On behalf of
J.Dunton Associates Limited.

Intended for
Venables Associates Limited.

Date
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Project Number
1700003351

# STIRLING ROAD DATA CENTRE, SLOUGH
# BACKUP GENERATOR AIR QUALITY MODELLING REPORT

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# EXECUTIVE SUMMARY

Ramboll UK Ltd. (Ramboll) has been commissioned by J.Dunton Associates Ltd to undertake air dispersion modelling in support of an Environmental Permit application for the installation and operation of a data centre backup power system comprising of eight diesel generators within the Slough Trading Estate on Stirling Road, Slough.

This report sets out the method and results of the dispersion modelling used to assess the impact of the diesel generator array on local air quality.

Broadly the scope of the air quality assessment includes:

- Review of local air quality data surrounding the Site;
- Desk study of the building arrangements and locations of human receptors sensitive to a change in local air quality resulting from the diesel generator emissions; and
- ADMS dispersion models with operational energy centre emissions to predict process contributions (PCs) at identified sensitive receptors for comparison against relevant ambient National Air Quality Objectives (NAQOs).

The modelling has demonstrated that operation of the backup generators would not have a significant impact on local human or ecological receptors.

The highest predicted annual mean $NO_2$ concentration is predicted to occur at a commercial façade immediately adjacent to the eastern boundary of the site. Concentrations at this location are predicted to comfortably comply with the annual mean $NO_2$ objective. At the closest residential receptor locations, the process contribution on annual mean concentrations is insignificant.

No exceedances of the short-term objective as a consequence of the operation of the backup generators for testing purposes is considered likely, with testing of units conducted on an individual/small group basis. All of the generators operating together in an emergency situation could be operated for a total of 34 hours per annum before there is a 1% chance of exceeding the hourly mean $NO_2$ objective at the closest commercial receptor to the site.

The modelling has demonstrated that at all relevant locations air quality would meet relevant NAQOs with the generators operational.

The maximum annual mean $NO_x$ PC at ecological receptors is only 0.13% of the NAQO and therefore well below the level of potential significance for long term impacts. On this basis, impacts of nitrogen and acid deposition would also be insignificant. Impacts of daily mean $NO_x$ concentrations are insignificant at all ecological receptors.

# 1. INTRODUCTION

Ramboll UK Ltd (Ramboll) has been commissioned by J.Dunton Associates Ltd ('the client'), to undertake air dispersion modelling in support of an Environmental Permit application for the installation and operation of a data centre backup power system comprising of eight diesel generators within the Slough Trading Estate on Stirling Road, Slough ('the site').

This report sets out the method and results of the dispersion modelling used to assess the impact of the diesel generator array on local air quality.

## 1.1 Site Description

The site lies in Slough Trading Estate, within Slough Borough Council (SBC), to the north of the Slough Heat and Power Plant and is centred on Ordnance Survey National Grid Reference 495360, 181666.

The Site's immediate surroundings to the east, west and south are industrial units forming the northern extent of the Slough Trading Estate. To the north of the site is a residential area. The site location is shown in Figure 1-1.

The site is not located within an Air Quality Management Area (AQMA). The nearest extent of the Slough AQMA is located 1.5 km south east of the closest site boundary.

The screening report for nature conversation sites from the Environment Agency listed the sites in Table 1-1 for consideration in the assessment.

Table 1-1: Nature Conservation Sites

| Site | Designation | Approximate Distance and Direction from Site |
|---|---|---|
| Windsor Forest & Great Park | SAC / SSSI | 6km south |
| Chilterns Beechwoods | SAC | 9.6km north west |
| Burnham Beeches | SAC / SSSI | 2.7km north |
| South London Waterbodies | SPA / Ramsar | 7.8km south east |
| Haymill Valley | LNR / LWS | 980m west |
| Cocksherd Wood | LNR / LWS | 1.2km north west |
| Stoke Park | LWS | 1.3km north east |
| Wet woodland next to Farnham Park Golf Course | LWS | 1.7km north east |
| Grove Wood Woodland | Ancient Woodland | 1.9km north west |
| Bottom Waltons Woodland | Ancient Woodland | 1.7km north west |

Whilst these nature conservation sites have been included in the assessment, it is very unlikely that there will be any significant effects given the separation distance to the site and the very limited operating hours of the generators.

