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Consulting Engineers Limited

Lakeside Replacement EfW and HTI Facility

Lakeside EfW

Air Quality Assessment

ENGINEERING + CONSULTING

Document approval

	Name	Signature	Position	Date
Prepared by:	Rhys Weir		Environmental Scientist	23/05/2019
Checked by:	Stuart Nock		Environmental Consultant	23/05/2019
Approved by:	Stephen Othen		Technical Director	23/05/2019

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Management Summary

Lakeside EfW Ltd is a joint venture between Grundon Waste Management Limited and Viridor. It operates the existing Lakeside Road Energy from Waste (EfW) facility in Colnbrook, Slough. Grundon Waste Management is the sole owner / operator of the high temperature incinerator (HTI) adjoined to the EfW on Lakeside Road. Lakeside EfW Ltd, Grundon Waste Management Limited and Viridor are hereafter collectively referred to as “Lakeside EfW Ltd”.

The proposed expansion of Heathrow Airport requires the removal of the existing facilities, so Lakeside EfW Ltd proposes to replace the facilities on a like-for-like basis. The replacement facilities ("the Proposed Development") will be located on nearby land situated to the west of the Iver South Sludge Dewatering centre and south of the M4 Motorway, London.

Review of Legislation

In the UK, the levels of pollution in the atmosphere are controlled by the National Air Quality Strategy and a number of European Directives which have been fully implemented. These have led to the setting of a number of Air Quality Assessment Levels (AQALs) for pollutants. The AQALs are set at a level well below those at which significant adverse health effects have been observed in the general population and in particularly sensitive groups.

In addition, Critical Levels have been set for the protection of ecosystems. Deposition of nitrogen and acid gases can cause nitrification and acidification of habitats. The Air Pollution Information System (APIS) provides Critical Loads for different habitats which consider the existing pollution loading for the site.

Review of Ambient Air Quality

Monitoring information collected by the UK Government and by local authorities has been used to assess the current levels of pollutants in the atmosphere close to the Proposed Development. Where local monitoring data is not available, conservative estimates based on national monitoring results have been used as a background concentration.

Identification of Sensitive Receptors

When assessing the impact of the Proposed Development, the assessment considers the point of maximum impact as a worst-case. In addition, the impact has been assessed at a number of identified sensitive receptors including the closest residential properties and ecologically sensitive receptors.

Dispersion Modelling of Emissions

The ADMS dispersion model is routinely used for air quality assessments to the satisfaction of local authorities and the Environment Agency. The model uses weather data from the local area to predict the spread and movement of the exhaust gases from the stack for each hour over a five-year period. The model takes account of wind speed, wind direction, temperature, humidity and the amount of cloud cover, as all of these factors influence the dispersion of emissions. The model also takes account of the effects of buildings and terrain on the movement of air.

To set up the model, it has been conservatively assumed that the Proposed Development operates for the whole year and releases emissions at the daily or short-term emission limits continuously.

The model was used to predict the ground level concentration of pollutants on a long-term and short-term basis across a grid of points. In addition, concentrations were predicted at the identified sensitive receptors.

Approach and Assessment of Impact on Air Quality – Protection of Human Health

The impact of air quality on human health has been assessed using a standard approach based on guidance provided by the Institute of Air Quality Management (IAQM) and the Environment Agency where appropriate.

Using this approach, the following can be concluded from the assessment.

1. In relation to the impact on human health:
    a. In accordance with Environmental Agency Guidance, the impact of all long-term process emissions associated with the 'Main Case' scenario can be considered 'not significant' at the point of maximum impact with the exception of the following pollutants:
        i. Annual mean and short-term nitrogen dioxide;
        ii. Short-term sulphur dioxide;
        iii. Annual mean particulate matter (as PM2.5);
        iv. Annual mean VOCs; and
        v. Annual mean cadmium;
    b. Using the IAQM 2017 screening criteria, the impact of all long-term process emissions associated with the 'Main Case' scenario can be considered 'negligible' at the point of maximum impact with the exception of the following pollutants:
        i. Annual mean and short-term nitrogen dioxide;
        ii. Short-term sulphur dioxide;
        iii. Annual mean particulate matter (as PM10);
        iv. Annual mean particulate matter (as PM2.5);
        v. Annual mean VOCs;
        vi. Annual mean cadmium; and
        vii. Annual mean PaHs.
2. For all of the pollutants listed above, the magnitude of change assessed in accordance with IAQM 2017 criteria is no worse than 'slight adverse' at all areas of relevant exposure.
3. The Environment Agency's approach to assessing the impact of metals has been used which considers the risk of exceeding the AQAL based on the existing background levels and contribution from the Facility. Using this approach, it has been determined that there is no risk of exceeding any AQAL for heavy metals.

Approach and Assessment of Impact on Air Quality – Protection of Ecosystems

The impact of emissions on atmospheric air quality in sensitive ecosystems has been assessed using a standard approach.

1. If the process contribution within a protected site is less than 1% of the long-term and less than 10% of the short-term benchmark, the emissions are 'not significant' and it can be concluded

that there will be 'no likely significant effect either alone and in-combination with other sources of pollutants, irrespective of background levels'.

2. If the process contribution at European and UK designated sites is greater than 1% of the relevant long-term, or 10% of the short-term benchmark, but the total predicted concentration including background levels is less than 70% of the relevant benchmark, the emissions are 'not likely to have a significant effect'.
3. If the process contribution at locally designated sites is less than the relevant benchmark, the emissions are 'not likely to have a significant effect'.

The impact of the deposition of nitrogen and acid gases on sensitive habitats has been assessed using the following approach.

1. It has been assumed that the Facility operates at the emission limits for the entire year.
2. Habitats have been assessed assuming all habitats are present at the point of greatest impact within each ecological site.
3. Where a feature consists of multiple locations, modelling has been undertaken at each of the closest points to the Facility and the maximum across all locations has been calculated to represent the feature.
4. The impact has been calculated based on the maximum predicted concentration over a five-year period at each ecological site and applying conservative deposition assumptions.
5. The results have been compared to habitat specific Critical Loads. The most sensitive habitat type has been conservatively assumed for each feature.

Two statutory designated sites and one locally designated site have been identified as requiring consideration within this assessment. At all of the sites, emissions from the operation of the Proposed Development can be screened out as 'not significant'.

Significance of Impact

Professional judgement has been used to determine the resulting significance of the effect of emissions associated with the operation of the Proposed Development. The assessment has shown that the operation of the Proposed Development will not cause a breach of any AQAL, that the annual mean magnitude of change can be described as no worse than 'slight adverse' for all pollutants at all areas of relevant exposure and that the magnitude of change is only slight adverse in small areas. Therefore, we conclude that the overall effect of the Proposed Development on local air quality will be 'not significant'. As such, there should be no air quality constraint in granting planning permission for the Proposed Development.

Contents

1 Introduction

1.1 Background

Lakeside EfW Ltd is a joint venture between Grundon Waste Management Limited and Viridor. It operates the existing Lakeside Road Energy from Waste (EfW) facility in Colnbrook, Slough. Grundon Waste Management is the sole owner / operator of the high temperature incinerator (HTI) adjoined to the EfW on Lakeside Road. Lakeside EfW Ltd, Grundon Waste Management Limited and Viridor are hereafter collectively referred to as "Lakeside EfW Ltd".

The proposed expansion of Heathrow Airport requires the removal of the existing facilities, so Lakeside EfW Ltd proposes to replace the facilities on a like-for-like basis. The replacement facilities will be located on nearby land situated to the west of the Iver South Sludge Dewatering centre and south of the M4 Motorway.

The replacement EfW facility (the Facility), just like the existing facility, will process approximately 440,0000 tonnes per annum of non-hazardous residual municipal solid waste (MSW) and commercial and industrial waste (C&I) primarily sourced within West London and the M4 corridor areas. The Facility has been designed to generate approximately 44 MWe at the design point and export approximately 39 MWe.

The HTI will process up to 10,000 tonnes per annum of mainly clinical hazardous waste.

1.2 Report structure

This report has the following structure.

- National and international air quality legislation and guidance are considered in Section 2.
- The current ambient air quality levels are detailed separately in Section 3.
- Section 4 outlines a review of local and national baseline air quality and highlights the residential properties and ecological receptors which are sensitive to changes in air quality associated with the Proposed Development.
- Section 5 considers the impact of the construction of the Proposed Development.
- Section 5.2 considers the impact of the operation of the Proposed Development.
- Section 7 considers any mitigation and monitoring which might be required.
- Section 8 reports the residual effects.
- Cumulative impacts of other developments are considered in section 9.
- The summary of the assessment can be found in Section 10.
- The Appendices include dispersion diagrams and detailed results tables from the analysis of the impact at ecological receptors.

2 Legislation and Policy

2.1 European legislation

European air quality legislation is consolidated under Directive 2008/50/EC, which came into force on 11 June 2008. This Directive consolidates previous legislation which was designed to deal with specific pollutants in a consistent manner and provides new air targets and limits for fine particulates. The consolidated Directives include:

- Directive 99/30/EC – the First Air Quality "Daughter" Directive – which sets Ambient Air Directive (AAD) Limit Values for nitrogen dioxide and oxides of nitrogen, sulphur dioxide, lead and particulate matter;
- Directive 2000/69/EC – the Second Air Quality "Daughter" Directive – which sets AAD Limit Values for benzene and carbon monoxide; and
- Directive 2002/3/EC – the Third Air Quality "Daughter" Directive – which seeks to establish long-term Target Values, an alert threshold and an information threshold for concentrations of ozone in ambient air.

The fourth daughter Directive – 2004/107/EC - was not included within the consolidation. It sets health-based Target Values for polycyclic aromatic hydrocarbons, cadmium, arsenic, nickel and mercury, for which there is a requirement to reduce exposure to as low as reasonably achievable.

2.2 National legislation and policy

The Air Quality Standards Regulations (2010) seek to transpose Directive 2008/50/EC and the Fourth Daughter Directive within the UK. The regulations also extend powers, under Section 85(5) of the Environment Act (1995), for the Secretary of State to give directions to local authorities for the implementation of these Directives.

The UK Government and the devolved administrations are required under the Environment Act (1995) to produce a national air quality strategy. This was published in 2007. The Air Quality Strategy (AQS) sets out the UK's air quality objectives and recognises that action at national, regional and local level may be needed, depending on the scale and nature of the air quality problem. This includes additional targets and limits for 15-minute sulphur dioxide and 1,3-butadiene and more stringent requirements for benzene and PAHs known as AQS Objectives. Environmental Assessment Levels (EALs) for other pollutants are presented on the gov.uk website as part of the Environment Agency's Environmental Management Guidance (Air emissions risk assessment for your environmental permit), which was last updated on 1st March 2016 and is referred to here as EA (2016). AAD Target and Limit Values, AQS Objectives, and EALs are set at levels well below those at which significant adverse health effects have been observed in the general population and in particularly sensitive groups. For the remainder of this report, these are collectively referred to as Air Quality Assessment Levels (AQALs). The AQALs used in this assessment are considered in section 3 below.

The UK Government published the Clean Air Strategy (CAS) in January 2019. This sets out the methods by which air pollution from all sectors will be reduced. The CAS has not introduced any new AQALs.

Local Air Quality Management Technical Guidance 16 (updated February 2018), referred to as LAQM (TG16), outlines that the AQALs apply in the following locations:

- Annual mean - all locations where members of the public might be regularly exposed - i.e. building facades of residential properties, schools, hospitals, care homes etc.
- 24-hour mean and 8-hour mean - all locations where the annual mean objective would apply together with hotels and gardens of residential properties.
- 1-hour mean - all locations where the annual mean, 24-hour and 8-hour mean apply together with kerbside sites and any areas where members of the public might be reasonably expected to spend one hour or more.
- 15-minute mean - all locations where members of the public might reasonably be exposed for a period of 15 minutes or more.

2.3 Local Air Quality Management

Under Section 82 of the Environment Act (1995) (Part IV), local authorities are required to periodically review and assess air quality within their area of jurisdiction under the system of Local Air Quality Management (LAQM). This review and assessment of air quality involves assessing present and likely future ambient pollutant concentrations against AQALs. If it is predicted that levels at the façade of buildings where members of the public are regularly present (normally residential properties) are likely to be exceeded, the local authority is required to declare an Air Quality Management Area (AQMA). For each AQMA, the local authority is required to produce an Air Quality Action Plan (AQAP), the objective of which is to reduce pollutant levels in pursuit of the relevant AQALs.

There are a number of AQMAs in the vicinity of the Proposed Development. These are discussed in section 4 below.

2.4 Industrial Pollution Regulation

Atmospheric emissions from industrial processes are controlled in the UK through the Environmental Permitting (England and Wales) Regulations (2010), and subsequent amendments. The Proposed Development will be regulated by the Environment Agency and need an Environmental Permit to operate. The Environmental Permit will include conditions to prevent fugitive emissions of dust and odour beyond the boundary of the installation. The Environmental Permit will also include limits on emissions to air.

The Industrial Emissions Directive (IED) (Directive 2010/75/EU) was adopted on 7th January 2013 and is the key European Directive which covers almost all regulation of industrial processes in the EU. Within the IED, the requirements of the relevant sector Best Available Techniques Reference Document (BREF) become binding as Best Available Techniques (BAT) guidance, as follows.

- Article 15, paragraph 2, of the IED requires that Emission Limit Values (ELVs) are based on BAT.
- Article 13 of the IED, requires that 'the Commission' develops BREFs.
- Article 21, paragraph 3, of the IED, requires that when updated BAT conclusions are published, the Competent Authority (in England this is the Environment Agency) has up to four years to revise permits for facilities covered by that activity to comply with the requirements of the sector specific BREF.

The Final Draft Waste incineration BREF was published by the European IPPC Bureau in December 2018 and is expected to be formally adopted in Q3 2019. Upon formal adoption, it is highly likely that the BREF will be implemented in the UK. The Environment Agency will be required to review and implement conditions within all permits which require operators to comply with the requirements set out in the BREF. This will include the Proposed Development. As currently drafted, the BREF will introduce BAT-AELs (BAT Associated Emission Limits) which are more stringent than those currently set out in the IED. The EfW Plant and HTI will be designed to meet the requirements of the BREF. Therefore, it has been assumed that the emissions from the Proposed Development will need, as a minimum, to comply with the BAT-AELs set out in the BREF for new plants.

3 Methodology

3.1 Air Quality Standards, Objectives and Guidelines

In the UK, AAD Limit Values, Targets, and air quality standards and objectives (AQOs) for major pollutants are described in The Air Quality Strategy (AQS). In addition, the Environment Agency include Environmental Assessment Levels (EALs) for other pollutants in the environmental management guidance document 'Air Emissions Risk Assessment for your Environmental Permit'[1] ("Air Emissions Guidance"). The long-term and short-term EALs from this document have been used when the AQS does not contain relevant objectives. Standards and objectives for the protection of sensitive ecosystems and habitats are also contained within the Air Emissions Guidance and the Air Pollution Information System (APIS).

3.1.1 Nitrogen dioxide

All combustion processes produce nitric oxide (NO) and nitrogen dioxide (NO_2), known by the general term of nitrogen oxides (NOx). In general, the majority of the NOx released is in the form of NO, which then reacts with ozone in the atmosphere to form nitrogen dioxide. Of the two compounds, nitrogen dioxide is associated with adverse effects on human health, principally relating to respiratory illness. The World Health Organisation (WHO) has stated that "many chemical species of nitrogen oxides exist, but the air pollutant species of most interest from the point of view of human health is nitrogen dioxide".

The major sources of NOx in the UK are road transport and power stations. According to the most recent annual report from the National Atmospheric Emissions Inventory (NAEI)[2], in 2016 road transport accounted for 34% of UK emissions, with power stations accounting for a further 22%. High levels of NOx in urban areas are almost always associated with high traffic densities.

The AQS includes two objectives to be achieved by 31 December 2005. Both of these objectives are included in the Air Quality Directive, with an achievement date of 1st January 2010.

- A limit for the one-hour mean of 200 µg/m^3, not to be exceeded more than 18 times a year (equivalent to the 99.79th percentile).
- A limit for the annual mean of 40 µg/m^3.

In addition, the AQS includes objectives for the protection of sensitive vegetation and ecosystems of 30 µg/m^3 for the annual mean, and 75 µg/m^3 for the daily mean concentration of nitrogen oxides.

3.1.2 Sulphur dioxide

Sulphur dioxide is predominantly released by the combustion of fuels containing sulphur. Around 68% of UK emissions in 2004 were associated with power stations, with much of the remainder associated with other combustion processes. Emissions of sulphur dioxide have reduced by 87% since 1970, due to a reduction in the number of coal-fired combustion plants, the installation of flue gas desulphurisation plants on a number of large coal-fired power stations and the reduction in sulphur content of liquid fuels.

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1 https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit#environmental-standards-for-air-emissions

2 NAIE Air Pollution Inventories for England, Scotland, Wales and Northern Ireland: 1990-2016, DEFRA.

The AQS contains three objectives for the control of sulphur dioxide:

- A limit for the 15-minute mean of 266 µg/m³, not to be exceeded more than 35 times a year (the 99.9th percentile) to be achieved by 31st December 2005.
- A limit for the one hour mean of 350 µg/m³, not to be exceeded more than 24 times a year (the 99.73rd percentile) to be achieved by 31st December 2004.
- A limit for the daily mean of 125 µg/m³, not to be exceeded more than 3 times a year (the 99.2nd percentile) to be achieved by 31st December 2004.

The hourly and daily objectives are included in the Air Quality Directive.

In addition, the AQS includes two objectives for the protection of vegetation and ecosystems. These are a concentration of 20 µg/m³ (reduced to 10 µg/m³ where lichens or bryophytes are present) as an annual mean and as a winter average.

3.1.3 Particulate matter

Concerns over the health impact of solid matter suspended in the atmosphere tend to focus on particles with a diameter of less than 10 µm, known as PM_{10}s. These particles have the ability to enter and remain in the lungs. Various epidemiological studies have shown increases in mortality associated with high levels of PM_{10}s, although the underlying mechanism for this effect is not yet understood. Significant sources of PM10s are road transport (22%), quarrying (16%) and stationary combustion (34%).

The AQS includes two objectives for PM_{10}s to be achieved by the end of 2004, both of which are included in the Air Quality Directive.

- A limit for the annual mean of 40 µg/m³, to be achieved by 2004.
- A daily limit of 50 µg/m³, not to be exceeded more than 35 times a year (the 90.41st percentile) to be achieved by 2004.

The previous AQS included some provisional objectives for 2010. These have been replaced by an exposure reduction objective for $PM_{2.5}$ in urban areas and a target value for $PM_{2.5}$ of 25 µg/m³ as an annual mean. This target value is included in the Air Quality Directive.

3.1.4 Carbon monoxide

Carbon monoxide is produced by the incomplete combustion of fuels containing carbon. By far the most significant source is road transport, which produces 67% of the UK's emissions. Carbon monoxide can interfere with the processes that transport oxygen around the body, which can prove fatal at very high levels.

Concentrations in the UK are well below levels at which health effects can occur. The AQS includes the following objective for the control of carbon monoxide, which is also included in the Air Quality Directive:

- A limit for the 8-hour running mean of 10 mg/m³, to be achieved by 1st January 2005.

The Air Emissions Guidance also defines a short-term (1-hour) EAL of 30 mg/m³. There is no long-term EAL.

3.1.5 Hydrogen chloride

There are no AQOs for hydrogen chloride contained within the AQS. However, the Air Emissions Guidance defines the short-term EAL as 750 µg/m³. There is no long-term EAL.

3.1.6 Hydrogen fluoride

There are no AQOs for hydrogen fluoride contained within the AQS. However, the Air Emissions Guidance defines the short-term EAL as 160 µg/m³ and the long-term EAL as 16 µg/m³.

The Air Emissions Guidance also provides Critical Levels for the protection of vegetation and ecosystems of 5 µg/m³ as a daily mean and 0.5 µg/m³ as a weekly mean concentration of hydrogen fluoride.

3.1.7 Ammonia

There are no AQOs for ammonia contained within the AQS. However, the Air Emissions Guidance defines the short-term EAL as 2,500 µg/m³ and the long-term EAL as 180 µg/m³. The Guidance also provides Critical Levels for the protection of vegetation and ecosystems. These are a concentration of 3 µg/m³ as an annual mean, reduced to 1 µg/m³ where lichens or bryophytes are present.

3.1.8 Metals

Lead is the only metal included in the AQS. Lead can have many health effects, including effects on the synthesis of haemoglobin, the nervous system and the kidneys. Emissions of lead in the UK have declined by 98% since 1970, due principally to the virtual elimination of leaded petrol.

The AQS includes objectives to limit the annual mean to 0.5 µg/m³ by the end of 2004 and to 0.25 µg/m³ by the end of 2008. Only the first objective is included in the Air Quality Directive.

The fourth Daughter Directive on air quality (Commission Decision 2004/107/EC) includes target values for arsenic, cadmium and nickel. However, the preamble to the Directive makes it clear that the use of these target values is relatively limited. Paragraph (5) states:

"The target values would not require any measures entailing disproportionate costs. Regarding industrial installations, they would not involve measures beyond the application of best available techniques (BAT) as required by Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control (5) and in particular would not lead to the closure of installations. However, they would require Member States to take all cost-effective abatement measures in the relevant sectors."

And paragraph (6) states:

"In particular, the target values of this Directive are not to be considered as environmental quality standards as defined in Article 2(7) of Directive 96/61/EC and which, according to Article 10 of that Directive, require stricter conditions than those achievable by the use of BAT."

Although these target values have been included in the assessment, it is important to note that the application of the target values would not have an effect on the design or operation of the EfW Plant or the HTI. These will be designed in accordance with BAT and include cost effective methods for the abatement of arsenic, cadmium and nickel, including the injection of activated carbon and a fabric filter.

Emissions limits will be set in the EP for a number of heavy metals which do not have air quality standards associated with them. The EALs for these metals, and lead, are summarised in Table 1.

Table 1: Environmental Assessment Levels (EALs) for Metals

Metal	Daughter Directive Target Level (µg/m³)	EALs (µg/m³)	
		Long-term	Short-term
Arsenic	0.006	0.003	-
Antimony	-	5	150
Cadmium	0.005	0.005	-
Chromium (II & III)	-	5	150
Chromium (VI)	-	0.0002	-
Cobalt	-	-	-
Copper	-	10	200
Lead	-	0.25	-
Manganese	-	0.15	1500
Mercury	-	0.25	7.5
Nickel	0.020	0.020	-
Thallium	-	-	-
Vanadium	-	5	1

3.1.9 Volatile Organic Compounds (VOCs)

A variety of VOCs could be released from the stack, of which benzene and 1,3-butadiene are included in the AQS and monitored at various stations around the UK. The AQS includes the following objectives for the running annual mean:

- Benzene – 5 µg/m³ to be achieved by 2010; and
- 1,3-butadiene – 2.25 µg/m³ to be achieved by 2003.

The Air Emissions Guidance includes a short-term EAL for benzene, calculated from occupational exposure. This is a limit of 195 µg/m³ for an hourly mean. There are no short-term EALs for 1,3-butadiene.

3.1.10 Dioxins and furans

Dioxins and furans are a group of organic compounds with similar structures, which are formed as a result of combustion in the presence of chlorine. Principal sources include steel production, power generation, coal combustion and uncontrolled combustion, such as bonfires. The Municipal Waste Incineration Directive and UK legislation imposed strict limits on dioxin emissions in 1995, with the result that current emissions from incineration of municipal solid waste in the UK in 1999 were less than 1% of the emissions from waste incinerators in 1995. The Waste Incineration Directive, now included in the IED, imposed even lower limits, reducing the limit to one tenth of the previously permitted level.

One dioxin, 2,3,7,8-TCDD, is a definite carcinogen and a number of other dioxins and furans are considered to be possible carcinogens. A tolerable daily intake (TDI) for Dioxins, furans and dioxins like PCBs has been recommended by the Committee on the Toxicity of Chemicals in Food, Consumer Products and the Environment of 2 pg I-TEQ per kg bodyweight per day.

Dioxins are not normally compared with set EALs, but the probable ingestion rates of dioxins by different groups of people is considered as part of the Human Health Risk Assessment contained as a separate document within the application.

3.1.11 Polychlorinated biphenyl (PCBs)

PCBs have high thermal, chemical and electrical stability and were manufactured in large quantities in the UK between the 1950s and mid-1970s. Commercial PCB mixtures, which contained a range of dioxin-like and non-dioxin like congeners, were sold under a variety of trade names, the most common in the UK being the Aroclor mixtures. UK legislative restrictions on the use of PCBs were first introduced in the early 1970s.

Although now banned from production current atmospheric levels of PCBs are due to the ongoing primary anthropogenic emissions (e.g. accidental release of products or materials containing PCBs), volatilisation from environmental reservoirs which have previously received PCBs (e.g. sea and soil) or incidental formation of some congeners during the combustion process.

There are no AQOs for PCBs contained within the AQS. However, the Air Emissions Guidance defines the short-term EAL as 6 µg/m³ and the long-term EAL as 0.2 µg/m³.

A number of PCBs are considered to possess dioxin like toxicity and are known as dioxin-like PCBs. The total intake from dioxins, furans and dioxins like PCBs is compared to the TDI for dioxins, furans and dioxin like PCBs as part of the Human Health Risk Assessment contained as a separate document within the application.

3.1.12 Polycyclic Aromatic Hydrocarbons (PAHs)

PAHs are members of a large group of organic compounds widely distributed in the atmosphere. The best-known PAH is benzo[a]pyrene (B[a]P). The AQS included an objective to limit the annual mean of B[a]P to 0.25 ng/m³ by the end of 2010. This goes beyond the requirements of European Directives, since the fourth Daughter Directive on air quality (Commission Decision 2004/107/EC) includes a target value for benzo(a)pyrene of 1 ng/m³ as an annual mean.

3.1.13 Summary

AAD Target and Limit Values, AQS Objectives, and EALs are set at levels well below those at which significant adverse health effects have been observed in the general population and in particularly sensitive groups. As noted earlier, these are collectively referred to as Air Quality Assessment Levels (AQALs). Table 2 and Table 3, along with Table 1 above for metals, summarise the air quality objectives and guidelines used in this assessment. The sources for each of the values can be found in the preceding sections.

Table 2: Air Quality Assessment Levels (AQALs)

Pollutant	Limit Value (µg/m³)	Averaging Period	Frequency of Exceedances
Nitrogen dioxide	200	1 hour	18 times per year (99.79th percentile)
	40	Annual	-
Sulphur dioxide	266	15 minutes	35 times per year (99.9th percentile)
	350	1 hour	24 times per year (99.73rd percentile)

Pollutant	Limit Value (µg/m³)	Averaging Period	Frequency of Exceedances
	125	24 hours	3 times per year (99.18th percentile)
Particulate matter (PM_{10})	50	24 hours	35 times per year (90.41st percentile)
	40	Annual	-
Particulate matter ($PM_{2.5}$)	25	Annual	-
Carbon monoxide	10,000	8 hours, running	-
	30,000	1 hour	
Hydrogen chloride	750	1 hour	-
Hydrogen fluoride	160	1 hour	-
	16	Annual	-
Ammonia	2,500	1 hour	-
	180	Annual	-
Lead	0.25	Annual	-
Benzene	5.00	Annual	-
	195	1 hour	-
1,3-butadiene	2.25	Annual, running	-
PCBs	6	1-hour	-
	0.2	Annual	-
PAHs	0.00025	Annual	-

Table 3: Critical Levels for the Protection of Vegetation and Ecosystems

Pollutant	Concentration (µg/m³)	Measured as
Nitrogen oxides (as nitrogen dioxide)	75	Daily mean
	30	Annual mean
Sulphur dioxide	10	Annual mean for sensitive lichen communities and bryophytes and ecosystems where lichens and bryophytes are an important part of the ecosystem's integrity
	20	Annual mean for all higher plants
Hydrogen fluoride	5	Daily mean
	0.5	Weekly mean
Ammonia	1	Annual mean for sensitive lichen communities and bryophytes and ecosystems where lichens and bryophytes are an important part of the ecosystem's integrity
	3	Annual mean for all higher plants

3.2 Construction Assessment

There is the potential for dust to be released into the atmosphere as a result of construction and demolition phase activities. These fugitive dust emissions have been assessed on a qualitative basis in accordance with the methodology outlined within the 2014 Institute of Air Quality Management (IAQM) guidance document 'Guidance on the assessment of dust from demolition and construction'. This guidance sets out the methodology for assessing the air quality impacts of construction and demolition and identifies good practice for mitigating and managing air quality impacts. It is noted that the quantity of dust emitted would be directly related to the area of land being worked and the nature, magnitude and duration of construction activities.

The assessment methodology is based on the risk of a construction site giving rise to dust impacts and the sensitivity of the surrounding area. Activities are divided into four types to reflect their different potential impacts. These are:

- demolition;
- earthworks;
- construction; and
- trackout.

Trackout is a less well-known term. It is defined by the IAQM as:

"The transport of dust and dirt from the construction / demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network. This arises when lorries leave the construction / demolition site with dusty materials, which may then spill onto the road, and/or when lorries transfer dust and dirt onto the road having travelled over muddy ground on site."

The assessment methodology considers three separate dust effects:

- annoyance due to dust soiling;
- harm to ecological receptors; and
- the risk of health effects due to significant increase in exposure to PM10 (particulate matter with a diameter less than 10µm).

The first stage of the assessment for the impact of fugitive emissions of dust during construction is to determine whether the impact can be screened out as 'negligible', or whether a more detailed assessment is required. The IAQM recommends that the developer will normally be required to undertake a detailed assessment where there is:

- a human receptor within 350m of the boundary of the Site;
- an ecological receptor within 50m of the boundary of the Site; or
- a human or ecological receptor within 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the Site entrance(s).

If the development cannot be screened out, the developer is to provide a clear description of the proposed demolition and construction activities, their location and duration, and any phasing of the development.

A human receptor, in this context, is any location where a person may experience the annoyance effects of airborne dust or dust soiling or suffer exposure to PM10 over a period of time relevant to the AQALs. These include:

- residential dwellings;
- schools;

- hospitals;
- care homes;
- hotels;
- gardens (where relevant public exposure is likely i.e. excluding extremities of gardens or front gardens); and
- sensitive commercial premises including; vehicle showrooms, food manufacturers; and electronics manufacturers.

Ecological receptors should include statutory and non-statutory designated sites.

If a detailed assessment is required, the second stage is to assess the risk of dust effects arising. A site is allocated to a risk category based on two factors; dust emission magnitude; and the sensitivity of the area. These factors are combined to give the risk of dust impact as described below.

The dust emission magnitude should be determined by considering the following criteria:

Table 4: Dust Emission Magnitude Criteria

Magnitude	Description
Demolition Activities	
Large	total building volume > 50,000m³, potentially dusty construction material (i.e. concrete), on-site crushing and screening, demolition activities > 20m above ground level
Medium	total building volume 20,000 - 50,000m³, potentially dusty construction material, demolition activities 10 – 20m above ground level
Small	total building volume < 20,000m³, construction material with low potentially for dust release (i.e. metal cladding or timber), demolition activities <10m above ground level, demolition during wetter months
Earthworks	
Large	total size area > 10,000m², potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), > 10 heavy earth moving vehicles active at any one time, formation of bunds > 8m in height, total material moved > 100,000 tonnes
Medium	total size area 2,500 – 10,000m², moderately dusty soil type (i.e. silt), 5 – 10 heavy earth moving vehicles active at any one time, formation of bunds 4 – 8m in height, total material moved 20,000 – 100,000 tonnes
Small	total size area < 2,500m², soil type with large grain size (i.e. sand), < 5 heavy earth moving vehicles active at any one time, formation of bunds < 4m in height, total material moved < 10,000 tonnes, earthworks during wetter months
Construction Activities	
Large	total building volume > 100,000m³, piling, on site concrete batching, sandblasting
Medium	total building volume 25,000 – 100,000m³, potentially dusty construction material (e.g. concrete), piling, on site concrete batching
Small	total building volume < 25,000m³, construction material with low potential for dust release (e.g. metal cladding or timber)

Magnitude	Description
Trackout	
Large	> 50 HDV (> 3.5t) trips in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length > 100 m
Medium	10 – 50 HDV (> 3.5t) trips in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 – 100 m
Small	< 10 HDV (> 3.5t) trips in any one day, surface material with low potential for dust release, unpaved road length < 50 m

Only receptors within 50 m of the routes(s) used by vehicles on the public highway and up to 500 m from the Site entrance(s) are considered to be at risk from the effects of dust.

The sensitivity of the area takes account of a number of factors:

- the specific sensitivities of receptors in the area;
- the proximity and number of those receptors;
- in the case of PM_{10}, the local background concentration; and
- site-specific factors, such as whether there are natural shelters, such as trees or other vegetation, to reduce the risk of wind-blown dust.

The type of receptors at different distances from the Site boundary or, if known, from the dust generating activities, should be included. Consideration also should be given to the number of `human receptors'. Exact counting of the number of `human receptors' is not required. Instead the guidance recommends that judgement is used to determine the receptors (a residential unit is one receptor) within each distance band.

There is no unified sensitivity classification scheme that covers the different potential effects on property, human health and ecological receptors. However, the following guidance is provided on the sensitivity of different types of receptors. For the sensitivity of people and their property to soiling it is recommended that professional judgement is used to identify where on the spectrum between high and low sensitivity a receptor lies, taking into account the following principles.

Table 5: Sensitivity to Dust Soiling Effects

Sensitivity	Justification
High	Users can reasonably expect an enjoyment of a high level of amenity; or The appearance, aesthetics or value of their property would be diminished by soiling; and the people or property would reasonably be expected to be present continuously, or at least regularly for extended periods as part of the normal pattern of use of the land. Indicative examples include dwellings, museums and other culturally important collections, medium and long term car parks and car showrooms.
Medium	Users would expect to enjoy a reasonable level of amenity but would not reasonably expect to enjoy the same level of amenity as in their home; or The appearance, aesthetic or value of their property could be diminished by soiling; or The people or property would not reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land; Indicative examples include parks and places of work.

Sensitivity	Justification
Low	The enjoyment of amenity would not reasonably be expected; or Property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; or There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. Indicative examples include playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short-term car parks and roads.

For the sensitivity of people to the health effects of PM_{10} the IAQM Guidance recommends that there are three sensitivities based on whether or not the receptor is likely to be exposed to elevated concentrations over a 24-hour period.

Table 6: Sensitivity to Heath Effects of PM10

Sensitivity	Justification
High	Locations where members of the public are exposed over a time period relevant to the air quality objective for PM10 (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). Indicative examples include residential properties. Hospitals, schools and residential care homes should also be considered as having equal sensitivity to residential areas for the purposes of this assessment.
Medium	Locations where the people exposed are workers, and exposure is over a time period relevant to the air quality objective for PM10 (in the case of the 24- hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). Indicative examples include office and shop workers, but will generally not include workers occupationally exposed to PM10, as protection is covered by Health and Safety at Work legislation.
Low	Locations where human exposure is transient. Indicative examples include public footpaths, playing fields, parks and shopping streets

The following table provides an example of possible sensitivities of receptors to ecological effects.

Table 7: Sensitivity to Ecological Effects

Sensitivity	Justification
High	Locations with an international or national designation and the designated features may be affected by dust soiling; or Locations where there is a community of a particularly dust sensitive species such as vascular species included in the Red Data List for Great Britain. Indicative examples include a Special Area of Conservation (SAC) designated for acid heathlands or a local site designated for lichens adjacent to the demolition of a large site containing concrete (alkali) buildings.

Sensitivity	Justification
Medium	Locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown; or Locations with a national designation where the features may be affected by dust deposition. Indicative example is a Site of Special Scientific Interest (SSSI) with dust sensitive features.
Low	Locations with a local designation where the features may be affected by dust deposition. Indicative example is a local Nature Reserve with dust sensitive features.

The following tables show how sensitivity of the area should be determined for dust soiling, human health and ecosystem impacts respectively. The sensitivity of the area should be derived for demolition, construction, earthworks and trackout.

Table 8: Sensitivity of the Area to Dust and Soiling Impacts on People and Property

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table 9: Sensitivity of the Area to Human Health Impacts

Receptor Sensitivity	Annual Mean PM10 Conc.	No. of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
High	>32 µg/m³	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28 - 32 µg/m³	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24 - 28 µg/m³	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24 µg/m³	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>32 µg/m³	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
		>10	Medium	Low	Low	Low	Low

Receptor Sensitivity	Annual Mean PM10 Conc.	No. of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
	28 - 32 µg/m³	1-10	Low	Low	Low	Low	Low
	24 - 28 µg/m³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<24 µg/m³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Table 10: Sensitivity of the Area to Ecological Impacts

Receptor Sensitivity	Distance from the Source (m)	
	<20	<50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

The dust magnitude and sensitivity of the area should be combined to determine the risk of impacts with no mitigation applied. The following matrices should be used. For the cases where the risk category is 'negligible', no mitigation measures beyond those required by accepted best practice would be necessary.

Table 11: Risk of Dust Impacts – Level of Mitigation Required

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
Demolition			
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible
Earthworks			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible
Construction			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible
Trackout			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

3.3 Process Emissions Assessment

3.3.1 Stack Emissions

The EPUK and IAQM (2017) guidance document has been developed for professionals operating within the planning system. It provides them with a means of reaching sound decisions, having regard to the air quality implications of development proposals. This is not intended to replace the guidance that exists for industrial developments which require a permit, but the guidance notes that the Environment Agency guidance has not been developed for conducting an assessment to accompany a planning application. The IAQM (2017) guidance states that it may be adapted using professional judgement. Therefore, where appropriate, Environment Agency guidance has been incorporated.

The IAQM (2017) guidance includes the following matrix which should be used to describe the impact based on the change in concentration relative to the AQAL and the overall predicted concentration with the scheme - i.e. the future baseline plus the process contribution.

Table 12: IAQM Impact Descriptors

Long term average concentration at receptor in assessment year	% change in concentration relative to Air Quality Assessment Level (AQAL)			
	1	2-5	6-10	>10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

It is intended that the change in concentration relative to the AQAL (the process contribution) is rounded to the nearest whole number. Therefore, any impact which is between 0.5% and 1.5% would be classified as a 1% change in concentration. An impact of less than 0.5% is described as negligible irrespective of baseline concentrations.

In order to be consistent with the methodology adopted in other sections of the Environmental Statement, only impacts described as moderate or above are considered to be significant in EIA terms.

The above matrix is only designed to be used with annual mean concentrations. For short term concentrations (i.e. those averaged over a period of an hour or less) the following descriptors of change should be used to describe the impact:

- < 10% - negligible;
- 10 - 20% - slight;
- 20 - 50% - moderate; and
- > 50% - substantial.

The approach for assessing the impact of short term emissions has been carried out in line with the IAQM (2017) guidance and does not take into account the background concentrations as it is noted that background concentrations are less important in determining the severity of impact for short term concentrations.

The IAQM (2017) guidance states that it is likely that a ‘medium’ or ‘high’ impact will give rise to a significant effect. The significance of the effect is determined based on professional scientific judgement, taking into account the severity of the impact, the extent of exposure, and the influence and validity of any assumptions made.

The IAQM (2017) guidance does not provide any descriptors for averaging periods of between 1 hour and a year. Therefore, for these periods the EA (2016) criteria have been used, which state that:

"process contributions can be considered insignificant if:

- *the long term process contribution is <1% of the long term environmental standard; and*
- *the short term process contribution is <10% of the short term environmental standard."*

Where an impact cannot be screened out as "insignificant" based on the outputs of the initial screening and modelling, the significance of the effect is determined based on professional scientific judgement of the likelihood of emissions causing an exceedance of an AQAL. This is a standard approach which allows the risk and likelihood of exceedance to be investigated and assessed in detail, following the first stage assessment.

For environmental permitting, consultation with the Environment Agency has revealed that if the long-term predicted environmental concentration (PEC) is below 70% of the AQAL, or the short-term process contribution is less than 20% of the headroom[3] it can be concluded that “there is little risk of the PEC exceeding the AQAL”, and the impact can be considered to be ‘not significant’.

In addition, the Environment Agency guidance document 'Guidance on assessing group 3 metals stacks emissions from incinerators - V.4 June 2016' for assessing the impact of emissions of metals relative to their respective AQALs states that where the process contribution (PC) for any metal exceeds 1% of the long term or 10% of the short term environmental standard (in this case the AQAL), this is considered to have potential for significant pollution. Where the PC exceeds these criteria, the PEC should be compared to the environmental standard. The PEC can be screened out where the PEC is less than the environmental standard. Where the impact is within these parameters it can be concluded that there is no risk of exceeding the AQAL and, as such, the magnitude of change and significance of effect is considered negligible.

For those substances which have the potential to accumulate in the environment, Tolerable Daily Intakes (TDI) (the amount of contaminant which can be ingested daily over a lifetime without appreciable health risk), and Index Doses (ID) (a level of exposure which is associated with a negligible risk to human health) are defined. Where the impact of process emissions is within these levels, emissions are expected to make a negligible impact on human health.

The IAQM (2017) guidance specifically states that it is not designed for assessing the impact at ecological sites. In lieu of any specific guidance for planning, the Environment Agency's guidance has been applied. This approach is considered appropriate as the EfW plant and HTI will also require an Environmental Permit to operate.

The Environment Agency's Operational Instruction documents explain how to assess atmospheric emissions from new or expanding Integrated Pollution Prevention and Control (IPPC) regulated industry applications, issued under the Environmental Permitting Regulations at ecologically sensitive sites. The process to follow to satisfy the requirements of the Conservation of Habitats and Species Regulations 2017 (as amended), Countryside and Rights of Way (CRoW) Act 2000, and the Environment Agency's wider duties under the Environment Act 1995 and the Natural Environment and Rural Communities Act 2006 (NERC06) are outlined.

[3] Calculated as the AQAL minus twice the long-term background concentration

Operational Instruction 67_12 "Detailed assessment of the impact of aerial emissions from new or expanding IPPC regulated industry for impacts on nature conservation"

Table 13: Ecological Screening Criteria

Threshold	European Sites	SSSIs	NNR, LNR, LWS, ancient woodland
Y (% threshold long-term)	1	1	100
Y (% threshold short-term)	10	10	100
Z (% threshold)	70	70	100
NOTES: Short term considers both daily and weekly. SSSI – Site of Special Scientific Interest NNR – National Nature Reserve LWS – Local Wildlife Site			

Where:

- Y is the long term process contribution (PC) calculated as a percentage of the relevant Critical Level or Load; and
- Z is the long term PEC calculated as a percentage of the relevant Critical Level or Load.

