IQE St Mellons - Further Assessment of Atmospheric Emissions

IQE

24th February 2017

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1. Introduction

Natural Resources Wales (NRW) has requested additional information (letter ref. PAN-001213) to accompany the permit variation application for the IQE facility at St Mellons in order to determine duly made status. This note provides information relating to Q6 (Environmental Risk Assessment):

- Ecological risk screening assessment for ammonia and oxides of nitrogen at additional ecological sites;
- Human health screening assessment for oxides of nitrogen and carbon monoxide.

The detailed modelling study of atmospheric emissions has been revised to reflect the use of the Edwards Spectra-G thermal oxidiser, a four-stage combustion process, which will abate ammonia emissions from point A1. The revised emissions from point A1 are shown in Table 1 below (those for A3 are unchanged from the main report).

Table 1. Revised A1 flue exhaust characteristics

Parameter	A1 (FAB 1)
Stack height, m (above ground level)	12
Actual discharge flow rate, Am^3/s	4.926
Stack diameter, m	0.73
Discharge velocity, m/s	11.77
Flue gas discharge temperature, K	295.15
Chlorine emission conc, mg/Nm^3	31.69
Chlorine emission rate g/s	0.144
Ammonia emission conc, mg/m^3	<3
Ammonia emission rate, g/s	0.01368
Oxides of nitrogen emission conc, mg/m^3	11.1*
Oxides of nitrogen emission rate, g/s	0.055
Carbon monoxide emission conc, mg/m^3	100^
Carbon monoxide emission rate, g/s	

* based on manufacturer's datasheet <25 ppm
^ based on Inorganic Chemicals Sector Guidance Emission Benchmark[1]
The abated ammonia emission occurs for 87% of the time.

The additional ecological receptors included explicitly in the model include:

- a second SSSI within the Gwent Levels,
- the Severn Estuary SAC/SPA/Ramsar over two kilometres to the south; and
- selected ancient woodland and local wildlife sites, within a two kilometre radius of IQE.

These sites were not explicitly considered previously, as they are all further away than the Gwent Levels Rumney and Peterstone SSSI (this is in immediate proximity to the site and hence subject to higher concentrations than those more remote locations). The River Usk SAC remains outside the scope of the assessment, as this waterbody does not contain features of interest relevant to impacts on vegetation.

The ecological receptors are shown as green triangles in Figure 1 and are labelled A to I (previously included human health receptors are shown as blue circles numbered 1 to 15). Descriptions of each site and the main priority habitat are given in Table 2.

[1] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/298067/geho0209bpit-e-e.pdf

