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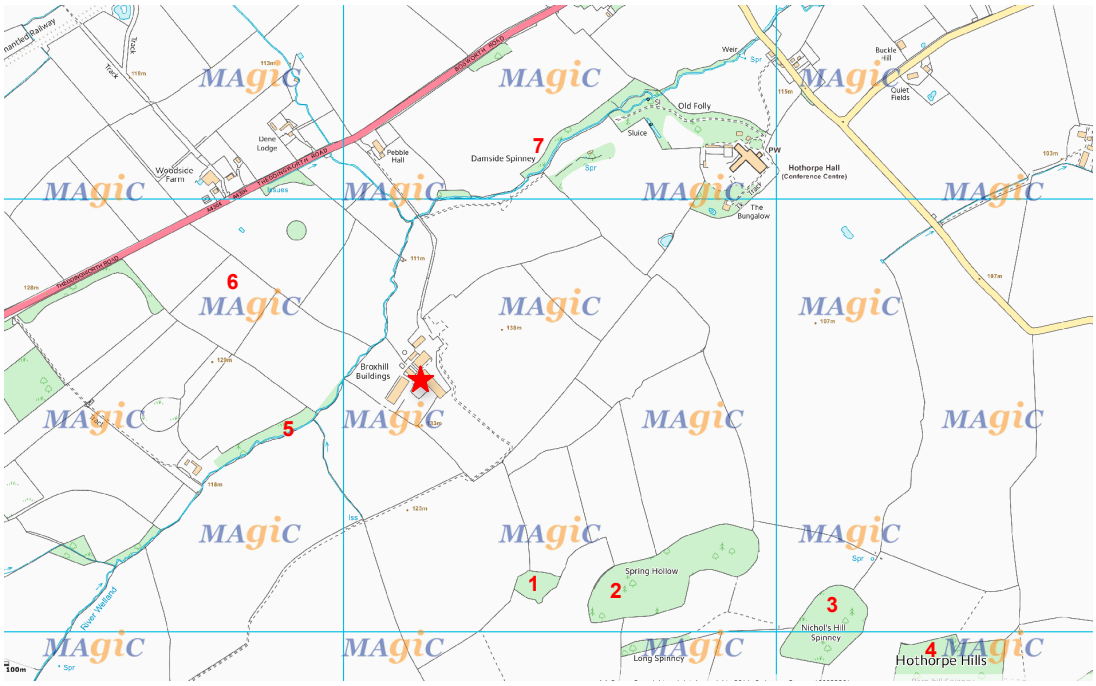
Re: An Assessment of the Potential Impact on Local Wildlife Sites of Pollutant Emissions from Proposed Power Generation Developments to be Built on the Welland Waste Management Site Near Theddingworth

Introduction

Welland Waste Management Ltd (WWM) has applied for planning permission to build a Thermophilic Aerobic Digestion (TAD) Facility on the Pebble Hall site to the south-west of Theddingworth, Leicestershire. An application has also been submitted to modify the planning permission for a Renewable Energy Generation Facility (REGF) on adjoining land on the WWM site. Consultation comments received from Northamptonshire County Council requested additional information on the potential cumulative impact of pollutant emissions from the proposed TAD facility and REGF on local wildlife sites, situated with 2km of the proposed development site. The following wildlife sites were identified using the MAGIC website[1].

1. Unnamed Deciduous Woodland BAP Priority Habitat;
2. Spring Hollow Deciduous Woodland BAP Priority Habitat;
3. Nichol's Hill Spinney Deciduous Woodland BAP Priority Habitat;
4. Hothorpe Hill Barn-Hill Spinney Deciduous Woodland BAP Priority Habitat;
5. Unnamed Deciduous Woodland BAP Priority Habitat 2;
6. National Inventory of Woodland & Trees Habitat; and,
7. Damside Spinney Deciduous Woodland BAP Priority Habitat.

The location of these local wildlife sites in relation to the proposed development site are shown in the following map, reproduced from the MAGIC website.



The location of the Welland Waste Management site is denoted by the red star.

