# ATMOSPHERIC DISPERSION MODELLING

URBAN RESERVE - BEAR POWER

PREPARED FOR: AMP PLC

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# 1.0 INTRODUCTION

SLR Consulting Ltd has been commissioned by Urban Reserve Limited (part of Aggregated Micro Power Holdings Limited) (the 'Applicant') to undertake Atmospheric Dispersion Modelling (ADM) to support the planning application submitted in respect of the development of a small scale gas fired power station on land off Weighbridge Road at Deeside Industrial Park, Deeside, Flintshire, Wales (known as 'Bear Power'). The application site is located within Flintshire County Council (FCC).

## 1.1 Background

The Proposed Development will comprise of two 2.5MWe Gas-Engine Generating-Sets (gen-sets) with 7m exhaust stacks, a gen-set including a ventilation/cooling equipment, a local distribution network substation and costumer substation buildings, and a gas kiosk. The gen-sets will be fired on natural gas and will export electricity for grid balancing purposes via the local 11kV HV network. Full details of the planning application are contained within the planning statement (PS) and the following details are of direct relevance to this assessment:

- The gen-sets will be fired on natural gas with the following capacities:
  - Bear Power 1 – 2.5$MW_e$; and
  - Bear Power 2 – 2.5$MW_e$;
- Combustion emissions are discharged via individual 7m high exhaust stacks;
- the gen-sets will comply with a nitrogen oxide (NOx) exhaust emission limit value (ELV) of <95mg/$Nm^3$ at 15% $O_2$.

The site will be classified as a Specified Generator (SG) and the individual gen-sets as 'new' Medium Combustion Plant (MCP) and therefore require an environmental permit (EP) issued by Natural Resources Wales (NRW) which will stipulate appropriate emission limits and monitoring requirements.

## 1.2 Scope and Objective

The scope of the assessment is limited to the point source combustion emissions to air at the installation. Consistent with NRW guidance for an engine fired on natural gas, only the release of oxides of nitrogen (NOx) have been assessed.

The objective of the study is to assess the potential impact of NOx emissions against the relevant Environmental Quality Standards for nitrogen dioxide ($NO_2$) for the protection of human health and for the protection of designated ecological receptors.

This report presents the approach, detailed methodology and findings of the ADM.

# 2.0 LEGISLATION AND RELEVANT GUIDANCE

## 2.1 National Air Quality Legislation and Guidance

### 2.1.1 Air Quality Regulations

The Air Quality Standards Regulations 2010 (the Regulations) provide a transposition of the Air Quality Directive (2008/50/EC), and transpose the Fourth Daughter Directive (2004/107/EC) within the UK. The regulations include Limit Values, Target Values, Objectives, Critical Levels and Exposure Reduction Targets for the protection of human health and the environment (collectively termed Air Quality Assessment Levels (AQALs) throughout this report). The standards applied in this assessment for protection of human health are provided in Table 2-1.

**Table 2-1**
**Applied Air Quality Standards** ($\mu g/m^3$)

| Pollutant | | Annual Standard | Short Term Standard |
|---|---|---|---|
| Nitrogen dioxide | $NO_2$ | 40 | 200 (1-hour) not to be exceeded more than 18 times per year |

The Welsh Government (WG) has published technical guidance for use in Local Air Quality Management[1]. According to LAQM.TG(16) air quality standards should only apply to locations where *'members of the public are likely to be regularly present and are likely to be exposed for a period of time appropriate to the averaging period of the objective. Authorities should not consider exceedences of the objectives at any location where relevant public exposure would not be realistic'* (examples are provided in Table 2-2). This is emphasised in NRW's SG modelling guidance that states the 1-hour mean should apply (but may not be limited to) '*residential properties, schools, hospitals, care homes, hotels, gardens, busy shopping streets, bus stations and railway stations that are not fully enclosed, and car parks where the public are reasonably expected to spend an hour or more*'.

Longer term standards such as annual means, should apply at houses or other locations which the public can be expected to occupy on a continuous basis. These standards do not apply to exposure at the workplace.

**Table 2-2**
**Relevant Public Exposure**

| Averaging Period | Relevant Locations | AQO's should apply at: | AQO's don't apply at: |
|---|---|---|---|
| Annual mean | Where individuals are exposed for a cumulative period of 6 months in a year | Building facades of residential properties, schools, hospitals etc. | Facades of offices<br>Hotels<br>Gardens of residences<br>Kerbside sites |
| 1-hour mean | Where individuals might reasonably be expected to spend one hour or longer | As above together with locations of regular access, car parks, bus stations etc. | Locations not publicly accessible or where occupation is not regular |

[1] Department for Environment, Food and Rural Affairs (DEFRA): Local Air Quality Management Review and Assessment Technical Guidance LAQM.TG(16), 2016

### 2.1.2 Air Quality Strategy

The United Kingdom Air Quality Strategy (AQS) 2007 for England, Scotland, Wales and Northern Ireland[2] sets out a comprehensive strategic framework within which air quality policy will be taken forward in the short to medium term, and the roles that Government, industry, NRW, local government, business, individuals and transport have in protecting and improving air quality. The AQS contains air quality objectives (AQOs) based on the protection of both human health and vegetation (ecosystems).

### 2.1.3 Local Air Quality Management

Authorities are required to periodically review and assess the quality of air within their administrative area. The reviews have to consider the present and future air quality and whether any AQOs prescribed in regulations are being achieved or are likely to be achieved in the future.

Where any of the prescribed AQOs are not likely to be achieved the authority concerned must designate an Air Quality Management Area (AQMA). For each AQMA the local authority has a duty to draw up an Air Quality Action Plan (AQAP) setting out the measures the authority intends to introduce to deliver improvements in local air quality in pursuit of the AQO. As such, Local Authorities (LAs), including FCC, have formal powers to control air quality through a combination of LAQM and by use of their wider planning policies.

The WG has published technical guidance for local authorities to use in their LAQM work[3]. This guidance, referred to in this report as LAQM.TG(16), has been used where appropriate in the assessment presented here.

## 2.2 Planning Policy

### 2.2.1 National Policy

#### Wales Spatial Plan

The Wales Spatial Plan (WSP)[4] states that development should be sustainable and contribute to improving wellbeing and quality of life by integrating social, economic and environmental objectives in the context of more efficient use of natural resources. The WSP aims to deliver sustainable development through its area strategies. The area strategy for the North East notes that "*…infrastructure such as energy … are already facing constraints in some places. It is therefore key that partners across North East Wales take a strategic approach to this issue to identify opportunities for creative solutions to … improve our resilience to climate change and benefit wildlife while permitting development in appropriate locations*."

#### Planning Policy Wales

Planning Policy Wales (PPW) (Edition 10 - December 2018)[5] sets out land use planning policies by the Welsh Government. The main role of the PPW is to ensure that the Welsh planning system works towards delivering sustainable development and improves social, economic, environmental and cultural wellbeing of Wales.

Section 6: Distinctive and Natural Places includes how the Welsh planning system should create policy in relation to natural theme and the environment. The following relates to air quality:

> *Enabling Development*
>
> *6.1.32" … enabling development does not give rise to significant risks … on air quality …"*
>
> *Framework for Addressing Air Quality and Soundscape*

[2] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, DEFRA. July 2007.
[3] Welsh Government : Local Air Quality Management Review and Assessment Technical Guidance LAQM.TG(16), 2016.
[4] People, Places, Futures. The Wales Spatial Plan. 2008 Update. 8th July 2008.
[5] Welsh Government. Planning Policy Wales. Edition 10. December 2018.