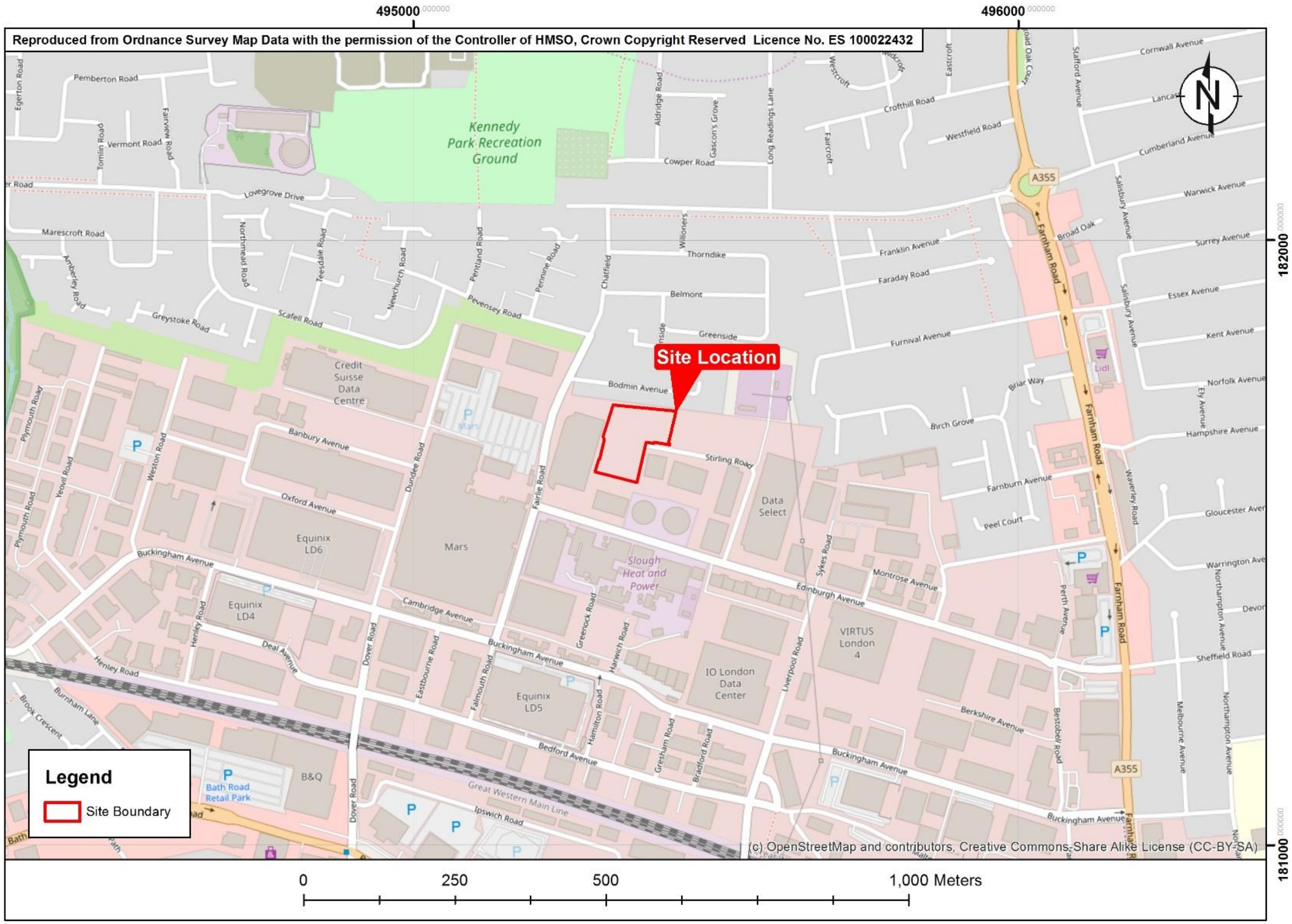


Figure 1-1: Site Location

# 2. METHODOLOGY

The scope of the assessment has been determined by consideration of the following:

- Review of local air quality data surrounding the Site, including air quality monitoring data from;
  - Slough Borough Council
  - AURN Network[1]
- Desk study of the building arrangements and locations of human receptors sensitive to a change in local air quality resulting from the diesel generator emissions;
- ADMS dispersion models with operational energy centre emissions to predict process contributions (PCs) at identified sensitive receptors for comparison against relevant ambient National Air Quality Objectives (NAQOs).

## 2.1 Air Emissions Risk Assessment

*Guidance on air emissions risk assessments*[2] was produced by the Environment Agency (EA) for developments which require a bespoke environmental permit under the *Environmental Permitting Regulations 2016 (as amended) (EPR)*. This *guidance* can be used to support an assessment of the overall impact of the emissions resulting from the installation to confirm that the emissions are acceptable (i.e. do not cause significant environmental pollution). However, the assessment has principally been carried out following the *EA Emissions from specified generators* guidance[3].

In addition, consideration has also been given to *Data Centre FAQ Headline Approach*[4] guidance issued by the EA to assist with permit applications for data centres.

## 2.2 Air Quality Strategy Objectives

### 2.2.1 Human Health Receptors

The long term and short-term NAQOs that are applicable to this assessment are detailed below in Table 2-1 in relation to human health.

Whilst the generator plant runs on diesel, emissions of particulate matter, sulphur dioxide, CO and HC have not been considered as emissions of these pollutants will be extremely low and unlikely to lead to breaches of environmental assessment levels given the limited number of operating hours of the generators.

Table 2-1: National Air Quality Objective

| Pollutant | Concentration ($\mu g/m^3$) | Averaging Period | NAQO Exceedances Allowed | Percentiles |
|---|---|---|---|---|
| Nitrogen dioxide ($NO_2$) | 200 | One hour mean | 18 | 99.79 |

[1] https://uk-air.defra.gov.uk/interactive-map sourced December 2018.

[2] https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit sourced November 2018.

[3] https://consult.environment-agency.gov.uk/psc/mcp-and-sg-regulations/supporting_documents/Specified%20Generators%20Modelling%20GuidanceINTERIM%20FINAL.pdf sourced November 2018

[4] Data Centre FAQ Headline Approach, DRAFT version 10.0 H.Tee 01/06/18 – Release to Industry

| Pollutant | Concentration ($\mu g/m^3$) | Averaging Period | NAQO Exceedances Allowed | Percentiles |
|---|---|---|---|---|
| Nitrogen dioxide ($NO_2$) | 40 | Annual mean | - | - |

### 2.2.2 Nature Conservation Receptors

In addition to the NAQO for human health, there is a critical level for the protection of vegetation and ecosystems of $30\mu g/m^3$ as an annual average. In addition, in terms of the assessment of the impacts of $NO_x$ emissions for an Environmental Permit, the assessment is required to consider the daily mean concentration against a critical level of $75\mu g/m^3$.

Recent guidance produced by the Institute of Air Quality Management (IAQM)[5] provides an explanation of the reasoning behind setting of the annual mean $NO_x$ objective for the protection of ecosystems (paragraphs D.4.8 to D.4.10):

> *'The critical level does not differentiate between the role of nitrogen deposition and $NO_x$ in the air. It is a precautionary general threshold, not specific to a particular habitat, plant species or impact pathway, below which there is currently a high degree of confidence that no adverse effects on vegetation will arise. Long term $NO_x$ concentrations below the critical level are therefore desirable. Some species or habitats may not show adverse effects until higher concentrations are present.*
>
> *The long term (annual mean) concentration of $NO_x$ is most relevant for its impacts on vegetation, as the effects, particularly through the nitrogen deposition pathway, are additive over months and years. This is reflected in the adoption of the long-term guideline in the EU Air Quality Directive as a limit value for vegetation. However, atmospheric exposure to very high concentrations of $NO_x$ for short periods (hours/days) may also have an adverse effect under certain conditions even if the long-term concentrations are below the limit value. The WHO guidelines include a short term (24-hour average) $NO_x$ critical level of $75\mu g/m^3$. Originally set at $200\mu g/m^3$ as a four-hour mean, the more detailed CD-ROM version of the 2000 WHO guidelines comments: "Experimental evidence exists that the CLE decreases from around $200\mu g/m^3$ to $75\mu g/m^3$ when in-combination with $O_3$ or $SO_2$ at or above their critical levels. In the knowledge that short-term episodes of elevated $NO_x$ concentrations are generally combined with elevated concentrations of $O_3$ or $SO_2$, $75\mu g/m^3$ is proposed for the 24 h mean." Ozone and $SO_2$ concentrations are typically low in the UK compared to many other countries. If a regulator does require the use of the short-term $NO_x$ critical level, given the low UK $SO_2$ concentrations IAQM consider it is most appropriate to use $200\mu g/m^3$ as the short term critical load.*
>
> *The relative importance of the long-term mean compared to the short term mean is reflected in several studies which state that the 'UNECE Working Group on Effects strongly recommended the use of the annual mean value, as the long term effects of NOx are thought to be more significant than the short term effects'. This IAQM guidance, therefore, recommends that only the annual mean $NO_x$ concentration is used in assessments unless specifically required by a regulator; for instance, as part of an*

