Air Quality Assessment

Thurrock Flexible Generation Plant

For Statera Energy Limited

Quality Management				
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1 Introduction

1.1 This report details the air quality assessment undertaken to accompany the permit application for the proposed installation of the gas-fired electricity generating facility in Thurrock. The facility would generate electricity during peak periods of demand, thereby reducing grid instability.

1.2 This air quality assessment covers evaluation of the impacts of the stack emissions on the local area.

1.3 The scheme has been revised to include 96 gas-fired engines routed in pairs through 48 stacks that would run for 1,500 hours per year as a five-year average. Following advice from the Environment Agency, the modelling assumes that the engines will run for up to 2,250 hours in a single year.

1.4 This report begins by setting out the policy and legislative context for the assessment. The methods and criteria used to assess potential air quality effects have then been described. The baseline air quality conditions have been established taking into account Defra estimates and local authority documents. The results of the assessment of air quality impacts have been presented. A conclusion has been drawn on the significance of the residual operational-phase effects.

2 Policy and Legislative Context

Ambient Air Quality Legislation and National Policy

Air Quality Standards Regulations

2.1 The Air Quality Standards Regulations 2010 [1], amended by The Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020 [2], sets limit values for ambient air concentrations for the main air pollutants: particulate matter (PM_{10} and $PM_{2.5}$), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), ozone (O_3), carbon monoxide (CO), lead (Pb) and benzene, certain toxic heavy metals (arsenic, cadmium and nickel) and polycyclic aromatic hydrocarbons (PAHs).

2.2 These limit values are legally binding on the Secretary of State. The Government and devolved administrations operate various national ambient air quality monitoring networks to measure compliance and develop plans to meet the limit values.

UK Air Quality Strategy

2.3 The Environment Act 1995 [3] established the requirement for the Government and the devolved administrations to produce a National Air Quality Strategy (AQS) for improving ambient air quality, the first being published in 1997 and having been revised several times since, with the latest published in 2007 [4]. The Strategy sets UK air quality standards♦ and objectives# for the pollutants in the Air Quality Standards Regulations plus 1,3-butadiene and recognises that action at national, regional and local level may be needed, depending on the scale and nature of the air quality problem. There is no legal requirement to meet objectives set within the UK AQS except where equivalent limit values are set within the Air Quality Standards Regulations.

2.4 The 1995 Environment Act also established the UK system of Local Air Quality Management (LAQM), that requires local authorities to go through a process of review and assessment of air quality in their areas, identifying places where objectives are not likely to be met, then declaring Air Quality Management Areas (AQMAs) and putting in place Air Quality Action Plans to improve air quality. These plans also contribute, at local level, to the achievement of the limit values in the Air Quality Standards Regulations.

♦ Standards are concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. Standards, as the benchmarks for setting objectives, are set purely with regard to scientific evidence and medical evidence on the effects of the particular pollutant on health, or on the wider environment, as minimum or zero risk levels.

Objectives are policy targets expressed as a concentration that should be achieved, all the time or for a percentage of time, by a certain date.

2.5 The limit values and objectives relevant to this assessment are summarised in Table 2.1. Although the limit values and the AQS objectives are numerically equal, there are some differences in where they apply and who is responsible for their achievement.

2.6 The Environment Agency online guidance entitled 'Environmental management – guidance, Air emissions risk assessment for your environmental permit' [5] provides further assessment criteria in the form of Environmental Assessment Levels (EALs).

Table 2.1: Summary of Relevant Air Quality Limit Values, Objectives and EALs

Pollutant	Averaging Period	Objectives/ Limit Values	Not to be Exceeded More Than
Nitrogen Dioxide (NO_2)	1 hour	200 µg.m^{-3}	18 times per calendar year
	Annual	40 µg.m^{-3}	-

Environmental Permitting Regulations

2.7 The Environmental Permitting Regulations (EPR) 2016 [6] define activities that require an Environmental Permit from the Environment Agency (EA).

2.8 EPR is a regulatory system that employs an integrated approach to control the environmental impacts of certain listed industrial activities including the generation of energy from waste. The intention of the regulatory system is to ensure that best available techniques (BAT) are used to prevent or minimise the effects of an activity on the environment, having regard to the effects of emissions to air, land and water via a single permitting process.

2.9 To gain a permit, Operators have to demonstrate in their applications, in a systematic way, that the techniques they are using or are proposing to use are the BAT for their installation and meet certain other requirements taking account of relevant local factors. The permitting process also places a duty on the regulating body to ensure that the requirements are included for permitted sites to which these apply.

2.10 The essence of BAT is that the techniques selected to protect the environment should achieve a high degree of protection of people and the environment taken as a whole. Indicative BAT standards are laid out in national guidance and where relevant, should be applied unless a different standard can be justified for a particular installation. The EA is legally obliged to go beyond BAT requirements where EU Air Quality Limit Values may be exceeded by an existing operator.

2.11 The Environment Agency's on-line guidance entitled '*Environmental management – guidance, Air emissions risk assessment for your environmental permit'* [5] provides guidelines for air dispersion modelling. The assessment of air quality effects for the engines is consistent with this guidance.

3 Assessment Methodology

Approach

3.1 This air quality assessment includes the key elements listed below:

- Establishing the background Ambient Concentration (AC) from consideration of Air Quality Review & Assessment findings and assessment of existing local air quality through a review of available air quality monitoring and Defra background map data in the vicinity of the site.
- Quantitative assessment of the operational effects on local air quality from stack emissions utilising a "new generation" Gaussian dispersion model, ADMS 6. Assessment of Process Contributions (PC) from the facility in isolation, and assessment of resultant Predicted Environmental Concentrations (PEC), taking into account cumulative impacts through incorporation of the AC.

3.2 Air quality guidance advises that the organisation engaged in assessing the overall risks should hold relevant qualifications and/or extensive experience in undertaking air quality assessments. The RPS air quality team members involved at various stages of this assessment have professional affiliations that include Member of the Institute of Air Quality Management and Member of the Institution of Environmental Science and have the required academic qualifications for these professional bodies.

Summary of Key Pollutants Considered

3.3 The key pollutant emissions associated with combustion processes in general are oxides of nitrogen (NOx), CO, SO_2, volatile organic compounds (VOCs), water and other pollutants in trace quantities. However, for gas-fired spark-ignition engines specifically, the pollutant of local concern is NOx.

3.4 The gas engines will comply with the 'EU Directive of the European Parliament and of the Council on the limitation of emissions of certain pollutants into the air from medium combustion plants' (referred to hereafter as the Medium Combustion Plant Directive or the MCPD). For new engines fuelled by natural gas, the only pollutant for which the MCPD provides a limit is nitrogen oxides (NOx). Moreover, the technology suppliers have advised that there are no other significant pollutant emissions.

3.5 Emissions of total NOx from combustion sources comprise nitric oxide (NO) and NO_2. The NO oxidises in the atmosphere to form NO_2. The assessment of operational impacts therefore focuses on changes in NO_2 concentrations at ground level receptors.

3.6 The technology suppliers have advised that there are no other significant pollutant emissions.

Atmospheric Dispersion Modelling of Pollutant Concentrations

3.7 In urban areas, pollutant concentrations are primarily determined by the balance between pollutant emissions that increase concentrations, and the ability of the atmosphere to reduce and remove pollutants by dispersion, advection, reaction and deposition. An atmospheric dispersion model is used as a practical way to simulate these complex processes; such a model requires a range of input data, which can include emissions rates, meteorological data and local topographical information. The model used and the input data relevant to this assessment are described in the following sub-sections.

3.8 The atmospheric pollutant concentrations in an urban area depend not only on local sources at a street scale, but also on the background pollutant level made up of the local urban-wide background, together with regional pollution and pollution from more remote sources brought in on the incoming air mass. This background contribution needs to be added to the fraction from the modelled sources, and is usually obtained from measurements or estimates of urban background concentrations for the area in locations that are not directly affected by local emissions sources. Background pollution levels are described in detail in Section 4.

Dispersion Model Selection

3.9 Several commercially available dispersion models can predict ground level concentrations arising from emissions to atmosphere from elevated point sources. Modelling for this study has been undertaken using ADMS 6, a version of the ADMS (Atmospheric Dispersion Modelling System) developed by Cambridge Environmental Research Consultants (CERC) that models a wide range of buoyant and passive releases to atmosphere either individually or in combination. The model calculates the mean concentration over flat terrain and also allows for the effect of plume rise, complex terrain, buildings and deposition. Dispersion models predict atmospheric concentrations within a set level of confidence and there can be variations in results between models under certain conditions. The ADMS 6 model has been formally validated and is widely used in the UK and internationally for regulatory purposes.

3.10 ADMS comprises a number of individual modules each representing one of the processes contributing to dispersion or an aspect of data input and output. Amongst the features of ADMS are:

- An up-to-date dispersion model in which the boundary layer structure is characterised by the height of the boundary layer and the Monin-Obukhov length, a length scale dependent on the friction velocity and the heat flux at the surface. This approach allows the vertical structure of the boundary layer, and hence concentrations, to be calculated more accurately than does the use of Pasquill-Gifford stability categories, which were used in many previous models (e.g. ISCST3). The restriction implied by the Pasquill-Gifford approach that the dispersion parameters are independent of height is avoided. In ADMS the concentration distribution is Gaussian in stable and neutral conditions, but the vertical distribution is non-Gaussian in convective conditions, to take account of the skewed structure of the vertical component of turbulence;

- Several complex modules including the effects of plume rise, complex terrain, coastlines, concentration fluctuations and buildings; and
- A facility to calculate long-term averages of hourly mean concentration, dry and wet deposition fluxes and radioactivity, and percentiles of hourly mean concentrations, from either statistical meteorological data or hourly average data.