*6.7.4"The planning system should … reduce average population exposure to air… pollution … and pursue any opportunities to reduce, or at least, minimise pollution exposure to air …"*

*6.7.5" … planning policy principle is to consider the effects which proposed developments may have on air … quality and the effects which existing air … quality may have on developments. Air quality … influence choice of location and distribution of development and it will be important to consider the relationship of proposed development and existing development and its surrounding areas and its potential to exacerbate or create poor air quality …"*

*6.7.6" In proposing new development, planning authorities and developers must … address any implication arising as a result of its association with, or location within, air quality management areas … or areas where there are sensitive receptors; not create areas of poor air quality … seek to incorporate measures which reduce overall exposure to air … pollution …"*

*6.7.7" … it may be necessary for a technical air quality … assessment to be undertaken …"*

*6.7.10 "Taking a sustainable approach will mean balancing short-term needs against long-term objectives to reduce public exposure to airborne pollution and giving particular consideration to the presence of air quality management areas … important to identify wider mitigation solutions to reduce air … pollution and to avoid exacerbating problems in existing air quality management areas …"*

*6.7.11 "… Where air and noise pollution are generated from the same source they should be considered and addressed together …"*

*6.7.12 "Planning authorities must consider current and future sources of air … pollution as part of developing their strategies for locating new development …"*

*6.7.14 "Proposed development should be designed and wherever possible to prevent adverse effects to amenity, health and the environment but as a minimum to limit or constrain any effects that do occur …"*

*Location of Commercial, Industrial and other Potentially Polluting Development*

*6.7.15 "… potentially polluting development includes … energy … infrastructure. Such developments should be located in areas where there is a low potential for public exposure, or where its impact can be minimised …"*

*6.7.16 "Relevant considerations in making planning decisions for potentially polluting development are likely to include:*

- *Location, including the reasons for selecting the chosen site itself;*
- *Impact on health and amenity;*
- *Effect of pollution on the natural and built environment and the enjoyment or areas and landscape and historic cultural value; …*
- *Effect on biodiversity and ecosystem resilience, including where there may be cumulative impacts on air … quality which may have adverse consequences for biodiversity and ecosystem resilience;*
- *The risk and impact of potential pollution from the development, insofar as this might lead to the creation of, or worsen the situation in, an air quality management area … where there are sensitive receptors …"*

*6.7.17 "… overall expectation that levels of pollution should be reduced as far as possible and for this reason the location of potentially polluting development should be taken into account as part of the overall strategies …"*

*6.7.18 "Early consideration is required to ascertain whether the location and design of proposed development is acceptable where air pollution … generating development is likely to affect a protected species, or is proposed in an area likely to affect a statutorily designated site …"*

### 2.2.2 Local Policy

#### Flintshire Unitary Development Plan 2000 – 2015

The Flintshire Unitary Development Plan (FUDP)[6] which was adopted in September 2011 was due to expire on the 31st December 2015. However, FCC acknowledge that the FUDP is still to be used as it is the most up to date adopted plan for development management purposes and it will be an important material consideration in any planning decisions until superseded by an adopted Local Development Plan which is currently under preparation.

Relevant policies within the FUDP include:

*Policy STR1: New Development*

*"New development will be … required to minimise or negate pollution to air …"*

*Policy STR7: Natural Environment*

*"The natural environment of Flintshire will be safeguarded by … protection of the … air."*

*Policy GEN1: General Requirements for Development*

*"… the development should not have a significant or adverse … effects of pollution."*

The guidance presented above from WSP, PPW and FUDP are considered within this assessment.

## 2.3 Environmental Permitting Regulations

The Environmental Permitting (England and Wales) Amendment Regulations 2018 implements European Union Directive 2015/2193/EU (the Medium Combustion Plant Directive, MCPD) in Schedule 25A, alongside additional controls relating to SG's through the SG Regulations (the SGR) in Schedule 25B.

The gen-sets are classified as 'new' MCP and as 'Tranche B' SG's as they would be installed post 1st December 2016; therefore they are required to comply with the MCPD and SGR requirements.

## 2.4 Protection of Ecological Receptors

Sites of nature conservation importance are provided environmental protection with respect to air quality through the application of standards known as Critical Levels ($C_{Le}$) for airborne concentrations and Critical Loads ($C_{Lo}$) for deposition to land from air.

SG guidance requires that designated ecological sites of should be screened against relevant standards if they are located within the following set distances from the SG:

- Special Protection Areas (SPAs), Special Areas of Conservation (SACs) or Ramsar sites within 5km[7] of the installation; and
- Sites of Special Scientific Interest (SSSIs) within 2km of the installation.

### 2.4.1 Critical Levels ($C_{Le}$)

$C_{Le}$ are a quantitative estimate of exposure to one or more airborne pollutants in gaseous form, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge. The relevant $C_{Le}$'s for the protection of vegetation and ecosystems are specified within the Air Quality Standards Regulations and AERA guidance (see Table 2-3).

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[6] Flintshire County Council: Flintshire Unitary Development Plan 2000 – 2015. Adopted 28th September 2011.
7 On the basis that the SGs are natural gas only, the set distance for SPAs, SACs and Ramsar sites is 5km.

**Table 2-3**
**Relevant $C_{Le}$ for the Protection of Vegetation and Ecosystems**

| Pollutant | $C_{Le}$ (µg/m$^3$) | Habitat and Averaging Period |
|---|---|---|
| Nitrogen oxides ($NO_x$) | 30 | Annual mean (all ecosystems) |
| | 75 | Daily mean (all ecosystems) |

### 2.4.2 Critical Loads ($C_{Lo}$)

$C_{Lo}$'s are a quantitative estimate of exposure to deposition of one or more pollutants, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge. Critical loads are set for the deposition of various substances to sensitive ecosystems. In relation to combustion emissions critical loads for eutrophication and acidification are relevant which can occur via both wet and dry deposition; however on a local scale only dry (direct deposition) is considered significant.

Empirical $C_{Lo}$ for eutrophication (derived from a range of experimental studies) are assigned based for different habitats, including grassland ecosystems, mire, bog and fen habitats, freshwaters, heathland ecosystems, coastal and marine habitats, and forest habitats and can be obtained from the UK Air Pollution Information System (APIS) website (www.apis.ac.uk/).

$C_{Lo}$ for acidification have been set in the UK using an empirical approach for non-woodland habitats on a 1km grid square based upon the mineralogy and chemistry of the dominant soil series present in the grid square, and the simple mass balance (SMB) equation for both managed and unmanaged woodland habitats.

The $C_{Lo}$'s for the ecological sites subject to assessment are presented in Section 4.3.

## 2.5 Assessment Guidance

### 2.5.1 Welsh Government Local Air Quality Management Technical Guidance LAQM.TG(16)

WG's Local Air Quality Management Technical Guidance[8] (LAQM.TG(16)) was published for use by local authorities in their LAQM review and assessment work. The document provides key guidance in aspects of air quality assessment, including screening, use of monitoring data, and use of background data that are applicable to all air quality assessments.

### 2.5.2 Environmental Protection UK (EPUK) and Institute of Air Quality Management (IAQM) Guidance

EPUK and IAQM have together published guidance[9] to help ensure that air quality is properly accounted for in the development control process. It clarifies when an air quality assessment should be undertaken, what it should contain, and how impacts should be described and assessed including guidelines for assessing the significance of impacts.

### 2.5.3 NRW Guidance for Air Quality Assessment

Guidance Notes produced by the WG provide a framework for regulation of installations and additional technical guidance produced by NRW are used to provide the basis for permit conditions. Of particular relevance to the

[8] Welsh Government Local Air Quality Management Technical Guidance (2016).
[9] Environmental Protection UK and Institute of Air Quality Management, 'Land-Use Planning and Development Control: Planning for Air Quality', 2017.

assessment of air quality impacts is the '*air emission risk assessment for your environmental permit*' guidance[10] (referred to as the AERA guidance throughout this report). The purpose of this guidance is to assist operators to assess risks to the environment and human health when applying for a permit under the EP Regulations.

