

# URBAN RESERVE – CARDIFF POWER

**Air Quality Assessment**  
**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 (AMP) Holdings Limited) (the 'Applicant') to undertake Atmospheric Dispersion Modelling (ADM) with respect to their planning application in respect of land off Cardiff Road, Reading. The Proposed Development, known as Cardiff Power, is for a small scale 4MW gas fired power station and is one of several similar AMP projects around the country referred to as Urban Reserve sites.

### 1.1 Proposed Development and Background

The Proposed Development will comprise of two 2MW<sub>e</sub> Gas-Engine Generating-Sets (gen-sets) with 7m exhaust stacks, including ventilation/cooling equipment, a transformer and DNO/customer substation building, and a gas kiosk. The gen-sets will be fired on natural gas and will export electricity for grid balancing purposes via the local 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:
  - Cardiff Power 1 – 2.0MW<sub>e</sub>; and
  - Cardiff Power 2 – 2.0MW<sub>e</sub>;
- combustion emissions are discharged via individual 7m high exhaust stacks;
- the gen-sets will comply with a nitrogen oxide (NO<sub>x</sub>) exhaust emission limit value (ELV) of <95mg/Nm<sup>3</sup> at 15% O<sub>2</sub>.

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 from the Environment Agency (EA) under the Environmental Permitting Regulations (England and Wales) 2016. The Environmental Permit will include conditions consistent with the EP Regulations on Emission Limit Values (ELV) to air from the generators 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 EA guidance, for gas engines fired on natural gas, the principal release of oxides of nitrogen (NO<sub>x</sub>) have been assessed.

Therefore the objective of the study is to assess the impact of NO<sub>x</sub> emissions against the relevant Air Quality Standards for nitrogen dioxide (NO<sub>2</sub>) for the protection of human health and the relevant Critical Levels (for NO<sub>x</sub>) and Critical Loads (for N and acid deposition) for the protection of designated ecological receptors.

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

## 2.0 POLICY, LEGISLATION AND RELEVANT GUIDANCE

### 2.1 National 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 are provided in Table 2-1.

**Table 2-1**  
**Applied AQALs**

| Pollutant        |                 | Annual Standard      | Short Term Standard                                                           |
|------------------|-----------------|----------------------|-------------------------------------------------------------------------------|
| Nitrogen dioxide | NO <sub>2</sub> | 40 µg/m <sup>3</sup> | 200 µg/m <sup>3</sup> (1-hour) not to be exceeded more than 18 times per year |
| Nitrogen oxide*  | NO <sub>x</sub> | 30 µg/m <sup>3</sup> | None                                                                          |

Table note: \*Critical Level for protection of vegetation.

Defra has published technical guidance for use in Local Air Quality Management<sup>1</sup>. 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 the EA Specified Generator 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                                                          | AQAL's should apply at:                                                          | AQAL'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    |

<sup>1</sup> 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 Clean Air Strategy<sup>2</sup> (CAS) sets out the comprehensive action that is required from across all parts of government and society to meet goals in respect of air quality and is a key part of delivering the governments '25 Year Environment Plan'.

### 2.1.3 Local Air Quality Management

Section 82 of the Environment Act 1995 (Part IV) requires local authorities 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 AQALs prescribed in the Regulations are being achieved or are likely to be achieved in the future.

Where any of the prescribed AQALs 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 AQAL. As such, Local Authorities (LAs), have formal powers to control air quality through a combination of LAQM and by use of their wider planning policies.

Defra has published technical guidance for use by local authorities in their LAQM work<sup>3</sup>. This guidance, referred to in this report as LAQM.TG(16), has been used where appropriate in the assessment presented here.

### 2.1.4 Protection of Nature Conservation Sites

Sites of nature conservation importance at a European, national and local level, are provided environmental protection from developments, including from atmospheric emissions.

The Conservation of Habitats and Species Regulations 2010 introduces the precautionary principle for protected European sites, i.e. that projects can only be permitted to proceed; having ascertained that there will be no adverse effect on the integrity of the designated site. It requires an assessment to determine if significant effects (alone or in combination) are likely, followed by an 'appropriate assessment' by the competent authority, if necessary.

Similarly, the Countryside and Rights of Way (CROW) Act 2000 provides protection to Sites of Special Scientific Interest (SSSIs) to ensure that developments are not likely to cause them damage.

Environmental Quality Standards exist for nature conservation sites known as Critical Levels (for airborne concentrations) and Critical Loads (for deposition of nitrogen or acid forming compounds). Critical loads are site specific, being a function of soil chemistry. The Critical Levels are set out in Table 2-3 and Critical Loads in Table 4-4.

**Table 2-3**  
**Relevant C<sub>Le</sub> for the Protection of Vegetation and Ecosystems**

| Pollutant                             | C <sub>Le</sub> (µg/m <sup>3</sup> ) | Averaging Period             |
|---------------------------------------|--------------------------------------|------------------------------|
| Nitrogen oxides<br>(NO <sub>x</sub> ) | 30                                   | Annual mean (all ecosystems) |
|                                       | 75                                   | Daily mean (all ecosystems)  |

<sup>2</sup> The Clean Air Strategy, DEFRA. January 2019.

<sup>3</sup> Department for Environment, Food and Rural Affairs (DEFRA): Local Air Quality Management Review and Assessment Technical Guidance LAQM.TG(16), 2016.

### 2.1.5 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 introduced by Defra relating to SG's through the SG Regulations (the SGR) in Schedule 25B.

The generators are classified as 'new' MCP and as 'Tranche B' SG's as they would be installed post 1<sup>st</sup> December 2016 therefore they are required to comply with the SGR requirements from 1<sup>st</sup> January 2019.