Model Inputs

Meteorological Data

3.11 The most important meteorological parameters governing the atmospheric dispersion of pollutants are wind direction, wind speed and atmospheric stability as described below:

- Wind direction determines the sector of the compass into which the plume is dispersed.
- Wind speed affects the distance that the plume travels over time and can affect plume dispersion by increasing the initial dilution of pollutants and inhibiting plume rise; and
- Atmospheric stability is a measure of the turbulence of the air, and particularly of its vertical motion. It therefore affects the spread of the plume as it travels away from the source. New generation dispersion models, including ADMS, use a parameter known as the Monin-Obukhov length that, together with the wind speed, describes the stability of the atmosphere.

3.12 For meteorological data to be suitable for dispersion modelling purposes, a number of meteorological parameters need to be measured on an hourly basis. These parameters include wind speed, wind direction, cloud cover and temperature. There are only a limited number of sites where the required meteorological measurements are made.

3.13 The year of meteorological data that is used for a modelling assessment can have a significant effect on source contribution concentrations. Dispersion model simulations have been performed using five years of data from Gravesend, between 2013 and 2017. The Gravesend meteorological station was closed in 2018 so this is the most recent data available.

3.14 Wind roses have been produced for each of the years of meteorological data used in this assessment and are presented in Figure 1.

Stack Parameters and Emissions Rates used in the Model

3.15 The Proposed Development comprises 95 engines, combined into 48 stacks with 2 flues per stack. There is one stack with only one flue but for the purposes of modelling it was assumed each stack had two flues. Therefore, the results presented in this report conservatively assume that there are 96 engines. The stack locations are shown in Figure 2. The emissions characteristics for each stack modelled are provided in Table 3.1. The NOx mass emission rate for each stack has been derived from the limit value in the MCPD. This is provided in Table 3.2.

Table 3.1 Stack Characteristics (per Stack)

Parameter	Unit	Stack
Stack height	m	20
Number of stacks	-	96
Effective internal diameter (individual flues)*	m	0.87
Efflux velocity	$m.s^{-1}$	20.2
Efflux temperature	^{o}C	351
Actual volumetric flow	$Am^3.s^{-1}$	12.0
Oxygen by (dry) volume	%	10.5
Water by volume	%	10.1
Normalised volumetric flow (dry, 0^0C, 15% O_2)	$Nm^3.s^{-1}$	8.30
NO_X Emission Concentration (dry, 0^0C, 15% O_2)*	$mg.Nm^{-3}$	95
CO Emission Concentration (dry, 0^0C, 15% O_2)*	$mg.Nm^{-3}$	390

*Flue is D shaped but assumed to be circular to include in the model. Effective diameter calculated from stack area of D shaped flue.
*The emission concentration complies with the Medium Combustion Plant (MCP) Directive limit of 95 mg Nm^{-3} (dry, 0^oC, 15% O_2) for new natural gas engines.

Table 3.2 Mass Emissions (per Stack) of Released Pollutant

Pollutants	Mass Emission Rate ($g.s^{-1}$)
NO_x	0.79
CO	3.23

Time Varying Emissions

3.16 The gas engines will only operate during peak demand. For the purposes of assessing the air quality impacts, modelling has been undertaken for a worst case scenario assuming that the gas engines operate for 2,250 hours per year which represents the largest total number of operational hours considered as part of this assessment. The site would on average only operate for 1,500 hours year.

Surface Roughness

3.17 The roughness of the terrain over which a plume passes can have a significant effect on dispersion by altering the velocity profile with height, and the degree of atmospheric turbulence. This is accounted for by a parameter called the surface roughness length.

3.18 A surface roughness length of 0.5 m has been used within the model to represent the average surface characteristics across the study area. This surface roughness length is typical of parkland and open suburbia.

Building Wake Effects

3.19 The movement of air over and around buildings generates areas of flow circulation, which can lead to increased ground level concentrations in the building wakes. Where building heights are greater than about 30 - 40% of the stack height, downwash effects can be significant. Table 3.3 sets out the dimensions of the building included within the assessment.

Table 3.3: Dimensions of Building Included Within the Dispersion Model

Building	x	y	Height (m)	Length (m)	Width (m)	Angle (º) from North
1	566140	176482	15	101	63	107
2	566291	176461	15	155	70	103
3	566373	176496	15	47	69	103
4	566149	176637	10	75	139	107
5	566142	176565	10	58	114	106
6	566102	176510	15	65	25	105
7	566351	176465	15	18	40	105
8	566377	176786	4.2	73	17	107
9	566408	176777	4.2	73	17	107
10	566436	176769	4.2	73	17	107
11	566351	176699	4.2	73	17	107
12	566382	176690	4.2	73	17	107
13	566410	176681	4.2	73	17	107
14	566366	176747	6.5	9	16	107
15	566340	176660	6.5	9	16	107
16	566369	176651	6.5	9	16	107
17	566399	176642	6.5	9	16	107
18	566395	176738	6.5	9	16	107
19	566426	176729	6.5	9	16	107

Receptors

3.20 The air quality assessment predicts the impacts at locations that could be sensitive to any changes. For assessing human-health impacts, such sensitive receptors should be selected where the public is regularly present and likely to be exposed over the averaging period of the objective. LAQM.TG22 [7] provides examples of exposure locations and these are summarised in Table 3.4.

Table 3.4: Example of Where Air Quality Objectives Apply

Averaging Period	Objectives should apply at:	Objectives should generally not apply at:
Annual-mean	All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes.	Building façades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence.

		Gardens of residential properties. Kerbside sites (as opposed to locations at the buildings façades), or any other location where public exposure is expected to be short-term.
Daily-mean	All locations where the annual-mean objective would apply, together with hotels. Gardens of residential properties.	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expect to be short-term.
Hourly-mean	All locations where the annual and 24 hour mean would apply. Kerbside sites (e.g. pavements of busy shopping streets). Those parts of car parks, bus stations and railway stations etc which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more. Any outdoor locations to which the public might reasonably be expected to spend 1-hour or longer.	Kerbside sites where the public would not be expected to have regular access

3.21 The effects of the proposed development have been assessed at the façades of local existing receptors. All human receptors have been modelled at a height of 1.5 m, representative of typical head height. The locations of these discrete receptors are listed in Table 3.5 and illustrated in Figure 2.

Table 3.5: Modelled Sensitive Receptors

Receptor ID	Description	X(m)	Y(m)
1	Fort Road	565364	176620
2	Sandhurst Road	565234	176294
3	School	563917	176252
4	Gateway Academy	564255	177812
5	Gravel Pit Cottages	567414	177570
6	Princess Margaret Rd	568507	177407
7	Walnut Tree Farm	566713	177540
8	The Green	566062	177921
9	West Street	564727	174466
10	Milton School	565429	174069
11	Royal Pier Road	565057	174392
12	West Tilbury Hall	566066	177709
13	Cooper Shore	566322	177515
14	R1	557439	179107
15	R2	557597	181084

Receptor ID	Description	X(m)	Y(m)
16	R3	561350	180920
17	R4	563478	180584
18	R5	563560	180866
19	R6	564894	181056
20	R7	563889	179678
21	R8	563101	177478
22	R9	563399	176576
23	R10	563911	176123
24	R11	564314	175875
25	R12	564434	175856
26	R13	565181	176256
27	R14	565039	176156
28	R15	565339	176504
29	R16	564701	175973
30	R17	564617	175897
31	R18	562008	180949
32	R19	563904	176281
33	R20	560604	180416
34	R21	560035	179870
35	R22	556895	179284
36	R23	555379	179902
37	R24	558144	183519
38	R25	567446	182119
39	R26	558009	184058
40	R27	563778	179720
41	16/01232/OUT (Proposed Development)	567251	177967
42	18/00664/CONDC (Proposed Development)	567931	178212
43	16/00412/OUT (Proposed Development)	565034	178056
44	15/00379/OUT (Proposed Development)	564844	178304
45	16/01475/SCR (Proposed Development)	567622	179079

Receptor ID	Description	X(m)	Y(m)
46	GR/17/674 (Proposed Development)	564174	172500
47	20141214 (Proposed Development)	564292	172307

Note: Receptors have been modelled at 1.5m above ground level, representative of typical head height

3.22 The AQS NO_2 objectives for all the different averaging periods apply at the façades of the modelled residential and school receptors.

3.23 Ecological receptors are considered in Appendix A.

NO_x to NO_2 Assumptions

3.24 The NOx emissions will typically comprise approximately 90-95% nitrogen monoxide (NO) and 5-10% nitrogen dioxide (NO_2) at the point of release. The NO oxidises in the atmosphere in the presence of sunlight, ozone and volatile organic compounds to form NO_2, which is the principal concern in terms of environmental health effects. The Environment Agency advises [8] that:

"For combustion processes where no more than 10% of nitrogen oxides are emitted as nitrogen dioxide, you can assume worst case conversion ratios to nitrogen dioxide of:

35% for short-term average concentrations

70% for long-term average concentrations"

3.25 These ratios have been used in the assessment.

Modelling of Long-term and Short-term Emissions

3.26 Long-term (annual-mean) NO_2 has been modelled for comparison with the relevant annual mean objectives.

3.27 For short-term NO_2, the objective is for the hourly-mean concentration not to exceed 200 $\mu g.m^{-3}$ more than 18 times per calendar year. As there are 8,760 hours in a non-leap year, the hourly-mean concentration would need to be below 200 $\mu g.m^{-3}$ in 8,742 hours, i.e. 99.79% of the time. Therefore, the 99.79th percentile of hourly NO_2 has been modelled.

