Environmental Permit Application – Bishops Stortford Sewage Treatment Works

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Executive summary

Under the Industrial Emissions Directive (IED), the anaerobic digestion assets at Bishop Stortford Sewage Treatment Works (STW) require an Environmental Permit (EP). The scope of anaerobic digestion activities includes all treatment stages and incorporates directly associated activities such as the operating combined heat and power (CHP) engine and boilers.

Thames Water Utilities Limited operates a STW near the town of Bishop Stortford, Hertfordshire (CM22 7QL). These operations include; one existing MAN CHP engine (with a thermal input capacity of 0.93 MWth), an existing Strebel duel-fuelled boiler (with a thermal input capacity of 0.8 MWth) and an existing Remeha duel-fuelled boiler (with a thermal input capacity of 0.8 MWth) as set out in the table below.

Medium Combustion Plant Information			
MCP specific identifier (emission source reference)	CHP engine 1 (A1)	Boiler 1 (A2)	Boiler 2 (A3)
12 - digit grid reference or latitude/longitude	E 550046 N 219743	E 550049 N 219761	E 550051 N 219759
Rated thermal input (MW) of the MCP	0.93	0.67	0.80
Type of MCP (diesel engine, gas turbine, other engine or other MCP)	CHP engine	Boiler	Boiler
Type of fuels used: gas oil (diesel), natural gas, gaseous fuels other than natural gas	Biogas	Dual fuelled (biogas / gas-oil). Modelled with biogas.	Dual fuelled (biogas / gas-oil). Modelled with biogas.
Date when the new MCP was first put into operation (DD/MM/YYYY)	2007	n/a[1]	n/a[1]
Sector of activity of the MCP or the facility in which it is applied (NACE code**)	5	5	5
Expected number of annual operating hours of the MCP and average load in use	Modelled continuously (i.e. 8,760 hours) at maximum load	Modelled continuously (i.e. 8,760 hours) at maximum load	Modelled continuously (i.e. 8,760 hours) at maximum load
Where the option of exemption under Article 6(8) is used the operator (as identified on Form A) should sign a declaration here that the MCP will not be operated more than the number of hours referred to in this paragraph	N / A	N / A	N / A

Note 1: Technically, both boilers are below the 1 MW threshold to be classified as medium combustion pant (MCP).

The Air Quality Impact Assessment presented within this report is required to support the EP application and assesses the potential for significant air quality effects from the operation of the CHP engine and boilers at the Bishop Stortford STW.

The potential impacts were determined for the following aspect:

- the potential impact on human health due to emissions of pollutants, including nitrogen dioxide (NO_2); carbon monoxide (CO); sulphur dioxide (SO_2), total volatile organic compounds (TVOC's) and particulate matter (PM_{10}, particles with an aerodynamic diameter of 10 microns or less and $PM_{2.5}$, particles with an aerodynamic diameter of 2.5 microns or less); and
- the potential impact on vegetation and ecosystems due to emissions of oxides of nitrogen (NOx) and SO_2.

Human receptors

The assessment indicates that the predicted modelled off-site concentrations and predicted concentrations at sensitive human receptors do not exceed any relevant long-term or short-term EQS.

The results indicates that for annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations, the respective process contributions (PCs) are either less than 1% of the relevant long-term environmental quality standard (EQS), or where the PC is greater than 1% (i.e. NO_2), the PEC is below 70% of the long-term EQS and the impact is considered 'not significant'.

It is noted the maximum annual mean NO_2 PC, predicted at R3, is elevated. Further analysis indicates that at R3, the CHP engine contributes approximately 82% of the annual mean NO_2 PC.

This assessment has been carried out on the assumption that the CHP engine and boilers operate continuously at maximum load throughout the year (i.e. 8,760 hours). This is a conservative assumption as, in practice, the CHP engine will have periods of shut-down and maintenance and may not always operate at maximum load. Furthermore, the boilers are unlikely to operate simultaneously and for more than 6,000 hours per year. The conservative approach adopted throughout the assessment means the predicted concentrations presented in this report are likely to be higher than would reasonably be expected.

For short-term NO_2, CO, SO_2 and fine particulate matter concentrations, the PCs are either less than 10% of the relevant EQS, or where the PC is greater than 10%, the corresponding PEC is below 70% of the short-term EQS and the impact is considered 'not significant'.

For annual mean and 24-hour mean TVOC concentrations at a sensitive human receptor location, the predicted environmental concentration (PEC) exceeds the relevant EQS for C_6H_6. This assessment assumes all TVOCs emitted by the combustion plant are C_6H_6 in the absence of EQSs for TVOC. This is an overly conservative assumption and C_6H_6 if present in the exhaust gases, would constitute only a very small proportion of total TVOC emissions (i.e. less than 1%). Therefore, informed by a wider understanding of the properties of biogas, the emissions of TVOCs is considered 'not significant'.

Therefore, when considering the conservative approach to the assessment and based on professional judgement, the emissions of assessed pollutants at sensitive human receptor locations and modelled off-site locations is considered 'not significant'.

Protected conservation areas

For critical levels, the results indicate that at the assessed Thorley Flood Pound Site of Special Scientific Interest (SSSI) and local nature sites, the annual mean NOx and SO_2 PCs are less than 1% and 100%, respectively, of the relevant critical level and the effect is considered 'insignificant' as per Environment Agency guidance (Environment Agency, 2023).

For the maximum 24-hour mean critical level for NOx, the results indicate that at the assessed Thorley Flood Pound SSSI and local nature sites, the PCs are less than 10% and 100%, respectively, of the relevant critical level and the effect is also considered 'insignificant' as per Environment Agency guidance (Environment Agency, 2023).

For critical loads, at the assessed local nature site, the PCs are less than 100% of the relevant critical load value for acid and nutrient nitrogen deposition and the impact can be described as 'insignificant' as per Environment Agency guidance (Environment Agency, 2023).

Summary

Based on the above assessment, it is concluded that the operation of the assessed combustion plant are acceptable from an air quality perspective.

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Appendices

1. Introduction

1.1 Background

Under the Industrial Emissions Directive (IED)[1] (European Union, 2010), the anaerobic digestion assets at Bishop Stortford Sewage Treatment Works (STW), require an Environmental Permit (EP). The scope of anaerobic digestion activities includes all treatment stages and incorporates directly associated activities such as the operating combined heat and power (CHP) gas engine and boilers.

Thames Water Utilities Limited (hereafter 'Thames Water') currently operates one existing MAN CHP engine (with a thermal input capacity of 0.93 MWth), an existing Strebel duel-fuelled[2] boiler (with a thermal input capacity of 0.8 MWth) and an existing Remeha duel-fuelled[2] boiler (with a thermal input capacity of 0.8 MWth) at its STW near the market town of Bishop Stortford, Hertfordshire (CM22 7QL) (hereafter 'the site'). Jacobs UK Limited (hereafter 'Jacobs') has carried out an Air Quality Impact Assessment (AQIA) on behalf of Thames Water to assess the potential impact of emissions from the existing CHP engine and boilers.

1.2 Study Outline

This AQIA is required to support the EP application and assesses the likely significant air quality effects of emissions to air from the CHP engine and boilers at the site. The air quality assessment has been carried out following the relevant Environment Agency guidance (Environment Agency, 2021; 2023). The AQIA considers:

- the potential impact on human health due to emissions of pollutants. The pollutants considered include nitrogen dioxide (NO_2); carbon monoxide (CO); sulphur dioxide (SO_2), total volatile organic compounds (TVOC's) and particulate matter (PM_{10}, particles with an aerodynamic diameter of 10 microns or less and $PM_{2.5}$, particles with an aerodynamic diameter of 2.5 microns or less); and
- the potential impact on vegetation and ecosystems due to emissions of oxides of nitrogen (NOx) and SO_2.

The site boundary (represented by the approximate site fenceline) is presented in Figure 1.

This report draws upon information provided from the following parties:

- Thames Water;
- SOCOTEC (responsible for air quality monitoring of the assessed CHP engine);
- ADM Ltd (meteorological data supplier);
- Ricardo Energy & Environment (responsible for air quality monitoring at Stansted Airport);
- Centre for Ecology and Hydrology (CEH);
- Department for Environment, Food and Rural Affairs (Defra);
- Uttlesford District Council; and
- East Hertfordshire District Council.

This report includes a description of the emission sources, description of methodology and significance criteria, a review of the baseline conditions including an exploration of the existing environment of the site and surrounding area, an evaluation of results and the potential impact of emissions on human health and protected conservation areas during operation and, finally, conclusions of the assessment.

1 European Directive 2010/75/EU.

2 Dual fuelled utilising biogas (primary fuel) or gas-oil.

2. Emission Sources

2.1 Emission Sources to Air

The location of the assessed CHP engine (emission point reference A1) and boilers (emission point reference A2 and A3) are presented in Figure 1.

The CHP engine and boilers (when utilising biogas) are fuelled by biogas generated from the site's anaerobic digestion process and emissions were modelled on this basis. As discussed previously, the boilers are a dual-fuel design and can run on biogas or gas-oil. However, for this assessment they have been modelled utilising biogas as this gives a worst-case scenario for emissions of NOx, typically the pollutant of main concern. The modelling only considers emissions from the CHP engine and boilers and no other emission points to air at the site have been included in the assessment. It should be noted that there is an on-site generator, which is only used in Triad or in an emergency and typically operates less than 100 hours per year. This generator does not form part of the scope for Environmental Permit and has therefore not been included in the assessment

Table 2-1 presents the emissions sources to air considered in this assessment.

Table 2-1: Combustion plant considered in this assessment

Parameters	MAN CHP engine (0.93 MWth)	Strebel boiler (0.67 MWth)	Remeha boiler (0.8 MWth)
Modelled fuel	Biogas	Biogas	Biogas
Emission point reference	A1	A2	A3

This assessment has been carried out on the assumption that the CHP engine and boilers operate continuously at maximum load throughout the year (i.e. 8,760 hours). This is a conservative assumption as, in practice, the CHP engine will have periods of shut-down and maintenance and may not always operate at maximum load. Furthermore, the boilers are unlikely to operate simultaneously and are unlikely to operate for more than 6,000 hours per year. However, for predicted modelled concentrations, it is assumed all assessed combustion plant operate continuously as this approach ensures that the worst-case or maximum long-term (i.e. annual mean) and short-term modelled concentrations are quantified (further consideration of this is provided in Appendix A).

2.2 Emissions Data

2.2.1 Emission concentration of pollutants

For the assessed CHP engine, the NOx emission concentration was obtained from on-site monitoring of the CHP engine (SOCOTEC, 2023). The CO and TVOC emission concentrations were derived from the Environment Agency's '*Guidance for monitoring landfill gas engine emissions*' (Environment Agency, 2010). For SO_2, in the absence of a specific emission limit value, the SO_2 emission concentration typically used in similar permit applications for biogas fuelled engines has been applied. Further consideration of this is provided in Appendix B. For particulates, in the absence of a specific emission limit value, the emission concentration was derived from a previous study of landfill gas engines (Land Quality Management Ltd, 2002).

For the boilers, as a worst-case approach to the assessment, the NOx and SO_2 emission concentrations are based on the emission limit value for existing medium combustion plant (MCP) (greater than 1 MWth) other than engines and gas turbines as regulated under the Medium Combustion Plant Directive (MCPD) EU/2015/2193[3] (European Union, 2015). This is a conservative approach as technically both boilers fall outside of the scope of MCPD as they are below the 1 MW threshold to be classified as MCP.

3 European Parliament and the Council of the European Union, Medium Combustion Plant Directive EU/2015/2193 of 25 November 2015 on the limitation of emissions of certain pollutants into the air from medium combustion plants and as transposed into Schedule

For CO and TVOC, in the absence of a specific emission limit value, the CO emission concentration was obtained from the value for natural gas from Defra's Process Guidance Note 1/3,*'Statutory Guidance for Boilers and Furnaces 20-50MW thermal input'* (Defra, 2012) and the TVOC emission concentration was derived from the Environment Agency's guidance '*Guidance for monitoring landfill gas engine emissions*', (Environment Agency, 2010).

2.2.2 Other emission parameters

For the CHP engine, the exhaust gas volumetric flow, oxygen and moisture content, efflux velocity and flue gas temperature were obtained from on-site monitoring of the assessed CHP engine (SOCOTEC, 2023).

For the boilers, the exhaust gas volumetric flow was determined using stoichiometric calculations based on the combustion of biogas fuel at the maximum thermal input rating of each boiler. In the absence of information regarding temperature, oxygen and moisture content of the boilers, the data used in the model is based on professional judgment acquired from previous work involving biogas fuelled boilers of a similar size.

The emissions inventory of releases to air from the CHP engine and boilers are provided in Appendix A.

25A of The Environmental Permitting (England and Wales) (Amendment) Regulations 2018 (United Kingdom (UK) Government, 2018.

3. Assessment Methodology

This section presents a summary of the methodology used for the assessment of the potential impacts of the site. A full description of the study inputs and assumptions are provided in Appendix A.

3.1 Assessment Location

For this assessment, 26 of the closest sensitive human receptors (such as residential properties, a canal barge mooring and a Public Right of Way (PRoW)) near the site were identified for modelling purposes. The location of these receptors are presented in Figure 2. There is an air quality management area (AQMA) in the vicinity of the site (see Section 4.2), which has also been included in the assessment.

In line with the Environment Agency guidance '*Air emissions risk assessment for your environmental permit*' (Environment Agency, 2023), it is necessary to identify protected conservation areas within the following distances from the site:

- European sites (i.e. Special Area of Conservation (SAC), Special Protection Area (SPA) and Ramsar sites) within 10 km; and
- Site of Special Scientific Interest (SSSI) and local nature sites (i.e. ancient woodlands, local wildlife sites (LWS) and national and local nature reserves (NNR and LNR)), within 2 km.

Based on these criteria; Thorley Flood Pound SSSl; Wallbury Plantation and Marsh LWS, Woodland by Raynham Road LWS, Thorley Washes LWS; Rushy Mead LWS; Twyfordbury Gravel Pit East LWS; Bishop's Stortford Cemetery LWS and Thorley Wash Meadow South LWS have been included in the assessment.

It should be noted some of the assessed protected conservation areas encompass the same geographic area. However, for the assessment against critical loads (see Section 5.2.2), all protected conservation areas have been assessed individually for completeness.

There are no European sites within 10 km of the site based on the CHP engine stack location.

The location of the assessed protected conservation areas are presented in Figure 3 and further details are set out in Appendix A.

3.2 Overall Methodology

The assessment was carried out using an atmospheric dispersion modelling technique. Atmospheric Dispersion Modelling System (ADMS) version 5.2.4 was used to model releases of the identified substances. The ADMS model predicts the dispersion of operational emissions from a specific source (e.g. a stack), and the subsequent concentrations over an identified area (e.g. at ground level across a grid of receptor points) or at specified points (e.g. a residential property). ADMS was selected because this model is fit for the purpose of modelling the emissions from the type of sources on-site (i.e. point source emissions from a combustion source) and is accepted as a suitable assessment tool by the Environment Agency.

The modelling assessment was undertaken in accordance with the Environment Agency guidance '*Air emissions risk assessment for your environmental permit*' (Environment Agency, 2023).

A summary of the dispersion modelling procedure is set out below.