Operational Instruction 67-12 states if:

- PC is less than Y% Critical Level and Load then emissions from the application are not significant, and
- PEC is less than Z% Critical Level and Load it can be concluded 'no likely significant effect' (alone and in-combination).

AQTAG 17 - "Guidance on in combination assessments for aerial emissions from EPR permits" states that:

"Where the maximum process contribution (PC) at the European site(s) is less than the Stage 2 de-minimis threshold of the relevant critical level or load [i.e. the criteria detailed in Table 13.13 above], the PC is considered to be inconsequential and there is no potential for an alone or in-combination effects with other plans and projects."

This assessment has been undertaken using the ADMS 5.2 dispersion model and the five most recent years for which weather data is available. Full details of the dispersion modelling methodology and inputs can be found in section 5.2. The model has been used to predict the ground level concentration of pollutants on a long and short-term basis across a grid of points. It has also been used to predict the concentration at specified points to present sensitive receptors.

For some pollutants which accumulate in the environment, inhalation is only one of the potential exposure routes. Therefore, other exposure routes have been considered. A detailed Human Health Risk Assessment has been carried out using the Industrial Risk Assessment Program-Human Health (IRAP-h View - Version 5.0). The programme, created by Lakes Environmental, is based on the United States Environment Protection Agency (USEPA) Human Health Risk Assessment Protocol. This Protocol is a development of the approach defined by Her Majesty's Inspectorate for Pollution (HMIP) in 1996, taking account of further research since that date. Full details of the modelling methodology and inputs can be found in the separate Human Health Risk Assessment report.

3.3.2 Plume Visibility

There is the potential for the plume to be visible under certain circumstances. This is caused by water vapour in the exhaust gases condensing as the exhaust gases cool, so that the plume appears visible. However, the water vapour in the gases mix with the ambient air as the plume disperses, so that the plume ceases to be visible once the water vapour content is low enough. If the exhaust gases are hot and dry, or if the weather conditions promote rapid dispersion and slow cooling, it is more likely that the water vapour will disperse before it condenses, so that the plume is not visible at all.

ADMS 5.2 includes a plume visibility module, which models the dispersion and cooling of water vapour and predicts whether the plume will be visible, based on the liquid water content of the plume. This module has been used to quantify the number of visible plumes likely to occur during the operation of the EfW and HTI facility.

A previous version of Environment Agency guidance note H1 – July 2003 - provided a methodology to quantify the potential impact from visible plumes. This methodology has not been incorporated into the latest version of the Environment Agency's guidance. However, in lieu of any other appropriate methodology this has been used for the purpose of this assessment. The criteria against which the results of the dispersion modelling can be assessed are detailed in the following table. A 'medium' or 'high' impact is likely to give rise to a significant effect.

Table 14: Summary of Qualitative Plume Visibility Assessment Criteria

Impact	Qualitative Description
Zero	No visible impacts resulting from the operation
Insignificant	Plume length exceeds boundary <5% of the daylight hours per year No local sensitive receptors
Low	Plume length exceeds boundary <5% of the daylight hours per year Sensitive local receptors
Medium	Plume length exceeds boundary >5% of the daylight hours per year Sensitive local receptors
High	Plume length exceeds boundary >25% of the daylight hours per year with obscuration Sensitive local receptors

3.4 Traffic Emissions Assessment

In order to assess the impact of the operational phase traffic, dispersion modelling has been undertaken using the ADMS-Roads model version 4.1. Full details of the methodology are presented in Section 5.2.

The maximum impact has been modelled using the same five years of meteorological data used for the process emissions modelling. Vehicles have been modelled at the following speeds, with the exception of slow-down sections within 50 m of major junctions which have been modelled at 20 kph for all vehicles:

- Site access: 20 kph;
- A4 London Road West of Colnbrook Bypass: 64 kph;
- A4 London Road (Colnbrook Bypass): 80kph.

The modelling has been undertaken assuming that vehicle emissions do not vary throughout the day. This is conservative as the majority of development-generated traffic occurs during daylight hours, when conditions are typically more conducive to dispersion of pollutants from road traffic. Emissions factors appropriate to the assessment years have been taken from the Department for Environment Food and Rural Affairs (DEFRA) Emissions Factor Toolkit (EFT) version 9.0.

The background concentrations of nitrogen dioxide for the assessment of traffic emissions have been taken from the DEFRA mapped background concentrations for the grid square of each receptor. Further details of the basis of the mapped background concentrations is provided in Section 4.1.1.

Model verification has been undertaken in accordance with the methodology prescribed by DEFRA is the guidance document 'Local Air Quality Management -Technical Guidance (TG)16, which was last updated in February 2018. Details of the model verification procedure are provided in Appendix B.

Assessment of the impact of traffic emissions has been undertaken with reference to the IAQM criteria detailed in Table 12.

3.5 Significance of effect

For the purpose of this assessment, the IAQM and EA criteria outlined above have been used to define the magnitude of change associated with the Facility. In accordance with IAQM 2017 guidance, professional judgement has then been used to determine the overall significance of effect of the development at receptor locations (i.e. as either 'significant' or 'not significant'). This judgement has considered:

- the existing air quality in the local area;
- the extent of the predicted impacts from the proposed development; and
- the influence and validity of the assumptions adopted in the dispersion modelling.

The IAQM 2017 guidance states that:

"In most cases, the assessment of impact severity for a proposed development will be governed by the long-term exposure experienced by receptors and it will not be a necessity to define the significance of effects by reference to short-term impacts. The severity of the impact will be substantial when there is a risk that the relevant AQAL for short-term concentrations is approached through the presence of the new source, taking into account the contribution of other prominent local sources."

4 Baseline Conditions

Reference should be made to Figure 1 in Appendix A which shows the site location and boundary of the Proposed Development. In this chapter we have reviewed the baseline air quality and defined appropriate baseline concentrations to be used in the EIA. We have also identified sensitive receptors in the area.

4.1 Baseline Concentrations

4.1.1 National modelling – mapped background data

In order to assist local authorities with their responsibilities under Local Air Quality Management, the DEFRA provides modelled background concentrations of pollutants across the UK on a 1 km by 1 km grid. This model is based on known pollution sources and background measurements and is used by local authorities in lieu of suitable monitoring data. Mapped background concentrations have been downloaded for the grid squares containing the Proposed Development and immediate surroundings. In addition, mapped atmospheric concentrations of ammonia are available from DEFRA via the National Environment Research Council (NERC) Centre for Ecology and Hydrology (CEH) throughout the UK on a 5 km by 5 km grid.

The mapped background data is calibrated against monitoring data. For instance, the 2015 mapped background concentrations are based on 2015 meteorological data and are calibrated against monitoring undertaken in 2015. As a conservative approach where mapped background data is used the concentration for the year against which the data was validated has been used. This eliminates any potential uncertainties over anticipated trends in future background concentrations.

It is noted that concentrations will vary over the modelling domain area. Therefore, the maximum mapped background concentration within the modelling domain has been calculated as presented in Table 15, together with the concentration at the Proposed Development site. The concentrations of nitrogen dioxide in each square surrounding the Proposed Development are shown in Figure 2, which shows that mapped background concentrations in the closer squares are below the maximum.

Table 15: Mapped Background Data

Pollutant	Annual Mean Concentration (µg/m³)		Dataset
	At Proposed Development	Max Within Modelling Domain	
Nitrogen dioxide	31.3	44.3	DEFRA 2015 Dataset
Oxides of nitrogen	48.9	86.5	DEFRA 2015 Dataset
Sulphur dioxide	4.0	33.0	DEFRA 2001 Dataset
Particulate matter (as PM_{10})	17.0	18.0	DEFRA 2015 Dataset
Particulate matter (as $PM_{2.5}$)	11.0	11.6	DEFRA 2015 Dataset
Carbon monoxide	456	506	DEFRA 2001 Dataset
Benzene	0.88	1.0	DEFRA 2001 Dataset
1,3-butadiene	0.41	0.6	DEFRA 2001 Dataset
Ammonia	1.7	1.7	DEFRA (CEH) 2014

4.1.2 AURN and LAQM monitoring data

The UK Automatic Urban and Rural Network (AURN) is a country-wide network of air quality monitoring stations operated on behalf of the DEFRA. This includes automatic monitoring of oxides of nitrogen, nitrogen dioxide, sulphur dioxide, ozone, carbon monoxide and fine particulate matter.

The closest AURN monitoring stations to the Proposed Development are:

- London Hillingdon, a suburban background site located approximately 3.1 km to the east of the Proposed Development; and
- London Harlington, an urban background site located approximately 4.4 km east of the Proposed Development.

In addition to the AURN site, three continuous analysers are operated by local authorities within 5 km of the Proposed Development.

- Slough Colnbrook, an urban background site located 1.3 km south of the Proposed Development;
- Slough Lakeside 1, an urban background site located 0.8 km south of the Proposed Development; and
- Slough Lakeside 2, an urban background site located 0.7 km south of the Proposed Development.

The monitoring results from these five stations are shown below.

Table 16: Summary of Continuous Monitoring Results

Site Name	2014	2015	2016	2017	2018	Average
Annual Mean Nitrogen Dioxide (µg/m^3)						
London Hillingdon	58.0	52.0	52.0	53.0	48.4	52.7
London Harlington	36.0	32.0	34.0	32.0	30.3	32.9
Slough Colnbrook	31.0	29.0	29.0	25.0	22.0	27.2
Slough Lakeside 2	34.0	29.0	32.0	26.0	27.0	29.6
Annual Mean PM10 (µg/m^3)						
Slough Colnbrook	20.0	20.0	15.0	16.0	-	17.8
Slough Lakeside 1	19.3	18.7	14.0	14.0	-	16.5
Slough Lakeside 2	13.2	13.9	15.0	14.0	-	14.0
Annual Mean PM2.5 (µg/m^3)						
Slough Colnbrook	7.2	7.0	6.0	7.0	-	6.8
Slough Lakeside 1	8.6	7.1	6	6	-	6.9
Slough Lakeside 2	7.3	5.2	6.0	7.0	-	6.4

Slough Borough Council, South Buckinghamshire District Council and London Borough of Hillingdon all operate networks of diffusion tubes to measure nitrogen dioxide, listed in Table 17. The results of all measurements within 5 km of the Proposed Development which were operational at some point after 2014 are shown in

Table 18. Most of the diffusion tubes are located close to busy roads, which will not be representative of background locations.

As there is a lot of data, the locations of the monitoring stations and the average concentrations for 2014-2018 are shown in Figure 3, with the measured and mapped concentrations closer to the Proposed Development shown in Figure 4. This shows that the maximum measured nitrogen dioxide concentration closest to the plant on Old Slade Lane, Iver (SB1) is below the AQAL at 27.5 $\mu g/m^3$. The concentrations further north, along Richings Way, are at or close to the AQAL of 40 $\mu g/m^3$ and then they fall away again, but these are measured at roadside tubes.

The background concentration has been taken as the measured concentration at SB1, as this is the most representative tube. However, the background concentration closer to main roads will be higher and this will be considered for each receptor.

Table 17: Summary of Diffusion Tubes

Site Name	Reference	Grid Reference		Type *	Distance (km)	Bearing (°)
		X	Y			
Heathrow Close	HD61	504848	176770	R	1.95	132
Harmondsworth Green	HD60	505753	177760	R	2.38	97
49 Zealand Avenue Lamp Post	HD200	505920	177188	R	2.68	109
28 Pinglestone Close	HD65	506081	177071	R	2.87	110
AURN Sipson	HD31	506951	178605	R	3.60	81
1 Porters Way	HD205	506503	179510	B	3.43	65
7 Bomber Close	HD59	507294	177322	R	3.97	101
31 Tavistock Road	HD67	505729	180290	R	3.23	46
4 Colham Avenue	HD51	506334	180266	R	3.68	53
104 Yiewsley High Street	HD204	506108	180493	B	3.64	48
5-7 Mulberry Crescent	HD206	507141	179628	B	4.06	67
35 Emden Close	HD207	507580	179812	R	4.54	67
Brendan Close	HD58	508412	177124	R	5.11	101
25 Cranford Lane, Harlington	HD57	508756	177717	R	5.38	94
10 West End Lane	HD213	508773	177352	B	5.43	98
Lakeside Road* (Grundon)	SLO12	503877	177459	I	0.78	141
Pippins	SLO14/15/16	503542	176827	S	1.25	173
Colnbrook By-pass	SLO7	503196	177349	I	0.74	195
Elbow Meadows	SLO13	503856	176538	S	1.60	163
Horton Road (Caravan Park)	SLO17	503136	175654	S	2.42	186
Rogans (Colnbrook by-pass)	SLO28	501941	177633	R	1.51	253
Brands Hill (B)	SLO32	501853	177620	R	1.60	254
Brands Hill	SLO18	501798	177659	R	1.64	256

Site Name	Reference	Grid Reference		Type *	Distance (km)	Bearing (°)
		X	Y			
Sutton Lane	SLO56	502241	178679	R	1.30	298
London Road	SLO10	501733	177725	R	1.69	258
London Road (B)	SLO39	501734	177733	R	1.69	259
London Road (C)	SLO45	501658	177781	R	1.76	261
Torridge Road	SLO11	501637	177999	S	1.76	268
Tweed Road	SLO9	501501	177879	O	1.90	264
Parlaunt Road	SLO55	503690	179278	K	1.74	301
Grampian Way	SLO8	501382	178101	O	2.01	271
High Street Langley (A)	SLO53	503936	180547	R	2.30	289
Ditton Road	SLO19	503972	179701	R	2.55	266
High Street Langley (B)	SLO54	501256	179067	R	2.36	295
Langley Road	SLO51	501014	179316	R	2.69	298
Station Road	SLO52	501161	179538	R	2.67	303
Iver, Old Slade Lane	SB1	503679	178586	R (B)	0.60	29
Richings Way	SB21	503690	179278	R	1.25	14
Tower Arms Thorney Lane Sth	SB32	504047	179475	R	1.56	25
Tower Arms Thorney Lane Sth	SB33	504047	179475	R	1.56	25
Thorney Lane South	SB22	503972	179701	R	1.74	20
Grand Union House	SB38	503618	180518	R	2.46	5
Thorney Lane North	SB23	503936	180547	R	2.54	12
Iver, Victoria Crescent	SB2	504056	180901	R	2.91	13
6 Thorney Lane North	SB30	503924	181127	R	3.11	10
6 Thorney Lane North	SB31	503924	181127	R	3.11	10
Swan Pub, Iver	SB28	503899	181199	R	3.18	9
Swan Pub, Iver	SB29	503899	181199	R	3.18	9
Langley Park Road	SB24	503050	181176	R	3.13	354
Iver, High Street	SB3	503688	181299	R	3.25	5
Bangors Road South	SB25	503604	181378	R	3.32	4
Notes: *B = Background, R = Roadside, K = Kerbside, I = Industrial, S = Suburban, O = Other						

Table 18: Summary of Diffusion Tube Results

Site Name	2014	2015	2016	2017	Average
HD61	36.9	34.4	31.9	34.0	34.3
HD60	31.6	26.8	24.2	27.8	27.6
HD200	40.4	35.2	29.4	42.7	36.9
HD65	33.7	29.9	26.7	30.0	30.1
HD31	46.8	40.7	34.3	45.3	41.8
HD205	41.5	41.1	35.9	37.9	39.1
HD59	33.3	29.1	30.3	32.6	31.3
HD67	30.4	28.7	25.8	26.9	28.0
HD51	36.3	33.3	32.3	32.9	33.7
HD204	39.3	40.9	32.0	37.0	37.3
HD206	34.6	30.0	29.6	34.7	32.2
HD207	37.7	31.2	24.9	33.3	31.8
HD58	39.5	37.2	34.2	47.5	39.6
HD57	39.5	35.6	35.5	39.4	37.5
HD213	39.4	37.0	37.4	45.6	39.9
SLO12	45.4	42.9	44.3	38.6	42.8
SLO14/15/16	30.3	29.9	30.8	26.0	29.3
SLO7	39.0	39.1	38.7	38.7	38.9
SLO13	37.9	34.9	35.9	30.5	34.8
SLO17	33.4	30.0	30.0	25.6	29.8
SLO28	50.9	56.3	58.1	45.3	52.7
SLO32	42.1	40.1	39.3	36.3	39.5
SLO18	53.1	61.1	63.7	55.2	58.3
SLO56	-	-	43.9	37.8	40.9
SLO10	51.2	48.3	52.3	45.3	49.3
SLO39	38.6	37.1	37.0	33.1	36.4
SLO45	36.6	33.5	32.7	31.4	33.5
SLO11	36.3	36.9	37.3	32.7	35.8
SLO9	39.0	35.6	37.4	35.3	36.8
SLO55	-	-	36.9	31.4	34.2
SLO8	42.4	40.0	41.3	40.4	41.0
SLO53	-	-	48.6	42.1	45.4
SLO19	38.8	41.1	40.0	34.6	38.6
SLO54	-	-	39.6	35.4	37.5

Site Name	2014	2015	2016	2017	Average
SLO51	-	-	42.8	37.8	40.3
SLO52	-	-	41.5	36.4	39.0
SB1	30.0	26.0	27.0	26.9	27.5
SB21	-	-	38.0	39.0	38.5
SB32	-	-	-	40.9	40.9
SB33	-	-	34.0	33.6	33.8
SB22	-	-	-	26.8	26.8
SB38	-	-	35.0	35.0	35.0
SB23	33.0	28.0	30.0	26.9	29.5
SB2	-	-	-	46.5	46.5
SB30	-	-	-	44.1	44.1
SB31	-	-	-	41.4	41.4
SB28	-	-	-	37.7	37.7
SB29	-	-	28.0	30.7	29.3
SB24	31.0	31.0	32.0	30.9	31.2
SB3	-	-	27.0	30.2	28.6
SB25	42.0	38.0	40.0	42.1	40.5

For particulate matter (as PM_{10} and $PM_{2.5}$), the maximum measured concentrations closest to the plant at the Slough-Lakeside 2 continuous monitoring station are below the AQALs at 15.0 µg/m^3 and 7.3 µg/m^3 for PM_{10} and $PM_{2.5}$ respectively. For the purpose of this analysis the maximum monitored PM_{10} and $PM_{2.5}$ concentrations from Slough-Lakeside 2 continuous monitoring station has been used as the baseline concentration in this assessment. However, the background concentration closer to main roads will be higher and this will be considered for each receptor.

4.1.3 National monitoring data

4.1.3.1 Hydrogen chloride

Hydrogen chloride is measured on behalf of DEFRA as part of the UK Eutrophying and Acidifying Atmospheric Pollutants (UKEAP) project. This consolidates the previous Acid Deposition Monitoring Network (ADMN), and National Ammonia Monitoring Network (NAMN). There are no monitoring locations within 10 km of the Proposed Development. A summary of data from all UK monitoring sites is presented in Table 19. The UK ceased monitoring of hydrogen chloride at the end of 2015.

Table 19:National Monitoring – Hydrogen Chloride

Site Type	Quantity	AQAL	Annual Mean Concentration (µg/m³)				
			2012	2013	2014	2015	2016
All	Min	-	0.11	0.15	0.10	0.12	-
	Max		0.49	0.50	0.54	0.71	-
	Average		0.27	0.31	0.26	0.24	-

In lieu of any local monitoring, the UK maximum from the national monitoring network has been used for the purpose of this assessment as a conservative estimate (0.71 µg/m^3 – 2015). The choice of baseline concentration will be considered further if the impact of the Proposed Development cannot be screened out as negligible irrespective of baseline concentrations – i.e. the long-term process contribution is greater than 0.5% of the AQAL.

4.1.3.2 Hydrogen fluoride

Baseline concentrations of hydrogen fluoride are not measured locally or nationally, since these are not generally of concern in terms of local air quality. However, the EPAQS report 'Guidelines for halogens and hydrogen halides in ambient air for protecting human health against acute irritancy effects' contains some estimates of baseline levels, reporting that measured concentrations have been in the range of 0.036 µg/m^3 to 2.35 µg/m^3.

In lieu of any local monitoring, the maximum measured baseline hydrogen fluoride concentration (2.35 µg/m³) has been used for the purpose of this assessment as a conservative estimate. The choice of baseline concentration will be considered further if the impact of the Proposed Development cannot be screened out as negligible irrespective of baseline concentrations – i.e. the long-term process contribution is greater than 0.5% of the AQAL.

4.1.3.3 Ammonia

Ammonia is also measured as part of the UKEAP project. There are no UKEAP monitoring locations within 10 km of the Proposed Development. A summary of data from all UK monitoring sites is presented in the following table.

Table 20: Ammonia Monitoring – UKEAP

Site	Quantity	AQAL (µg/m³)	Annual Mean Concentration (µg/m³)				
			2011	2012	2013	2014	2015
All	Min	180	0.1	0.1	0.1	0.1	0.1
	Max	180	7.7	7.2	8.5	5.5	5.5
	Average	180	2.1	1.5	1.7	1.5	1.7

In lieu of any UKEAP monitoring, the maximum mapped background over the modelling domain has been used for the purpose of this assessment, noting that this may be an overestimation. The choice of baseline concentration will be considered further if the impact of the Proposed Development cannot be screened out as negligible irrespective of baseline concentrations – i.e. the long-term process contribution is greater than 0.5% of the AQAL.

4.1.3.4 Volatile Organic Compounds

As part of the Automatic and Non-Automatic Hydrocarbon Network, benzene concentrations are measured at sites co-located with the AURN across the UK. In 2007, due to low monitored concentrations of 1,3-butadiene at non-automatic sites, DEFRA took the decision to cease non-automatic monitoring of 1,3-butadiene.

There are no monitoring locations within 10 km of the Proposed Development.

In lieu of any local monitoring of benzene or 1,3-butadiene, the maximum mapped background concentration within the modelling domain has been used as the baseline concentration for the purpose of this assessment. The choice of baseline concentration will be considered further if the impact of the Proposed Development cannot be screened out as negligible irrespective of baseline concentrations – i.e. the long-term process contribution is greater than 0.5% of the AQAL.

4.1.3.5 Metals

Metals are measured as part of the Rural Metals and UK Urban/Industrial Networks (previously the Lead, Multi-Element and Industrial Metals Networks). There are no metals monitoring locations within 10 km of the Proposed Development. It is considered that the urban background monitoring sites are likely to be most like the conditions close to the Proposed Development. A summary of data from all UK urban background monitoring sites is presented in Table 21.

Table 21: Metals Monitoring - Average of all Urban background Sites

Substance	Annual Mean Concentration (ng/m^3)						Max (as % of AQAL)
	AQAL	2013	2014	2015	2016	2017	
Arsenic	3	0.59	0.66	0.79	0.73	0.74	26.47%
Cadmium	5	0.20	0.20	0.26	0.19	0.20	5.14%
Chromium	5000	3.27	7.76	8.48	13.16	9.25	0.26%
Copper	10000	7.82	8.26	11.10	10.40	10.37	0.11%
Mercury	250	2.25	2.09	3.69	2.54	2.47	1.47%
Manganese	150	6.26	8.54	10.90	8.77	8.26	7.27%
Nickel	20	1.96	2.86	6.61	5.95	5.29	33.03%
Lead	250	8.39	9.65	10.35	9.70	8.30	4.14%
Vanadium	5000	1.15	1.24	1.55	0.92	0.92	0.03%
Antimony*	5000						0.00%
Cobalt	-	0.17	0.20	0.25	0.23	0.25	-
*Notes: Antimony is not monitored at any urban background sites. The average across all UK monitoring sites has been used.							

4.1.3.6 Dioxins, furans and polychlorinated biphenyl (PCBs)

Dioxins, furans and PBCs are monitored on a quarterly basis at a number of urban and rural stations in the UK as part of the Toxic Organic Micro Pollutants (TOMPs) network. There are no monitoring locations within 10 km of the Proposed Development.

A summary of dioxin and furan and PCB concentrations from all monitoring sites across the UK is presented in Table 22 and Table 23.

Table 22:TOMPS – Dioxin and Furans Monitoring

Site	Annual Mean Concentration (fgTEQ/m³)				
	2012	2013	2014	2015	2016
Auchencorth Moss	0.13	0.85	0.01	0.01	0.18
Hazelrigg	8.75	2.03	2.59	5.29	3.10
High Muffles	4.33	0.60	1.09	0.54	4.40
London Nobel House	15.45	3.50	2.87	4.35	18.67
Manchester Law Courts	33.00	10.20	16.95	5.95	8.67
Weybourne	9.25	2.33	1.62	1.42	20.37

Table 23:TOMPS – PCB Monitoring

Site	Annual Mean Concentration (pg/m³)				
	2012	2013	2014	2015	2016
Auchencorth Moss	10.46	10.48	22.96	24.30	25.90
Hazelrigg	28.78	28.78	25.90	41.48	21.92
High Muffles	13.74	13.75	26.02	33.12	33.17
London Nobel House	83.20	83.20	107.04	121.17	118.40
Manchester Law Courts	101.72	101.73	127.46	97.74	99.60
Weybourne	19.54	19.53	16.97	20.92	41.88

As shown, the concentrations vary significantly between sites and years. As no site is located in close proximity to the Development, the maximum monitored concentration has been used as the background concentration within this assessment (33.00 fg/TEQ/m³ for dioxins and furans and 127.46 pg/m³ for PCBs). The choice of baseline concentrations will be considered further if the impact of the Proposed Development cannot be screened out as negligible irrespective of baseline concentrations – i.e. the long-term process contribution is greater than 0.5% of the AQAL.

4.1.3.7 Polycyclic Aromatic Hydrocarbons (PAHs)

Polycyclic Aromatic Hydrocarbons (PAHs) are monitored at a number of stations in the UK as part of the PAH network. There are no monitoring locations within 10 km of the Proposed Development. For the purpose of this assessment, benzo(a)pyrene is considered as this is the only PAH which an AQAL has been set. A summary of benzo(a)pyrene concentrations from all monitoring sites within the UK is presented in Table 24.

Table 24: National Monitoring - Benzo(a)pyrene

Site Type	Quantity	AQAL	Annual Mean Concentration (ng/m³)				
			2013	2014	2015	2016	2017
Urban background	Min	0.25	0.05	0.04	0.03	0.03	0.03
	Max		**3.87**	**3.72**	**3.50**	**1.30**	**0.87**
	Average		**0.48**	**0.49**	**0.37**	**0.34**	**0.26**

As shown, there is an exceedance of the AQAL for BaP across the UK urban background sites in all years. However, The Fourth Daughter Directive outlines target assessment thresholds for benzo(a)pyrene of 1.0 ng/m³ total content in the PM10 fraction averaged over a calendar year, with an upper assessment threshold of 0.6 ng/m³ and a lower assessment threshold of 0.4 ng/m³. In all years the average at a background site is less than the Fourth Daughter Directive assessment threshold.

In lieu of any local monitoring of PAHs, the maximum of the UK average concentrations has been used (0.49 ng/m³ – 2014). It is noted that this exceeds the AQAL. The choice of baseline concentration will be considered further if the impact of the Development cannot be described as negligible irrespective of the total concentration.

4.2 Summary

The preceding sections have provided a review of the baseline local and national monitoring data and national modelled background concentrations. Table 25 presents the values for the annual baseline concentrations that have been used to evaluate the impact of the Proposed Development as part of this assessment.

Table 25: Summary of Baseline Concentrations

Pollutant	Annual Mean Concentration	Units	Source
Nitrogen dioxide	27.5	µg/m³	Maximum monitored concentration - Old Slade Lane, Iver diffusion tube
Sulphur dioxide	33.0	µg/m³	Maximum mapped background concentration from across the modelling domain – DEFRA 2001 dataset.
Particulate matter (as PM10)	15.0	µg/m³	Maximum monitored concentration - Slough-Lakeside 2 continuous monitoring station
Particulate matter (as PM2.5)	7.3	µg/m³	Maximum monitored concentration - Slough-Lakeside 2 continuous monitoring station
Carbon monoxide	506	µg/m³	Maximum mapped background concentration from across the modelling domain – DEFRA 2001 dataset
Benzene	1.0	µg/m³	Maximum mapped background concentration from across the modelling domain – DEFRA 2001 dataset
1,3-butadiene	0.6	µg/m³	Maximum mapped background concentration from across the modelling domain – DEFRA 2001 dataset
Ammonia	1.7	µg/m³	Maximum mapped background concentration from across the modelling domain – DEFRA (CEH) 2014

Pollutant	Annual Mean Concentration	Units	Source
Hydrogen chloride	0.7	µg/m³	Maximum monitored concentration across the UK 2011 to 2015
Hydrogen fluoride	2.3	µg/m³	Maximum measured concentration from EPAQS report
Mercury	3.7	ng/m³	Maximum average annual monitored concentration across all UK urban background sites 2013 to 2017
Cadmium	0.26	ng/m³	
Dioxins and Furans	33.0	fg/m³	Maximum monitored across the UK 2012 to 2016
Dioxin-like PCBs	127.5	pg/m³	
PaHs	0.49	ng/m³	Maximum of the UK average concentrations
Arsenic	0.79	ng/m³	Maximum monitored concentration at all urban background sites across the UK 2013 to 2017
Antimony	-	ng/m³	
Chromium	13.16	ng/m³	
Cobalt	0.25	ng/m³	
Copper	11.10	ng/m³	
Lead	10.35	ng/m³	
Manganese	10.90	ng/m³	
Nickel	6.61	ng/m³	
Vanadium	1.55	ng/m³	

4.3 Sensitive Receptors

As part of this assessment, the predicted process contributions at a number of sensitive receptors has been evaluated.

4.3.1 Dust Sensitive Receptors

The following table outlines how many sensitive receptor locations have been identified in the relevant distance bands from the boundary of the Site and construction compound. For clarity, the IAQM methodology states that one residential unit is one high sensitivity receptor. No potentially dust sensitive ecological receptors have been identified in the relevant screening distances from the Site. The Old Slake Lake LWS lies to the east of the Site; however this lies more than 50 m from the Site boundary at the closest point. Therefore, impact of the construction phase of the Proposed Development on ecological receptors is not considered further.

Table 26: Dust Sensitive Receptors - Number of Human Receptors

Distance from the source (m)	Estimated number of human receptors			
	From Site Boundary		From Site Access Routes*	
Receptor Sensitivity	High	Medium	High	Medium
<20	0	0	0	4
<50	0	0	0	8

Distance from the source (m)	Estimated number of human receptors			
	From Site Boundary		From Site Access Routes*	
<100	0	1	-	-
<350	0	2	-	-

Note:
*Distance from site access routes is used in the assessment of trackout, and only receptors within 50m of the edge of the road (up to 500m from the Site entrance) need to be considered.

4.3.2 Vehicle Emission Sensitive Receptors

The roadside human sensitive receptors (labelled as Roads Receptors, RRs) along the roads for which traffic data is available (see Section 5.2) are listed in Table 27 and displayed in Figure 6 of appendix A [Roads Modelling Setup].

Table 27: Vehicle Sensitive Receptors

ID	Name	Location	
		x	y
RR1	2 Colnbrook Bypass	505352	177099
RR2	4 Colnbrook Bypass	505329	177104
RR3	6 Colnbrook Bypass	505315	177107
RR4	8 Colnbrook Bypass	505292	177113
RR5	8 Orchard Court, the Island	505075	177097
RR6	Disraeli Court, London Road	501736	177731
RR7	540 London Road	501662	177732
RR8	563 London Road	501632	177792
RR9	2 Laburnum Grove	501552	177801
RR10	2 Tweed Road	501539	177846

4.3.3 Process Emission Sensitive Receptors

The human sensitive receptors included in this assessment are listed in Table 28 and displayed in Figure 5 of appendix A [Human Sensitive Receptors].

Table 28: Human Sensitive Receptors

ID	Name	Location		Distance from the stack (m)
		x	y	
R1	Old Slade Lane 1, Richings Park	503732	178404	482
R2	Old Slade Lane 2, Richings Park	503613	178623	602
R3	Old Slade Lane 3, Richings Park	503551	178731	686
R4	Main Drive, Richings Park	503282	179033	976
R5	North Park, Richings Park	503018	179083	1086

ID	Name	Location		Distance from the stack (m)
		x	y	
R6	Sutton Lane 1, Langley	502272	178911	1404
R7	Sutton Lane 2, Langley	502424	178468	1048
R8	London Road, Colnbrook	501993	177564	1484
R9	Vicarage Way, Colnbrook	502680	177297	1045
R10	The Hawthrorns, Colnbrook	503618	176909	1177
R11	The Island, Longford	505036	177064	1925
R12	Verbena Close, West Drayton	505678	178424	2315
R13	Lily Drive, West Drayton	505588	178837	2329
R14	The Common, West Drayton	505107	178577	1791
R15	Mayfield Park, West Drayton	505169	179072	2044
R16	Thorney Mill Road, Thorney	504785	179368	1909
R17	Richings Way, Richings Park	504037	179425	1507
R18	Parlaunt Park Primary Academy	501849	179291	1971
R19	Foxborough Primary School	501419	178285	1984
R20	Colnbrook CoE School	502604	177047	1285
R21	Harmondsworth Primary School	505572	177500	2253
R22	Laurel Lane Primary School	505971	178915	2717
R23	St Catharine Catholic Primary School	505728	179521	2754

The impacts of emissions from the Proposed Development have been assessed at these receptor locations and are discussed in Section 6.7.

4.3.4 Air Quality Management Areas (AQMAs)

Under Section 82 of the Environment Act (1995) (Part IV), local authorities are required to undertake an ongoing exercise to review air quality within their area of jurisdiction. Slough Borough Council has declared four Air Quality Management Areas (AQMAs) due to concerns over nitrogen dioxide concentrations. Of these, three lie within 5 km of the Proposed Development and have been included in the assessment. A review of AQMAs declared by neighbouring councils has shown that three additional AQMAs lie within 5 km of the Proposed Development. Details of these AQMAs are provided in the table below.

Table 29: AQMAs

AQMA name	Reason for declaration	Distance from stack at closest point (km)	Bearing
South Borough Council			
Slough AQMA No.1	Annual mean nitrogen dioxide	1.5	West
Slough AQMA No.2	Annual mean nitrogen dioxide	1.5	South-west

AQMA name	Reason for declaration	Distance from stack at closest point (km)	Bearing
Slough AQMA No.4	Annual mean nitrogen dioxide	4.7	North-West
South Bucks District Council			
South Bucks district Council AQMA No. 2	Annual mean nitrogen dioxide	0.1	North
Hillingdon London Council			
Hillingdon AQMA	Annual mean nitrogen dioxide	1.0	East
Spelthorne Borough Council			
Spelthorne AQMA	Annual mean nitrogen dioxide	2.4	South

4.3.5 Ecological Sensitive Receptors

A study was undertaken to identify the following sites of ecological importance in accordance with the Air Emissions Guidance criteria:

- Special Protection Areas (SPAs), Special Areas of Conservation (SACs), or Ramsar sites within 10 km of the stack of the Proposed Development;
- Sites of Special Scientific Interest (SSSIs) within 2 km of the stack of the Proposed Development; and
- National Nature Reserves (NNR), Local Nature Reserves (LNRs), Local Wildlife Sites (LWSs) and ancient woodlands within 2 km of the stack of the Proposed Development.

The sensitive ecological receptors identified as a result of the study are displayed in Figure 8 [Ecological Sensitive Receptors] and listed in Table 30. A review of the citation and APIS website for each site has been undertaken to determine if lichens or bryophytes are an important part of the ecosystem's integrity. If lichens or bryophytes are present, the more stringent Critical Level has been applied as part of the assessment.

Table 30: Sensitive Ecological Receptors

ID	Site	Designation	Closest point to Proposed Development		Distance from stack at closest point (km)	Lichens or bryophytes present
			X	Y		
European and UK Designated Sites						
E1	South West London Waterbodies	SPA/Ramsar	502730	175700	2.5	No
E2	Windsor Forest & Great Park	SAC	497500	174150	7.0	Yes
Locally Designated Sites						
E3	Old Wood	Ancient Woodland	503240	178260	0.2	Yes(1)

ID	Site	Designation	Closest point to Proposed Development		Distance from stack at closest point (km)	Lichens or bryophytes present
			X	Y		
E4	Old Slade Lake	LWS	503730	178160	0.3	Yes(1)
E5	Opposite Iver Station	BNS(2)	503410	179910		Yes(1)
E6	Lower Colne	SINC(3)	504890	178180	1.5	Yes(1)
E7	Queen Mother Reservoir	LWS	501700	177463	1.8	Yes(1)

Notes:

(1) It is not known from the citations whether lichens or bryophytes are present at the locally designated sites. As a conservative measure it has been assumed that lichens amd bryophytes are present and the lower Critical Levels presented in Table 3 have been applied.

(2) Biological Notification Site

(3) Site of Importance for Nature Conservation

5 Effect of proposals during construction

5.1 Dust

It is anticipated that construction activities will take place at various locations across the Site. However, as a worst-case assumption, it has been assumed that dust generating activities will occur at the boundary of the Site and construction compound.

The IAQM methodology detailed in Section 3.2 is based on:

- The dust emission magnitude for the Site – which is based on the type of activities undertaken; and
- The sensitivity of the area – which is based on the number of properties within certain distances of the boundary of the works.

5.1.1 Dust emission magnitude

The quantity of dust emitted is related to the area of land being worked and the level of construction activities, in terms of the nature, magnitude and duration of those activities. The wind direction, wind speed and rainfall at the time when a construction activity is taking place will also influence whether there is likely to be a dust impact. Atmospheric conditions which promote adverse impacts can occur in any direction from the Proposed Development. However, adverse impacts are more likely to occur downwind of the prevailing wind direction and / or close to the worked areas. Impacts are also more likely to occur during drier periods as rainfall acts as a natural dust suppressant.

The dust emission magnitude has been classified for each type of activity using the criteria outlined in Table 4:

- Demolition – There are only very minor demolition/removal activities associated with the Proposed Development. As such, demolition impacts have been scoped out of this assessment.
- Earthworks - The total area of the Site is >10,000 m^2. There will be substantial earthworks involved in the construction of the development platform. On this basis, the dust emission magnitude is deemed to be 'large'.
- Construction - The total building volume will be >100,000m^3 and involve potentially dusty activities. As a conservative assumption, the dust emission magnitude is deemed to be 'large'.
- Trackout – The Transport Assessment has identified that peak HGV construction traffic will be around 340 HGV movements in total. Therefore, the dust emission magnitude from trackout is deemed to be 'large'.

5.1.2 Sensitivity of the area

As detailed in Section 4.3.1, no high sensitivity human receptors (i.e. residential dwellings, hospitals or schools) have been identified within the relevant screening distances (i.e. within 350m of the boundary of the Site and construction compound, or within 50m of any route used by construction vehicles on the public highway, up to 500m from the Site entrance).

The medium sensitivity receptors identified are places of work and a golf course, the closest being the industrial premises on the land adjacent to the Proposed Development. The IAQM guidance does not indicate the number of receptors that should represent a place of work. However, according to the criteria, as there are no medium sensitivity receptors within 20 m and no high sensitivity receptors in the area, the sensitivity of the area to dust deposition effects should be classed as low.

As shown in Table 9, the sensitivity of the area to human health effects of dust depends on the annual mean PM_{10} concentration. The annual mean background concentration of PM_{10} is 15 µg/m³. Using the criteria in Table 9 and taking into account this background concentration, the sensitivity of the area to human health effects is 'low' as there are no high sensitivity receptors within 20 m of the Site.

A summary of the sensitivity of the area is provided in the table below.

Table 31: Sensitivity of the Surrounding Area

Potential Impact	Earthworks	Construction	Trackout
Dust deposition	Low	Low	Medium
Human health	Low	Low	Low

5.1.3 Dust impact risk assessment

The risk of dust emissions from a construction site causing loss of amenity and / or health or ecological effects is related to:

- the activities being undertaken (number of vehicles and plant etc.);
- the duration of these activities;
- the size of the site;
- the meteorological conditions (wind speed, direction and rainfall);
- the proximity of receptors to the activity;
- the adequacy of the mitigation measures applied to reduce or eliminate dust; and
- the sensitivity of the receptors to dust.

The risk of dust impacts from construction phase activities is summarised in the following table using the criteria outlined in Section 3.2. This is based on the dust emission magnitude and the sensitivity of the area.

Table 32: Summary of Dust Risk to Define Site Specific Mitigation

Potential Impact	Earthworks	Construction	Trackout
Dust deposition	Low Risk	Low Risk	Medium Risk
Human health	Low Risk	Low Risk	Low Risk

In summary, the Proposed Development has been assessed to be a medium risk site. As the highest risk category is greater than 'negligible', site-specific mitigation measures will need to be implemented. Suitable mitigation measures are detailed in Section 7.

5.2 Construction phase traffic emissions

5.2.1 Traffic generation rates

24-hour AADT flows were provided by the Transport Consultant for the baseline year in which traffic surveys were undertaken (2019), along with a growth factor to factor the baseline traffic to be representative of the opening year (2023). The profile of construction traffic flows has also been provided. This profile shows that:

- peak numbers of HGVs occur in Q4 of year 1 (i.e. Q4 of 2020), with 340 HGV movements, 680 passenger vehicle movements and 2 abnormal loads daily; and
- peak total vehicle movements occur in Q2 of 2021, with 250 HGV movements, 1000 passenger vehicle movements and 6 abnormal loads daily.

The maximum impact of vehicle emissions could occur either during the peak HGV movements or peak total movements. Therefore, both scenarios have been assessed, but only the maximum has been reported. The assessment considers the following scenarios:

- 2021 'Do minimum'; and
- 2021 'Do something'.

The 'Do minimum' scenario represents the traffic in the absence of the Proposed Development (i.e., the future baseline), and has been factored from 2019 survey data using the factor provided by the Transport Consultant. The 'Do something' scenario is the future baseline traffic plus the traffic generated by the construction phase of the Proposed Development. Although the peak HGV traffic is predicted to occur in Q4 of 2020 and peak total traffic in Q2 of 2021, for simplicity both have been assessed as occurring in 2021. This is considered conservative as the 'Do minimum' traffic flows are slightly higher in 2021 than 2020. The assessment showed that the impact of the peak HGV traffic is greater than the impact of peak total traffic at all receptor locations considered. Therefore, the results for the peak HGV traffic are presented in Section 5.4 below.