[5] A guide to the assessment of air quality impacts on designated nature conservation sites, D.4.9, v1.0 June 2019

> *industrial permit application where high, short term peaks in emissions, and consequent ambient concentrations, may occur.'*

As the extract from the IAQM guidance makes clear however, compliance with the annual mean critical level is the more significant of the two parameters and is likely to highly protective of vegetation in general. Nevertheless, as required by EA guidance, the daily mean $NO_x$ concentration has been evaluated against a critical level of 75µg/m$^3$ which is likely to be highly conservative.

In addition, the above referenced IAQM guidance also states in Paragraph 5.5.4.4 in relation to annual mean impacts and nitrogen and acid deposition:

> *'...where the change in $NO_x$ concentrations is less than 0.4µg/m$^3$, it is unlikely that it would exceed 1% of the most stringent critical loads for nitrogen and deposition for a sensitive habitat.'*

The predicted annual mean $NO_x$ concentrations have therefore been used to assess whether or not nitrogen and acid deposition will likely exceed 1% of the relevant critical load.

# 3. DISPERSION MODELLING

Air quality impacts were modelled using the ADMS5[6] air quality dispersion model. This uses representative meteorological data for the local area and plant emissions data to predict ambient concentrations of pollutants in the vicinity of the stack.

A detailed dispersion modelling checklist is presented in Appendix 1, together with an Electronic Workbook setting out all applicable modelling, inputs, outputs and results.

In addition, raw modelling files have been supplied electronically in Appendix 2.

the referenced guidance therein, including the *EA Guidance* for detailed air quality assessments as set out on the *UK Government website*[7].

## 3.1 Parameters and Emissions to be Assumed in the Dispersion Model

The eight diesel generators that form the backup power system for the data centre are grouped in pairs to the south of the data centre building. The exit flues for each pair of generators are grouped together into a single stack, one stack per pair of generators, which discharges to atmosphere 16 m above local ground level to ensure adequate dispersion of the emissions.

The emission points location is shown below in Figure 3-1.

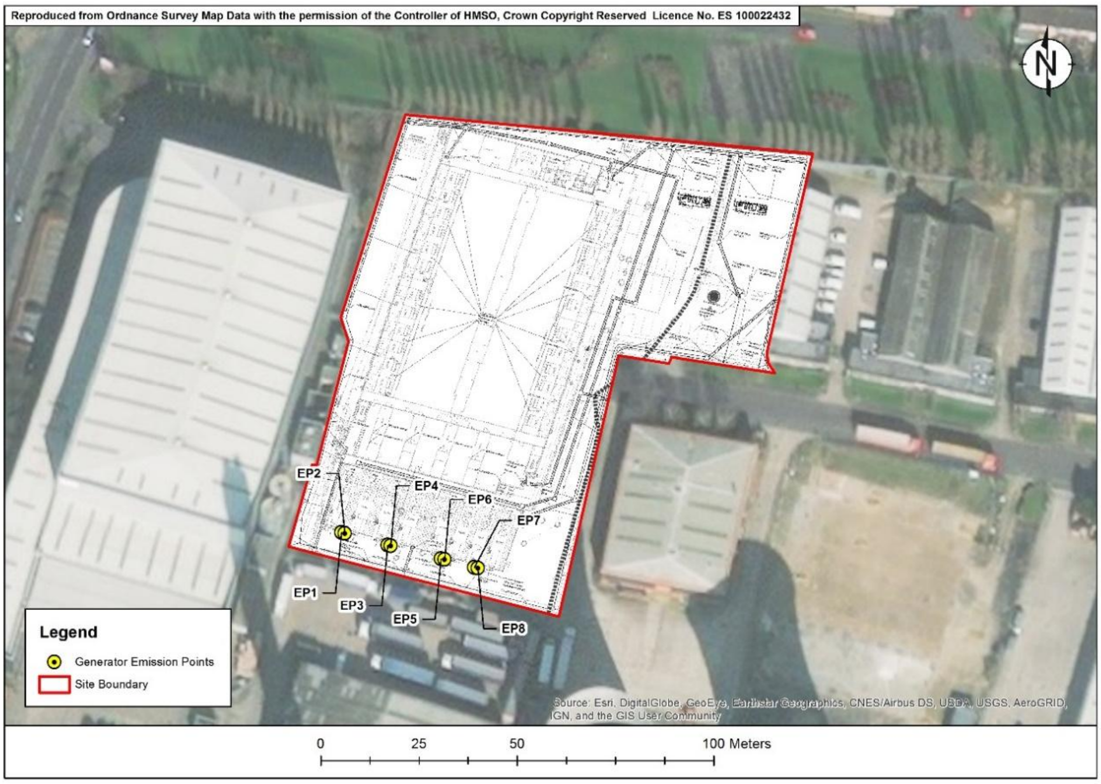


Figure 3-1: Emission Point Locations

[7] https://www.gov.uk/guidance/environmental-permitting-air-dispersion-modelling-reports sourced November 2018.

The input data provided by the operator and used in the detailed modelling is provided in Table 3-11. The emission data is based on the Cummins Exhaust emission data sheet C3750 D5 for full standby power.

The '.apl' files have been provided within Appendix 2.