## 2.2 Planning Policy Context

### 2.2.1 National Planning Policy Framework

The National Planning Policy Framework (NPPF)<sup>4</sup> describes the policy context in relation to pollutants, with specific reference to air quality its states:

*"Planning policies and decisions should contribute to and enhance the natural and local environment by:*

*[....]*

*e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of .. air ... pollution ... Development should, wherever possible, help to improve local environmental conditions such as air ... quality ..."*

*[....]*

*Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan."*

The NPPF is accompanied by supporting Planning Practice Guidance (PPG) which includes guiding principles on how planning can take account of the impacts of new development on air quality. In regards to air quality, the PPG states

*"Whether or not air quality is relevant to a planning decision will depend on the Proposed Development and its location. Concerns could arise if the development is likely to generate air quality impact in an area where air quality is known to be poor. They could also arise where the development is likely to adversely impact upon the implementation of air quality strategies and action plans and/or, in particular, lead to a breach of EU legislation (including that applicable to wildlife)."*

The PPG sets out the information that may be required within the context of a supporting air quality assessment, stating that *"assessments should be proportional to the nature and scale of development proposed and the level of concern about air quality [...] Mitigation options where necessary, will depend on the Proposed Development and should be proportionate to the likely impact"*.

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<sup>4</sup> <https://www.gov.uk/government/publications/national-planning-policy-framework--2> (March 2012)

The policies within the NPPF and accompanying PPG in relation to air pollution are considered within this assessment.

### 2.2.2 Local Policy

The Reading Core Strategy<sup>5</sup> provides strategic policies for development across the borough. The Core Strategy includes policy CS34: - Pollution and Water Resources that specifically deals with air quality stating:

*“Development will only be permitted where it would not be damaging to the environment through air, land, noise or light pollution; where it would preserve or ideally enhance ground and surface water quality; and where existing water resources, sewerage and wastewater treatment infrastructure are adequate to support the Proposed Development [...]”*

## 2.3 Assessment Guidance Documents

The key guidance documents consulted in undertaking this air quality assessment are described below.

### 2.3.1 Defra Local Air Quality Management Technical Guidance

Defra technical guidance 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.

### 2.3.2 Air Quality Planning Guidance

Environmental Protection UK (EPUK) and the IAQM have together published guidance<sup>6</sup> 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 in terms of significance of effect.

### 2.3.3 Environment Agency Guidance for Air Quality Assessment

Guidance Notes produced by Defra provide a framework for regulation of installations and additional technical guidance produced by the EA are used to provide the basis for permit conditions. Of particular relevance to the assessment of air quality impacts is the EA's 'air emission risk assessment for your environmental permit' guidance<sup>7</sup> (referred to as the AERA guidance throughout this report). The purpose of this guidance is to assist operators to assess risks to the air environment and human health when applying for a permit under the EP Regulations.

In relation to SG, the EA have produced specific guidance<sup>8</sup> for the assessment of emissions to air from SG to supplement their existing AERA guidance to clarify their exact requirements for SG's, as opposed to the more generic AERA guidance requirements.

The EA also provides specific guidance for assessing impacts on ecological sites known as AQTAG.06<sup>9</sup>.

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<sup>5</sup> Reading Borough Local Development Framework, Core Strategy, Adopted January 2008 With Alteration Adopted 27th January 2015

<sup>6</sup> Environmental Protection UK and Institute of Air Quality Management, 'Land-Use Planning and Development Control: Planning for Air Quality', 2017

<sup>7</sup> <https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit>

<sup>8</sup> Emissions from specified generators. Guidance on dispersion modelling for oxides of nitrogen assessment from specified generator. Version 1, environment agency, UNCLASSIFIED.

<sup>9</sup> AQTAG06 – Technical Guidance on detailed modelling approach for an appropriate assessment for emissions to air. Environment Agency, March 2014 version.

## 3.0 ASSESSMENT METHODOLOGY

The dispersion modelling has been undertaken with due consideration to the EA's AERA guidance and SG modelling guidance. The modelling approach is based upon the following stages:

- review of generator 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. The emission concentrations are compliant with the MCPD.

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

| Parameter / Source                      | Genset 1       | Genset 2       |
|-----------------------------------------|----------------|----------------|
| Fuel                                    | Natural gas    | Natural gas    |
| Stack Location (NGR x,y)                | 470488, 174099 | 470493, 174099 |
| Stack Height (m)                        | 7.0            | 7.0            |
| Flow (Am <sup>3</sup> /s)               | 8.16           | 8.16           |
| Stack diameter (m)                      | 0.45           | 0.45           |
| Velocity (m/s)                          | 51.3           | 51.3           |
| Emission temperature (C)                | 420            | 420            |
| Flow (Nm <sup>3</sup> /s) <sup>a)</sup> | 5.72           | 5.72           |
| NOx Concentration (mg/Nm <sup>3</sup> ) | 95             | 95             |
| NOx emission g/s                        | 0.54           | 0.54           |

Table Note:

- a) Normalised to 273K, dry, 101.3kPa, 15% O<sub>2</sub> assuming in-stack oxygen concentration of 9% (dry) and moisture content 11%.

### 3.2 Model Setup

For this assessment the AERMOD model<sup>10</sup> 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

<sup>10</sup> Software used: Lakes AERMOD View, (Executable Aermod\_18081)

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 a 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.