The baseline data can be used for model verification purposes. However, the most recent pollutant monitoring data available is from 2017. Therefore, the traffic data has been factored using a growth factor provided by the Transport Consultant to obtain traffic flows representative of 2017. In addition, traffic data has been provided for the Site access road and the A4 Colnbrook Bypass east and west of the Site access, whilst monitoring data available for model verification purposes is mostly from sites located on the A4 London Road west of the Colnbrook Bypass. Therefore, traffic flows for the A4 London Road west of the Colnbrook Bypass for 2017 have been downloaded from the Department for Transport (DfT) website[4] for count point 78344 for use in the assessment.

Table 33 shows a summary of the construction phase traffic flows as Annual Average Daily Traffic (AADT) for the above scenarios, and for the development impact (i.e. Do something – Do minimum).

[4] https://roadtraffic.dft.gov.uk/#6/55.254/-6.064/basemap-regions-countpoints

Table 33: Construction Phase Traffic - AADT

Road link	2017 Baseline[1]		2021 Do Minimum		2021 Do Something		Development Impact	
	LDVs	HDVs	LDVs	HDVs	LDVs	HDVs	LDVs	HDVs
Site Access	0	0	0	0	680	342	680	342[3]
A4 Colnbrook Bypass east of site access	12,099	3,688	12,583	3,815	12,911	4,005	967	284
A4 Colnbrook Bypass west of site access	12,099	3,688	12,583	3,815	12,934	4,118	1,033	228
A4 London Road west of Colnbrook Bypass[2]	20,542	3,162	20,949	3,225	21,300	3,377	1,033	228

Notes:

(1) Data factored from 2019 to 2017 for use in model verification study using the growth factor provided by Transport Consultant.

(2) Data for A4 London Road west of Colnbrook Bypass obtained from DfT count point 78344 and factored to 2021 flows using the growth factor provided by Transport Consultant.

(3) HGVs generated by the Construction Phase of the Proposed Development includes abnormal loads.

5.3 Methodology

In order to assess the impact of the construction phase traffic, dispersion modelling has been undertaken using the ADMS-Roads model version 4.1. The meteorological and surface characteristics used are the same as those used for the assessment of process emission presented in Section 6.5.2.

Vehicles have been modelled at the following speeds, with the exception of slow-down sections within 50 m of major junctions which have been modelled at 20 kph for all vehicles:

- Site access: 20 kph;
- A4 London Road West of Colnbrook Bypass: 64 kph;
- A4 London Road (Colnbrook Bypass): 80kph.

The modelling has been undertaken assuming that vehicle emissions do not vary throughout the day. This is conservative as the majority of development-generated traffic occurs during daylight hours, when conditions are typically more conducive to dispersion of pollutants from road traffic.

Assessment of the impact of traffic emissions has been undertaken with reference to the IAQM criteria detailed in Table 12.

5.3.1 Emissions factors and background concentrations

Emissions factors have been taken from the Department for Environment Food and Rural Affairs (DEFRA) Emissions Factor Toolkit (EFT) version 9.0. Emissions factors for 2017 have been used for the verification year (2017). Whilst it may be considered appropriate to use 2021 emission factors for the opening year, this relies on projections of reducing average emissions from the vehicle fleet in future years. Therefore, 2019 emissions factors have been used for the 2021 scenarios as a conservative measure, i.e., it is assumed that average emissions will not reduce from current levels.

The background concentrations of nitrogen dioxide for the assessment of traffic emissions have been taken from the 2017 DEFRA mapped background concentrations for the grid square of each receptor. As a conservative measure it has been assumed that background concentrations will not decrease in future years. Further details of the basis of the mapped background concentrations are provided in Section 4.1.1. The mapped background concentrations for each roads receptor are detailed below.

Table 34: Background Concentrations for traffic emissions assessment

Receptor		2017 Mapped Background Concentration (µg/m³)		
		Nitrogen Dioxide	PM_{10}	$PM_{2.5}$
RR1	2 Colnbrook Bypass	29.35	16.69	11.53
RR2	4 Colnbrook Bypass	29.35	16.69	11.53
RR3	6 Colnbrook Bypass	29.35	16.69	11.53
RR4	8 Colnbrook Bypass	29.35	16.69	11.53
RR5	8 Orchard Court, the Island	29.35	16.69	11.53
RR6	Disraeli Court, London Road	23.79	17.37	12.04
RR7	540 London Road	23.79	17.37	12.04
RR8	563 London Road	23.79	17.37	12.04
RR9	2 Laburnum Grove	23.79	17.37	12.04

Receptor		2017 Mapped Background Concentration (µg/m³)		
		Nitrogen Dioxide	PM_{10}	$PM_{2.5}$
RR10	2 Tweed Road	23.79	17.37	12.04

5.3.2 Approach to modelling queueing traffic

A review of typical traffic conditions has been undertaken using Google Maps. This has indicated that during weekdays there is typically heavy queueing along the A4 at the western end of Colnbrook Bypass and on the A4 London Road between the Colnbrook Bypass and the M4. This information has been used to determine representative queue zones for use in the model.

Guidance has been taken from CERC guidance note 60 – Modelling queuing traffic[5]. This note recommends the following approach:

1. Assume a representative average vehicle length – the project Transport Consultant recommended 5.75 m which is the highways industry standard.
2. Assume that the vehicles are travelling at the slowest speed it is possible to model (5 km/h).
3. Calculate a representative AADT for the queue zones. The AADT can be calculated as:

   AADT = [speed(m/hour)/vehicle length(m)] x 24
4. Using the assumed values from (1) and (2), this gives a representative AADT of 20,870 vehicles.

In addition to the above methodology, the following points should be noted:

- The queue zones are either on, off or set to a factor of 0.5 depending upon the hour of the day, based upon the hours of queueing identified from Google Maps traffic data.
- Factoring the queue zones and slow-down phases by 0.5 assumes queue conditions for 50% of the hour factored. This has been used to represent the hours when queueing is present only some of the time, when less severe congestion has been identified either from Google Maps traffic data.
- There is no information as to how queue length or duration will change in future years. Extrapolating from queue length information on Google Maps is not possible. Therefore, the queue lengths and durations are identical in all scenarios.

5.3.3 Roads NOx conversion to NO_2

The background NO_2 concentrations have been used to convert modelled road contribution of NOx to NO_2 in accordance with the methodology outlined in LAQM.TG(16) using the DEFRA NOx to NO_2 calculator (version 7.1, April 2019).

When converting from NOx to NO_2 the following inputs have been used:

- The year has been taken as the same as the emissions data, i.e. 2017 or 2019 (conservatively selected to assess traffic in 2021) as appropriate;
- The local authority has been selected as "Slough"; and
- The traffic mix has been selected as "All London traffic".

[5] CERC note 60, Modelling queuing traffic, August 2004

5.3.4 Model verification

Model verification has been undertaken in accordance with the methodology prescribed by DEFRA in the guidance document 'Local Air Quality Management -Technical Guidance (TG16) (referred to hereafter as LAQM.TG(16)), which was last updated in February 2018. Details of the model verification procedure are provided in Appendix B.

The verification procedure has produced an adjustment factor of 1.3469. This factor has been applied to the modelled road-NOx concentrations. In the absence of any monitoring data for PM_{10} and $PM_{2.5}$ suitable for verification, it is considered appropriate to apply the adjustment factor for NOx to concentrations of PM_{10} and $PM_{2.5}$.

5.4 Results

The impact of vehicle emissions of nitrogen dioxide generated during the construction phase of the Proposed Development is presented in Table 35 below.

Table 35: Construction Phase Annual Mean Nitrogen Dioxide Impact at Roadside Receptors

Receptor	2021 Do Minimum PEC		2021 Do Something PEC		Proposed Development Impact		Magnitude of Change
	µg/m³	% of AQAL	µg/m³	% of AQAL	µg/m³	% of AQAL	
RR1	35.92	89.80%	36.08	90.20%	0.16	0.40%	Negligible*
RR2	36.10	90.25%	36.27	90.68%	0.17	0.42%	Negligible*
RR3	36.24	90.60%	36.42	91.05%	0.18	0.45%	Negligible*
RR4	36.16	90.40%	36.33	90.83%	0.17	0.43%	Negligible*
RR5	31.12	77.80%	31.18	77.95%	0.06	0.15%	Negligible*
RR6	36.99	92.48%	37.39	93.48%	0.40	1.00%	Negligible
RR7	31.94	79.85%	32.18	80.45%	0.24	0.60%	Negligible
RR8	35.56	88.90%	35.85	89.63%	0.29	0.72%	Negligible
RR9	31.82	79.55%	32.02	80.05%	0.20	0.50%	Negligible
RR10	34.88	87.20%	35.17	87.93%	0.29	0.72%	Negligible

Note:
** Negligible irrespective of total concentration*

The impact of vehicle emissions of particulate matter (as PM_{10}) generated during the construction phase of the Proposed Development is presented in Table 36 below.

Table 36: Construction Phase Annual Mean PM_{10} Impact at Roadside Receptors

Receptor	2021 Do Minimum PEC		2021 Do Something PEC		Proposed Development Impact		Magnitude of Change
	µg/m³	% of AQAL	µg/m³	% of AQAL	µg/m³	% of AQAL	
RR1	17.85	44.63%	17.89	44.74%	0.041	0.10%	Negligible*
RR2	17.89	44.73%	17.93	44.84%	0.042	0.11%	Negligible*

Receptor	2021 Do Minimum PEC		2021 Do Something PEC		Proposed Development Impact		Magnitude of Change
	µg/m³	% of AQAL	µg/m³	% of AQAL	µg/m³	% of AQAL	
RR3	17.92	44.80%	17.96	44.91%	0.043	0.11%	Negligible*
RR4	17.91	44.78%	17.95	44.89%	0.043	0.11%	Negligible*
RR5	17.14	42.86%	17.16	42.91%	0.018	0.04%	Negligible*
RR6	18.86	47.16%	18.91	47.27%	0.046	0.12%	Negligible*
RR7	18.36	45.90%	18.39	45.97%	0.029	0.07%	Negligible*
RR8	19.32	48.30%	19.37	48.44%	0.053	0.13%	Negligible*
RR9	18.59	46.49%	18.63	46.57%	0.032	0.08%	Negligible*
RR10	19.08	47.69%	19.12	47.81%	0.046	0.11%	Negligible*
Note:							
** Negligible irrespective of total concentration*							

The impact of vehicle emissions of particulate matter (as $PM_{2.5}$) generated during the construction phase of the Proposed Development is presented in Table 37 below.

Table 37: Construction Phase Annual Mean $PM_{2.5}$ Impact at Roadside Receptors

Receptor	2021 Do Minimum PEC		2021 Do Something PEC		Proposed Development Impact		Magnitude of Change
	µg/m³	% of AQAL	µg/m³	% of AQAL	µg/m³	% of AQAL	
RR1	12.21	48.86%	12.24	48.95%	0.023	0.09%	Negligible*
RR2	12.24	48.95%	12.26	49.04%	0.024	0.10%	Negligible*
RR3	12.25	49.01%	12.28	49.11%	0.025	0.10%	Negligible*
RR4	12.25	48.99%	12.27	49.09%	0.025	0.10%	Negligible*
RR5	11.80	47.19%	11.81	47.23%	0.010	0.04%	Negligible*
RR6	12.96	51.84%	12.99	51.95%	0.028	0.11%	Negligible*
RR7	12.64	50.58%	12.66	50.65%	0.017	0.07%	Negligible*
RR8	13.20	52.81%	13.23	52.93%	0.030	0.12%	Negligible*
RR9	12.77	51.10%	12.79	51.17%	0.019	0.08%	Negligible*
RR10	13.07	52.26%	13.09	52.37%	0.027	0.11%	Negligible*
Note:							
** Negligible irrespective of total concentration*							

As shown, the impact of construction phase vehicle emissions of nitrogen dioxide at five receptor locations is less than 0.5% of the AQAL and the magnitude of change can be screened out as ‘negligible’ irrespective of the total concentration. At the remaining five receptor locations the impact rounds to 1% of the AQAL and the PEC is less than 94.5% of the AQAL, so the magnitude of change is described as ‘negligible’.

The impact of construction phase vehicle emissions of particulate matter (as PM_{10} and $PM_{2.5}$) at all receptor locations considered is less than 0.5% of the AQAL and the magnitude of change can be screened out as ‘negligible’ irrespective of the total concentration.

As the impact can be described as ‘negligible’ at al receptor locations considered, we conclude that the overall effect of vehicle emissions during the construction phase of the Proposed Development on local air quality will be ‘not significant’.

6 Effect of proposals during operation

6.1 Selection of model

Detailed dispersion modelling was undertaking using the model ADMS 5.2, developed and supplied by Cambridge Environmental Research Consultants (CERC). This is a new generation dispersion model, which characterises the atmospheric boundary layer in terms of the atmospheric stability and the boundary layer height. In addition, the model uses a skewed Gaussian distribution for dispersion under convective conditions, to take into account the skewed nature of turbulence. The model also includes modules to take account of the effect of buildings and complex terrain.

ADMS is routinely used for modelling of emissions for planning and Environmental Permitting purposes to the satisfaction of the Environment Agency and Local Authorities. An analysis of the variation in model outputs has been undertaken and the maximum predicted concentration for each pollutant and averaging period has been used to determine the significance of any potential impacts.

6.2 Emission limits

The IED (Directive 2010/75/EU), adopted on 7th January 2013, is the key European Directive which covers almost all regulation of industrial processes in the EU. Within the IED, the requirements of the relevant sector BREF become binding as BAT guidance, as follows.

- Article 15, paragraph 2, of the IED requires that Emission Limit Values (ELVs) are based on best available techniques, referred to as BAT.
- Article 13 of the IED, requires that 'the Commission' develops BAT guidance documents (referred to as BREFs).
- Article 21, paragraph 3, of the IED, requires that when updated BAT conclusions are published, the Competent Authority (in England this is the Environment Agency) has up to four years to revise permits for facilities covered by that activity to comply with the requirements of the sector specific BREF.

The Final Draft Waste incineration BREF was published by the European IPPC Bureau in December 2018. Formal adoption of the BREF is expected in Q3 2019. Upon adoption of the final BREF, the Environment Agency will be required to review and implement conditions within all permits which require operators to comply with the requirements set out in the BREF. This will include the Proposed Development. As currently drafted, the BREF will introduce BAT-Associated Emission Limits (BAT-AELs) which are more stringent than the ELVs currently set out in the IED. It has been assumed that emissions from the Proposed Development will comply with the BAT-AELs, or the emission limits from Annex VI Part 3 of the Industrial Emissions Directive (IED) for waste incineration plants where BAT-AELs are not applicable. As an exception, lower emission limits are proposed for oxides of nitrogen from the EfW plant, due to the sensitivity of the local area, and a lower short term emission limit is proposed for sulphur dioxide.

6.3 Source and emissions data

The principal inputs to the model with respect to the emissions to air from the Proposed Development are presented in Table 38 to Table 40.

Table 38: Stack Source Data, Proposed Development

Item	Unit	HTI	EfW (per line)
Stack Data			
Height	m	55	55
Internal diameter – effective diameter	m	0.86	2.34
Location	m, m	503390.9, 178063.5	503390.9, 178063.5
Flue Gas Conditions			
Temperature	°C	140	140
Exit moisture content	% v/v	8.9%	16.08%
Exit oxygen content	% v/v dry	13.00%	7.00%
Reference oxygen content	% v/v dry	11.00%	11.00%
Volume at reference conditions (dry, ref O_2)	Nm^3/s	4.10	50.50
Volume at actual conditions	Am^3/s	8.71	64.92
Flue gas exit velocity	m/s	15	15.1
Note: *The Proposed Development will operate two independent EfW lines as well as the HTI. The data in this table is for each line individually.*			

Table 39: Stack Emissions Data – Daily Averages

Pollutant	Daily or Periodic ELV	HTI	EfW (per line)
	Conc. (mg/Nm^3)	Release Rate (g/s)	
Oxides of nitrogen (as NO_2)	120 (HTI), 100 (EfW)	0.492	5.050
Sulphur dioxide	30	0.123	1.515
Carbon monoxide	50	0.205	2.252
Fine Particulate Matter (PM)(1)	5	0.0205	0.2525
Hydrogen chloride	6	0.0246	0.3030
Volatile organic compounds (as TOC)	10	0.410	0.5050
Hydrogen fluoride	1	0.0410	0.0505
Ammonia	10	0.410	0.5050
Cadmium and thallium	0.02	0.082 mg/s	1.010 mg/s
Mercury	0.02	0.082 mg/s	1.010 mg/s
Other metals(2)	0.3	1.23 mg/s	15.15 mg/s
Benzo(a)pyrene (PaHs)(3)	0.04 µg/Nm^3	0.164 µg/s	2.020 µg/s
Dioxins and furans and PCBs	0.06 ng/Nm^3	0.246 ng/s	3.030 ng/s

Notes:

All emissions are expressed at reference conditions of dry gas, 11% oxygen, 273.15K.

(1) As a worst-case it has been assumed that the entire PM emissions consist of either PM_{10} or $PM_{2.5}$ for comparison with the relevant AQALs.

Pollutant	Daily or Periodic ELV	HTI	EfW (per line)
	Conc. (mg/Nm³)	Release Rate (g/s)	
(2) Other metals consist of antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni) and vanadium (V). *(3) The 90th %ile recorded emission concentration of B[a]P from the first Draft Waste incineration BREF, published by the European IPPC Bureau, was 0.04 ug/Nm³, or 0.00004 mg/Nm³ (dry, 11% oxygen, 273K). This is assumed to be the emission concentration for the Proposed Development.*			

Table 40: Stack Emissions Data – Half hourly Averages

Pollutant	Half-hourly ELV	HTI	EfW (per line)
	Conc. (mg/Nm³)	Release Rate (g/s)	
Oxides of nitrogen (as NO_2)	200	0.820	10.100
Sulphur dioxide	90	0.369	4.545
Carbon monoxide	150	0.615	7.575
Fine Particulate Matter (PM)(2)	30	0.123	1.515
Hydrogen chloride	60	0.246	10.100

If the Proposed Development continually operated at the half-hourly limits, the daily limits would be exceeded. The Proposed Development is designed to achieve the daily limits and as such will only operate at the short-term limits for short periods on rare occasions.

Additionally, the Proposed Development is designed to operate at full capacity and is not anticipated to have significant changes in loading. Therefore, it is appropriate to base the assessment on the design point of the system.

We have also modelled the impact of the existing Lakeside facilities, so that this can be subtracted from the impact of the proposed facilities to give a net change in permitted impacts. This is also used to consider the impacts during commissioning. The stack emissions data for these is shown below.

Table 41: Stack Source Data, Current Facilities

Item	Unit	HTI	EfW (per line)
Stack Data			
Height	m	75	75
Internal diameter – effective diameter	m	0.86	2.52
Location	m, m	503390.9, 178063.5	503901.2, 177366.2
Flue Gas Conditions			
Temperature	°C	140	145
Exit moisture content	% v/v	8.9%	16.08%
Exit oxygen content	% v/v dry	13.00%	11.00%
Reference oxygen content	% v/v dry	11.00%	18.00%

Item	Unit	HTI	EfW (per line)
Volume at reference conditions (dry, ref O_2)	Nm^3/s	4.10	40.00
Volume at actual conditions	Am^3/s	8.71	73.78
Flue gas exit velocity	m/s	15	14.8
Note: *The existing plant includes two independent EfW lines as well as the HTI. The data in this table is for each line individually.*			

Table 42: Stack Emissions Data for existing facilities – Daily Averages

Pollutant	Daily or Periodic ELV	HTI	EfW (per line)
	Conc. (mg/Nm^3)	Release Rate (g/s)	
Oxides of nitrogen (as NO_2)	200	0.82	8.0
Sulphur dioxide	50	0.205	2.0
Carbon monoxide	50	0.205	2.0
Fine Particulate Matter (PM)(1)	10	0.041	0.4
Hydrogen chloride	10	0.041	0.4
Volatile organic compounds (as TOC)	10	0.041	0.4
Hydrogen fluoride	1	0.0041	0.04
Ammonia	10	0.41	0.4
Cadmium and thallium	0.05	0.205 mg/s	2.0 mg/s
Mercury	0.05	0.205 mg/s	2.0 mg/s
Other metals(2)	0.5	2.05 mg/s	20.0 mg/s
Benzo(a)pyrene (PaHs)(3)	0.04 µg/Nm^3	0.164 µg/s	1.6 µg/s
Dioxins and furans and PCBs	0.1 ng/Nm^3	0.41 ng/s	4.0 ng/s

Notes:

All emissions are expressed at reference conditions of dry gas, 11% oxygen, 273.15K.

(1) As a worst-case it has been assumed that the entire PM emissions consist of either PM_{10} or $PM_{2.5}$ for comparison with the relevant AQALs.

(2) Other metals consist of antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni) and vanadium (V).

(3) The 90th %ile recorded emission concentration of B[a]P from the first Draft Waste incineration BREF, published by the European IPPC Bureau, was 0.04 ug/Nm^3, or 0.00004 mg/Nm^3 (dry, 11% oxygen, 273K). This is assumed to be the emission concentration for the existing facilities.

6.4 Scenarios considered

To determine the difference in air quality impacts, this assessment has compared the following two scenarios:

1. 'Best-case'– based on The Proposed Development operating at the emission limits as described in Table 32; and
2. 'Commissioning' – based on the Proposed Development operating one line at the emission limits detailed in Table 32 simultaneously with one line of the operational Lakeside EfW and HTI operating at the IED limits.

For this assessment, the modelling of both scenarios has been undertaken using ADMS version 5.2. The same five years of meteorological data (2014 – 2018) have been used in each model to allow for a comparison between the results.

6.5 Other Inputs

6.5.1 Modelling domain

Modelling has been undertaken over an 8 km x 8 km grid with a spatial resolution of 80m. The grid spacing in each direction is less than 1.5 times the minimum stack height considered in accordance with the Environment Agency's modelling guidance. Reference should be made to Figure 9 for a graphical representation of the modelling domain used. The extent of the modelling domain is detailed in Table 43.

Table 43: Modelling Domain

Grid Quantity	Value
Grid spacing (m)	80
Grid points	101
Grid Start X (m)	499400
Grid Finish X (m)	507400
Grid Start Y (m)	174100
Grid Finish Y (m)	182100

6.5.2 Meteorological data and surface characteristics

The impact of meteorological data was taken into account by using weather data from the Heathrow Airport meteorological recording station for the years 2014 – 2018. Heathrow Airport is located adjacent to the Proposed Development.

The period 2014 to 2018 was chosen as this was the most recent full set of data available at the time of starting the air quality modelling. The Environment Agency recommends that 5 years of data are used to take into account inter-annual fluctuations in weather conditions. Wind roses for each year can be found in Figure 10.

The minimum Monin-Obukhov length can be selected in ADMS for both the dispersion site and the meteorological site. This is a measure of the minimum stability of the atmosphere and can be adjusted to account for urban heat island effects which prevent the atmosphere in urban areas from ever becoming completely stable. The minimum Monin-Obukhov length has been set to 30 m for both the dispersion site and the meteorological site. This value is considered appropriate as both the dispersion site and the meteorological site due to their location on the edge of a large city.

The surface roughness length can be selected in ADMS for both the dispersion site and the meteorological site. The surface roughness has been set to 0.5m for the meteorological site and 0.5 m for the dispersion site. The value of 0.5 m is appropriate for the both sites which accounts for the mixture of surrounding suburban and industrial areas, open fields and woodland.

6.5.3 Buildings

The presence of adjacent buildings can significantly affect the dispersion of the atmospheric emissions in various ways:

- Wind blowing around a building distorts the flow and creates zones of turbulence. The increased turbulence can cause greater plume mixing.
- The rise and trajectory of the plume may be depressed slightly by the flow distortion. This downwash leads to higher ground level concentrations closer to the stack than those which would be present without the building.

The Environment Agency recommends that buildings should be included in the modelling if they are both:

- Within 5L of the stack (where L is the smaller of the building height and maximum projected width of the building); and
- Taller than 40% of the stack.

The ADMS 5.2 user guide also states that buildings less than one third of the stack height will not have any effect on dispersion.

A review of the site layout has been undertaken and the details of the applicable buildings are presented in Table 44. The building has a variable height of between 16 m and 42m with an aerodynamic shape and it was considered that including the full height of the building would overstate its effect on dispersion. Therefore, a more representative height of 34 m was used. A site plan showing which buildings have been included in the model is presented in Figure 11.

Table 44: Building Details

Buildings	Centre Point		Height (m)	Width (m)	Length (m)	Angle (°)
	X (m)	Y (m)				
North	503393.8	178040.6	34	45	62.15	358
South	503396.5	177964.4	34	75	91.26	358

6.5.4 Terrain

It is recommended that, where gradients within 500 m of the modelling domain are greater than 1 in 10, the complex terrain module within ADMS (FLOWSTAR) should be used. A review of the local area has deemed that the effect of terrain does not need to be taken into account in the modelling.

6.5.5 Chemistry

The Proposed Development will release nitric oxide (NO) and nitrogen dioxide (NO_2) which are collectively referred to as NOx. In the atmosphere, nitric oxide will be converted to nitrogen dioxide in a reaction with ozone which is influenced by solar radiation. Since the air quality objectives are expressed in terms of nitrogen dioxide, it is important to be able to assess the conversion rate of nitric oxide to nitrogen dioxide.

Ground level NOx concentrations have been predicted through dispersion modelling. Nitrogen dioxide concentrations reported in the results section assume 70% conversion from NOx to nitrogen dioxide for annual means and a 35% conversion for short term (hourly) concentrations, based upon the worst-case scenario in the Environment Agency methodology. Given the short travel time to the areas of maximum concentrations, this approach is considered conservative.

6.6 Sensitivity Assessment

6.6.1 Surface Roughness

The sensitivity of the results to surface roughness length has been considered by running the model with a range of surface roughness lengths for the dispersion site. The following parameters were kept constant:

- model – ADMS 5.2;
- stack height – 55 m;
- buildings – included;
- meteorological site surface roughness – 0.5 m;
- dispersion site Monin-Obukhov length – 30 m;
- meteorological site Monin-Obukhov length – 30 m;
- terrain – excluded; and
- meteorological data used – Heathrow Airport 2015.

Table 45 presents the ground level concentration of oxides of nitrogen at the point of maximum impact for each surface roughness value.

Table 45: Choice of Dispersion Site Surface Roughness Length

Surface Roughness Length (m)	NO_x Process Contribution (µg/m^3)		
	Annual Mean	Max 1-hour	99.79%ile of 1-hour
0.2	2.43	18.39	17.68
0.3	2.72	17.51	16.95
0.5	**3.08**	**16.36**	**15.97**
1	3.89	14.77	14.23

As shown, using varying surface roughness values leads to slightly different concentrations on an annual mean and short-term basis, with higher surface roughness values resulting in greater the peak annual mean impacts and smaller short-term impacts. The 0.5 m surface roughness value was selected for the model as this was deemed the most appropriate for the relatively urban surroundings of the dispersion site.

6.6.2 Buildings

The sensitivity of the results to the effect of buildings has been considered by running the model with and without building inputs. The following parameters were kept constant:

- model – ADMS 5.2;
- stack height – 55 m;
- dispersion site surface roughness value – 0.5 m;
- meteorological site surface roughness – 0.5 m;
- dispersion site Monin-Obukhov length – 30 m
- meteorological site Monin-Obukhov length – 30 m;
- terrain – excluded; and
- meteorological data used – Heathrow Airport 2015.

Table 46 presents the ground level concentration of oxides of nitrogen at the point of maximum impact for each building scenario.

Table 46: Effect of Buildings

Scenario used in model	NO_x Process Contribution (µg/m³)		
	Annual Mean	Max 1-hour	99.79%ile of 1-hour
Buildings	**3.08**	**16.36**	**15.97**
No buildings	0.94	7.69	5.21

As shown, modelling the presence of buildings results in a greater peak annual concentration than the 'no buildings' scenario. Based on the layout of the Proposed Development, it is expected that building downwash effects will influence the dispersion of pollutants. As such, buildings have been included in the dispersion model as this represents a realistic and conservative approach.

6.6.3 Terrain

The sensitivity of the results to the effect of terrain has been considered by running the model with and without a terrain file. The following parameters were kept constant:

- model – ADMS 5.2;
- stack height – 55 m;
- dispersion site surface roughness value – 0.5 m;
- meteorological site surface roughness – 0.5 m;
- dispersion site Monin-Obukhov length – 30 m;
- meteorological site Monin-Obukhov length – 30 m;
- buildings – included; and
- meteorological data used – Heathrow Airport 2015.

Table 47 presents the ground level concentration of oxides of nitrogen at the point of maximum impact for each terrain scenario.

Table 47: Effect of Terrain

Scenario used in model	NO_x Process Contribution (µg/m³)		
	Annual Mean	Max 1-hour	99.79%ile of 1-hour
Terrain	3.12	16.36	15.91
No terrain	**3.08**	**16.36**	**15.97**

As shown, the presence of terrain has a minimal impact on the long-term and short-term concentrations. As such, terrain has been excluded from the dispersion model.

6.7 Modelling Results – Main Case

The general approach of this assessment is to evaluate the highest predicted process contribution to ground level concentrations over the five modelled years (2014 – 2018), known as the point of maximum impact. In addition, the predicted impacts have been evaluated at the human sensitive receptors presented in Section 4.3.2.

6.7.1 Results at the point of maximum impact

Table 48 presents the maximum predicted impact of process emissions for the five modelled years (2014 – 2018) at the point of maximum impact for the Proposed Development. The results are compared to the relevant AQALs. Impacts that do not screen out as 'insignificant' in accordance with Environment Agency guidance are highlighted, and impacts that cannot be described as 'negligible' irrespective of the total concentration in accordance with the IAQM 2017 criteria are shown in bold.

If either of these criteria are exceeded, further analysis has been undertaken.

It should be noted that this assessment is considered highly conservative as it assumes that:

- the Proposed Development continually operates at the emission limits outlined in Section 6.2;
- for comparison with short term AQOs, the Proposed Development operates at the short term ELVs during the worst-case conditions for dispersion of emissions;
- the entire PM emissions consist of either PM_{10} or $PM_{2.5}$;
- the entire VOC emissions consist of either benzene or 1,3-butadiene; and
- cadmium is released at 100% of the combined emission limit for cadmium and thallium.

Table 48: Dispersion Modelling Results for Proposed Development – Point of Maximum Impact

Pollutant	Quantity	Units	AQAL	Background conc.	Process Contribution (PC)					Max PC		PEC	
					2014	2015	2016	2017	2018	Conc.	Max as % of AQAL	Conc.	Max as % of AQAL
Nitrogen dioxide	Annual mean	µg/m³	40	27.5	2.58	3.74	2.60	2.62	1.99	3.74	**9.36%**	31.24	78.11%
	99.79th %ile of hourly means*	µg/m³	200	55.00	38.08	38.97	37.99	38.07	37.07	38.97	**19.49%**	93.97	46.99%
Sulphur dioxide	99.18th %ile of daily means	µg/m³	125	66.00	9.87	11.42	9.75	9.70	8.60	11.42	9.14%	77.42	61.94%
	99.73rd %ile of hourly means*	µg/m³	350	66.00	48.55	49.48	48.43	48.68	47.32	49.48	**14.14%**	115.48	32.99%
	99.9th %ile of 15 min. means*	µg/m³	266	66.00	51.68	52.80	51.73	51.95	50.22	52.80	**19.85%**	118.80	44.66%
Particulates (PM_{10})	Annual mean	µg/m³	40	15.00	0.18	0.26	0.18	0.18	0.14	0.26	**0.66%**	15.26	38.16%
	90.41 %ile of daily means	µg/m³	50	30.00	0.68	0.88	0.59	0.68	0.53	0.88	1.75%	30.88	61.75%
Particulates ($PM_{2.5}$)	Annual mean	µg/m³	25	7.30	0.18	0.26	0.18	0.18	0.14	0.26	**1.05%**	7.56	30.25%
Carbon monoxide	8 hour running mean†	µg/m³	10,000	1012.00	27.31	27.02	26.94	25.85	25.99	27.31	0.27%	1039.31	10.39%
Hydrogen chloride	Hourly mean*	µg/m³	16	1.40	34.33	34.20	34.31	34.53	42.06	42.06	5.61%	43.46	5.80%

Pollutant	Quantity	Units	AQAL	Background conc.	Process Contribution (PC)					Max PC		PEC	
					2014	2015	2016	2017	2018	Conc.	Max as % of AQAL	Conc.	Max as % of AQAL
Hydrogen fluoride	Hourly mean*	µg/m³	160	4.60	2.29	2.28	2.29	2.30	2.80	2.80	1.75%	7.40	4.63%
Ammonia	Annual mean	µg/m³	180	1.70	0.36	0.53	0.36	0.37	0.28	0.53	0.29%	2.23	1.24%
	Hourly mean	µg/m³	2,500	3.40	5.72	5.70	5.72	5.75	7.01	7.01	0.28%	10.41	0.42%
VOCs (as benzene)	Annual mean	µg/m³	5	1.00	0.36	0.53	0.36	0.37	0.28	0.53	**10.52**%	1.53	30.52%
	Hourly mean*	µg/m³	195	2.00	5.72	5.70	5.72	5.75	7.01	7.01	3.60%	9.01	4.62%
VOCs (as 1,3-butadiene)	Annual mean	µg/m³	2.25	0.60	0.36	0.53	0.36	0.37	0.28	0.53	**23.37**%	1.13	50.03%
Mercury	Annual mean	ng/m³	250	3.70	0.72	1.05	0.73	0.73	0.56	1.05	0.42%	4.75	1.90%
	Hourly mean	ng/m³	7,500	7.40	11.44	11.40	11.44	11.51	14.02	14.02	0.19%	21.42	0.29%
Cadmium	Annual mean	ng/m³	5	0.26	0.72	1.05	0.73	0.73	0.56	1.05	**21.03**%	1.31	26.23%
	Hourly mean	ng/m³	-	0.52	11.44	11.40	11.44	11.51	14.02	14.02	-	14.54	-
PaHs	Annual mean	pg/m³	250	490.00	1.45	2.10	1.46	1.47	1.11	2.10	**0.84%**	492.10	196.84%
Dioxins and Furans	Annual mean	fg/m³	-	33.00	2.17	3.15	2.19	2.20	1.67	3.15	-	36.15	-
PCBs	Annual mean	ng/m³	200	127.50	0.18	0.26	0.18	0.18	0.14	0.26	0.13%	127.76	63.88%
PCBs	Hourly mean	ng/m³	6,000	255.00	2.86	2.85	2.86	2.88	3.51	3.51	0.06%	258.51	4.31%

* - run at the half-hourly emission limit.

† - run at the 10 minute emission limit.

As shown in Table 48, the following pollutants do not screen out as 'insignificant' in accordance with Environment Agency guidance or 'negligible' irrespective of the total concentration in accordance with the IAQM 2017 criteria:

- Annual mean and short-term nitrogen dioxide;
- Short-term sulphur dioxide;
- Annual mean particulate matter (as $PM_{2.5}$);
- Annual mean VOCs;
- Annual mean cadmium; and
- Annual mean PaHs.

In addition, annual mean particulate matter (as PM_{10}) and annual mean PaHs do not screen out as 'negligible' irrespective of the total concentration, but do screen out as 'insignificant' in accordance with Environment Agency guidance.

Further analysis of these pollutants has been carried out at sensitive receptors, taking account of background concentrations.

The long-term and short-term impact of the Proposed Development for all other pollutants can be screened out as 'insignificant' in accordance with Environment Agency guidance and 'negligible' irrespective of the total concentration in accordance with the IAQM 2017 criteria based on the process contribution alone, and so further assessment is not required.

6.7.2 Further assessment – annual mean nitrogen dioxide

Table 49 shows the maximum predicted annual mean nitrogen dioxide concentrations over the five modelled years (2014 – 2018) at the point of maximum impact and at each identified receptor location, in addition to the contribution from background sources. For this assessment of annual mean nitrogen dioxide, the impact of the existing Lakeside facilities has been subtracted to give a net change in permitted impacts. This is because the emission limit for the replacement EfW and HTI plant is half the emission limit for the existing EfW and HTI plant and therefore there is a potential benefit from the change.

Impacts that do not screen out as 'insignificant' in accordance with Environment Agency guidance are highlighted, and impacts that cannot be described as 'negligible' irrespective of the total concentration in accordance with the IAQM 2017 criteria are shown in bold.

Table 49: Further Analysis – Annual Mean Nitrogen Dioxide

Receptor ID	Receptor Name	Net PC		PEC	
		Conc. (µg/m³)	as % of AQAL	Conc. (µg/m³)	as % of AQAL
Point of maximum impact		3.45	**8.6%**	30.95	77.4%
R1	Old Slade Lane 1, Richings Park	2.69	**6.7%**	30.19	75.5%
R2	Old Slade Lane 2, Richings Park	1.33	**3.3%**	28.83	72.1%
R3	Old Slade Lane 3, Richings Park	0.76	**1.9%**	28.26	70.7%
R4	Main Drive, Richings Park	0.40	**1.0%**	27.90	69.8%
R5	North Park, Richings Park	0.24	**0.6%**	27.74	69.4%
R6	Sutton Lane 1, Langley	0.06	0.2%	27.56	68.9%
R7	Sutton Lane 2, Langley	0.07	0.2%	27.57	68.9%

Receptor ID	Receptor Name	Net PC		PEC	
		Conc. (µg/m³)	as % of AQAL	Conc. (µg/m³)	as % of AQAL
R8	London Road, Colnbrook	0.08	0.2%	27.58	69.0%
R9	Vicarage Way, Colnbrook	0.26	**0.6%**	27.76	69.4%
R10	The Hawthrorns, Colnbrook	0.05	0.1%	27.55	68.9%
R11	The Island, Longford	-0.12	-0.3%	27.38	68.5%
R12	Verbena Close, West Drayton	0.01	<0.1%	27.51	68.8%
R13	Lily Drive, West Drayton	-0.03	-0.1%	27.47	68.7%
R14	The Common, West Drayton	-0.01	<0.1%	27.49	68.7%
R15	Mayfield Park, West Drayton	-0.08	-0.2%	27.42	68.5%
R16	Thorney Mill Road, Thorney	0.07	0.2%	27.57	68.9%
R17	Richings Way, Richings Park	0.36	**0.9%**	27.86	69.7%
R18	Parlaunt Park Primary Academy	0.03	<0.1%	27.53	68.8%
R19	Foxborough Primary School	0.06	0.1%	27.56	68.9%
R20	Colnbrook CoE School	0.15	0.4%	27.65	69.1%
R21	Harmondsworth Primary School	-0.28	-0.7%	27.22	68.1%
R22	Laurel Lane Primary School	-0.01	<0.1%	27.49	68.7%
R23	St Catharine Catholic Primary School	-0.07	-0.2%	27.43	68.6%

Note:

PEC includes contribution of 27.50 µg/m³ which is the maximum monitored at the SB1 diffusion tube.

Assumes 70% conversion of NOx to NO_2.

As shown, the annual mean net process contribution from the Proposed Development cannot be screened out as ‘insignificant’ at the point of maximum impact. In addition, the PEC is predicted to be greater than 70% of the AQAL and as such it can be concluded that the impact of emissions cannot be screened out as ‘not significant' under EA guidance. Using the IAQM guidance the magnitude of change of can be described as described as ‘moderate adverse’ as the annual mean net process contribution is 5.5 - 10.5% of the AQAL and the PEC is less than 94.5% of the AQAL. In addition, this impact occurs in a small area within the South Buck District Council AQMA No. 2, declared for annual mean nitrogen dioxide concentrations. However, a review of local air quality monitoring data shows that baseline concentrations in the AQMA where the impact occurs are likely to be no more than 27.5 µg/m³ (the average monitored concentration at the SB1 Iver, Old Slade Lane). The impacts at areas of relevant exposure within the AQMA are described below.

Figure 12 shows the spatial distribution of emissions in relation to the human sensitive receptors identified for assessment. An analysis of the plot files shows that the area which cannot be screened out as ‘insignificant’ in accordance with Environment Agency guidance and ‘negligible’ irrespective of the total concentration in accordance with the IAQM 2017 criteria extends across a small area along Old Slade Lane, i.e. an area where the AQAL applies.

To assess the impact at areas of relevant exposure, the impact at sensitive receptors has been considered.

Under the IAQM guidance, the impact at all but seven sensitive receptors is less than 0.5% of the AQAL, and so can be described as 'negligible' irrespective of the total concentration. R1, R2 and R3 are all located on Old Slade Lane and R4 is located in close proximity, on Main Drive. Therefore, the background concentration presented in

Table 18 (27.5 µg/m³ monitored at SB1 Iver, Old Slade Lane) is applicable. When this background concentration is applied the impact of the Proposed Development at R1 is described as 'slight adverse' as the annual mean process contribution is 5.5 - 10.5% of the AQAL and the PEC is less than 75.5% of the AQAL. The impact of the Proposed Development at R2, R3 and R4 is described as 'negligible' as the annual mean process contribution is less than 5.5% of the AQAL and the PEC is less than 75.5% of the AQAL.

R5 is located along North Park, which is a fairly busy road. There are a number of houses along this road where the impact cannot be screened out as 'negligible' irrespective of the total concentration. There is a diffusion tube on this road which measures 39 µg/m³, but this is only 1.6 m from the kerbside. Along North Park, the closest house to the road is 4m away and by applying an adjustment for distance correction provided by DEFRA[6], the approximate background concentration is 36.7µg/m³. Applying this as the baseline concentration at R5, the PEC is predicted to be 36.94 µg/m³, or 92.3% of the AQAL. Therefore, the impact of the Proposed Development at R5 is described as 'negligible' as the annual mean process contribution is less than 1.5% of the AQAL and the PEC is less than 94.5% of the AQAL.

R9 in located in Colnbrook. Measured concentrations in Colnbrook away from main roads are up to 29 µg/m³. When this background concentration is applied, the PEC is predicted to be 29.26 µg/m³ or Therefore, the impact of the Proposed Development at R9 is described as 'negligible' as the annual mean process contribution is less than 1.5% of the AQAL and the PEC is less than 75.5% of the AQAL.