Table 3-1: Stack Emissions Modelling Input Parameters

| Parameter | Generator |
|---|---|
| Number of Units | 8 |
| Engine BHP | 4308 |
| Number of Stacks | 4 (2 flues each) |
| Flue Diameter (m) | 0.5 |
| Stack Temperature (°C) | 413 |
| Volume Flow ($Am^3/s$) - per flue | 9.33 |
| Exit velocity (m/s) | 47.5 |
| $NO_x$ Emission (g/BHP – hr) | 7.4 |
| $NO_x$ Emission (g/s) – per flue | 8.86 |
| Notes:<br>Assumed that the generator is operating at Full Standby Power<br>$NO_x$ emissions are equivalent to 3,700mg/$Nm^3$ at 5% oxygen | |

## 3.2 Operational Hours

### 3.2.1 Generator Testing

There are three types of testing regime for the generators, and two Scenarios have been modelled to assess the impact of generator testing, as detailed below:

- Each generator will be tested monthly off-load. The generator will be started and run for 1 hour. Each generator will be tested individually in normal working hours and one generator tested per day. Using this schedule all generators will be tested each month;
- Each year all generators will be tested to their full rated capacity via an electrical load bank. Each generator will be tested for 3-hours at full load. This testing will be carried out on an individual basis and in normal working hours. This test will negate the need for the monthly off load test; and
- Each year a black building test will be carried out for each data hall. This test is usually conducted outside of normal working hours, the test typically lasts for six hours and four generators operate simultaneously for this test. This test will negate the need for the monthly off load test. This test will be carried out for each data hall; i.e. twice per year to cover the data centre.

Scenario 1: Based on the above, each generator will operate for a total of nineteen hours per year (i.e. ten hourly tests, one three-hour test and one six-hour test). This has been modelled as Scenario 1. As the flues are grouped together in two per stack, each stack will have emissions totalling thirty-eight hours. The total operating hours for testing are one hundred and fifty-two per year (eight generators, nineteen hours each).

For Scenario 1, the model was run using one representative emission point continuously for an entire year. A sensitivity test was conducted by running the model for the stacks at the extreme ends of the array (EP1 and EP8) and the highest off-site impacts were found to occur from EP1. The results presented in this report are therefore from EP1.

Scenario 1 has also been used to predict NOx concentrations at nature conservation sites.

Scenario 2: This scenario considers the impact of four generators operating simultaneously to simulate the effect of the black building test. As the flues are grouped together in two per stack, the modelling has been undertaken assuming emissions from two stacks operating together (EP1 to EP4). The total operating hours for testing in this scenario are twelve. There is therefore no likelihood of exceeding the hourly mean $NO_2$ objective under this scenario, as the operating hours are less than the eighteen allowable exceedances per year. The assessment considers the number of hours that four of the generators could operate simultaneously in any one year with a 1% chance of exceeding the 1-hour mean objective at the most impacted receptor location. In terms of annual mean impacts, these are effectively covered by the modelling undertaken in Scenario 1 (19 hours operation per generator per year).

### 3.2.2 Emergency Operation

For emergency operation the assessment is different, as the annual operating hours cannot be predicted, and it is not planned to use the generators in an emergency situation. The assessment therefore considers the number of hours that all of the generators could operate simultaneously in any one year with a 1% chance of exceeding the 1-hour mean objective at the most impacted receptor location.

## 3.3 Special Treatments

The conversion ratio of 35% for short-term and 70% for long term has been applied for the conversion of $NO_X$ to $NO_2$ in accordance with the EA Emission from specified generators guidance.

In order to undertake the assessment, the modelling was undertaken assuming that the generators operate all-year round. For compliance with the annual mean objectives during testing (Scenario 1), the predicted concentrations were scaled to the total annual operating hours that the generators will be run for.

For compliance with the daily mean NOx critical level for nature conservation sites, the modelling was undertaken assuming that the generators operate all year round and the highest concentration reported from the 5-years' worth of modelling. This is likely to significantly overestimate the concentrations as the very limited operating hours of the generators during testing means that they are unlikely to be operating during all of the worst case periods for dispersion.

For compliance with the 1-hour mean objective during testing, the modelling was again undertaken assuming that the generators operate all-year round. The number of hours that the 1-hour objective of 200 $\mu g/m^3$ was predicted to be exceeded assuming all-year round operation was calculated from the modelling, and this was combined with the annual operating hours to predict the likelihood of actually exceeding the objective during testing.

For the emergency operating scenario, all of the generators were assumed to be operating all-year round. The number of hours that the 1-hour objective of 200 $\mu g/m^3$ was predicted to be exceeded assuming all-year round operation was calculated from the results of the modelling, and using the hypergeometric distribution function, the allowable operating hours were calculated for a 1% probability of exceeding the 1-hour mean objective at the most impacted receptor location. In accordance with the Emissions from specified generators guidance, in an emergency situation when the operating period is greater than 1 hour, the calculated probability has been multiplied by 2.5.

The likelihood of exceeding the 1-hour mean objective also takes into account the baseline pollutant concentrations in the vicinity of the site. For the short-term assessment, the background concentration is assumed to be twice the annual mean background concentration. As the dispersion modelling was undertaken for $NO_x$ emissions, for estimating the number of exceedances of the hourly mean $NO_2$ objective, the exceedance concentration in the model was set as follows:

Model exceedance concentration = (200 – twice annual mean background)/0.35

### 3.4 Meteorological Data

The dispersion modelling has been undertaken with five years of meteorology data 2013 to 2017 inclusive, from Heathrow Airport which is approximately 11 km to the south east of the Site.

Adopting the maximum hourly stack emissions across the five years of meteorological data will ensure the worst-case long and short-term concentrations from the stacks are considered within the assessment. Such an approach is considered conservative in context of future operating years.

The '.met' files have been provided electronically in Appendix 2.

### 3.5 Buildings Effects

Tall buildings can have a substantial impact on the dispersion of pollutants from stacks, as a result of building downwash i.e. pollutants being drawn down in the wake of a building, giving rise to high concentrations close to the base of the buildings.

An assessment of all buildings within 5 times the stack height was conducted using UK Government LiDAR data available online[8]. The buildings included within the modelling are provided below in Table 3-2 and shown below in Figure 3-2.

Table 3-2: Building Heights

| Building ID | Building Description | Height (m Above Local Ground Level) |
|---|---|---|
| Data Centre | Stirling Road data centre | 12 |
| Bldg 2 | Fullers Logistics | 18 |
| Bldg 3 | Fullers Logistics | 9 |
| Bldg 4 | Toyota Material Handling | 8 |
| Bldg 5 | Fullers Logistics | 9 |
| Bldg 6 | Eastern Cooling Tower | 37 |
| Bldg 7 | Western Cooling Tower | 34 |

[8] https://environment.data.gov.uk/DefraDataDownload/?Mode=survey


Figure 3-2: Modelled Buildings

## 3.6 Terrain

The terrain in the vicinity of the development is relatively flat, and therefore terrain effects have not been included within the modelling.

The modelling adopts the maximum surface roughness value of 1 m for the Site, to take account of the urban location and the topographic features such as tall buildings which increase the ground's surface roughness. The meteorological measurement site's surface roughness default of 0.3 was adopted within the modelling.