Figure 1. Modelled ecological and human health receptors

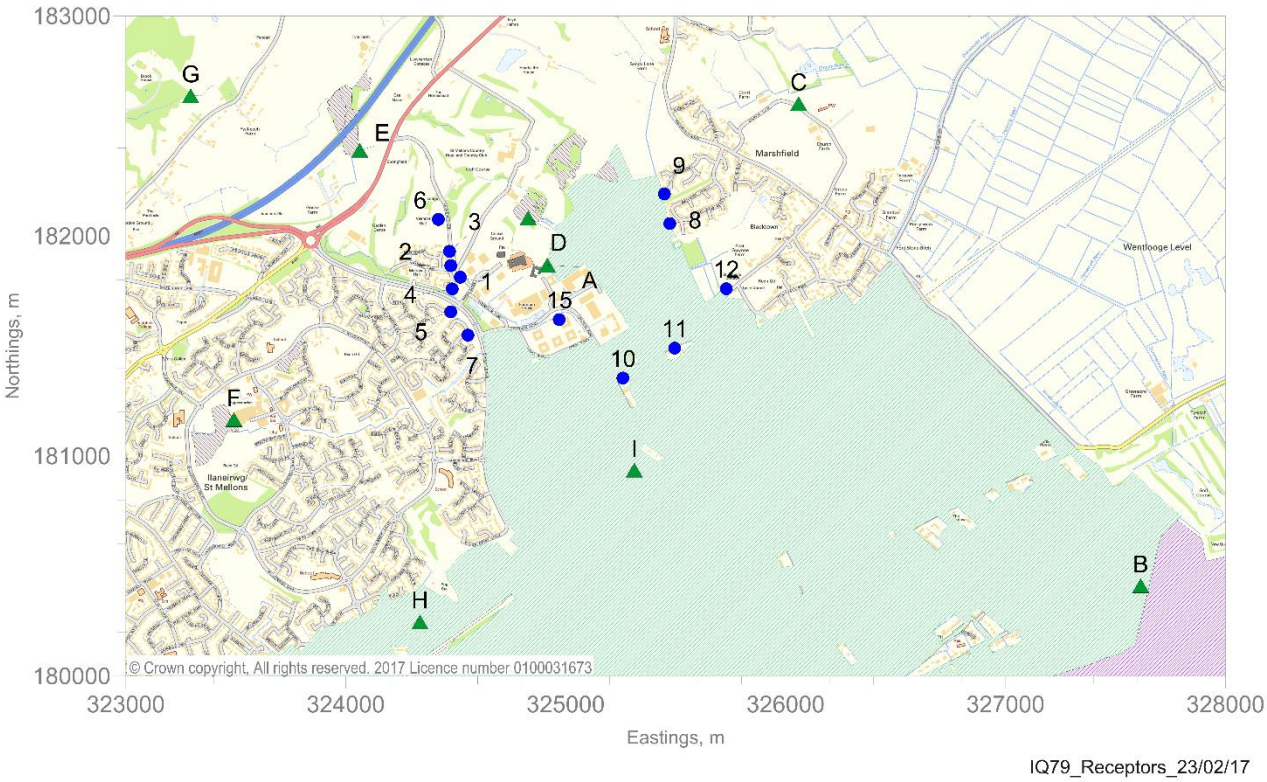


Table 2. Additional ecological sites included in model

ID	Site	OS grid ref	Priority habitat
*A**	*Gwent Levels Rumney & Peterstone SSSI*	*324917, 181868*	*Standing open water & canals*
B	Severn Estuary SAC	327615, 180410	Saltmarsh
C	Gwent Levels St Brides SSSI	326060, 182601	Standing open water & canals
D	Ancient woodland at Golf Club	324830, 182082	Broadleaved woodland
E	Tyla Farm Wood LWS	324064, 182390	Broadleaved woodland
F	Cath Cobb Wood LWS	323492, 181166	Broadleaved woodland
G	Druidstone Road LWS	323295, 182638	Broadleaved woodland
H	Hendre Lake West LWS	324337, 180246	Broadleaved woodland
I	Marshfield LWS	325312, 180935	Floodplain grazing marsh

* This site was included in the main modelling study.

2. Ammonia

The assessment of ammonia has been revised for the abated emission rate for A1 and to include additional ecological receptors in the surrounding area. The results of the revised assessment at these sites are summarised in Table 3 for the closest local receptors and the annual mean ground level ammonia concentrations are plotted in Figure 2. The associated model run file (IQ79) is attached.

Table 3. Annual mean ammonia (abated) and oxides of nitrogen concentrations and nitrogen deposition rates at additional ecological sites

ID	Site	NH_3 PC µg/m³	NH_3 PC / EAL† %	NO_x PC µg/m³	NO_x PC / EAL† %	N dep PC kg/ha/yrΔ	N dep PC / CL* %
A	Gwent Levels Rumney & Peterstone SSSI	1.3	44	1.0	3.3	7.0	^
B	Severn Estuary SAC	0.02	0.6	0.01	<0.1	0.09	0.5
C	Gwent Levels St Brides SSSI	0.01	0.5	0.01	<0.1	0.07	^
D	Ancient woodland at Golf Club	0.33	11	0.24	0.8	2.66	26
E	Tyla Farm Wood LWS	0.02	0.6	0.01	<0.1	0.15	1.6
F	Cath Cobb Wood LWS	0.03	1.1	0.02	0.1	0.27	2.7
G	Druidstone Road LWS	0.01	0.2	0.00	<0.1	0.06	0.6
H	Hendre Lake West LWS	0.01	0.3	0.01	<0.1	0.07	0.7
I	Marshfield LWS	0.02	0.6	0.01	<0.1	0.10	0.5

† EAL = environmental assessment level. As there is no information in the public domain to suggest that lichen are present at any of the sites, an EAL for ammonia of 3 µg/m³ is applied across the board.
Δ Total N deposition due to NH_3 and NOx
* CL = critical load 20 kgN/ha/yr for saltmarsh and grazing marsh, 10 kgN/ha/yr for broadleaved woodland[2].
^ Standing open waters not sensitive to N deposition.

The main air quality report in support of the BAT assessment (Atkins 2016) estimated the abated ammonia results at Gwent Levels Rumney and Peterstone SSSI to be an annual mean concentration of 1.3 µg/m³ (maximum found at the nearest point to the IQE facility). The background concentration is 1.3 µg/m³ giving a total concentration (PEC) of 2.6 µg/m³, below the EAL.