In relation to SG, NRW have adopted specific guidance for the assessment of emissions to air from SG[11] to supplement their existing '*Air emissions risk assessment for your environmental permit*' (the AERA guidance) to clarify their exact requirements for SG's.

NRW also provides specific guidance for assessing impacts on ecological sites known as AQTAG06[12].

[10] https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit

[11] Emissions from specified generators. Guidance on dispersion modelling for oxides of nitrogen assessment from specified generator. Version 1, Environment Agency, UNCLASSIFED.

[12] AQTAG06 – Technical Guidance on detailed modelling approach for an appropriate assessment for emissions to air. Environment Agency, March 2014 version.

# 3.0 ASSESSMENT METHODOLOGY

This ADM has been undertaken with due consideration to the SG modelling guidance, AERA and dispersion modelling reporting guidance[13]. The modelling approach is based upon the following stages:

- review of gen-set specification and operational envelope to define emission sources, pollutant emission rates and characteristics;
- identification of sensitive receptors;
- compilation of the existing air quality baseline and review of Local Air Quality Management (LAQM) status; and
- calculation of process contribution to ground level concentrations and evaluation against relevant environmental standards for both human and ecological receptors.

## 3.1 Quantification of Emissions

The emission parameters applied in the modelling are provided in Table 3-1 below. The generator emission parameters have been input on the basis of manufacturer's design and specifications.

**Table 3-1**
**Emission Parameters**

| Parameter / Source | PPU2080NG | PPU2535NG |
|---|---|---|
| Stack Location (NGR x,y) | 331366, 371796 | 331362, 371795 |
| Stack Height (m) | 7 | 7 |
| Emission temperature (K) | 693 | 693 |
| Stack diameter (m) | 0.60 | 0.60 |
| Velocity (m/s) | 37.0 | 37.0 |
| Flow ($Nm^3/s$ STP)[(a)] | 7.03 | 7.03 |
| NOx Concentration ($mg/Nm^3$) | 95 | 95 |
| NOx emission g/s | 0.67 | 0.67 |

Table Note:
a) Normalised to 273K, dry, 101.3kPa, 15% $O_2$ assuming stack oxygen concentration of 9% (dry) and moisture content 11%.

## 3.2 Model Setup

For this assessment the AERMOD model[14] has been applied; this model is widely used and accepted by NRW and the EA for undertaking such assessments and its predictions have been validated against real-time monitoring data by the United States (US) Environmental Protection Agency (EPA). It is therefore considered a suitable model for this assessment.

### 3.2.1 Model Domain / Receptors

The modelling has been undertaken using a receptor grid across an Ordnance Survey map of the study area. Pollutant exposure isopleths are generated by interpolation between receptor points and superimposed onto the map. This method allows the maximum ground level concentration outside the site boundary to be assessed.

[13] Air Dispersion modelling report requirements (for detailed air dispersion modelling). AQMAU, Environment Agency (not dated).
[14] Software used: Lakes AERMOD View, (Executable Aermod_18081)

A nested receptor grid of 5km$^2$ centred upon the site was applied as follows:

- 250m x 250m at 10m grid resolution;
- 500m x 500m at 25m grid resolution;
- 1250m x 1250m at 50m grid resolution;
- 2500m x 1250m at 50m grid resolution.

In addition, the modelling of discrete sensitive receptor locations as described in Section 4.1 was undertaken to assess the impact at relevant exposure locations for annual mean impact and facilitate the discussion of results.

### 3.2.2 Building Downwash

Building downwash occurs when turbulence, induced by nearby structures, causes pollutants emitted from an elevated source to be displaced and dispersed rapidly towards the ground, resulting in elevated ground level concentrations. Building downwash has been considered for buildings that have a maximum height equivalent to at least 40% of the emission height and which are within a distance defined as five times the lesser of the height or maximum projected width of the building.

The integrated Building Profile Input Programme (BPIP) module within AERMOD was used to assess the potential impact of building downwash upon predicted dispersion characteristics. Structures input to the model are represented in Figure 3-1.

**Figure 3-1**
**Modelled Buildings and Structures**

### 3.2.3 Topography

The presence of elevated terrain can significantly affect the dispersion of pollutants and the resulting ground level concentration in a number of ways. Elevated terrain reduces the distance between the plume centre line and the ground level, thereby increasing ground level concentrations. Elevated terrain can also increase turbulence and, hence, plume mixing with the effect of increasing concentrations near to a source and reducing concentrations further away.

AERMOD utilises digital elevation data to determine the impact of topography on dispersion from a source. Topography was incorporated within the modelling using 30m resolution Shuttle Radar Topography Mission (SRTM) terrain data files. Data was processed by the AERMAP function within AERMOD to calculate terrain heights (see Figure 4-3).

### 3.2.4 Meteorological Data and Preparation

The meteorological data provider was consulted for the closest and most representative dataset appropriate to the study area. The closest observation site is Hawarden meteorological station approximately 5.2km to the south east. A windrose is presented in Figure 4-4.

The meteorological data (5 year hourly sequential data for 2012-2016 inclusive) was obtained in .met format from the data supplier and converted to the required surface and profile formats for use in AERMOD using AERMET View meteorological pre-processor. Details specific to the site location were used to define surface roughness, albedo and bowen ratio in the conversion (see Table 3-2).

**Table 3-2**
**Applied Surface Characteristics**

| Zone (Start) | Zone (end) | Albedo | Bowen Ration | Surface Roughness (m) |
|---|---|---|---|---|
| 80 | 280 | 0.20 | 1.625 | 1 |
| 280 | 80 | 0.29 | 0.925 | 0.04025 |

### 3.2.5 Dispersion Coefficients

The 'rural' option for dispersion coefficients was selected in accordance with AERMOD guidance[15].

### 3.2.6 Dispersion Model Uncertainty

For this assessment the AERMOD model has been applied; this model is widely used and accepted by the EA for undertaking such assessments and its predictions have been validated against real-time monitoring data by the United State (US) Environmental Protection Agency (EPA). Model validation studies[16] for AERMOD generally suggest that these dispersion models are for the vast majority of cases able to predict maximum short term high percentiles concentrations well within a factor of two and the latest evaluation study for AERMOD version 18081 shows the composite (geometric mean) ratio of predicted to observed short-term averages from 'test sites' (where real-time monitoring data is available to validate model performance), to be between 0.96 and 1.2.

## 3.3 Assessment of Impacts on Air Quality

### 3.3.1 Operational envelope

As a worst case scenario it has been assumed that the SG operates at maximum output for 8,760 hours per year.

### 3.3.2 Treatment of Model Output

The assessment of impacts against the standards as defined in Section 2.1.1 was undertaken using model output as described in Table 3-3 below.

[15] EPA, AERMOD Implementation Workgroup, Aermod Implementation Guide (August 3, 2015)
[16] AERMOD: Latest Features and Evaluation Results, EPA-454/R-03-003, June 2003 (United States Environmental Protection Agency)

With respect to NOx emissions, it is considered given the nature of the generators and fuel that the primary $NO_2$ to NOx ratio will be <10%[17]; therefore as per the SG guidance and the EA's Air Quality Modelling and Assessment Unit (AQMAU) guidance[18] on conversion ratio for $NO_x$ and $NO_2$ it has been assumed that 70% of $NO_x$ is present as $NO_2$ in relation to long term impacts and 35% of NOx is present as $NO_2$ in relation to short-term impacts.

**Table 3-3**
**Model Outputs**

| Averaging Period | Model Output – Process Contribution (PC) | Predicted Environmental Concentration (PEC) |
|---|---|---|
| 1 hour mean. Not to be exceeded more than 18 times a calendar year | 99.79%ile of 1-hour means for $NO_2$ | PC + 2 x annual mean background |
| 24-hour maximum | 24-hour max from 5 met. years | PC + 2 x annual mean background |
| Calendar year | Annual mean from 5 met. years | PC + annual mean background |

As per the EA's guidance the peak 1-hr $NO_2$ concentration has also been presented; although there is no assessment level to compare this with.