A nested receptor grid extending 2km from the site was applied as follows:

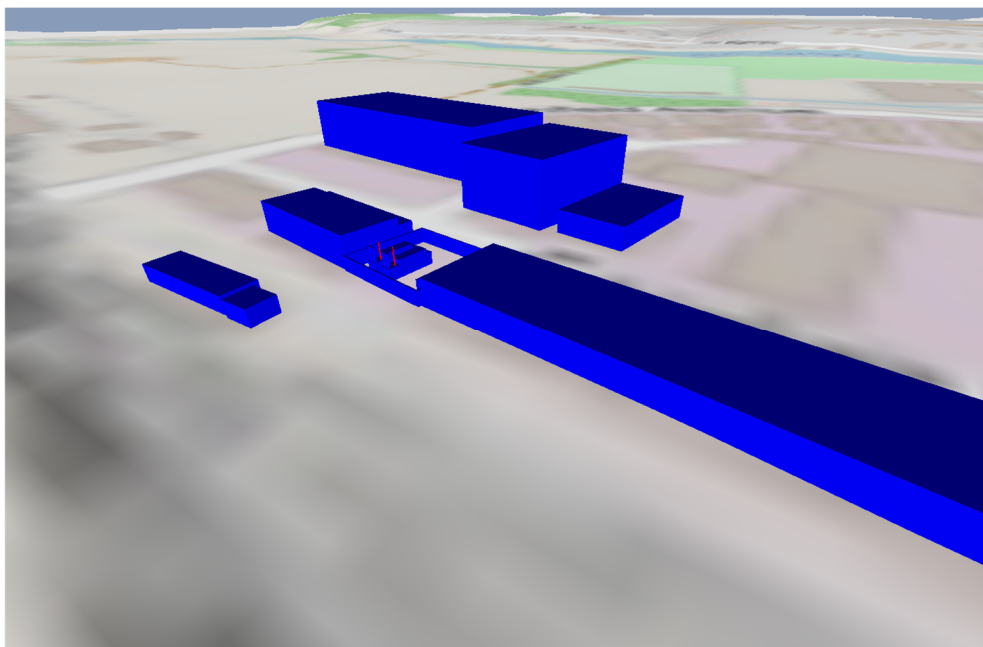
- 200m x 200m at 20m grid resolution;
- 400m x 400m at 50m grid resolution;
- 2000m x 2000m at 100m grid resolution; and
- 4000m x 4000m at 200m grid resolution.

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 4-4).

### 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 recording all the parameters necessary for dispersion modelling. The closest observation site is Farnborough Airport approximately 20km south east. A windrose is presented in Figure 4-3.

The meteorological data (5 years of hourly sequential data between 2011 and 2016) 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 Ratio | Surface Roughness (m) |
|--------------|------------|--------|-------------|-----------------------|
| 0            | 45         | 0.215  | 0.875       | 0.07                  |
| 45           | 75         |        |             | 0.02                  |
| 75           | 150        |        |             | 0.38                  |
| 150          | 230        |        |             | 0.26                  |
| 230          | 275        |        |             | 0.05                  |
| 275          | 0          |        |             | 0.17                  |

### 3.2.5 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<sup>11</sup> 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

<sup>11</sup> AERMOD: Latest Features and Evaluation Results, EPA-454/R-03-003, June 2003 (United States Environmental Protection Agency)

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

The operational hours will be determined by grid balancing requirements, to present a precautionary (worst case) assessment it has been assumed that the generators operate at maximum output for 8,760 hours per year. In reality there would also be some down-time for maintenance.

#### 3.3.2 Treatment of Model Output

The assessment of impacts against the standards as defined in Table 2-1 was undertaken using model output as described in Table 3-3 below.

With respect to NO<sub>x</sub> emissions, it is considered given the nature of the generators and fuel that the primary NO<sub>2</sub> to NO<sub>x</sub> ratio will be <10%<sup>12</sup>; therefore as per the SG guidance and the EA Air Quality Modelling and Assessment Unit (AQMAU) guidance<sup>13</sup> on conversion ratio for NO<sub>x</sub> and NO<sub>2</sub> it has been assumed that 70% of NO<sub>x</sub> is present as NO<sub>2</sub> in relation to long term impacts and 35% of NO<sub>x</sub> is present as NO<sub>2</sub> 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 <sub>2</sub> | PC + 2 x annual mean background             |
| Calendar year                                                      | Annual mean from 5 met. years                 | PC + annual mean background                 |

#### 3.3.3 Significance of Effects on Human receptors

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.

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

| Concentration with development at receptor location | 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 |

<sup>12</sup> [https://www3.epa.gov/scram001/no2\\_isr\\_database.htm](https://www3.epa.gov/scram001/no2_isr_database.htm)

<sup>13</sup> Environment Agency, Air Quality Modelling and Assessment Unit, 'Conversion Ratios for NO<sub>x</sub> and NO<sub>2</sub>' (no date)

| Concentration with development at | Percentage Change in Air Quality Relative to AQAL (%) |             |             |             |
|-----------------------------------|-------------------------------------------------------|-------------|-------------|-------------|
|                                   | Slight                                                | Moderate    | Moderate    | Substantial |
| 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 |

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

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.

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

Deposition rates were calculated using empirical methods recommended by the EA AQTAG06<sup>14</sup>. Dry deposition flux was calculated using the following equation:

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

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 are as shown in Table 3-5.

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

| Chemical Species | Recommended deposition velocity (m/s) |        |
|------------------|---------------------------------------|--------|
| NO <sub>2</sub>  | Grassland                             | 0.0015 |
|                  | Woodland                              | 0.0030 |

<sup>14</sup> AQTAG06 – Technical Guidance on detailed modelling approach for an appropriate assessment for emissions to air. Environment Agency, March 2014 version.

