

Technical note:

GFP II Limited – Harts Farm Way Air Dispersion Modelling

1. Introduction

GFP II Limited (GFP II Ltd) has proposed to build a power plant in Havant that generates electricity to export power to the National Grid when demand outstrips supply. The site consists of 10 gas generators each rated at 2,535kW.

This technical note provides information to inform GFP II Ltd's on potential impacts on local air quality of different operating regimes. It is assumed that the engines will not operate outside the hours 07:00–23:00.

There is an adjacent installation operated by Peak Gen Power Limited (Peak Gen) to the northwest of the GFP II Ltd site. The two installations are assumed to operate independently, and it is further assumed that they may both operate at the same time. The emissions of the Peak Gen installation have, therefore, been accounted for in modelling the impacts of the GFP II Ltd installation.

1.1 Site description

The proposed site is located between the A27 Road to the north, industrial units to the east and west and a Sewage Treatment Plant to the south.

The installation is proposed to be located off Harts Farm Way near Havant, at grid reference 470617, 105826. It lies within the Havant Borough Council (HBC) administrative area. The closest residential receptors are properties located on Brockhampton Road, approximately 450m to the north east and on Mill Lane, approximately 380m to the north west.

A separate installation of electricity generating engines is located approximately 170m to the northwest.

Parts of a number of Ramsar, Special Protection Areas (SPA), Special Areas of Conservation (SAC) and Sites of Special Scientific Interest (SSSI) have been identified within 10 km of the installation, namely:

- Chichester and Langstone Harbours (Ramsar, SPA);
- Solent Maritime (SAC);
- Portsmouth Harbour (Ramsar, SPA),
- Solent & Isle Of Wight Lagoons (SAC);
- Langstone Harbour (SSSI); and
- Chichester Harbour (SSSI).

Farlington Marshes Local Nature Reserve (LNR) and an area of ancient woodland lie within 2 km.

2. Assessment methodology

2.1 Process emissions

The GFP II Ltd installation as modelled here consists of 10 MTU 20V4000 GS (GG20V4000A1) gas-fired engines, each rated at 2,535kWe. Each engine sits within its own container with its own individual stack. Their total electrical export is rated at approximately 25 MW_e. However, GFP's export agreement is for just 20 MW, so the engines will either be derated or not all will be operated when called. The assessment presented here assumes that all 10 engines operate at full rating, and is therefore pessimistic.

The adjacent Peak Gen Power installation consists of 10 16V4000G63 diesel (compression-ignition) engines manufactured by MTU, likewise each in its own container and with its own stack. Their total electrical export is 20 MW_e. It is assumed that the Peak Gen Power installation operates for a maximum of 500 hours per year¹.

Model input parameters are given in Table 2.1 and Table 2.2. The process data has been derived from manufacturer's engine specification provided by GFP II Ltd and existing process and emissions data held by Wood.

Table 2.1 Modelled stack characteristics

Parameter	GFP II Ltd Gas	Peak Gen Power Diesel
Release height (m)	8.5	4.96
Flue diameter (m)	0.47	0.5
Efflux velocity (m s ⁻¹)	45.8	39
Efflux temperature (°C)	419	491
Actual oxygen (%)	9.2	8.6
Moisture (%)	2.8	2.7

Table 2.2 Modelled stack emission rates, per engine (g s⁻¹)

Pollutant	GFP II Ltd Gas	Peak Gen Power Diesel
NO _x	0.58	1.14
CO	2.31	1.32

2.2 Modelled domain and receptors

The human receptors considered were chosen based on locations where people may be located and judged in terms of the likely duration of their exposure to pollutants and proximity to the site.

¹ Wood (2018) Peak Gen Power Ltd Havant Power Plant Air Quality Impact Assessment.

Guidance from the Environmental Agency (EA)² requires impacts at certain local sensitive ecological receptors to be assessed. Ecological receptors meeting the EA criteria are summarised in Section 1.1.