Significance Criteria

3.28 The on-line Environment Agency online guidance entitled *'Environmental management – guidance, Air emissions risk assessment for your environmental permit'* [5] provides details for screening out substances for detailed assessment. In particular, it states that:

"To screen out a PC for any substance so that you don't need to do any further assessment of it, the PC must meet both of the following criteria:

- *the short-term PC is less than 10% of the short-term environmental standard*
- *the long-term PC is less than 1% of the long-term environmental standard*

If you meet both of these criteria you don't need to do any further assessment of the substance.

If you don't meet them you need to carry out a second stage of screening to determine the impact of the PEC."

3.29 It continues by stating that:

"You must do detailed modelling for any PECs not screened out as insignificant."

3.30 It then states that further action may be required where:

"your PCs could cause a PEC to exceed an environmental standard (unless the PC is very small compared to other contributions – if you think this is the case contact the Environment Agency)

The PEC is already exceeding an environmental standard"

3.31 The EA online guidance 'Environmental permitting: air dispersion modelling reports' [9] states:

"For a detailed modelling assessment PCs are insignificant where they are less than:

- *10% of a short-term environmental standard*
- *1% of a long-term environmental standard*

At the detailed modelling stage there are no criteria to determine whether:

- *PCs are significant*
- *PECs are insignificant or significant*

You must explain how you judged significance and base this on the site specific circumstances."

3.32 On that basis, the results of the detailed modelling presented in this report have been used as follows:

- The effects are not considered significant if the short-term PC is less than 10% of the short-term Environmental Assessment Level (EAL) or the PEC is below the EAL; and
- The effects are not considered significant if the long-term PC is less than 1% of the long-term EAL or the PEC is below the EAL

Uncertainty

3.33 All air quality assessment tools, whether models or monitoring measurements, have a degree of uncertainty associated with the results. The choices that the practitioner makes in setting-up the model, choosing the input data, and selecting the baseline monitoring data will decide whether the final predicted impact should be considered a central estimate, or an estimate tending towards the upper bounds of the uncertainty range (i.e. tending towards worst-case).

3.34 The atmospheric dispersion model itself contributes some of this uncertainty, due to it being a simplified version of the real situation: it uses a sophisticated set of mathematical equations to approximate the complex physical and chemical atmospheric processes taking place as a pollutant is released and as it travels to a receptor. The predictive ability of even the best model is limited by how well the turbulent nature of the atmosphere can be represented.

3.35 Each of the data inputs for the model, listed earlier, will also have some uncertainty associated with them. Where it has been necessary to make assumptions, these have mainly been made towards the upper end of the range informed by an analysis of relevant, available data to achieve an assessment that has a conservative bias overall. Where no significant effects are predicted, based on conservative assumptions, there is no need to revisit these assumptions, although the opportunity exists to do so.

3.36 The main components of uncertainty in the total predicted concentrations, made up of the background concentration and the modelled fraction, include those summarised in Table 3.6.

Table 3.6: Approaches to Dealing with Uncertainty used Within the Assessment

Concentration	Source of Uncertainty	Approach to Dealing with Uncertainty	Comments
Background Concentration	Characterisation of future baseline air quality (i.e. the air quality conditions in the future assuming that the development does not proceed)	The future background concentration used in the assessment is the same as the current background concentration and no reduction has been assumed. This is a conservative assumption as, in reality, background concentrations are likely to reduce over time as cleaner vehicle technologies form an increasing proportion of the fleet.	The background concentration is the major proportion of the total predicted concentration. The conservative assumptions adopted ensure that the background concentration used within the model contribute to the final result being towards the top of the uncertainty range, rather than a central estimate.
Model Input/Output Data	Meteorological Data	Uncertainties arise from any differences between the conditions at the met station and the development site, and between the historical met years and the future years. These have been minimised by using meteorological data collated at a representative measuring site. The model has been run for five full years of meteorological conditions.	The modelled fraction is likely to contribute to the predicted concentrations being towards between a central estimate and the top of the uncertainty range.

Concentration	Source of Uncertainty	Approach to Dealing with Uncertainty	Comments
	Receptors	The model has been run for a grid of receptors. In addition, receptor locations have been identified where concentrations are highest or where the greatest changes are expected.	

3.37 The analysis of the component uncertainties indicates that, overall, the predicted total concentration is likely to be towards the high end of the range of predictions (i.e. towards worst-case) rather than being a central estimate. The actual concentrations that will be found when the site is operational are unlikely to be higher than those presented within this report and are more likely to be lower.

4 Baseline Air Quality Conditions

Overview

4.1 The background concentration often represents a large proportion of the total pollution concentration, so it is important that the background concentration selected for the assessment is realistic. National Planning Practice Guidance and EPUK/IAQM guidance highlight public information from Defra and local monitoring studies as potential sources of information on background air quality.

4.2 A detailed review of baseline conditions was undertaken as part of the Air Quality Chapter of the Environmental Statement submitted in 2020 to the Planning Inspectorate. The background air quality was characterised by drawing on information from the following sources:

- Defra maps [10], which show estimated pollutant concentrations across the UK in 1 km grid squares;
- published results of local authority Review and Assessment (R&A) studies of air quality, including local monitoring and modelling studies; and
- The results of the Tilbury 2 Air Quality Assessment (Tilbury2 Project Team, 2017); and
- The results of the RPS project specific nitrogen dioxide (NO_2) monitoring study undertaken in 2018.

4.3 Modelling of cumulative developments was also undertaken for the 2020 Environmental Statement to derive a cumulative baseline concentration. This included the following cumulative developments:

- Tilbury 2
- Lower Thames Crossing
- Tilbury Green Power Biomass plant
- Tilbury Peak Reserve plant (gas engines x 14)
- Thames Enterprise Park Energy Centre (EfW and gas engines)
- Gateway Energy Centre (CCGT x 2, Auxiliary Boilers x 2)
- Purfleet Regeneration Centre Energy Centre (Boilers x 8, CHP x 2)

Review of Local Monitoring

4.4 The most recently measured annual-mean NO_2 concentrations for Thurrock Council and Gravesham Borough Council monitors used to establish baseline conditions are presented in Table 4.1. Data for 2020 and 2021 has not been included due to the impact of the COVID-19 pandemic.

Table 4.1: Monitored Annual-Mean NO_2 Concentrations

Monitor ID	Concentration (µg.m^{-3})								
	2013	2014	2015	2016	2017	Average (2013 to 2017)*	2018	2019	2022
Thurrock Council Monitors									
TILE	35.26	35.85	31.68	34.92	36.18	34.8	33.4	35.2	25.5
TL	37.13	35.56	30.55	35.68	35.81	34.9	32.9	34.8	24.7
TK4	32.79	31.05	29.50	31.51	30.1	31.0	-	-	-
TILD	38.08	33.90	31.12	36.85	37.15	35.4	35.0	35.1	22.4
TSR	31.88	27.17	27.39	28.05	29.02	28.7	26.8	28.5	20.9
Gravesham Borough Council Monitors									
GR13	45.2	42.5	40	37.5	44	41.8	47.1	46.1	37.6
GR62	34	29.7	29.2	30.2	31.2	30.9	30.7	30.8	24.8
GR90	37.2	31.5	28.6	30.5	31.2	31.8	-	-	-

*Used in 2020 ES chapter.

4.5 Data from 2013 to 2017 was used to inform the baseline concentrations used in the 2020 ES chapter. The table above shows that measured concentrations in 2022 are lower than measured in 2013 to 2017 indicating that background concentrations have decreased since the 2020 ES chapter. On that basis, the use of background concentrations from the 2020 ES chapter will be conservative.