### Critical Loads - Eutrophication

The critical loads for nitrogen deposition (N) are recorded in units of kgN/ha/yr. The deposition PC is converted from  $\mu\text{g}/\text{m}^2/\text{s}$  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 ( $\mu\text{g}/\text{m}^2/\text{s}$ ) 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 <sub>2</sub>  | 6.84                                          |

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

The calculation of the process contribution of N 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 than CLminN only the acidifying affects of sulphur from the process need to be considered:*

*Where PEC N Deposition < CLminN*

$$PC \text{ as } \% \text{ CL function} = (PC \text{ S deposition} / CL_{\text{maxS}}) * 100$$

*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*

$$PC \text{ as } \% \text{ CL function} = ((PC \text{ of S+N deposition}) / CL_{\text{maxN}}) * 100'$$

### 3.4.2 Significance of Effect on Ecological Receptors

In addition to the AERA guidance, the EA's Operational Instruction 66\_12<sup>15</sup> details how the 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, or 'no likely damage' for SSSI's.

- PC does not exceed 1% long-term C<sub>Le</sub> and/or C<sub>Lo</sub> or that the PEC does not exceed 70% long-term C<sub>Le</sub> and/or C<sub>Lo</sub> for European sites and SSSIs;
- PC does not exceed 10% short-term C<sub>Le</sub> for NO<sub>x</sub> 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 EAs Operational Instruction 67\_12

<sup>15</sup> 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

(‘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.

## 4.0 BASELINE ENVIRONMENT

### 4.1 Site Setting and Sensitive Receptors

The Application Site is located on Cardiff road in a predominantly industrial and commercial area to the north-west of Reading city centre. The grid reference of the site is SU 70491 74108. The mainline Bristol, Reading, London Railway line is located approximately 15m immediately to the south of the Application Site. To the east and west are commercial businesses. The nearest residential properties are approximately 310m to the east on Cardiff Road, approximately 360m to the south-west beyond the railway and over 750m to the north beyond the River Thames.

The Application Site is within the administrative area of Reading Borough Council (RBC) with respect to Local Air Quality Management and is located within the Reading AQMA.

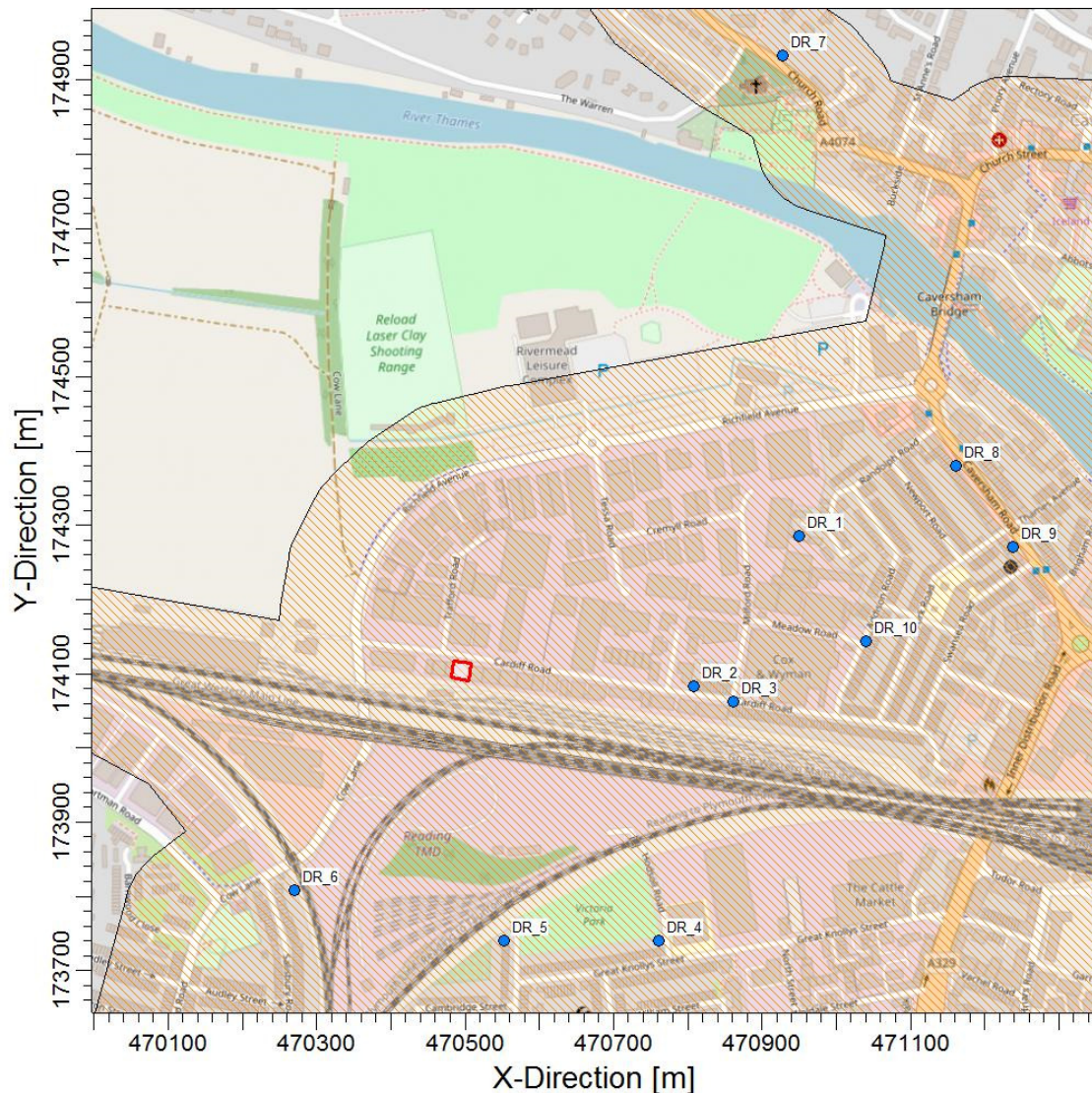
The site setting, assessed receptor locations (as described in the following sections) and AQMA are presented in Figure 4-1.