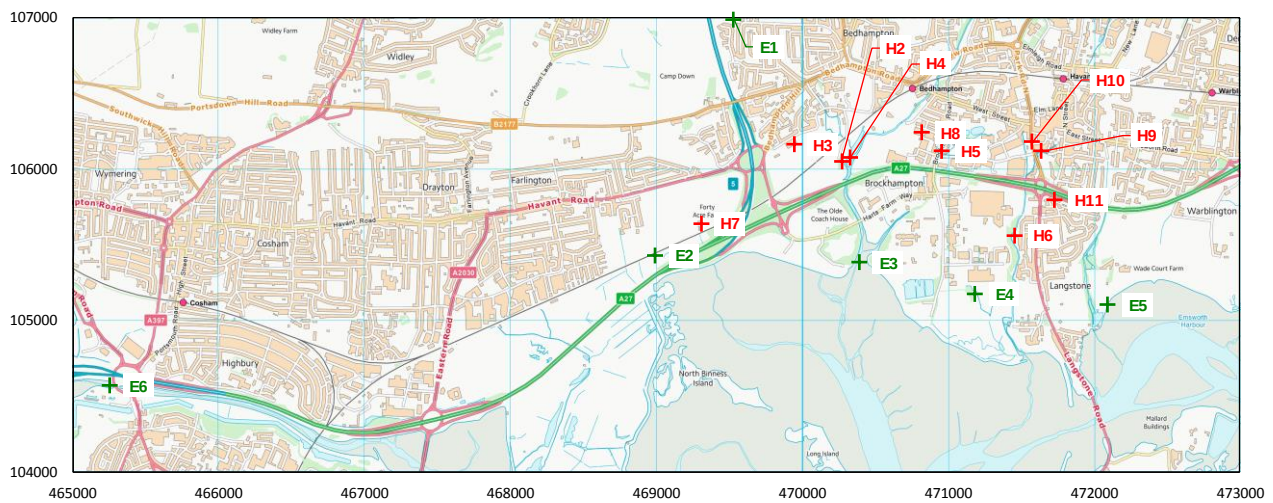
Modelled receptors locations are presented in Table 2.3 and Figure 2.1.

Table 2.3 Modelled receptors

ID	Type	Y (m)	X (m)	Description
H2	Residential	470273	106054	Mill Lane, Brockhampton
H3	Residential	469945	106161	Lower Road, Brockhampton
H4	Residential	470330	106079	Mill Lane, Brockhampton
H5	Residential	470958	106118	Brockhampton Road, Brockhampton,
H6	Residential	471454	105563	Brookmead Way, Langstone
H7	Residential	469309	105643	Havant Road, Bedhampton
H8	Residential	470818	106240	Abrams Way, Brockhampton
H9	Residential	471641	106121	Bosmere Junior School, South Street, Brockhampton
H10	Residential	471577	106179	Bulbeck Road, Brockhampton
H11	Residential	471733	105795	Rectory Road, Langstone
E1	Ecological	469532	106992	Ancient Woodland
E2	Ecological	468990	105431	Chichester and Langstone Harbours Ramsar/SPA, Farlington Marshes LNR
E3	Ecological	470389	105382	Chichester and Langstone Harbours Ramsar/SPA, Solent Maritime SAC
E4	Ecological	471184	105177	Chichester and Langstone Harbours Ramsar/SPA
E5	Ecological	472097	105106	Chichester and Langstone Harbours Ramsar/SPA, Solent Maritime SAC
E6	Ecological	465249	104568	Portsmouth Harbour Ramsar/SPA

² Environment Agency (2016) Air emissions risk assessment for your environmental permit.

Figure 2.1 Modelled receptor locations



3. Assessment criteria

3.1 Criteria appropriate to the assessment

Air quality assessment levels (AQALs)

There is a large number of sources of standards against which air quality should be assessed, and these often use different terms for the assessment levels, including limit value, air quality standard (AQS), air quality objective (AQO), environmental assessment level (EAL), critical level (CLE), critical load (CL) and target. For simplicity, this document follows IAQM/EPUK (2015) is using the term “air quality assessment level (AQAL)”, or simply assessment level, to refer to any of these, unless it is useful to be more specific (e.g. to indicate the legal status of the AQAL).

Table 3.1 sets out those AQALs that are relevant to this assessment.