Assumed Background Concentrations

4.6 The NO_2 background concentrations used in the assessment are set out in Table 4.2.

Table 4.2: Summary of Assumed Background Concentrations

Receptor ID	Receptor Name	Baseline Annual-Mean NO_2 Concentration (µg.m^{-3})	Data Source	Cumulative Annual-Mean Baseline Concentration (µg.m^{-3})
1	Fort Road	26.4	Project specific monitoring location 3	28.7
2	Sandhurst Road	26.4	Project specific monitoring location 3	31.1
3	School	34.0	Thurrock monitoring - Average of TILE, TL, TK4, TILD	35.7
4	Gateway Academy	28.7	Thurrock monitoring - TSR	30.4
5	Gravel Pit Cottages	18.0	Project specific monitoring location 5	19.9
6	Princess Margaret Rd	18.0	Project specific monitoring location 5	18.7
7	Walnut Tree Farm	18.3	Project specific monitoring location 4	20.5
8	The Green	18.3	Project specific monitoring location 4	19.4
9	West Street	41.8	Gravesham monitoring - GR13	42.4
10	Milton School	30.9	Gravesham monitoring - GR62	31.3
11	Royal Pier Road	31.8	Gravesham monitoring - GR90	32.3
12	West Tilbury Hall	18.3	Project specific monitoring location 4	19.4
13	Cooper Shore	18.3	Project specific monitoring location 4	19.5
14	R1	31.1	Tilbury2 Air Quality Assessment (Note: these concentrations are the predicted concentrations with Tilbury2 in place in 2020)	31.5
15	R2	27.6		27.9
16	R3	28.3		28.8
17	R4	26.9		27.6
18	R5	32.2		32.9
19	R6	26.9		29.8
20	R7	28.1		30.0
21	R8	28.9		30.4
22	R9	36.6		37.4
23	R10	30.6		31.4
24	R11	26.6		27.8
25	R12	26.1		27.4

26	R13	26.4		27.9
27	R14	26.8		28.4
28	R15	23.6		25.5
29	R16	25.8		27.4
30	R17	26.2		27.8
31	R18	24.1		24.6
32	R19	31.6		32.4
33	R20	23.5		23.9
34	R21	34.8		35.2
35	R22	24.8		25.2
36	R23	34.1		34.4
37	R24	28.5		28.8
38	R25	33.8		36.5
39	R26	22.6		22.8
40	R27	24.5		26.4
41	16/01232/OUT	18.0	Project specific monitoring location 5	21.1
42	18/00664/CONDC	29.9	Thurrock monitoring - ETRS	30.7
43	16/00412/OUT	18.3	Project specific monitoring location 4	19.8
44	15/00379/OUT	18.3	Project specific monitoring location 4	19.8
45	16/01475/SCR	29.9	Thurrock monitoring - ETRS	30.7
46	GR/17/674	22.4	Gravesham monitoring – GR75	23.8
47	20141214	38.6	Gravesham Monitoring – GR57	40.0

Note: (a) Short-term background data approximately equate to the 90th percentile, which is approximately equivalent to 2 x the annual mean.

5 Assessment of Operational-Phase Air Quality Impacts

Results of Stack Emissions Modelling

Short-term NO_2 Impacts

5.1 Table 5.1 summarises the short-term, predicted PCs at the discrete sensitive receptors.

Table 5.1: Short-term Predicted NO_2 Concentrations ($\mu g.m^{-3}$) at Sensitive Receptors

Receptor	Process Contribution (1 hour 99.79th percentile) $\mu g.m^{-3}$	Process Contribution as % of EAL	Cumulative AC $\mu g.m^{-3}$	PEC $\mu g.m^{-3}$	PEC as % of EAL
Fort Road	95.3	48	78.9	174.2	87
Sandhurst Road	93.7	47	86.8	180.5	90
School	49.1	25	85.0	134.1	67
Gateway Academy	48.3	24	73.7	122.0	61
Gravel Pit Cottages	86.9	43	51.3	138.2	69
Princess Margaret Rd	54.1	27	47.9	102.1	51
Walnut Tree Farm	118.7	59	53.6	172.3	86
The Green	89.9	45	52.1	142.0	71
West Street	43.1	22	98.3	141.3	71
Milton School	40.6	20	74.3	114.9	57
Royal Pier Road	43.9	22	77.4	121.3	61
West Tilbury Hall	99.0	50	52.4	151.4	76
Cooper Shore	118.9	59	52.3	171.2	86
R1	18.8	9	70.2	89.0	45
R2	19.8	10	62.0	81.8	41
R3	27.9	14	65.4	93.3	47
R4	33.4	17	65.3	98.7	49
R5	32.5	16	75.5	108.0	54
R6	43.7	22	69.8	113.4	57
R7	34.9	17	71.2	106.1	53
R8	34.8	17	74.5	109.3	55
R9	40.1	20	88.6	128.7	64
R10	48.9	24	77.1	125.9	63

Receptor	Process Contribution (1 hour 99.79th percentile) µg.m-3	Process Contribution as % of EAL	Cumulative AC µg.m-3	PEC µg.m-3	PEC as % of EAL
R11	52.8	26	70.7	123.6	62
R12	54.5	27	70.5	125.0	62
R13	90.3	45	80.6	170.9	85
R14	81.5	41	80.0	161.4	81
R15	98.2	49	75.1	173.3	87
R16	63.8	32	74.2	137.9	69
R17	57.7	29	72.6	130.3	65
R18	28.2	14	57.6	85.8	43
R19	48.9	24	77.9	126.9	63
R20	26.0	13	56.7	82.7	41
R21	25.4	13	79.1	104.5	52
R22	18.2	9	57.4	75.6	38
R23	16.4	8	74.6	91.0	46
R24	17.5	9	63.1	80.6	40
R25	27.5	14	82.5	109.9	55
R26	16.9	8	51.0	68.0	34
R27	34.8	17	63.8	98.6	49
16/01232/OUT	77.4	39	54.5	131.9	66
18/00664/CONDC	58.1	29	73.7	131.8	66
16/00412/OUT	54.8	27	52.6	107.3	54
15/00379/OUT	48.9	24	52.7	101.5	51
16/01475/SCR	46.7	23	73.2	119.9	60
GR/17/674	28.2	14	56.0	84.3	42
20141214	27.1	14	88.4	115.5	58

EAL for 1 hour 99.79th percentile (NO_2) is 200 µg.m-3.

5.2 The predicted PCs exceed 10% of the EAL but when the PC is added to the background concentration the PEC does not exceed 100% of the EAL. On that basis, the impacts can be screened out as insignificant.

5.3 This is based on the worst case assumption that all 96 engines will operate all year to ensure the worst case meteorological conditions were assessed. In reality the engines will run for up to 1,500 hours per year as a five-year average and the probability of all engines running at the same time in the hours with the worst case meteorological conditions is low.

5.4 The baseline concentrations used in this assessment are assumed to be the same as used for the DCO application. This is conservative as background concentrations have decreased significantly as outlined in section 4.

Long-term NO_2 Impacts

5.5 Table 5.2 summarises the long-term maximum PC and PEC values at the selected discrete sensitive receptors. This assumes that the engines will run for 2,250 hours per year when in reality the engines would operate for 1,500 hours per year as a five-year average.

Table 5.2: Long-term Predicted NO_2 Concentrations ($\mu g.m^{-3}$) at Sensitive Receptors

Receptor	Process Contribution (Annual Mean) $\mu g.m^{-3}$	Process Contribution as % of EAL	Cumulative AC $\mu g.m^{-3}$	PEC $\mu g.m^{-3}$	PEC as % of EAL
Fort Road	3.3	8	28.7	32.0	80
Sandhurst Road	2.3	6	31.1	33.4	83
School	1.1	3	35.7	36.8	92
Gateway Academy	0.5	1	-	-	-
Gravel Pit Cottages	3.6	9	19.9	23.5	59
Princess Margaret Rd	2.1	5	18.7	20.9	52
Walnut Tree Farm	4.7	12	20.5	25.2	63
The Green	1.6	4	19.4	21.0	52
West Street	0.5	1	-	-	-
Milton School	0.4	1	-	-	-
Royal Pier Road	0.5	1	-	-	-
West Tilbury Hall	1.9	5	19.4	21.3	53
Cooper Shore	2.7	7	19.5	22.2	55
R1	0.2	0	-	31.6	79
R2	0.1	0	-	28.0	70
R3	0.2	1	-	29.0	72
R4	0.3	1	-	28.0	70
R5	0.3	1	-	33.2	83
R6	0.5	1	-	30.3	76
R7	0.4	1	-	30.3	76
R8	0.4	1	-	30.8	77
R9	0.8	2	37.4	38.2	95
R10	1.0	3	31.4	32.5	81
R11	1.0	3	27.8	28.8	72

Receptor	Process Contribution (Annual Mean) µg.m^{-3}	Process Contribution as % of EAL	Cumulative AC µg.m^{-3}	PEC µg.m^{-3}	PEC as % of EAL
R12	1.0	3	27.4	28.4	71
R13	2.1	5	27.9	30.0	75
R14	1.7	4	28.4	30.1	75
R15	3.1	8	25.5	28.6	72
R16	1.2	3	27.4	28.7	72
R17	1.1	3	27.8	28.9	72
R18	0.3	1	-	-	-
R19	1.1	3	32.4	33.5	84
R20	0.2	1	-	-	-
R21	0.2	0	-	-	-
R22	0.1	0	-	-	-
R23	0.1	0	-	-	-
R24	0.1	0	-	-	-
R25	0.3	1	-	-	-
R26	0.1	0	-	-	-
R27	0.4	1	-	-	-
16/01232/OUT	3.1	8	21.1	24.2	60
18/00664/CONDC	1.9	5	30.7	32.6	82
16/00412/OUT	0.6	2	19.8	20.4	51
15/00379/OUT	0.6	1	-	-	-
16/01475/SCR	1.2	3	30.7	32.0	80
GR/17/674	0.2	1	-	-	-
20141214	0.2	1	-	-	-

EAL for annual-mean NO_2 is 40 µg.m^{-3}.

5.6 The predicted PCs exceed 1% of the EAL at some locations but when the PC is added to the background concentration the PEC does not exceed 100% of the EAL and the impacts can be screened out as not significant at all receptors.

5.7 The baseline concentrations used in this assessment are assumed to be the same as used for the DCO application. This is conservative as background concentrations have decreased significantly as outlined in section 4.

Short-term CO Impacts

5.8 Table 5.2 summarises the maximum hourly mean PCs and 8-hourly mean PC for CO at the selected discrete sensitive receptors. The AC is derived from the Defra mapped concentration estimate for the application site.