#### 4.1.1 Human Receptors

According to 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 ten locations surrounding the Application Site have been selected to inform the risk assessment in terms of relevant annual mean exposure (shown in Figure 4-1 as DR1 to DR10). 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 Application Site.

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

| Reference | Description |
|-----------|-------------|
| DR1       | Residential |
| DR2       | Residential |
| DR3       | Residential |
| DR4       | Residential |
| DR5       | Residential |
| DR6       | Residential |
| DR7       | Residential |
| DR8       | Residential |
| DR9       | Residential |
| DR10      | Residential |



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

#### 4.1.2 Ecological Receptors

The EA's SG guidance requires that designated ecological sites should be screened against relevant standards if they are located within the following set distances:

- Special Protection Areas (SPAs), Special Areas of Conservation (SACs) or Ramsar sites within 10km of the installation; and
- Sites of Special Scientific Interest (SSSIs) within 2km of the installation.

There is a single designated site within the relevant screening distances; the Hartslock Wood SAC located approximately 9.6km north west (details for which are presented in Table 4-2).

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

| Interest Status | Site (Designation) | Most Sensitive Interest Feature          | Ref |
|-----------------|--------------------|------------------------------------------|-----|
| European        | Hartslock Wood SAC | Taxus baccata woods of the British Isles | ER1 |

## 4.2 Ambient Air Quality

### 4.2.1 Local Air Quality Management

The Application Site lies within the administrative area of RBC and within the Reading AQMA. The Reading AQMA has been designated for exceedances of the NO<sub>2</sub> annual mean AQAL. The AQMA covers all the major arterial roads in and out of the town as well as the central area. According to most recent published LAQM report<sup>16</sup> *'the majority of the AQMA does not exceed the AQAL, but there are hotspot locations along each route that do'*. The Application Site is within the central area of the AQMA.

### 4.2.2 Local Monitoring Data

RBC undertake monitoring using automated monitors and passive diffusion tubes. The closest NO<sub>2</sub> monitoring locations are shown in Figure 4-2 and recent results taken from the most recent published LAQM report are presented in Table 4-3. The monitoring results show that in the local area away from busy roads (DT44 and 45) that baseline annual mean concentrations are between 28µg/m<sup>3</sup> and 30µg/m<sup>3</sup> and at typical roadside locations range between 33µg/m<sup>3</sup> and 40µg/m<sup>3</sup> and exceed 40µg/m<sup>3</sup> at some 'hot spot' locations (DT42 and DT43).

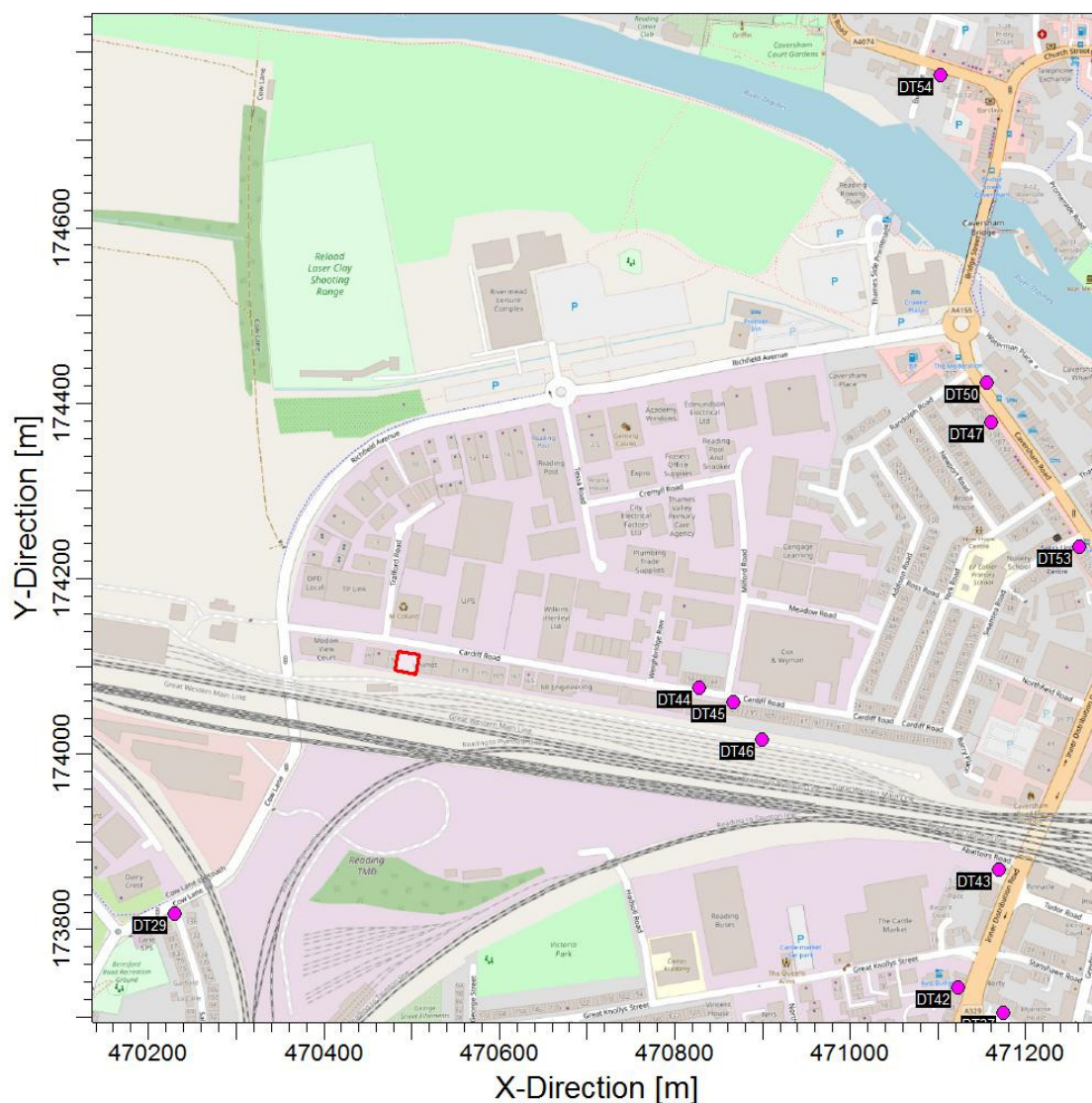
**Table 4-3**  
**NO<sub>2</sub> monitoring**