Table 3.1 Air quality assessment levels

Pollutant	Receptors affected	AQS/AQO/EAL	Averaging Period	Value
NO₂	Human	AQS	Annual mean	40 $\mu\text{g m}^{-3}$
		AQS	1-hour mean, not to be exceeded more than 18 times a year (equivalent to 99.79th percentile)	200 $\mu\text{g m}^{-3}$
CO	Human	AQS	8-hour running mean across a day	10,000 $\mu\text{g m}^{-3}$
		EAL	1-hour mean	30,000 $\mu\text{g m}^{-3}$
NO_x	Ecological	AQS	Annual mean	30 $\mu\text{g m}^{-3}$
		Target	Daily mean	75 $\mu\text{g m}^{-3}$
		WHO assessment level	Daily mean	200 $\mu\text{g m}^{-3}$ *
Nitrogen deposition	Ecological	Critical load	Annual mean	Site-specific
Acid deposition	Ecological	Critical load	Annual mean	Site-specific

* Where O₃ and SO₂ are not present above their critical levels.

The critical level for daily mean NO_x derives from WHO guidance, which suggests a level of 75 $\mu\text{g m}^{-3}$ where ozone (O₃) and SO₂ are present above their critical levels. We have reviewed Defra's monitoring data for ozone and SO₂ for 2019 at the monitoring stations in the Southeast England region that measure ozone (eight stations) and/or SO₂ (seven stations), as well as other data sources for these pollutants.

Concerning sulphur dioxide (SO₂), the critical level is 20 $\mu\text{g m}^{-3}$ for ecosystems (other than lichens, which are not expected to be present at sensitive locations close to the proposed installation). Monitored annual mean concentrations for 2019 in Southeast England are between 0.8 $\mu\text{g m}^{-3}$ (at Chilbolton) and 1.7 $\mu\text{g m}^{-3}$ (at Southampton Centre). Defra has not produced background maps of SO₂ since 2001, since it is considered not to be a significant problem except in a few specific locations. APIS gives modelled maximum SO₂ concentrations at the Portsmouth Harbour SPA, Solent and Southampton Water SPA and Solent Maritime SAC of 3.18 $\mu\text{g m}^{-3}$, 5.17 $\mu\text{g m}^{-3}$ and 5.17 $\mu\text{g m}^{-3}$ respectively. Concentrations of SO₂ are therefore less than 26% of the critical level throughout the designated sites. Even if the lower SO₂ critical level of 10 $\mu\text{g m}^{-3}$ was applied, SO₂ concentrations would still be at most 52% of the critical level.

Concerning ozone, APIS does not offer a quantitative critical level for this pollutant. The AQS Regulations have two values for the critical level as a May–July AOT40, namely a Target Value of 18,000 $\mu\text{g m}^{-3} \text{ h}$ and a long-term objective of 6000 $\mu\text{g m}^{-3} \text{ h}$, the latter corresponding to the guideline value proposed by WHO of 3 ppm h for crops. Environment Agency guidance quotes a critical level of 18,000 $\mu\text{g m}^{-3} \text{ h}$. Monitored AOT40 concentrations for 2019 in Southeast England vary widely between 329 $\mu\text{g m}^{-3} \text{ h}$ at Reading New Town and 7011 $\mu\text{g m}^{-3} \text{ h}$ at Rochester Stoke. Concentrations are generally much higher in rural locations than urban locations, as there is less of a scavenging effect due to lower concentrations of NO. Of the eight monitoring stations in Southeast England that measure ozone, only two have an AOT40 above 6000 $\mu\text{g m}^{-3} \text{ h}$ (Canterbury at 6251 $\mu\text{g m}^{-3} \text{ h}$ and Rochester Stoke at 7011 $\mu\text{g m}^{-3} \text{ h}$); it should be noted that these are both in the east of the region and lower concentrations are found in the west, closer to the proposed installation. The closest monitoring station to the proposed installation is Portsmouth, where the AOT40 is 1246 $\mu\text{g m}^{-3} \text{ h}$. Concentrations of ozone in the vicinity of the proposed installation are therefore considered very unlikely to exceed the critical level.

It is therefore concluded from the available monitoring and modelling data that predicted environmental concentrations of both SO₂ and ozone will be comfortably below their respective critical levels at the habitat sites in question, and therefore 200 µg m⁻³ is the appropriate value for the daily NO_x critical level.

4. Assessment of impacts

This section summarises the results of the dispersion modelling and compares predicted ground level concentrations against the assessment criteria detailed in Section 3. The predicted concentrations resulting from the GFP II Ltd installation (i.e. the process contribution (PC)) are presented along with the total predicted environmental concentrations (PEC), which include the background contribution from the Peak Gen site and other sources unrelated to the installation.