1. Information on plant location and stack parameters were supplied by Thames Water (Thames Water, 2023). Information on the CHP engine and boilers were obtained from various sources as described in Section 2.2.
2. Five years of hourly sequential data recorded at Stansted Airport meteorological station (2016 – 2020 inclusive) were used for the assessment (ADM Ltd, 2021).
3. Information on the main buildings located on-site, that could influence dispersion of emissions from the boiler and flare stacks were estimated from Defra's environmental open-data applications and datasets (Defra, 2023a) and Google Earth (Google Earth, 2023).
4. The maximum predicted concentrations (at a modelled height of 1.5 m or 'breathing zone') at the assessed sensitive human receptor locations R1 – R21 (representing long-term exposure at residential properties and a canal barge mooring) were considered for the assessment of annual mean, 24-hour mean, 8-hour mean, 1-hour mean and 15-minute mean pollutant concentrations within the study area.

For receptors R22-R26 (representing a PRoW which runs adjacent to the western boundary of the site), only the 1-hour mean and 15-minute mean concentrations were considered. The maximum predicted concentrations at an off-site location in the vicinity of the site were considered for the assessment of short-term (1-hour and 15-minute mean) concentrations. For the considered AQMA (see Section 4.2), the annual mean NO_2 concentrations were considered only.

5. The above information was entered into the dispersion model.
6. The dispersion model was run to provide the Process Contribution (PC). The PC is the estimated maximum environmental concentration of substances due to releases from the process alone. The results were then combined with baseline concentrations (see Section 4.2) to provide the Predicted Environmental Concentration (PEC) of the substances of interest.
7. The PECs were then assessed against the appropriate environmental standards for air emissions for each substance set out in the Environment Agency's guidance (Environment Agency, 2023) document to determine the nature and extent of any potential adverse effects.
8. Modelled concentrations were processed using geographic information system (GIS) software (ArcMap 10.8.1) to produce contour plots of the model results. These are provided for illustrative purposes only; assessment of the model results was based on the numerical values outputted by the dispersion model on the model grid (see Figure 2) and at the specific receptor locations and were processed using Microsoft Excel.
9. The predicted concentrations of NOx and SO_2 were also used to assess the potential impact on critical levels and critical loads (i.e. acid and nutrient nitrogen deposition) (see Section 3.3.2) at the assessed protected conservation areas. Details of the deposition assessment methodology are provided in Appendix B.

In addition to the above, a review of existing ambient air quality in the area was undertaken to understand the baseline conditions at the site and at receptors within the study area. These existing conditions were determined by reviewing the monitoring data already available for the area and other relevant sources of information. The review of baseline air quality is set out in Section 4.

Where appropriate, a conservative approach has been adopted throughout the assessment to increase the robustness of the model predictions. In addition, an analysis of various sensitivity scenarios has also been carried out (see Section 5.3) to determine how changes to model parameters (e.g. differing surface roughness values or modelling without considering buildings) may impact on predicted concentrations at sensitive human receptors and off-site locations.

3.3 Assessment Criteria

3.3.1 Environmental Quality Standards: Human Receptors

In the UK, the focus on local air quality is reflected in the air quality objectives (AQOs) set out in the *Air Quality Strategy for England, Scotland, Wales and Northern Ireland* (AQS) (Defra and the Devolved Administrations, 2007). The AQS stipulates a number of air quality objectives for nine main air pollutants with respect to ambient levels of air quality (Defra, 2007). The AQOs are similar to the limit values that were transposed from the relevant EU directives into UK legislation by The *Air Quality Standards Regulations 2010* (UK Government, 2010). The objectives are based on the current understanding of health effects of exposure to air pollutants and have been specified to control health and environmental risks to an acceptable level. They apply to places where people are regularly present over the relevant averaging period. The objectives set for the protection of human health and vegetation of relevance to the project are summarised in Table 3-1. Relevant Environmental Assessment Levels (EALs) set out in the Environment Agency guidance (Environment Agency, 2023) are also included in Table 3-1 where these supplement the AQOs.

For the purposes of reporting, the AQOs and EALs have been collectively termed as Environmental Quality Standards (EQSs).

Table 3-1: Air quality objectives and environmental assessment levels

Pollutant	EQS (µg/m^3)	Concentration measured as
NO_2	40	Annual mean
	200	1-hour mean, not to be exceeded more than 18 times a year (99.79th percentile)
CO	10,000	Maximum daily 8 hour running mean (100th percentile)
	30,000	Maximum 1-hour mean (100th percentile)
SO_2	125	24-hour mean not to be exceeded more than 3 times a year (99.18th percentile)
	350	1-hour mean not to be exceeded more than 24 times a year (99.73rd percentile)
	266	15-minute mean not to be exceeded more than 35 times a year (99.9th percentile)
PM_{10}	40	Annual mean
	50	24-hour mean, not to be exceeded more than 35 times a year (90.41st percentile)
$PM_{2.5}$	20	Annual mean
TVOC[1]	5[2]	Annual mean
	30[2]	Maximum 24-hour mean (100th percentile)

Note 1: VOCs may contain a wide range of organic compounds and it is often difficult to determine or identify each and every compound present. The TVOC emissions from the assessed combustion plant will largely comprise methane (CH_4) which is not directly harmful to human health.
Note 2: For the purposes of this assessment, the annual mean and 24-hour mean AQO for benzene (C_6H_6) has been applied as it is a standard substitute that adequately represents a worst-case scenario for VOCs.

For the assessment of long-term average concentrations (i.e. the annual mean concentrations) at human receptors, impacts were described using the following criteria:

- if the PC is less than 1% of the long-term EQS, the contribution can be considered as 'insignificant' and not representative of a significant effect (i.e. not significant) (Environment Agency, 2021);
- if the PC is greater than 1% of the EQS but the PEC is less than 70% of the long-term air quality objective, based on professional judgement, this would be classed as 'not significant'; and
- where the PC is greater than 1% of the EQS and the PEC is greater than 70% of the EQS, professional judgement is used to determine the overall significance of the effect (i.e. whether the effect would be 'not significant' or 'significant'), taking account of the following:
    - the scale of the changes in concentrations;
    - whether or not an exceedance of an EQS is predicted to arise in the study area where none existed before, or an exceedance area is substantially increased as a result of the development; and
    - uncertainty, including the influence and validity of any assumptions adopted in undertaking the assessment.

For the assessment of short-term average concentrations (e.g. the 1-hour mean NO_2 concentrations, and the 15-minute, 1-hour and 24-hour mean SO_2 concentrations etc.), impacts were described using the following criteria:

- if the PC is less than 10% of the short-term EQS, this would be classed as 'insignificant' and not representative of a significant effect (i.e. not significant) (Environment Agency, 2021);
- if the PC is greater than 10% of the EQS but less than 20% of the headroom between the short-term background concentration and the EQS, based on professional judgement, this can also be described as not significant; and
- where the PC is greater than 10% of the EQS and 20% of the headroom, professional judgement is used to determine the overall significance of the effect (i.e. whether the effect would be not significant or significant) in line with the approach specified above for long-term average concentrations.

Environment Agency guidance recommends that further action will not be required if proposed emissions comply with Best Available Techniques Associated Emission Levels (BAT AELs) and resulting PECs do not exceed the relevant EQS (Environment Agency, 2023).

3.3.2 Environmental Quality Standards: Protected Conservation Areas

Critical levels

The environmental standards set for protected conservation areas of relevance to the project are summarised in Table 3-2 (Environment Agency, 2023).

Table 3-2: Air Quality Objectives and Environmental Assessment Levels for protected conservation areas

Pollutant	EQS (µg/m^3)	Concentration measured as
NOx	30	Annual mean limit value for the protection of vegetation (referred to as the "critical level")
	75	Maximum 24-hour mean for the protection of vegetation (referred to as the "critical level")
SO_2	10	Annual mean limit value for the protection of vegetation (referred to as the "critical level") where lichens or bryophytes are present
	20	Annual mean limit value for the protection of vegetation (referred to as the "critical level") where lichens or bryophytes are not present

Critical loads

Critical loads for pollutant deposition to statutorily designated habitat sites in the UK and for various habitat types have been published by the CEH and are available from the Air Pollution Information System (APIS) website. Critical Loads are defined on the APIS website (Centre for Ecology and Hydrology, 2023) as:

"a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge".

Compliance with these benchmarks is likely to result in no significant adverse effects on the natural environment at these locations. The critical loads for the designated habitat sites considered in this assessment are set out in Table 3-3.

For the assessed Thorley Flood Pound SSSI, the *Site Relevant Critical Loads* tool function on the APIS website was used. However, there was no critical load data available.

For the assessed local nature sites, the *Search by Location* function on the APIS website was used. Where the likely vegetation type inhabiting the assessed local nature site is unknown, the acid grassland (representing short vegetation type) and coniferous woodland (representing tall vegetation type) habitat feature were selected on the APIS website, which is generally the most sensitive short and tall vegetation type to nutrient nitrogen and acid deposition.

The critical loads for the designated habitat sites considered in this assessment are set out in Table 3-3.

Table 3-3: Critical loads for modelled protected conservation areas

Rec ref	Protected conservation area	Habitat feature applied	Vegetation type (for deposition velocity)	Critical load Acid deposition (kEqH+/ha/year)			Nitrogen deposition(kg N/ha/year)
				CLMaxS	CLMinN	CLMax N	Minimum
H1	Thorley Flood Pound SSSI	Fen, marsh and swamp (Carex riparia swamp)	Short	No critical load data available			No critical load data available
H2	Wallbury Plantation and Marsh LWS	Acid grassland	Short	4.140	0.223	4.363	5
		Coniferous woodland	Tall	8.336	0.142	8.478	5
H3	Woodland by Raynham Road LWS	Coniferous woodland	Tall	10.806	0.214	11.020	5
H4		Acid grassland	Short	4.140	0.223	4.363	5

Rec ref	Protected conservation area	Habitat feature applied	Vegetation type (for deposition velocity)	Critical load Acid deposition (kEqH+/ha/year)			Nitrogen deposition(kg N/ha/year)
				CLMaxS	CLMinN	CLMax N	Minimum
	Thorley Washes LWS	Coniferous woodland	Tall	8.336	0.142	8.478	5
H5a	Rushy Mead LWS	Acid grassland	Short	4.140	0.223	4.363	5
		Coniferous woodland	Tall	8.336	0.142	8.478	5
H5b		Acid grassland	Short	4.140	0.223	4.363	5
		Coniferous woodland	Tall	8.336	0.142	8.478	5
H5c		Acid grassland	Short	4.140	0.223	4.363	5
		Coniferous woodland	Tall	8.336	0.142	8.478	5
H6	Twyfordbury Gravel Pit East LWS	Coniferous woodland	Tall	8.336	0.142	8.478	5
H7	Bishops Stortford Cemetery LWS	Acid grassland	Short	4.140	0.223	4.363	5
		Coniferous woodland	Tall	8.365	0.142	8.507	5
H8	Thorley Wash Meadow South LWS	Acid grassland	Short	4.140	0.295	4.435	5

Critical load functions for acid deposition are specified on the basis of both nitrogen and sulphur derived acid. The critical load function contains a value for sulphur derived acid and two values for nitrogen derived acid deposition (a minimum and maximum value). The APIS website provides advice on how to calculate the PC (i.e. emissions from the modelled process alone) and the PEC (i.e. the PC added to the existing deposition) as a percentage of the acid critical load function and how to determine exceedances of the critical load function. This guidance was adopted for this assessment. The minimum of the range of nitrogen critical loads was used for the assessment in line with the advice on the APIS website (Centre for Ecology and Hydrology, 2023).

Significance Criteria – SSSI

With regard to concentrations at the assessed designated habitat site, the Environment Agency guidance (Environment Agency, 2023) states emissions can be described as 'insignificant' and no further assessment is required (including the need to calculate PECs) if:

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

Where appropriate, the significance of the predicted long-term (annual mean) concentrations or deposition at protected conservation areas were determined in line with Environment Agency guidance (Environment Agency, 2023) summarised as follows:

- Where the PC is less than 1% of the relevant critical level or critical load, the emission is not likely to have a significant effect alone or in combination irrespective of the existing concentrations or deposition rates.
- Where the PC is above 1%, further consideration of existing background concentrations or deposition rates is required, and where the total concentration or deposition is less than 70% of the critical level or critical load, calculated in combination with other committed projects or developments as appropriate, the emission is not likely to have a significant effect.

- Where the contribution is above 1%, and the total concentration or deposition rate is greater than 70% of the critical level or critical load, either alone or in combination with other committed projects or developments, then this may indicate a significant effect and further consideration is likely to be required.

The above approach is used to give a clear definition of what effects can be disregarded as 'insignificant', and which need to be considered in more detail in relation to the predicted annual mean concentrations or deposition.

For short-term mean concentrations (i.e. the 24-hour mean critical level for NOx) where the PC is less than 10% of the critical level then it would be regarded as 'insignificant'. A potentially significant effect would be identified where the short-term PC from the modelled sources would lead to the total concentration exceeding the critical level. Further consideration is likely to be required in this situation.

Significance Criteria – Local nature sites

The relevant significance criteria for these protected conservation areas are set out below.

With regard to concentrations or deposition rates at local nature sites, the Environment Agency guidance (Environment Agency, 2023) states emissions can be described as 'insignificant' and no further assessment is required (including the need to calculate PECs) if:

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

The above approach is used to give a clear definition of what effects can be disregarded as 'insignificant', and which need to be considered in more detail in relation to the predicted annual mean concentrations or deposition.

4. Existing Environment

4.1 Location

The site is situated approximately 2 km southeast from the centre of the market town of Bishops Stortford within the administrative boundary of Uttlesford District Council and adjacent to the administrative boundary of East Herefordshire District Council. The area surrounding the site generally comprises agricultural land use interspersed with residential properties. The M11 motorway is approximately 0.2 km southeast of the site at its closest point. Stansted Airport is approximately 3 km northeast of the site.

There are several sensitive human receptors in the vicinity of the site in respect of potential air emissions from the process. The most relevant sensitive receptors have been identified from local mapping and are summarised in Appendix A and presented in Figure 2. The nearest modelled residential property is approximately 180 m north of the CHP engine.

4.2 Local Air Quality Management

A review of baseline air quality was carried out prior to undertaking the air quality assessment. This was carried out to determine the availability of baseline air quality data recorded in the vicinity of the site and also if data from other regional or national sources such as the UK Air Information Resource (UK-AIR) (Defra, 2023b) website could be used to represent background concentrations of the relevant pollutants in the vicinity of the site.

As part of the Local Air Quality Management (LAQM) process, Uttlesford District Council and East Hertfordshire District Council have declared a total of four AQMAs across their respective administrative boundaries. The closest AQMA termed 'Bishops Stortford AQMA' was declared by East Hertfordshire District Council in 2007 for elevated concentrations of annual mean NO_2. This AQMA is approximately 1.5 km north-northwest of the CHP engine at its closest point and has been included in the assessment.

Uttlesford District Council and East Hertfordshire District Council also carry out regular assessments and monitoring of air quality within the respective boroughs as part of the LAQM process. The most recent Air Quality Annual Status Reports (Uttlesford District Council, 2021) (East Hertfordshire District Council, 2021) and other relevant sources were reviewed to determine the concentrations of NO_2 and particulates in the vicinity of the site. It should be noted none of the other assessed pollutants are monitored by East Hertfordshire District Council and Uttlesford District Council.