| Site     | Type           | Distance from kerb (m) | 2015 Annual Mean (µg/m <sup>3</sup> ) | 2016 Annual Mean (µg/m <sup>3</sup> ) | 2017 Annual Mean (µg/m <sup>3</sup> ) |
|----------|----------------|------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| RD1/DT50 | Automated      | 3m                     | 38                                    | 39                                    | 36                                    |
| DT29     | Diffusion tube | 1m                     | 31                                    | 32                                    | 33                                    |
| DT37     | Diffusion tube | 25m                    | 33                                    | 35                                    | 34                                    |
| DT42     | Diffusion tube | 3m                     | 48                                    | 43                                    | 45                                    |
| DT43     | Diffusion tube | 4m                     | 42                                    | 41                                    | 43                                    |
| DT44     | Diffusion tube | 4m                     | 32                                    | 29                                    | 30                                    |
| DT45     | Diffusion tube | 2m                     | 32                                    | 28                                    | 28                                    |
| DT46     | Diffusion tube | N/A                    | 39                                    | 35                                    | 34                                    |
| DT47     | Diffusion tube | 7m                     | 39                                    | 35                                    | 36                                    |
| DT51     | Diffusion tube | 6.5m                   | 41                                    | 41                                    | 40                                    |
| DT53     | Diffusion tube | 7m                     | 40                                    | 36                                    | 36                                    |

<sup>16</sup> Reading Borough Council 2017 Air Quality Annual Status Report (ASR) (June 2017)

| Site | Type           | Distance from kerb (m) | 2015 Annual Mean ( $\mu\text{g}/\text{m}^3$ ) | 2016 Annual Mean ( $\mu\text{g}/\text{m}^3$ ) | 2017 Annual Mean ( $\mu\text{g}/\text{m}^3$ ) |
|------|----------------|------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|
| DT54 | Diffusion tube | 2.5m                   | 35                                            | 37                                            | 36                                            |

Table note: all locations are classified as 'roadside' in the ASR



**Figure 4-2**  
**Nearby NO<sub>2</sub> monitoring Locations**

#### 4.2.3 Application of Baseline Data in the Assessment

A range of discrete receptor locations around the Application Site have been modelled including locations close to busy roads and locations in more suburban locations away from busy roads. For the more suburban locations the 2017 baseline monitoring data from DT44 of  $30\mu\text{g}/\text{m}^3$  has been applied (DR1-6, and 10) and for other locations the 2017 data from the closest monitoring site has been applied as follows:

- DR7 (DT54:  $36\mu\text{g}/\text{m}^3$ )
- DR8 (DT47:  $36\mu\text{g}/\text{m}^3$ )
- DR9 (DT53:  $36\mu\text{g}/\text{m}^3$ )

## 4.3 Baseline Conditions at Ecological Receptors

The APIS website<sup>17</sup>, 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 NO<sub>x</sub> concentrations, current deposition rates and C<sub>Lo</sub>'s for nutrient nitrogen (Table 4-4) and C<sub>Lo</sub> functions for acidity (Table 4-5).

**Table 4-4**  
**Nitrogen Critical Loads and Current Loads**

| Ref. | APIS Critical Load Class<br>(most sensitive) | NO <sub>x</sub><br>Annual<br>Mean<br>(µg/m <sup>3</sup> ) | Critical Load<br>Range<br>(kg N/ha/yr) | Critical Load<br>Applied in<br>Assessment<br>(kg N/ha/yr) | Current<br>Load<br>(kg<br>N/ha/yr) |
|------|----------------------------------------------|-----------------------------------------------------------|----------------------------------------|-----------------------------------------------------------|------------------------------------|
| ER1  | Taxus baccata woods of the British Isles     | 30.1                                                      | 5-15                                   | 10                                                        | 25.5                               |

**Table 4-5**  
**Acid Critical Load Functions and Current Loads**

| Ref. | APIS Critical Load Class<br>(most sensitive) | Critical Load Function<br>(k <sub>eq</sub> /ha/yr) |        |        | Current Load<br>(k <sub>eq</sub> /ha/yr) |      |
|------|----------------------------------------------|----------------------------------------------------|--------|--------|------------------------------------------|------|
|      |                                              | CLmaxS                                             | CLminN | CLmaxN | N                                        | S    |
| ER1  | Taxus baccata woods of the British Isles     | 1.145                                              | 0.142  | 1.283  | 1.82                                     | 0.19 |