## 3.7 Sensitive Receptors

The model was run using a 11.1m spaced grid 1000m by 1200m, approximately centred on the modelled stack location.

A number of discrete human receptor locations were included within the modelling. These included representative residential dwellings to the north of the site at façade locations and commercial façade locations to the east, west and south of the site.

The modelled discrete human health receptor locations are provided in Figure 3-3.

The locations of nature conservation sites were included in the modelling as specific points closest to the site.

Details of the modelled human health and nature conservation receptor locations are provided in Table 1 of Appendix 1 (provided as an electronic workbook).

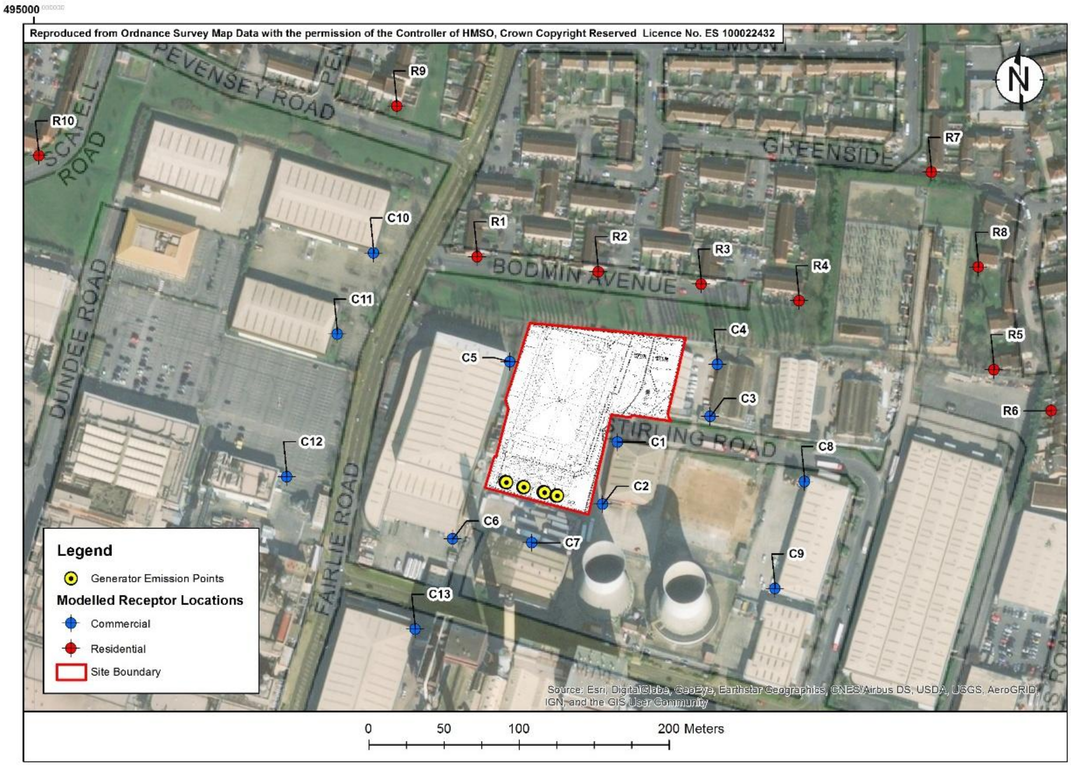


Figure 3-3: Sensitive Human Receptors Off-Site

## 3.8 Inclusion of Other Local Sources of Air Pollutants

An examination of other industrial sources of air pollution within 500 m of the facility as identified on the Government Website[9] was conducted. The Slough Heat and Power Ltd Energy from Waste (EfW) plant is located 200m south of the site. This is recorded as having released 22400 kg per annum of nitrogen oxides. The impact of emissions from Slough Heat and Power is assumed to be in the background concentration. Given the relative heights of the releases and different operating hours of the two sites, it is unlikely that the emission plumes will significantly overlap in any case.

The data centre is more than 250m from the closest generator sets of the Equinix data centre campus and therefore there is unlikely to be any cumulative impact of emissions from the data centres.

## 3.9 Significance Criteria

For comparison with the annual mean NAQO for human health and nature conservation sites, a value of 1% of the environmental assessment level was used to identify insignificant impacts.

To assess the probability of exceedances of the short term annual mean $NO_2$ objective at specified human health receptors, the hypergeometric probability distribution statistical test has been used. The use of this statistical test is following the Emissions from Specified Generators guidance published by the EA. The following probabilities and their significance have been used in this assessment, shown below in Table 3-3.

[9] https://data.gov.uk/dataset/cfd94301-a2f2-48a2-9915-e477ca6d8b7e/pollution-inventory sourced November 2018.

Table 3-3: Short-term Probability and Significance for $NO_2$

| Probability | Significance |
|---|---|
| 1% | Indicates exceedance is highly unlikely |
| 5% | Indicates that exceedance is unlikely provided generator lifetime is less than 20 years |
| >5% | Indicates potential for exceedance |

For assessing the significance of the 24-hour mean $NO_x$ PC against the critical level for nature conservation sites a value of 10% was used for national and international designated sites, and a value of 100% was used for local designated sites. PCs below these thresholds are deemed to be insignificant in accordance with EA guidance.

# 4. BASELINE

## 4.1 Local Monitoring Data

According to the latest air quality reports and monitoring available online (2018 Air Quality Annual Status Report), there have been continued exceedances of the annual $NO_2$ NAQO at roadside locations within the declared AQMAs.

Automatic monitoring stations in proximity to the Site are located 1.9 km south east at a roadside location (SLH 12) and an urban background location (SLH 4) within the No. 3 Slough AQMA (as shown in Figure 4-1). A summary of the results from this station is shown in Table 4-1.

Table 4-1: $NO_2$ Concentrations Recorded at Local Automatic Monitoring Stations

| NAQO | Years | | | | |
|---|---|---|---|---|---|
| | 2013 | 2014 | 2015 | 2016 | 2017 |
| Annual Mean (µg/m³) (40) | | | | | |
| SLH12 | NA | | | | 41.5* |
| SLH4 | 35.9 | 35.5 | 30.3 | 30 | 33 |
| Number of Hours exceeding 200 µg/m³ (18 exceedances allowed) | | | | | |
| SLH12 | NA | | | | 0 (117) |
| SLH4 | 0 | 0 | 0 (101) | 0 | 0 |
| The 99.8th percentile of hourly means in brackets, as the period of valid data is less than 90 %<br>* data capture <75%<br>NA: Not Available<br>Bold is an exceedance of NAQO | | | | | |

In addition, long term average concentrations of $NO_2$ are monitored using diffusion tubes at a number of locations within the vicinity of the Site. Data from the most relevant diffusion tubes is set out in Table 4-2 and their locations shown in Figure 4-1.