Furthermore, Ricardo Energy and Environment (Ricardo Energy & Environment, 2023) on behalf of Stansted Airport Ltd, carry out air quality monitoring of NO_2 and particulates at the nearby Stansted Airport.

Table 4-1 presents information on the nearest monitoring locations to the site and the corresponding 2019 monitored annual mean NO_2 and particulate concentrations, as this dataset is the latest available representative data not affected by the Covid pandemic and related travel restrictions.

Table 4-1: Nearest monitoring locations to the site

Site ID	Description	Site type	Location	Distance and direction from the boiler stacks	Pollutants monitored	2019 Annual mean concentration (µg/m³)
Automatic monitoring						
Stansted 3	East of High House	-	E 555933 N 223359	6.91 km, ENE	NO_2	19.8 µg/m³
					PM_{10}	15.6 µg/m³
					$PM_{2.5}$	9.7 µg/m³
Non-automatic monitoring (diffusion tubes)						

Site ID	Description	Site type	Location	Distance and direction from the boiler stacks	Pollutants monitored	2019 Annual mean concentration (µg/m^3)
EH17, EH35 & EH36 (East Hertfordshire District Council)	Dunmow Road, Bishops Stortford	Kerbside	E 549364 N 221215	1.62 km, NNW	NO_2	60.7 µg/m^3
EH19, EH39 & EH40 (East Hertfordshire District Council)	London Road, Bishops Stortford	Kerbside	E 549250 N 221200	1.66 km, NNW	NO_2	59.8 µg/m^3
UT024 (Uttlesford District Council)	Takeley Hill, Hatfield Forest	Rural	E 554671 N 221010	4.79 km, ENE	NO_2	11.4 µg/m^3
UT009 (Uttlesford District Council)	Burton End	Roadside	E 552403 N 223965	4.84 km, NNE	NO_2	30.1 µg/m^3

The automatic and non-automatic monitoring locations presented in Table 4-1 are not considered representative of conditions experienced at the site due to the monitoring site type and / or respective distance from the site. Non-automatic monitoring locations EH17, EH35 & EH36 are located adjacent to the A1250 and non-automatic monitoring locations EH19, EH39 & EH40 are located adjacent to the A1060.

For the assessed pollutants, information on background air quality in the vicinity of the site were obtained from Defra background map datasets (Defra, 2023b). The 2018-based background maps by Defra are estimates based upon the principal local and regional sources of emissions and ambient monitoring data. For SO_2 and CO concentrations, the 2001-based background maps were used. For TVOC concentrations, the 2010-based background maps for C_6H_6 were used. These background concentrations are presented in Table 4-2.

As it is necessary to determine the potential impact of emissions from the site at the assessed protected conservation areas, the background concentrations of NOx and SO_2 were also identified. These background concentrations were also obtained from the Defra background map datasets (Defra, 2023b) and are displayed in Table 4-2.

Table 4-2: Background concentrations: adopted for use in assessment for human receptors and protected conservation areas

Pollutant	Annual mean concentration (µg/m^3)	Description
Human receptors		
NO_2	9.8 – 14.8	Defra 1 km x 1 km background map value for the assessed sensitive human receptor locations, 2023 map concentration
CO	134 - 144	Defra 1 km x 1 km background map value for the assessed sensitive human receptor locations, 2001 based map concentration
PM_{10}	14.0 – 16.8	Defra 1 km x 1 km background map value for the assessed sensitive human receptor locations, 2023 map concentration
$PM_{2.5}$	9.0 – 10.2	Defra 1 km x 1 km background map value for the assessed sensitive human receptor locations, 2023 map concentration
SO_2	3.6 – 4.1	Defra 1 km x 1 km background map value for the assessed sensitive human receptor locations, 2001 based map concentration
C_6H_6	0.25 – 0.31	Defra 1 km x 1 km background map value for the assessed sensitive human receptor locations, 2010 map concentration
Protected conservation areas		
NOx	12.4 – 16.5	Defra 1 km x 1 km background map value for the assessed protected conservation areas, 2023 map concentration
SO_2	3.6 – 4.0	Defra 1 km x 1 km background map value for the assessed sensitive human receptor locations, 2001based map concentration

The long-term background concentrations were doubled to estimate the short-term background concentrations in line with the Environment Agency guidance (Environment Agency, 2023).

4.3 Existing Deposition Rates

Existing acid and nutrient nitrogen deposition levels were obtained from APIS (Centre for Ecology and Hydrology, 2023). As a conservative approach to the assessment, it is assumed the vegetation type selected is present at the specific modelled location within the assessed protected conservation area. The existing deposition values at the assessed ecological designations are set out in Table 4-3.

Table 4-3: Existing deposition at modelled habitat sites

Rec ref	Protected conservation area	Vegetation type (for deposition velocity)	Existing deposition rates		
			Existing acid deposition (kEqH+/ha/year)		Existing nutrient N deposition (kg N/ha/year)
			Nitrogen	Sulphur	Nitrogen
H1	Thorley Flood Pound SSSI	Short	-	-	17.50
H2	Wallbury Plantation and Marsh LWS	Short	1.22	0.13	17.15
		Tall	2.20	0.16	30.82
H3	Woodland by Raynham Road LWS	Tall	2.27	0.16	31.84
H4	Thorley Washes LWS	Short	1.22	0.13	17.15
		Tall	2.20	0.16	30.82
H5a	Rushy Mead LWS	Short	1.22	0.13	17.15
		Tall	2.20	0.16	30.82
H5b		Short	1.22	0.13	17.15
		Tall	2.20	0.16	30.82
H5c		Short	1.22	0.13	17.15
		Tall	2.20	0.16	30.82
H6	Twyfordbury Gravel Pit East LWS	Tall	2.20	0.16	30.82
H7	Bishops Stortford Cemetery LWS	Short	1.32	0.14	18.51
		Tall	2.34	0.18	32.80
H8	Thorley Wash Meadow South LWS	Short	1.22	0.13	17.15

5. Results

5.1 Human Receptors

The results presented below are the maximum modelled concentrations predicted at any of the 26 assessed sensitive human receptor locations and the maximum modelled concentrations at any off-site location for the five years of meteorological data used in the study. Furthermore, the maximum annual mean NO_2 concentration at the assessed AQMA is also discussed.

The results of the dispersion modelling are set out in Table 5-1, which presents the following information:

- EQS (i.e. the relevant air quality standard);
- estimated annual mean background concentration (see Section 4) that is representative of the baseline;
- PC, the maximum modelled concentrations due to the emissions from the assessed combustion plant;
- PEC, the maximum modelled concentration due to process emissions combined with estimated baseline concentrations;
- PC and PEC as a percentage of the EQS; and
- PC as a percentage of headroom (i.e. the PC as a percentage of the difference between the short-term background concentration and the EQS, for short-term predictions only).

The full results at assessed human receptor locations are presented in Appendix C.

Table 5-1: Results of detailed assessment

Pollutant	Averaging period	Assessment location	Location where maximum PC predicted	EQS (µg/m^3)	Baseline air quality level (µg/m^3)	PC (µg/m^3)	PEC (µg/m^3)	PC / EQS (%)	PEC / EQS (%)	PC as a percentage of headroom (%)
CO	Maximum 8-hour running mean	Sensitive locations	R2	10,000	287	78.5	365.4	0.8%	3.7%	0.8%
	Maximum 1-hour mean	Maximum off-site	E 549977 N 219791	30,000	287	379.5	666.3	1.3%	2.2%	1.3%
		Sensitive locations	R3	30,000	287	118.3	405.2	0.4%	1.4%	0.4%
NO_2	Annual mean	Sensitive locations	R3	40	14.8	4.9	19.7	12.2%	49.2%	-
		Sensitive locations	Bishops Stortford AQMA	40	-	0.1	-	0.3%	-	-
	1-hour mean (99.79th percentile)	Maximum off-site	E 549977 N 219791	200	26.8	108.9	135.7	54.5%	67.9%	62.9%
		Sensitive locations	R3	200	29.6	35.3	64.8	17.6%	32.4%	20.7%
SO_2	24-hour mean (99.18th percentile)	Sensitive locations	R3	125	7.3	17.6	25.0	14.1%	20.0%	15.0%
	1-hour mean (99.73rd percentile)	Maximum off-site	E 549977 N 219791	350	7.3	94.0	101.3	26.8%	28.9%	27.4%
		Sensitive locations	R3	350	7.3	35.8	43.1	10.2%	12.3%	10.4%
	15-minute mean (99.9th percentile)	Maximum off-site	E 549977 N 219791	266	7.3	105.5	112.8	39.7%	42.4%	40.8%
		Sensitive locations	R3	266	7.3	46.4	53.8	17.5%	20.2%	18.0%
PM_{10}	Annual mean	Sensitive locations	R3	40	16.6	0.06	16.6	0.1%	41.6%	0.2%
	24-hour mean (90.41st percentile)	Sensitive locations	R3	50	33.2	0.20	33.4	0.4%	66.8%	1.2%
$PM_{2.5}$	Annual mean	Sensitive locations	R3	20	10.1	0.06	10.2	0.3%	51.0%	0.6%

Pollutant	Averaging period	Assessment location	Location where maximum PC predicted	EQS ($\mu g/m^3$)	Baseline air quality level ($\mu g/m^3$)	PC ($\mu g/m^3$)	PEC ($\mu g/m^3$)	PC / EQS (%)	PEC / EQS (%)	PC as a percentage of headroom (%)
TVOC	Annual mean	Sensitive locations	R3	5 (C_6H_6)	0.3	9.8	10.1	196.7%	202.6%	208.9%
	Maximum 24-hour mean	Sensitive locations	R2	30 (C_6H_6)	0.6	113.9	114.5	379.6%	381.6%	387.5%

Note 1: For annual mean NO_2, PM_{10} and $PM_{2.5}$ and TVOC concentrations, 24-hour mean PM_{10} and SO_2 concentrations and 8-hour mean CO concentrations, R22 – R26 have been omitted from analysis as these receptor locations represent a PRoW (i.e. short-term exposure only). The full results are presented in Appendix C.

The results in Table 5-1 indicate that the predicted modelled off-site concentrations and predicted concentrations at sensitive human receptors do not exceed any relevant long-term or short-term EQS.

Table 5-1 indicates that for annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations, the respective PCs are either less than 1% of the relevant long-term EQS, or where the PC is greater than 1% (i.e. NO_2), the PEC is below 70% (i.e. 49.2%) of the long-term EQS and the impact is considered 'not significant'.

It is noted the maximum annual mean NO_2 PC, predicted at R3, which represents a residential property adjacent to the northern boundary of the site, is elevated. Further analysis indicates that at R3, the CHP engine contributes approximately 82% of annual mean NO_2 PCs.

This assessment has been carried out on the assumption that the CHP engine and boilers operate continuously at maximum load throughout the year (i.e. 8,760 hours). This is a conservative assumption as, in practice, the CHP engine will have periods of shut-down and maintenance and may not always operate at maximum load. Furthermore, the boilers are unlikely to operate simultaneously and for more than 6,000 hours per year. The conservative approach adopted throughout the assessment means the predicted concentrations presented in Table 5-1 are likely to be higher than would reasonably be expected.

For short-term NO_2, CO, SO_2 and particulate concentrations, the PCs are either less than 10% of the relevant EQS, or where the PC is greater than 10%, the corresponding PEC is below 70% of the short-term EQS and the impact is considered 'not significant'.

For annual mean TVOC concentrations at a sensitive human receptor location, the maximum PC of 9.8 μg/m^3 is predicted at R3. The corresponding PEC exceeds the annual mean EQS for C_6H_6.

For maximum 24-hour mean TVOCs concentrations at a sensitive human receptor location, the maximum PEC (predicted at R2) is 114.5 μg/m^3, which exceeds the 24-hour mean EQS for C_6H_6. This assessment assumes all TVOCs emitted by the combustion plant are C_6H_6 in the absence of EQSs for TVOC. This is an overly conservative assumption and C_6H_6 if present in the exhaust gases, would constitute only a very small proportion of total TVOC emissions (i.e. less than 1%). Therefore, informed by a wider understanding of the properties of biogas, the emissions of TVOCs is considered 'not significant'.

Isopleths (see Figures 4 and 5) have been produced for annual mean and 1-hour mean (99.79th percentile) NO_2 concentrations. The figures are based on the year of meteorological data which resulted in the highest PC at a sensitive human receptor location.

5.2 Protected Conservation Areas

5.2.1 Assessment against Critical Levels

The environmental effects of releases from the site at the assessed protected conservation areas has been determined by comparing predicted concentrations of released substances with the EQSs for the protection of vegetation (critical levels) (see Table 3-2). The results of the detailed modelling at the assessed protected conservation areas are shown in Table 5-2. The results presented are the maximum predicted concentrations at the modelled locations for the five years of meteorological data used in the study area.

For SO_2 PCs, the relevant EQS was based on the assumption that lichens and bryophytes were present at the assessed protected conservation areas, therefore adopting the lower critical level of 10 μg/m^3 (compared to 20 μg/m^3) as a conservative approach.

Table 5-2: Results of detailed assessment at assessed protected conservation sites for annual mean NOx and SO_2 concentrations and for maximum 24-hour mean NOx concentrations

Rec ref	Protected Conservation Area	EQS (μg/m^3)	Background concentration (μg/m^3)	PC (μg/m^3)	PEC (μg/m^3)	PC/EQS (%)	PEC/EQS (%)
Annual mean NOx concentrations							
H1	Thorley Flood Pound SSSI	30	12.4	0.14	12.5	0.5%	41.8%

Rec ref	Protected Conservation Area	EQS (µg/m^3)	Background concentration (µg/m^3)	PC (µg/m^3)	PEC (µg/m^3)	PC/EQS (%)	PEC/EQS (%)
H2	Wallbury Plantation and Marsh LWS		12.4	0.18	12.6	0.6%	42.0%
H3	Woodland by Raynham Road LWS		16.5	0.18	16.6	0.6%	55.5%
H4	Thorley Washes LWS		13.7	0.26	13.9	0.9%	46.4%
H5a	Rushy Mead LWS		13.7	1.92	15.6	6.4%	51.9%
H5b			13.7	2.00	15.7	6.7%	52.2%
H5c			13.7	2.28	15.9	7.6%	53.1%
H6	Twyfordbury Gravel Pit East LWS		13.7	1.43	15.1	4.8%	50.3%
H7	Bishops Stortford Cemetery LWS		13.7	0.17	13.9	0.6%	46.2%
H8	Thorley Wash Meadow South LWS		12.1	0.09	12.2	0.3%	40.6%
Annual mean SO_2 concentrations							
H1	Thorley Flood Pound SSSI	10	3.7	0.05	3.7	0.5%	37.3%
H2	Wallbury Plantation and Marsh LWS		3.7	0.06	3.7	0.6%	37.4%
H3	Woodland by Raynham Road LWS		3.6	0.06	3.7	0.6%	36.8%
H4	Thorley Washes LWS		4.0	0.09	4.1	0.9%	41.2%
H5a	Rushy Mead LWS		4.0	0.65	4.7	6.5%	46.8%
H5b			4.0	0.68	4.7	6.8%	47.1%
H5c			4.0	0.78	4.8	7.8%	48.1%
H6	Twyfordbury Gravel Pit East LWS		4.0	0.49	4.5	4.9%	45.2%
H7	Bishops Stortford Cemetery LWS		4.0	0.06	4.1	0.6%	40.8%
H8	Thorley Wash Meadow South LWS		3.6	0.03	3.6	0.3%	36.1%
Maximum 24-hour mean NOx concentrations							
H1	Thorley Flood Pound SSSI	75	24.8	5.9	30.7	7.8%	40.9%
H2	Wallbury Plantation and Marsh LWS		24.8	8.0	32.8	10.6%	43.7%
H3	Woodland by Raynham Road LWS		32.9	2.4	35.4	3.3%	47.2%
H4	Thorley Washes LWS		27.3	12.6	39.9	16.8%	53.2%
H5a	Rushy Mead LWS		27.3	23.5	50.8	31.4%	67.8%
H5b			27.3	32.3	59.6	43.0%	79.4%
H5c			27.3	40.9	68.2	54.6%	91.0%
H6	Twyfordbury Gravel Pit East LWS		27.3	37.8	65.1	50.4%	86.8%
H7	Bishops Stortford Cemetery LWS		27.4	2.9	30.3	3.8%	40.3%

Rec ref	Protected Conservation Area	EQS (µg/m^3)	Background concentration (µg/m^3)	PC (µg/m^3)	PEC (µg/m^3)	PC/EQS (%)	PEC/EQS (%)
H8	Thorley Wash Meadow South LWS		24.2	4.5	28.7	6.0%	38.2%

The results in Table 5-2 indicate that at the assessed Thorley Flood Pound SSSI and local nature sites, the annual mean NOx and SO_2 PCs are less than 1% and 100%, respectively, of the relevant critical level and the effect is considered 'insignificant' as per Environment Agency guidance (Environment Agency, 2023).