### 3.3.3 Significance of Effects on Human receptors

To assess the potential impact on air quality, the predicted exposure is compared to the standards and the results of the dispersion modelling have been presented in the form of:

- tabulated concentrations at discrete receptor locations to facilitate the discussion of results; and
- illustrations of the impact as isopleths (contours of concentration) for the criteria selected enabling determination of impact at any locations within the study area.

Descriptors for predicted impacts applied in this assessment are taken from the EPUK-IAQM Guidance. The matrix for assessment against annual mean AQALs is reproduced in Table 3-4. For short-term AQALs the EPUK-IAQM guidance indicates that PC's <10% of the AQAL can be classified as 'negligible', 10-20% 'small', 20-50% 'medium', and >50% 'large' and the significance of this impact can be described as 'negligible', 'slight', 'moderate', or 'substantial' respectively without considering background concentrations. This approach has been applied to the EALs (i.e. those substances not regulated in Air Quality Standards Regulations).

**Table 3-4**
**Impact Descriptors**

| Concentration with development | Percentage Change in Air Quality Relative to AQAL (%) | | | |
|---|---|---|---|---|
| | 1* | 2-5 | 6-10 | >10 |
| 75% or less of AQAL | Negligible | Negligible | Slight | Moderate |
| 76-94% of AQAL | Negligible | Slight | Moderate | Moderate |
| 95-102% of AQAL | Slight | Moderate | Moderate | Substantial |
| 103-109% of AQAL | Moderate | Moderate | Substantial | Substantial |
| 110% or more of AQAL | Moderate | Substantial | Substantial | Substantial |

[17] https://www3.epa.gov/scram001/no2_isr_database.htm
[18] Welsh Government, Air Quality Modelling and Assessment Unit, 'Conversion Ratios for NOx and $NO_2$' (no date)

Table note: *a process contribution of less than 1% is considered negligible regardless of the total concentration.

The EPUK-IAQM guidance requires a judgment on the significance of the 'effect' as 'significant' or 'not significant'. Primarily this is based upon the impact descriptors (i.e. it states *'it is likely that a 'moderate' or 'substantial' impact will give rise to a significant effect and a 'negligible' or 'slight' impact will not have a significant effect'*), however other considerations may also have a bearing, for example:

- the existing and future air quality in the absence of the development;
- the extent of current and future population exposure to the impacts;
- the worst case assumptions adopted when undertaking the prediction of impacts; and
- the extent to which the proposed development has adopted best practice to eliminate and minimise emissions.

## 3.4 Assessment of Impacts on Vegetation and Ecosystems

### 3.4.1 Calculation of Contribution to Critical Loads

Dry deposition flux was calculated using the following equation:

Dry deposition flux ($\mu g/m^2/s$) = ground level concentration ($\mu g/m^3$) x deposition velocity (m/s)

Wet deposition occurs via the incorporation of the pollutant into water droplets which are then removed in rain or snow and is not considered significant over short distances (AQTAG06) compared with dry deposition and therefore for the purposes of this assessment, wet deposition has not been considered.

The applied deposition velocities for the relevant chemical species are as shown in Table 3-5.

**Table 3-5**
**Applied Deposition Velocities**

| Chemical Species | Recommended deposition velocity (m/s) | |
|---|---|---|
| $NO_2$ | Grassland | 0.0015 |
| | Woodland | 0.0030 |

#### Critical Loads - Eutrophication

The critical loads for nitrogen deposition (N) are recorded in units of kgN/ha/yr. The deposition PC is converted from $\mu g/m^2/s$ to units of kgN/ha/year by multiplying the dry deposition flux by the standard conversion factor of 95.9.

#### Critical Loads - Acidification

The predicted deposition rates are converted to units of equivalents (keq/ha/year), which is a measure of how acidifying the chemical species can be, by multiplying the dry deposition flux (kg/ha/year) by standard conversion factors as presented in Table 3-6.

**Table 3-6**
**Applied Acidification Conversion Factors**

| Chemical Species | Conversion factor [kg/ha/year to keq/ha/year] |
|---|---|
| $NO_2$ | 6.84 |

### Calculation of PC as a percentage of Acid Critical Load Function

The calculation of the process contribution of N and S to the acid critical load function has been carried out according to the guidance on APIS, which is as follows:

> *'The potential impacts of additional sulphur and/or nitrogen deposition from a source are partly determined by PEC, because only if PEC of nitrogen deposition is greater than CLminN will the additional nitrogen deposition from the source contribute to acidity. Consequently, if PEC is less that CLminN only the acidifying affects of sulphur from the process need to be considered:*
>
> *Where PEC N Deposition < CLminN*
>
> *PC as % CL function = (PC S deposition/CLmaxS)*100*
>
> *Where PEC is greater than CLminN (the majority of cases), the combined inputs of sulphur and nitrogen need to be considered. In such cases, the total acidity input should be calculated as a proportion of the CLmaxN.*
>
> *Where PEC N Deposition > CLminN*
>
> *PC as %CL function = ((PC of S+N deposition)/CLmaxN)*100'*

## 3.4.2 Assessment of Impact and Significance

In addition to the AERA guidance, Operational Instruction 66_12[19] details how the significance of air quality impacts on ecological sites should be assessed. This guidance provides risk based screening criteria to determine whether impacts will have 'no likely significant effects (alone and in-combination)' for European sites, 'no likely damage' for SSSI's:

- PC does not exceed 1% long-term $C_{Le}$ and/or $C_{Lo}$ or that the PEC does not exceed 70% long-term $C_{Le}$ and/or $C_{Lo}$ for European sites and SSSIs; and
- PC does not exceed 10% short-term $C_{Le}$ for NOx for European sites and SSSIs.

Where impacts cannot be classified as resulting in 'no likely significant effect', more detailed assessment may be required depending on the sensitivity of the feature in accordance with Operational Instruction 67_12 ('*Detailed assessment of the impact of aerial emissions from new or expanding IPPC regulated industry for impacts on nature conservation*'). This can require the consideration of the potential for in-combination effects, the actual distribution of sensitive features within the site, and local factors (such as the water table).

The guidance provides the following further criteria:

- if the PEC does not exceed 100% of the appropriate limit it can be assumed there will be no adverse effect;
- if the background is below the limit, but a small PC leads to an exceedance – decision based on local considerations;
- if the background is currently above the limit and the additional PC will cause a small increase – decision based on local considerations;
- if the background is below the limit, but a significant PC leads to an exceedance – cannot conclude no adverse effect; and
- if the background is currently above the limit and the additional PC is large - cannot conclude no adverse effect.

[19] EA Working Instruction 66_12 - Simple assessment of the impact of aerial emissions from new or expanding IPPC regulated industry for impacts on nature conservation

# 4.0 BASELINE ENVIRONMENT

## 4.1 Site Setting

The Application Site is located on the northern edge of Deeside Industrial Park at the approximate national grid reference (NGR): 331372, 371798 which is within the administrative area of FCC which is also part of the North Wales Combined Authority (NWCA). The A548 network runs in an east to west orientation north of the Application Site.

The immediate locale of the Application Site is predominantly used for industrial and commercial purposes. The closest residential receptor is approximately 2km north east of the Application Site in the village of Puddington.

The closest ecological sites of international or national designation include the following:

- Dee Estuary Ramsar, Special Area of Conservation (SAC) and SSSI is located approximately 625m north west of the Application Site;
- Deeside and Buckley Newt sites SAC approximately 3.5km south west of the Application Site;
- Inner Marsh Farm SSSI is located approximately 1.6km north west of the Application Site; and
- Shotton Lagoons and Reedbeds SSSI is located approximately 1.3km south west of the Application Site.