4.1 Human health effects

Annual mean nitrogen dioxide (NO₂)

Predicted concentrations of annual mean NO₂ are given in are given in Table 4.1, 4.2 and 4.3. Contour plots of the annual mean NO₂ PC are given in Figure 4.1, Figure 4.2 and Figure 4.3. These concentrations tables and figures assume the GFP II Ltd installation operates for up to a notional 1500, 2000 and 2500 hours a year respectively.

The receptor experiencing the highest PEC in all three scenarios is H07 representing a property situated between the A230 Havant Road and the A27 Havant Bypass. Assuming the installation operates for a maximum of 2500 hours per year, concentrations at all receptors are well within the AQAL.

Table 4.1 Annual mean NO₂ impacts – 1500 hours operation

Receptor	AQAL (µg m ⁻³)	PC (µg m ⁻³)	PEC (µg m ⁻³)	PC (% of AQAL)	PEC (% of AQAL)
H02	40	0.37	18.97	0.9%	47.4%
H03	40	0.15	19.51	0.4%	48.8%
H04	40	0.39	19.13	1.0%	47.8%
H05	40	1.13	19.62	2.8%	49.0%
H06	40	0.26	19.85	0.6%	49.6%
H07	40	0.08	23.16	0.2%	57.9%
H08	40	0.79	19.35	2.0%	48.4%
H09	40	0.24	18.62	0.6%	46.6%
H10	40	0.27	18.66	0.7%	46.7%
H11	40	0.22	19.80	0.5%	49.5%

Table 4.2 Annual mean NO₂ impacts – 2000 hours operation

Receptor	AQAL ($\mu\text{g m}^{-3}$)	PC ($\mu\text{g m}^{-3}$)	PEC ($\mu\text{g m}^{-3}$)	PC (% of AQAL)	PEC (% of AQAL)
H02	40	0.50	19.09	1.2%	47.7%
H03	40	0.21	19.56	0.5%	48.9%
H04	40	0.52	19.26	1.3%	48.1%
H05	40	1.50	19.99	3.8%	50.0%
H06	40	0.34	19.94	0.9%	49.8%
H07	40	0.11	23.18	0.3%	58.0%
H08	40	1.06	19.62	2.6%	49.0%
H09	40	0.32	18.70	0.8%	46.8%
H10	40	0.36	18.75	0.9%	46.9%
H11	40	0.29	19.87	0.7%	49.7%

Table 4.3 Annual mean NO₂ impacts – 2500 hours operation

Receptor	AQAL ($\mu\text{g m}^{-3}$)	PC ($\mu\text{g m}^{-3}$)	PEC ($\mu\text{g m}^{-3}$)	PC (% of AQAL)	PEC (% of AQAL)
H02	40	0.62	19.22	1.6%	48.0%
H03	40	0.26	19.61	0.6%	49.0%
H04	40	0.65	19.39	1.6%	48.5%
H05	40	1.88	20.37	4.7%	50.9%
H06	40	0.43	20.02	1.1%	50.1%
H07	40	0.14	23.21	0.3%	58.0%
H08	40	1.32	19.88	3.3%	49.7%
H09	40	0.41	18.78	1.0%	47.0%
H10	40	0.45	18.84	1.1%	47.1%
H11	40	0.37	19.95	0.9%	49.9%