[1] http://www.natureonthemap.naturalengland.org.uk/MagicMap.aspx

Basis for Assessment

The potential cumulative impact on local ecological habitat sites, due to emissions from the proposed TAD facility and REGF, has been assessed in terms of the maximum process contributions for the following pollutants in relation to their respective Critical Levels, and associated time averaging periods, as specified in Table B4 of Environment Agency Horizontal Guidance Note H1 Annex F:

- Oxides of nitrogen (NO_X) 30 µg m^{-3} as an annual average;
- Oxides of nitrogen (NO_X) 75 µg m^{-3} as a daily average;
- Sulphur dioxide (SO_2) 20 µg m^{-3} as an annual average;
- Ammonia (NH_3) 1 µg m^{-3} as an annual average for lichens and bryophytes;
- Hydrogen fluoride (HF) <5 µg m^{-3} as a daily average; and,
- Hydrogen fluoride (HF) <0.5 µg m^{-3} as a weekly average.

The assessment also considered the potential cumulative impact of emissions from the proposed TAD facility and REGF on the local wildlife sites in relation to site-specific critical loads for nitrogen and acidity deposition, obtained from the UK Air Pollution Information System (APIS) website[2].

Critical Levels Assessment

An assessment of the impact of emissions from the proposed TAD facility and REGF on local wildlife sites has been undertaken in relation to the above Critical Levels. The results are presented in the following table.

Table 1 Critical Levels Assessment for Oxides of Nitrogen (NO_X) and Sulphur Dioxide (SO_2)

	Annual NOx PC (µg m^{-3})	% Critical Level	Daily NOx PC (µg m^{-3})	% Critical Level	Annual SO_2 PC (µg m^{-3})	% Critical Level
Unnamed Deciduous Woodland BAP Priority Habitat	1.7	6%	26	35%	0.4	2%
Spring Hollow Deciduous Woodland BAP Priority Habitat	1.1	4%	18	24%	0.3	1%
Nichol's Hill Spinney Deciduous Woodland BAP Priority Habitat	0.6	2%	9	11%	0.1	1%
Hothorpe Hill Barn-Hill Spinney Deciduous Woodland BAP Priority Habitat	0.4	1%	6	8%	0.1	1%
Unnamed Deciduous Woodland BAP Priority Habitat 2	3.2	11%	65	87%	0.8	4%
National Inventory of Woodland & Trees Habitat	1.1	4%	36	48%	0.3	1%
Damside Spinney Deciduous Woodland BAP Priority Habitat	4.1	14%	36	47%	1.0	5%

As can be seen in the above table, the annual average NO_X Process Contribution is between ~1% and ~11% of the annual NO_X Critical Level at the above local wildlife sites. The APIS website indicates that the existing annual average NO_X concentration in the vicinity of the Welland Waste Management site is 11.3 µg m^{-3}. Therefore, the Predicted Environmental Concentration due to emissions from the proposed TAD facility and REGF is likely to be ~12 to ~15 µg m^{-3}, and well within the critical level value of 30 µg m^{-3}. Accordingly, process contributions in relation to the annual NO_X critical level can be screened out as insignificant at the above locations.

Annual average SO_2 process contributions were all ~1% to ~5% of the 20 µg m^{-3} Critical Level, with an estimated background concentration of ~1.4 µg m^{-3}, there is little risk of exceeding the annual average critical level for SO_2.

The daily average NO_X Process Contributions were estimated to be between ~10% to ~90% of the Critical Level value of 75 µg m^{-3}. With an estimated annual average background concentration of ~11 µg m^{-3}, there is little risk of exceeding the annual average critical level for NO_X at all but Receptor 5, where a marginal exceedence could potentially occur. However, it should be borne in mind that the assessment is based upon a series of worst case assumptions with NO_X emissions at the maximum emission limit value for the TAD facility and REGF. When operational, emissions of NO_X will be well

[2] http://www.apis.ac.uk/search-by-location

below the emission limit values prescribed in the respective environmental permits for each of the two facilities.

The corresponding process contributions for ammonia and hydrogen fluoride are based upon an assumed ammonia concentration in the emissions to atmosphere of 2 mg Nm^{-3}, and for HF emissions from the REGF at the IED ELV of 1 mg Nm^{-3}. The results are presented in the following table.