The contribution from the IQE facility is two orders of magnitude lower at all other designated sites within two kilometres, with one exception: the ancient semi-natural woodland immediately to the north at St Mellons Golf Club (Forestry Commission ID 15221). At the closest point of this non-statutory designation to the facility, the ammonia PC is 0.33 µg/m³, or 11% of the EAL of 3 µg/m³. The contour plot in Figure 2 demonstrates how concentrations reduce rapidly across the extent of the site such that at the northern boundary it halves to around 0.16 µg/m³.

[2] http://www.apis.ac.uk/indicative-critical-load-values

As the PCs at this and all other non-statutory local wildlife sites and ancient woodland are less than 100% of the EAL for ammonia, the PEC does not require consideration (in line with Environment Agency air emissions risk assessment methodology) and the results are thus deemed not to be significant.

At the Severn Estuary SAC/SPA, the PC is extremely small at 0.02 µg/m^3. The mapping website MAGIC indicates the presence of intertidal saltmarsh at this location; this is conservatively assumed to be sensitive to ammonia although APIS does not support this assertion. The PC is less than 1% of the ammonia EAL and therefore is considered to be insignificant.

At the Gwent Levels St Brides SSSI, the habitat is classified on APIS as standing open water and canals, however it is conservatively assumed that coastal and floodplain grazing marsh may be present and sensitive to ammonia. The ammonia PC of 0.01 µg/m^3 is less than 1% of the EAL and therefore is considered to be insignificant.

Figure 2. Incremental annual mean ground level ammonia concentrations (abated) (µg/m^3)



3. Oxides of Nitrogen

Detailed modelling of emissions of oxides of nitrogen (NOx) from the thermal oxidiser has been undertaken based on the specification for the Edwards Spectra G exhaust management system. This states an emission rate of <25 ppm NO and <2 ppm NO_2. Emissions will be released via point A1 for which stack characteristics were presented in Table 1. The results are shown in Table 2 (alongside those for ammonia).

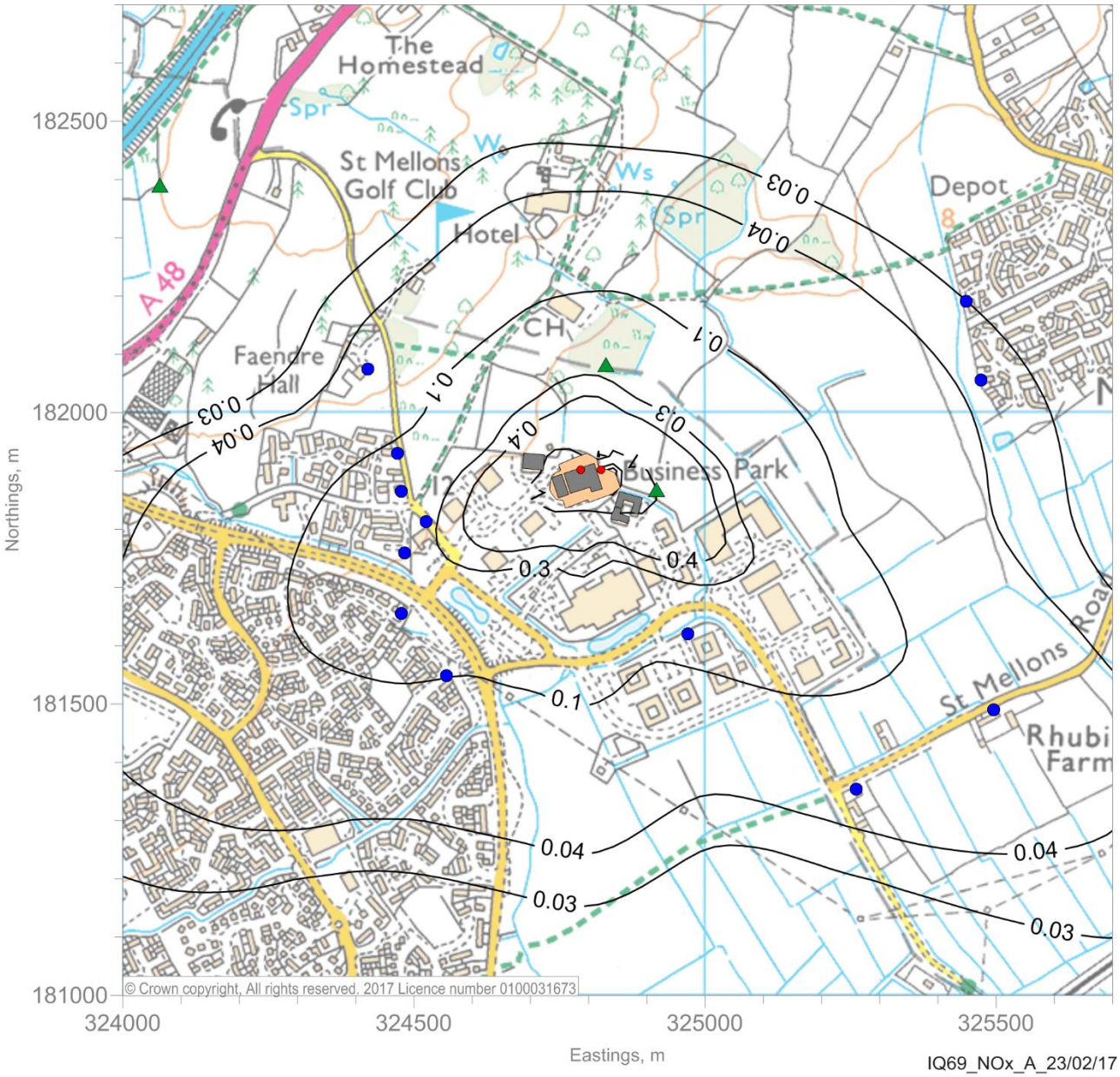
Figure 3 shows that the maximum incremental annual mean ground level concentration of NO_x at the closest point of the Gwent Levels Rumney and Peterstone SSSI is 1 µg/m^3. This is equivalent to 3% of the critical level for vegetation. According to the APIS website, the background NO_x concentration in the surrounding area is 24.2 to 27.6 µg/m^3. Therefore the critical level will not be exceeded at this or any other modelled receptor. It should be noted that the Gwent Levels Rumney and Peterstone SSSI and the adjacent St Brides SSSI are classified as standing open waters and canals so not considered to be sensitive to NO_x (although there is vegetation within the site boundary it is not an interest feature).