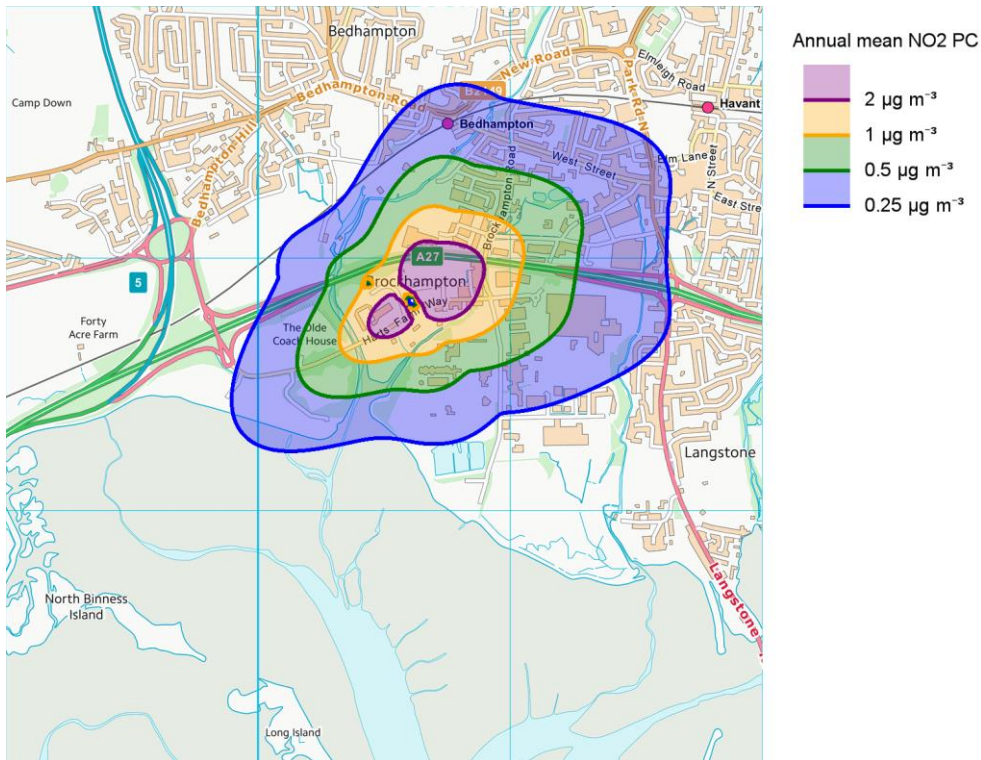
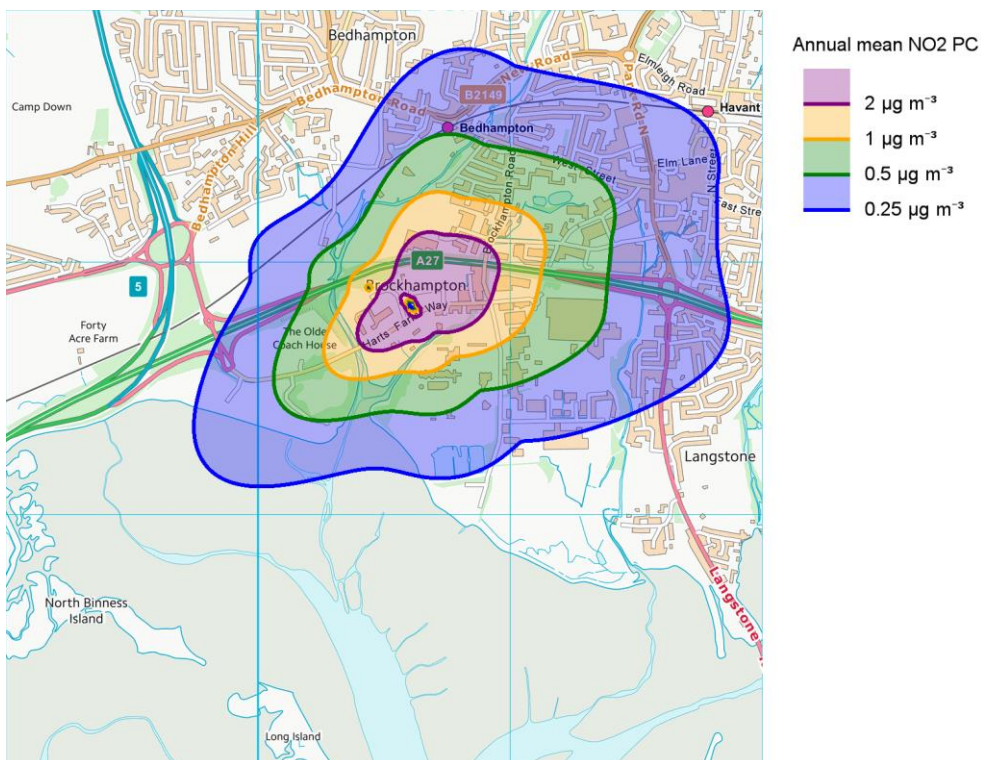
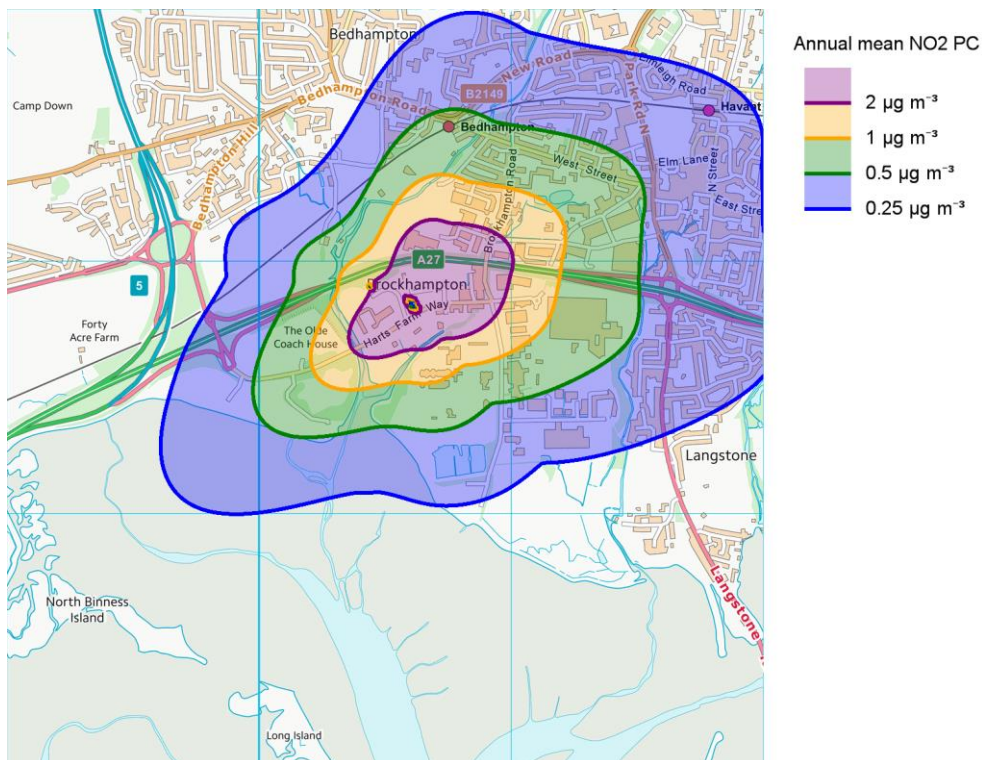
Figure 4.1 Annual mean NO₂ PC contours – 1500 hours operationFigure 4.2 Annual mean NO₂ PC contours – 2000 hours operation