R17 is located away from a busy road between Richings Way and Thorney Lane South. A review of local air quality monitoring data shows that baseline concentrations close to this receptor are likely to be no more than 37.3 µg/m³ (the average maximum monitored at a roadside location near the receptor in the last four years – at the SB32 and SB33 Tower Arms, Thorney Lane co-located diffusion tubes). Applying this as the baseline concentration at R17 as a conservative measure, the PEC is predicted to be 37.5 µg/m³, or 93.9% of the AQAL. Therefore, the impact of the Proposed Development at R17 is described as 'negligible' as the annual mean process contribution is less than 1.5% of the AQAL and the PEC is less than 94.5% of the AQAL.

6.7.3 Further assessment – hourly mean nitrogen dioxide

Table 50 shows the maximum predicted nitrogen dioxide 99.79th percentile of hourly means concentrations over the five modelled years (2014 – 2018) at the point of maximum impact and at each identified receptor location, in addition to the contribution from background sources.

Impacts that do not screen out as 'insignificant' in accordance with Environment Agency guidance are highlighted, and impacts that cannot be described as 'negligible' irrespective of the total concentration in accordance with the IAQM 2017 criteria are shown in bold.

These results assume that the EfW Facility operates at the half-hourly emission limit of 200 mg/Nm³. In reality, the EfW Facility will mainly run below the daily emission limit of 100 mg/Nm³, so the results are considered conservative.

[6] Available from https://laqm.defra.gov.uk/tools-monitoring-data/no2-falloff.html

Table 50: Further Analysis – Hourly Mean Nitrogen Dioxide

Receptor ID	Receptor Name	PC		PEC	
		Conc. (µg/m³)	as % of AQAL	Conc. (µg/m³)	as % of AQAL
Point of maximum impact		38.97	**19.5%**	93.97	47.0%
R1	Old Slade Lane 1, Richings Park	25.11	**12.6%**	80.11	40.1%
R2	Old Slade Lane 2, Richings Park	19.44	9.7%	74.44	37.2%
R3	Old Slade Lane 3, Richings Park	16.66	8.3%	71.66	35.8%
R4	Main Drive, Richings Park	11.86	5.9%	66.86	33.4%
R5	North Park, Richings Park	10.62	5.3%	65.62	32.8%
R6	Sutton Lane 1, Langley	7.53	3.8%	62.53	31.3%
R7	Sutton Lane 2, Langley	9.62	4.8%	64.62	32.3%
R8	London Road, Colnbrook	6.61	3.3%	61.61	30.8%
R9	Vicarage Way, Colnbrook	10.66	5.3%	65.66	32.8%
R10	The Hawthrorns, Colnbrook	8.31	4.2%	63.31	31.7%
R11	The Island, Longford	5.73	2.9%	60.73	30.4%
R12	Verbena Close, West Drayton	4.73	2.4%	59.73	29.9%
R13	Lily Drive, West Drayton	4.48	2.2%	59.48	29.7%
R14	The Common, West Drayton	5.82	2.9%	60.82	30.4%
R15	Mayfield Park, West Drayton	5.13	2.6%	60.13	30.1%
R16	Thorney Mill Road, Thorney	5.67	2.8%	60.67	30.3%
R17	Richings Way, Richings Park	7.27	3.6%	62.27	31.1%
R18	Parlaunt Park Primary Academy	5.34	2.7%	60.34	30.2%
R19	Foxborough Primary School	4.96	2.5%	59.96	30.0%
R20	Colnbrook CoE School	8.59	4.3%	63.59	31.8%
R21	Harmondsworth Primary School	4.86	2.4%	59.86	29.9%
R22	Laurel Lane Primary School	4.18	2.1%	59.18	29.6%
R23	St Catharine Catholic Primary School	4.23	2.1%	59.23	29.6%

Using the IAQM guidance the magnitude of change at the point of maximum impact can be described as described as 'slight adverse' as the annual mean process contribution at the point of maximum impact is >10% of the short-term AQAL. The impact at all but one sensitive receptor is less than 10% of the AQAL, and so can be described as 'negligible' irrespective of the total concentration. At R1, the process contribution is predicted to be 25.1 µg/m³, or 12.6% of the short-term AQAL. Therefore, the impact of the Proposed Development at R1 is described as 'slight adverse.'

Under EA guidance, the short-term process contribution from the Proposed Development cannot be screened out as 'insignificant' at the point of maximum impact. Considering background concentrations, the headroom is 200 µg/m³ - (27.5µg/m³ x 2) = 145 µg/m³. The process contribution is 38.97 µg/m³, which is 26.87% of the headroom. Based on the predicted short-term process contribution, it cannot be concluded that there is little risk of the PEC exceeding the AQAL.

Figure 13 shows the spatial distribution of emissions in relation to the human sensitive receptors identified for assessment. This shows the area that cannot be screened out as 'insignificant' in accordance with Environment Agency guidance and 'negligible' irrespective of the total concentration in accordance with the IAQM 2017 criteria. An analysis of the plot files shows that the process contribution only exceeds 10% of the AQAL in a small area along Old Slade Lane, which only includes one receptor, R1. However, there is a very low likelihood of emissions at the half-hourly ELV coinciding with the worst-case weather conditions for dispersion, and the PEC is less than half of the AQAL.

Under the EA Guidance, the process contribution at R1 is 17.3% of the headroom, which is less than 20%, and therefore there is little risk of the AQAL being exceeded.

6.7.4 Further assessment – annual mean PM as PM_{10}

Table 51 shows the maximum predicted annual mean particulate matter concentrations (as PM_{10}) over the five modelled years (2014 – 2018) at the point of maximum impact and at each identified receptor location, in addition to the contribution from background sources. This analysis conservatively assumes that the entire PM is released at the ELV for total dust and the entire emissions consist of only PM_{10}.

Table 51: Further Analysis - Annual Mean Particulate Matter (As PM10)

Receptor ID	Receptor Name	PC		PEC	
		Conc. (µg/m³)	as % of AQAL	Conc. (µg/m³)	as % of AQAL
Point of maximum impact		0.26	**0.7%**	15.26	38.16%
R1	Old Slade Lane 1, Richings Park	0.21	**0.5%**	15.21	38.0%
R2	Old Slade Lane 2, Richings Park	0.11	0.3%	15.11	37.8%
R3	Old Slade Lane 3, Richings Park	0.08	0.2%	15.08	37.7%
R4	Main Drive, Richings Park	0.05	0.1%	15.05	37.6%
R5	North Park, Richings Park	0.03	0.1%	15.03	37.6%
R6	Sutton Lane 1, Langley	0.01	<0.1%	15.01	37.5%
R7	Sutton Lane 2, Langley	0.01	<0.1%	15.01	37.5%
R8	London Road, Colnbrook	0.01	<0.1%	15.01	37.5%
R9	Vicarage Way, Colnbrook	0.03	0.1%	15.03	37.6%
R10	The Hawthrorns, Colnbrook	0.01	<0.1%	15.01	37.5%
R11	The Island, Longford	0.02	<0.1%	15.02	37.5%
R12	Verbena Close, West Drayton	0.03	0.1%	15.03	37.6%
R13	Lily Drive, West Drayton	0.03	0.1%	15.03	37.6%
R14	The Common, West Drayton	0.04	0.1%	15.04	37.6%
R15	Mayfield Park, West Drayton	0.02	0.1%	15.02	37.6%
R16	Thorney Mill Road, Thorney	0.03	0.1%	15.03	37.6%

Receptor ID	Receptor Name	PC		PEC	
		Conc. (µg/m³)	as % of AQAL	Conc. (µg/m³)	as % of AQAL
R17	Richings Way, Richings Park	0.04	0.1%	15.04	37.6%
R18	Parlaunt Park Primary Academy	0.01	<0.1%	15.01	37.5%
R19	Foxborough Primary School	0.01	<0.1%	15.01	37.5%
R20	Colnbrook CoE School	0.03	0.1%	15.03	37.6%
R21	Harmondsworth Primary School	0.02	<0.1%	15.02	37.5%
R22	Laurel Lane Primary School	0.02	0.1%	15.02	37.6%
R23	St Catharine Catholic Primary School	0.02	<0.1%	15.02	37.5%
Note: PEC includes contribution of 15.00 µg/m³ which is the maximum monitored concentration from the Slough Lakeside 2 continuous monitor.					

The PC is less than 1% of the AQAL at all sensitive receptor locations considered, and therefore the impact at all sensitive receptors can be screened out as 'insignificant' using the Environment Agency's screening criteria.

Using the IAQM guidance, the impact at all but one sensitive receptor is less than 0.5% of the AQAL, and so can be described as 'negligible' irrespective of the total concentration. At R1 the annual mean process contribution is 0.5% of the AQAL and the PEC is 38.0% of the AQAL, and therefore the impact can be described as 'negligible' as the annual mean process contribution is less than 1.5% of the AQAL and the PEC is less than 75.5% of the AQAL.

6.7.5 Further assessment – annual mean PM as $PM_{2.5}$

Table 52 shows the maximum predicted annual mean particulate matter concentrations (as $PM_{2.5}$) over the five modelled years (2014 – 2018) at the point of maximum impact and at each identified receptor location, in addition to the contribution from background sources. This analysis conservatively assumes that the entire PM is released at the ELV for total dust and the entire emissions consist of only $PM_{2.5}$.

Table 52: Further Analysis - Annual Mean Particulate Matter (As PM2.5)

Receptor ID	Receptor Name	PC		PEC	
		Conc. (µg/m³)	as % of AQAL	Conc. (µg/m³)	as % of AQAL
Point of maximum impact		0.26	**1.0%**	7.56	30.3%
R1	Old Slade Lane 1, Richings Park	0.21	**0.9%**	7.51	30.1%
R2	Old Slade Lane 2, Richings Park	0.11	0.4%	7.41	29.6%
R3	Old Slade Lane 3, Richings Park	0.08	0.3%	7.38	29.5%
R4	Main Drive, Richings Park	0.05	0.2%	7.35	29.4%
R5	North Park, Richings Park	0.03	0.1%	7.33	29.3%
R6	Sutton Lane 1, Langley	0.01	0.1%	7.31	29.3%
R7	Sutton Lane 2, Langley	0.01	0.1%	7.31	29.3%

Receptor ID	Receptor Name	PC		PEC	
		Conc. (µg/m³)	as % of AQAL	Conc. (µg/m³)	as % of AQAL
R8	London Road, Colnbrook	0.01	0.1%	7.31	29.3%
R9	Vicarage Way, Colnbrook	0.03	0.1%	7.33	29.3%
R10	The Hawthrorns, Colnbrook	0.01	<0.1%	7.31	29.2%
R11	The Island, Longford	0.02	0.1%	7.32	29.3%
R12	Verbena Close, West Drayton	0.03	0.1%	7.33	29.3%
R13	Lily Drive, West Drayton	0.03	0.1%	7.33	29.3%
R14	The Common, West Drayton	0.04	0.2%	7.34	29.4%
R15	Mayfield Park, West Drayton	0.02	0.1%	7.32	29.3%
R16	Thorney Mill Road, Thorney	0.03	0.1%	7.33	29.3%
R17	Richings Way, Richings Park	0.04	0.2%	7.34	29.4%
R18	Parlaunt Park Primary Academy	0.01	<0.1%	7.31	29.2%
R19	Foxborough Primary School	0.01	<0.1%	7.31	29.2%
R20	Colnbrook CoE School	0.03	0.1%	7.33	29.3%
R21	Harmondsworth Primary School	0.02	0.1%	7.32	29.3%
R22	Laurel Lane Primary School	0.02	0.1%	7.32	29.3%
R23	St Catharine Catholic Primary School	0.02	0.1%	7.32	29.3%
Note: PEC includes contribution of 7.30 µg/m³ which is the maximum monitored concentration from the Slough Lakeside 2 continuous monitor.					

Using the IAQM guidance the magnitude of change can be described as 'negligible' as the annual mean process contribution is less than 1.5% of the AQAL and the PEC is less than 75.5% of the AQAL.

Under EA guidance, the annual mean process contribution from the Proposed Development cannot be screened out as 'insignificant' at the point of maximum impact. However, when the background concentration is applied the PEC is predicted to be less than 70% of the AQAL and as such the impact of emissions can be screened out as 'not significant' using the EA guidance. The PC is less than 1% of the AQAL at all sensitive receptor locations considered, and therefore the impact at these receptors can be screened out as 'insignificant' using the Environment Agency's screening criteria.

Figure 15 shows the spatial distribution of emissions in relation to the human sensitive receptors identified for assessment. This shows the area that cannot be screened out as 'insignificant' in accordance with Environment Agency guidance and 'negligible' irrespective of the total concentration in accordance with the IAQM 2017 criteria is uninhabited and the annual mean AQAL does not apply.

Using the IAQM guidance, the impact at all but one sensitive receptor is less than 0.5% of the AQAL, and so can be described as 'negligible' irrespective of the total concentration. At R1 the annual mean process contribution is 0.9% of the AQAL and the PEC is 30.1% of the AQAL, and therefore the impact can be described as 'negligible' as the annual mean process contribution is less than 1.5% of the AQAL and the PEC is less than 75.5% of the AQAL.

6.7.6 Further assessment – annual mean VOCs (as benzene)

Table 53 shows the maximum predicted annual mean VOC concentrations (as benzene) over the five modelled years (2014– 2018) at the point of maximum impact and at each identified receptor location, in addition to the contribution from background sources. It should be noted that this conservatively assumes that all the VOC released from the Proposed Development consist of only benzene.

Table 53: Further Analysis – Annual Mean VOCs as Benzene

Receptor ID	Receptor Name	PC		PEC	
		Conc. (µg/m³)	as % of AQAL	Conc. (µg/m³)	as % of AQAL
Point of maximum impact		0.53	**10.5%**	1.53	30.5%
R1	Old Slade Lane 1, Richings Park	0.43	**8.6%**	1.43	28.6%
R2	Old Slade Lane 2, Richings Park	0.22	**4.5%**	1.22	24.5%
R3	Old Slade Lane 3, Richings Park	0.15	**3.1%**	1.15	23.1%
R4	Main Drive, Richings Park	0.10	**1.9%**	1.10	21.9%
R5	North Park, Richings Park	0.06	**1.3%**	1.06	21.3%
R6	Sutton Lane 1, Langley	0.03	**0.5%**	1.03	20.5%
R7	Sutton Lane 2, Langley	0.03	**0.6%**	1.03	20.6%
R8	London Road, Colnbrook	0.03	**0.6%**	1.03	20.6%
R9	Vicarage Way, Colnbrook	0.06	**1.3%**	1.06	21.3%
R10	The Hawthrorns, Colnbrook	0.02	**0.5%**	1.02	20.5%
R11	The Island, Longford	0.03	**0.6%**	1.03	20.6%
R12	Verbena Close, West Drayton	0.06	**1.2%**	1.06	21.2%
R13	Lily Drive, West Drayton	0.05	**1.0%**	1.05	21.0%
R14	The Common, West Drayton	0.08	**1.5%**	1.08	21.5%
R15	Mayfield Park, West Drayton	0.05	**1.0%**	1.05	21.0%
R16	Thorney Mill Road, Thorney	0.07	**1.4%**	1.07	21.4%
R17	Richings Way, Richings Park	0.08	**1.7%**	1.08	21.7%
R18	Parlaunt Park Primary Academy	0.02	0.4%	1.02	20.4%
R19	Foxborough Primary School	0.02	0.4%	1.02	20.4%
R20	Colnbrook CoE School	0.05	**1.0%**	1.05	21.0%
R21	Harmondsworth Primary School	0.03	**0.6%**	1.03	20.6%
R22	Laurel Lane Primary School	0.04	**0.9%**	1.04	20.9%
R23	St Catharine Catholic Primary School	0.03	**0.7%**	1.03	20.7%

Note:
PEC includes contribution of 1.0 µg/m³ which is the maximum mapped background concentration over the modelling domain.

As shown, the annual mean process contribution from the Proposed Development cannot be screened out as 'insignificant' under EA guidance at the point of maximum impact. However, when the background concentration is applied the PEC is predicted to be less than 70% of the AQAL and as such it can be concluded that the impact of emissions is ‘not significant'.

Using the IAQM Guidance, the magnitude of change associated with process emissions from the Proposed Development is described as ‘moderate adverse’ as the annual mean process contribution is >10% of the AQAL and the PEC is less than 75.5% of the AQAL. Figure 16 shows the spatial distribution of emissions in relation to the human sensitive receptors identified for assessment. This shows the area that cannot be screened out as ‘insignificant’ in accordance with Environment Agency guidance and ‘negligible’ irrespective of the total concentration in accordance with the IAQM 2017 criteria. As shown, the point of maximum impact is uninhabited and the annual mean AQAL does not apply.

To assess the impact at areas of relevant exposure the impact at sensitive receptors has been considered. The change in impact at 10 sensitive receptors is less than 1% of the AQAL and can be screened out as ‘insignificant’. At 13 sensitive receptor locations the impact of the Proposed Development is greater than 1%. However, when the background concentration is applied the PEC is below 70% of the AQAL. Therefore, using the Environment Agency’s screening criteria, the impact of the Proposed Development at the sensitive receptors can be screened out as ‘not significant’.

Under the IAQM guidance, the impact at two sensitive receptors is less than 0.5% of the AQAL, and so can be described as ‘negligible’ irrespective of the total concentration. The impact at 20 sensitive receptor locations is 0.5% - 5.5% of the AQAL. When the background concentration is applied the impact can be described as ‘negligible’, as the annual mean process contribution is less than 5.5% of the AQAL and the PEC is less than 75.5% of the AQAL.

At R1 the impact is predicted to be 8.5% of the AQAL and the PEC is 28.6% of the AQAL. Therefore, when the background concentration is applied, the impact is described as ‘slight adverse’. However, this is highly conservative, as it assumes that all the VOCs released from the Proposed Development consist of only benzene. In reality, benzene makes up less than 20% of VOC emissions and EfW plants operate with VOC concentrations below 20% of the emission limit. This means that the actual process contribution will be less than 0.5% of the AQAL.

6.7.7 Further assessment – annual mean VOCs (as 1,3-butadiene)

Table 54 shows the maximum predicted annual mean VOC concentrations (as 1,3-butadiene) over the five modelled years (2014 – 2018) at the point of maximum impact and at each identified receptor location, in addition to the contribution from background sources. It should be noted that this conservatively assumes that all the VOC released from the Proposed Development consist of only 1,3-butadiene.

Table 54: Further Analysis – Annual Mean VOCs as 1,3-Butadiene

Receptor ID	Receptor Name	PC		PEC	
		Conc. (µg/m³)	as % of AQAL	Conc. (µg/m³)	as % of AQAL
Point of maximum impact		0.53	**23.4%**	1.13	50.0%
R1	Old Slade Lane 1, Richings Park	0.43	**19.1%**	1.03	45.8%
R2	Old Slade Lane 2, Richings Park	0.22	**9.9%**	0.82	36.6%
R3	Old Slade Lane 3, Richings Park	0.15	**6.8%**	0.75	33.5%
R4	Main Drive, Richings Park	0.10	**4.2%**	0.70	30.9%
R5	North Park, Richings Park	0.06	**2.9%**	0.66	29.5%

Receptor ID	Receptor Name	PC		PEC	
		Conc. (µg/m³)	as % of AQAL	Conc. (µg/m³)	as % of AQAL
R6	Sutton Lane 1, Langley	0.03	**1.2%**	0.63	27.9%
R7	Sutton Lane 2, Langley	0.03	**1.3%**	0.63	27.9%
R8	London Road, Colnbrook	0.03	**1.3%**	0.63	28.0%
R9	Vicarage Way, Colnbrook	0.06	**2.8%**	0.66	29.5%
R10	The Hawthrorns, Colnbrook	0.02	**1.1%**	0.62	27.8%
R11	The Island, Longford	0.03	**1.4%**	0.63	28.0%
R12	Verbena Close, West Drayton	0.06	**2.7%**	0.66	29.4%
R13	Lily Drive, West Drayton	0.05	**2.2%**	0.65	28.9%
R14	The Common, West Drayton	0.08	**3.4%**	0.68	30.0%
R15	Mayfield Park, West Drayton	0.05	**2.2%**	0.65	28.9%
R16	Thorney Mill Road, Thorney	0.07	**3.0%**	0.67	29.7%
R17	Richings Way, Richings Park	0.08	**3.8%**	0.68	30.4%
R18	Parlaunt Park Primary Academy	0.02	**0.8%**	0.62	27.5%
R19	Foxborough Primary School	0.02	**0.8%**	0.62	27.5%
R20	Colnbrook CoE School	0.05	**2.3%**	0.65	29.0%
R21	Harmondsworth Primary School	0.03	**1.4%**	0.63	28.1%
R22	Laurel Lane Primary School	0.04	**1.9%**	0.64	28.6%
R23	St Catharine Catholic Primary School	0.03	**1.5%**	0.63	28.1%
Note: PEC includes contribution of 0.60 µg/m³ which is the maximum mapped background concentration over the modelling domain.					

As shown, the annual mean process contribution from the Proposed Development cannot be screened out as 'insignificant' at the point of maximum impact under EA guidance. However, when the background concentration is applied the PEC is predicted to be less than 70% of the AQAL and as such it can be concluded that the impact of emissions is 'not significant'.

Using the IAQM guidance the magnitude of change associated with process emissions from the Proposed Development is described as 'moderate adverse' as the annual mean process contribution is >10% of the AQAL and the PEC is less than 75.5% of the AQAL. Figure 17 shows the spatial distribution of emissions in relation to the human sensitive receptors identified for assessment. This shows the area that cannot be described as 'negligible' irrespective of the total concentration in accordance with the IAQM 2017 criteria. As shown, the point of maximum impact is uninhabited and the annual mean AQAL does not apply.

To assess the impact at areas of relevant exposure the impact at sensitive receptors has been considered. The impact at all but two sensitive receptors is greater than 1% of the AQAL. However, when the background concentration is applied, the overall PEC is below 70% of the AQAL. Therefore, using the Environment Agency's screening criteria, the impact of the Proposed Development at all sensitive receptors can be screened out as 'not significant'.

Under the IAQM guidance, the impact at 20 sensitive receptors is 0.5% - 5.5% of the AQAL. When the background concentration is applied, the impact can be described as 'negligible' as the annual mean process contribution is less than 5.5% of the AQAL and the PEC is less than 75.5% of the AQAL.

At R2 and R3 the impact is described as 'slight adverse' as the annual mean process contribution is 5.5 -10.5% of the AQAL and the PEC is less than 75.5% of the AQAL.

At R1 the impact is described as 'moderate adverse' as the annual mean process contribution is greater than 10.5% of the AQAL and the PEC is less than 75.5% of the AQAL.

However, this is highly conservative, as it assumes that all the VOCs released from the Proposed Development consist of only 1,3-butadiene. In reality, 1,3-butadiene makes up less than 10% of VOC emissions and EfW plants operate with VOC concentrations below 20% of the emission limit. This means that the actual process contribution will be less than 0.5% of the AQAL.

6.7.8 Further assessment – annual mean cadmium

As previously noted, this assessment has initially used a screening assumption that cadmium is released from the Proposed Development at the combined emission limit for cadmium and thallium. However, monitoring from waste incineration facilities has indicated that concentrations of cadmium are typically approximately 35% of the ELV. Therefore, this assessment has considered the impact of cadmium under the following three scenarios:

3. screening – assumes cadmium is released at 100% of the combined ELV;
4. worst-case – assumes cadmium is released at 50% of the combined ELV; and
5. typical – assumes cadmium is released at 35% of the combined ELV.

Table 55 shows the maximum predicted annual mean cadmium concentrations over the five modelled years (2014 – 2018) at the point of maximum impact and at each identified receptor location.

Table 55: Further Analysis – Annual Mean Cadmium

Site ID	Site Name	PC		PEC	
		Conc. (ng/m³)	as % of AQAL	Conc. (ng/m³)	as % of AQAL
Point of maximum impact – screening		1.05	**21.0%**	1.31	26.2%
Point of maximum impact – worst-case		0.53	**10.5%**	0.79	15.7%
Point of maximum impact – typical		0.37	**7.4%**	0.63	12.6%
Receptors – Typical					
R1	Old Slade Lane 1, Richings Park	0.86	**6.0%**	1.12	22.4%
R2	Old Slade Lane 2, Richings Park	0.45	**3.1%**	0.71	14.1%
R3	Old Slade Lane 3, Richings Park	0.31	**2.1%**	0.57	11.3%
R4	Main Drive, Richings Park	0.19	**1.3%**	0.45	9.0%
R5	North Park, Richings Park	0.13	**0.9%**	0.39	7.8%
R6	Sutton Lane 1, Langley	0.05	0.4%	0.31	6.3%
R7	Sutton Lane 2, Langley	0.06	0.4%	0.32	6.3%
R8	London Road, Colnbrook	0.06	0.4%	0.32	6.4%
R9	Vicarage Way, Colnbrook	0.13	**0.9%**	0.39	7.7%

Site ID	Site Name	PC		PEC	
		Conc. (ng/m^3)	as % of AQAL	Conc. (ng/m^3)	as % of AQAL
R10	The Hawthrons, Colnbrook	0.05	0.3%	0.31	6.2%
R11	The Island, Longford	0.06	0.4%	0.32	6.4%
R12	Verbena Close, West Drayton	0.12	**0.9%**	0.38	7.7%
R13	Lily Drive, West Drayton	0.10	**0.7%**	0.36	7.2%
R14	The Common, West Drayton	0.15	**1.1%**	0.41	8.2%
R15	Mayfield Park, West Drayton	0.10	**0.7%**	0.36	7.2%
R16	Thorney Mill Road, Thorney	0.14	**1.0%**	0.40	7.9%
R17	Richings Way, Richings Park	0.17	**1.2%**	0.43	8.6%
R18	Parlaunt Park Primary Academy	0.04	0.3%	0.30	6.0%
R19	Foxborough Primary School	0.04	0.3%	0.30	5.9%
R20	Colnbrook CoE School	0.10	**0.7%**	0.36	7.3%
R21	Harmondsworth Primary School	0.06	0.4%	0.32	6.5%
R22	Laurel Lane Primary School	0.09	**0.6%**	0.35	6.9%
R23	St Catharine Catholic Primary School	0.07	**0.5%**	0.33	6.5%

Note:
PEC includes contribution of 0.26 ng/m^3 which is the maximum annual average monitored concentration from UK urban background sites (2013 – 2017)

As shown, in the 'screening scenario', the annual mean process contribution from the Proposed Development cannot be screened out as 'insignificant' at the point of maximum impact using EA guidance. However, the PEC is predicted to be less than 70% of the AQAL and as such it can be concluded that the impact of emissions is 'not significant'. Using the IAQM guidance the magnitude of change associated with process emissions from the Proposed Development is described as 'moderate adverse' as the annual mean process contribution is >10% of the AQAL and the PEC is less than 75.5% of the AQAL. However, this is extremely conservative as monitoring data from facilities processing a similar fuel has indicated concentrations of cadmium are usually about 35% of the limit. The annual mean cadmium process contribution as a percentage of the AQAL for this screening assumption is presented in Figure 18.

To assess the impact at areas of relevant exposure, the impact at sensitive receptors has been considered using the 'typical scenario'. The change in impact at 16 sensitive receptors is less than 1% of the AQAL and can be screened out as 'insignificant'. At seven sensitive receptor locations the impact of the Proposed Development is greater than 1%. However, when the background concentration is applied the PEC is below 70% of the AQAL. Therefore, using the Environment Agency's screening criteria, the impact of the Proposed Development at the sensitive receptors can be screened out as 'not significant'.

Under the IAQM guidance, the impact at eight sensitive receptors is less than 0.5% of the AQAL, and so can be described as 'negligible' irrespective of the total concentration. The impact at 14 sensitive receptors is 0.5% - 5.5% of the AQAL. When the background concentration is applied, the impact can be described as 'negligible' as the annual mean process contribution is less than 5.5% of the AQAL and the PEC is less than 75.5% of the AQAL. At R1 the impact is predicted to be 5.5% -

10.5% of the AQAL and the PEC is predicted to be below 75.5% of the AQAL. Therefore, the impact is described as 'slight adverse' at this receptor only.

6.7.9 Further assessment – annual mean PaHs

Table 56 shows the maximum predicted annual mean PaHs over the five modelled years (2014 – 2018) at the point of maximum impact and at each identified receptor location, in addition to the contribution from background sources.

Table 56: Further Analysis - Annual Mean PaHs

Receptor ID	Receptor Name	PC		PEC	
		Conc. (µg/m³)	as % of AQAL	Conc. (µg/m³)	as % of AQAL
Point of maximum impact		2.10	**0.8%**	492.10	196.8%
R1	Old Slade Lane 1, Richings Park	1.72	**0.7%**	491.72	196.7%
R2	Old Slade Lane 2, Richings Park	0.89	0.4%	490.89	196.4%
R3	Old Slade Lane 3, Richings Park	0.61	0.2%	490.61	196.2%
R4	Main Drive, Richings Park	0.38	0.2%	490.38	196.2%
R5	North Park, Richings Park	0.26	0.1%	490.26	196.1%
R6	Sutton Lane 1, Langley	0.11	<0.1%	490.11	196.0%
R7	Sutton Lane 2, Langley	0.11	<0.1%	490.11	196.0%
R8	London Road, Colnbrook	0.12	<0.1%	490.12	196.0%
R9	Vicarage Way, Colnbrook	0.25	0.1%	490.25	196.1%
R10	The Hawthrorns, Colnbrook	0.10	<0.1%	490.10	196.0%
R11	The Island, Longford	0.12	<0.1%	490.12	196.0%
R12	Verbena Close, West Drayton	0.25	0.1%	490.25	196.1%
R13	Lily Drive, West Drayton	0.20	0.1%	490.20	196.1%
R14	The Common, West Drayton	0.30	0.1%	490.30	196.1%
R15	Mayfield Park, West Drayton	0.20	0.1%	490.20	196.1%
R16	Thorney Mill Road, Thorney	0.27	0.1%	490.27	196.1%
R17	Richings Way, Richings Park	0.34	0.1%	490.34	196.1%
R18	Parlaunt Park Primary Academy	0.08	<0.1%	490.08	196.0%
R19	Foxborough Primary School	0.07	<0.1%	490.07	196.0%
R20	Colnbrook CoE School	0.21	0.1%	490.21	196.1%
R21	Harmondsworth Primary School	0.13	0.1%	490.13	196.1%
R22	Laurel Lane Primary School	0.17	0.1%	490.17	196.1%
R23	St Catharine Catholic Primary School	0.13	0.1%	490.13	196.1%
Note: PEC includes contribution of 490.0 µg/m³ which is the maximum of the UK average concentrations.					

As shown, the annual mean process contribution from the Proposed Development can be screened out as 'insignificant' at the point of maximum impact using EA guidance.

Using the IAQM guidance, the magnitude of change can be described as 'moderate adverse' as the annual mean process contribution is less than 1.5% of the AQAL and the PEC is greater than 110% of the AQAL. Baseline concentrations in the vicinity of the Proposed Development are already high at 196.0% of the AQAL, and the process contribution from the Proposed Development is very small at 0.8% of the AQAL. Therefore, emissions from the Proposed Development represent a small proportion of the long-term average concentration.

Figure 19 shows the spatial distribution of emissions in relation to the human sensitive receptors identified for assessment. This shows the area that cannot be described as 'negligible' irrespective of the total concentration in accordance with the IAQM 2017.

As shown, the PC is less than 1% of the AQAL at all sensitive receptor locations considered, and therefore the impact at these receptors can be screened out as 'insignificant' using the Environment Agency's screening criteria.

Using the IAQM guidance, the impact at all but one sensitive receptor is less than 0.5% of the AQAL, and so can be described as 'negligible' irrespective of the total concentration. At R1 the annual mean process contribution is 0.7% of the AQAL and the PEC is 196.7% of the AQAL, and therefore the impact is described as 'moderate adverse'. Excluding the process contribution from the Proposed Development, the PEC is already predicted to be 196.0% of the AQAL. Therefore, emissions from the Proposed Development represent a small proportion of the long-term average concentration at R1 (0.7% of the AQAL).

6.7.10 Further assessment – 99.73rd %ile of hourly means sulphur dioxide

Table 57 shows the maximum predicted 99.73rd %ile of hourly mean sulphur dioxide concentrations over the five modelled years (2014 – 2018) at the point of maximum impact and at each identified receptor location, in addition to the contribution from background sources.

Impacts that do not screen out as 'insignificant' in accordance with Environment Agency guidance are highlighted, and impacts that cannot be described as 'negligible' irrespective of the total concentration in accordance with the IAQM 2017 criteria are shown in bold.

Table 57: Further Analysis – 99.73rd %ile of Hourly Means Sulphur Dioxide

Receptor ID	Receptor Name	PC		PEC	
		Conc. (µg/m³)	as % of AQAL	Conc. (µg/m³)	as % of AQAL
Point of maximum impact		49.48	**14.1%**	115.48	33.0%
R1	Old Slade Lane 1, Richings Park	32.15	9.2%	98.15	28.0%
R2	Old Slade Lane 2, Richings Park	24.68	7.1%	90.68	25.9%
R3	Old Slade Lane 3, Richings Park	21.36	6.1%	87.36	25.0%
R4	Main Drive, Richings Park	14.97	4.3%	80.97	23.1%
R5	North Park, Richings Park	13.48	3.9%	79.48	22.7%
R6	Sutton Lane 1, Langley	9.60	2.7%	75.60	21.6%

Receptor ID	Receptor Name	PC		PEC	
		Conc. (µg/m³)	as % of AQAL	Conc. (µg/m³)	as % of AQAL
R7	Sutton Lane 2, Langley	11.90	3.4%	77.90	22.3%
R8	London Road, Colnbrook	8.22	2.3%	74.22	21.2%
R9	Vicarage Way, Colnbrook	13.44	3.8%	79.44	22.7%
R10	The Hawthrorns, Colnbrook	10.43	3.0%	76.43	21.8%
R11	The Island, Longford	7.07	2.0%	73.07	20.9%
R12	Verbena Close, West Drayton	5.95	1.7%	71.95	20.6%
R13	Lily Drive, West Drayton	5.64	1.6%	71.64	20.5%
R14	The Common, West Drayton	7.35	2.1%	73.35	21.0%
R15	Mayfield Park, West Drayton	6.51	1.9%	72.51	20.7%
R16	Thorney Mill Road, Thorney	7.26	2.1%	73.26	20.9%
R17	Richings Way, Richings Park	9.22	2.6%	75.22	21.5%
R18	Parlaunt Park Primary Academy	6.60	1.9%	72.60	20.7%
R19	Foxborough Primary School	6.19	1.8%	72.19	20.6%
R20	Colnbrook CoE School	10.80	3.1%	76.80	21.9%
R21	Harmondsworth Primary School	6.09	1.7%	72.09	20.6%
R22	Laurel Lane Primary School	5.11	1.5%	71.11	20.3%
R23	St Catharine Catholic Primary School	5.11	1.5%	71.11	20.3%

As shown, the short-term process contribution from the Proposed Development cannot be screened out as 'insignificant' at the point of maximum impact. The headroom is 350 µg/m³ - (33.0 µg/m³ x 2) = 284 µg/m³. The process contribution is 49.4 µg/m³, which is 17.4% of the headroom. Therefore, for 1-hour sulphur dioxide concentrations, it can be concluded that "there is little risk of the PEC exceeding the AQAL", and the impact can be considered to be 'not significant'.

Using the IAQM guidance the magnitude of change at the point of maximum impact can be described as 'slight adverse' as the process contribution is >10% of the short-term AQAL. Figure 20 shows the spatial distribution of emissions in relation to the human sensitive receptors identified for assessment. This shows the area that cannot be described as 'negligible' irrespective of the total concentration in accordance with the IAQM 2017 criteria. An analysis of the plot files shows that the process contribution exceeds 10% of the AQAL in a small area along Old Slade Lane and neighbouring golf course, i.e. an area where the AQAL applies. However, there is a very low likelihood of emissions at the half-hourly ELV coinciding with the worst-case weather conditions for dispersion.

To assess the impact at areas of relevant exposure the impact at sensitive receptors has been considered. The change in impact at all sensitive receptors is less than 10% of the AQAL and can be screened out as 'insignificant'.

Under the IAQM guidance, the impact at all sensitive receptors is less than 10% of the AQAL, and so can be described as 'negligible' irrespective of the total concentration.

6.7.11 Further assessment – 99.9th %ile of 15-minute means sulphur dioxide

Table 58 shows the maximum 99.9th %ile of 15-minute mean concentrations over the five modelled years (2014 – 2018) at the point of maximum impact and at each identified receptor location, in addition to the contribution from background sources.

Impacts that do not screen out as 'insignificant' in accordance with Environment Agency guidance are highlighted, and impacts that cannot be described as 'negligible' irrespective of the total concentration in accordance with the IAQM 2017 criteria are shown in bold.

Table 58: Further Analysis – 99.9th %ile of 15-minute means sulphur dioxide

Receptor ID	Receptor Name	PC		PEC	
		Conc. (µg/m³)	as % of AQAL	Conc. (µg/m³)	as % of AQAL
Point of maximum impact		52.80	**19.9%**	118.80	44.7%
R1	Old Slade Lane 1, Richings Park	35.29	**13.3%**	101.29	38.1%
R2	Old Slade Lane 2, Richings Park	27.75	**10.4%**	93.75	35.2%
R3	Old Slade Lane 3, Richings Park	24.00	9.0%	90.00	33.8%
R4	Main Drive, Richings Park	18.55	7.0%	84.55	31.8%
R5	North Park, Richings Park	16.63	6.3%	82.63	31.1%
R6	Sutton Lane 1, Langley	11.95	4.5%	77.95	29.3%
R7	Sutton Lane 2, Langley	14.57	5.5%	80.57	30.3%
R8	London Road, Colnbrook	10.97	4.1%	76.97	28.9%
R9	Vicarage Way, Colnbrook	16.55	6.2%	82.55	31.0%
R10	The Hawthrorns, Colnbrook	13.14	4.9%	79.14	29.8%
R11	The Island, Longford	10.16	3.8%	76.16	28.6%
R12	Verbena Close, West Drayton	10.33	3.9%	76.33	28.7%
R13	Lily Drive, West Drayton	10.14	3.8%	76.14	28.6%
R14	The Common, West Drayton	11.88	4.5%	77.88	29.3%
R15	Mayfield Park, West Drayton	9.59	3.6%	75.59	28.4%
R16	Thorney Mill Road, Thorney	9.95	3.7%	75.95	28.6%
R17	Richings Way, Richings Park	11.72	4.4%	77.72	29.2%
R18	Parlaunt Park Primary Academy	9.64	3.6%	75.64	28.4%
R19	Foxborough Primary School	9.03	3.4%	75.03	28.2%
R20	Colnbrook CoE School	13.49	5.1%	79.49	29.9%
R21	Harmondsworth Primary School	10.57	4.0%	76.57	28.8%
R22	Laurel Lane Primary School	8.56	3.2%	74.56	28.0%
R23	St Catharine Catholic Primary School	8.44	3.2%	74.44	28.0%

As shown, the short-term process contribution from the Proposed Development cannot be screened out as 'insignificant' at the point of maximum impact. The headroom is 266 µg/m³ - (33.0 µg/m³ x 2) = 284 µg/m³. The process contribution is 52.8 µg/m³, which is 26.4% of the headroom. Therefore, for 15-minute mean sulphur dioxide concentrations, it cannot be concluded that "there is little risk of the PEC exceeding the AQAL", and the impact cannot be considered to be 'not significant'. Using the IAQM guidance the magnitude of change of can be described as described as 'slight adverse' as the process contribution is >10% of the short-term AQAL.

Figure 21 shows the spatial distribution of emissions in relation to the human sensitive receptors identified for assessment. This shows the area that cannot be described as 'negligible' irrespective of the total concentration in accordance with the IAQM 2017 criteria.

To assess the impact at areas of relevant exposure the impact at sensitive receptors has been considered. The change in impact at 21 sensitive receptors is less than 10% of the AQAL and can be screened out as 'insignificant'. At two sensitive receptor locations the impact of the Proposed Development is greater than 10%. However, when the background concentration is applied, the PEC is predicted to be well below the short-term AQAL and therefore there is little risk of the AQAL being exceeded.

Under the IAQM guidance, the impact at all but two sensitive receptors is less than 10% of the AQAL, and so can be described as 'negligible' irrespective of the total concentration. At R1 and R2 the process contribution is predicted to be greater than 10 % of the short-term AQAL. Therefore, the impact of the Proposed Development at R1 and R2 is described as 'slight adverse.'

6.7.12 Metals assessment

The Environment Agency document 'Guidance to Applicants on Impact Assessment for Group 3 Metals Stack Releases – V.4 June 2016'[7] ("Metals Guidance") outlines the following two-stage assessment methodology for detailed modelling of Group 3 metals.

1. First it should be assumed that each metal is released at 100% of the total metal ELV (i.e. 0.3 mg/Nm^3).
2. If the impact cannot be 'screened out' under the first-stage assessment, it should be assumed that each metal is released at the maximum concentration monitored at an existing facility[8].

The Metals Guidance states that where the process contribution for any metal exceeds 1% of the long-term AQAL or 10% of the short-term AQAL, there is potential for significant pollution. Where the process contribution exceeds these criteria, the PEC should be compared to the AQAL. The impact can be screened out as 'not significant' where the PEC is less than 100% of the environmental standard.

[7] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/532474/LIT_7349.pdf

[8] Data sourced from 18 municipal waste incinerators and waste wood co-incinerators between 2007 and 2015, as stated in Appendix A of the Metals Guidance document

Table 59: Long-Term Metals Results for Proposed Development – Point of Maximum Impact

Metal	AQAL (ng/m³)	Background conc. (ng/m³)	Stage 1 assessment (1)				Stage 2 assessment (2)				
			PC		PEC		Metal as % of total ELV	PC		PEC	
			ng/m³	as % AQAL	ng/m³	as % AQAL		ng/m³	as % AQAL	ng/m³	as % AQAL
Arsenic	3	0.79	15.77	525.75%	16.56	552.08%	8.3%	1.31	43.81%	2.10	70.15%
Antimony	5,000	-	15.77	0.32%	-	-	3.8%	0.60	0.01%	-	-
Chromium	5,000	13.16	15.77	0.32%	28.93	0.58%	30.7%	4.84	0.10%	18.00	0.36%
Chromium (VI)	0.2	2.63	15.77	7886.25%	18.40	9202.25%	0.012%	0.006	3.42%	2.63	1316.92%
Cobalt	-	0.25	15.77	-	16.02	-	1.9%	0.29	-	0.54	-
Copper	10,000	11.10	15.77	0.16%	26.87	0.27%	9.7%	1.52	0.02%	12.62	0.13%
Lead	250	10.35	15.77	6.31%	26.12	10.45%	16.8%	2.64	1.06%	12.99	5.20%
Manganese	150	10.90	15.77	10.52%	26.67	17.78%	20.0%	3.15	2.10%	14.05	9.37%
Nickel	20	6.61	15.77	78.86%	22.38	111.91%	73.3%	11.57	57.83%	18.18	90.88%
Vanadium	5,000	1.55	15.77	0.32%	17.32	0.35%	2.0%	0.32	0.01%	1.87	0.04%

Notes:

(1) Assumes that each metal is released at 100% of the total metal ELV (i.e. 0.3 mg/Nm³).