For the maximum 24-hour mean critical level for NOx, the results indicate that at the assessed Thorley Flood Pound SSSI and local nature sites, the PCs are less than 10% and 100%, respectively, of the relevant critical level and the effect is also considered 'insignificant' as per Environment Agency guidance (Environment Agency, 2023).

5.2.2 Assessment against Critical Loads

The rate of deposition of acidic compounds and nitrogen containing species have been estimated at the assessed protected conservation areas. This allows the potential for adverse effects to be evaluated by comparison with critical loads for acid and nutrient nitrogen deposition. The assessment took account of emissions of NOx and SO_2 only. As discussed previously, no critical load data was available for Thorley Flood Pound SSSI.

Critical load functions for acid deposition are specified on the basis of both nitrogen-derived acid and sulphur-derived acid. This information, including existing deposition levels at habitat sites, is available from APIS (Centre for Ecology and Hydrology, 2023). Further information on the assessment of deposition is provided in Appendix B. The full detailed modelled results are displayed in Table 5-3 and Table 5-4.

Table 5-3: Modelled acid deposition at assessed protected conservation areas

Ref	Habitat	Vegetation type (for deposition velocity)	Critical load (CL) (kEqH+/ha/year)			Existing acid deposition (kEqH+/ha/year)					
			CLMaxS	CLMinN	CLMaxN	Existing deposition (N)	Existing deposition (S)	PC	PEC	PC/CL (%)	PEC/CL (%)
H1	Thorley Flood Pound SSSI	Short	No critical load data available			-	-	0.007	-	-	-
H2	Wallbury Plantation and Marsh LWS	Short	4.140	0.223	4.363	1.22	0.13	0.009	1.36	0.2%	31%
		Tall	8.336	0.142	8.478	2.20	0.16	0.017	2.38	0.2%	28%
H3	Woodland by Raynham Road LWS	Tall	10.806	0.214	11.020	2.27	0.16	0.017	2.45	0.2%	22%
H4	Thorley Washes LWS	Short	4.140	0.223	4.363	1.22	0.13	0.013	1.36	0.3%	31%
		Tall	8.336	0.142	8.478	2.20	0.16	0.025	2.39	0.3%	28%
H5a	Rushy Mead LWS	Short	4.140	0.223	4.363	1.22	0.13	0.091	1.44	2.1%	33%
		Tall	8.336	0.142	8.478	2.20	0.16	0.182	2.54	2.1%	30%
H5b		Short	4.140	0.223	4.363	1.22	0.13	0.095	1.45	2.2%	33%
		Tall	8.336	0.142	8.478	2.20	0.16	0.190	2.55	2.2%	30%
H5c		Short	4.140	0.223	4.363	1.22	0.13	0.109	1.46	2.5%	33%
		Tall	8.336	0.142	8.478	2.20	0.16	0.218	2.58	2.6%	30%
H6	Twyfordbury Gravel Pit East LWS	Tall	8.336	0.142	8.478	2.20	0.16	0.137	2.50	1.6%	29%
H7	Bishops Stortford Cemetery LWS	Short	4.140	0.223	4.363	1.32	0.14	0.008	1.47	0.2%	34%
		Tall	8.365	0.142	8.507	2.34	0.18	0.017	2.54	0.2%	30%
H8	Thorley Wash Meadow South LWS	Short	4.140	0.295	4.435	1.22	0.13	0.004	1.35	0.1%	31%

Table 5-4: Modelled nitrogen deposition at assessed protected conservation area

Ref	Habitat	Vegetation type (for deposition velocity)	Minimal Critical Load (CL)	Existing nutrient deposition (kgN/ha-year)				
				Existing deposition	PC	PEC	PC/CL (%)	PEC/CL(%)
H1	Thorley Flood Pound SSSI	Short	-	17.50	0.014	17.51	-	-
H2	Wallbury Plantation and Marsh LWS	Short	5	17.15	0.018	17.17	0.4%	343%
		Tall	5	30.82	0.036	30.86	0.7%	617%
H3	Woodland by Raynham Road LWS	Tall	5	31.84	0.035	31.88	0.7%	638%
H4	Thorley Washes LWS	Short	5	17.15	0.026	17.18	0.5%	344%
		Tall	5	30.82	0.052	30.87	1.0%	617%
H5a	Rushy Mead LWS	Short	5	17.15	0.193	17.34	3.9%	347%
		Tall	5	30.82	0.386	31.21	7.7%	624%
H5b		Short	5	17.15	0.201	17.35	4.0%	347%
		Tall	5	30.82	0.403	31.22	8.1%	624%
H5c		Short	5	17.15	0.230	17.38	4.6%	348%
		Tall	5	30.82	0.459	31.28	9.2%	626%
H6	Twyfordbury Gravel Pit East LWS	Tall	5	30.82	0.289	31.11	5.8%	622%
H7	Bishops Stortford Cemetery LWS	Short	5	18.51	0.017	18.53	0.3%	371%
		Tall	5	32.80	0.035	32.83	0.7%	657%
H8	Thorley Wash Meadow South LWS	Short	5	17.15	0.009	17.16	0.2%	343%

The results in Table 5-3 and Table 5-4 indicate that at the assessed local nature sites, the PCs are less than 100% of the relevant critical load value for acid and nutrient nitrogen deposition and the impact can also be described as 'insignificant' as per Environment Agency guidance (Environment Agency, 2023). As discussed previously, no critical load data was available on the APIS website (Centre for Ecology and Hydrology, 2023) for Thorley Flood Pound SSSI.

It should be noted acid and nitrogen deposition rates currently exceed their relevant critical loads at the majority of assessed protected conservation areas. However, this is a relatively common situation at protected conservation areas across the UK due to the high baseline deposition rates.

5.3 Sensitivity Analysis

A sensitivity study was undertaken to see how changes to the surface roughness and omission of the buildings in the 2018 model (which predicted the highest annual mean NO_2 concentrations at sensitive human receptor locations) and 2017 model (which predicted the highest 1-hour mean NO_2 concentrations at modelled off-site locations) and 2019 model (which predicted the highest 1-hour mean NO_2 concentrations at sensitive human receptor locations) may impact on predicted concentrations at sensitive human receptors and off-site locations. The results of the sensitivity analysis are presented in Table 5-5 to Table 5-7.

Table 5-5: Sensitivity analysis - fixed surface roughness of 0.1 m

Pollutant	Averaging period	Assessment location	Original PC (surface roughness 0.4 m) (µg/m³)	Surface roughness length 0.1 m				
				PC (µg/m³)	PEC (µg/m³)	PC/EQS	PEC/EQS	% difference in PC/EQS compared to original
NO_2	Annual mean	Sensitive locations	4.9	5.1	19.9	12.8%	49.8%	0.6%
	1 hour mean (99.79th percentile)	Maximum off-site	108.9	152.6	179.4	76.3%	89.7%	21.8%
		Sensitive locations	35.3	51.6	61.5	16.0%	30.8%	-1.7%

The results in Table 5-5 indicate that the change to maximum predicted annual mean concentrations for NO_2 is negligible when using a surface roughness value of 0.1 m compared to the original value of 0.4 m. For 1-hour mean (99.79th percentile) NO_2 concentrations at an off-site location, the PC is higher and at a sensitive human receptor location, the PC is lower. However, a surface roughness of 0.1 m (representing root crops) is not considered representative of the site and surrounding area.

Table 5-6: Sensitivity analysis - fixed surface roughness of 1 m

Pollutant	Averaging period	Assessment location	Original PC (surface roughness 0.4 m) (µg/m³)	Surface roughness length 1 m				
				PC (µg/m³)	PEC (µg/m³)	PC/EQS	PEC/EQS	% difference in PC/EQS compared to original
NO_2	Annual mean	Sensitive locations	4.9	4.6	19.4	11.5%	48.4%	-0.7%
	1 hour mean (99.79th percentile)	Maximum off-site	108.9	71.7	98.4	35.8%	49.2%	-18.6%
		Sensitive locations	35.3	28.9	58.5	14.5%	29.2%	-3.2%

The results in Table 5-6 indicate that the change to maximum predicted annual mean concentrations for NO_2 is negligible when using a surface roughness value of 1 m compared to the original value of 0.4 m. For 1-hour mean (99.79th percentile) NO_2 concentrations at an off-site location and sensitive human receptor locations, the PCs were lower modelling with an increased surface roughness value of 1 m. However, a surface roughness of 1 m (representing a large city centre location with built-up areas and tall buildings) is not considered representative of the site and surrounding area.

Table 5-7: Sensitivity analysis - no buildings

Pollutant	Averaging period	Assessment location	Original PC (with buildings) (µg/m^3)	No buildings				
				PC (µg/m^3)	PEC (µg/m^3)	PC/EQS	PEC/EQS	% difference in PC/EQS compared to original
NO_2	Annual mean	Sensitive locations	4.9	4.4	19.2	11.1%	48.1%	-1.1%
	1 hour mean (99.79th percentile)	Maximum off-site	108.9	75.8	102.6	37.9%	51.3%	-16.6%
		Sensitive locations	35.3	32.0	61.5	16.0%	30.8%	-17.6%

The results in Table 5-7 indicate that the differences between the maximum predicted concentrations with and without the buildings is such that including buildings within the model is the preferred option for this study, to maintain a more realistic approach.

6. Conclusions

This report has assessed the potential air quality impacts associated with the operation of the biogas fuelled CHP engine and boilers at the Bishop Stortford STW. The predicted impacts were assessed against the relevant air quality standards and guidelines for the protection of human health and protected conservation areas.

6.1 Human receptors

The assessment indicates that that, the predicted modelled off-site concentrations and predicted concentrations at sensitive human receptors do not exceed any relevant long-term or short-term EQS.

The results Table 5-1indicates that for annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations, the respective PCs are either less than 1% of the relevant long-term EQS, or where the PC is greater than 1% (i.e. NO_2), the PEC is below 70% of the long-term EQS and the impact is considered 'not significant'.

It is noted the maximum annual mean NO_2 PC, predicted at R3, is elevated. Further analysis indicates that at R3, the CHP engine contributes approximately 82% of the annual mean NO_2 PC.

This assessment has been carried out on the assumption that the CHP engine and boilers operate continuously at maximum load throughout the year (i.e. 8,760 hours). This is a conservative assumption as, in practice, the CHP engine will have periods of shut-down and maintenance and may not always operate at maximum load. Furthermore, the boilers are unlikely to operate simultaneously and for more than 6,000 hours per year. The conservative approach adopted throughout the assessment means the predicted concentrations presented in this report are likely to be higher than would reasonably be expected.

For short-term NO_2, CO, SO_2 and particulate concentrations, the PCs are either less than 10% of the relevant EQS, or where the PC is greater than 10%, the corresponding PEC is below 70% of the short-term EQS and the impact is considered 'not significant'.

For annual mean and 24-hour mean TVOC concentrations at a sensitive human receptor location, the respective PECs exceed the relevant EQS for C_6H_6. This assessment assumes all TVOCs emitted by the combustion plant are C_6H_6 in the absence of EQSs for TVOC. This is an overly conservative assumption and C_6H_6 if present in the exhaust gases, would constitute only a very small proportion of total TVOC emissions (i.e. less than 1%). Therefore, informed by a wider understanding of the properties of biogas, the emissions of TVOCs is considered 'not significant'.

Therefore, when considering the conservative approach to the assessment and based on professional judgement, the emissions of assessed pollutants at sensitive human receptor locations and modelled off-site locations is considered 'not significant'.

6.2 Protected conservation areas

For critical levels, the results indicate that at the assessed Thorley Flood Pound SSSI and local nature sites, the annual mean NOx and SO_2 PCs are less than 1% and 100%, respectively, of the relevant critical level and the effect is considered 'insignificant' as per Environment Agency guidance (Environment Agency, 2023).

For the maximum 24-hour mean critical level for NOx, the results indicate that at the assessed Thorley Flood Pound SSSI and local nature sites, the PCs are less than 10% and 100%, respectively, of the relevant critical level and the effect is also considered 'insignificant' as per Environment Agency guidance (Environment Agency, 2023).

For critical loads, at the assessed local nature site, the PCs are less than 100% of the relevant critical load value for acid and nutrient nitrogen deposition and the impact can be described as 'insignificant' as per Environment Agency guidance (Environment Agency, 2023).

6.3 Summary

Based on the above assessment, it is concluded that the operation of the assessed combustion plant are acceptable from an air quality perspective.

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8. Figures

Figure 1: Approximate site fenceline, modelled stack locations and modelled buildings

Figure 2: Extent of modelled grid, AQMA and sensitive human receptor locations

Figure 3: Protected conservation areas

Figure 4: Annual mean nitrogen dioxide process contributions, 2018 meteorological data

Figure 5: 1-hour mean (99.79th percentile) nitrogen dioxide process contributions, 2019 meteorological data

Legend

- Approximate site fenceline
- Modelled stack locations
- Modelled buildings

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
0	04/04/2023	Initial Issue	DH	SB	SB	HG

Jacobs

Client: Thames Water

Project

ENVIRONMENTAL PERMIT APPLICATION - BISHOPS STORTFORD SEWAGE TREATMENT WORKS

Drawing Title

APPROXIMATE SITE FENCELINE, MODELLED STACK LOCATION AND MODELLED BUILDINGS

Drawing Status: FINAL

Scale @ A3	1:2,000	DO NOT SCALE
Jacobs No.	B22849AZ	Rev 0
Client No.		