Table 5.3: Short-term Predicted CO Concentrations (µg.m^{-3}) at Sensitive Receptors

Receptor	Process Contribution (1 hour) µg.m^{-3}	Process Contribution as % of EAL	Process Contribution (8 hour mean) µg.m^{-3}	Process Contribution as % of EAL	AC µg.m^{-3}	PEC µg.m^{-3}	PEC as % of EAL
Fort Road	2075	7	1453	15	644	2097	21
Sandhurst Road	2127	7	1489	15	644	2133	21
School	1048	3	734	7	-	-	-
Gateway Academy	923	3	646	6	-	-	-
Gravel Pit Cottages	2110	7	1477	15	644	2121	21
Princess Margaret Rd	1119	4	784	8	-	-	-
Walnut Tree Farm	2601	9	1820	18	644	2464	25
The Green	2056	7	1439	14	644	2083	21
West Street	1141	4	799	8	-	-	-
Milton School	1159	4	812	8	-	-	-
Royal Pier Road	1208	4	846	8	-	-	-
West Tilbury Hall	1992	7	1395	14	644	2039	20
Cooper Shore	1671	6	1169	12	644	1813	18
R1	299	1	209	2	-	-	-
R2	304	1	213	2	-	-	-
R3	433	1	303	3	-	-	-
R4	526	2	368	4	-	-	-
R5	483	2	338	3	-	-	-
R6	604	2	423	4	-	-	-
R7	646	2	452	5	-	-	-
R8	799	3	559	6	-	-	-
R9	812	3	568	6	-	-	-
R10	1029	3	720	7	-	-	-
R11	1335	4	934	9	-	-	-
R12	1415	5	991	10	-	-	-
R13	2071	7	1450	15	644	2094	21
R14	1879	6	1315	13	644	1959	20

Receptor	Process Contribution (1 hour) µg.m^{-3}	Process Contribution as % of EAL	Process Contribution (8 hour mean) µg.m^{-3}	Process Contribution as % of EAL	AC µg.m^{-3}	PEC µg.m^{-3}	PEC as % of EAL
R15	2309	8	1617	16	644	2261	23
R16	1543	5	1080	11	644	1724	17
R17	1497	5	1048	10	-	-	-
R18	431	1	302	3	-	-	-
R19	1037	3	726	7	-	-	-
R20	423	1	296	3	-	-	-
R21	409	1	286	3	-	-	-
R22	280	1	196	2	-	-	-
R23	234	1	164	2	-	-	-
R24	274	1	192	2	-	-	-
R25	469	2	328	3	-	-	-
R26	257	1	180	2	-	-	-
R27	623	2	436	4	-	-	-
16/01232/OUT	1979	7	1385	14	644	2029	20
18/00664/CONDC	1316	4	922	9	-	-	-
16/00412/OUT	1208	4	845	8	-	-	-
15/00379/OUT	1104	4	773	8	-	-	-
16/01475/SCR	1058	4	741	7	-	-	-
GR/17/674	614	2	430	4	-	-	-
20141214	615	2	430	4	-	-	-

EAL for hourly-mean CO is 30,000 µg.m^{-3}.
EAL for 8-hour mean CO is 10,000 µg.m^{-3}.

5.9 The predicted PCs exceed 10% of the EAL at some locations but when the PC is added to the background concentration the PEC does not exceed 100% of the EAL and the impacts can be screened out as not significant at all receptors.

Significance of Effects

5.10 It is generally considered good practice that, where possible, an assessment should communicate effects both numerically and descriptively. Professional judgement by a competent, suitably qualified professional is required to establish the significance associated with the consequence of the impacts.

5.11 Based on the predicted concentrations, the effects are deemed to be not significant, with no predicted exceedances of any objectives or standards at modelled discrete receptors.

Sensitivity and Uncertainty

5.12 Section 3 provided an analysis of the sources of uncertainty in the results of the assessment. The conclusion of that analysis was that, overall, the predicted total concentration is likely to be towards the top of the uncertainty range rather than being a central estimate. The actual concentrations that will be found when the development is operational are unlikely to be higher than those presented within this report and are more likely to be lower.

5.13 The effects at existing receptors are shown to be not significant even for this conservative scenario. Consequently, further sensitivity analysis has not been undertaken and, in practice, the impacts at sensitive receptors are likely to be lower than those reported in this conservative assessment.

6 Mitigation

Operational Phase

6.1 Predicted concentrations of pollutants from the operational phase of the proposed facility have been demonstrated by the assessment to meet the relevant air quality standards and objectives. On that basis, no additional mitigation is proposed.

7 Conclusions

7.1 This assessment has considered the air quality impacts during the operational phase of the proposed Thurrock Flexible Generation Plant.

7.2 The operational effects of NO_2 and CO emissions from the facility's stacks have been predicted using good practice approaches. The assessment has been undertaken based on a number of conservative assumptions, including using the worst-case meteorological conditions for the five years modelled and modelling the stack emissions for 2,250 hours. The results show that with the gas engines operational, the predicted concentrations are below the relevant air quality standards.

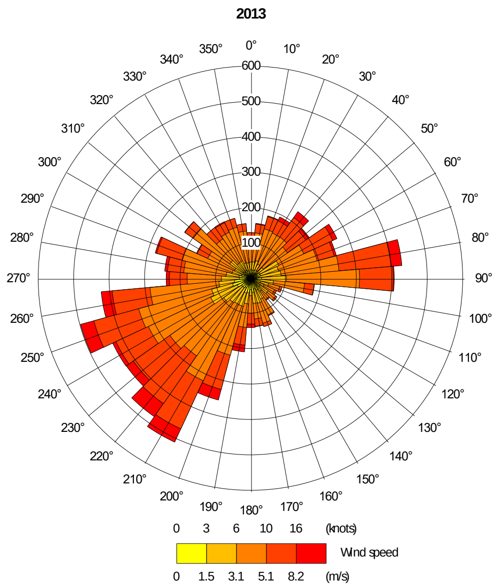
7.3 Using professional judgement, the resulting air quality effect of the proposed development is considered to be 'not significant' overall.

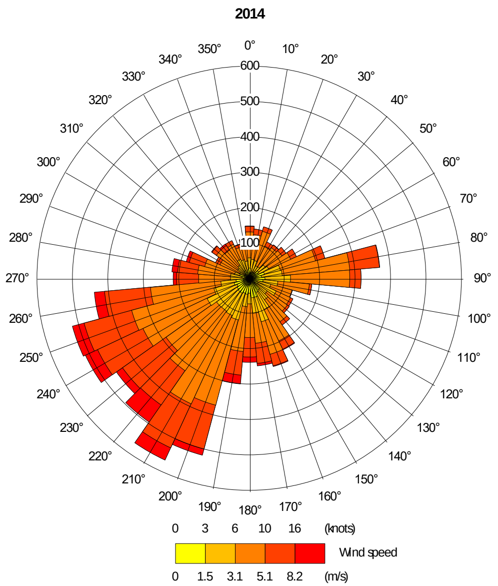
7.4 The proposed development does not, in air quality terms, conflict with national or local policies. There are no constraints to the development in the context of air quality.

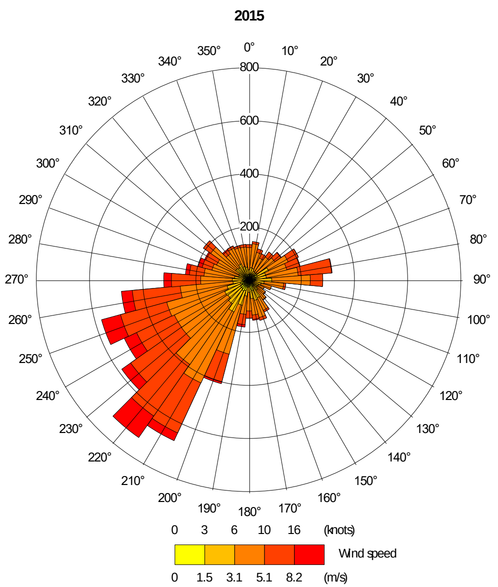
Glossary

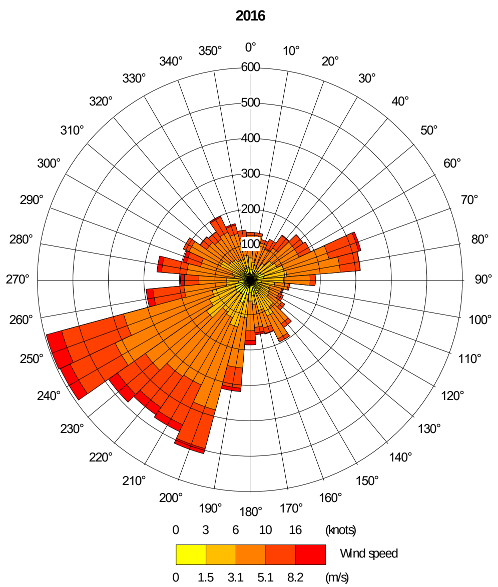
ADMS	Atmospheric Dispersion Modelling System
AQMA	Air Quality Management Area
AQS	Air Quality Strategy
Effect	The consequences of an impact, experienced by a receptor
EPUK	Environmental Protection UK
IAQM	Institute of Air Quality Management
Impact	The change in atmospheric pollutant concentration and/or dust deposition. A scheme can have an 'impact' on atmospheric pollutant concentration but no effect, for instance if there are no receptors to experience the impact
R&A	Review and Assessment
Receptor	A person, their land or property and ecologically sensitive sites that may be affected by air quality
Risk	The likelihood of an adverse event occurring