(2) Assumes that each metal is released at the maximum concentration monitored at an existing facility, as presented in Appendix A of the Environment Agency Metals Guidance.

(3) There is no monitoring of the separate species of chromium in the UK. This assessment assumes that background concentrations of chromium (VI) equate to 20% of the total chromium concentration, as required by the Metals Guidance methodology.

Table 60: Short-Term Metals Results for Proposed Development – Point of Maximum Impact

Metal	AQAL (ng/m³)	Baseline Concentration (ng/m³)	Assuming each metal emitted at 100% of the group ELV		Metal (as % of ELV)	Assuming each metal emitted as per Environment Agency maximum monitored	
			PC as % of AQAL	PEC as % of AQAL		PC as % of AQAL	PEC as % of AQAL
Arsenic	-	1.58	-	-	8.3%	-	-
Antimony	150,000	-	0.14%	-	3.8%	0.01%	-
Chromium	150,000	26.32	0.14%	0.16%	30.7%	0.04%	0.06%
Chromium (VI)	-	5.26	-	-	0.04%	-	-
Cobalt	-	0.50	-	-	1.9%	-	-
Copper	200,000	22.20	0.11%	0.12%	9.7%	0.01%	0.02%
Lead	-	20.70	-	-	16.8%	-	-
Manganese	1,500,000	21.80	0.01%	0.02%	20.0%	0.003%	0.004%
Nickel	-	13.22	-	-	73.3%	-	-
Vanadium	1,000	3.10	21.03%	21.34%	2.0%	0.42%	0.73%

6.7.12.1 Long-term results

As shown in Table 59 if it is assumed that the entire emissions of metals consist of only one metal, the annual process contributions of arsenic, chromium (VI), cobalt, lead, manganese and nickel are predicted to be greater than 1% of the long-term AQAL at the point of maximum impact. However, only the PEC for arsenic, chromium (VI) and nickel is predicted to be greater than 100% of the AQAL under this worst-case screening assumption.

If it is assumed that the Proposed Development will perform no worse than a currently permitted facility, the predicted process contribution is below 1% of the AQAL for all metals with the exception of arsenic, chromium (VI), lead, manganese and nickel. However, the PECs for arsenic, lead, manganese and nickel are well below 100% of the AQAL, and so the impacts can be screened out. Using the Environment Agency guidance criteria, it can be concluded that there is no risk of exceeding the long-term AQAL for all metals, with the exception of chromium (VI).

The predicted process contribution for chromium (VI) exceeds 1% of the AQAL and the PEC exceeds 100% of the AQAL. However, this assumes that each metal is released at the maximum concentration monitored at an existing facility. The average concentration monitored at an existing facility is 0.001 ng/m^3. Using this as the emission concentration for the Proposed Development, the impact is predicted to be 0.92% of the AQAL. Hence, this can be screened out and there is no potential for significant pollution.

6.7.12.2 Short-term results

As shown, even if it is assumed that each metal is released from the Proposed Development at the total metal ELV, the maximum 1-hour process contribution at the point of maximum impact is predicted to be less than 10% of the short-term AQAL, with the exception of vanadium. However, the PEC for vanadium is well below 100% of the AQAL, and so the impacts can be screened out. Therefore, using the Metals Guidance criteria, it can be concluded that:

- there is no risk of exceeding the short-term AQAL for any metal;
- there is no potential for significant pollution;
- the impact can be ‘screened out’ under the first-stage assessment; and
- there is no requirement for further assessment using the second-stage methodology.

6.7.13 Impact at ecological receptors

6.7.13.1 Atmospheric emissions - Critical Levels

The impact of emissions from the Proposed Development has been compared to the Critical Levels listed in Table 13. In accordance with the stated assessment methodology, further assessment would be undertaken where the PC of a particular pollutant is greater than 1% of the long term or 10% of the short-term Critical Level for European and UK designated sites, and where the PC of a particular pollutant is greater than 100% of the Critical Level for locally-designated sites. The process contribution has been calculated based on the maximum predicted using all five years of weather data.

Table 61: Impact of Emissions at Ecological Sites – as % of Critical Level

Site	NO_x		SO_2	HF		NH_3
	Annual Mean	Daily Mean	Annual Mean	Weekly Mean	Daily Mean	Annual Mean
European designated sites (within 10km) and UK designated sites (within 2km)						
South West London Waterbodies	0.7%	4.7%	0.3%	2.9%	0.7%	0.7%
Windsor Forest & Great Park (1)	0.3%	1.4%	0.3%	0.9%	0.2%	0.9%
Locally designated sites (within 2km)						
Old Wood (1)	3.4%	26.9%	2.9%	12.9%	4.0%	9.7%
Old Slade Lake(1)	10.8%	39.2%	9.5%	30.2%	5.9%	31.5%
Opposite Iver Station (1)	1.6%	5.5%	1.4%	3.2%	0.8%	4.7%
Lower Colne(1)	3.2%	7.3%	2.8%	5.7%	1.1%	9.5%
Queen Mother Reservoir(1)	0.8%	6.7%	0.7%	4.9%	1.0%	2.4%

Notes:
(1) Lower critical levels for sulphur dioxide (10 µg/m³) and ammonia (1 µg/m³) for the protection of lichens and bryophytes have been applied.

As shown in Table 61, at all locally designated ecological sites the process contribution is less than 100% of the Critical Level for all pollutants considered. Therefore, the impact of the Proposed Development can be screened out as 'not significant'.

At all European and UK statutory designated sites the process contribution is less than 1% of the long-term and less than 10% of the short-term Critical Level for all pollutants and can be screened out as 'not significant'.

6.7.13.2 Deposition of emissions - Critical Loads

In addition to the Critical Levels for the protection of ecosystems, habitat specific Critical Loads for nature conservation sites at risk from acidification and nitrogen deposition (eutrophication) are outlined in the APIS.

An assessment has been made for each habitat feature identified in APIS for the specific site. The site-specific features tool has been used to identify the feature habitats, and then the search by location tool to find the habitat specific Critical Load for the specific points assessed within the designated sites. The relevant Critical Loads are presented in Appendix C [APIS Critical Loads].

If the impact of process emissions upon nitrogen or acid deposition is greater than 1% of the Critical Load, further assessment has been undertaken.

APIS does not include site specific Critical Loads for non-designated sites. In lieu of this, the search by location function of APIS has been used. The Critical Loads using this function are based on a broad habitat type and location.

6.7.13.3 Deposition of emissions - Critical Loads - results

Appendix D [Deposition Analysis at Ecological Sites] presents the results at each of the identified statutory designated ecological receptors. The contribution from the Proposed Development has been assessed against the most sensitive feature in each statutory designated site.

As shown in Appendix D, at all locally designated sites the process contribution is less than 100% of the relevant Critical Loads, and the impact of the Proposed Development can be screened out as 'not significant'.

At all identified European and UK statutory designated sites, the process contribution is less than 1% of the relevant Critical Loads and can be screened out as 'not significant'.

6.8 Modelling Results – Commissioning

6.8.1 Results at the point of maximum impact

Table 62 presents the predicted impact of process emissions for the five modelled years (2014 – 2018) at the point of maximum impact for the commissioning phase of the Proposed Development. The results presented are limited to annual mean nitrogen dioxide, maximum hourly hydrogen chloride, and all pollutants which are assessed using percentiles. A discussion of the implications for all other pollutants is presented below Table 62.

The results are compared to the relevant AQALs. Impacts that do not screen out as 'insignificant' in accordance with Environment Agency guidance are highlighted, and impacts that cannot be described as 'negligible' irrespective of the total concentration in accordance with the IAQM 2017 criteria are shown in bold.

Table 62: Dispersion Modelling Results for Commissioning Phase of Proposed Development – Point of Maximum Impact

Pollutant	Quantity	Units	AQAL	Background conc.	Process Contribution (PC)					Max PC		PEC	
					2014	2015	2016	2017	2018	Conc.	Max as % of AQAL	Conc.	Max as % of AQAL
Nitrogen dioxide	Annual mean	µg/m³	40	27.5	2.10	2.66	1.95	2.00	1.65	2.66	**6.64%**	30.16	75.39%
	99.79th %ile of hourly means	µg/m3	200.00	55.00	24.29	23.35	22.70	22.67	23.17	24.29	**12.15%**	79.29	39.65%
Sulphur dioxide	99.18th %ile of daily means	µg/m³	125	66.00	7.19	6.94	5.86	5.73	5.11	7.19	5.75%	73.19	58.55%
	99.73rd %ile of hourly means*	µg/m³	350	66.00	31.59	30.21	29.47	29.69	30.12	31.59	9.02%	97.59	27.88%
	99.9th %ile of 15 min. means*	µg/m³	266	66.00	35.34	34.31	33.77	34.19	34.34	35.34	**13.29**%	101.34	38.10%
Particulates (PM_{10})	90.41 %ile of daily means	µg/m³	50	30.00	0.49	0.58	0.44	0.46	0.38	0.58	1.17%	30.58	61.17%
Carbon monoxide	8 hour running mean†	µg/m³	10,000	1012.00	14.18	14.59	14.64	14.45	13.95	14.64	0.15%	1026.64	10.27%
Carbon monoxide	Hourly mean *	µg/m³	30,000	1012.00	60.18	55.50	78.63	54.80	88.20	88.20	0.29%	1100.20	3.67%
Hydrogen chloride	Hourly mean*	µg/m³	16	1.40	21.90	21.31	31.45	21.10	35.28	35.28	4.70%	36.68	4.89%

As shown in Table 62, the long-term and short-term impacts from the commissioning phase of the Proposed Development are predicted to be lower than the base-case scenario at the point of maximum impact. As Table 62 considers the impact over all relevant averaging periods, it is concluded that the impact of the commissioning phase is lower than the base-case scenario for all pollutants at the point of maximum impact.

The change in impact at certain sensitive receptors closer to the operational Lakeside Facility are predicted to be higher than in the best-case scenario. However, due to the decommissioning of one line, the impacts at these receptors will be lower than the impact with the currently permitted Lakeside Facility.

6.9 Plume Visibility

6.9.1 Base assumptions

The plume visibility assessment has been undertaken using ADMS 5.2. The assessment has been undertaken on the basis of a plume moisture content from the EfW of 16.1% by volume, or 0.115 kg water per kg dry gas, and gas exit temperature of 140°C, and a plume moisture content from the HTI of 8.9% by volume, or 0.059 kg water per kg dry gas, and gas exit temperature of 140°C

6.9.2 Plume visibility results

Table 63 details the plume visibility results during daylight hours.

Table 63: Plume Visibility Results

Weather Data Year	Percentage of daylight hours the plume is visible	Percentage of daylight hours with a visible plume extending beyond Site boundary	Furthest distance from stack a plume is visible (m)
2014	5.9%	2.3%	284
2015	6.6%	1.7%	241
2016	8.3%	2.9%	289
2017	8.3%	2.9%	393
2018	9.9%	3.2%	284

A visible plume extends beyond the Site boundary for less than 5% of daylight hours. In accordance with the EA significance criteria detailed in Table 14, as the plume length exceeds the distance to the site boundary for less than 5% of the year and there are local sensitive receptors, the visual impact of the plume is assessed to be 'low'. In addition, although visible plumes are predicted to occasionally extend over the M4 motorway, the results of the modelling show that there are no occasions where a visible plume reaches the ground. Therefore, there is no risk of a visible plume causing obscured vision for drivers on the M4 motorway or any other road.

A visual representation of the maximum distance a visible plume extends in each direction from the stack is shown in Figure 22. The furthest distance from the stack visible plume is predicted to reach is 393 m.

6.10 Operational phase traffic emissions

As the Proposed Development is a like-for-like replacement for the existing Facilities, the operational traffic already forms the existing baseline. The only change to traffic during the operational phase is that the Site access for the Proposed Development is slightly further west along the A4 than the site access for the existing facilities. Therefore, there will only be a net change in development-generated traffic between the existing site access and the Proposed Development Site access. There are no residential sensitive receptors along this stretch of road. As such, there is no relevant exposure and it is concluded that the impact of operational phase traffic emissions is 'negligible'.

6.11 Significance of effect

Professional judgement has been used to determine the resulting significance of the effect of emissions associated with the operation of the Proposed Development. This judgement has been based on dispersion modelling using the following conservative assumptions:

- the Proposed Development will continually operate at the ELVs, except for the pollutants detailed below;
- the worst-case assumption for the conversion of NOx to nitrogen dioxide has been applied;
- the Proposed Development will operate at the short-term ELVs during worst-case meteorological conditions for dispersion; and
- the impacts presented are based on the maximum concentrations from five years of weather data.

The assessment has shown that the operation of the Proposed Development will not cause a breach of any AQAL, and the annual mean magnitude of change can be described as no worse than 'slight adverse' for all pollutants at all areas of relevant exposure. This judgment has been based on typical speciation and emissions of VOCs, cadmium and chromium (VI) from existing waste incineration facilities, and operation at the ELVs for all other pollutants.

The magnitude of change of short-term nitrogen dioxide and sulphur dioxide concentrations is described as 'slight adverse' at some areas of relevant exposure, but the extent of these impacts is limited and is only predicted to occur under the conservative assumptions listed above. As noted in Section 3.5, the IAQM 2017 guidance states that the significance of effect "*will be governed by the long-term exposure experienced by receptors and it will not be a necessity to define the significance of effects by reference to short-term impact*". Therefore, we conclude that the overall effect of the Proposed Development on local air quality will be 'not significant'. As such, there should be no air quality constraint in granting planning permission for the Proposed Development.

7 Mitigation and Monitoring

7.1 Operational phase

No additional mitigation is required beyond that imbedded into the design and required by legislation that will be regulated by the Environment Agency under the Environmental Permit. This is described in chapter 3 of the Environmental Statement.

7.2 Construction Phase

The construction dust assessment has identified the Site as a 'medium risk' site. Appropriate mitigation measures will be based on best practice for a site and will be detailed in a Construction Environmental Management Plan (CEMP) for the Proposed Development. A framework CEMP is included in technical appendix C of the ES. Appropriate mitigation measures for a site of this size and nature that could be implemented are as follows:

- Display the name and contact details of person(s) accountable for dust issues on the Site boundary. This may be the environment manager / engineer or the Site manager.
- Display the head or regional office contact information.
- Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emission in a timely manner, and record the measure taken.
- Make the complaints log available to the local authority (Slough Borough Council) when asked.
- Record any exceptional incidents that cause dust and/or air emission, either on- or off- site, and the action taken to resolve the situation in the logbook.
- Plan site layout so that machinery and dust causing activities are located away from receptors, as far as possible.
- Keep site fencing, barriers and scaffolding clean using wet methods.
- Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover, seed or fence stockpiles to prevent wind whipping.
- Ensure all on vehicles switch off engines when stationary - no idling vehicles.
- Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.
- Ensure an adequate water supply on the Site for effective dust / particulate matter suppression /mitigation, using non-potable water where possible and appropriate.
- Ensure equipment is readily available on site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.
- Prohibit bonfires and burning of waste materials.
- Ensure sand and other aggregates are stored in designated areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.
- Ensure vehicles entering and leaving the Site are covered to prevent escape of materials during transport.
- Implement a wheel washing system.

- Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the Site exit.

The mitigation measures stated above are based on best practice for a site of the size and nature. It is considered that with the implementation of these measures any residual impacts would not be significant, either alone or in-combination with other developments.

8 Residual Effects

8.1 Construction Phase

The impact of construction phase dust emissions will be mitigated by the implementation of mitigation measures such as those detailed in Section 7. These mitigation measures are based on best practice for a site of this size and nature and scale of the Proposed Development. With the implementation of these measures any residual construction dust impacts will be 'negligible' and the residual effect will be not significant.

8.2 Operational Phase

No additional mitigation measures have been recommended and therefore the effects will remain as described in Section 7.

9 Cumulative Effects

A number of local projects have been identified which may have cumulative effects with the Proposed Development. These are:

1. The Cemex Langley Site north of North Park Road;
2. Cemex operations at Datchet Quarry;
3. Thorney Mill/Link Park Heathrow; and
4. The M4 Smart Motorway.

However, none of these cumulative schemes include process emissions, and therefore have no potential for cumulative impacts with emissions from the stack of the Proposed Development.

The North Park Cemex project has the potential to generate dust from mineral activities. However, the site is approximately 1km from the Site boundary and cumulative impacts are considered extremely unlikely at that distance. In addition, the environmental statement for North Park concludes that the magnitude of dust effects at receptors would be 'negligible'.

Therefore, it is concluded that there is no potential for significant cumulative effects with the above schemes.

10 Summary and Conclusions

The impact of the Proposed Development has been assessed as part of this assessment using industry standard approaches. The main air quality effect would be as a result of emissions from the stack of the Proposed Development.

Within this air quality assessment, the following two scenarios have been considered:

- The Proposed Development operating at the emission limits as set out in Table 39 ("Main Case"); and
- The Proposed Development operating one line at the emission limits as set out in Table 39 simultaneously with one line of the operational Lakeside EfW and CWI operating at the IED limits ("Commissioning Phase").

This assessment has included a review of baseline pollution levels, dispersion modelling of emissions and quantification of the impact of these emissions on local air quality.

The primary conclusions of the assessment are presented below.

1. In relation to the impact on human health:
    a. Using the IAQM 2017 screening criteria, the impact of all long-term process emissions associated with the 'Main Case' scenario can be considered 'negligible' at the point of maximum impact with the exception of the following pollutants:
        i. Annual mean and short-term nitrogen dioxide;
        ii. Short-term sulphur dioxide;
        iii. Annual mean particulate matter (as PM10);
        iv. Annual mean particulate matter (as PM2.5);
        v. Annual mean VOCs;
        vi. Annual mean cadmium; and
        vii. Annual mean PaHs.
    b. In accordance with Environmental Agency Guidance, the impact of all long-term process emissions associated with the 'Main Case' scenario can be considered 'not significant' at the point of maximum impact with the exception of the following pollutants:
        i. Annual mean and short-term nitrogen dioxide;
        ii. Short-term sulphur dioxide;
        iii. Annual mean particulate matter (as PM2.5);
        iv. Annual mean VOCs; and
        v. Annual mean cadmium;
2. For all of the pollutants listed above, the magnitude of change assessed in accordance with IAQM 2017 criteria is no worse than 'slight adverse' at all areas of relevant exposure.
3. In relation to the impact on ecologically sensitive sites:
    a. At all of the statutory designated sites, the impact of process emissions from the 'Main Case' scenario of the Proposed Development can be screened out as 'not significant'.
    b. At all non-statutory designated sites, the impact of process emissions from the 'Main Case' scenario of the Proposed Development can be screened out as 'not significant'.
4. The impact of all long-term and short-term process emissions associated with the commissioning phase scenario is no higher than process emissions associated with the best-case scenario.

Based on the above, professional judgement has been used to determine the resulting significance of the effect of emissions associated with the operation of the Proposed Development.

The assessment has shown that the operation of the Proposed Development will not cause a breach of any AQAL, and the annual mean magnitude of change can be described as no worse than 'slight adverse' for all pollutants at all areas of relevant exposure. Therefore, we conclude that the overall effect of the Proposed Development on local air quality will be 'not significant'.

11 References

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Defra, 2018, Nitrogen dioxide fall off with distance calculator v4.2

Appendices

Appendices

A Figures

Figure 1: Site Location

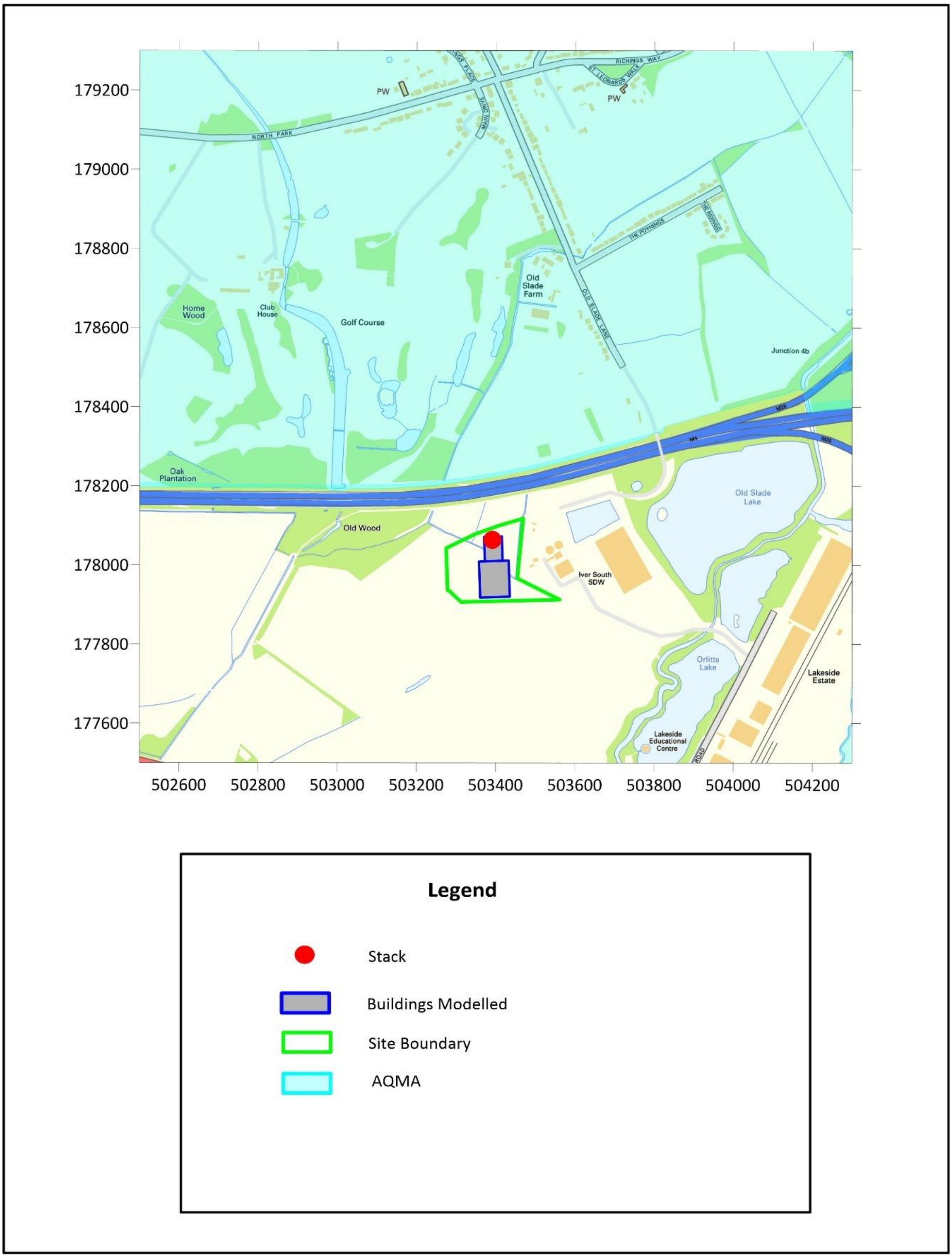
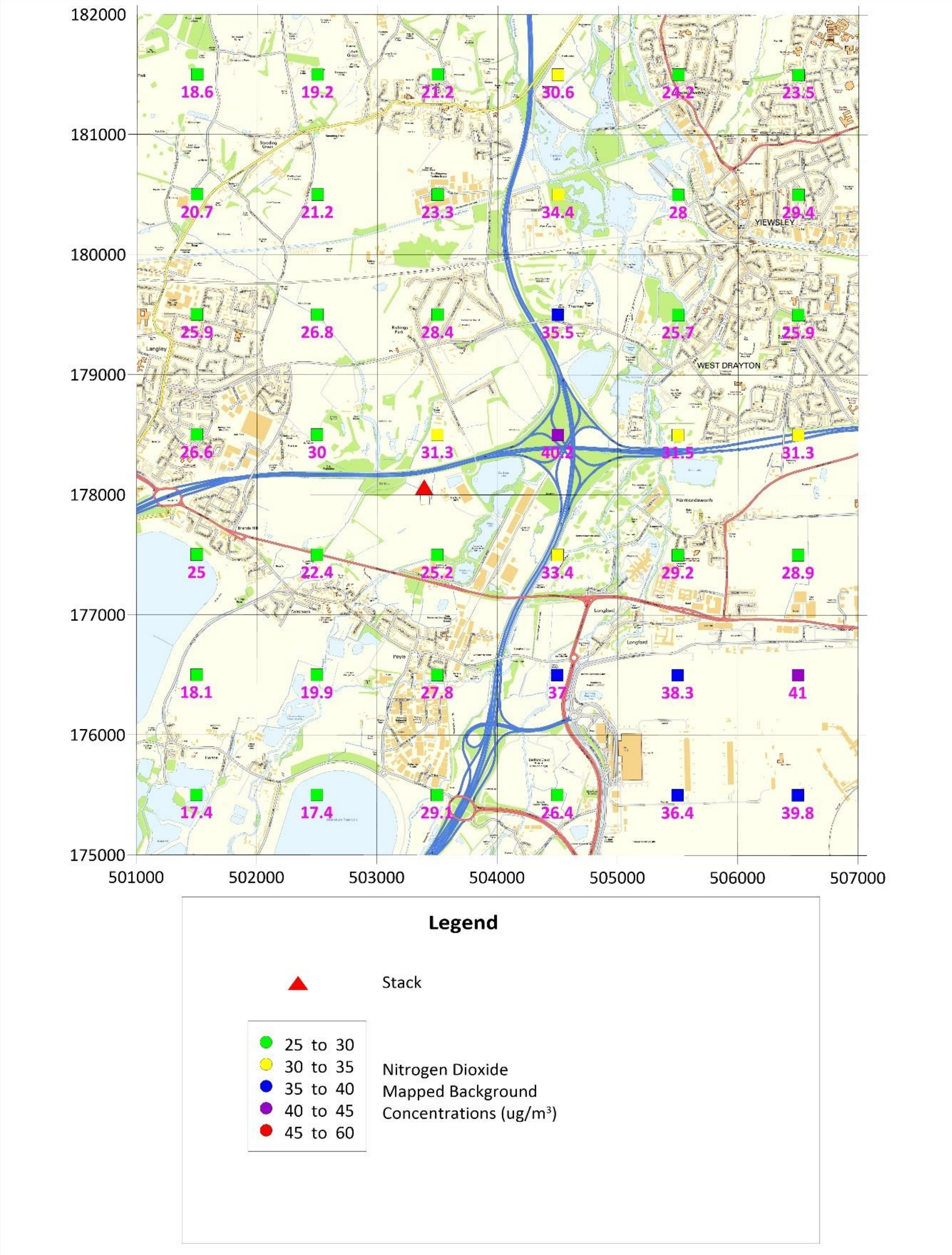
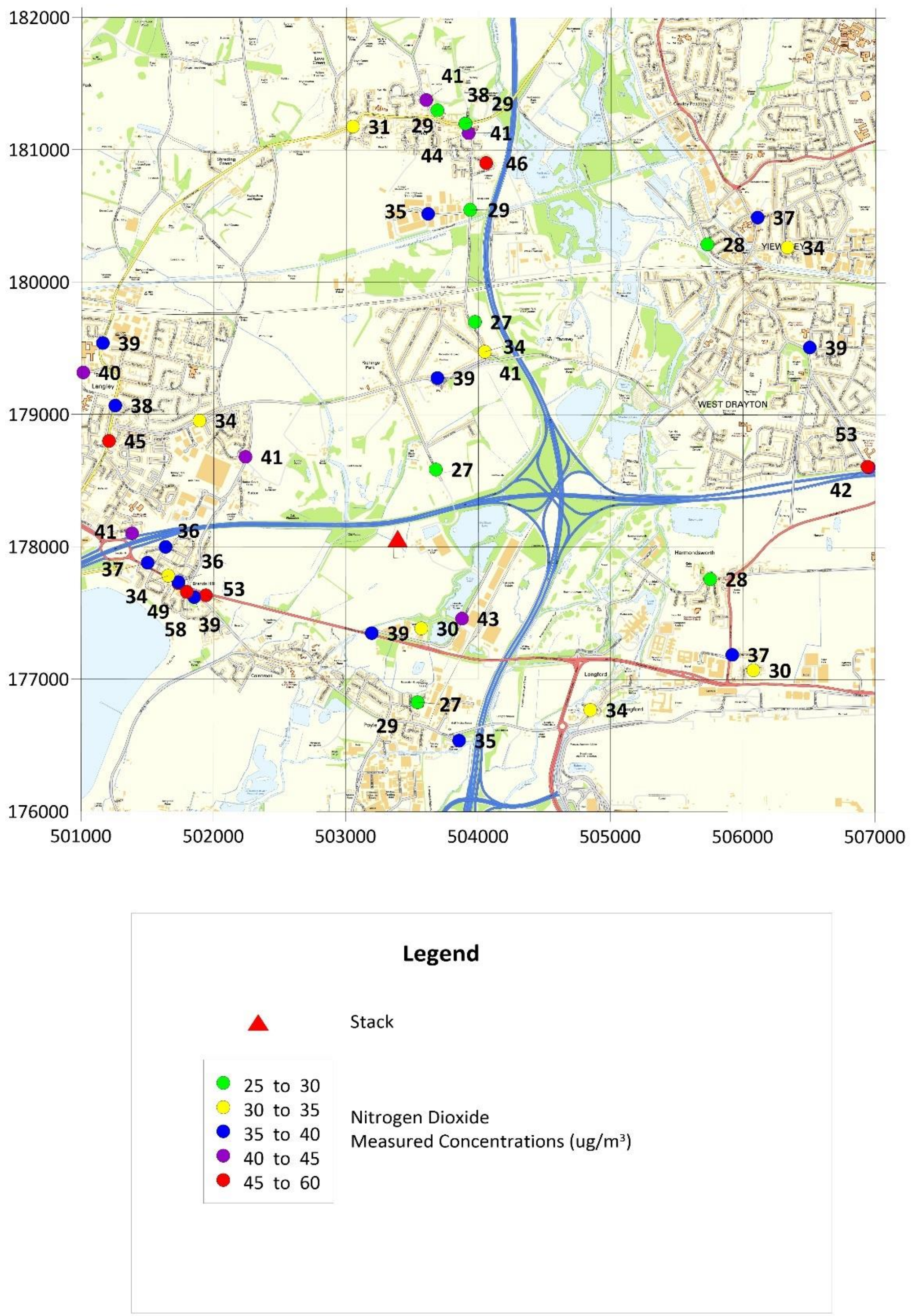


Figure 2: Mapped Background Nitrogen Dioxide concentrations



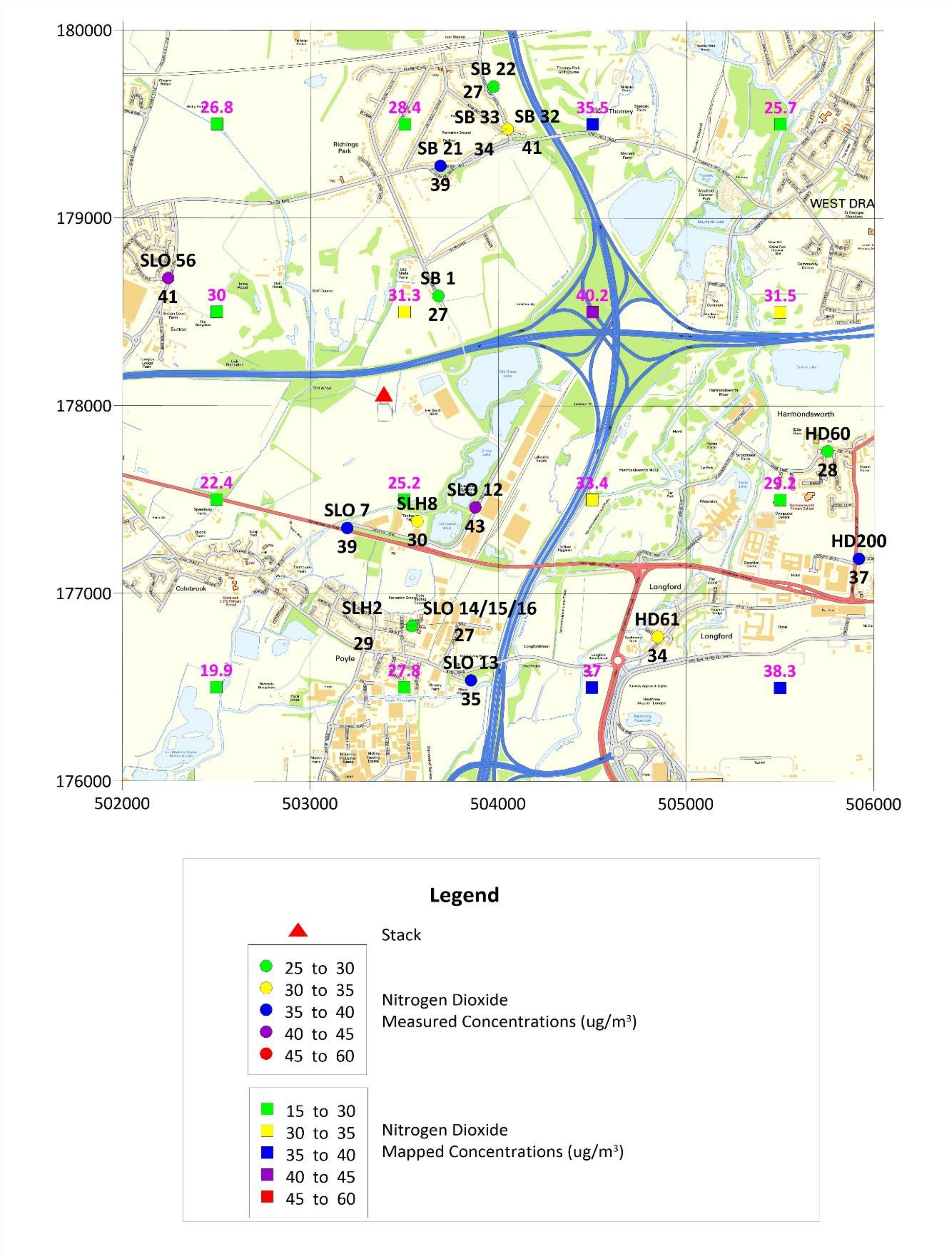
Source: UK Air – background mapping data for local authorities