At the nearest ancient woodland area, the golf club to the north of the site, the annual mean increment is less than 0.3 µg/m^3 or 1% of the critical level. At all other designated sites, including the Severn Estuary SAC, contributions are an order of magnitude lower.

The maximum increment to daily average NO_x concentration is 4.3 µg/m^3, which is less than 10% of the non-statutory guideline of 75 µg/m^3.

On this basis, the impact of short- and long-term emissions of NO_x on ecological sites can be concluded not to be significant.

Figure 3. Incremental annual mean ground level oxides of nitrogen concentrations (µg/m³)



4. Nitrogen Dioxide

For comparison with human health air quality objectives, the results as NOx were converted to NO_2 using very conservative assumptions: 100% conversion to NO_2 for the annual mean and 50% for the hourly mean. The results are shown in Table 4.

Table 1. Incremental ground level annual and maximum hourly average nitrogen dioxide concentrations at human health receptors

ID	Receptor name	NO_2 PC (annual) µg/m^3	NO_2 PC / EAL %	NO_2 PC (hourly) µg/m^3	NO_2 PC / EAL %
1	Heron Marsh - Flaming Grill	-	-	5.9	2.9
2	Vaendre Lane	0.18	0.5	5.4	2.7
3	Vaendre Close	0.12	0.3	5.3	2.7
4	Clos Padrig	0.23	0.6	5.3	2.7
5	Saffron Drive	0.16	0.4	4.7	2.3
6	Vaendre Hall	0.05	0.1	2.8	1.4
7	Brython Drive	0.10	0.3	4.5	2.3
8	Mallards Reach	0.04	0.1	1.3	0.6
9	The Meadows	0.03	0.1	1.5	0.8
10	Ty-Ffynnon Farm	0.05	0.1	1.6	0.8
11	Rhubina Farm	0.07	0.2	1.1	0.6
12	St Alban's Cottage	0.03	0.1	1.1	0.5
13	Cricket Ground	-		7.5	3.7
14	Golf Club House	-		4.6	2.3
15	Tiptoes Day Nursery	0.14	0.4	4.7	2.3

The contour plot in Figure 3 shows that there are no sensitive human receptors within the 0.4 µg/m^3 contour (which is equivalent to 1% of the AQS objective for NO_2 of 40 µg/m^3). The highest increment to annual mean ground level concentrations of NO_2 is 0.2 µg/m^3 at receptor 4, Clos Padrig. The increments at all other residential receptors are even lower.