Figure 4.3 Annual mean NO₂ PC contours – 2500 hours operation



Hourly mean nitrogen dioxide (NO₂)

Predicted concentrations of 99.79th percentile 1-hour mean NO₂ are given in Table 4.4. As is normal practice, this table assumes that the engines (on both the GFP II Ltd and Peak Gen sites) operate for 16 hours a day, 365 days a year, in order to ensure that the worst meteorology is captured; this is therefore a pessimistic assessment.

The receptor experiencing the highest PEC is H02 representing a property situated on Mill Lane, however concentrations at all receptors are well within the AQAL.

Table 4.4 99.79th percentile 1-hour mean NO₂ impacts

Receptor	AQAL ($\mu\text{g m}^{-3}$)	PC ($\mu\text{g m}^{-3}$)	PEC ($\mu\text{g m}^{-3}$)	PC (% of AQAL)	PEC (% of AQAL)
H02	200	20.72	150.11	10.4%	75.1%
H03	200	10.71	81.95	5.4%	41.0%
H04	200	22.85	154.20	11.4%	77.1%
H05	200	20.31	79.01	10.2%	39.5%
H06	200	11.69	74.43	5.8%	37.2%
H07	200	8.70	79.15	4.3%	39.6%
H08	200	18.79	77.47	9.4%	38.7%
H09	200	9.33	63.16	4.7%	31.6%
H10	200	9.22	63.44	4.6%	31.7%
H11	200	9.33	68.04	4.7%	34.0%

Carbon Monoxide (CO)

The impact of CO (1-hour and 8-hours means) has also been assessed. There is no risk of CO causing an exceedance of relevant assessment levels.

4.2 Ecological effects

Annual mean nitrogen oxide (NO_x)

Predicted concentrations of annual mean NO₂ are given in are given in Table 4.5, 4.6 and 4.7. These concentrations tables assume the GFP II Ltd installation operates for up to a notional 1500, 2000 and 2500 hours a year respectively.