Drawing Number

FIGURE 1

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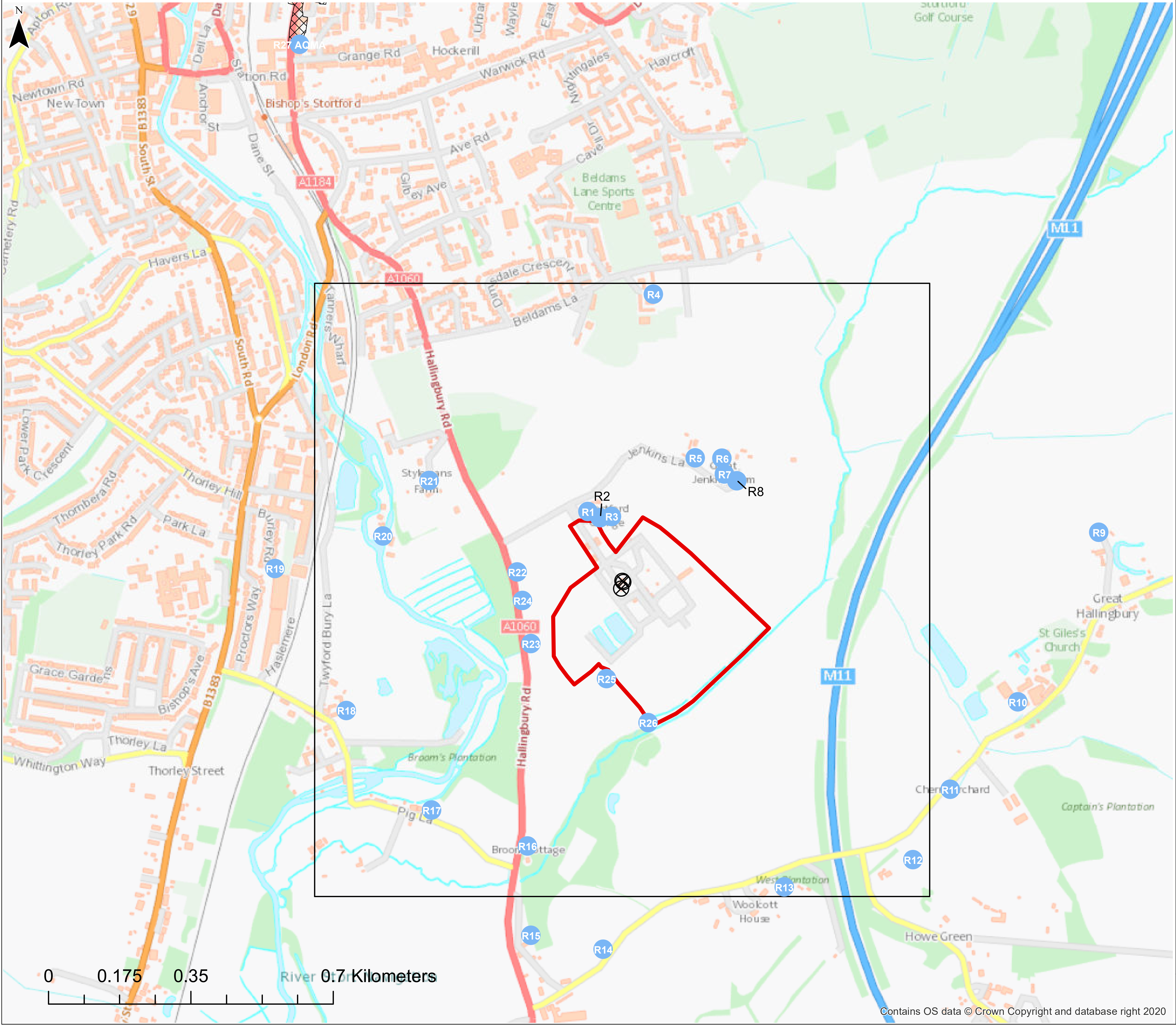

Legend

- Approximate site fenceline
- Modelled of stack locations
- Extent of modelled grid
- Air Quality Managament Area (AQMA)
- R1 Sensitive human receptor locations

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
0	04/04/2023	Initial Issue	DH	SB	SB	HG

Jacobs

Client: Thames Water

Project: ENVIRONMENTAL PERMIT APPLICATION - BISHOPS STORTFORD SEWAGE TREATMENT WORKS

Drawing Title: EXTENT OF MODELLED GRID, AQMA AND SENSITIVE HUMAN RECEPTOR LOCATIONS

Drawing Status: FINAL

Scale @ A3	1:9,000	DO NOT SCALE
Jacobs No.	B22849AZ	Rev 0
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Drawing Number: FIGURE 2

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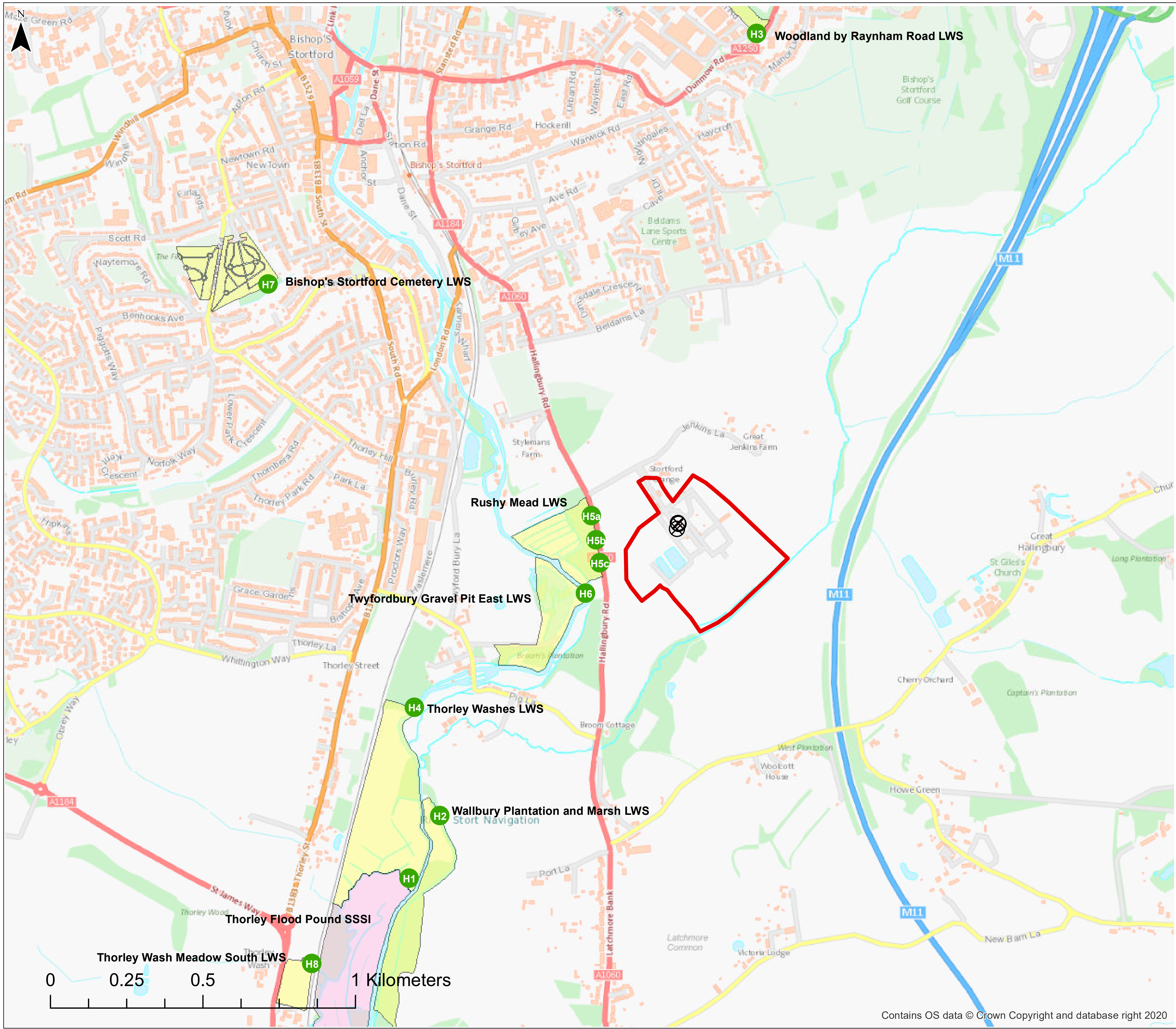

Legend

- Approximate site fenceline
- Modelled of stack locations
- Site of Special Scientific Interest (SSSI)
- Local Wildlife Site (LWS)
- Protected conservation area

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
0	04/04/2023	Initial Issue	DH	SB	SB	HG

Jacobs

Client: Thames Water

Project: ENVIRONMENTAL PERMIT APPLICATION - BISHOPS STORTFORD SEWAGE TREATMENT WORKS

Drawing Title: PROTECTED CONSERVATION AREAS

Drawing Status: FINAL

Scale @ A3	1:12,000	DO NOT SCALE
Jacobs No.	B22849AZ	Rev 0
Client No.		

Drawing Number: FIGURE 3

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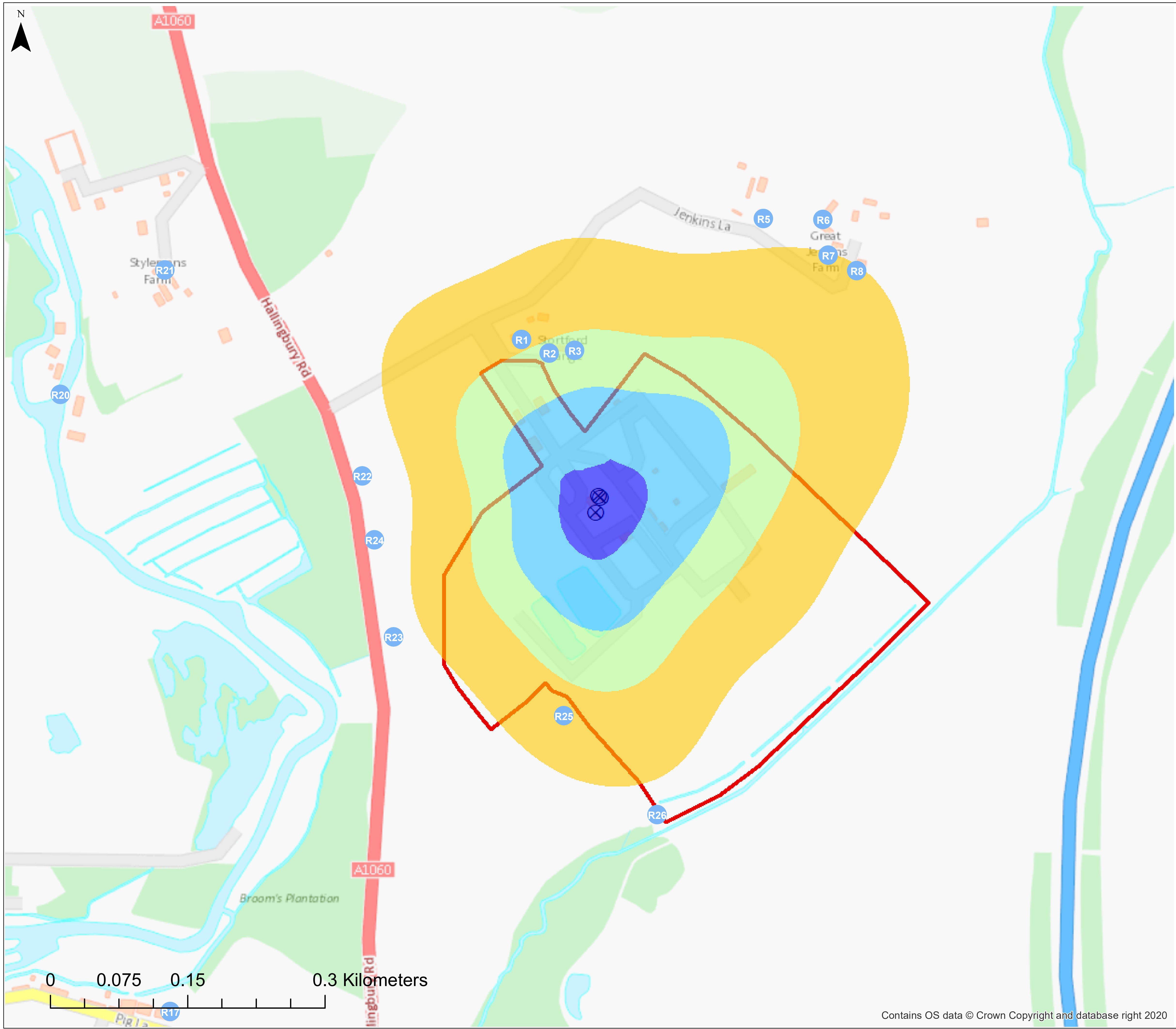

Legend

- Approximate site fenceline
- Modelled of stack locations
- Sensitive human receptor locations

Annual mean nitrogen dioxide process contributions (µg/m^3)

- 0 - 2
- 2 - 4
- 4 - 8
- 8 - 40
- 40 - 5,008

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
0	04/04/2023	Initial Issue	DH	SB	SB	HG

Jacobs

Client

Thames Water

Project

ENVIRONMENTAL PERMIT APPLICATION - BISHOPS STORTFORD SEWAGE TREATMENT WORKS

Drawing Title

ANNUAL MEAN NITROGEN DIOXIDE PROCESS CONTRIBUTIONS, 2018 METEOROLOGICAL DATA

Drawing Status

FINAL

Scale @ A3	1:4,000	DO NOT SCALE	
Jacobs No.	B22849AZ	Rev	0
Client No.			