Table 4-2: Annual Mean $NO_2$ Concentrations at Diffusion Tube Stations (µg/m³)

| Site | ID | Classification | Distance from Site | Years | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | 2013 | 2014 | 2015 | 2016 | 2017 |
| Tuns Lane (B) | SLO 50 | Kerbside | 2 km south | NA | | | | 45.3 |
| Tuns Lane | SLO 23 | Urban Background | 1.8 km south east | 40.7 | 36.4 | 36.1 | 36.4 | 33.6 |
| Salt Hill | SLO 1_2_3 | Urban Background | 1.9 km south east | 34.3 | 33.7 | 35.6 | 32.3 | 31.1 |
| Windmill (Bath Rd) | SLO 43 | Roadside | 1.8 km south east | 44.5 | 41.2 | 39.5 | 42 | 37.2 |
| Farnham Road | SLO 30 | Roadside | 1.7 km south east | 41.7 | 35.7 | 40.4 | 34.1 | 32.6 |

| Site | ID | Classification | Distance from Site | Years | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | 2013 | 2014 | 2015 | 2016 | 2017 |
| Sandringham Court | SLO 41 | Other | 1.4 km west | 27.9 | 28.1 | 32.3 | 25.9 | 25.9 |
| Walpole Rd | SLO 42 | Other | 1.8 km west | 29 | 28.4 | 24.9 | 28.4 | 23.1 |
| Essex Avenue | SLO 31 | Suburban | 800 m east | 35.7 | 32.1 | 30.1 | 30.9 | 28.7 |
| Notes: **Bold** is an exceedance of NAQO<br>NA: Not Available | | | | | | | | |

The $NO_2$ results from the urban background, suburban and other monitoring locations shows a comfortable compliance with the annual mean $NO_2$ objective at urban locations set back from A roads and motorways.

The roadside monitoring locations in proximity to A roads have recorded elevated concentrations of $NO_2$. Exceedances of the annual mean objective (40µg/m$^3$) have been recorded at the SLO50 and SLH12 kerbside monitoring location, although data capture in this location was limited as the site commenced operation mid-2017. Monitoring at other roadside locations (SLO43 and SLO30) have previously recorded exceedances of the annual mean $NO_2$ objective, but not in the most recent year of monitoring, and concentrations have shown a downward trend for the last five years. No diffusion tubes have recorded annual mean concentrations in excess of 60 µg/m$^3$ in the years shown above, indicating that it is unlikely that the short-term objective has been exceeded, and no exceedances of the short-term objective have been recorded by the automatic monitors.

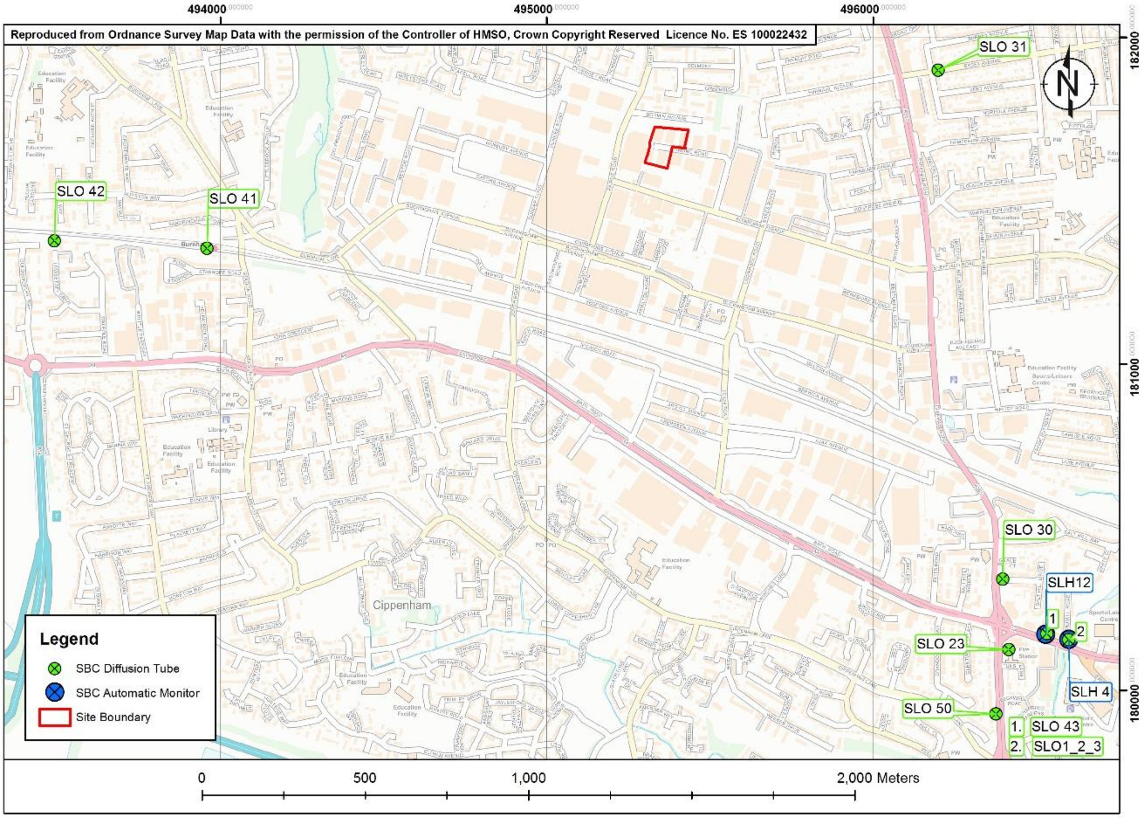


Figure 4-1: The Location of Monitoring Stations

## 4.2 Air Quality at the Site

Given the distance of the site from the local A road network, air quality would be expected to be in compliance with all relevant air quality NAQOs. The suburban monitoring site SLO31 is located downwind of the Slough Trading Estate and associated air emission sources, and therefore this monitoring location is likely to provide a worst-case assessment of the annual mean background concentration in the vicinity of the site. This can be seen in the comparison of the SLO31 data with the 2017 Defra predicted background concentrations in Table 4-2.