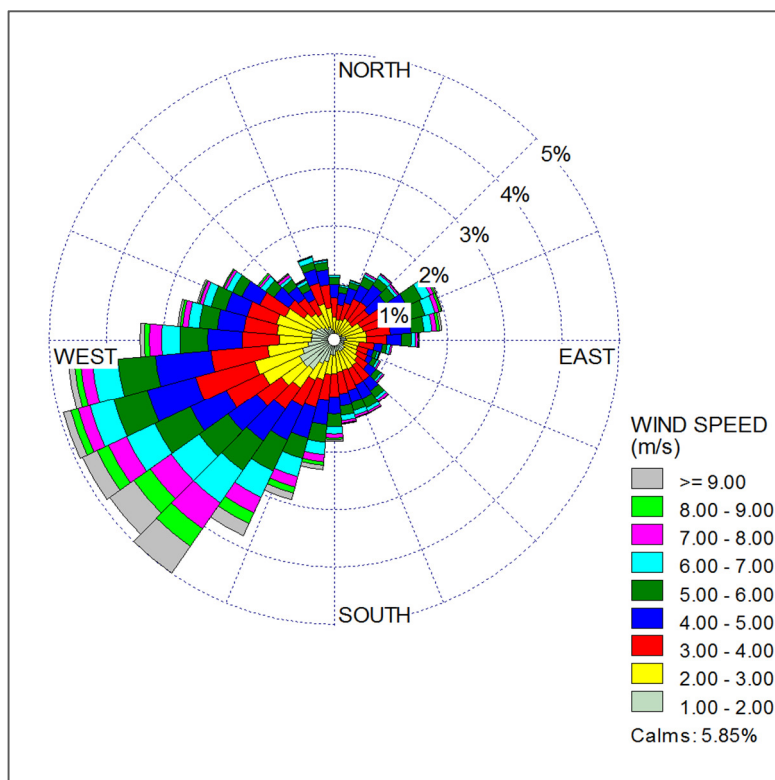
## 4.4 Meteorological Conditions

A windrose, showing the frequency of wind speed and direction, used in the assessment is provided in Figure 4-3. The windrose shows winds from the south west are most frequent.

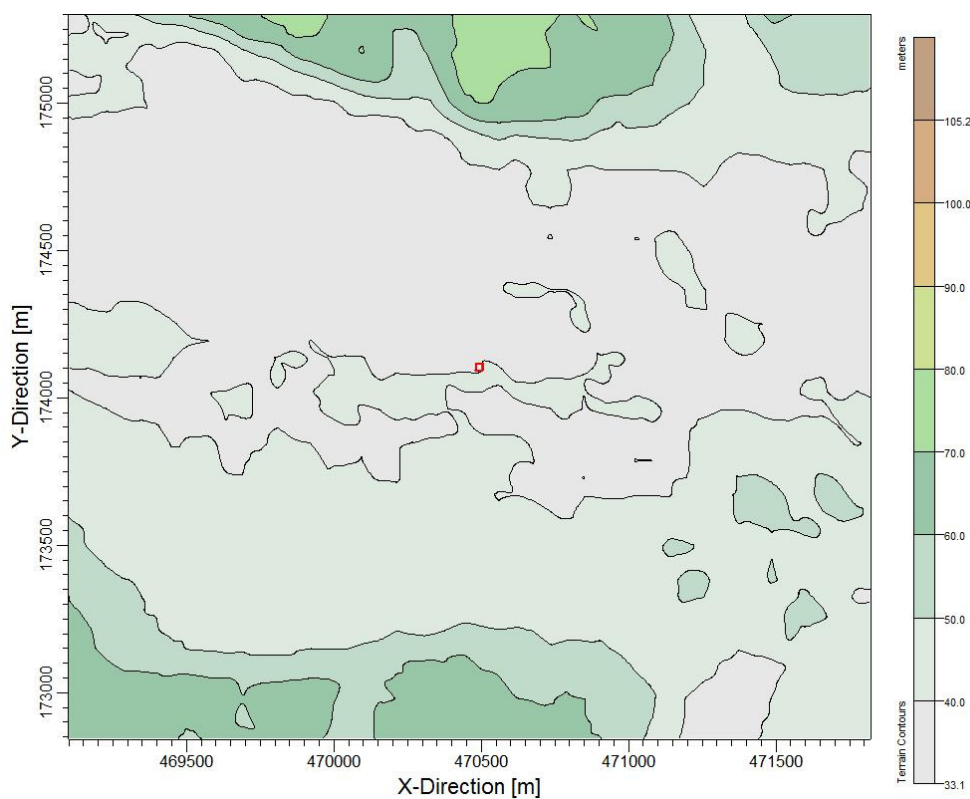
## 4.5 Topography

The Application Site lies at approximately 40m above ordnance datum (AOD) in a flat river valley that runs east-west. To the north the land rises to approximately 70mAOD within 1km and to the south to approximately 60mAOD within 1 km. Topography has been incorporated into the model and is illustrated in Figure 4-4.

<sup>17</sup> <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)



**Figure 4-3**  
**Windrose (2011-2016)**



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

## 5.0 ASSESSMENT RESULTS

### 5.1 NO<sub>2</sub> Impacts

Predicted annual mean NO<sub>2</sub> impacts at the modelled receptor locations are summarised in Table 5-1 (an isopleth plot is presented in Appendix A). The impact can be described as negligible at the majority of receptor locations and 'slight adverse' at the closest locations (DR1 and DR2), however the AQAL is not exceeded at any of the receptor locations.