Figures









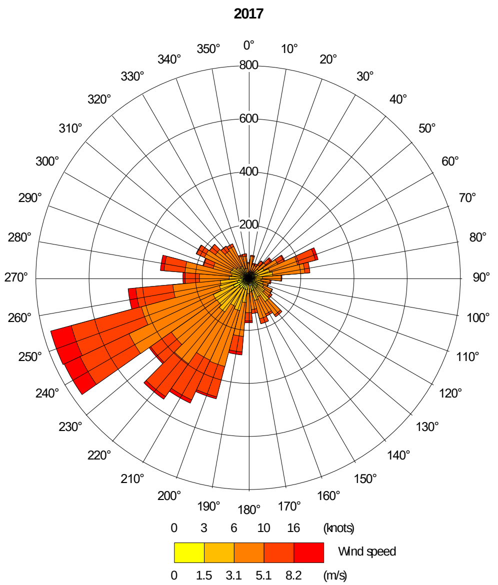


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Figure 1: Wind Roses

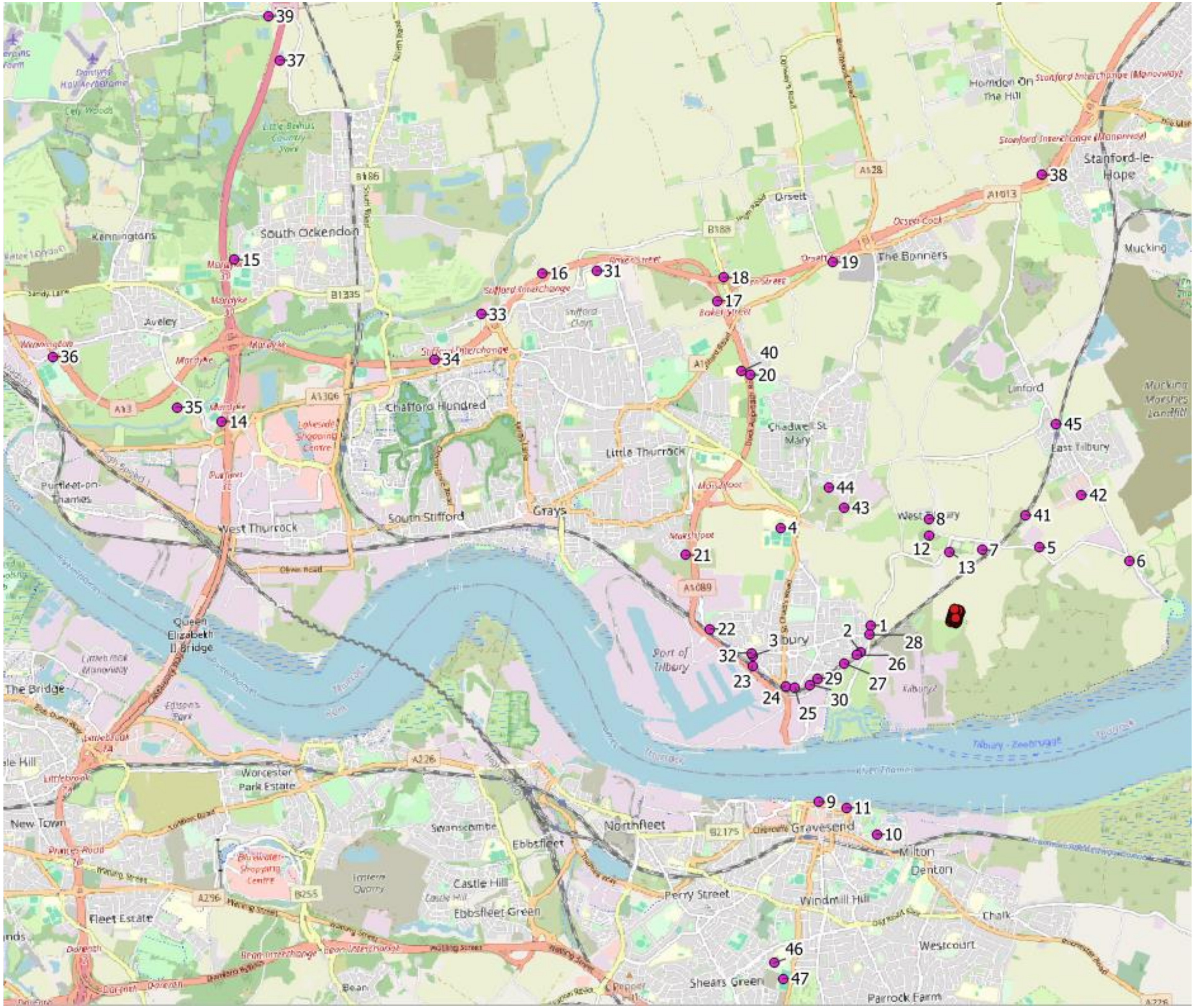

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Figure 2: Stacks and Receptors Modelled

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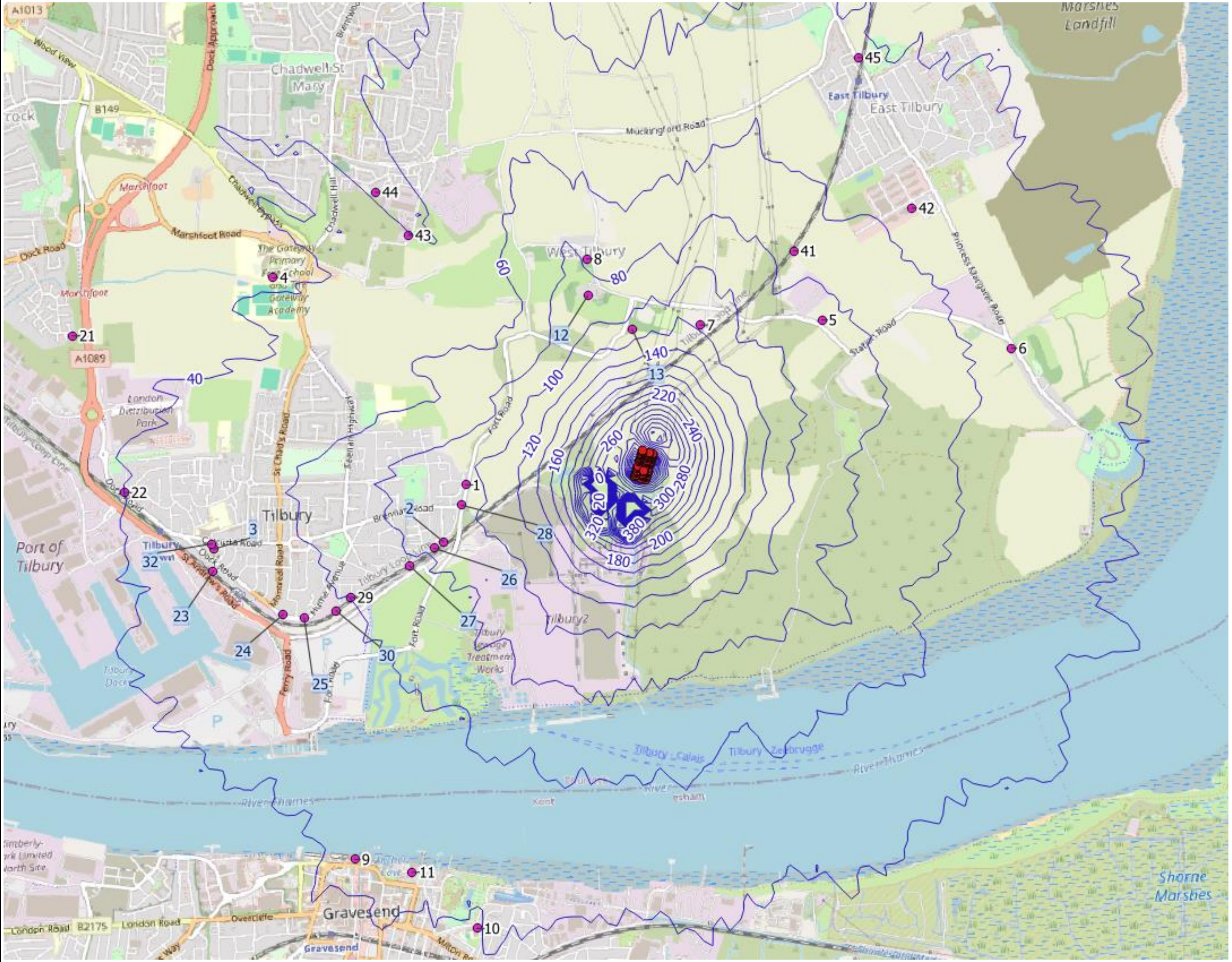

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Figure 3: 99.79th Percentile Hourly-mean NO_2 Process Contributions ($\mu g.m^{-3}$)