Drawing Number

FIGURE 4

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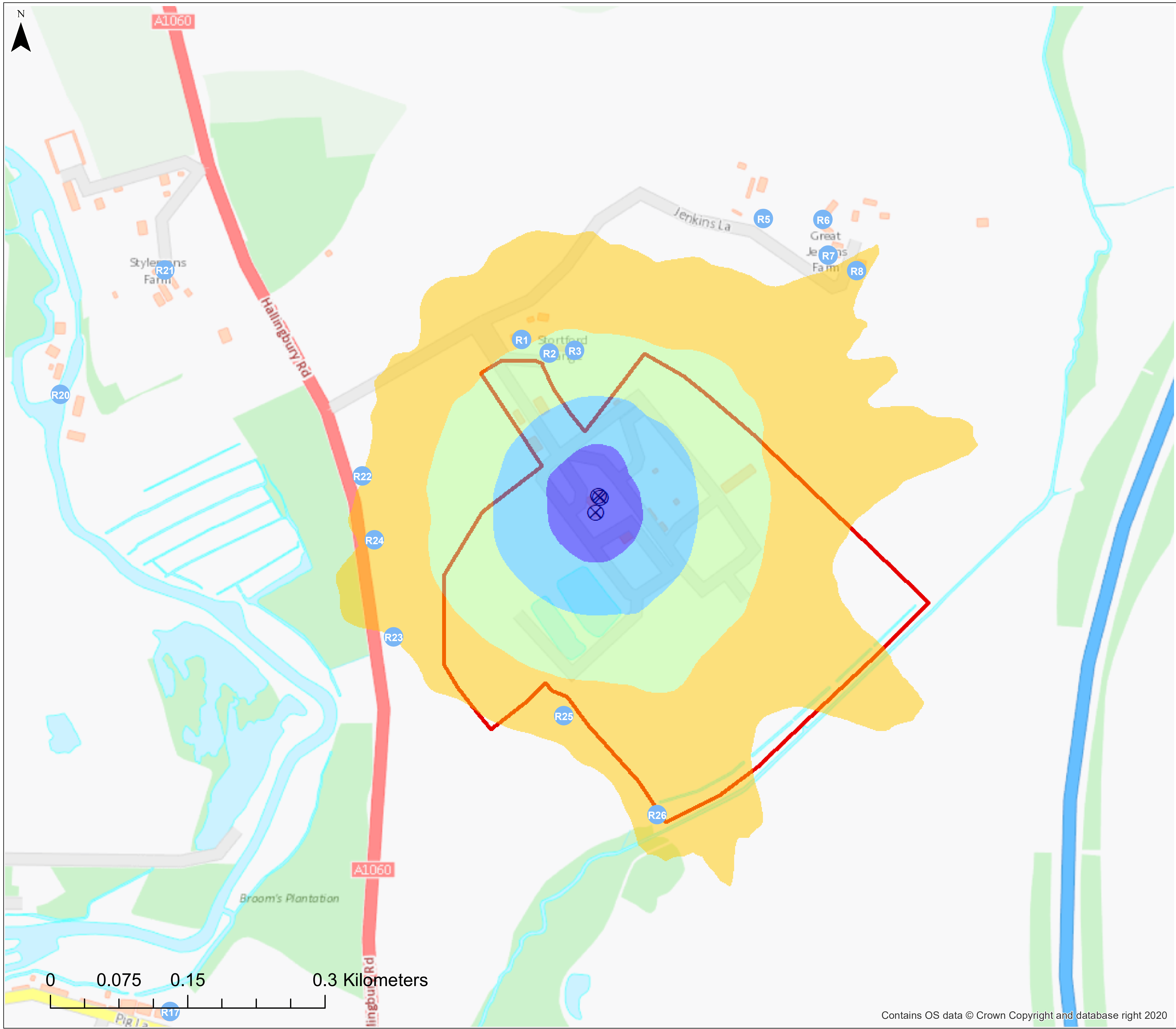

Legend

- Approximate site fenceline
- Modelled of stack locations
- Sensitive human receptor locations

1-hour mean (99.79th percentile) nitrogen dioxide process contributions (µg/m³)

- 0 - 20
- 20 - 30
- 30 - 60
- 60 - 200
- 200 - 32,0000

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
0	04/04/2023	Initial Issue	DH	SB	SB	HG

Jacobs

Client

Thames Water

Project

ENVIRONMENTAL PERMIT APPLICATION - BISHOPS STORTFORD SEWAGE TREATMENT WORKS

Drawing Title

1-HOUR MEAN (99.79th PERCENTILE) NITROGEN DIOXIDE PROCESS CONTRIBUTIONS, 2019 METEOROLOGICAL DATA

Drawing Status: FINAL

Scale @ A3	1:4,000	DO NOT SCALE	
Jacobs No.	B22849AZ	Rev	0
Client No.			

Drawing Number

FIGURE 5

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Appendix A. Dispersion Model Input Parameters

A.1 Emission Parameters

The emissions data used to represent the site for the scenario described in Section 2 is set out in Table A-1.

Table A-1. Dispersion modelling parameters

Parameters	Unit	MAN CHP engine (0.93 MWth)	Strebel boiler (0.67 MWth)	Remeha boiler (0.8 MWth)
Modelled fuel	-	Biogas	Biogas	Biogas
Emission point	-	A1	A2	A3
Assessed annual operation hours	Hours	8,760	8,760	8,760
Stack location	m	E 550046 N 219743	E 550049 N 219761[3]	E 550051 N 219759[3]
Stack position		Vertical (capped)	Vertical	Vertical
Stack height	m	3.00	8.50	8.50
Stack diameter	m	0.35	0.40	0.40
Effective stack diameter	m	4.24[2]	-	
Flue gas temperature	°C	311	136	136
Efflux velocity	m/s	9.7 (0.1 modelled)[2]	5.4	6.5
Moisture content of exhaust gas	%	7.7	6.9	6.9
Oxygen content of exhaust gas (dry)	%	5.6	6.4	6.4
Volumetric flow rate (actual)	m^3/s	1.415	0.679	0.811
Volumetric flow rate (normal)[1]	Nm^3/s	1.563	0.341	0.407
NOx emission concentration[1]	mg/Nm^3	507	250	250
NOx emission rate	g/s	0.793	0.085	0.102
CO emission concentration[1]	mg/Nm^3	519	100	100
CO emission rate	g/s	0.812	0.034	0.041
PM_{10} / $PM_{2.5}$ emission concentration[1]	mg/Nm^3	2.7	5	5
PM_{10} / $PM_{2.5}$ emission rate	g/s	0.004	0.002	0.002
SO_2 emission concentration[1]	mg/Nm^3	130	200	200
SO_2 emission rate	g/s	0.203	0.068	0.081
TVOC emission concentration[1]	mg/Nm^3	371	1,126	1,126
TVOC emission rate	g/s	0.580	0.384	0.459

Note 1: Normalised flows and concentrations presented at 273 K, 101.3 kPa, dry gas and oxygen content of 15% (CHP engine) and 3% (boilers).
Note 2: As the CHP engine stack is capped, an effective stack diameter was applied in the model based on the volumetric flow rate (actual) divided by an assumed efflux velocity of 0.1 m/s.
Note 3: As the boiler stacks are in close proximity to each other, an aai file was used in the model to represent the effects of a single plume.

A.2 Dispersion Model Inputs

A.2.1 Structural influences on dispersion

The main structures within the site which have been included in the model to reflect the existing site layout are identified within Table A-2 and presented in Figure 1. A sensitivity study has been carried out to assess the sensitivity of the model to using the buildings module.

Table A-2. Building parameters

Building	Modelled building shapes	Length / diameter (m)	Width (m)	Height (m)	Angle of length to north	Centre point co-ordinates	
						Easting	Northing
Boiler house	Rectangular	13.13	7.61	3.80	143	550051	219762
Building 2	Rectangular	11.70	5.81	5.50	143	550041	219754
Engine housing	Rectangular	6.01	3.56	2.90	53	550047	219740
Oil tank	Rectangular	5.02	2.72	3.00	53	550044	219744
Primary digester 1	Circular	22.15	-	10.80	-	550069	219749
Primary digester 2	Circular	10.70	-	13.10	-	550016	219764
Secondary digester	Circular	13.16	-	9.12	-	550044	219726
Primary digester 3	Circular	22.50	-	10.80	-	550042	219784

A.3 Other model inputs

Other model input parameters are presented in Table A-3.

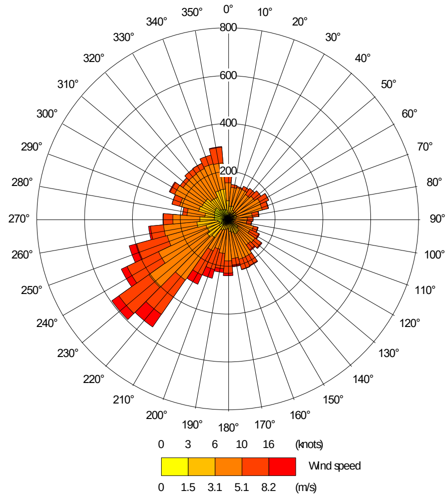
Table A-3. Other model inputs

Parameter	Value used	Comments
Surface roughness length for dispersion site	0.4	This is appropriate for the dispersion site where the local land-use ranges from parkland to open suburbia. A sensitivity study has been carried out with fixed surface roughness values of 0.1 m and 1.0 m.
Surface roughness length at meteorological station site	0.5	This is appropriate for an area where the local land-is relatively built up such as at Stansted Airport.
Minimum Monin-Obukhov Length	1 m	Typical values for the dispersion site.
Surface Albedo	0.23 m	Typical values for the dispersion site.
Priestley-Taylor Parameter	1 m	Typical values for the dispersion site.
Terrain	Not included	Guidance for the use of the ADMS model suggests that terrain is normally incorporated within a modelling study when the gradient exceeds 1:10. As the gradient in the vicinity of the site does not exceed 1:10, a terrain file was not included in the modelling.
Meteorological data	Stansted Airport meteorological station, 2016 - 2020	Stansted Airport meteorological station is located approximately 3.1 km northeast of the site and is considered the closest most representative meteorological monitoring station to the site.
Combined flue option	Yes	As the boiler stacks are in close proximity to each other, aai file was used in the model to represent the effects of a single plume.

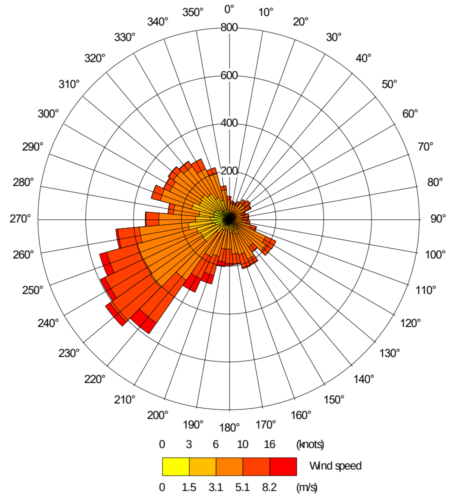
A.3.1 Meteorological Data

The wind roses for each year of meteorological data utilised in the assessment are shown below.

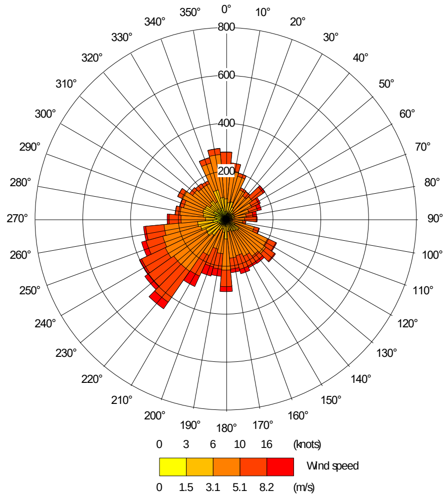
Stansted Airport meteorological station, 2016



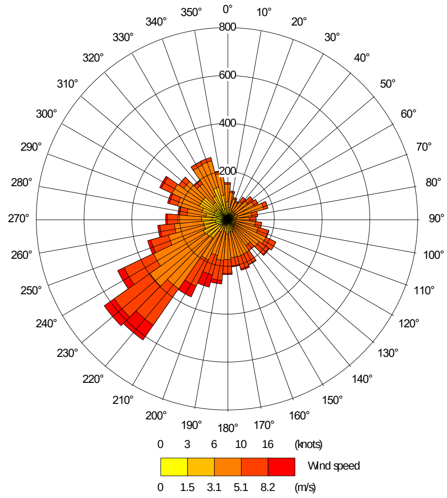
Stansted Airport meteorological station, 2017



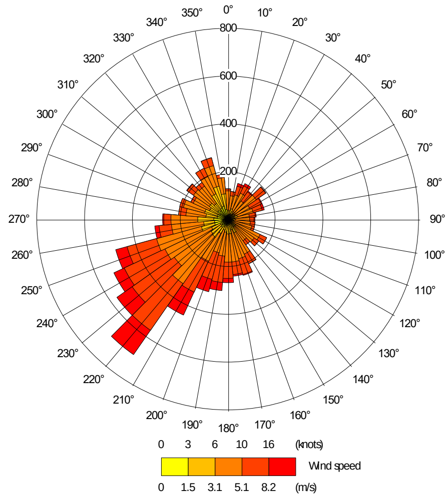
Stansted Airport meteorological station, 2018



Stansted Airport meteorological station, 2019



Stansted Airport meteorological station, 2020



A.3.2 Model Domain/Study Area

The ADMS model calculates the predicted concentrations based on a user defined grid system. Generally, the larger the study area, the greater the distance between the grid calculation points and the lower the resolution of the dispersion model predictions. This is to be offset against the need to encompass an appropriately wide area within the dispersion modelling study to capture the dispersion of the stack emissions.

The modelled grid was specified as a 1.5 km x 1.5 km grid with calculation points every 10 m (i.e. 151 points along each grid axis) with a grid height of 1.5 m. This size of grid was selected to provide a good grid resolution and also encompass a sufficient area so that the maximum predicted concentrations would be determined. The area within the site boundary was excluded from the modelled grid as it is not accessible to the general public. The modelled grid parameters are presented in Table A-4.

Table A-4. Modelled grid parameters

	Start	Finish	Number of grid points	Grid spacing (m)
Easting	549296	550796	151	10
Northing	218993	220493	151	10
Grid height	1.5	1.5	1	-

As well as the modelled grid, the potential impact at 26 sensitive human receptors (e.g. exposure locations such as residential properties and a PRoW), Bishop Stortford AQMA and 8 protected conservation areas within the required study area were assessed. The receptor locations are shown in Figure 2 and Figure 3 and further details of the human receptor locations and protected conservation areas are provided in Table A-5 and Table A-6 respectively.

Table A-5. Assessed sensitive human receptor

Receptor	Description	Grid reference		Distance from the boiler stacks (km)	Direction from the boiler stacks
		Easting	Northing		
R1	Residential property on Jenkins Lane	549965	219931	0.21	NNW
R2	Residential property on Jenkins Lane	549995	219916	0.18	NNW
R3	Residential property on Jenkins Lane	550023	219919	0.18	N
R4	Residential property on Jenkins Lane	550126	220465	0.73	N
R5	Residential property on Bowling Lane	550229	220063	0.37	NNE
R6	Residential property on Jenkins Lane	550294	220062	0.40	NE
R7	Residential property on Jenkins Lane	550300	220023	0.38	NE
R8	Residential property on Jenkins Lane	550331	220006	0.39	NE
R9	Residential property off Church Road	551220	219880	1.18	E
R10	Residential property on Church Road	551021	219463	1.01	ESE
R11	Residential property on Church Road	550855	219248	0.95	ESE
R12	Residential property on Church Road	550764	219075	0.98	SE
R13	Residential property on Church Road	550447	219008	0.84	SSE
R14	Residential property on Church Road	550002	218855	0.89	S
R15	Residential property off Church Road	549825	218889	0.88	SSW
R16	Residential property on A1060	549816	219109	0.67	SSW
R17	Residential property on Pig Lane	549581	219197	0.72	SW
R18	Residential property on Pig Lane	549371	219442	0.74	WSW
R19	Residential property on Burley Road	549196	219791	0.85	W

Receptor	Description	Grid reference Easting	Grid reference Northing	Distance from the boiler stacks (km)	Direction from the boiler stacks
R20	Canal barge mooring	549461	219871	0.60	WNW
R21	Residential property off Hallingbury Road	549575	220007	0.54	WNW
R22	PRoW	549791	219782	0.26	W
R23	PRoW	549825	219606	0.26	WSW
R24	PRoW	549804	219712	0.24	W
R25	PRoW	550011	219520	0.22	S
R26	PRoW	550113	219412	0.34	SSE
R27	Bishop Stortford AQMA	549256	221079	1.55	NNW

Table A-6. Assessed protected conservation area locations

Receptor	Description	Grid reference Easting	Grid reference Northing	Distance from the CHP engine stack (km)	Direction from the CHP engine stack
H1	Thorley Flood Pound SSSI	549169	218596	1.44	SW
H2	Wallbury Plantation and Marsh LWS	549269	218801	1.22	SW
H3	Woodland by Raynham Road LWS	550308	221364	1.64	N
H4	Thorley Washes LWS	549186	219157	1.04	SW
H5a	Rushy Mead LWS	549767	219784	0.28	W
H5b		549782	219705	0.27	W
H5c		549794	219630	0.28	WSW
H6	Twyfordbury Gravel Pit East LWS	549747	219530	0.37	SW
H7	Bishops Stortford Cemetery LWS	548707	220543	1.56	WNW
H8	Thorley Wash Meadow South LWS	548850	218317	1.86	SW

A.3.3 Treatment of oxides of nitrogen

It was assumed that 70% of NOx emitted from the assessed combustion plant will be converted to NO_2 at ground level in the vicinity of the site, for determination of the annual mean NO_2 concentrations, and 35% of emitted NOx will be converted to NO_2 for determination of the hourly mean NO_2 concentrations, in line with guidance provided by the Environment Agency (Environment Agency, 2021). This approach is likely to overestimate the annual mean NO_2 concentrations considerably at the most relevant assessment locations close to the site.