### 4.1.1 Human Receptors

According to WG's LAQM.TG(16), air quality standards should only apply to locations where members of the public may be reasonably likely to be exposed to air pollution for the duration of the relevant limit value. As such seven sensitive locations have been selected to inform the risk assessment in terms of relevant annual mean exposure (shown in Figure 4-1 and Table 4-1 as HR1 to HR7). Further, the dispersion modelling has been completed using a receptor grid to allow potential short-term exposure to be assessed at all locations surrounding the Site.

**Table 4-1**
**Modelled Discrete Human Receptor Locations**

| Receptor | | National Grid Reference (NGR) | |
|---|---|---|---|
| | | x | y |
| HR1 | Church Farm | 333672 | 371820 |
| HR2 | Vicarage House | 333654 | 371857 |
| HR3 | Holme Farm | 333253 | 373006 |
| HR4 | Puddington Old Hall | 333262 | 373279 |
| HR5 | Burton Village 1 | 331526 | 374103 |
| HR6 | Burton Village 2 | 331825 | 373988 |
| HR7 | Bishop Wilson Church of England Primary School | 331888 | 374004 |

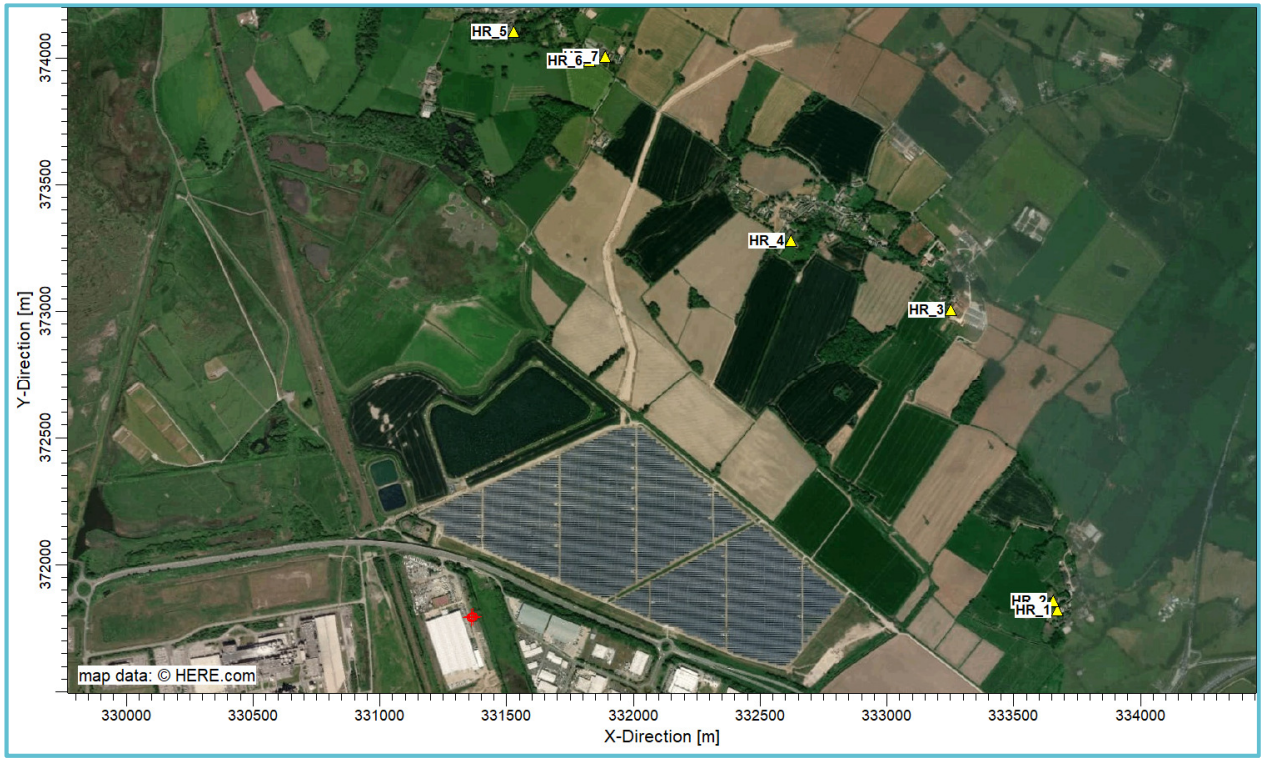


**Figure 4-1**
**Modelled Discrete Human Receptor Locations**

### 4.1.2 Ecological Receptors

International and national designated sites within the relevant screening distances are presented in Table 4-2 (as per the Magic.gov.uk).

**Table 4-2**
**Designated Ecological Sites**

| Interest Status | Site (Designation) | Ref. in assessment | Predominant APIS Habitat classification within study area[(a)] |
|---|---|---|---|
| National (SSSI) | Inner Marsh Farm | ER1 | Neutral Grassland |
| | Shotton Lagoons and Reedbeds | ER2 | Broadleaved Woodland |
| International (SAC, SPA, Ramsar) | The Dee Estuary SAC (& SSSI)<br>River Dee & Bala Lake SAC (& SSSI) | ER3 | Saltmarsh |
| | Deeside and Buckley Newt SAC | ER4 | Woodland (acidophilus Quercus dominated) |
| (a) Predominant habitat within the study area i.e. 5km from the Application Site. | | | |

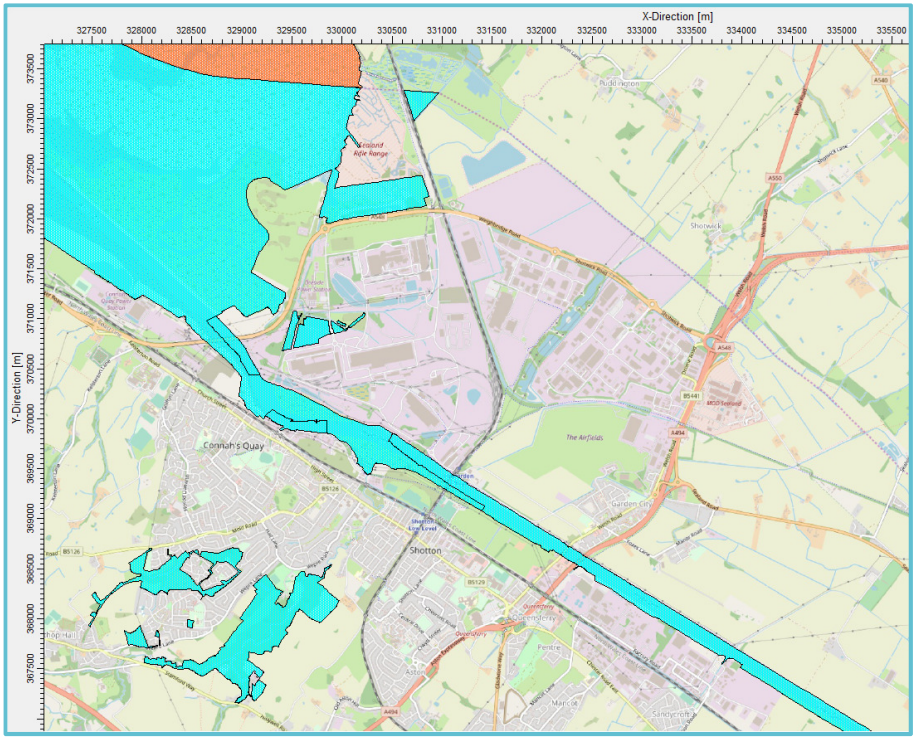


**Figure 4-2**
**Designated Ecological Sites**

## 4.2 Ambient Air Quality

### 4.2.1 Local Air Quality Management

A review of published NWCA LAQM report[20] indicates that there have not been any exceedences of $NO_2$ or $PM_{10}$ AQALs at areas of relevant exposure within FCC administrative area. As such, no air quality management areas (AQMA) have been declared within the authority's administrative area.