Figure 3: Nitrogen Dioxide measured concentrations



Source: Local authority reports and AURN database

Figure 4: Nitrogen dioxide - mapped and measured concentrations



Source: Local authority reports and AURN database

Figure 5: Human Sensitive Receptors

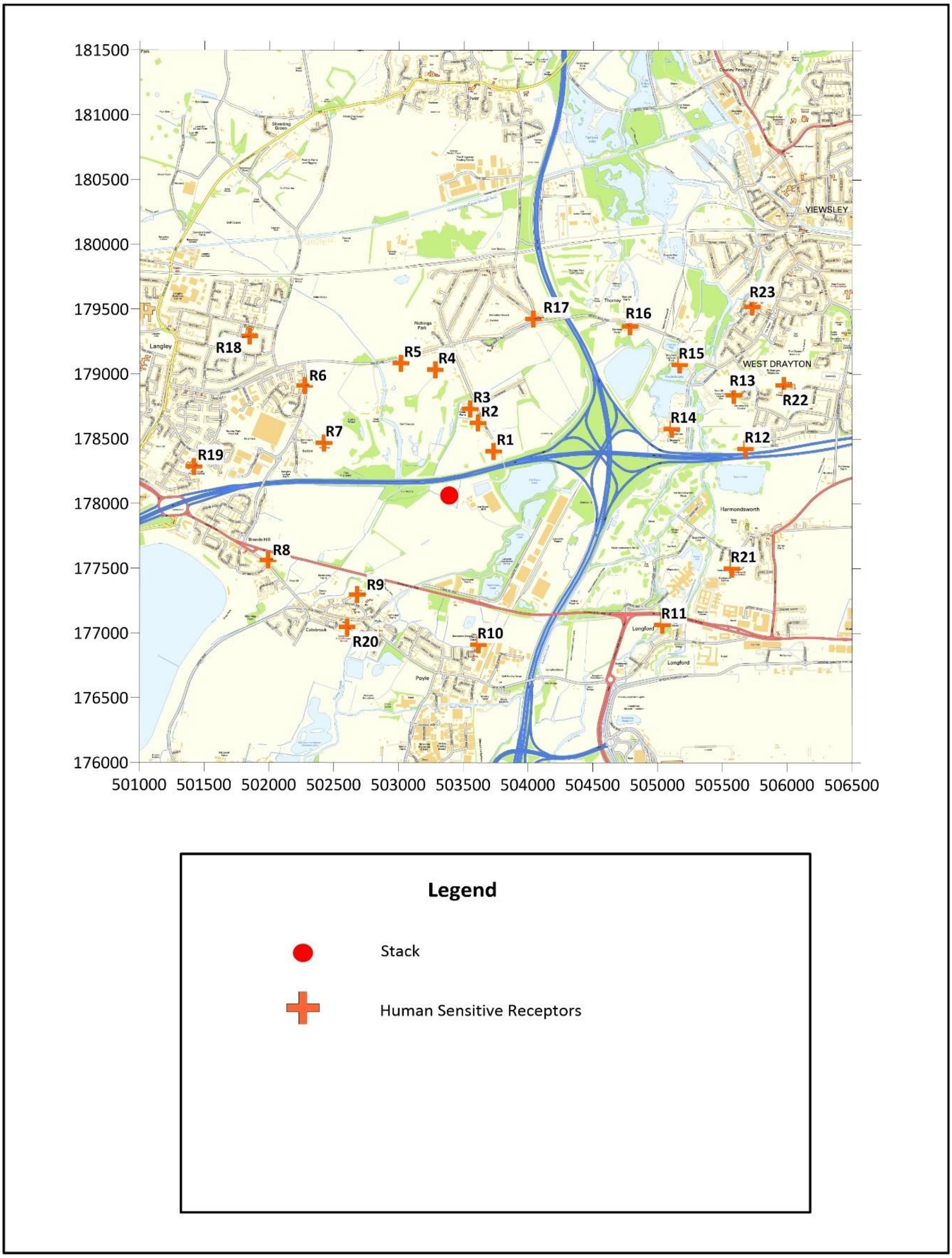


Figure 6: Roads Modelling Setup

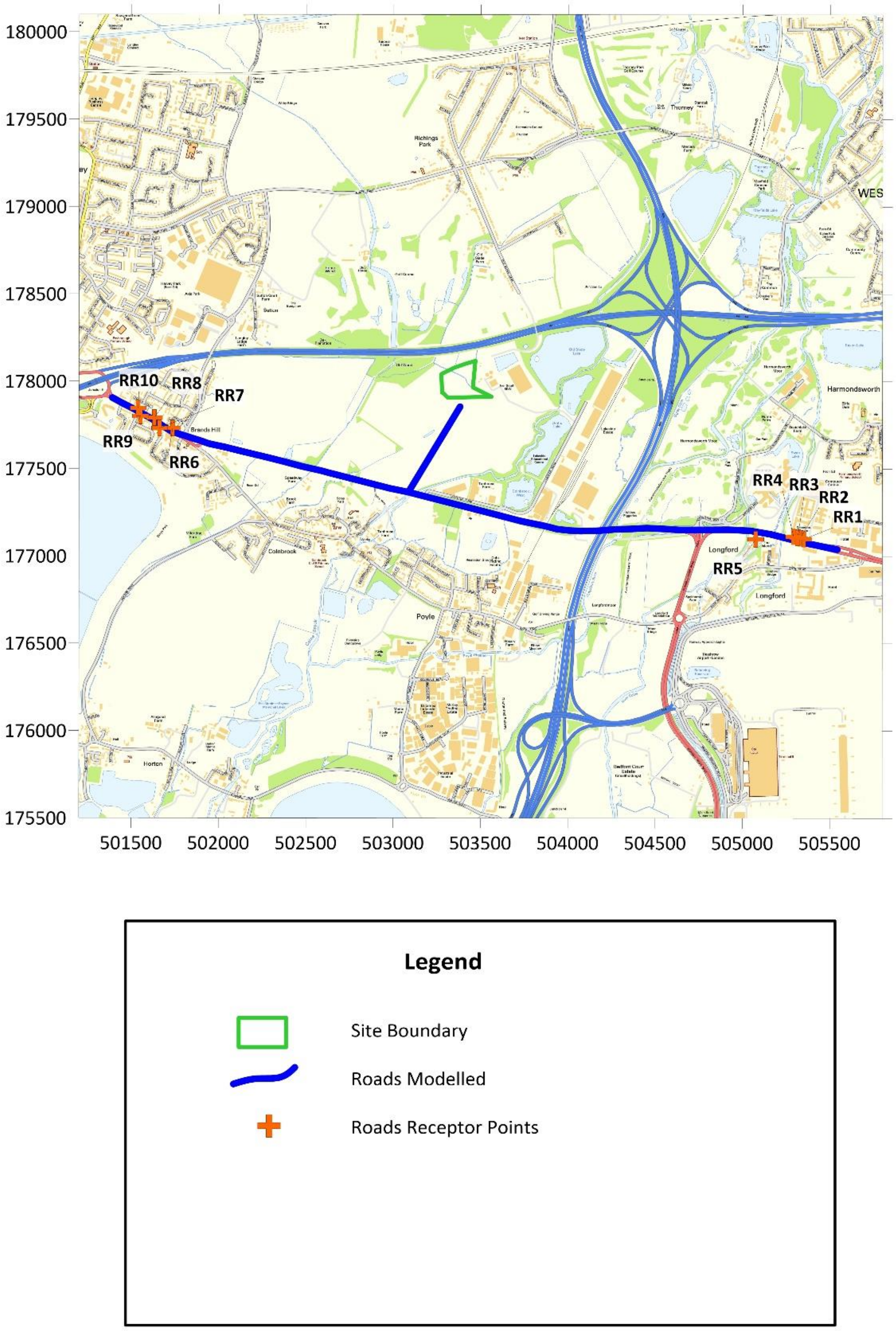


Figure 7: Monitoring Sites for Roads Model Verification

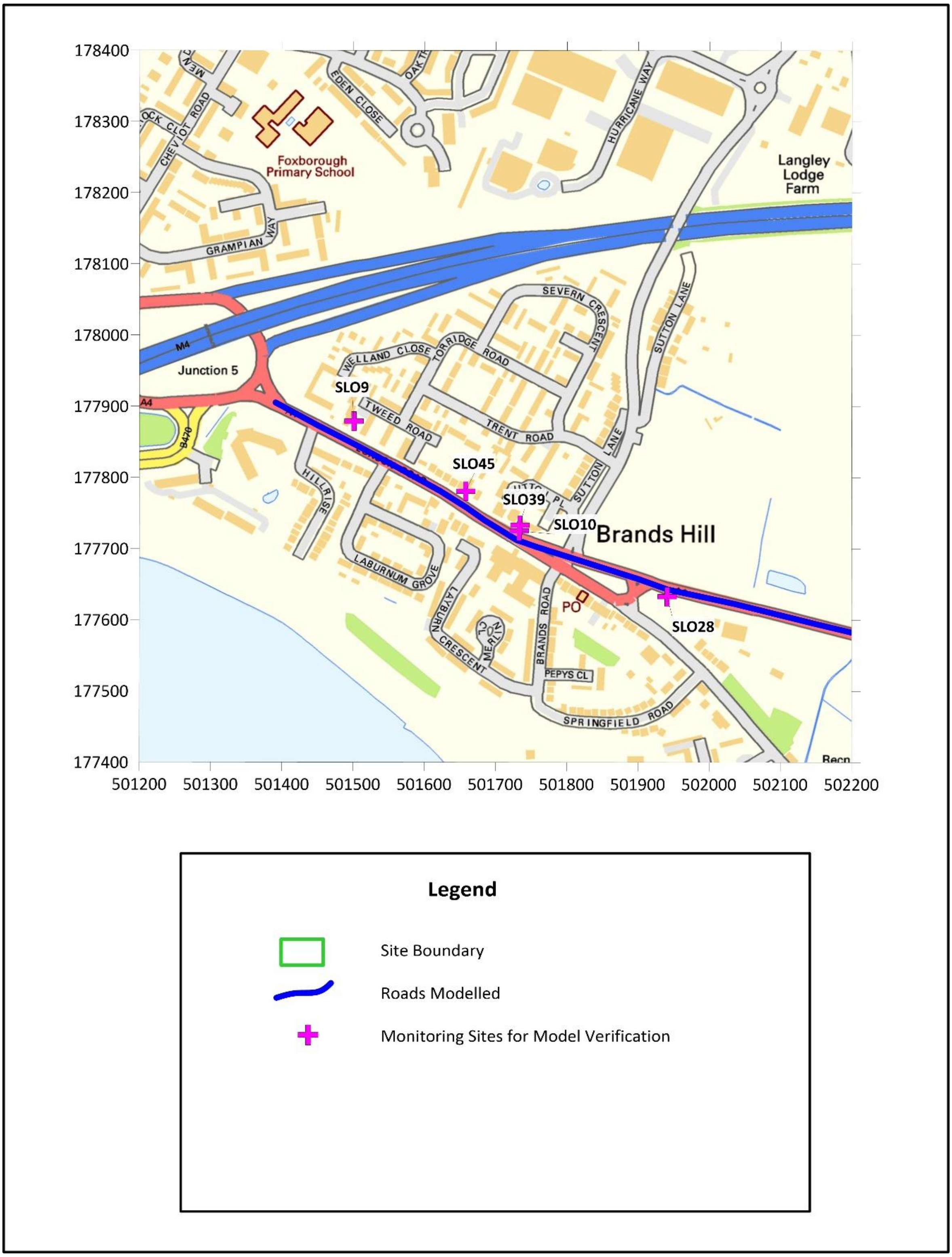


Figure 8: Ecological Sensitive Receptors

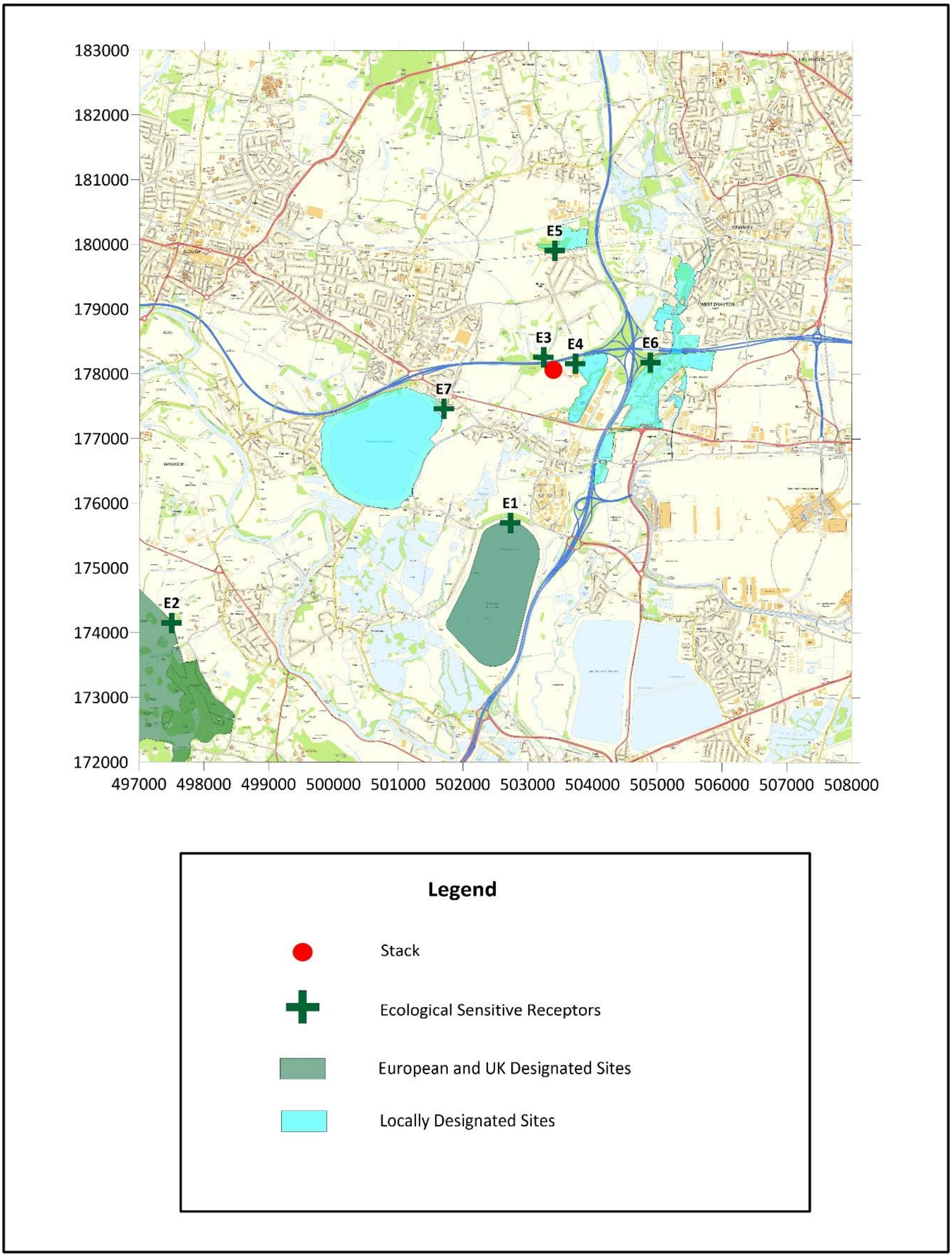


Figure 9: Modelling Domain

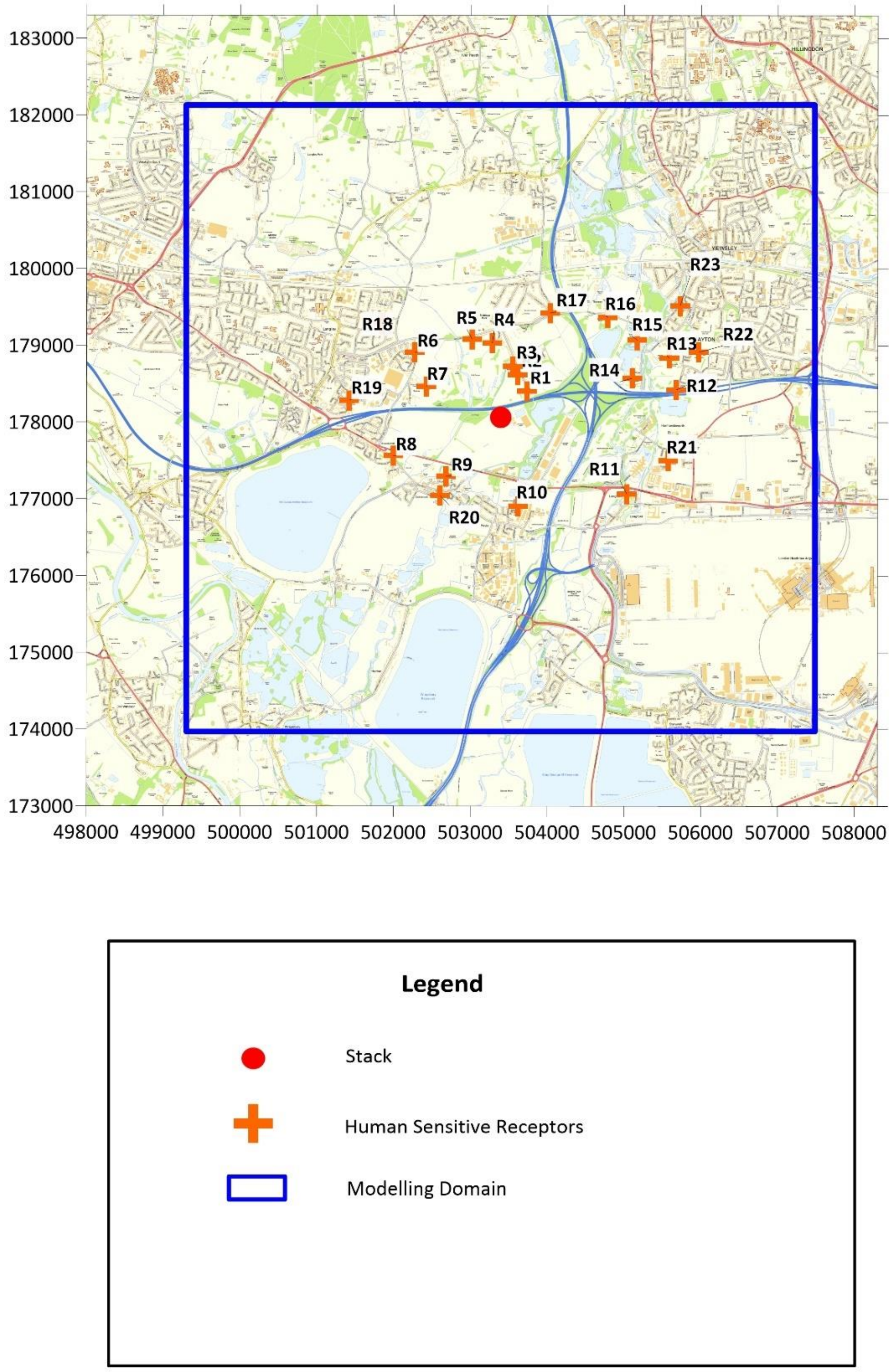


Figure 10: Wind Roses

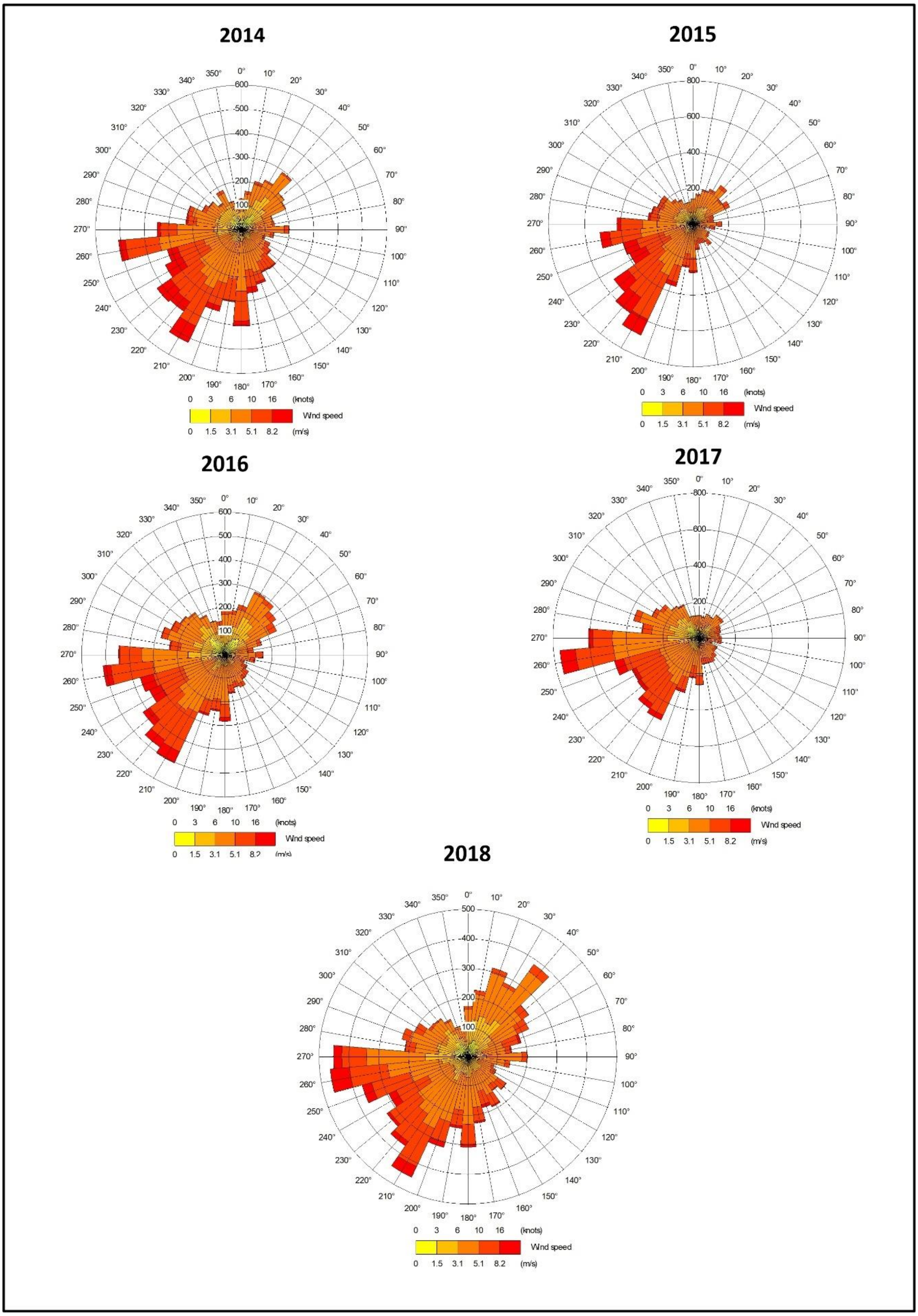


Figure 11: Building Details

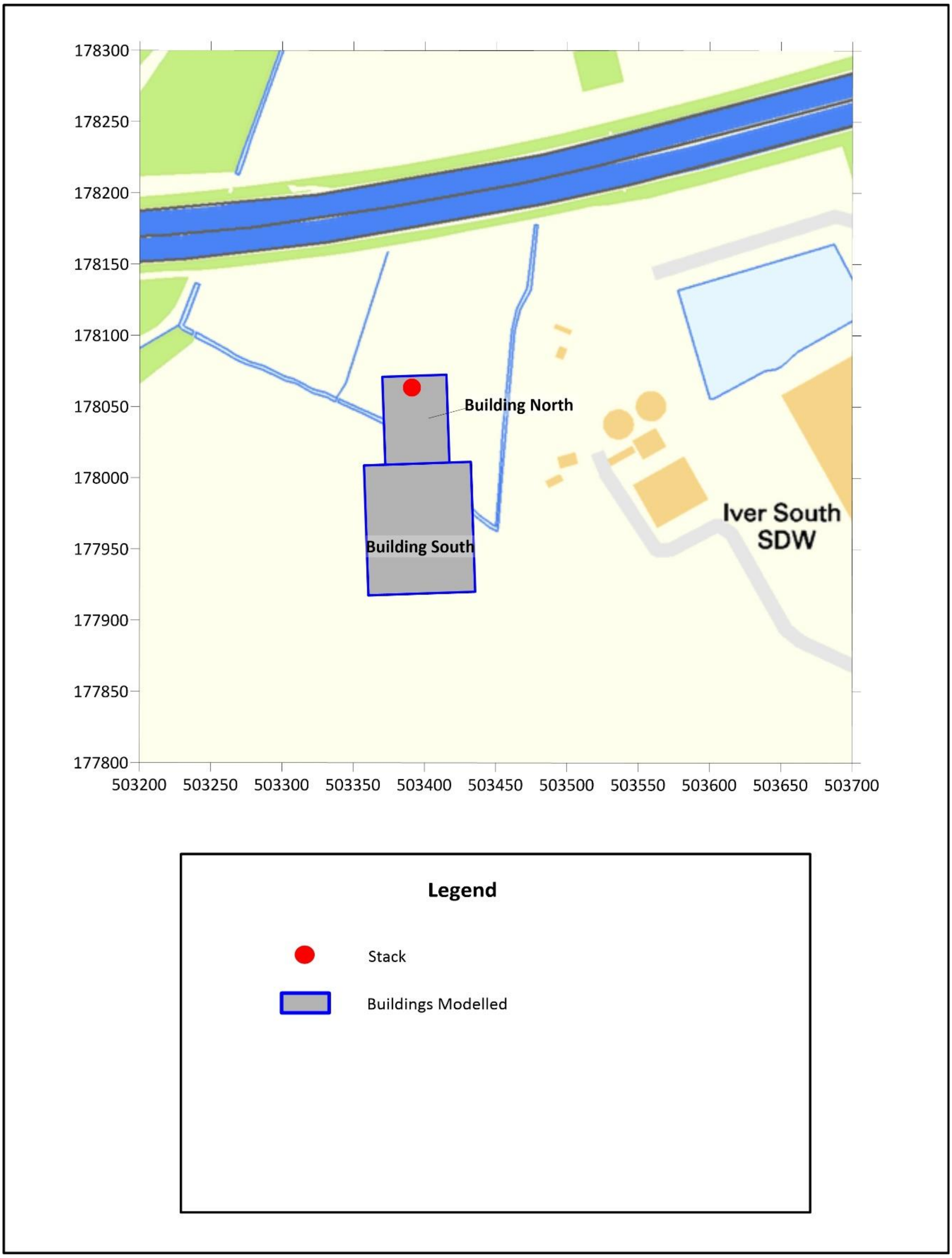


Figure 12: Annual Mean NO_2 Analysis – Main Case

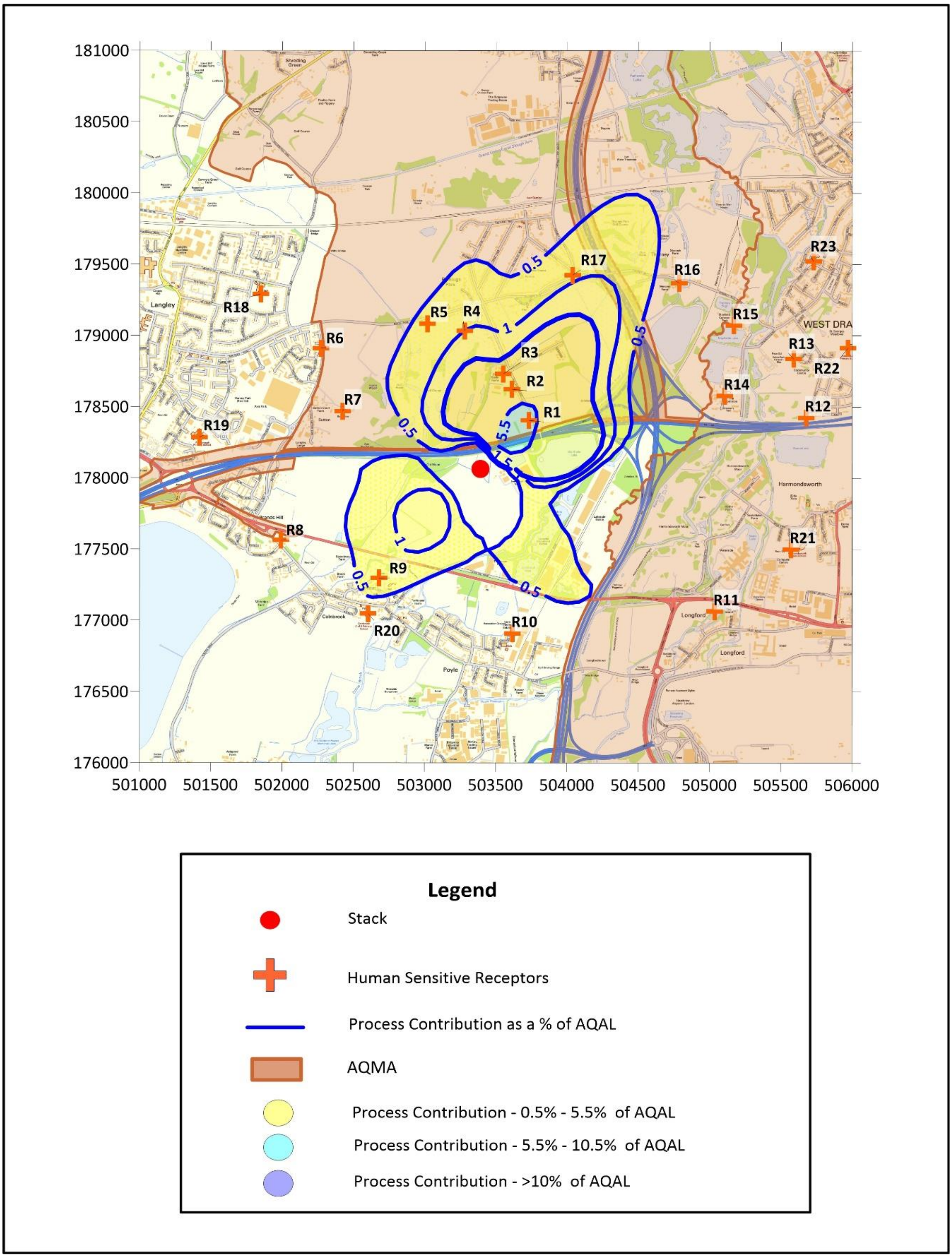


Figure 13: 99.79%ile 1-hour Nitrogen Dioxide Analysis

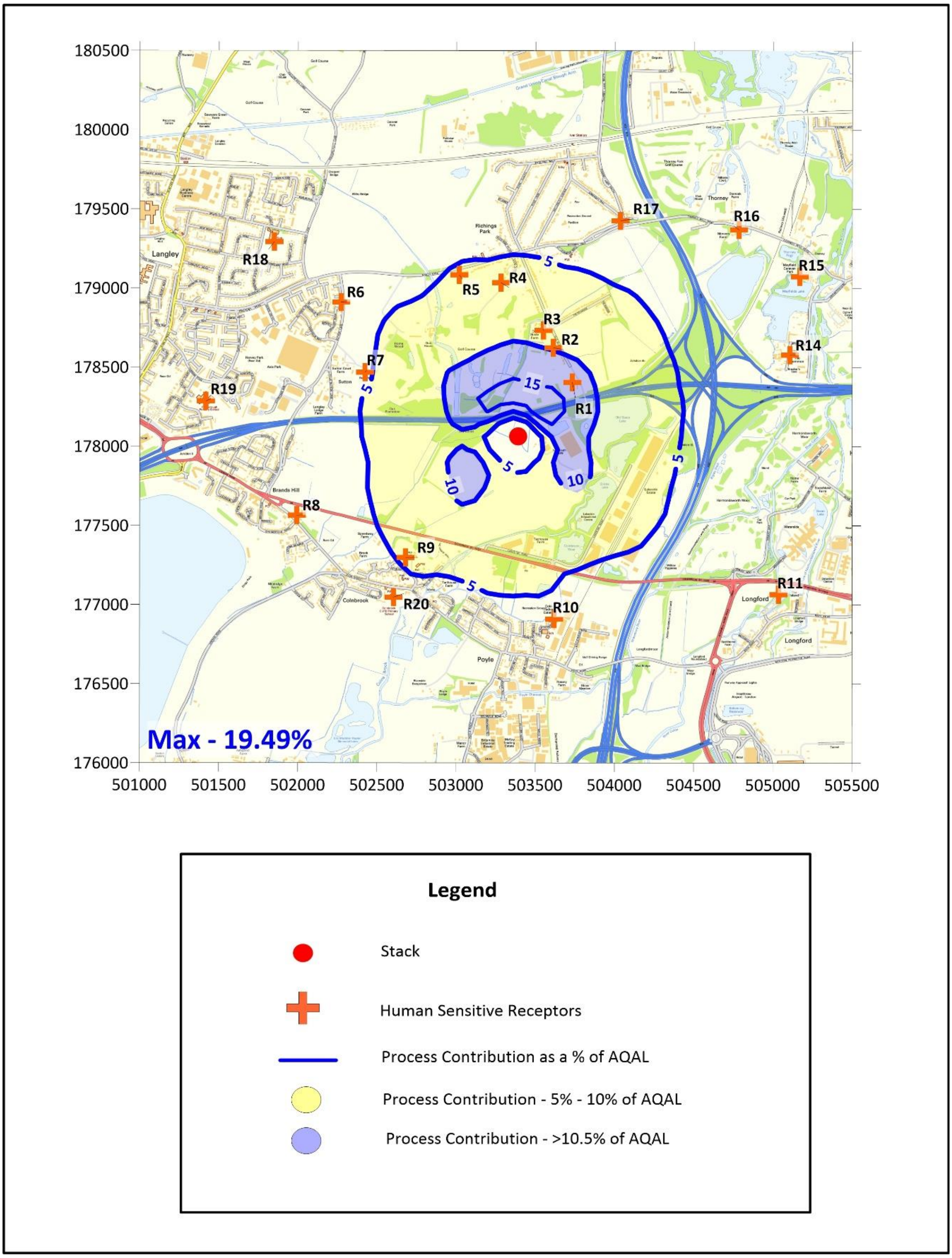


Figure 14: Annual Mean PM 10 Analysis

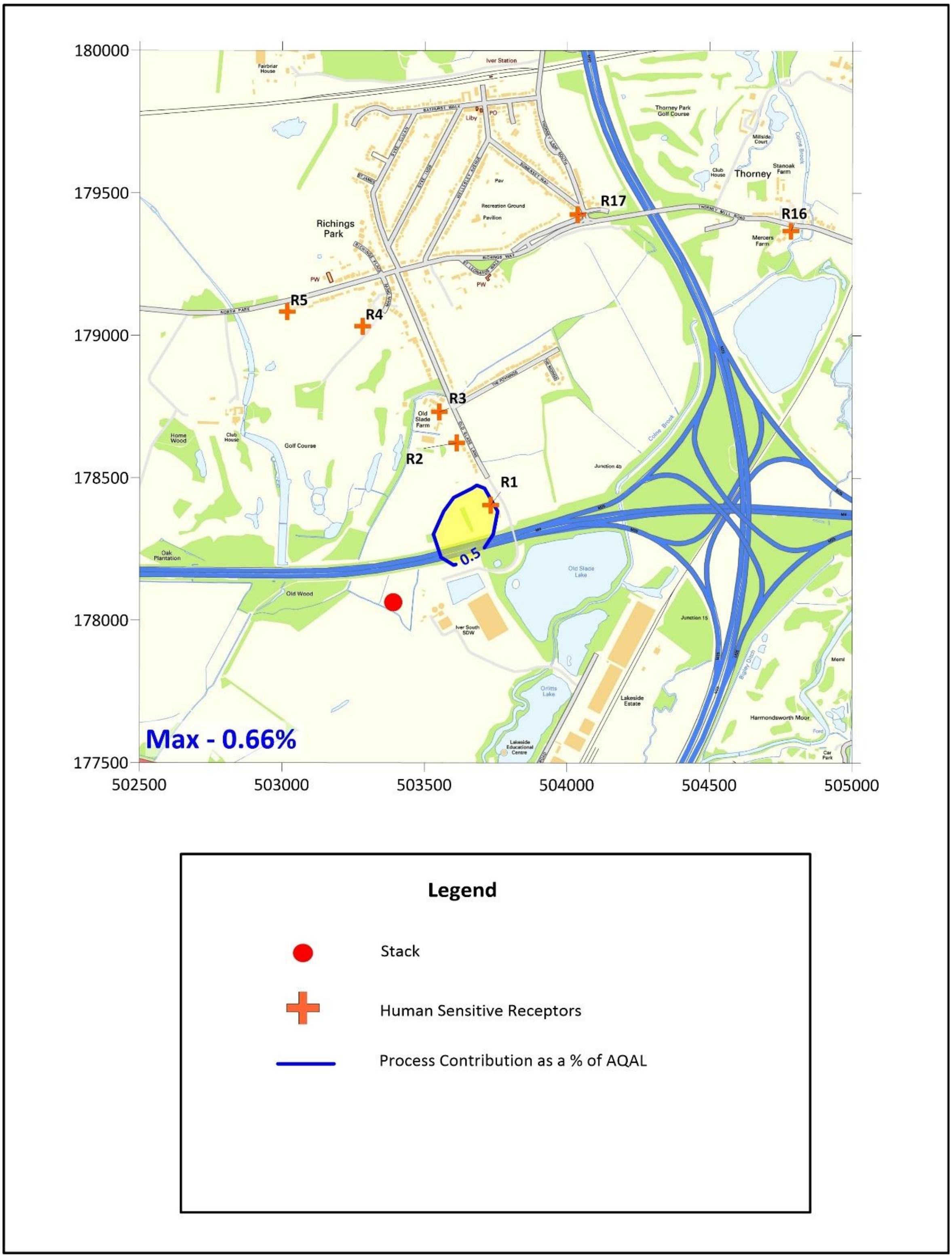


Figure 15: Annual Mean PM 2.5 Analysis

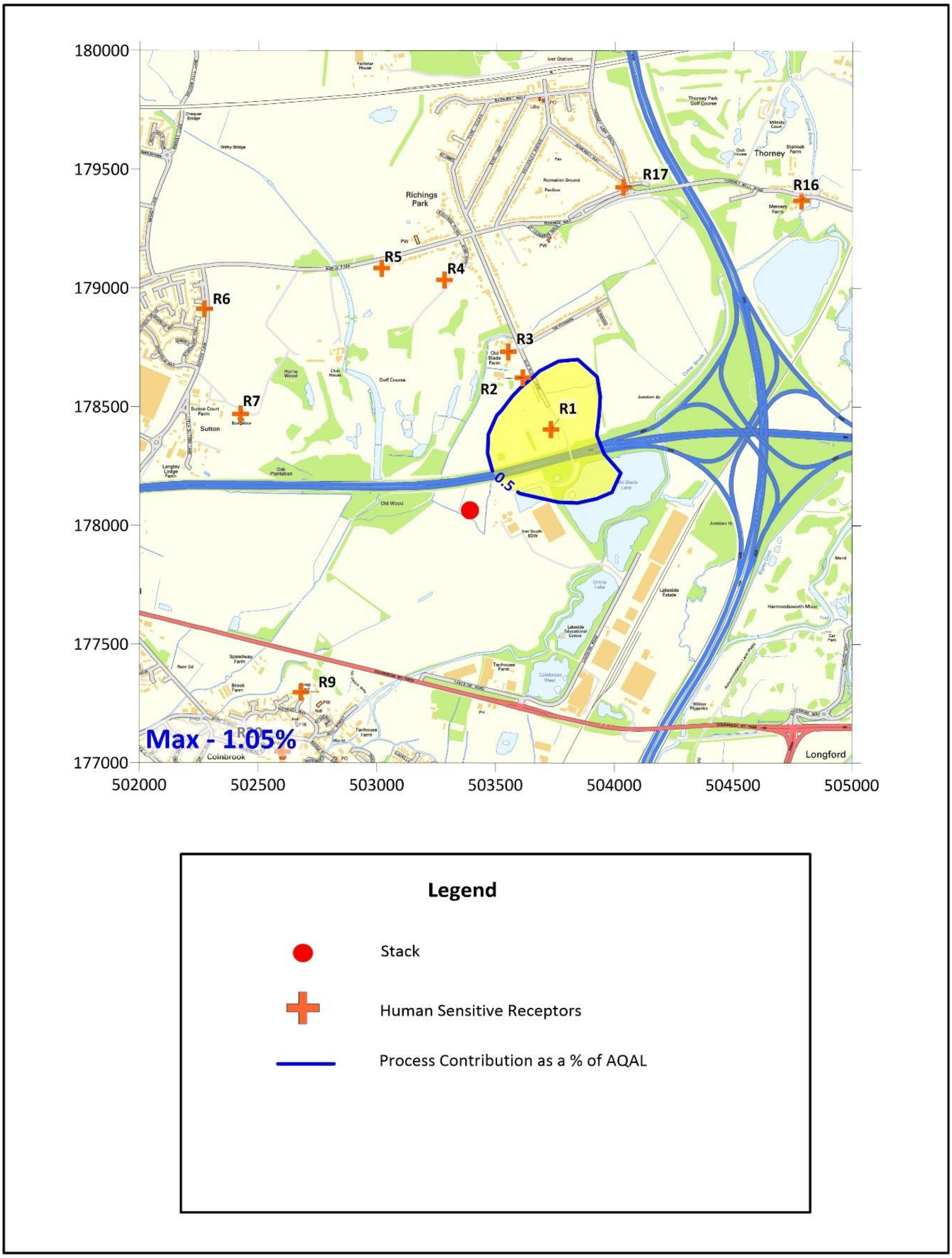


Figure 16: Annual Mean VOCs (as benzene) Analysis

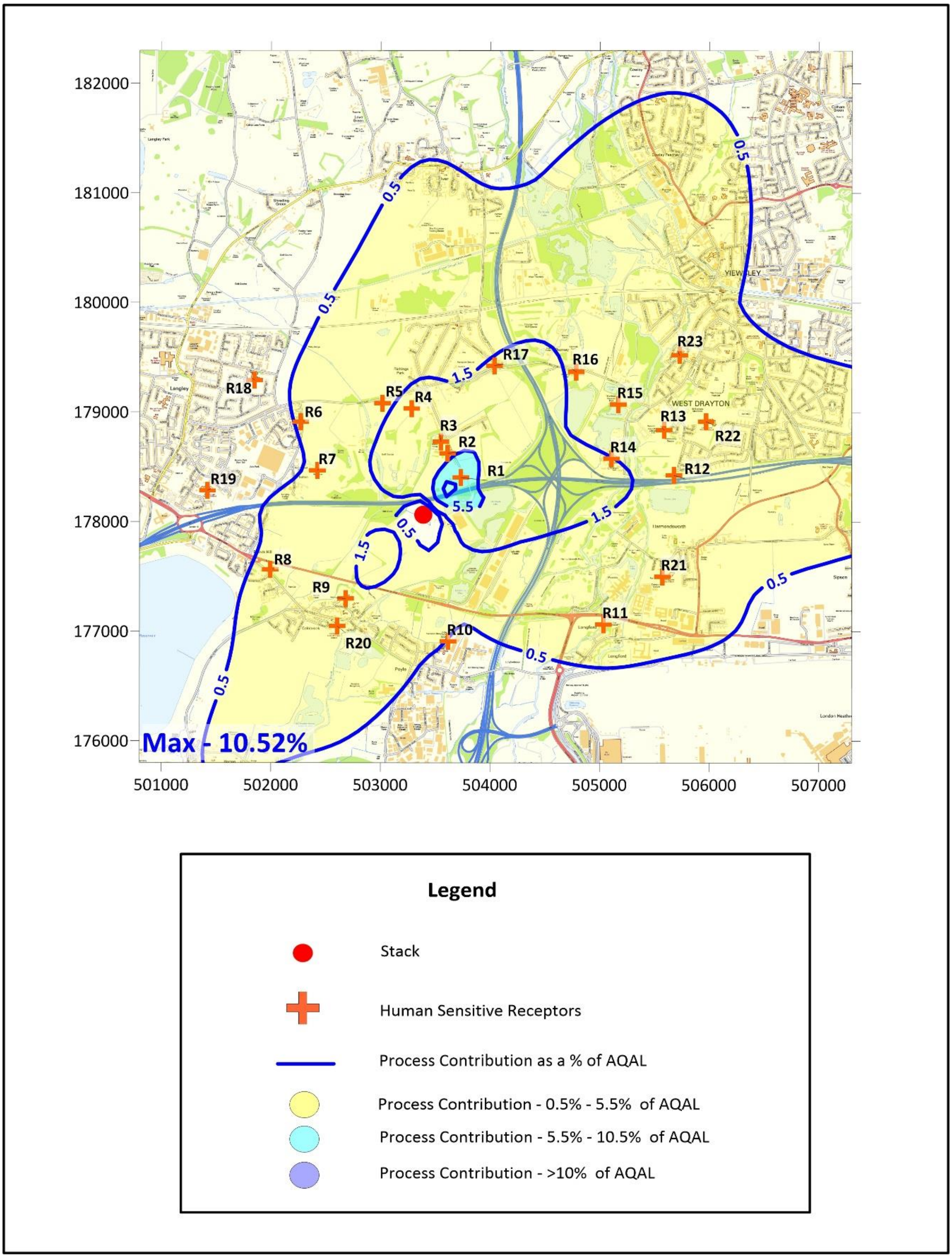


Figure 17: Annual Mean VOCs (as 1,3-Butadiene) Analysis

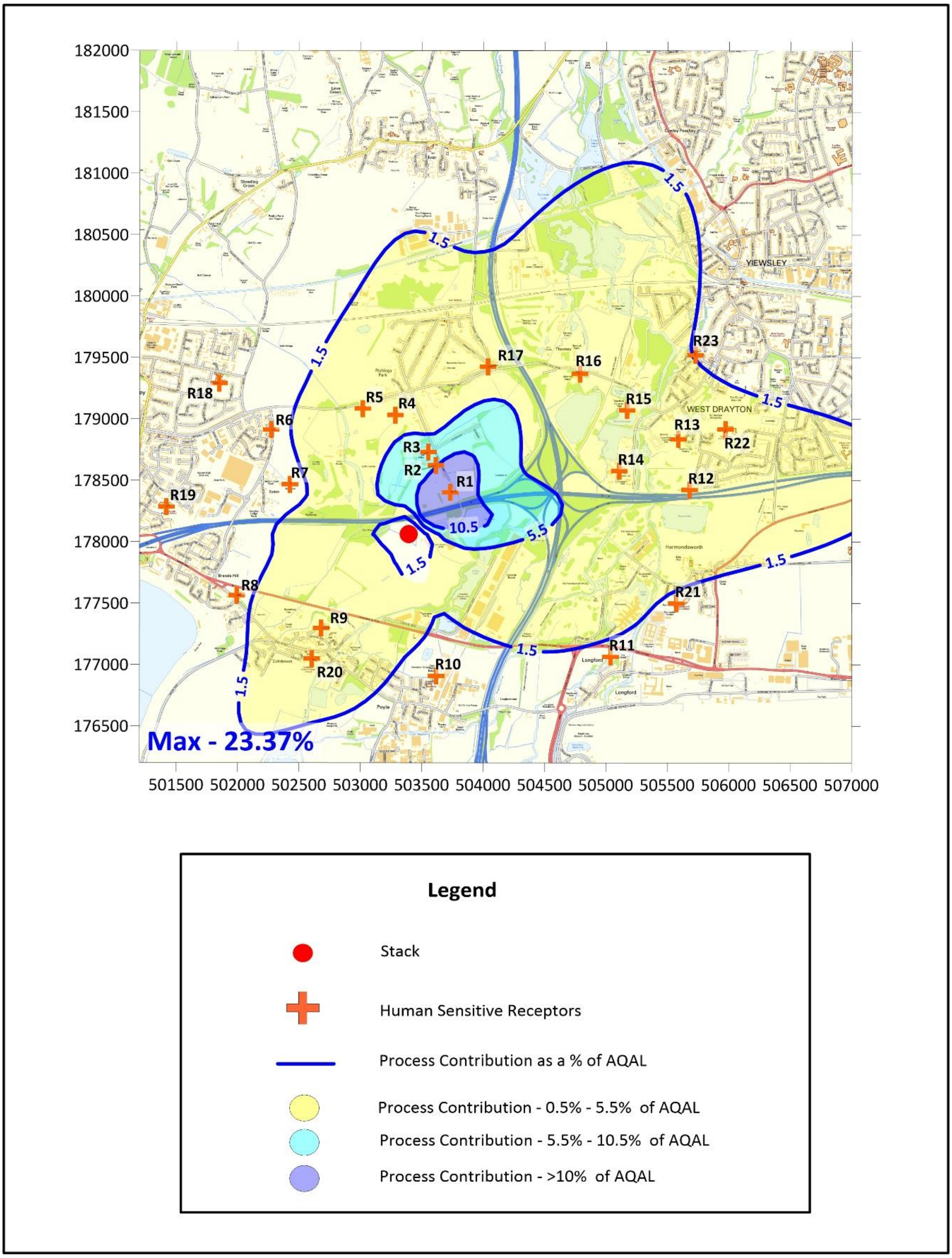


Figure 18: Annual Mean Cadmium 'Typical Scenario' Analysis

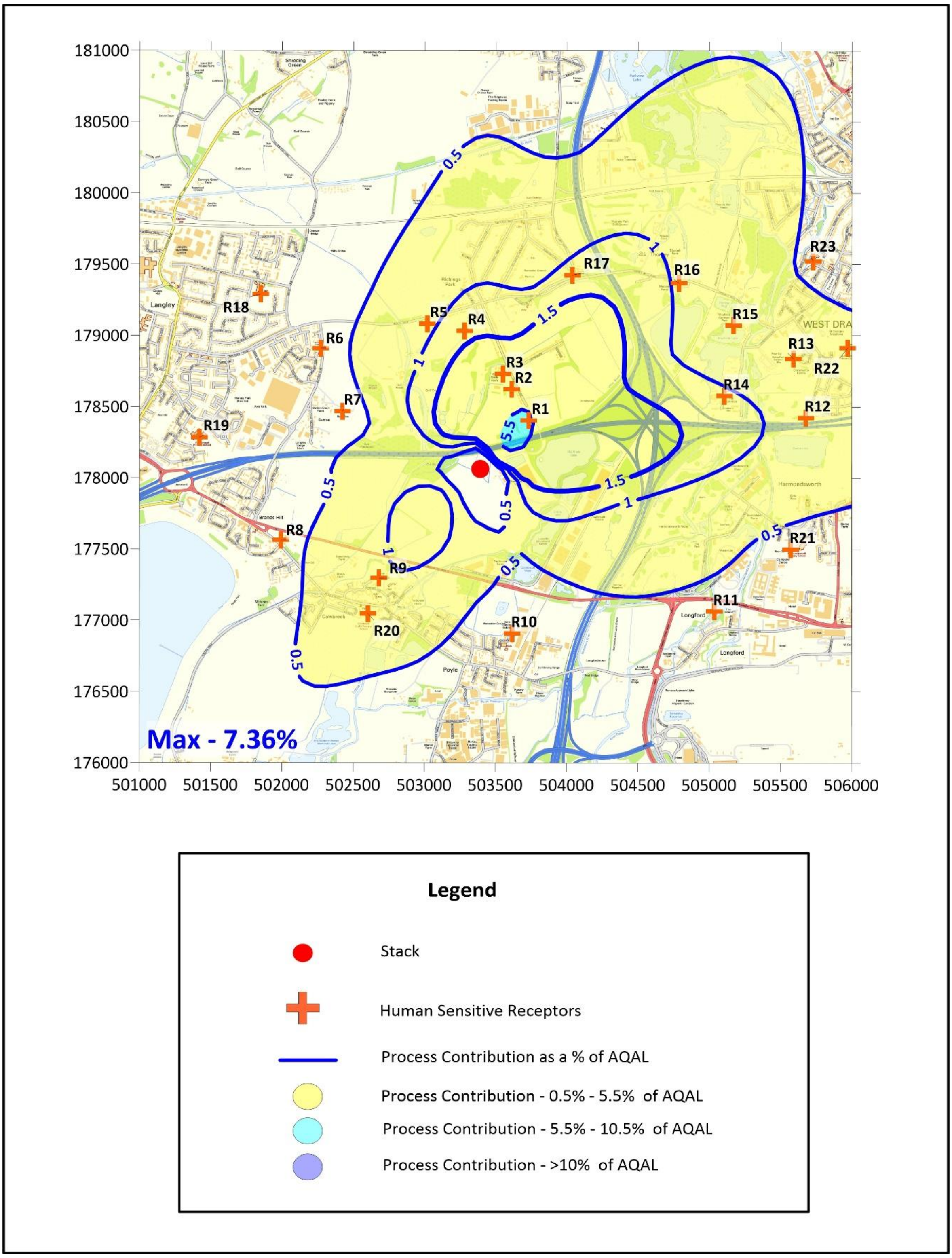


Figure 19: Annual Mean PaH Analysis

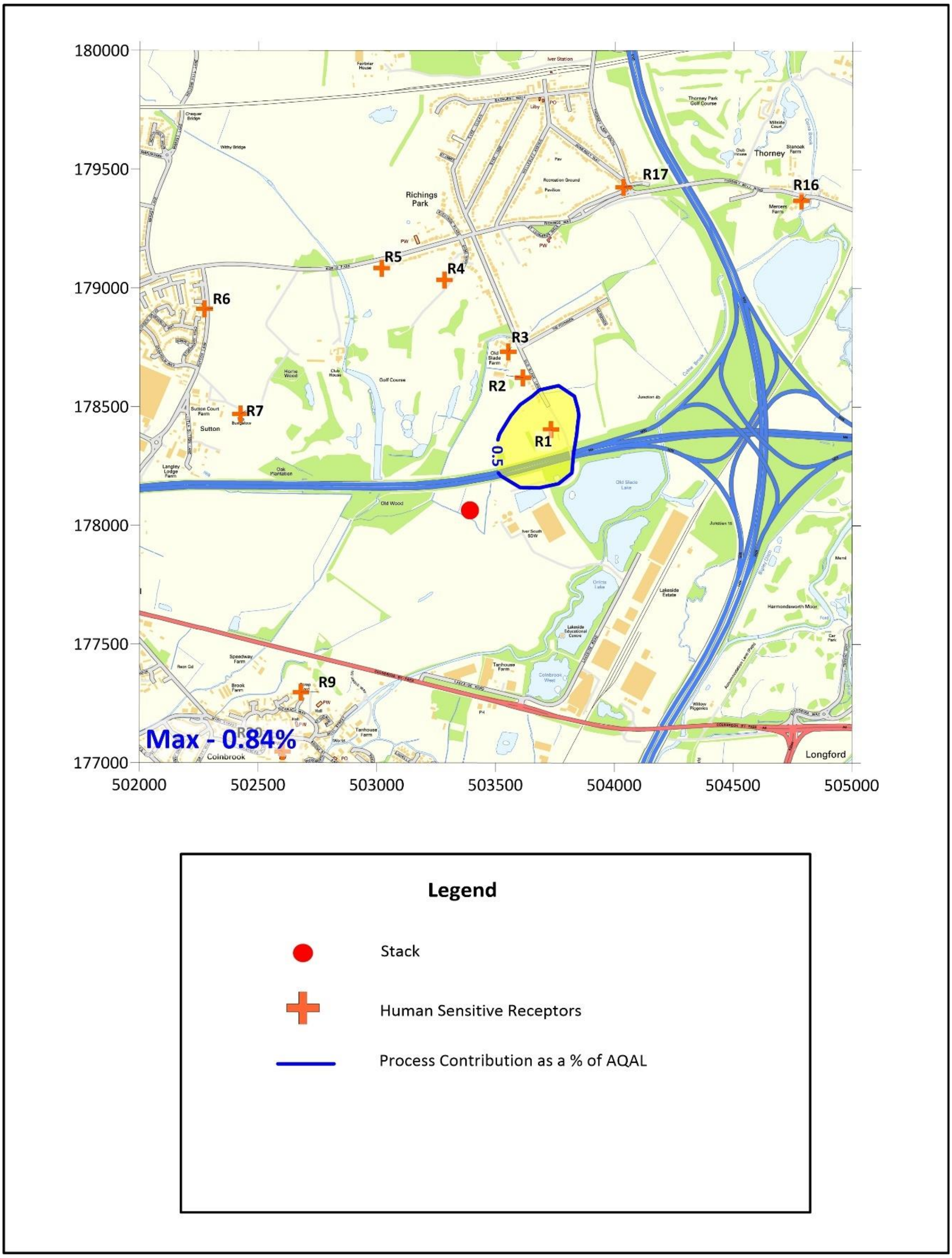


Figure 20: 99.73rd %ile of 1-Hour Sulphur Dioxide Analysis

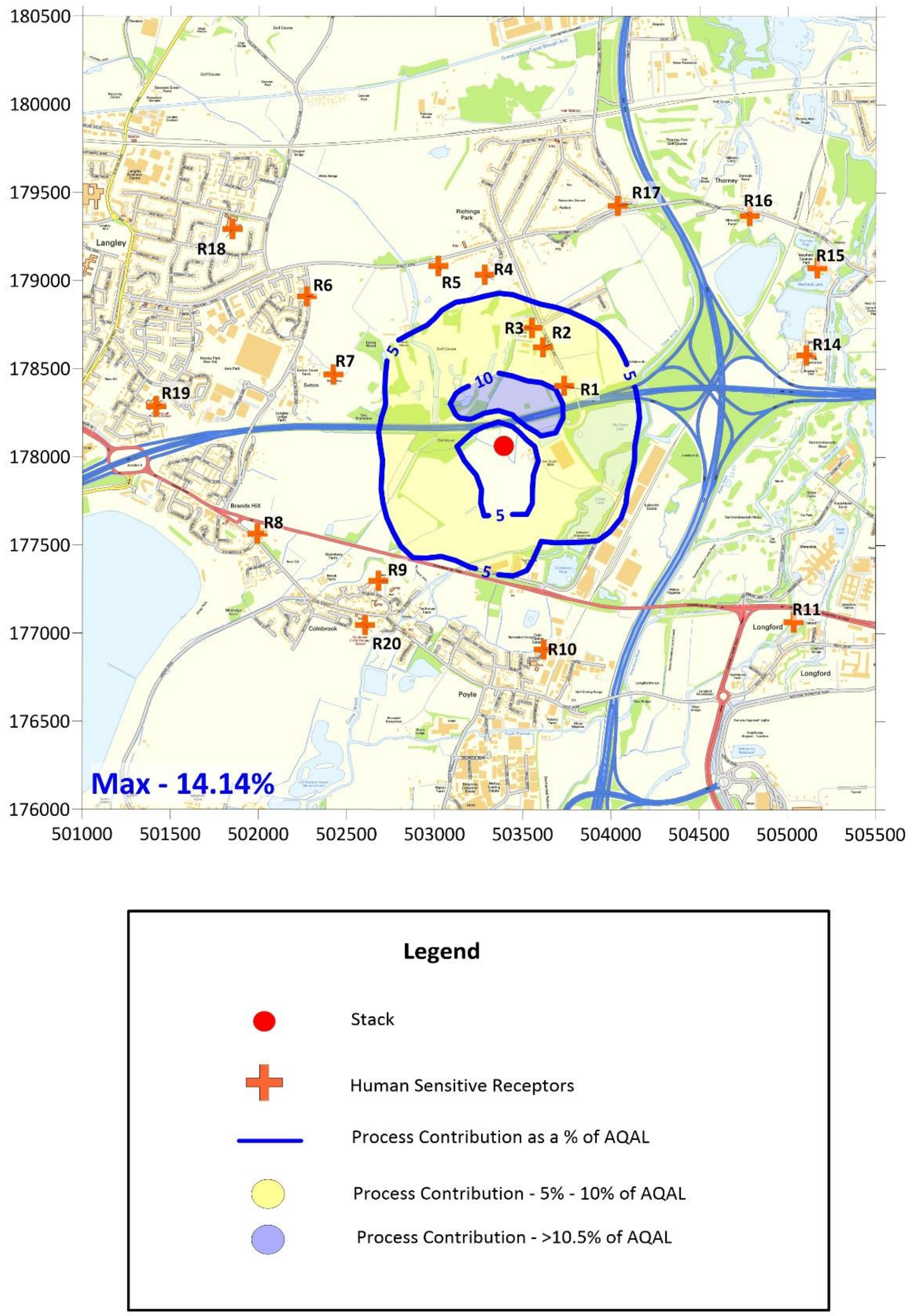


Figure 21: 99.9th %ile of 15. Min Sulphur Dioxide Analysis

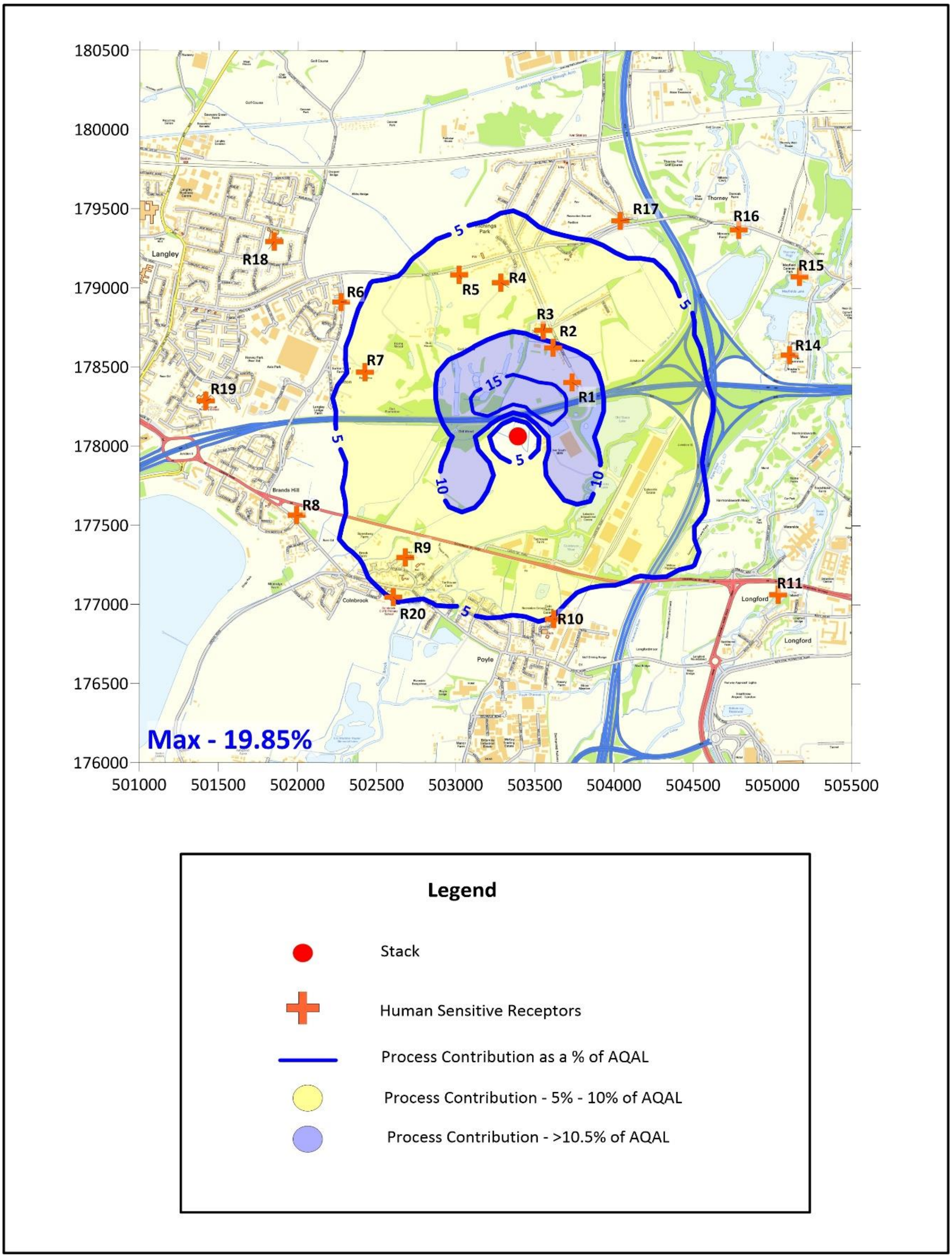
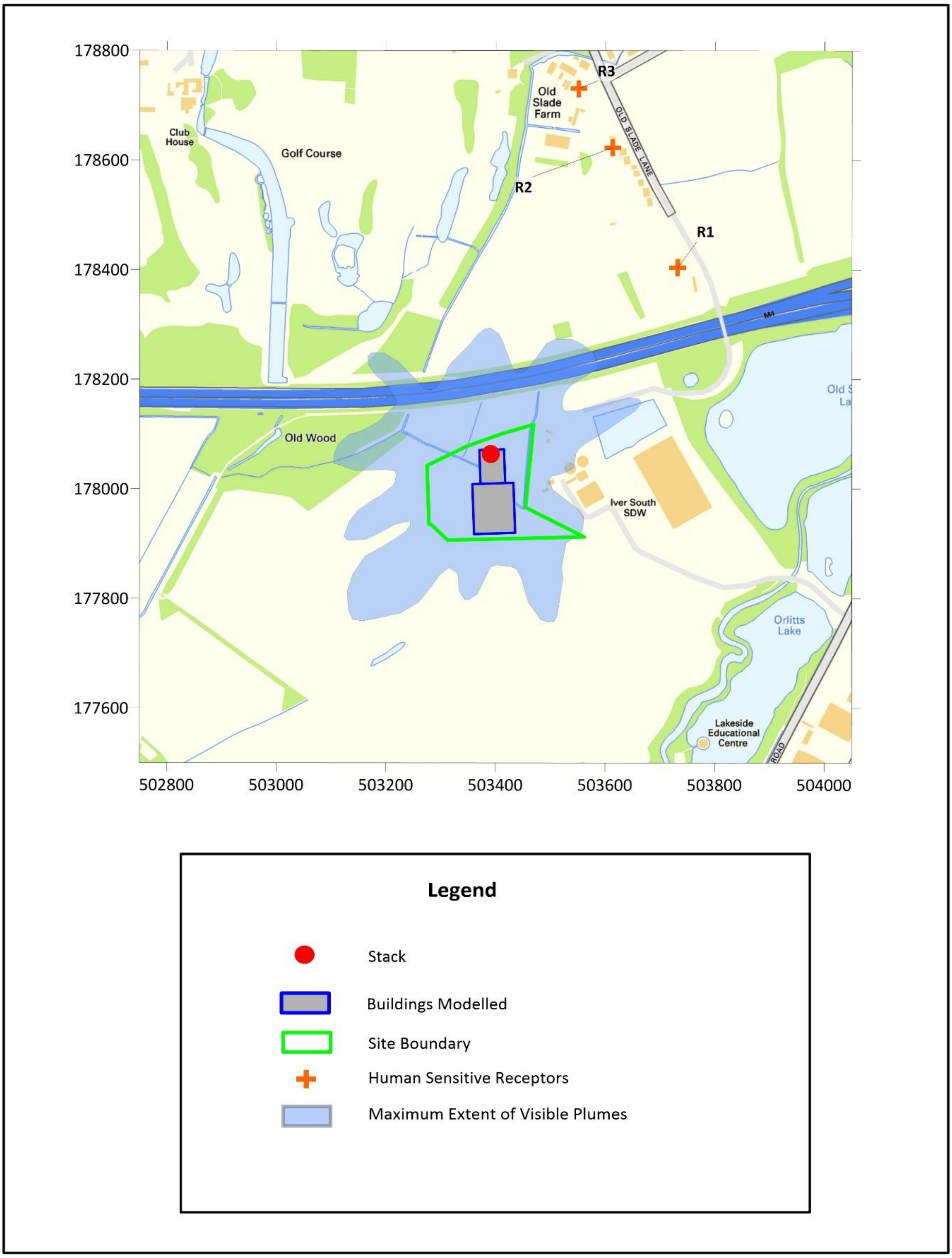


Figure 22: Plume Visibility



B Roads Modelling Verification Procedure

The ADMS Model has been validated against real world monitoring, however LAQM.TG(16) recommends that the model output is verified. The verification process should involve the comparison between predicted and measured concentrations at one or more suitable local sites and forms an essential component of a detailed assessment for road traffic models. Part of the verification process involves improvements to the base model to provide a better representation of the monitored data. This includes checks on:

- Traffic data;
- Road widths;
- Distance between sources and monitoring locations;
- Speed estimates;
- Street canyons;
- Background concentrations; and
- Monitoring data.

All of these have been reviewed and the model refined to increase the accuracy as much as possible.

Five monitoring locations have been identified as suitable for model verification. The results of the verification procedure are detailed below.

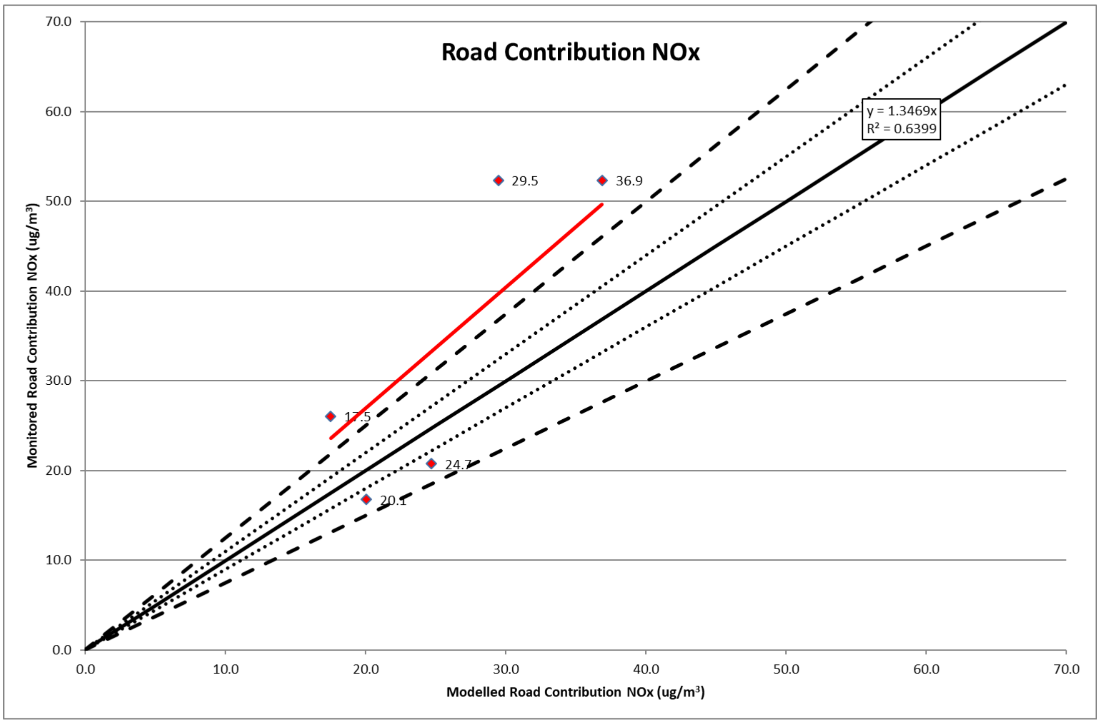
Table 64: Verification Procedure: Initial Comparison (All Pollutant Concentrations Expressed as µg/m³)

Monitoring Site	Location		2017 monitored NO_2	2017 mapped background NO_2	2017 monitored road NOx	2017 modelled road NOx	Ratio of monitored to modelled road NOx	2017 modelled total NO_2	Ratio of monitored to modelled total NO_2
	X	Y							
SLO9	501501	177879	35.3	23.8	26.0	17.5	1.5	31.73	0.90
SLO10	501733	177725	45.3	23.8	52.3	36.9	1.4	39.59	0.87
SLO39	501734	177733	33.1	23.8	20.7	24.7	0.8	34.75	1.05
SLO45	501658	177781	31.4	23.8	16.8	20.1	0.8	32.81	1.04
SLO28	501941	177633	45.3	23.8	52.3	29.5	1.8	36.68	0.81

Note:

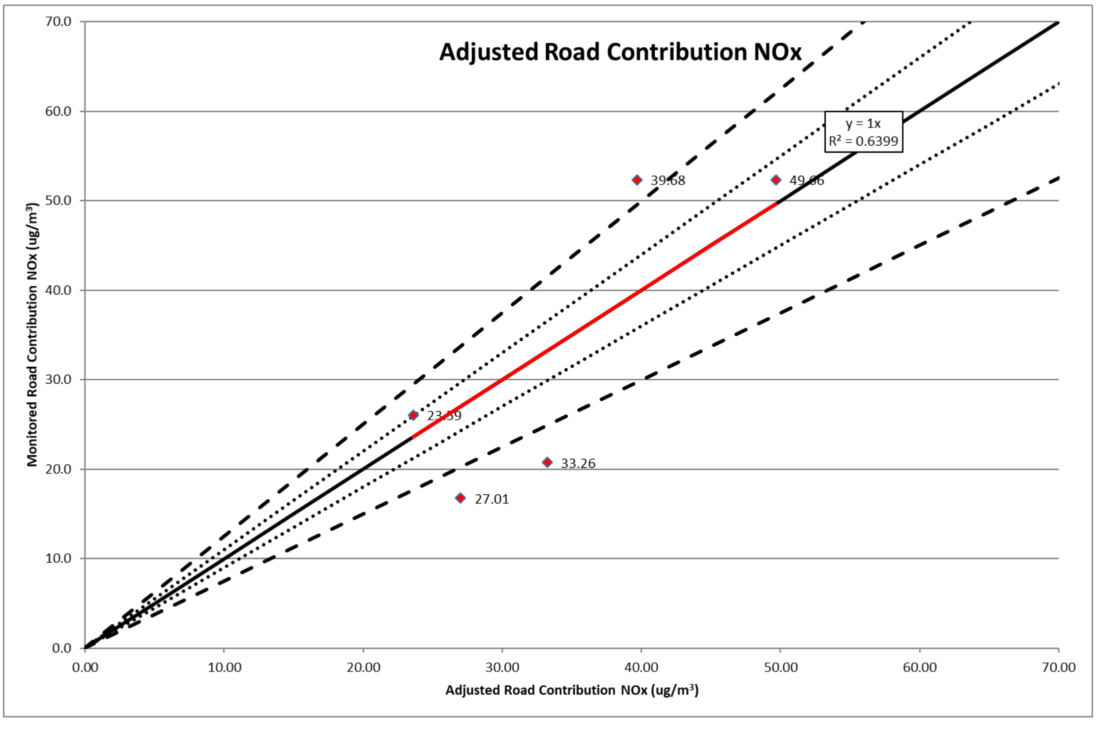
All NOx to NO_2 conversions undertaken using DEFRA's NOx to NO_2 calculator V7.1, for 2017 and using the 'All London traffic' traffic mix setting.

Figure 23: Comparison of Monitored against Modelled Road NOx.



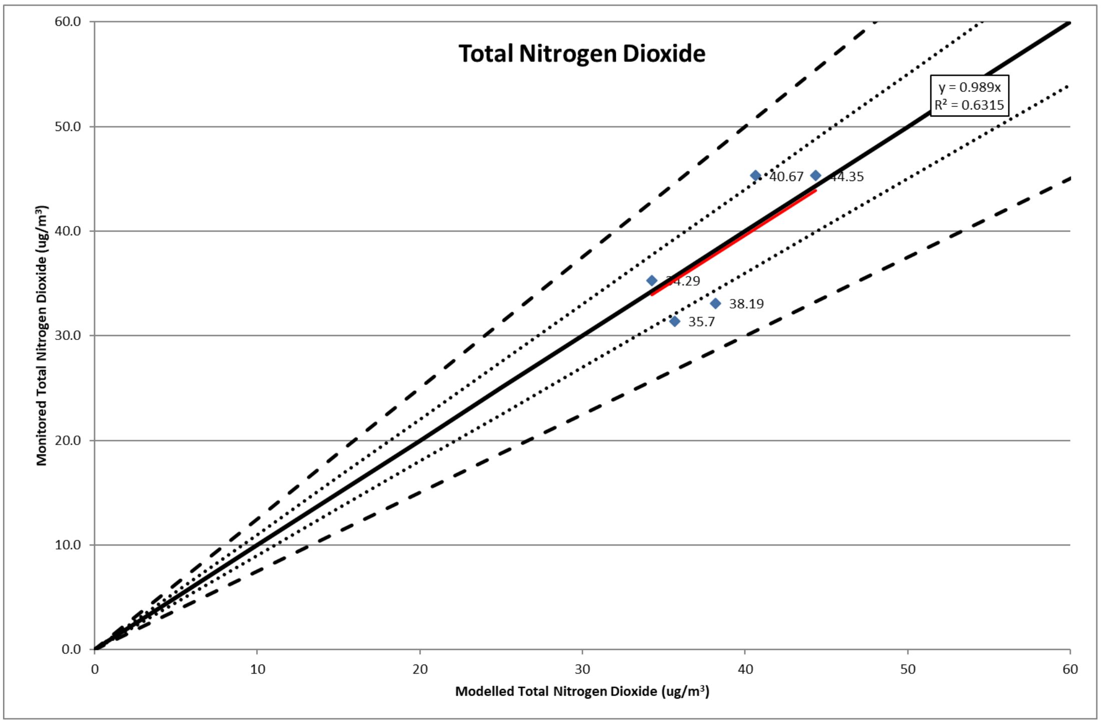
As shown, the model is slightly under-predicting road-NOx. The adjustment factor calculated from the graph is 1.3469. This adjustment factor has been applied to the modelled road NOx. The monitored road-NOx has been plotted against adjusted modelled road-NOx, as presented below.

Figure 24: Comparison of Monitored against Adjusted Modelled Road NOx.



The adjusted road NOx has been used to calculate the adjusted total nitrogen dioxide concentration. The results are plotted below.

Figure 25: Comparison of Monitored against Adjusted Modelled Total NO_2



A summary of a comparison between the adjusted modelled total NO_2 and monitored NO_2 is presented in the table below.

Table 65: Verification Procedure: Adjusted Model Results Comparison

Location	2017 monitored total NO_2	2017 adjusted modelled total NO_2 (μg/m³)	% Difference (modelled - monitored / monitored)
SLO9	35.3	34.29	-3%
SLO10	45.3	44.35	-2%
SLO39	33.1	38.19	15%
SLO45	31.4	35.7	14%
SLO28	45.3	40.67	-10%

Note:

All NOx to NO_2 conversions undertaken using DEFRA's NOx to NO_2 calculator V7.1, for 2017 and using the 'All London traffic' traffic mix setting.

The verification procedure has shown that, following adjustment, the modelled total NO_2 is within 15% of monitored NO_2 at all monitoring locations.

In lieu of sufficient roadside monitoring to undertake verification for modelled concentrations of PM_{10} and $PM_{2.5}$, as set out in LAQM.TG(16) the model adjustment factor for NO_2 (1.3469) has been applied to the modelled road-PM_{10} and road-$PM_{2.5}$ outputs.

C APIS Critical Loads

Table 66: Nitrogen Deposition Critical Loads

Site	Habitat Type	NCL Class	Lower Critical Load (kgN/ha/yr)	Upper Critical Load (kgN/ha/yr)	Maximum Background (kgN/ha/yr)
European designated sites (within 10km)					
South West London Waterbodies	Standing open water and canals	No comparable habitat with established critical load estimate available	-	-	11.2
Windsor Forest & Great Park	Old acidophilous oak woods with Quercus robur on sandy plains (H9190)	Acidophilous Quercus-dominated woodland	10	15	28.14
Locally designated sites (within 2km)					
Old Wood	Broadleaved, Mixed and Yew Woodland	Acidophilous Quercus-dominated woodland	10	20	30.8
Old Slade Lake	Broadleaved, Mixed and Yew Woodland	Broadleaved deciduous woodland	10	20	30.66
Opposite Iver Station	Neutral grassland	Low and medium altitude hay meadows	20	30	17.78
Lower Colne	Neutral grassland	Low and medium altitude hay meadows	20	30	17.78
Queen Mother Reservoir	Standing open water and canals	No comparable habitat with established critical load estimate available	-	-	-

Table 67: Acid Deposition Critical Loads

Site	Habitat Type	Acidity Class	Minimum Critical Load Function (keq/ha/yr)			Maximum Background (keq/ha/yr)	
			CLminN	CLmaxN	CLmaxS	N	S
European designated sites (within 10km)							
South West London Waterbodies	Standing open water and canals	Not sensitive	-	-	-	0.8	0.25
Windsor Forest & Great Park	Old acidophilous oak woods with Quercus robur on sandy plains (H9190)	Unmanaged Broadleafed/Coniferous Woodland	0.357	2.756	2.399	1.82	0.22
Locally designated sites (within 2km)							
Old Wood	Broadleaved, Mixed and Yew Woodland	Unmanaged Broadleafed/Coniferous Woodland	0.357	3.204	2.847	2.2	0.26
Old Slade Lake	Broadleaved, Mixed and Yew Woodland	Unmanaged Broadleafed/Coniferous Woodland	0.357	3.204	2.847	2.19	0.31
Opposite Iver Station	Neutral grassland	Calcareous grassland (using base cation)	1.071	5.071	4	1.27	0.26
Lower Colne	Neutral grassland	Calcareous grassland (using base cation)	1.071	5.071	4	1.27	0.26
Queen Mother Reservoir	Standing open water and canals	Not sensitive	-	-	-	-	-

D Deposition Analysis at Ecological Sites

Table 68: Annual Mean Process Contribution used for Deposition Analysis

Site	Annual Mean Process Contribution (ng/m³)			
	Nitrogen Dioxide	Sulphur Dioxide	Hydrogen Chloride	Ammonia
European and UK designated sites (within 10km)				
South West London Waterbodies	152.8	64.3	12.8	21.3
Windsor Forest & Great Park	61.2	26.0	5.2	8.6
Locally designated sites (within 2km)				
Old Wood	707.7	296.2	58.1	96.8
Old Slade Lake	2260.1	957.9	189.0	315.1
Opposite Iver Station	332.1	145.7	28.1	46.8
Lower Colne	673.9	292.9	56.8	94.7
Queen Mother Reservoir	169.2	70.7	14.3	23.8

Table 69: Deposition Calculation – Grassland

Site	Deposition Velocity Class	Dry Deposition (kg/ha/yr)				Total N Deposition (kgN/ha/yr)	Acid Deposition keq/ha/yr	
		Nitrogen Dioxide	Sulphur Dioxide	Hydrogen Chloride	Ammonia		N	S
European and UK designated sites (within 10km)								
South West London Waterbodies	Grassland	0.02	0.12	0.10	0.11	0.13	0.01	0.01
Windsor Forest & Great Park	Woodland	0.01	0.05	0.04	0.04	0.05	0.004	0.01
Locally designated sites (within 2km)								
Old Wood	Woodland	0.10	0.56	0.45	0.50	0.60	0.04	0.06
Old Slade Lake	Woodland	0.33	1.81	1.45	1.64	1.96	0.14	0.19
Opposite Iver Station	Grassland	0.05	0.28	0.22	0.24	0.29	0.02	0.03
Lower Colne	Grassland	0.10	0.55	0.44	0.49	0.59	0.04	0.06