A.3.4 Calculation of PECs

In the case of long-term mean concentrations, it is relatively straightforward to combine modelled process contributions with baseline air quality levels, as long-term mean concentrations due to plant emissions could be added directly to long-term mean baseline concentrations.

It is not possible to add short-period peak baseline and process concentrations directly. 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.

As described in the Environment Agency guidance (Environment Agency, 2021), for most substances the short-term peak PC values are added to twice the long-term mean baseline concentration to provide a reasonable estimate of peak concentrations due to emissions from all assessed sources.

A.3.5 Modelling Uncertainty

There are always uncertainties in dispersion models, in common with any environmental modelling study, because a dispersion model is an approximation of the complex processes which take place in the atmosphere. Some of the key factors which lead to uncertainty in atmospheric dispersion modelling are as follows.

- The quality of the model output depends on the accuracy of the input data enter the model. Where model input data are a less reliable representation of the true situation, the results are likely to be less accurate.
- The meteorological data sets used in the model are not likely to be completely representative of the meteorological conditions at the site. However, the most suitable available meteorological data was chosen for the assessment.
- Models are generally designed on the basis of data obtained for large scale point sources and may be less well validated for modelling emissions from smaller scale sources.
- The dispersion of pollutants around buildings is a complex scenario to replicate. Dispersion models can take account of the effects of buildings on dispersion; however, there will be greater uncertainty in the model results when buildings are included in the model.
- Modelling does not specifically take into account individual small-scale features such as vegetation, local terrain variations and off-site buildings. The roughness length (zo) selected is suitable to take general account of the typical size of these local features within the model domain.
- To take account of these uncertainties and to ensure the predictions are more likely to be over-estimates than under-estimates, the conservative assumptions described below have been used for this assessment.

A.3.6 Conservative Assumptions

The conservative assumptions adopted in this study are summarised below.

- The CHP engine and boilers were assumed to operate for 8,760 hours each calendar year but in practice, the CHP engine will have periods of shut-down and maintenance and may not always operate at maximum load. Furthermore, the boilers are unlikely to operate simultaneously and for more than 6,000 hours per year.
- The study is based on emissions being continuously at the emission limits and calculated emissions specified.
- The maximum predicted concentrations at any residential areas as well as off-site locations were considered for the assessment of short-term concentrations and the maximum predicted concentrations at any residential areas were considered for assessment of annual mean concentrations within the air quality study area. Concentrations at other locations will be less than the maximum values presented.
- The highest predicted concentrations obtained using any of the five different years of meteorological data have been used in this assessment. During a typical year the ground level concentrations are likely to be lower.
- It was assumed that 100% of the particulate matter emitted from the plant is in the PM_{10} size fraction. The actual proportion will be less than 100%.
- It was assumed that 100% of the particulate matter emitted from the plant is in the $PM_{2.5}$ size fraction. The actual proportion will be less than 100%.
- It was assumed the vegetation type selected for the respective protected conservation areas is present at the specific modelled location where the highest PC was predicted.
- This assessment assumes all TVOCs emitted by the combustion plant are C_6H_6 in the absence of EQSs for TVOC.

Appendix B. Calculating Acid and Nitrogen Deposition

B.1 Methodology

Nitrogen and acid deposition have been predicted using the methodologies presented in the Air Quality Technical Advisory Group (AQTAG) guidance note: AQTAG 06 '*Technical Guidance on Detailed Modelling Approach for an Appropriate Assessment for Emissions to Air*' (AQTAG, 2014).

When assessing the deposition of nitrogen, it is important to consider the different deposition properties of nitric oxide and nitrogen dioxide. It is generally accepted that there is no wet or dry deposition arising from nitric oxide in the atmosphere. Thus, it is normally necessary to distinguish between nitric oxide (NO) and nitrogen dioxide in a deposition assessment. In this case, the conservative assumption that 70% of the oxides of nitrogen are in the form of nitrogen dioxide was adopted.

Information on the existing nitrogen and acid deposition was obtained from the APIS database (Centre for Ecology and Hydrology, 2023). Information on the deposition critical loads for the SSSI and local nature sites were also obtained from the APIS database using the Site Relevant Critical Load function and Search by Location function, respectively.

The annual dry deposition flux can be obtained from the modelled annual average ground level concentration via use of the formula:

Dry deposition flux (µg/m^2/s) = ground level concentration (µg/m^3) x deposition velocity (m/s)

(where µg refers to µg of the chemical species under consideration).

The deposition velocities for various chemical species recommended for use (AQTAG, 2014) are shown below in Table B-1.

Table B-1. Recommended dry deposition velocities

Chemical species	Recommended deposition velocity (m/s)	
NO_2	Grassland (short)	0.0015
	Forest (tall)	0.003
SO_2	Grassland (short)	0.012
	Forest (tall)	0.024

To convert the dry deposition flux from units of µg/m^2/s (where µg refers to µg of the chemical species) to units of kg N/ha/yr (where kg refers to kg of nitrogen) multiply the dry deposition flux by the conversion factors shown in Table B-2. To convert dry deposition flux to acid deposition multiply by factors shown in Table B-3.

Table B-2. Dry deposition flux conversion factors for nutrient nitrogen deposition

µg/m^2/s of species	Conversion factor to kg N/ha/yr
NO_2	95.9

Table B-3. Dry deposition flux conversion factors for acidification

µg/m^2/s of species	Conversion factor to keq/ha/yr
NO_2	6.84
SO_2	9.84

Appendix C. Results at Sensitive Human Locations

Table C-1. Results of detailed assessment at sensitive human receptor locations for maximum 8-hour mean and 1-hour mean CO predicted concentrations

Receptor ID	Baseline air quality level (µg/m³)	Maximum 8-hour running mean					Maximum 1-hour mean				
		EQS (µg/m³)	PC (µg/m³)	PEC (µg/m³)	PC/EQS (%)	PEC/EQS (%)	EQS (µg/m³)	PC (µg/m³)	PEC (µg/m³)	PC/EQS (%)	PEC/EQS (%)
R1	287	10,000	67.5	354	0.7%	3.5%	30,000	90.8	378	0.3%	1.3%
R2	287		78.5	365	0.8%	3.7%		118.3	405	0.4%	1.4%
R3	282		76.5	359	0.8%	3.6%		114.3	397	0.4%	1.3%
R4	287		14.8	302	0.1%	3.0%		38.1	325	0.1%	1.1%
R5	287		28.6	315	0.3%	3.2%		75.4	362	0.3%	1.2%
R6	287		37.9	325	0.4%	3.2%		68.7	356	0.2%	1.2%
R7	287		42.6	329	0.4%	3.3%		71.8	359	0.2%	1.2%
R8	287		40.2	327	0.4%	3.3%		70.9	358	0.2%	1.2%
R9	269		12.9	282	0.1%	2.8%		23.3	292	0.1%	1.0%
R10	269		12.3	281	0.1%	2.8%		27.5	296	0.1%	1.0%
R11	282		17.4	300	0.2%	3.0%		28.4	311	0.1%	1.0%
R12	282		16.9	299	0.2%	3.0%		27.4	310	0.1%	1.0%
R13	282		16.0	298	0.2%	3.0%		33.7	316	0.1%	1.1%
R14	272		17.7	289	0.2%	2.9%		29.5	301	0.1%	1.0%
R15	275		9.2	284	0.1%	2.8%		31.1	306	0.1%	1.0%
R16	287		14.8	302	0.1%	3.0%		40.7	328	0.1%	1.1%
R17	287		14.6	301	0.1%	3.0%		39.0	326	0.1%	1.1%
R18	287		15.6	302	0.2%	3.0%		36.3	323	0.1%	1.1%
R19	287		11.8	299	0.1%	3.0%		30.6	317	0.1%	1.1%
R20	287		18.4	305	0.2%	3.1%		44.2	331	0.1%	1.1%
R21	288		34.3	322	0.3%	3.2%		49.7	337	0.2%	1.1%
R22	287		62.9	350	0.6%	3.5%		85.1	372	0.3%	1.2%
R23	287		49.3	336	0.5%	3.4%		79.5	366	0.3%	1.2%
R24	287		60.2	347	0.6%	3.5%		82.9	370	0.3%	1.2%
R25	282		57.9	340	0.6%	3.4%		85.2	368	0.3%	1.2%

Receptor ID	Baseline air quality level (µg/m³)	Maximum 8-hour running mean					Maximum 1-hour mean				
		EQS (µg/m³)	PC (µg/m³)	PEC (µg/m³)	PC/EQS (%)	PEC/EQS (%)	EQS (µg/m³)	PC (µg/m³)	PEC (µg/m³)	PC/EQS (%)	PEC/EQS (%)
R26	282		48.6	331	0.5%	3.3%		76.7	359	0.3%	1.2%

Table C-2. Results of detailed assessment at sensitive human receptor locations for annual mean and 1-hour mean (99.79th percentile) NO_2 predicted concentrations

Receptor ID	Annual mean						99.79th percentile of 1-hour mean					
	Baseline air quality level (µg/m³)	EQS (µg/m³)	PC (µg/m³)	PEC (µg/m³)	PC/EQS (%)	PEC/EQS (%)	EQS (µg/m³)	Baseline air quality level (µg/m³)	PC (µg/m³)	PEC (µg/m³)	PC/EQS (%)	PEC/EQS (%)
R1	10.4	40	3.6	14.0	9.0%	34.9%	200	20.7	28.8	49.5	14.4%	24.8%
R2	10.4		4.6	14.9	11.5%	37.4%		20.7	34.2	54.9	17.1%	27.5%
R3	14.8		4.9	19.7	12.2%	49.2%		29.6	35.3	64.8	17.6%	32.4%
R4	13.4		0.4	13.8	1.1%	34.6%		26.8	7.0	33.8	3.5%	16.9%
R5	13.4		2.1	15.5	5.3%	38.8%		26.8	16.4	43.2	8.2%	21.6%
R6	13.4		2.2	15.6	5.5%	38.9%		26.8	18.2	45.0	9.1%	22.5%
R7	13.4		2.6	16.0	6.6%	40.0%		26.8	21.0	47.8	10.5%	23.9%
R8	13.4		2.7	16.0	6.6%	40.1%		26.8	22.5	49.2	11.2%	24.6%
R9	10.6		0.4	11.0	0.9%	27.5%		21.2	6.7	28.0	3.4%	14.0%
R10	10.6		0.3	11.0	0.9%	27.4%		21.2	6.4	27.6	3.2%	13.8%
R11	14.8		0.4	15.2	1.0%	38.0%		29.6	8.3	37.9	4.2%	18.9%
R12	14.8		0.4	15.2	1.0%	37.9%		29.6	7.0	36.6	3.5%	18.3%
R13	14.8		0.4	15.2	1.0%	38.0%		29.6	8.0	37.6	4.0%	18.8%
R14	13.1		0.3	13.4	0.8%	33.5%		26.1	6.1	32.2	3.1%	16.1%
R15	9.8		0.3	10.1	0.7%	25.1%		19.5	5.0	24.5	2.5%	12.2%
R16	10.4		0.4	10.8	1.1%	27.0%		20.7	7.0	27.8	3.5%	13.9%
R17	10.4		0.3	10.7	0.8%	26.7%		20.7	6.3	27.0	3.1%	13.5%

Receptor ID	Annual mean						99.79th percentile of 1-hour mean					
	Baseline air quality level (µg/m³)	EQS (µg/m³)	PC (µg/m³)	PEC (µg/m³)	PC/EQS (%)	PEC/EQS (%)	EQS (µg/m³)	Baseline air quality level (µg/m³)	PC (µg/m³)	PEC (µg/m³)	PC/EQS (%)	PEC/EQS (%)
R18	10.4		0.3	10.7	0.8%	26.7%		20.7	6.6	27.3	3.3%	13.7%
R19	10.4		0.2	10.6	0.5%	26.4%		20.7	5.1	25.8	2.5%	12.9%
R20	10.4		0.4	10.8	1.0%	26.9%		20.7	7.4	28.1	3.7%	14.0%
R21	13.0		0.6	13.6	1.6%	34.1%		26.0	9.7	35.7	4.9%	17.9%
R22	10.4		1.6	11.9	3.9%	29.8%		20.7	19.7	40.4	9.9%	20.2%
R23	10.4		1.8	12.1	4.5%	30.4%		20.7	20.3	41.0	10.2%	20.5%
R24	10.4		1.6	12.0	4.0%	30.0%		20.7	21.4	42.1	10.7%	21.1%
R25	14.8		2.9	17.7	7.4%	44.3%		29.6	25.5	55.0	12.7%	27.5%
R26	14.8		1.7	16.5	4.2%	41.1%		29.6	24.0	53.6	12.0%	26.8%
R27 (AQMA)	--		0.1	-	0.3%	-		-				

Table C-3. Results of detailed assessment at sensitive human receptor locations for 24-mean (99.18th percentile) and 1-hour mean (99.73rd percentile) SO_2 predicted concentrations

Receptor ID	99.18th percentile of 24-hour mean						99.73rd percentile of 1-hour mean					
	Baseline air quality level (µg/m³)	EQS (µg/m³)	PC (µg/m³)	PEC (µg/m³)	PC/EQS (%)	PEC/EQS (%)	EQS (µg/m³)	Baseline air quality level (µg/m³)	PC (µg/m³)	PEC (µg/m³)	PC/EQS (%)	PEC/EQS (%)
R1	8.1	125	13.7	21.7	10.9%	17.4%	350	8.1	29.6	37.7	8.5%	10.8%
R2	8.1		17.0	25.0	13.6%	20.0%		8.1	35.1	43.2	10.0%	12.3%
R3	7.3		17.6	25.0	14.1%	20.0%		7.3	35.8	43.1	10.2%	12.3%
R4	7.3		1.7	9.1	1.4%	7.2%		7.3	6.5	13.9	1.9%	4.0%
R5	7.3		4.9	12.3	4.0%	9.8%		7.3	15.5	22.8	4.4%	6.5%