Table 2 Critical Levels Assessment for Ammonia (NH_3) and Hydrogen Fluoride (HF)

	Annual NH_3 PC (µg m^{-3})	% Critical Level	Daily HF PC (µg m^{-3})	% Critical Level	Weekly HF PC (µg m^{-3})	% Critical Level
Unnamed Deciduous Woodland BAP Priority Habitat	0.02	2%	0.13	2.6%	0.06	12%
Spring Hollow Deciduous Woodland BAP Priority Habitat	0.01	1%	0.09	1.8%	0.04	7%
Nichol's Hill Spinney Deciduous Woodland BAP Priority Habitat	0.01	1%	0.043	0.9%	0.017	3%
Hothorpe Hill Barn-Hill Spinney Deciduous Woodland BAP Priority Habitat	0.004	0.4%	0.031	0.6%	0.013	3%
Unnamed Deciduous Woodland BAP Priority Habitat 2	0.03	3%	0.33	6.5%	0.17	34%
National Inventory of Woodland & Trees habitat	0.01	1%	0.18	3.6%	0.03	7%
Damside Spinney Deciduous Woodland BAP Priority Habitat	0.04	4%	0.18	3.6%	0.08	15%

As can be seen, Process Contributions of ammonia and hydrogen fluoride are well below their respective Critical Levels at all of the above local wildlife sites, and can be screened out as insignificant. The assessment for ammonia was based upon the lower critical level of 1 µg m^{-3} for lichens and bryophytes.

Deposition Assessment Relative to Site-Specific Critical Loads

Critical load data for nitrogen deposition at the local wildlife site locations were obtained from the APIS website and are summarised in Table 3.

Table 3 Baseline Critical Loads for Nitrogen Deposition

Receptor	Critical Load (kgN/ha/yr)		Baseline Condition (kgN/ha/yr)*	"Headroom" (kgN/ha/yr	
	Low Limit	High Limit		Low Limit	High Limit
Unnamed Deciduous Woodland BAP Priority Habitat	10	20	44.4	-34.4	-24.4
Spring Hollow Deciduous Woodland BAP Priority Habitat	10	20	44.4	-34.4	-24.4
Nichol's Hill Spinney Deciduous Woodland BAP Priority Habitat	10	15	44.4	-34.4	-24.4
Hothorpe Hill Barn-Hill Spinney Deciduous Woodland BAP Priority Habitat	10	15	44.4	-34.4	-24.4
Unnamed Deciduous Woodland BAP Priority Habitat 2	10	20	44.4	-34.4	-24.4
National Inventory of Woodland & Trees habitat	10	20	44.4	-34.4	-24.4
Damside Spinney Deciduous Woodland BAP Priority Habitat	10	20	44.4	-34.4	-24.4

Note: Negative values denote that the critical load is currently exceeded

As can be seen, the data from the APIS website indicate that the Critical Load for nitrogen deposition is currently exceeded at all of the above ecological habitat receptor locations. However, there is no information available in the literature on whether the ecological habitats are suffering significant harm as a result of the current exceedence of the critical load for nitrogen deposition.

The situation for acidity deposition is somewhat different, as shown in Table 4.

Table 4 Baseline Critical Loads for Acidity Deposition

Receptor Name	Acidity Critical Load (keqN/ha/yr)	Background (keqN/ha/yr)	Headspace (keqN/ha/yr)	Acidity Critical Load (keqS/ha/yr)	Background (keqS/ha/yr)	Headspace (keqS/ha/yr)
Unnamed Deciduous Woodland BAP Priority Habitat	2.65	3.17	-0.52	2.29	0.29	2.0
Spring Hollow Deciduous Woodland BAP Priority Habitat	2.65	3.17	-0.52	2.29	0.29	2.0
Nichol's Hill Spinney Deciduous Woodland BAP Priority Habitat	2.65	3.17	-0.52	2.29	0.29	2.0
Hothorpe Hill Barn-Hill Spinney Deciduous Woodland BAP Priority Habitat	8.67	3.17	5.5	8.31	0.29	8.0
Unnamed Deciduous Woodland BAP Priority Habitat 2	2.9	3.17	-0.27	2.54	0.29	2.3
National Inventory of Woodland & Trees habitat	2.9	3.17	-0.27	2.54	0.29	2.3
Damside Spinney Deciduous Woodland BAP Priority Habitat	2.65	3.17	-0.52	2.29	0.29	2.0

As can be seen, the data indicate that the critical load for acid deposition (keqS/ha/yr) is currently not exceeded at any of the above locations, although the critical load for acid deposition as N is marginally exceeded at most locations..