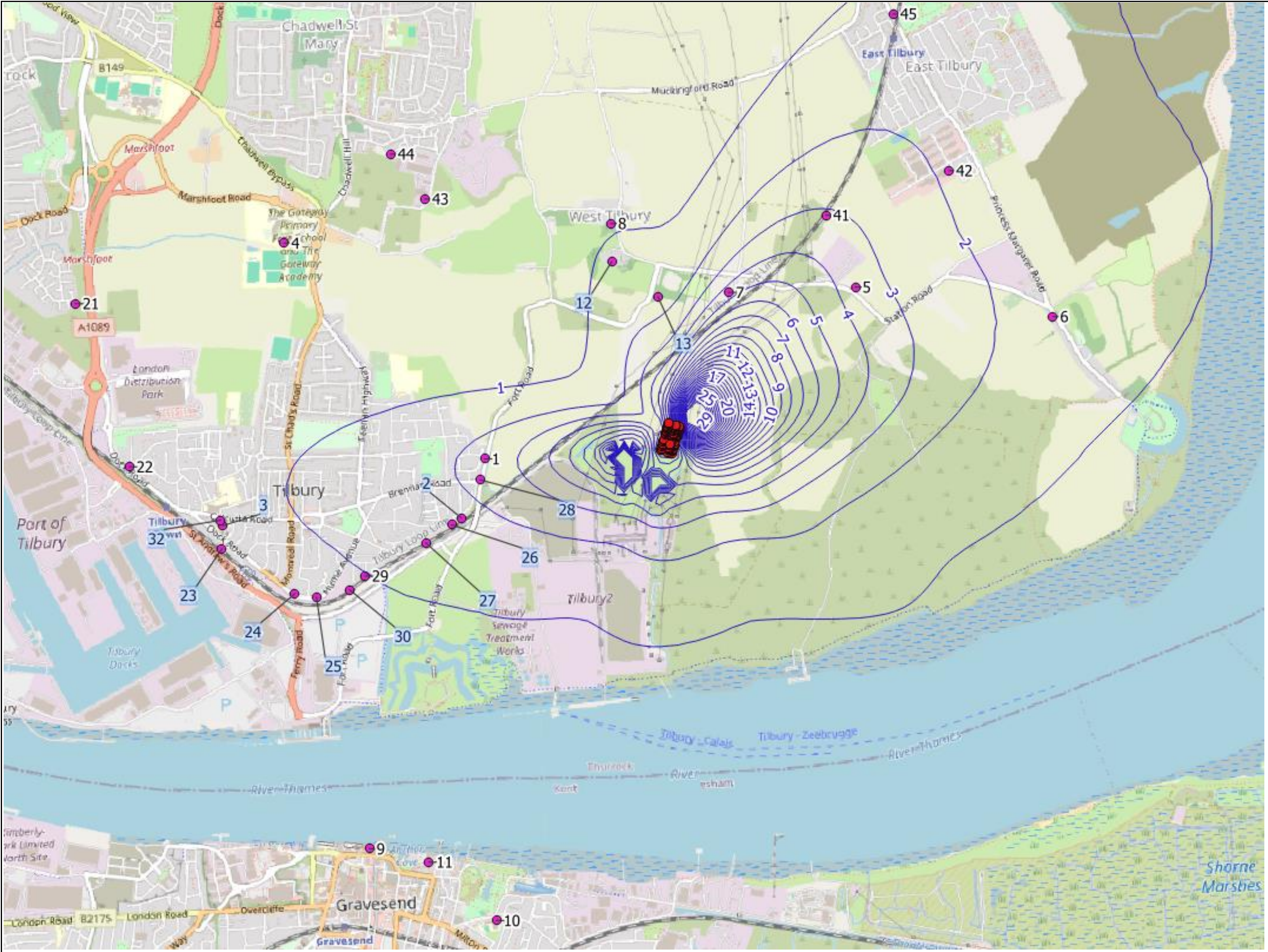

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Figure 4: Annual-mean NO_2 Process Contributions ($\mu g.m^{-3}$)

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Appendices

Appendix A: Impacts on Habitat Sites

A.1 This assessment considers the impact of the development on NO_X concentrations, nutrient nitrogen deposition and acid deposition at the following sites within 15 km of the proposed development:

- Thames Estuary and Marshes Special Protection Area (SPA);
- North Downs Woodlands Special Area of Conservation (SAC);
- Basildon Meadows Site of Special Scientific Interest (SSSI);
- Canvey Wick SSSI;
- Chattenden Woods and Lodge Hill SSSI;
- Cobham Woods SSSI;
- Darenth Wood SSSI;
- Grays Thurrock Chalk Pit SSSI;
- Great Crabbles Wood SSSI;
- Halling to Trottiscliffe Escarpment SSSI;
- Hangmans Wood and Deneholes SSSI;
- Holehaven Creek SSSI;
- Mucking Flats and Marshes SSSI;
- Northward Hill SSSI;
- Pitsea Marsh SSSI;
- Shorne and Ashenbank Woods SSSI;
- South Thames Estuary and Marshes SSSI;
- Thorndon Park SSSI;
- Tower Hill to Cockham Wood SSSI;
- Vange and Fobbing Marshes SSSI;
- West Thurrock Lagoon and Marshes SSSI;
- Langdon Ridge SSSI;

- Broom Hill Local Wildlife Site (LWS);
- West Tillbury Hall LWS;
- Low Street Pit LWS;
- Lytag Brownfield LWS;
- Tilbury Centre LWS;
- Tilbury Marshes LWS; and
- Goshems Farm LWS.

Critical Levels

A.2 Critical levels are maximum atmospheric concentrations of pollutants for the protection of vegetation and ecosystems and are specified within relevant European air quality directives and corresponding UK air quality regulations. PCs and PECs of NOx have been calculated for comparison with the 30 $\mu g.m^{-3}$ annual-mean critical level. Similarly, the PCs and PECs for NH_3 have been compared against the relevant critical level for NH_3, which ranged from 1 to 3 $\mu g.m^{-3}$ at the habitat sites. Background NO_x and NH_3 concentrations at each designated site have been derived from the UK Air Pollution Information System (APIS) database [11].

Critical Loads

A.3 Critical loads refer to the quantity of pollutant deposited, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge.

Critical Loads – Nutrient Nitrogen Deposition

A.4 Percentage contributions to nutrient nitrogen deposition have been derived from the results of the ADMS dispersion modelling. Deposition rates have been calculated using empirical methods recommended by the EA, as follows:

- The dry deposition fluxes of NO_2 ($\mu g.m^{-2}.s^{-1}$) have been calculated by multiplying the ground level NO_2 concentrations ($\mu g.m^{-3}$) by their deposition velocities. In this case, the habitats at the identified sites are all low level, mostly comprising grassland and saltmarshes, and the deposition velocities provided by the EA guidance for short habitats would be most appropriate. The deposition velocities for short habitats are 0.0015 $m.s^{-1}$.
- Wet deposition in the near field is not significant compared with dry deposition for N [12] and therefore for the purposes of this assessment, wet deposition has not been considered.
- The deposition flux of N in units of $kg.ha^{-1}.year^{-1}$ has been calculated from the dry deposition fluxes of NO_2 in units of $\mu g.m^{-2}.s^{-1}$, by multiplying the dry deposition fluxes by the standard conversion factors of 96.

A.5 Predicted contributions to nitrogen deposition have been calculated and compared with the relevant critical load range for the habitat types associated with the designated site. These have been derived from the APIS database.

Critical Loads – Acidification

A.6 The acid deposition rate, in equivalents keq.ha^{-1}.year^{-1}, has been calculated by multiplying the total N deposition flux (kg.ha^{-1}.year^{-1}) by a conversion factor of 0.071428. This takes into account the degree to which a chemical species is acidifying, calculated as the proportion of N within the molecule.

A.7 Predicted contributions to acid deposition have been calculated and compared with the minimum critical load function for the habitat types associated with each designated site as derived from the APIS database.

Significance Criteria

A.8 The PC and PEC of NO_x and N/acid deposition have been compared against the relevant critical level/load for the relevant habitat type/interest feature. Based on current Environment Agency guidelines [13] and the Institute of Air Quality Management Position Statement [14].

A.9 The following criteria have been used to determine if the impacts are significant:

- If the long-term PC does not exceed 1% of relevant critical level/load the emission is considered not significant; and
- If the long-term PC exceeds 1% but the resulting PEC is below 100% of the relevant critical level/load, the emission is not considered significant;

For local nature sites the EA online guidance states "*You don't need to calculate PEC for local nature sites. If your PC exceeds the screening criteria you need to do detailed modelling.*"

A.10 Where potentially significant impacts have been identified, the impacts have been passed to the project's ecologist to allow the significance of the likely effect to be determined.

Results

A.11 The ambient NOx concentrations and existing deposition rates have been obtained from APIS.