Receptor ID	99.18th percentile of 24-hour mean						99.73rd percentile of 1-hour mean					
	Baseline air quality level (µg/m^3)	EQS (µg/m^3)	PC (µg/m^3)	PEC (µg/m^3)	PC/EQS (%)	PEC/EQS (%)	EQS (µg/m^3)	Baseline air quality level (µg/m^3)	PC (µg/m^3)	PEC (µg/m^3)	PC/EQS (%)	PEC/EQS (%)
R6	7.3		5.8	13.2	4.7%	10.5%		7.3	14.5	21.9	4.2%	6.2%
R7	7.3		6.7	14.0	5.4%	11.2%		7.3	17.6	24.9	5.0%	7.1%
R8	7.3		6.3	13.6	5.0%	10.9%		7.3	16.7	24.0	4.8%	6.9%
R9	7.2		1.2	8.4	1.0%	6.7%		7.2	6.3	13.5	1.8%	3.9%
R10	7.2		1.5	8.6	1.2%	6.9%		7.2	5.6	12.7	1.6%	3.6%
R11	7.3		1.7	9.0	1.4%	7.2%		7.3	7.5	14.8	2.1%	4.2%
R12	7.3		1.7	9.0	1.4%	7.2%		7.3	6.3	13.6	1.8%	3.9%
R13	7.3		2.2	9.5	1.8%	7.6%		7.3	7.9	15.2	2.3%	4.3%
R14	7.3		1.3	8.6	1.1%	6.9%		7.3	4.7	12.0	1.3%	3.4%
R15	7.4		1.4	8.8	1.2%	7.0%		7.4	4.8	12.2	1.4%	3.5%
R16	8.1		2.2	10.3	1.8%	8.2%		8.1	6.7	14.8	1.9%	4.2%
R17	8.1		1.9	9.9	1.5%	7.9%		8.1	5.1	13.2	1.5%	3.8%
R18	8.1		2.0	10.1	1.6%	8.0%		8.1	6.3	14.4	1.8%	4.1%
R19	8.1		1.1	9.2	0.9%	7.4%		8.1	4.9	12.9	1.4%	3.7%
R20	8.1		2.0	10.1	1.6%	8.1%		8.1	6.5	14.5	1.8%	4.2%
R21	7.5		3.6	11.1	2.9%	8.9%		7.5	8.7	16.2	2.5%	4.6%
R22	8.1		8.2	16.2	6.5%	13.0%		8.1	18.9	26.9	5.4%	7.7%
R23	8.1		9.2	17.2	7.3%	13.8%		8.1	18.7	26.7	5.3%	7.6%
R24	8.1		8.7	16.8	7.0%	13.4%		8.1	20.4	28.4	5.8%	8.1%
R25	7.3		11.3	18.6	9.0%	14.9%		7.3	23.2	30.6	6.6%	8.7%
R26	7.3		7.1	14.4	5.7%	11.6%		7.3	18.1	25.4	5.2%	7.3%

Table C-4. Results of detailed assessment at sensitive human receptor locations for 15-minute mean (99.9th percentile) SO_2 predicted concentrations

Receptor ID	99.9th percentile of 15-minute mean					
	Baseline air quality level (µg/m³)	EQS (µg/m³)	PC (µg/m³)	PEC (µg/m³)	PC/EQS (%)	PEC/EQS (%)
R1	8.1	266	39.8	47.8	14.9%	18.0%
R2	8.1		45.2	53.3	17.0%	20.0%
R3	7.3		46.4	53.8	17.5%	20.2%
R4	7.3		13.6	20.9	5.1%	7.9%
R5	7.3		27.1	34.4	10.2%	12.9%
R6	7.3		31.0	38.4	11.7%	14.4%
R7	7.3		30.1	37.4	11.3%	14.1%
R8	7.3		30.3	37.7	11.4%	14.2%
R9	7.2		11.7	18.8	4.4%	7.1%
R10	7.2		11.7	18.8	4.4%	7.1%
R11	7.3		14.5	21.8	5.4%	8.2%
R12	7.3		12.6	19.9	4.7%	7.5%
R13	7.3		15.3	22.7	5.8%	8.5%
R14	7.3		11.5	18.8	4.3%	7.1%
R15	7.4		7.1	14.5	2.7%	5.4%
R16	8.1		11.9	20.0	4.5%	7.5%
R17	8.1		8.2	16.3	3.1%	6.1%
R18	8.1		11.6	19.7	4.4%	7.4%
R19	8.1		7.3	15.3	2.7%	5.8%
R20	8.1		13.1	21.2	4.9%	8.0%
R21	7.5		14.9	22.4	5.6%	8.4%
R22	8.1		26.1	34.1	9.8%	12.8%
R23	8.1		25.7	33.7	9.7%	12.7%
R24	8.1		26.9	35.0	10.1%	13.2%
R25	7.3		30.6	38.0	11.5%	14.3%

Receptor ID	99.9th percentile of 15-minute mean					
	Baseline air quality level (µg/m³)	EQS (µg/m³)	PC (µg/m³)	PEC (µg/m³)	PC/EQS (%)	PEC/EQS (%)
R26	7.3		41.3	48.6	15.5%	18.3%

Table C-5. Results of detailed assessment at sensitive human receptor locations for annual mean and 24-hour mean (90.41st) percentile) PM_{10} predicted concentrations

Receptor ID	Annual mean						90.41st percentile of 24-hour mean					
	Baseline air quality level (µg/m³)	EQS (µg/m³)	PC (µg/m³)	PEC (µg/m³)	PC/EQS (%)	PEC/EQS (%)	EQS (µg/m³)	Baseline air quality level (µg/m³)	PC (µg/m³)	PEC (µg/m³)	PC/EQS (%)	PEC/EQS (%)
R1	14.1	40	0.04	14.1	0.1%	35.3%	50	28.1	0.14	28.3	0.3%	56.6%
R2	14.1		0.05	14.1	0.1%	35.3%		28.1	0.19	28.3	0.4%	56.7%
R3	16.6		0.06	16.6	0.1%	41.6%		33.2	0.20	33.4	0.4%	66.8%
R4	16.3		0.01	16.3	0.0%	40.7%		32.5	0.02	32.6	0.0%	65.1%
R5	16.3		0.02	16.3	0.1%	40.7%		32.5	0.07	32.6	0.1%	65.2%
R6	16.3		0.03	16.3	0.1%	40.7%		32.5	0.07	32.6	0.1%	65.2%
R7	16.3		0.03	16.3	0.1%	40.8%		32.5	0.09	32.6	0.2%	65.3%
R8	16.3		0.03	16.3	0.1%	40.8%		32.5	0.08	32.6	0.2%	65.3%
R9	14.5		0.00	14.5	0.0%	36.3%		29.0	0.01	29.0	0.0%	58.1%
R10	14.5		0.00	14.5	0.0%	36.3%		29.0	0.01	29.0	0.0%	58.1%
R11	16.6		0.00	16.6	0.0%	41.5%		33.2	0.01	33.2	0.0%	66.4%
R12	16.6		0.00	16.6	0.0%	41.5%		33.2	0.02	33.2	0.0%	66.4%
R13	16.6		0.00	16.6	0.0%	41.5%		33.2	0.02	33.2	0.0%	66.4%
R14	16.8		0.00	16.8	0.0%	41.9%		33.5	0.02	33.5	0.0%	67.1%
R15	14.4		0.00	14.4	0.0%	35.9%		28.7	0.01	28.7	0.0%	57.5%
R16	14.1		0.00	14.1	0.0%	35.2%		28.1	0.02	28.2	0.0%	56.3%
R17	14.1		0.00	14.1	0.0%	35.2%		28.1	0.01	28.1	0.0%	56.3%

Receptor ID	Annual mean						90.41st percentile of 24-hour mean					
	Baseline air quality level (µg/m³)	EQS (µg/m³)	PC (µg/m³)	PEC (µg/m³)	PC/EQS (%)	PEC/EQS (%)	EQS (µg/m³)	Baseline air quality level (µg/m³)	PC (µg/m³)	PEC (µg/m³)	PC/EQS (%)	PEC/EQS (%)
R18	14.1		0.00	14.1	0.0%	35.2%		28.1	0.02	28.1	0.0%	56.3%
R19	14.1		0.00	14.1	0.0%	35.2%		28.1	0.01	28.1	0.0%	56.3%
R20	14.1		0.00	14.1	0.0%	35.2%		28.1	0.02	28.2	0.0%	56.3%
R21	14.0		0.01	14.0	0.0%	35.0%		28.0	0.03	28.0	0.1%	56.0%
R22	14.1		0.02	14.1	0.0%	35.2%		28.1	0.08	28.2	0.2%	56.4%
R23	14.1		0.02	14.1	0.0%	35.2%		28.1	0.08	28.2	0.2%	56.4%
R24	14.1		0.02	14.1	0.0%	35.2%		28.1	0.08	28.2	0.2%	56.4%
R25	16.6		0.03	16.6	0.1%	41.6%		33.2	0.14	33.3	0.3%	66.6%
R26	16.6		0.02	16.6	0.0%	41.5%		33.2	0.08	33.3	0.2%	66.5%

Table C-6. Results of detailed assessment at sensitive human receptor locations for annual mean $PM_{2.5}$ predicted concentrations

Receptor ID	Annual mean					
	Baseline air quality level (µg/m³)	EQS (µg/m³)	PC (µg/m³)	PEC (µg/m³)	PC/EQS (%)	PEC/EQS (%)
R1	9.0	20	0.04	9.0	0.2%	45.2%
R2	9.0		0.05	9.0	0.3%	45.2%
R3	10.1		0.06	10.2	0.3%	51.0%
R4	10.0		0.01	10.0	0.0%	50.0%
R5	10.0		0.02	10.0	0.1%	50.1%
R6	10.0		0.03	10.0	0.1%	50.1%
R7	10.0		0.03	10.0	0.2%	50.1%
R8	10.0		0.03	10.0	0.2%	50.1%
R9	9.1		0.00	9.1	0.0%	45.7%

Receptor ID	Annual mean					
	Baseline air quality level (µg/m³)	EQS (µg/m³)	PC (µg/m³)	PEC (µg/m³)	PC/EQS (%)	PEC/EQS (%)
R10	9.1		0.00	9.1	0.0%	45.6%
R11	10.1		0.00	10.1	0.0%	50.7%
R12	10.1		0.00	10.1	0.0%	50.7%
R13	10.1		0.00	10.1	0.0%	50.7%
R14	10.2		0.00	10.2	0.0%	50.8%
R15	9.1		0.00	9.1	0.0%	45.3%
R16	9.0		0.00	9.0	0.0%	45.0%
R17	9.0		0.00	9.0	0.0%	45.0%
R18	9.0		0.00	9.0	0.0%	45.0%
R19	9.0		0.00	9.0	0.0%	45.0%
R20	9.0		0.00	9.0	0.0%	45.0%
R21	9.1		0.01	9.2	0.0%	45.8%
R22	9.0		0.02	9.0	0.1%	45.0%
R23	9.0		0.02	9.0	0.1%	45.0%
R24	9.0		0.02	9.0	0.1%	45.0%
R25	10.1		0.03	10.2	0.2%	50.8%
R26	10.1		0.02	10.2	0.1%	50.8%

Table C-7. Results of detailed assessment at sensitive human receptor locations for annual mean and maximum 24-hour mean TVOC predicted concentrations

Receptor ID	Annual mean						100th percentile of maximum 24-hour mean					
	Baseline air quality level (µg/m³)	EQS (µg/m³)	PC (µg/m³)	PEC (µg/m³)	PC/EQS (%)	PEC/EQS (%)	EQS (µg/m³)	Baseline air quality level (µg/m³)	PC (µg/m³)	PEC (µg/m³)	PC/EQS (%)	PEC/EQS (%)
R1	0.3		7.3	7.6	145.2%	151.3%		0.6	92.7	93.3	309.0%	311.1%

Receptor ID	Annual mean						100th percentile of maximum 24-hour mean					
	Baseline air quality level (µg/m³)	EQS (µg/m³)	PC (µg/m³)	PEC (µg/m³)	PC/EQS (%)	PEC/EQS (%)	EQS (µg/m³)	Baseline air quality level (µg/m³)	PC (µg/m³)	PEC (µg/m³)	PC/EQS (%)	PEC/EQS (%)
R2	0.3	5 (Benzene)	9.3	9.6	185.7%	191.8%	30 (Benzene)	0.6	113.9	114.5	379.6%	381.6%
R3	0.3		9.8	10.1	196.7%	202.6%		0.6	96.0	96.6	319.9%	321.8%
R4	0.3		0.9	1.2	18.0%	23.9%		0.6	9.3	9.9	31.1%	33.1%
R5	0.3		4.3	4.6	86.0%	92.0%		0.6	25.8	26.4	86.1%	88.1%
R6	0.3		4.5	4.8	89.4%	95.4%		0.6	25.9	26.5	86.3%	88.3%
R7	0.3		5.3	5.6	106.9%	112.9%		0.6	30.5	31.1	101.7%	103.7%
R8	0.3		5.4	5.7	108.1%	114.0%		0.6	43.8	44.4	146.1%	148.1%
R9	0.3		0.7	1.0	14.7%	19.8%		0.5	8.1	8.6	27.1%	28.7%
R10	0.3		0.7	0.9	13.5%	18.5%		0.5	6.6	7.1	21.9%	23.6%
R11	0.3		0.8	1.1	16.0%	21.8%		0.6	8.1	8.7	27.0%	28.9%
R12	0.3		0.7	1.0	14.9%	20.7%		0.6	7.4	8.0	24.8%	26.8%
R13	0.3		0.8	1.1	16.8%	22.7%		0.6	11.0	11.6	36.6%	38.5%
R14	0.3		0.7	0.9	13.3%	18.6%		0.5	7.6	8.1	25.3%	27.1%
R15	0.3		0.6	0.9	11.6%	17.2%		0.6	6.5	7.1	21.7%	23.5%
R16	0.3		0.8	1.1	16.6%	22.6%		0.6	10.3	10.9	34.3%	36.3%
R17	0.3		0.6	0.9	11.9%	18.0%		0.6	21.1	21.7	70.2%	72.2%
R18	0.3		0.6	0.9	12.7%	18.8%		0.6	18.0	18.6	59.9%	61.9%
R19	0.3		0.4	0.7	7.9%	14.0%		0.6	6.2	6.8	20.5%	22.5%
R20	0.3		0.8	1.1	15.6%	21.7%		0.6	11.5	12.1	38.4%	40.5%
R21	0.3		1.3	1.6	25.1%	31.2%		0.6	18.9	19.5	62.8%	64.9%
R22	0.3		2.9	3.2	58.9%	65.0%		0.6	35.1	35.7	116.8%	118.9%
R23	0.3		3.4	3.7	67.5%	73.5%		0.6	49.6	50.2	165.2%	167.3%
R24	0.3		3.1	3.4	61.2%	67.3%		0.6	49.7	50.3	165.6%	167.6%
R25	0.3		5.4	5.7	107.7%	113.5%		0.6	52.5	53.0	174.8%	176.8%

Receptor ID	Annual mean						100th percentile of maximum 24-hour mean					
	Baseline air quality level (μg/m^3)	EQS (μg/m^3)	PC (μg/m^3)	PEC (μg/m^3)	PC/EQS (%)	PEC/EQS (%)	EQS (μg/m^3)	Baseline air quality level (μg/m^3)	PC (μg/m^3)	PEC (μg/m^3)	PC/EQS (%)	PEC/EQS (%)
R26	0.3		3.2	3.5	64.5%	70.4%		0.6	39.0	39.6	130.2%	132.1%