The ADMS model was configured to estimate deposition of NO_2, NH_3, SO_2, HCl and HF at the local wildlife sites, due to emissions from the proposed TAD facility and REGF.

The deposition velocities for NO_2, SO_2, NH_3 and HCl were taken from AQTAG 06[3], while the corresponding value for HF was obtained from a literature reference (see below).

Table 5 Deposition Velocities Used in Calculations

Substance	Deposition Velocity (mm/s)
Nitrogen Dioxide (Grassland)	1.5
Nitrogen Dioxide (Woodland)	3.0
Sulphur Dioxide (Grassland)	12.0
Sulphur Dioxide (Woodland)	24.0
Ammonia (Grassland)	20.0
Ammonia (Woodland)	30.0
Hydrogen Chloride (Grassland)	25.0
Hydrogen Chloride (Woodland)	60.0
Hydrogen Fluoride (Grassland)*	2.0

Note: * Reference: Fluorides in the Environment, Weinstein, LH and Davison, AW, CABI Publishing (2004)

Nitrogen Deposition

An assessment of nitrogen deposition was undertaken in relation to site-specific Critical Loads data, obtained from the APIS website, and summarised in Table 3. Nitrogen deposition rates associated with emissions from the proposed TAD facility and REGF were calculated according to the method recommended by the Environment Agency in AQTAG 06, and as used by Laxen and Marner in a study carried out in support of the development of the Dorset and Poole, Local Waste Plan[4]. The method involves the calculation of the annual deposition rate from the annual Process Contribution and the deposition velocity for NO_2 using Equation 1.

[3] AQTAG 06, Technical Guidance on Detailed Modelling Approach for an Appropriate Assessment for Emissions to Air, Ji Ping Shi, Environment Agency Air Quality Monitoring and Assessment Unit, 20th April 2010.
[4] An Assessment of Possible Air Quality Impacts on Vegetation from Processes Set out in the Bournemouth, Dorset & Poole Waste Local Plan, Air Quality Consultants Ltd, April 2005

Equation 1 Calculation of Deposition Rate

$$\text{Deposition Rate } (\mu g\ m^{-2} s^{-1}) = \text{ Deposition Velocity } (m\ s^{-1}) \times \text{ Concentration } (\mu g\ m^{-3})$$

Laxen and Marner commented that NO_X deposits to vegetation mainly via uptake of nitrogen dioxide through stomata, and that nitric oxide does not deposit at a significant rate. Environment Agency guidance recommends using a factor of 70% for the conversion of NO_X to NO_2 to provide a worst case basis for assessment of long term impacts[5]. Accordingly, this conversion rate was used as the basis for calculating the nitrogen deposition rates associated with emissions of NO_X and NH_3 from the proposed TAD facility and REGF. Only dry deposition was considered by Laxen and Marner as wet deposition effects, close to the point of release, are considered to be much less significant than dry deposition mechanisms.

> *Wet deposition of the emitted pollutants this close to the emission source will be restricted to wash-out, or below cloud scavenging. For this to occur, rain droplets must come into contact with the gas molecules before they hit the ground. Falling raindrops displace the air around them, effectively pushing gasses away. The low solubility of nitrogen dioxide and nitric oxide means that any scavenging of these gases will be a negligible factor.*

The results from the nitrogen deposition rate calculations are summarised in the following table and are based upon emissions of NO_X and NH_3 from the proposed TAD facility and REGF.

Table 6 Process Contribution to Nutrient Nitrogen Deposition at Local Wildlife Sites

Receptor Name	Deposition (kgN/ha/yr)	Deposition (kgN/ha/yr) (PC as % Lower Critical Load)
Unnamed Deciduous Woodland BAP Priority Habitat	0.5	5%
Spring Hollow Deciduous Woodland BAP Priority Habitat	0.3	3%
Nichol's Hill Spinney Deciduous Woodland BAP Priority Habitat	0.2	2%
Hothorpe Hill Barn-Hill Spinney Deciduous Woodland BAP Priority Habitat	0.1	1%
Unnamed Deciduous Woodland BAP Priority Habitat 2	0.9	9%
National Inventory of Woodland & Trees Habitat	0.3	3%
Damside Spinney Deciduous Woodland BAP Priority Habitat	1.2	12%