The receptor experiencing the highest PEC is E03 representing Chichester and Langstone Harbours (Ramsar/SPA). The impacts at this receptor cannot be screened out as insignificant and under EA guidance requires further assessment by a qualified ecologist to determine whether there are sensitive habitats present and whether there are any likely significant effects. Figure 4.4 shows a contour of NO_x PC with 2500 hours operation, showing the 0.45 $\mu\text{g m}^{-3}$ contour corresponding to the 1% criterion (before rounding), overlaid on the Ramsar/SPA site boundary. The overlap represents the region where the impacts cannot be screened out as insignificant.

Effects at all receptors including E03 can be screened out as not significant if the installation operates for up to 1280 hours per year.

Table 4.5 Annual mean NO_x impacts - 1500 hours operation

Receptor	AQAL ($\mu\text{g m}^{-3}$)	PC ($\mu\text{g m}^{-3}$)	PEC ($\mu\text{g m}^{-3}$)	PC (% of AQAL)	PEC (% of AQAL)
E01	30	0.05	28.20	0.2%	94.0%
E02	30	0.09	31.57	0.3%	105.2%

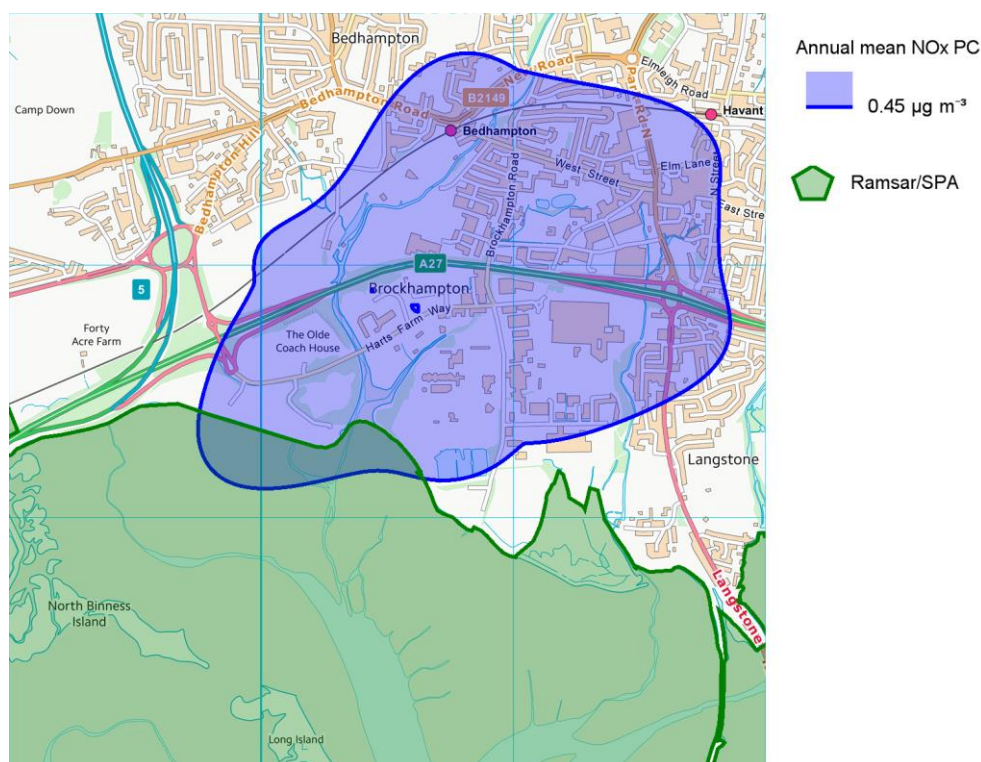
Receptor	AQAL ($\mu\text{g m}^{-3}$)	PC ($\mu\text{g m}^{-3}$)	PEC ($\mu\text{g m}^{-3}$)	PC (% of AQAL)	PEC (% of AQAL)
E03	30	0.52	32.21	1.7%	107.4%
E04	30	0.20	29.22	0.7%	97.4%
E05	30	0.13	22.63	0.4%	75.4%
E06	30	0.02	31.43	0.1%	104.8%