The maximum increment to hourly mean ground level concentrations of NO_2 is 7 µg/m^3 at receptor 7.5, the cricket ground, which is just 4% of the AQS standard for NO_2 of 200 µg/m^3. The increments at all other short-term receptors are even lower.

On this basis the impact of thermal oxidiser emissions on human health in the short- and long-term can be concluded not to be significant. Consideration of total concentrations (including background) is not required.

5. Carbon Monoxide

An emission rate for carbon monoxide is not quoted on the Edwards Spectra G datasheet. Based on the Inorganic Chemicals sector guidance (EPR4.03) Annex F Emission Benchmarks, the emission concentration may be up to 100 mg/m^3.

The AQS objective for carbon monoxide is significantly less stringent than that for NO_2 (10,000 µg/m^3 as an eight-hour mean). Were the carbon monoxide emission to be ten times that of NO_x, the maximum eight hourly ground level concentration at a relevant receptor would be 200 µg/m^3 or just 2% of the eight hourly standard. Emissions of carbon monoxide can thus readily be dismissed as not significant.

6. Nitrogen Deposition

Nitrogen deposition associated with combined releases of NO_x and ammonia has been calculated using the approach set out in AQTAG06 "*Technical guidance on detailed modelling approach for an appropriate assessment for emissions to air*". The results are shown in the last two columns of Table 3. [Note that the total contribution to nitrogen deposition from NO_x and ammonia is dominated by the latter (>97%)].

The incremental nitrogen deposition rate within the Gwent Levels Rumney and Peterstone SSSI is 7.0 kgN/ha/yr and is two orders of magnitude lower at the St Brides SSSI at 0.07 kgN/ha/yr. There are no critical loads for standing open water and canals habitat type on APIS.

The incremental nitrogen deposition rate within the Severn Estuary SAC/SPA is 0.09 kgN/ha/yr. The lower critical load for saltmarsh is 20 kg N/ha/yr, to which the facility contributes 0.4%. The PC can therefore considered to be insignificant. APIS notes that overall nitrogen deposition is likely to be of low importance for saltmarsh systems as the inputs are likely to be "*significantly below the large nutrient loadings from river and tidal inputs*".

Within the closest area of semi-natural ancient woodland at St Mellons Golf Club, the maximum nitrogen deposition rate is 2.66 kgN/ha/yr or 27% of the lower critical load for broadleaved woodland (10 kgN/ha/yr). The rate rapidly reduces with increasing distance from the IQE facility, such that it is halved by the northern boundary of the woodland area. At the other ancient woodland and local wildlife sites further afield, the nitrogen deposition rate is an order of magnitude or two lower. Nitrogen deposition is therefore concluded not to cause significant pollution at any non-statutory site as the PC is less than 100% of the appropriate environmental criterion.

7. Acid Deposition

The acid deposition rate at the closest area of ancient woodland, St Mellons Golf Glub, was calculated in accordance with AQTAG06 to be 0.19 keq/ha/yr. The CLmaxN for this location (taken from APIS) is 2.85 keq/ha/yr. Acid deposition is therefore concluded not to cause significant pollution at this non-statutory site as the PC is less than 100% of the appropriate environmental criterion. This conclusion can be extended to all other locations, where the PC will be one or two orders of magnitude lower.

APIS notes that effects of acid deposition at coastal grazing marsh are likely to be small as these habitats are generally brackish and alkaline. Equally, effects at saltmarsh are invariably likely to be small as these habitats are inter-tidal and are naturally subject to large influxes of nutrients. Critical loads for acid deposition are therefore unavailable for these habitats.

8. References

Information sources and guidance consulted in preparing this note:

- http://www.apis.ac.uk/indicative-critical-load-values
- http://magic.defra.gov.uk/MagicMap.aspx
- http://maps.forestry.gov.uk/imf/imf.jsp?site=fcwales_ext&
- http://lle.gov.wales/catalogue/item/AncientWoodlandInventory2011/?lang=en
- https://www.cardiff.gov.uk/ENG/resident/Planning/Planning-Policy/Documents/Biodiversity%20Part%202%20-%20Approved%20June%202011.pdf
- https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit#screening-for-protected-conservation-areas
- AQTAG06 Technical guidance on detailed modelling approach for an appropriate assessment for emissions to air (Updated version, Approved March 2014).

9. Model Files

The model run output files are attached to this note:

- The output file for the main model run (unabated NH3, Cl, arsine and phosphine) is IQ89. Note that the results were post-processed in Excel to account for the amount of time each pollutant was emitted for from each point source.
- The output file for the abated ammonia model run is IQ79.
- The output file for the oxides of nitrogen model run is IQ69.

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