The results show that nitrogen deposition attributable to emissions of NO_X and NH_3 from the proposed TAD facility and REGF plant is predicted to be less than 10% of the site-specific Lower Critical Load, apart from the nearest downwind receptor location (Damside Spinney), where the Process Contribution represents ~12% of the Critical Load. Despite the fact that the Critical Load for nitrogen deposition is currently exceeded at the above locations, the magnitude of the Process Contribution is small and is probably not measurable with any reasonable degree of accuracy, and can probably be screened out as insignificant.

It should also be noted that exceedence of a Critical Load is not a quantitative estimate of damage to a particular habitat, but represents the potential for damage to occur. There is no evidence in the available literature to indicate that the above local wildlife sites are suffering as a consequence of nitrogen deposition from nearby sources. Accordingly, on this basis, the incremental increase in nitrogen deposition attributable to emissions of NO_X and NH_3 from the proposed TAD facility and REGF is small and is unlikely to have a measurable effect on the integrity of the above ecological habitat sites.

Acid Deposition

An assessment of acidity deposition was undertaken based upon Critical Load data for acid deposition from the APIS website. The assessment followed the same procedure that was used in the assessment of nitrogen deposition, and the results are summarised in Table 7.

[5] http://webarchive.nationalarchives.gov.uk/20140328084622/http://www.environment-agency.gov.uk/static/documents/Conversion_ratios_for__NOx_and_NO2_.pdf

Table 7 Process Contribution to Acid Deposition at Local Wildlife Sites

Receptor Name	Increase in Acidity Deposition Due to Emissions of NO_X & NH_3 (keqN/ha/yr)	Increase in Acidity Deposition Due to Emissions of NO_X & NH_3 (% Critical Load)	Increase in Acidity Deposition Due to Emissions of SO_2, HCl & HF (keqS/ha/yr)	Increase in Deposition Due to Emissions of SO_2, HCl & HF (% Critical Load)
Unnamed Deciduous Woodland BAP Priority Habitat	0.03	1.3%	0.1	6%
Spring Hollow Deciduous Woodland BAP Priority Habitat	0.02	0.8%	0.1	4%
Nichol's Hill Spinney Deciduous Woodland BAP Priority Habitat	0.01	0.4%	0.05	2%
Hothorpe Hill Barn-Hill Spinney Deciduous Woodland BAP Priority Habitat	0.01	0.1%	0.03	0.4%
Unnamed Deciduous Woodland BAP Priority Habitat 2	0.06	2.2%	0.3	11%
National Inventory of Woodland & Trees habitat	0.02	0.7%	0.1	4%
Damside Spinney Deciduous Woodland BAP Priority Habitat	0.08	3.1%	0.1	6%

The above results show that acidic deposition attributable to emissions of NO_X and NH_3 from the proposed TAD facility and REGF is predicted to be between <1% and ~3% of site-specific Critical Load values, and are probably not measurable with any reasonable degree of accuracy. The situation is slightly different where the process contributions are of a similarly low value, but as the critical load value is lower, the process contributions represent a greater percentage of the critical load.

Nevertheless, there is no evidence in the available literature to indicate that the above ecological receptors are currently suffering as a consequence of acid deposition from nearby sources, accordingly, acidity deposition at the above local wildlife sites can be screened out as insignificant.

Conclusions

The results from a detailed assessment of the impact of emissions from the proposed TAD facility and REGF on nearby local wildlife sites showed that critical levels and site-specific critical load values for nitrogen deposition are currently exceeded at the receptor locations considered.

Maximum process contributions for NO_X, SO_2, NH_3 and HF were well below their respective critical levels and were screened out as insignificant. Similar conclusions were drawn for maximum process contributions to nitrogen and acidity deposition in relation to relevant site-specific critical load.

There is no evidence available in the literature to indicate that current exceedences of critical levels and critical loads are causing observable or measurable harm to the local wildlife sites in the vicinity of the Welland Waste Management site. Accordingly, it is concluded that emissions from the proposed TAD facility and REGF are unlikely to have a significant impact on local wildlife sites in the vicinity of the development site.

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