**Table 5-1**  
**Predicted NO<sub>2</sub> Annual Mean Impacts**

| Receptor | PC (µg/m <sup>3</sup> ) | PC as % of Standard | PEC (µg/m <sup>3</sup> ) | PEC as % of Standard | Impact Descriptor |
|----------|-------------------------|---------------------|--------------------------|----------------------|-------------------|
| DR1      | 0.7                     | 1.6%                | 30.7                     | 76.6%                | Slight adverse    |
| DR2      | 0.6                     | 1.6%                | 30.6                     | 76.6%                | Slight adverse    |
| DR3      | 0.5                     | 1.2%                | 30.5                     | 76.2%                | Negligible        |
| DR4      | 0.5                     | 1.3%                | 30.5                     | 76.3%                | Negligible        |
| DR5      | 0.5                     | 1.2%                | 30.5                     | 76.2%                | Negligible        |
| DR6      | 0.4                     | 0.9%                | 30.4                     | 75.9%                | Negligible        |
| DR7      | 0.5                     | 1.1%                | 36.5                     | 91.1%                | Negligible        |
| DR8      | 0.4                     | 1.0%                | 36.4                     | 91.0%                | Negligible        |
| DR9      | 0.3                     | 0.8%                | 36.3                     | 90.8%                | Negligible        |
| DR10     | 0.4                     | 1.1%                | 30.4                     | 76.1%                | Negligible        |

Predicted short-term impacts are summarised in Table 5-2. The PC is insignificant/negligible (<10%) at all the discrete receptors. The maximum ground level impact has been reported and does not exceed the AQAL, this occurs close to the Application Site and is not a location of relevant public exposure. An isopleth plot is presented in Appendix A.

**Table 5-2**  
**Predicted NO<sub>2</sub> 1-hr Mean (99.79%ile) Impacts**

| Receptor                     | PC (µg/m <sup>3</sup> ) | PC as % of Standard | PEC (µg/m <sup>3</sup> ) | PEC as % of Standard | Impact Descriptor |
|------------------------------|-------------------------|---------------------|--------------------------|----------------------|-------------------|
| Max. impact outside boundary | 87.6                    | 43.8%               | 147.6                    | 73.8%                | n/a               |
| DR1                          | 6.4                     | 3.2%                | 66.4                     | 33.2%                | Insignificant     |
| DR2                          | 7.7                     | 3.9%                | 67.7                     | 33.9%                | Insignificant     |
| DR3                          | 6.7                     | 3.3%                | 66.7                     | 33.3%                | Insignificant     |
| DR4                          | 16.5                    | 8.2%                | 76.5                     | 38.2%                | Insignificant     |
| DR5                          | 16.2                    | 8.1%                | 76.2                     | 38.1%                | Insignificant     |

| Receptor | PC ( $\mu\text{g}/\text{m}^3$ ) | PC as % of Standard | PEC ( $\mu\text{g}/\text{m}^3$ ) | PEC as % of Standard | Impact Descriptor |
|----------|---------------------------------|---------------------|----------------------------------|----------------------|-------------------|
| DR6      | 7.9                             | 4.0%                | 67.9                             | 34.0%                | Insignificant     |
| DR7      | 17.8                            | 8.9%                | 89.8                             | 44.9%                | Insignificant     |
| DR8      | 4.2                             | 2.1%                | 76.2                             | 38.1%                | Insignificant     |
| DR9      | 3.9                             | 2.0%                | 75.9                             | 38.0%                | Insignificant     |
| DR10     | 5.8                             | 2.9%                | 65.8                             | 32.9%                | Insignificant     |

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

On the basis of the level of impact, i.e. 'negligible' and 'slight adverse', the overall effect on air quality is considered 'not significant'.

## 5.2 Impacts on Ecological Receptors

### 5.2.1 Critical Levels

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

- the NOx PC does not exceed 1% of the  $C_{Le}$  and the PC is therefore insignificant; and
- the maximum daily NOx PC does not exceed 10% of the  $C_{Le}$  and the PC is therefore insignificant.

Therefore the impact is considered to have 'no likely significant effect' on the SAC.

**Table 5-3**  
**Impact on Critical Levels**

| Critical Level | PC ( $\mu\text{g}/\text{m}^3$ ) | PC as % of $C_{Le}$ |
|----------------|---------------------------------|---------------------|
| NOx Annual     | <0.1                            | <0.1%               |
| NOx 24 hour    | 0.5                             | 0.6%                |

### 5.2.2 Impacts on Critical Loads

The results of the assessment are presented in Table 5-4 and Table 5-5. The findings are that the PC's do not exceed 1% of the  $C_{Lo}$ 's for the SAC; the impact is therefore considered to have 'no likely significant effect'.

**Table 5-4**  
**Impact on Nitrogen Critical Load**

| Site | Applied $C_{Lo}$<br>(kg N/ha/yr) | PC<br>(kg N/ha/yr) | PC as % of $C_{Lo}$ |
|------|----------------------------------|--------------------|---------------------|
| ER1  | 10                               | 0.002              | <0.1%               |

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

| Site | N PC<br>(kg eq/ha/yr) | PC as % of $C_{Lo}$ |
|------|-----------------------|---------------------|
| ER1  | <0.001                | <0.01%              |

## 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 Environment Agency 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 effect' on the designated ecological site.

# APPENDIX A

## Isopleth Plots



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



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

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