Table 4-3: Background Concentrations (µg/m$^3$)

| Source | X (m) | Y (m) | Total $NO_2$ 2017 | % Data Capture 2017 |
|---|---|---|---|---|
| SLO31 | 496200 | 181900 | 29 | 92 |
| Defra background maps | 496500 | 181500 | 22.8 | NA |

To assess the short-term PEC against the short-term air quality objectives, a background concentration of double the annual mean as been used, i.e. 58µg/m$^3$.

# 5. MODELLING RESULTS

## 5.1 Introduction

The results are provided electronically in Appendix 1. A summary of the results are presented in Tables 5-1, 5-2, 5-3 and 5-4.

## 5.2 Generator Testing - Human Health Impacts

### 5.2.1 Annual Mean Concentrations

Relevant receptors for annual mean concentrations are the residential properties in the vicinity of the site. The Process Contributions (PCs) and Predicted Environmental Concentrations (PECs) for these receptors are shown in Table 5-1.

Table 5-1: Predicted Annual Mean $NO_2$ Concentrations for Generator Testing – Scenario 1

| Receptor | AQS µg/m³ | Background Concentration µg/m³ | PC µg/m³ | PC as % of the AQS | PEC µg/m³ | PEC as a % of the AQS |
|---|---|---|---|---|---|---|
| R1 | 40 | 29 | 0.37 | 0.9 | 29.4 | 73.4 |
| R2 | 40 | 29 | 0.40 | 1.0 | 29.4 | 73.5 |
| R3 | 40 | 29 | 0.41 | 1.0 | 29.4 | 73.5 |
| R4 | 40 | 29 | 0.35 | 0.9 | 29.4 | 73.4 |
| R5 | 40 | 29 | 0.25 | 0.6 | 29.2 | 73.1 |
| R6 | 40 | 29 | 0.21 | 0.5 | 29.2 | 73.0 |
| R7 | 40 | 29 | 0.19 | 0.5 | 29.2 | 73.0 |
| R8 | 40 | 29 | 0.22 | 0.5 | 29.2 | 73.0 |
| R9 | 40 | 29 | 0.18 | 0.5 | 29.2 | 73.0 |
| R10 | 40 | 29 | 0.06 | 0.2 | 29.1 | 72.7 |

The maximum PC occurs at Receptor 3 and this contribution is 1% of the assessment level and therefore can be considered insignificant. The PECs range from 73.0% to 73.5% of the assessment level, but these are dominated by the assumed background concentration. As noted in Section 4.2, the assumed background concentration is likely to be conservative and therefore it is likely that the PECs will be below 70% of the assessment level.

### 5.2.2 Hourly Mean Concentrations

The predicted exceedance probability for 19 hours operational testing per year is presented in Table 5-2. This modelling scenario assumes that the generators are tested for 1 hour individually. For all of the modelled receptor locations, the probability of exceeding the 1-hour mean objective is 0.0%.

Table 5-2: Summary of Short-Term $NO_2$ Impacts – Scenario 1

| Receptor Location | Maximum Number of Exceedances | Successes in Sample | Sample Size | Successes in Population | Population | Probability (%) |
|---|---|---|---|---|---|---|
| R1 | 88.5 | 133 | 152 | 8672 | 8760 | 0.0 |
| R2 | 0 | 133 | 152 | 8760 | 8760 | 0.0 |
| R3 | 0 | 133 | 152 | 8760 | 8760 | 0.0 |
| R4 | 0 | 133 | 152 | 8760 | 8760 | 0.0 |
| R5 | 0 | 133 | 152 | 8760 | 8760 | 0.0 |
| R6 | 0 | 133 | 152 | 8760 | 8760 | 0.0 |
| R7 | 0 | 133 | 152 | 8760 | 8760 | 0.0 |
| R8 | 0 | 133 | 152 | 8760 | 8760 | 0.0 |
| R9 | 0 | 133 | 152 | 8760 | 8760 | 0.0 |
| R10 | 0 | 133 | 152 | 8760 | 8760 | 0.0 |
| C1 | 4.1 | 133 | 152 | 8756 | 8760 | 0.0 |
| C2 | 42.6 | 133 | 152 | 8717 | 8760 | 0.0 |
| C3 | 106.4 | 133 | 152 | 8654 | 8760 | 0.0 |
| C4 | 0.0 | 133 | 152 | 8760 | 8760 | 0.0 |
| C5 | 0.0 | 133 | 152 | 8760 | 8760 | 0.0 |
| C6 | 13.3 | 133 | 152 | 8747 | 8760 | 0.0 |
| C7 | 9.2 | 133 | 152 | 8751 | 8760 | 0.0 |
| C8 | 0 | 133 | 152 | 8760 | 8760 | 0.0 |
| C9 | 0 | 133 | 152 | 8760 | 8760 | 0.0 |
| C10 | 0 | 133 | 152 | 8760 | 8760 | 0.0 |
| C11 | 44.2 | 133 | 152 | 8716 | 8760 | 0.0 |
| C12 | 84.0 | 133 | 152 | 8676 | 8760 | 0.0 |
| C13 | 3.1 | 133 | 152 | 8757 | 8760 | 0.0 |

For Scenario 2 (black building test), in which four generators are tested for six hours twice per year, this testing could be undertaken for 51 hours per year before there would be a 1% probability of the 1-hour mean objective being exceeded at the nearest commercial receptor (using the hypergeometric distribution function).

## 5.3 Generator Testing – Nature Conservation Sites

### 5.3.1 Annual Mean Concentrations

The Process Contributions (PCs) for the assessed nature conservation sites are shown in Table 5-3.

Table 5-3: Predicted Annual Mean $NO_x$ Concentrations for Generator Testing – Scenario 1

| Receptor | AQS µg/m³ | PC µg/m³ | PC as % of the AQS |
|---|---|---|---|
| Windsor Forest SAC | 30 | 0.002 | 0.01 |
| Chilterns Beechwoods SAC | 30 | 0.001 | 0.00 |
| Burnham Beeches SAC | 30 | 0.010 | 0.03 |
| South West London SPA/Ramsar | 30 | 0.002 | 0.01 |
| Haymill Valley LNR/LWS | 30 | 0.021 | 0.07 |
| Cocksherd Wood LNR/LWS | 30 | 0.019 | 0.06 |
| Stoke Park LWS | 30 | 0.038 | 0.13 |
| Farnham Park LWS | 30 | 0.021 | 0.07 |
| Grove Wood Woodland | 30 | 0.011 | 0.04 |
| Lock's Bottom Woodland | 30 | 0.013 | 0.04 |

As anticipated, given the separation distance to the nature conservation sites and the limited operating hours during testing, the predicted annual mean $NO_x$ concentrations are very low. Given the magnitude of the predicted $NO_x$ concentrations, nitrogen and acid deposition at the nature conservation sites will also be well below the relevant critical loads.