Queen Mother Reservoir	Grassland	0.02	0.13	0.11	0.12	0.15	0.01	0.01

Table 70: Deposition Calculation – Woodland

Site	Deposition Velocity Class	Dry Deposition (kg/ha/yr)				Total N Deposition (kgN/ha/yr)	Acid Deposition keq/ha/yr	
		Nitrogen Dioxide	Sulphur Dioxide	Hydrogen Chloride	Ammonia		N	S
European designated sites (within 10km)								
South West London Waterbodies	Grassland	0.04	0.24	0.24	0.17	0.20	0.01	0.03

Site	Deposition Velocity Class	Dry Deposition (kg/ha/yr)				Total N Deposition (kgN/ha/yr)	Acid Deposition keq/ha/yr	
		Nitrogen Dioxide	Sulphur Dioxide	Hydrogen Chloride	Ammonia		N	S
Windsor Forest & Great Park	Woodland	0.01	0.10	0.10	0.07	0.08	0.01	0.01
Locally designated sites (within 2km)								
Old Wood	Woodland	0.20	1.12	1.07	0.75	0.96	0.07	0.13
Old Slade Lake	Woodland	0.65	3.63	3.48	2.45	3.11	0.22	0.42
Opposite Iver Station	Grassland	0.10	0.55	0.52	0.36	0.46	0.03	0.06
Lower Colne	Grassland	0.19	1.11	1.05	0.74	0.93	0.07	0.13
Queen Mother Reservoir	Grassland	0.05	0.27	0.26	0.19	0.23	0.02	0.03

Table 71: Detailed Results – Nitrogen Deposition

Site	NCL Class	Deposition Velocity	Process Contribution		
			PC N dep (kgN/ha/yr)	% of Lower CL	% of Upper CL
European and UK designated sites (within 10km)					
South West London Waterbodies	No comparable habitat with established critical load estimate available	Grassland	0.13	-	-
Windsor Forest & Great Park	Acidophilous Quercus-dominated woodland	Woodland	0.08	0.85%	0.57%
Locally designated sites (within 2km)					
Old Wood	Broadleaved deciduous woodland	Woodland	0.96	9.58%	4.79%
Old Slade Lake	Broadleaved deciduous woodland	Woodland	3.11	31.06%	15.53%
Opposite Iver Station	Low and medium altitude hay meadows	Grassland	0.29	1.45%	0.97%

Site	NCL Class	Deposition Velocity	Process Contribution		
			PC N dep (kgN/ha/yr)	% of Lower CL	% of Upper CL
Lower Colne	Low and medium altitude hay meadows	Grassland	0.59	2.94%	1.96%
Queen Mother Reservoir	No comparable habitat with established critical load estimate available	Grassland	0.15	-	-

Table 72: Detailed Results – Acid Deposition

Site	Acidity Class	Deposition Velocity	Process Contribution			Predicted Environmental Concentration		
			N (keq/ha/yr)	S (keq/ha/yr)	% of Min CL Function	N (keq/ha/yr)	S (keq/ha/yr)	% of Min CL Function
European and UK designated sites (within 10km)								
South West London Waterbodies	Not sensitive	Grassland	0.01	0.01	-	0.81	0.26	-
Windsor Forest & Great Park	Unmanaged Broadleafed/Coniferous Woodland	Woodland	0.01	0.01	0.64%	1.83	0.23	74.66%
Locally designated sites (within 2km)								
Old Wood	Unmanaged Broadleafed/Coniferous Woodland	Woodland	0.07	0.13	6.20%	2.27	0.39	82.98%
Old Slade Lake	Unmanaged Broadleafed/Coniferous Woodland	Woodland	0.22	0.42	20.11%	2.412	0.733	98.14%
Opposite Iver Station	Calcareous grassland (using base cation)	Grassland	0.02	0.03	0.99%	1.291	0.289	31.16%

Site	Acidity Class	Deposition Velocity	Process Contribution			Predicted Environmental Concentration		
			N (keq/ha/yr)	S (keq/ha/yr)	% of Min CL Function	N (keq/ha/yr)	S (keq/ha/yr)	% of Min CL Function
Lower Colne	Calcareous grassland (using base cation)	Grassland	0.04	0.06	2.00%	1.312	0.319	32.17%
Queen Mother Reservoir	Not sensitive	Grassland	0.01	0.01	-	0.011	0.015	-

ENGINEERING + CONSULTING

FICHTNER
Consulting Engineers Limited

Kingsgate (Floor 3), Wellington Road North,
Stockport, Cheshire, SK4 1LW,
United Kingdom

t: +44 (0)161 476 0032
f: +44 (0)161 474 0618

www.fichtner.co.uk

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Human Health Risk Assessment

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Document approval

	Name	Signature	Position	Date
Prepared by:	Rhys Weir		Environmental Scientist	23/05/2019
	Stuart Nock		Environmental Consultant	28/05/2019
Checked by:	Stephen Othen		Technical Director	28/05/2019

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Contents

1 Introduction

Fichtner Consulting Engineers Ltd (Fichtner) has been engaged to undertake a Human Health Risk Assessment (HHRA) to support the planning application for the replacement Lakeside Energy from Waste plant and High Temperature Incinerator (HTI) (the Facility).

As the fuel combusted at the Facility will be sourced from waste, the limits on emissions to air will be based on those outlined in Chapter IV and Annex VI of the Industrial Emissions Directive (IED) (2010/75/EU) for waste incineration and co-incineration plants. This will include limits on emissions of heavy metals and dioxins and furans from the Facility. Within the IED, the requirements of the relevant sector Best Available Techniques(BAT) Reference document (BREF) become binding as BAT guidance.

The Final Draft Waste incineration BREF was published by the European IPPC Bureau in December 2018. Formal adoption of the BREF is expected in the third quarter of 2019. Upon adoption of the final BREF, the Environment Agency will be required to review and implement conditions within all permits which require operators to comply with the requirements set out in the BREF within four years of adoption. This will apply to the Facility. As currently drafted, the BREF will introduce BAT-Associated Emission Levels (BAT-AELs), some of which are more stringent than the Emission Limit Values (ELVs) currently set out in the IED. It has been assumed that emissions from the Facility will comply with the draft BAT-AELs.

The advice from health specialists such as the Health Protection Agency that the damage to health from emissions from incineration and co-incineration plants is likely to be very small, and probably not detectable. Nevertheless, the specific effects on human health of the proposed plant have been considered, and are presented in this report.

For most substances released from the Facility, the most significant effects on human health will arise by inhalation. The Air Quality Assessment Levels (AQALs) outlined within the Air Quality Assessment have been set by the various authorities at a level which is considered to present minimum or zero risk to human health. It is widely accepted that, if the concentrations in the atmosphere are less than the AQALs, then the pollutant is unlikely to have an adverse effect on human health.

For some pollutants which accumulate in the environment, inhalation is only one of the potential exposure routes. Therefore, other exposure routes are considered in this assessment.

2 Issue Identification

2.1 Issue

The key issue for consideration is the release of substances from the Facility to atmosphere which have the potential to harm human health. No other sources will include emissions of either metals or dioxins.

The existing Lakeside EfW and HTI facilities are on part of the land identified as being required for the proposed Heathrow expansion and would need to be demolished to accommodate this. Replacement EfW and HTI facilities are now therefore proposed on a 'like for like' basis on nearby land situated to the west of the Iver South Sludge Dewatering Centre and south of the M4 motorway.

The Facility will be designed to meet the BAT-AELs outlined in the Draft WI BREF. Limits have been set for pollutants known to be produced during the combustion of municipal waste which have the potential to impact upon the local environment either on human health or ecological receptors. These pollutants include:

- nitrogen dioxide, sulphur dioxide, particulate matter, carbon monoxide, ammonia;
- acid gases - hydrogen chloride, and hydrogen fluoride;
- total organic carbon;
- metals - mercury, cadmium, thallium, antimony, arsenic, lead, cobalt, copper, manganese, nickel and vanadium;
- dioxin and furans;
- dioxin like PCBs; and
- polycyclic aromatic hydrocarbons (PAHs).

For most substances released from the Facility, the most significant effects on human health will arise by inhalation. An Air Quality Assessment has been undertaken to determine the impact of atmospheric concentrations of the pollutants listed above based on the levels transposed under UK Law in the UK Air Quality Strategy and those set by the Environment Agency. These levels have been set at a level which is considered to present minimum or zero risk to human health.

Some pollutants, including dioxins, furans, dioxin-like polychlorinated biphenyls (PCBs) and heavy metals, accumulate in the environment, which means that inhalation is only one of the potential exposure routes. Therefore, impacts cannot be evaluated in terms of their effects on human health by simply reference to ambient air quality standards. An assessment needs to be made of the overall human exposure to the substances by the local population and the risk that this exposure causes.