Table 4.6 Annual mean NO_x impacts - 2000 hours operation

Receptor	AQAL ($\mu\text{g m}^{-3}$)	PC ($\mu\text{g m}^{-3}$)	PEC ($\mu\text{g m}^{-3}$)	PC (% of AQAL)	PEC (% of AQAL)
E01	30	0.07	28.22	0.2%	94.1%
E02	30	0.12	31.60	0.4%	105.3%
E03	30	0.70	32.38	2.3%	107.9%
E04	30	0.27	29.29	0.9%	97.6%
E05	30	0.17	22.67	0.6%	75.6%
E06	30	0.02	31.43	0.1%	104.8%

Table 4.7 Annual mean NO_x impacts - 2500 hours operation

Receptor	AQAL ($\mu\text{g m}^{-3}$)	PC ($\mu\text{g m}^{-3}$)	PEC ($\mu\text{g m}^{-3}$)	PC (% of AQAL)	PEC (% of AQAL)
E01	30	0.08	28.23	0.3%	94.1%
E02	30	0.15	31.63	0.5%	105.4%
E03	30	0.87	32.56	2.9%	108.5%
E04	30	0.34	29.35	1.1%	97.8%
E05	30	0.21	22.71	0.7%	75.7%
E06	30	0.03	31.44	0.1%	104.8%

Figure 4.4 Annual mean NO_x PC contours – 2500 hours operation

Daily mean nitrogen oxide (NO_x)

Predicted concentrations of daily mean NO_x are given in Table 4.8. As is normal practice, this table assumes that the engines (on both the GFP II Ltd and Peak Gen sites) operate for 16 hours a day, 365 days a year, in order to ensure that the worst meteorology is captured; this is therefore a pessimistic assessment.

The receptor experiencing the highest PEC is E03 representing Chichester and Langstone Harbours (Ramsar/SPA). Impacts at this receptor cannot be screened out as not significant if the installation operates for 16 hours per day, and would require assessment by a quantified ecologist to determine if there are any likely significant effects. Effects at all receptors including E03 can be screened out as not significant if the installation operates for up to 13 hours per day or at the reduced output of 20MWe.

Table 4.8 Daily mean NO_x impacts

Receptor	AQAL (µg m ⁻³)	PC (µg m ⁻³)	PEC (µg m ⁻³)	PC (% of AQAL)	PEC (% of AQAL)
E01	200	4.17	70.59	2.1%	35.3%
E02	200	6.11	84.71	3.1%	42.4%
E03	200	24.46	139.80	12.2%	69.9%
E04	200	13.21	97.21	6.6%	48.6%
E05	200	7.54	68.08	3.8%	34.0%
E06	200	1.23	67.03	0.6%	33.5%

The EA sometimes prefer a target of $75 \mu\text{g m}^{-3}$ for daily mean NO_x . Under this AQAL, the impacts cannot be screened out as insignificant if the installation operates for up to 16 hours per day at receptors E03, E04 and E05.

Deposition

The impact of deposition (acid and nitrogen) on the ecological features has been assessed. There is no risk of it causing an exceedance of relevant assessment levels, regardless of operational hours.

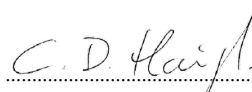
5. Conclusions

This assessment has used detailed dispersion modelling to undertake an impact assessment of emissions to air from the Harts Farm Way power plant. Emissions from the adjacent Peak Gen site have been included in the assessment. The pollutants covered by the assessment are:

- Oxides of nitrogen (NO_x and NO_2);
- Carbon monoxide (CO);
- Nitrogen deposition; and
- Acid deposition.

5.1 Summary of results

- The predicted annual and hourly means NO_2 concentrations at all receptors are within the AQAL if the installation operates for up to 2500 hours per year;
- The predicted 1-hour and 8-hours means CO concentrations at all receptors are within the AQAL if the installation operates for up to 2500 hours per year;
- The ecological impacts of NO_x (annual and daily mean) at receptors located on Chichester and Langstone Harbours (Ramsar/SPA) cannot be screened out as not significant at 1500, 2000 and 2500 operational hours, and require further assessment by a qualified ecologist to determine if there are any likely significant effects on the ecological status of the sites;
- The ecological impacts of acid and nitrogen deposition has been assessed. There is no risk of any of them causing an exceedance of relevant assessment levels, AQAL if the installation operates for up to 2500 hours per year; and
- Impacts include the contribution from the adjacent Peak Gen site. However, other plans and projects have not been reviewed to determine if there might be likely significant effects on ecological sites in combination.

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