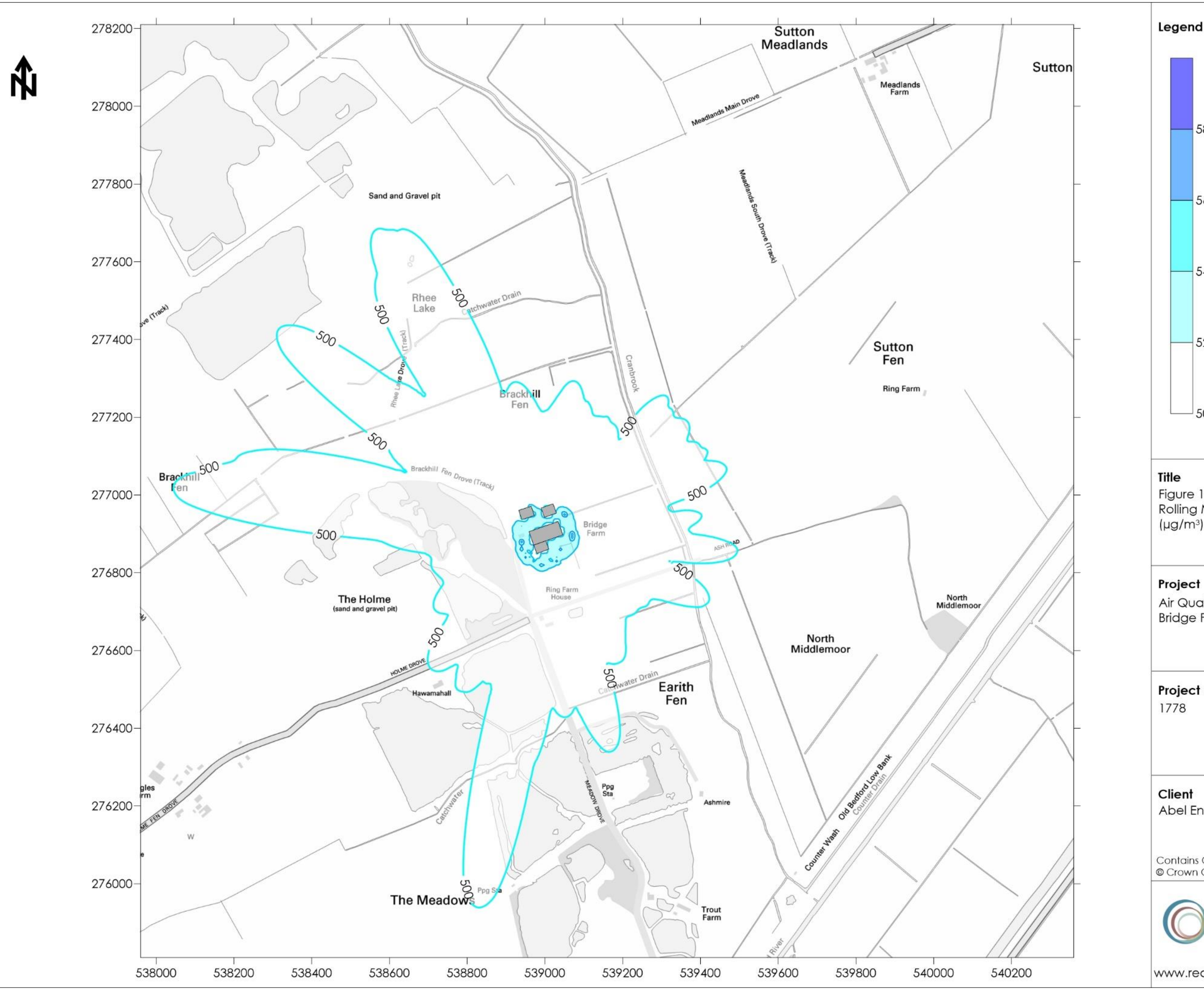

Title

Figure 14 - Predicted 8-hour Rolling Mean CO Concentrations (µg/m³) 2010 Meteorological Data

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