### 4.2.2 Local Air Quality Monitoring Data

FCC undertakes diffusion tube monitoring at 52 locations across its administrative area. The following diffusion tube locations monitoring data for 2015 and 2016 are presented in Table 4-3 :

- 'Site 28' – classified as an 'industrial' monitoring location, approximately 425m north of the Application Site;
- 'Site 25' – classified as an 'industrial' monitoring location, approximately 680m east of the Application Site;
- 'Site 29' – classified as an 'industrial' monitoring location, approximately 800m west of the Application Site;
- 'Site 23' – classified as a 'kerbside' monitoring location, approximately 1.6km south east of the Application Site; and
- 'Site 26' – classified as an 'industrial' monitoring location, approximately 1.7km south west of the Application Site.

[20] North Wales Combined Authority. Annual Status Report 2017. September 2017.

**Table 4-3**
**FCC $NO_2$ passive monitoring**

| Site | 2015 Annual Mean (µg/m³) | 2016 Annual Mean (µg/m³) |
|---|---|---|
| Site 28 | 17.4 | 15.5 |
| Site 25 | 18.1 | 21.3 |
| Site 29 | 15.8 | 18.0 |
| Site 23 | 21.4 | 24.4 |
| Site 26 | 15.0 | 16.3 |

The measured 2016 annual mean concentration from Site 25 has been applied in this assessment.

### 4.2.3 Modelled Background Pollutant Concentrations

Background pollutant concentration data on a 1km x 1km spatial resolution is provided by Defra through the UK AIR website and is routinely used to support LAQM and Air Quality Assessments. Background pollutant concentrations for $NO_2$ are based upon a 2015 base year and projected to future years[21] (2018 is presented below). The background concentrations for the grid squares containing the Application Site and nearby receptors are shown in Table 4-4.

**Table 4-4**
**Annual Mean Background Concentrations**

| X,Y (NGR) | $NO_2$ (µg/m³) |
|---|---|
| 331500, 371500 (Site) | 14.5 |
| 333500, 371500 | 14.6 |
| 333500, 372500 | 9.6 |
| 333500, 373500 | 8.8 |
| 331500, 374500 | 8.1 |
| 330500, 372500 | 8.9 |
| 329500, 372500 | 7.8 |

## 4.3 Baseline Conditions at Ecological Receptors

The APIS website[22], a support tool for assessment of potential effects of air pollutants on habitats and species developed in partnership by the UK conservation agencies and regulatory agencies and the Centre for Ecology and Hydrology has been used to provide information on baseline concentrations, current deposition rates and $C_{Lo}$'s for nutrient nitrogen (Table 4-5) and $C_{Lo}$ functions for acidity (Table 4-6).

[21] Background mapping data for local authorities – http://uk-air.defra.gov.uk/data/laqm-background-home.

[22] http://www.apis.ac.uk/ (at the time of writing the APS backgrounds have reverted to 2013-15 3 year average following an issue with the 2014-16 data)

**Table 4-5**
**Nitrogen Critical Levels, Loads and Current Loads**

| Ref. | APIS Habitat Class | $NO_x$ Annual Mean ($\mu g/m^3$) | Critical Load Range (kg N/ha/yr) | Current Load (kg N/ha/yr) |
|---|---|---|---|---|
| ER1 | Neutral Grassland | 16.94 | 20 - 30 | 19.32 |
| ER2 | Broadleaved Woodland | 16.94 | N/A | 32.9 |
| ER3 | Saltmarsh | 14.42 | 20 - 30 | 19.32 |
| ER4 | Woodland (acidophilus Quercus dominated) | 19.3 | 10 – 15 | 33.6 |

**Table 4-6**
**Acid Critical Load Functions and Current Loads**

| Ref. | APIS Habitat Classification | Critical Load Function ($K_{eq}$/ha/yr) | | | Current Load ($K_{eq}$ha/yr) | |
|---|---|---|---|---|---|---|
| | | CLmaxS | CLminN | CLmaxN | N | S |
| ER1 | Neutral Grassland | 4.1 | 0.438 | 4.538 | 1.38 | 0.29 |
| ER2 | Broadleaved Woodland | 1.758 | 0.357 | 11.12 | 2.35 | 0.33 |
| ER3 | Saltmarsh | Not acid sensitive | | | 1.38 | 0.29 |
| ER4 | Woodland (acidophilus Quercus dominated) | 1.4 | 0.4 | 1.8 | 2.4 | 0.33 |

## 4.4 Topography

The topography within the Application Site locale is relatively flat, with ground levels on-site approximately 25m above sea level (ASL). Ground levels reduce in all directions in the immediate locale of the Application Site. Further from the Application Site there are slight undulations in height, eventually reaching sea level, to the southwest, west and northwest on the Dee Estuary. The surrounding topography is illustrated in Figure 4-3 below.

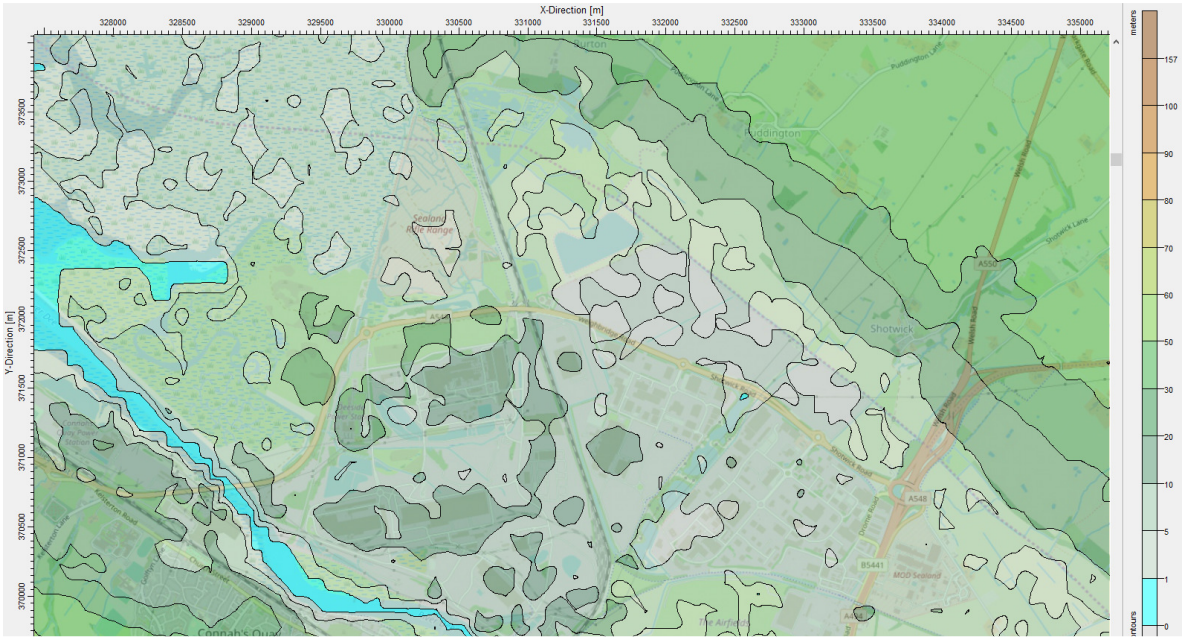


**Figure 4-3**
**Surrounding Topography**

## 4.5 Meteorological Conditions

A windrose showing the frequency of wind speed and direction, used in the assessment is provided in Figure 4-4. The windrose shows winds from the south east are most frequent.