A.12 The predicted annual-mean NO_X concentrations are compared with the critical levels in Table A.1. The predicted nutrient N deposition rate is compared with the critical load in Table A.2. The predicted acid deposition rates are compared with the critical load function in Table A.3

Table A.1 Predicted Annual-Mean NO_x Concentrations at Designated Habitat Sites

Site Name	Critical Level	PC	PC/ Critical Level (%)	AC (µg.m^{-3})	PEC (µg.m^{-3})	PEC/ Critical Level (%)
Thames Estuary and Marshes SPA	30	2.0	7	18.5	20.5	68
North Downs Woodlands SAC		0.1	0	-	-	-
Basildon Meadows SSSI		0.3	1	-	-	-
Canvey Wick SSSI		0.4	1	-	-	-
Chattenden Woods and Lodge Hill SSSI		0.3	1	-	-	-
Cobham Woods SSSI		0.2	1	-	-	-
Darenth Wood SSSI		0.3	1	-	-	-
Grays Thurrock Chalk Pit SSSI		0.3	1	-	-	-
Great Crabbles Wood SSSI		0.2	1	-	-	-
Halling to Trottiscliffe Escarpment SSSI		0.1	0	-	-	-
Hangmans Wood and Deneholes SSSI		0.5	2	24.2	24.7	82
Holehaven Creek SSSI		0.4	1	-	-	-

Mucking Flats and Marshes SSSI		2.2	7	23.5	25.7	86
Northward Hill SSSI		0.2	1	-	-	-
Pitsea Marsh SSSI		0.3	1	-	-	-
Shorne and Ashenbank Woods SSSI		0.2	1	-	-	-
South Thames Estuary and Marshes SSSI		1.1	4	18.0	19.1	64
Thorndon Park SSSI		0.2	1	-	-	-
Tower Hill to Cockham Wood SSSI		0.2	1	-	-	-
Vange and Fobbing Marshes SSSI		0.5	2	19.3	19.8	66
West Thurrock Lagoon and Marshes SSSI		0.4	1	-	-	-
Langdon Ridge SSSI		0.3	1	-	-	-
Broom Hill LWS		8.7	29	-	-	-
West Tilbury Hall LWS		2.9	10	-	-	-
Low Street Pit LWS		7.7	26	-	-	-
Lytag Brownfield LWS		11.3	38	-	-	-

Tilbury Centre LWS		3.9	13	-	-	-
Tilbury Marshes LWS		3.1	10	-	-	-
Goshems Farm LWS		4.2	14	-	-	-

Table A.2 Predicted Nutrient N Deposition at Designated Habitat Sites

Site Name	Critical Load	PC ($kgN.ha^{-1}.yr^{-1}$)	PC/ Critical Load (%)	AC ($kgN.ha^{-1}.yr^{-1}$)	PEC ($kgN.ha^{-1}.yr^{-1}$)	PEC/ Critical Load (%)
Thames Estuary and Marshes SPA	8	0.20	3	11.5	11.7	146
North Downs Woodlands SAC	5	0.02	0	-	-	-
Basildon Meadows SSSI	20	0.03	0	-	-	-
Canvey Wick SSSI	10	0.04	0	-	-	-
Chattenden Woods and Lodge Hill SSSI	15	0.05	0	-	-	-
Cobham Woods SSSI	15	0.03	0	-	-	-
Darenth Wood SSSI	15	0.05	0	-	-	-
Grays Thurrock Chalk Pit SSSI	-	0.03	-	-	-	-
Great Crabbles Wood SSSI	15	0.04	0	-	-	-

Halling to Trottiscliffe Escarpment SSSI	5	0.03	1	-	-	-
Hangmans Wood and Deneholes SSSI	-	0.05	-	-	-	-
Holehaven Creek SSSI	-	0.05	-	-	-	-
Mucking Flats and Marshes SSSI	20	0.22	1	-	-	-
Northward Hill SSSI	-	0.02	-	-	-	-
Pitsea Marsh SSSI	15	0.03	0	-	-	-
Shorne and Ashenbank Woods SSSI	15	0.04	0	-	-	-
South Thames Estuary and Marshes SSSI	20	0.11	1	-	-	-
Thorndon Park SSSI	15	0.04	0	-	-	-
Tower Hill to Cockham Wood SSSI	15	0.03	0	-	-	-
Vange and Fobbing Marshes SSSI	-	0.05	-	-	-	-
West Thurrock Lagoon and Marshes SSSI	20	0.04	0	-	-	-
Langdon Ridge SSSI	10	0.06	1	-	-	-

Broom Hill LWS	10	0.88	9	-	-	-
West Tilbury Hall LWS	10	0.29	3	-	-	-
Low Street Pit LWS	10	0.78	8	-	-	-
Lytag Brownfield LWS	10	1.14	11	-	-	-
Tilbury Centre LWS	10	0.39	4	-	-	-
Tilbury Marshes LWS	20	0.32	2	-	-	-
Goshems Farm LWS	20	0.42	2	-	-	-

Table A.3 Predicted Acid Deposition at Designated Habitat Sites

Site Name	Interest Feature	CLMinN	CLMaxN	Existing Deposition (keq.ha^{-1}.yr^{-1})	PC (keq.ha^{-1}.yr^{-1})	PC/ Critical Load (%)
Thames Estuary and Marshes SPA	Charadrius hiaticula (Europe/Northern Africa - wintering) - Ringed plover (A137)	0.499	1.389	0.89	0.014	1
North Downs Woodlands SAC	Taxus baccata woods of the British Isles (H91J0)	0.142	1.983	1.925	0.002	0
	Asperulo-Fagetum beech forests (H9130)	0.142	1.983	1.925	0.002	0

	Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites) (H6210)	0.856	4.856	1.925	0.002	0
Basildon Meadows SSSI	Neutral grassland (Cynosurus cristatus - Centaurea nigra grassland)	0.438	2.48	1.925	0.002	0
Chattenden Woods and Lodge Hill SSSI	Neutral grassland (Cynosurus cristatus - Centaurea nigra grassland)	0.856	4.856	0.955	0.004	0
South Thames Estuary and Marshes SSSI	Anas querquedula - Garganey	0.856	4.856	0.887	0.008	0
	Numenius arquata - Curlew	0.856	4.856	0.887	0.008	0
Thorndon Park SSSI	Broad-leaved, mixed and yew woodland (Quercus robur - Pteridium aquilinum - Rubus fruticosus woodland)	0.142	2.065	1.822	0.003	0
Langdon Ridge SSSI	Broad-leaved, mixed and yew	0.357	2.889	1.854	0.004	0

	woodland (Crataegus monogyna - Hedra helix scrub)					
	Broad-leaved, mixed and yew woodland (Fraxinus excelsior - Acer campestre - Mercurialis perennis woodland)	0.357	2.889	1.854	0.004	0
	Broad-leaved, mixed and yew woodland (Quercus robur - Pteridium aquilinum - Rubus fruticosus woodland)	0.357	2.889	1.854	0.004	0
	Fen, marsh and swamp (Juncus subnodulosus - Cirsium palustre fen meadow)	1.071	5.071	0.994	0.002	0
	Neutral grassland (Cynosurus cristatus - Centaurea nigra grassland)	1.071	5.071	0.994	0.002	0
Broom Hill LWS	Acid grassland	0.438	4.578	-	0.063	14

West Tilbury Hall LWS	Acid grassland	0.48	4.578	-	0.021	4
Low Street Pit LWS	Acid grassland	0.223	1.113	-	0.056	25
Lytag Brownfield LWS	Acid grassland	0.48	4.578	-	0.081	17
Tilbury Centre LWS	Acid grassland	0.48	4.578	-	0.028	6

Interpretation of Results

A.13 The maximum annual-mean NO_X PC does not exceed 1% (or 100% for LWS) of the critical level, or the PECs do not exceed the critical level at all sites. On that basis, the emissions are not considered to be significant.

A.14 The maximum nitrogen deposition PC does not exceed 1% (or 100% for the LWS) of the critical load for all habitat sites except the Thames Estuary SPA. On that basis, the emissions are not considered to be significant.

A.15 At the Thames Estuary SPA, the project's ecologist advised:

"The CL is taken from the Site-Relevant Critical Load tool on APIS and is for acidic coastal stable dune grassland. This habitat type does not occur within the Thames Estuary and Marshes SPA; indeed the main associations of this species within the SPA are the grazing marsh and inter-tidal mudflats, in particular at Mucking Flats near east Tilbury and further east at Allhallows-on-Sea (Frost et al., 2016). Such habitats are not susceptible to either acid or nutrient nitrogen deposition on the basis that they are both high nutrient systems (as demonstrated by a high critical load of 20-30 kgN.ha^{-1}.yr^{-1}) and brackish (or salt water) and therefore more alkaline.

On this basis, it is considered that the data on APIS is not directly relevant to the population of Ringed Plover using the SPA where a higher critical load/CLF would be more appropriate, given the habitat associations of this species in this geographic location. Therefore, there is no potential for a likely significant effect on Ringed Plover using the Thames Estuary and Marshes SPA as a result of emissions to air from the proposed facility".

A.16 The maximum acid deposition PC does not exceed 1% (or 100% for LWS) of the critical load function for interest features at all sites. On that basis, the emissions are not considered to be significant.

References

1 Defra, 2010, The Air Quality Standards Regulations.

2 The Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020

3 HMSO (1995) Environment Act 1995

4 Defra, 2007, The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. Volume 2.

5 Environment Agency (2020) https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit#environmental-standards-for-air-emissions

6 OPSI (2016) The Environmental Permitting (England and Wales) Regulations 2016

7 Mayor of London, 2019 London Local Air Quality Management Technical Guidance, 2019 (LLAQM.TG19)

8 https://www.gov.uk/guidance/environmental-permitting-air-dispersion-modelling-reports

9 https://www.gov.uk/guidance/environmental-permitting-air-dispersion-modelling-reports

10 Drawn from Defra Maps at http://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018

11 Air Pollution Information Systems, www.apis.ac.uk

12 Approaches to modelling local nitrogen deposition and concentrations in the context of Natura 2000 - Topic 4

13 https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit#screening-for-protected-conservation-areas

14 IAQM (2016) Use of a Criterion for the Determination of an Insignificant Effect of Air Quality Impacts on Sensitive Habitats