### 5.3.2 Daily Mean Concentrations

The predicted daily mean concentrations are presented in Table 5-4. The predicted concentrations are likely to be significantly over-estimated given the limited operating hours of the generators (as the predicted concentrations are based on operating continuously all year round).

Table 5-4: Summary of Short-Term $NO_x$ Impacts – Scenario 1

| Receptor | AQS µg/m³ | PC µg/m³ | PC as % of the AQS |
|---|---|---|---|
| Windsor Forest SAC | 75 | 1.9 | 2.5 |
| Chilterns Beechwoods SAC | 75 | 1.1 | 1.5 |
| Burnham Beeches SAC | 75 | 4.9 | 6.5 |
| South West London SPA/Ramsar | 75 | 1.5 | 2.0 |
| Haymill Valley LNR/LWS | 75 | 17.6 | 23.5 |
| Cocksherd Wood LNR/LWS | 75 | 12.3 | 16.4 |
| Stoke Park LWS | 75 | 10.3 | 13.7 |
| Farnham Park LWS | 75 | 6.8 | 9.1 |
| Grove Wood Woodland | 75 | 7.6 | 10.1 |
| Lock's Bottom Woodland | 75 | 12.4 | 16.6 |

For the international designated sites the predicted daily mean $NO_x$ concentrations are less than 10% of the critical level. For the local designated sites the predicted daily mean $NO_x$ concentrations are less than 100% of the critical level. In both cases therefore, the predicted short-term $NO_x$ concentrations are insignificant.

## 5.4 Emergency Operation

For the Emergency Operation scenario, in which all eight generators could be operating, based on the hypergeometric distribution function the emergency operation could occur for 34 hours per year before the 1-hour mean objective would be exceeded with a 1% probability at the nearest commercial receptor.

# 6. CONCLUSIONS

This air quality assessment has considered the long- and short-term pollutant concentrations arising from the operation of the eight emergency generators associated with the data centre on Stirling Road.

The modelling has demonstrated that testing of the generators would not have a significant impact on annual mean $NO_2$ concentrations at the closest residential receptors. Based upon the proposed testing regime, there would be a <1% probability of exceeding the 1-hour mean objective at the nearest commercial or residential receptors to the site.

Emergency operation of the generators could occur for up to 34 hours per year before there is a 1% chance of exceeding the 1-hour mean objective at the nearest commercial receptors to the site.

The modelling has demonstrated that testing of the generators would not have a significant impact on nature conservation sites.

# APPENDIX 1
# RESULTS AND MODELLING WORKBOOK (ELECTRONICALLY)

Table A1: Modelling and Results Workbook Contents

| Spreadsheet Tab | Spreadsheet | Details |
|---|---|---|
| 1 – EmPar | Emission Parameters | Emission parameter calculations |
| 2 - Recpt | Modelled Receptors | Location and description of modelled receptors – human health and nature conservation |
| 3 – Rslts LT NO2 | Results | Annual mean $NO_2$ modelling results for all discrete receptors – Scenario 1 |
| 4 – Rslts ST NO2 | Results | Hourly exceedance $NO_2$ modelling results for all discrete receptors and statistical test – Scenario 1 |
| 5 – Rslts Scenario 2 | Results | Hourly exceedance $NO_2$ modelling results for all discrete receptors and statistical test – Scenario 2 |
| 6 – Rslts Emergency | Results | Hourly exceedance $NO_2$ modelling results for all discrete receptors and statistical test – Emergency Operation |
| 7 – Rslts Nature Conservation | Results | Annual and hourly $NO_x$ modelling results – Scenario 1 |

# APPENDIX 2
# MODELLING FILES (ELECTRONICALLY)

Table A2: Modelling Files Checklist

| File | Name |
|---|---|
| Model input file scenario 1 (1 file included, other met years the same apart from met year) – human health | R170_3351_A_EP1Cont_13.APL |
| Model results files scenario 1 – human health | R170_3351_A_EP1Cont_13.plt<br>R170_3351_A_EP1Cont_14.plt<br>R170_3351_A_EP1Cont_15.plt<br>R170_3351_A_EP1Cont_16.plt<br>R170_3351_A_EP1Cont_17.plt |
| Model input file scenario 2 (1 file included, other met years the same apart from the met year) – human health | R170_3351_1_EP1 S2Cont_13.APL |
| Combined source file scenario 2 – human health | Combined.AAI |
| Model results files scenario 2 – human health | R170_3351_A_EP1 S2Cont_13.plt<br>R170_3351_A_EP1 S2Cont_14.plt<br>R170_3351_A_EP1 S2Cont_15.plt<br>R170_3351_A_EP1 S2Cont_16.plt<br>R170_3351_A_EP1 S2Cont_17.plt |
| Model input file Emergency Operation (1 file included, other met years the same apart from the met year) | R170_3351_A_EP1 Emergency_Cont_13.APL |
| Model results files emergency operation | R170_3351_A_EP1 S2Cont_13.plt<br>R170_3351_A_EP1 S2Cont_14.plt<br>R170_3351_A_EP1 S2Cont_15.plt<br>R170_3351_A_EP1 S2Cont_16.plt<br>R170_3351_A_EP1 S2Cont_17.plt |
| Model input file scenario 1 (1 file included, other met years the same apart from met year) – nature conservation | R170_3351_A_EP1Cont_13 eco.apl |

| File | Name |
|---|---|
| Model results files scenario 1 – nature conservation | R170_3351_A_EP1Cont_13 eco.plt<br>R170_3351_A_EP1Cont_14 eco.plt<br>R170_3351_A_EP1Cont_15 eco.plt<br>R170_3351_A_EP1Cont_16 eco.plt<br>R170_3351_A_EP1Cont_17 eco.plt |
| 2013 – 2017 Heathrow Meteorological Data | Heathrow _2013.met<br>Heathrow _2014.met<br>Heathrow _2015.met<br>Heathrow _2016.met<br>Heathrow _2017.met |