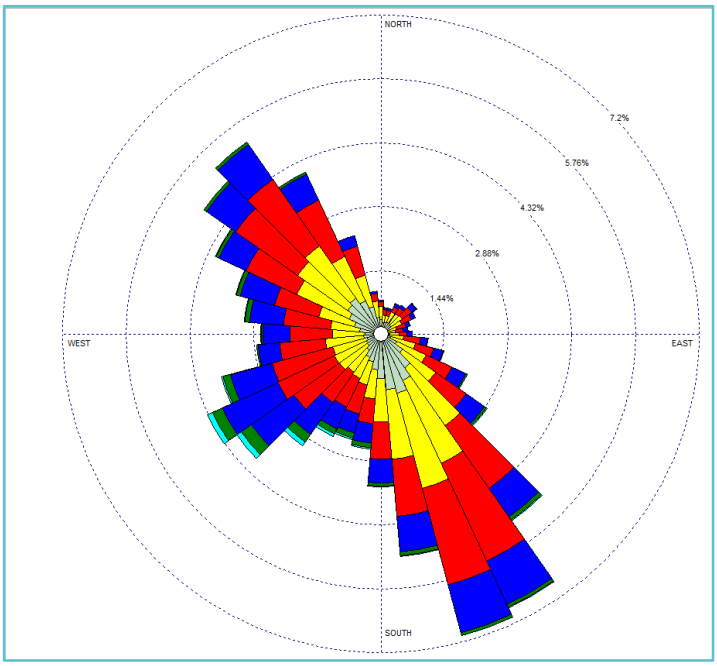


**Figure 4-4**
**Windrose (Hawarden, 2012 - 2016)**

# 5.0 ASSESSMENT RESULTS

## 5.1 Annual $NO_2$ Impacts

Predicted annual mean $NO_2$ impacts at the modelled residential receptor locations are summarised in Table 5-1 (an isopleth plot is presented in Appendix A). The PC can be considered insignificant at all receptors as the PC is less than 1% and can be described as 'negligible'.

**Table 5-1**
**Predicted $NO_2$ Annual Mean Impacts**

| Receptor | PC (µg/m³) | PC as % of Standard | PEC (µg/m³) | PEC as % of Standard | Impact Descriptor |
|---|---|---|---|---|---|
| HR1 | 0.06 | 0.2 | 21.4 | 53.4% | Negligible |
| HR2 | 0.06 | 0.2 | 21.4 | 53.4% | Negligible |
| HR3 | 0.07 | 0.2 | 21.4 | 53.4% | Negligible |
| HR4 | 0.09 | 0.2 | 21.4 | 53.5% | Negligible |
| HR5 | 0.10 | 0.3 | 21.4 | 53.5% | Negligible |
| HR6 | 0.09 | 0.2 | 21.4 | 53.5% | Negligible |
| HR7 | 0.08 | 0.2 | 21.4 | 53.5% | Negligible |

## 5.2 Short-term $NO_2$ Impacts

Predicted short-term impacts are summarised in Table 5-2. The PC is insignificant (<10%) at all residential receptors and the inclusion of background concentrations does not lead to predicted exceedances of the relevant standard at any location. An isopleth plot is presented in Appendix A.

**Table 5-2**
**Predicted $NO_2$ 1-hr Mean (99.79%ile) Impacts**

| Receptor | PC (µg/m³) | PC as % of Standard | PEC (µg/m³) | PEC as % of Standard | Impact Descriptor |
|---|---|---|---|---|---|
| Max. impact outside boundary | 61.8 | 30.9% | 104.4 | 52% | n/a |
| HR1 | 1.4 | 0.7% | 44.0 | 22% | insignificant |
| HR2 | 1.5 | 0.7% | 44.1 | 22% | insignificant |
| HR3 | 1.7 | 0.8% | 44.3 | 22% | insignificant |
| HR4 | 2.5 | 1.3% | 45.1 | 23% | insignificant |
| HR5 | 3.5 | 1.7% | 46.1 | 23% | insignificant |
| HR6 | 3.1 | 1.6% | 45.7 | 23% | insignificant |
| HR7 | 3.0 | 1.5% | 45.6 | 23% | insignificant |

Table note: n/a = not an applicable exposure location for 1-hour mean therefore impact descriptor not applied.

## 5.3 Impacts on Ecological Receptors

### 5.3.1 Critical Levels

The results of the assessment of impacts on $C_{Le}$'s are presented in Table 5-3 and Table 5-4 below. The findings are as follows:

- the annual average NOx PC exceeds 1% of the $C_{Le}$ for ER1 and ER3 however the PEC does not exceed 70%;
- the maximum daily NOx PC exceeds 10% of the $C_{Le}$ for ER3 however the PEC does not exceed 70%;

Therefore the impact is considered to have 'no likely significant effects' for European sites and 'no likely damage' for SSSI's.

**Table 5-3**
**Impact on NOx Annual Mean Critical Levels**

| Site | PC (µg/m$^3$) | PC as % of $C_{Le}$ | PEC (µg/m$^3$) | PEC as % of $C_{Le}$ |
|---|---|---|---|---|
| ER1 | 0.32 | 1.1% | 17.26 | 57.5% |
| ER2 | 0.15 | 0.5% | 17.09 | 57.0% |
| ER3 | 0.79 | 2.6% | 17.73 | 59.1% |
| ER4 | 0.08 | 0.3% | 19.38 | 64.6% |

**Table 5-4**
**Impact on 24-hour Mean NOx Critical Level**

| Site | PC (µg/m$^3$) | PC as % of $C_{Le}$ | PEC (µg/m$^3$) | PEC as % of $C_{Le}$ |
|---|---|---|---|---|
| ER1 | 2.0 | 2.6% | 35.84 | 47.8% |
| ER2 | 3.6 | 4.8% | 37.47 | 50.0% |
| ER3 | 8.0 | 10.7% | 41.87 | 55.8% |
| ER4 | 2.9 | 3.8% | 41.47 | 55.3% |

### 5.3.2 Impacts on Nitrogen Critical Loads

The results of the assessment are presented in Table 5-5 below. The findings are that the PC's do not exceed 1% of the $C_{Lo}$'s and therefore the impact is considered to have 'no likely significant effects' for European sites and 'no likely damage' for SSSI's.

**Table 5-5**
**Impact on Nitrogen Critical Load**

| Site | Applied $C_{Lo}$ (kg N/ha/yr) | PC (kg N/ha/yr) | PC as % of $C_{Lo}$ |
|---|---|---|---|
| ER1 | 20 | 0.032 | 0.2% |
| ER2 | 10 | 0.030 | 0.3% |
| ER3 | 20 | 0.080 | 0.4% |
| ER4 | 10 | 0.016 | 0.2% |

### 5.3.3 Impacts on Acid Critical Loads

The results of the assessment are presented in below. The findings are that the PC's do not exceed 1% of the $C_{Lo}$'s and therefore the impact is considered to have 'no likely significant effects' for European sites and 'no likely damage' for SSSI's.

**Table 5-6**
**Impact on Acid Critical Load**

| Site | Applied $C_{Lo}$ (keq/ha/yr) | PC (keq/ha/yr) | PC as % of $C_{Lo}$ |
|---|---|---|---|
| ER1 | 4.538 | 0.002 | 0.05% |
| ER2 | 11.12 | 0.002 | 0.02% |
| ER3 | Not acid sensitive | | |
| ER4 | 1.4 | 0.001 | 0.06% |

# 6.0 SUMMARY AND CONCLUSIONS

This ADM assessment has quantified and assessed the potential air quality impacts associated with combustion emissions from the proposed development using NRW approved techniques against published standards for the protection of human health and designated ecological sites.

The conclusions of the ADM assessment are as follows:

- the effects of the proposed development on air quality in respect of national Air Quality Standards are 'not significant'; and
- the emissions from the plant are considered to have 'no likely significant effects' for European sites and 'no likely damage' for SSSI's.

# APPENDIX A

## Isopleth Plots

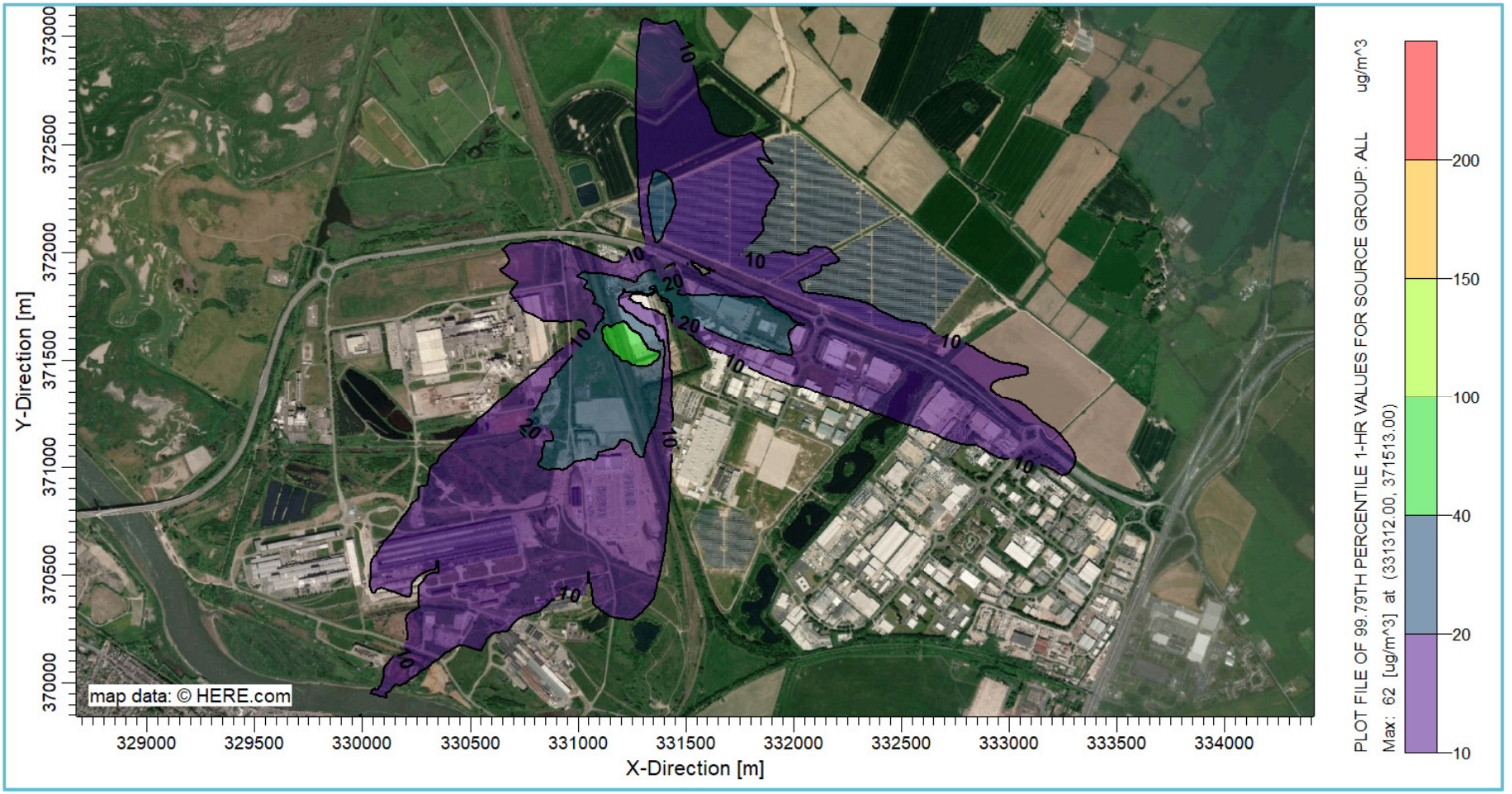


**Figure A-1**
**1-hour Mean (99.79%ile) Nitrogen Dioxide Process Contribution**

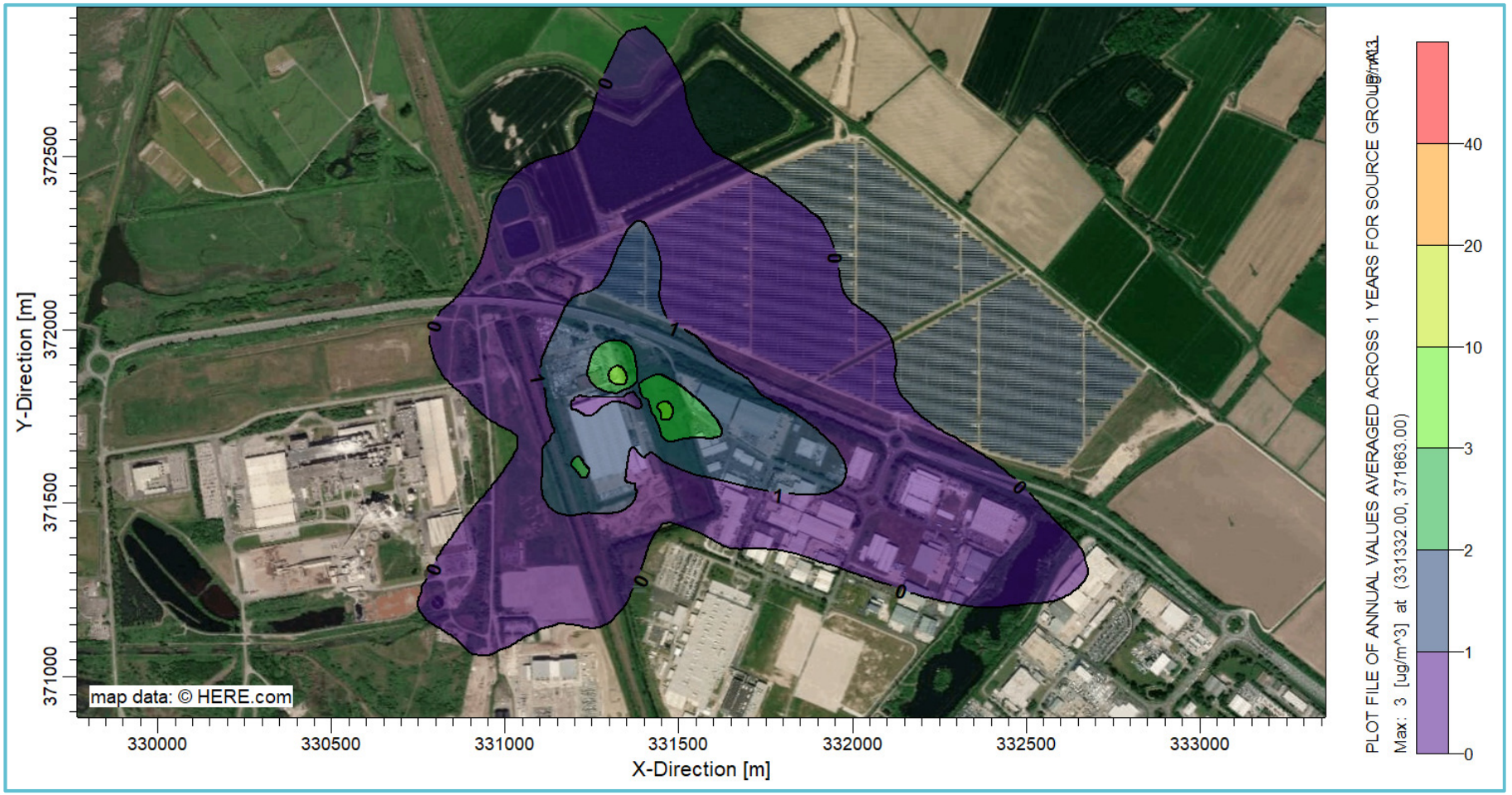


**Figure A-2**
**Annual Mean Nitrogen Dioxide Process Contribution**

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