2.2 Chemicals of Potential Concern (COPC)

The substances which have been considered within this assessment are those which are authorised (as listed above). Although Emission Limit Values (ELVs) for PAHs are not currently set from installations, monitoring is required by legislation in the UK. Therefore, benzo(a)pyrene has been included in the assessment to represent PAH emissions. The following have been considered COPCs for the purpose of this assessment:

- PCDD/Fs (individual congeners) and dioxin like PCBs;
- Benzene;

- Benzo(a)pyrene;
- Mercury (Hg);
- Mercuric chloride;
- Cadmium (Cd);
- Arsenic (As);
- Chromium (Cr), trivalent and hexavalent; and
- Nickel (Ni).

This risk assessment investigates the potential for long term health effect of these COPCs through other routes than just inhalation.

3 Assessment Criteria

IRAP calculates the total exposure through each of the different pathways so that a dose from inhalation and ingestion can be calculated for each receptor. By default, these doses are then used to calculate a cancer risk, using the USEPA's approach. However, the Environment Agency recommends that the results be assessed using the UK's approach, which is explained in the Environment Agency's document "Human Health Toxicological Assessment of Contaminants in Soil", ref SC050021. This approach involves two types of assessment:

- For substances with a threshold level for toxicity, a Tolerable Daily Intake (TDI) is defined. This is "an estimate of the amount of a contaminant, expressed on a bodyweight basis, which can be ingested daily over a lifetime without appreciable health risk." A Mean Daily Intake (MDI) is also defined, which is the typical intake from background sources (including dietary intake) across the UK. In order to assess the impact of the Facility, the predicted intake of a substance due to emissions from the Facility is added to the MDI and compared with the TDI.
- For substances without a threshold level for toxicity, an Index Dose (ID) is defined. This is a level of exposure which is associated with a negligible risk to human health. The predicted intake of a substance due to emissions from the Facility is compared directly with the ID without taking account of background levels.

Substances can reach the body either through inhalation or through ingestion (oral exposure) and the body handles chemicals differently depending on the route of exposure. For this reason, different TDI and IDs are defined for inhalation and oral exposure.

The following table outlines the MDIs (the typical intake from existing background sources) for the pollutants released from the Facility. These figures are defined in the "Contaminants in soil: updated collation of toxicology data and intake values for humans" series of toxicological reports, available from the Environment Agency's website. The values for nickel have been taken from the Environment Agency's August 2015 document following the publication of the new expert opinion by the European Food Safety Authority.

Table 1: Mean Daily Intake of Each Substance

Substance	Mean Daily Intake, 70 kg adult (µg/kg bw/day)		Mean Daily Intake, 20 kg child (µg/kg bw/day)	
	Intake Ingestion	Intake, Inhalation	Intake Ingestion	Intake, Inhalation
Arsenic	0.07	0.0002	0.19	0.0005
Benzene	0.04	2.9	0.11	7.4
Benzene(a)pyrene	-	-	-	-
Cadmium	0.19	0.0003	0.5	0.0007
Chromium	1.81	0.0009	4.70	0.002
Chromium VI	0.18	-	0.47	-
Methyl mercury	0.007	-	0.019	-
Mercuric chloride	0.014	-	0.037	-
Nickel	1.9	0.0037	4.96	0.0096
Dioxins and dioxin like PCBs	0.7 pg WHO-TEQ/kg bw/day		1.8 pg WHO-TEQ/kg bw/day	

Table 2: Tolerable Daily Intake of Each Substance (µg/kg bw/day)

Substance	Index dose, Ingestion	Index dose, Inhalation	TDI, Ingestion	TDI, Inhalation
Arsenic	0.3	0.002	-	-
Benzene	0.29	1.4	-	-
Benzene(a)pyrene	0.02	0.00007	-	-
Cadmium	-	-	0.36	0.0014
Chromium	-	0.001	3	-
Chromium VI	-	-	3	-
Methyl mercury	-	-	0.23	0.23
Mercuric chloride	-	-	2	0.06
Nickel	-	-	2.8	0.006
Dioxins and dioxin like PCBs	-	-	2 pg WHO-TEQ/kg bw/day	

To allow comparison with the TDI for dioxins, intake values for each dioxin are multiplied by a factor known as the WHO-TEF. A full list of the WHO-TEF values for each dioxin is provided in Appendix A.

The following table presents the MDI for an adult and child as a proportion of the TDI.

Table 3: Mean Daily Intake of Each Substance as a % of the TDI

Substance	Mean Daily Intake, 70 kg adult (µg/kg bw/day)		Mean Daily Intake, 20 kg child (µg/kg bw/day)	
	Intake Ingestion	Intake, Inhalation	Intake Ingestion	Intake, Inhalation
Cadmium	53.2%	20.4%	137.7%	52.9%
Chromium	60.5%	-	156.6%	-
Methyl mercury	3.1%	-	8.0%	-
Mercuric chloride	0.7%	-	1.9%	-
Nickel (screening)	68.4%	61.7%	177.1%	159.7%
Nickel (based on monitoring data)	-	31.5%	-	81.5%
Dioxins and dioxin like PCBs	35.00%		90.65%	

The TDI for each pollutant has been set at a level which can be ingested daily over a lifetime without appreciable health risk, and the ID for each pollutant without a toxicity threshold has been set at a level which is associated with a negligible risk to human health. Therefore, if the total exposure is less than the TDI or ID for a pollutant, it can be concluded that the impact of the Facility is negligible and the effect is not significant.

As shown, the MDI of cadmium, chromium and nickel from existing sources exceeds the TDI for children. The implications of the MDI exceeding the TDI for these pollutants are discussed below.

3.1 Chromium

The MDI for chromium is set for chromium III and taken from the DEFRA report "Contaminants in Soil: Collation of Toxicological Data and Intake Values for Humans. Chromium". This states that there are no published reports on the adverse effects in humans resulting from ingested chromium III. Almost all toxicological opinion is that chromium III compounds are of low oral toxicity, and indeed the UK Committee on Medial Aspects of Food Policy recommends chromium III in the diet. The World Health Organisation (WHO) have reviewed the daily intake of chromium from foods and found that existing levels do not represent a toxicity problem. The WHO conclude that "in the form of trivalent compounds, chromium is an essential nutrient and is relatively non-toxic for man and other mammalian species".

The DEFRA report explains that the TDI has been derived from the USEPA's Reference Dose of 3 µg/kg bw/day for chromium VI. This is the only explicitly derived safety limit for oral exposures of chromium. DEFRA recommends that the USEPA Reference Dose is applied to all the chromium content as a starting point. Therefore, the TDI presented in Table 2 is actually the TDI for chromium VI, not total chromium. Assessing the total dietary intake of chromium against this TDI is highly conservative.

3.2 Cadmium

The key determinant of cadmium's toxicity potential is its chronic accumulation in the kidney The Environment Agency in their toxicology report "Contaminants in Soil: Collation of Toxicological Data and Intake Values for Humans. Cadmium" explains that chronic exposure to levels in excess of the TDI might be associated with an increase in kidney disease in a proportion of those exposed, but (small) exceedances lasting for shorter periods are of less consequence. Therefore, assessing a lifetime exposure is appropriate. If we assess the exposure of a receptor over a lifetime (i.e. a period as a child and adult) the lifetime MDI is below the TDI.

3.3 Nickel

The MDI and TDI (oral) for nickel have been revised following the publication by the European Food Safety Authority of new expert opinion relating to the reproductive and developmental effects in experimental animals. The MDI exceeds the TDI for children for both inhalation and ingestion. The updated MDI for inhalation is 0.259 µg/day for an adult which, assuming an inhalation rate of 20 m^3/day, equates to an atmospheric concentration of 13.0 ng/m^3. The background concentration used in the Air Quality Assessment is 6.61 ng/m^3, which is the highest annual concentration averaged across all urban background sites across the UK from 2013 to 2017. As such, it is considered that an MDI based on an atmospheric concentration of 13.0 ng/m^3 is over-conservative. Therefore, a concentration of 6.61 ng/m^3 as used in the Air Quality Assessment has been used as the basis for the MDI for the inhalation of nickel.

4 Conceptual Site Model

4.1 Conceptual site model

A detailed Human Health Risk Assessment has been carried out using the Industrial Risk Assessment Program-Human Health (IRAP-h View – Version 5.0). The programme, created by Lakes Environmental, is based on the United States Environment Protection Agency (USEPA) Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities[1]. This Protocol is a development of the approach defined by Her Majesties Inspectorate on Pollution (HMIP) in the UK in 1996[2], taking account of further research since that date. The exposure pathways included in the IRAP model are shown in Table 4.

Exposure to gaseous contaminants has the potential to occur by direct inhalation or vapour phase transfer to plants. In addition, exposure to particulate phase contaminants may occur via indirect pathways following the deposition of particles to soil. These pathways include:

- ingestion of soil and dust;
- uptake of contaminants from soil into the food-chain (through home-grown produce and crops); and
- direct deposition of particles onto above ground crops.

The pathways through which inhalation and ingestion occur and the receptors that have been considered to be impacted via each pathway are shown in the table below.

Table 4: Pathways Considered

Pathway	Residential	Agricultural
Direct inhalation	Yes	Yes
Ingestion of soil	Yes	Yes
Ingestion of home-grown produce	Yes	Yes
Ingestion of drinking water	Yes	Yes
Ingestion of eggs from home-grown chickens	-	Yes
Ingestion of home-grown poultry	-	Yes
Ingestion of home-grown beef	-	Yes
Ingestion of home-grown pork	-	Yes
Ingestion of home-grown milk	-	Yes
Ingestion of breast milk (infants only)	Infants only	

Some households may keep chickens and consume eggs and potentially the birds. The impact on these households is considered to be between the impact at an agricultural receptor and a standard resident receptor. The approach used considers an agricultural receptor at the point of maximum impact as a complete worst case.

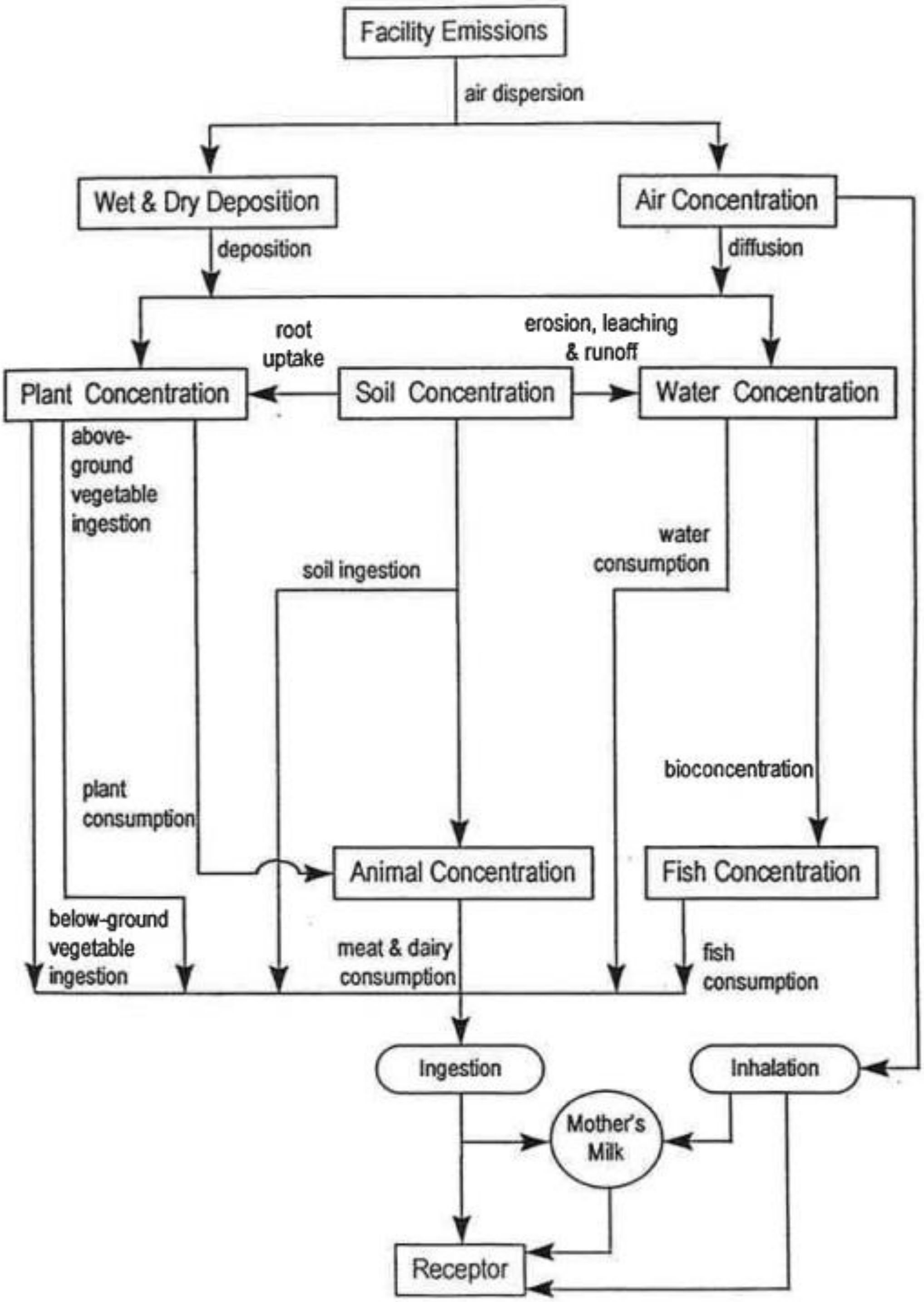
As shown in Figure 1, the pathway from the ingestion of mother's milk in infants is considered within the assessment. This considers all dioxins and dioxin-like PCBs. The IRAP model calculates

[1] USEPA (2005) Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities.

[2] HMIP (1996) Risk Assessment of Dioxin Releases from Municipal Waste Incineration Processes.

the amount of these COPCs entering the mother's milk and being passed on to the infants. The impacts are then compared against the TDI.

Figure 1: Conceptual Site Model – Exposure Pathways



4.2 Pathways excluded from assessment

The intake of dioxins via dermal absorption, groundwater and surface water exposure pathways is very limited and as such these pathways are excluded from the HHRA. The justification for excluding these pathways is highlighted in the following sections.

4.2.1 Dermal absorption

Both the HMIP and the USEPA note that the contribution from dermal exposure to soils impacted from thermal treatment facilities is typically a very minor pathway and is typically very small relative to contributions resulting from exposures via the food chain.

The USEPA[3] provide an example from the risk assessment conducted for the Waste Technologies, Inc. hazardous thermal treatment in East Liverpool, Ohio. This indicated that for an adult subsidence farmer in a subarea with high exposures, the risk resulting from soil ingestion and dermal contact was 50-fold less than the risk from any other pathway and 300-fold less than the total estimated risk.

The HMIP document[4] provides a screening calculation using conservative assumptions, which states that the intake via dermal absorption is 30 times lower than the intake via inhalation, which is itself a minor contributor to the total risk.

As such the pathway from dermal absorption is deemed to be an insignificant risk and has been excluded from this assessment.

4.2.2 Groundwater

Exposure via groundwater can only occur if the groundwater is contaminated and consumed untreated by an individual.

The USEPA[5] have concluded that the build-up of dioxins in the aquifer over realistic travel times relevant to human exposure was predicted to be so small as to be essentially zero.

As such the pathway from groundwater is deemed to be an insignificant risk and has been excluded from this assessment.

4.2.3 Surface water

A possible pathway is via deposition of emissions directly onto surface water – i.e. local drinking water supplies or rainwater storage tanks.

Surface water generally goes through several treatment steps and as such any contaminants would be removed from the water before consumption. Run off to rainwater tanks may not go through the same treatment. However, rain water tanks have a very small surface area and as such the potential for deposition and build-up of COPCs is limited. As such, the pathway from contaminated surface water is deemed to be an insignificant risk and has been excluded from this assessment.

[3] USEPA (2005) Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities.

[4] HMIP (1996) Risk Assessment of Dioxin Releases from Municipal Waste Incineration Processes.

[5] USEPA (2005) Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities.

4.2.4 Fish consumption

The consumption of locally caught fish has been excluded from the assessment. Whilst fish makes up a proportion of the UK diet, it is not likely that this would be sourced wide-scale from close proximity to the Facility.

A review of the local waterbodies has been undertaken to see if there are any game fishing lakes in the local area[6]. None have been identified within the modelling domain. The closest game fishing lake is the Halliford Mere Trout Fishery approximately 12.5 km to the south-east of the Facility. Due to the distance from the Facility, emissions from the Facility would not have a significant impact at this location and as such this pathway has been excluded from this assessment.

River fishing may be undertaken in the local area. However, river-caught fish will not be a significant pathway as any small amounts of contaminants would be washed downstream rather than accumulating. Therefore, there is little risk of significant amounts of contaminants from the Proposed Development accumulating in fish in the local area and this pathway has been excluded from this HHRA.

[6] Locations Map, http://www.fisharound.net/where-to-fish/locations-map

5 Sensitive Receptors

This assessment considers the possible effects on human health at key receptors, where humans are likely to be exposed to the greatest impact from the Facility, and at the point of maximum impact of annual mean emissions.

For the purposes of this assessment, receptor locations have been categorised as ‘residential’ or ‘agricultural’. Residential receptors represent a known place of residence that is occupied within the study area. Agricultural receptors represent a farm holding or area land of horticultural interest.

The ground-level concentrations resulting from emissions from the Facility are highest only in the locality of the plant. A subset of the specific receptors identified in the Air Quality Assessment have been considered in this Assessment; these are the receptors closest to the Facility which are predicted to experience the highest impact. In addition, a receptor has been assessed at the point of maximum impact. These sensitive receptors are listed in Table 5. Reference should be made to Appendix B which shows the location of these receptors with respect to the Facility.

Table 5: Sensitive Receptors

ID	Receptor Name	Location		Type of Receptor
		X	Y	
MAX	Point of maximum impact	503640	178340	Agricultural / Residential
R1	Old Slade Lane 1, Richings Park	503732	178404	Residential
R2	Old Slade Lane 2, Richings Park	503613	178623	Residential
R3	Old Slade Lane 3, Richings Park	503551	178731	Residential
R4	Main Drive, Richings Park	503282	179033	Residential
R5	North Park, Richings Park	503018	179083	Residential
R6	Sutton Lane 1, Langley	502272	178911	Residential
R7	Sutton Lane 2, Langley	502424	178468	Agricultural
R8	London Road, Colnbrook	501993	177564	Residential
R9	Vicarage Way, Colnbrook	502680	177297	Residential
R10	The Hawthrorns, Colnbrook	503618	176909	Residential
R11	Colnbrook CoE School	502604	177047	Residential

6 IRAP Model Assumptions and Inputs

The following section details the user defined assumptions used within the IRAP model and provides justifications where appropriate.

6.1 Concentrations in soil

The concentration of each chemical in the soil is calculated from the deposition results of the air quality modelling for vapour phase and particle phase deposition. The critical variables in calculating the accumulation of pollutants in the soil are as follows:

- the lifetime of the Facility is taken as 30 years; and
- the soil mixing depth is taken as 2 cm in general and 30 cm for produce.

The split between the solid and vapour phase for the substance considered depends on the specific physical properties of each chemical.

In order to assess the amount of substance which is lost from the soil each year through volatilisation, leaching and surface run-off, a soil loss constant is calculated. The rates for leaching and surface runoff are taken as constant, while the rate for volatilisation is calculated from the physical properties of each substance.

6.2 Concentrations in plants

The concentrations in plants are determined by considering direct deposition and air-to-plant transfer for above ground produce, and root uptake for above ground and below ground produce.

The calculation takes account of the different types of plant. For example, uptake of substances through the roots will differ for below ground and above ground vegetables, and deposition onto plants will be more significant for above ground vegetables.

6.3 Concentrations in animals

The concentrations in animals are calculated from the concentrations in plants, assumed consumption rates and bio-concentration factors. These vary for different animals and different substances, since the transfer of chemicals between the plants consumed and animal tissue varies.

It is also assumed that 100% of the plant materials eaten by animals is grown on soil contaminated by emission sources. This is likely to be a highly pessimistic assumption for UK farming practice.

6.4 Concentrations in humans

6.4.1 Intake via inhalation

This is calculated from inhalation rates of typical adults and children and atmospheric concentrations. The inhalation rates used for adults and children are:

- adults - 20m^3/day; and
- children – 7.2m^3/day.

These are as specified within the Environment Agency series of reports: "Contaminants in soil: updated collation of toxicology data and intake values for humans". The calculation also takes account of time spent outside, since most people spend most of their time indoors.

6.4.2 Intake via soil ingestion

This calculation allows for the ingestion of soil and takes account of different exposure frequencies. It allows for ingestion of soil attached to unwashed vegetables, unintended ingestion when farming or gardening and, for children, ingestion of soil when playing.

6.4.3 Ingestion of food

The calculation of exposure due to ingestion of food draws on the calculations of concentrations in animals and plants and takes account of different ingestion rates for the various food groups by different age groups.

For most people, locally-produced food is only a fraction of their diet and so exposure factors are applied to allow for this.

6.4.4 Breast milk ingestion

For infants, the primary route of exposure is through breast milk. The calculation draws on the exposure calculation for adults and then allows for the transfer of chemicals in breast milk to an infant who is exclusively breast-fed.

The only pathway considered for dioxins for a breast feeding infant is through breast milk. The modelled scenario consists of the accumulation of pollutants in the food chain up to an adult receptor, the accumulation of pollutants in breast milk and finally the consumption of breast milk by an infant.

The assumptions used were:

- Exposure duration of infant to breast milk — 1 year
- Proportion of ingested dioxin that is stored in fat — 0.9
- Proportion of mother's weight that is stored in fat — 0.3
- Fraction of fat in breast milk — 0.04
- Fraction of ingested contaminant that is absorbed — 0.9
- Half-life of dioxins in adults — 2,555 days
- Ingestion rate of breast milk — 0.688kg/day

6.5 Estimation of COPC concentration in media

The IRAP-h model uses a database of physical and chemical parameters to calculate the COPC concentrations through each of the different pathways identified. The base physical and chemical parameters have been used in this assessment.

In order to calculate the COPC concentrations, a number of site specific pieces of information are required.

Weather data was obtained for the period 2014 to 2018 from the London Heathrow weather station, as used within the Air Quality Assessment. This provides the annual average precipitation which can be used to calculate the general IRAP-h input parameters, as presented in Table 6.

Table 6: Ground Type Dependent Properties

Input Variable	Assumption	Value (cm/year)
Annual average evapotranspiration	70% of annual average precipitation	43.54
Annual average irrigation	0% of annual average precipitation	0.00
Annual average precipitation	100% of annual average precipitation	62.21
Annual average runoff	10% of annual average precipitation	6.22

The average wind speed was taken as 4.14 m/s, calculated from the average of the five years of weather data used in the Air Quality Assessment.

A number of assumptions have been made with regard to the deposition of the different phases. These are summarised in the following table.

Table 7: Deposition Assumptions

Deposition Phase	Dry Deposition Velocities (m/s)	Ratio Dry deposition to Wet deposition	
		Dry Deposition	Wet Deposition
Vapour	0.005	1.0	2.0
Particle	0.010	1.0	2.0
Bound particle	0.010	1.0	2.0
Mercury vapour	0.029	1.0	0.0
Note: the above deposition velocities have been agreed with the UK Environment Agency for all IRAP based assessments where modelling of specific deposition of pollutants is not undertaken. These are considered to be conservative.			

These deposition assumptions have been applied to the annual mean concentrations predicted using the dispersion modelling which was undertaken as part of the Air Quality Assessment, to generate the inputs needed for the IRAP modelling. For details of the dispersion modelling methodology please refer to the Air Quality Assessment.

6.6 Modelled emissions

For the purpose of this assessment it is assumed that the Facility operates at the BAT-AELs within the Draft WI BREF for its entire operational life. In reality the Facility will be shut down for periods of maintenance and monitoring of similar facilities in the UK shows that they operate below the emission limits prescribed in their permits.

The following tables present the emissions rates of each COPC modelled and the associated ELVs which have been used to derive the emission rate.

Table 8: COPC Emissions Modelled

COPC	Emission Limit Value (mg/Nm³)	Emission rate	Units
Benzene	10	1051.0	mg/s
PAHs (Benzo(a)pyrene)	0.00004	4.20	µg/s
Elemental mercury	0.00004	4.20	µg/s

COPC	Emission Limit Value (mg/Nm³)	Emission rate	Units
Mercuric chloride	0.024	1.01	mg/s
Cadmium	0.010	1.05	mg/s
Arsenic	0.025	2.63	mg/s
Chromium	0.092	9.67	mg/s
Chromium VI	0.00004	3.68	µg/s
Nickel	0.220	23.12	mg/s

Table 9: COPC Emissions Modelled

COPC	Emission Limit Value (ng I-TEQ/Nm³)	Emission rate (ng/s)
2,3,7,8-TCDD	0.06	0.195
1,2,3,7,8-PeCDD		1.545
1,2,3,4,7,8-HxCDD		1.809
1,2,3,6,7,8-HxCDD		1.626
1,2,3,7,8,9-HxCDD		1.292
1,2,3,4,6,7,8-HpCDD		10.742
1,2,3,4,6,7,8,9-OctaCDD		25.481
2,3,7,8-TCDF		1.746
1,2,3,7,8-PCDF		1.746
2,3,4,7,8-PCDF		3.373
1,2,3,4,7,8-HxCDD		13.737
1,2,3,6,7,8-HxCDF		5.087
1,2,3,7,8,9-HxCDF		0.265
2,3,4,6,7,8-HxCDF		5.491
1,2,3,4,6,7,8-HpCDF		27.706
1,2,3,4,7,8,9-HpCDF		2.704
1,2,3,4,6,7,8,9-OctaCDF		22.480
Dioxin like PCBs	0.0092	0.967

A number of points should be noted for each group of COPCs:

1. **Benzene (Table 8).**
    a. It has been assumed that the entire TOC emissions consist of only benzene.
    b. It has been assumed that TOC emissions are emitted at the daily ELV.
2. **PAHs (Table 8).**
    a. It has been assumed that the entire PAH emissions consist of only benzo(a)pyrene.
    b. Benzo(a)pyrene is not a regulated pollutant within the IED. The 90th %ile recorded emission concentration of benzo(a)pyrene from the first Draft Waste incineration BREF, published by

the European IPPC Bureau, was 0.04 ug/Nm³, or 0.00004 mg/Nm³ (dry, 11% oxygen, 273K). This is assumed to be the emission concentration for the Facility.

3. **Group 1 metals - mercury and compounds (Table 8).**
    a. It has been assumed that the ELV of total mercury is 0.02 mg/Nm³.
    b. The concentration of elemental mercury has been taken as 0.2% of the total mercury and compounds ELV.
    c. The concentration of mercury chloride has been taken as 48% of the total mercury and compounds ELV.
    d. The losses to the global cycle have been taken as 51.8% of the total mercury and compounds ELV.
4. **Group 2 metals – cadmium and compounds (Table 8).**
    a. The assessment is based on the ELV of 0.02 mg/Nm³ for cadmium and compounds.
    b. It is assumed that the emissions of cadmium and thallium are each half of the combined ELV.
5. **Group 3 metals – arsenic, chromium, and nickel (Table 8).**

The emissions of arsenic, total chromium and nickel have been taken as no worse than a currently operating facility as detailed in Table A1 of the Environment Agency "Guidance on assessing group 3 metals stack emissions from incinerators – v4", which is reproduced in Table 10. This data is based on monitoring at 18 MWI and Waste Wood Co-Incinerators between 2007 and 2015 operating under the IED in the UK. In line with the metals analysis undertaken as part of the Air Quality Assessment, the emission concentration of chromium VI has been assumed to be the average concentration at an existing facility.

6. **Dioxins and furans (Table 9).**

These are a group of similar halogenated organic compounds, which are generally found as a complex mixture. The toxicity of each compound is different and is generally expressed as a Toxic Equivalent Factor (TEF), which relates the toxicity of each individual compound to the toxicity of 2,3,7,8-TCDD, the most toxic dioxin. A full list of the TEF values for each dioxin is provided in Table 11. The total concentration is then expressed as a Toxic Equivalent (TEQ).

The split of the different dioxins and furans is based on split of congeners for a release of 0.06 ng I-TEQ/Nm³ as presented in Table 11

The split of the different dioxins and furans is based on split of congeners for a release of 1 ng I-TEQ/Nm³ as presented in Table 11. To determine the emission rates, this split of the different dioxins has been multiplied by normalised volumetric flow rate to determine the release rate of each congener. The output of the IRAP model is then multiplied by the relevant TEFs to determine the total intake TEQ for comparison with the TDI.

Dioxin like PCBs (Table 9)

There are a total of 209 PCBs, which act in a similar manner to dioxins, are generally found in complex mixtures and also have TEFs.

The UK Environment Agency has advised that 44 measurements of dioxin like PCBs have been taken at 24 MWIs between 2008 and 2010. The following data summarises the measurements, all at 11% reference oxygen content:

- Maximum = 9.2×10^{-3} ng[TEQ]/m³
- Mean = 2.6×10^{-3} ng[TEQ]/m³
- Minimum = 5.6×10^{-5} ng[TEQ]/m³

For the purpose of this assessment, as a conservative assumption, the maximum monitored PCB concentration has been used which has been converted to an emission rate using the volumetric flow rate at reference conditions.

The IRAP software, and the HHRAP database which underpins it, does not include any data on individual PCBs, but it does include data for take-up and accumulation rates within the food chain for two groups of PCBs, known as Aroclor 1254 and Aroclor 1016. Each Arocolor is based on a fixed composition of PCBs. Since we are not aware of any data on the specification of PCBs within incinerator emissions, as a worst-case assumption we have assumed that the PCBs are released in each of the two Aroclor compositions.

Table 10: Monitoring Data from Municipal Waste Incinerators

Pollutant	Measured Concentration as % of IED Group 3 ELV (i.e. Draft BAT-AEL)		
	Mean	Max	Min
Arsenic	0.33%	8.33%	0.07%
Chromium	2.80%	30.67%	0.07%
Chromium VI	0.012%	0.043%	0.0008%
Nickel	5.00%	73.33%	0.83%
Note: The two highest nickel concentrations are outliers being 73%, as above, and 27% of the ELV. The third highest concentration is 0.053 mg/Nm³ or 18% of the ELV.			

Table 11: Basis for the Emission Rate of Dioxins and Furans

Dioxin / furan	Split of Congeners for a release of 1 ng I-TEQ/Nm³	I-TEFs for the congeners	Emission concentration (ng/Nm³)	Emission rate (ng/s)
2,3,7,8-TCDD	0.031	1	0.0019	0.195
1,2,3,7,8-PeCDD	0.245	0.5	0.0147	1.545
1,2,3,4,7,8-HxCDD	0.287	0.1	0.0172	1.809
1,2,3,6,7,8-HxCDD	0.258	0.1	0.0155	1.626
1,2,3,7,8,9-HxCDD	0.205	0.1	0.0123	1.292
1,2,3,4,6,7,8-HpCDD	1.704	0.01	0.1022	10.742
1,2,3,4,6,7,8,9-OctaCDD	4.042	0.001	0.2424	25.481
2,3,7,8-TCDF	0.277	0.1	0.0166	1.746
1,2,3,7,8-PCDF	0.277	0.05	0.0166	1.746
2,3,4,7,8-PCDF	0.535	0.5	0.0321	3.373
1,2,3,4,7,8-HxCDD	2.179	0.1	0.1307	13.737
1,2,3,6,7,8-HxCDF	0.807	0.1	0.0484	5.087
1,2,3,7,8,9-HxCDF	0.042	0.1	0.0025	0.265
2,3,4,6,7,8-HxCDF	0.871	0.1	0.0522	5.491

Dioxin / furan	Split of Congeners for a release of 1 ng I-TEQ/Nm³	I-TEFs for the congeners	Emission concentration (ng/Nm³)	Emission rate (ng/s)
1,2,3,4,6,7,8-HpCDF	4.395	0.01	0.2636	27.706
1,2,3,4,7,8,9-HpCDF	0.429	0.01	0.0257	2.704
1,2,3,4,6,7,8,9-OctaCDF	3.566	0.001	0.2139	22.480
Total (I-TEQ)	20.150	-	1.2086	127.027

Note:

Split of the congeners is taken from Table 7.2a from the HMIP document and factored by the ELV to determine the split for the proposed ELV. This has then been multiplied by the Normalised Volumetric Flow rate to determine the release rate in g/s.

7 Results

7.1 Assessment against TDI - point of maximum impact

The following tables present the impact of emissions from the Facility at the point of maximum impact for an 'Agricultural' receptor. As explained in section 3, this receptor type assumes the direct inhalation, and ingestion from soil, drinking water, and home-grown eggs and meat, beef, pork, and milk. This assumes that the person lives at the point of maximum impact and consumes home-grown produce etc. Reference should be made to Appendix B for the location of the point in relation to the Facility.

Where appropriate a comparison has been made to the TDI or ID.

Table 12: Impact Analysis – TDI – Point of Maximum Impact - Adult

Substance	MDI (% of TDI)		Process Contribution (% of TDI)		Overall (% of TDI)	
	Inhalation	Ingestion	Inhalation	Ingestion	Inhalation	Ingestion
Agricultural						
Cadmium	20.41%	53.17%	10.73%	0.30%	31.14%	53.47%
Chromium	-	60.48%	-	3.10%	-	63.57%
Chromium VI	-	6.05%	-	0.0012%	-	6.05%
Methyl mercury	-	3.11%	-	0.11%	-	3.22%
Mercuric chloride	-	0.71%	-	0.41%	-	1.13%
Mercury	1.19%	-	0.0010%	-	1.19%	-
Nickel	31.48%	68.37%	55.08%	5.72%	86.55%	74.08%
Dioxins and dioxin like PCBs	35.00%		19.55%		54.55%	
Residential						
Cadmium	20.41%	53.17%	10.73%	0.19%	31.14%	53.37%
Chromium	-	60.48%	-	0.25%	-	60.72%
Chromium VI	-	6.05%	-	0.00009%	-	6.05%
Methyl mercury	-	3.11%	-	0.04%	-	3.15%
Mercuric chloride	-	0.71%	-	0.04%	-	0.76%
Mercury	1.19%	-	0.0010%	-	1.19%	-
Nickel	31.48%	68.37%	55.08%	0.53%	86.55%	68.90%
Dioxins and dioxin like PCBs	35.00%		0.44%		35.44%	

Table 13: Impact Analysis – TDI – Point of Maximum Impact - Child

Substance	MDI (% of TDI)		Process Contribution (% of TDI)		Overall (% of TDI)	
	Inhalation	Ingestion	Inhalation	Ingestion	Inhalation	Ingestion
Agricultural						
Cadmium	52.86%	**137.72%**	13.52%	0.69%	66.38%	**138.42%**
Chromium	-	**156.63%**	-	4.99%	-	**161.63%**
Chromium VI	-	15.66%	-	0.0019%	-	15.67%
Methyl mercury	-	8.04%	-	0.23%	-	8.27%
Mercuric chloride	-	1.85%	-	0.65%	-	2.50%
Mercury	3.08%	-	0.0013%	-	3.08%	-
Nickel	81.52%	**177.07%**	69.40%	8.71%	**150.92%**	**185.78%**
Dioxins and dioxin like PCBs		90.65%		27.63%		**118.28%**
Residential						
Cadmium	52.86%	**137.72%**	13.52%	0.46%	66.38%	**138.18%**
Chromium	-	**156.63%**	-	0.69%	-	**157.32%**
Chromium VI	-	15.66%	-	0.00%	-	15.66%
Methyl mercury	-	8.04%	-	0.11%	-	8.16%
Mercuric chloride	-	1.85%	-	0.18%	-	2.03%
Mercury	3.08%	-	0.0013%	-	3.08%	-
Nickel	81.52%	**177.07%**	69.40%	1.27%	**150.92%**	**178.35%**
Dioxins and dioxin like PCBs		90.65%		1.36%		92.01%

The TDI is an estimate of the amount of a contaminant, expressed on a bodyweight basis, which can be ingested daily over a lifetime without appreciable health risk. As shown in Table 12 and Table 13, for the worst-case receptor the overall impact (including the contribution from existing dietary intakes) is less than the TDI for chromium VI and mercury (including compounds). Therefore, there would not be an appreciable health risk based on the emission of these pollutants.

For a child receptor the total ingestion of cadmium, chromium and nickel, total inhalation of nickel, and the total intake of dioxins exceed the TDI. A discussion of the impact from each of these pollutants is provided below.

7.1.1 Cadmium

Total ingestion of cadmium exceeds the TDI for the child receptor. However, this is a reflection of the fact the MDI is over 100% of the TDI. The process contribution is small at only 0.69% of the ingestion TDI for an agricultural child at the point of maximum impact.

As noted in Section 3.2, the key determinant of cadmium's toxicity potential is its chronic accumulation in the kidney. The Environment Agency explains that chronic exposure to levels in excess of the TDI might be associated with an increase in kidney disease in a proportion of those exposed, but (small) exceedances lasting for shorter periods are of less consequence. When lifetime exposure is assessed (i.e. a period being a child and an adult) the overall intake is well below the TDI. Therefore, there would not be an appreciable health risk based on the emission of cadmium over a lifetime of an individual.

7.1.2 Chromium

As shown in Table 10, concentrations of total chromium in emissions from municipal waste incineration processes are typically 2.80% of the draft BAT-AEL, with only a fraction of this being in the hexavalent form. Using the worst case assumption that emissions of chromium are the maximum monitored from an existing waste incineration facility (30.67% of the draft BAT-AEL), the process contribution is 4.99% of the TDI for an agricultural child at the point of maximum impact. If emissions are taken to be the average emission concentration shown in Table 10 (2.80% of the draft BAT-AEL), the process contribution is only 0.46% of the TDI.

Almost all toxicological opinion is that chromium III compounds are of low oral toxicity and the WHO state that "in the form of trivalent compounds, chromium is an essential nutrient and is relatively non-toxic for man and other mammalian species". Although the TDI is predicted to be exceeded, this is due to existing dietary intake.

The TDI is based on the USEPA's Reference Dose for chromium VI. Assessing the total dietary intake of chromium against this TDI is highly conservative. As the process contribution is small, the existing levels of chromium do not represent a toxicity problem and the TDI is highly conservative, there would not be an appreciable health risk based on the emissions of chromium over the lifetime of an individual.

7.1.3 Nickel

7.1.3.1 Ingestion

The total ingestion of nickel exceeds the TDI for the child receptor. However, this is a reflection of the fact the MDI is over 100% of the TDI. The process contribution is 8.71% of the TDI. This is based on the conservative assumption that the process contribution is based on emissions of nickel at 73.3% of the draft Group 3 metals BAT-AEL. As outlined in Table 10, this is the maximum of the monitoring data and is an outlier. The mean concentration is only 5% of the draft Group 3 metals BAT-AEL. If it is assumed that the Facility operates at 5% of the draft Group 3 metals BAT-AEL, the process contribution would be only 0.59% of the ingestion TDI at the point of maximum impact for the agricultural child receptor. On this basis, it is considered that the Facility would not significantly increase the health risks for children from the ingestion of nickel.

7.1.3.2 Inhalation

The total inhalation of nickel exceeds the TDI for the child receptor and the process contribution is 69.4% of the TDI. However, applying the same method as above in which it is assumed that the Facility operates at 5% of the draft Group 3 metals BAT-AEL, the process contribution is 4.7% of the TDI and the total inhalation is 86.3% of the TDI. As the total inhalation does not exceed the TDI, it is not considered that the Facility would not significantly increase the health risks for children from the inhalation of nickel.

7.1.4 Dioxins

The total ingestion and inhalation of dioxins exceeds the TDI for an agricultural child at the point of maximum impact. However, the predicted impact is based on the child receptor being exposed to the maximum airborne concentrations and consuming produce, eggs, meat and milk grown at the point of maximum impact. As this is unrealistic, the impact at the maximum impacted receptor has been considered further in Section 7.4.

In addition, when lifetime exposure is assessed (i.e. a period being a child and an adult) the overall impact is well below the TDI. Therefore, there would not be an appreciable health risk based on the emissions of dioxins over a lifetime of an individual.

7.2 Breast milk exposure

The total accumulation of dioxins in an infant, considering the breast milk pathway and based on an adult agricultural receptor at the point of maximum impact feeding an infant, is 3.034 pg WHO-TEQ / kg-bw / day which is 151.7% of the TDI. For a residential type receptor this is only 0.056 pg WHO-TEQ / kg-bw / day which is 2.8% of the TDI. There are no ingestion pathways besides breast milk ingestion for an infant receptor.

The process contribution for the hypothetical maximum impacted receptor (an agricultural receptor at the point of maximum impact) exceeds the TDI. However, this receptor does not exist in reality. The impact at the maximum impacted receptor is considered in Section 7.4.

7.3 Assessment against ID - point of maximum impact

Table 14 and Table 15 outline the impact of emissions from the Facility for an 'agricultural' and a 'residential' receptor located at the point of maximum impact as a percentage of the ID.

Table 14: Impact Analysis – ID – Point of Maximum Impact - Adult

Substance	Inhalation (% of ID)	Ingestion (% of ID)
Agricultural		
Arsenic	18.78%	1.52%
Benzene	10.73%	2.47%
Benzo[a]pyrene	0.86%	1.80%
Chromium	**138.19%**	-
Residential		
Arsenic	18.78%	0.56%
Benzene	10.73%	2.62%
Benzo[a]pyrene	0.86%	0.02%
Chromium	**138.19%**	-

Table 15: Impact Analysis – ID – Point of Maximum Impact - Child

Substance	Inhalation (% of ID)	Ingestion (% of ID)
Agricultural		
Arsenic	23.66%	2.65%
Benzene	13.52%	5.80%
Benzo[a]pyrene	1.08%	2.60%
Chromium	**174.12%**	-
Residential		
Arsenic	23.66%	1.35%
Benzene	13.52%	4.65%
Benzo[a]pyrene	1.08%	0.05%
Chromium	**174.12%**	-

The ID is the level of exposure which is associated with a negligible risk to human health. As shown, for this worst-case receptor the process contribution is well below the ID for all pollutants except chromium. However, this is based on the worst case assumption that emissions of chromium are the maximum monitored from an existing waste incineration facility (30.67% of the draft BAT-AEL). If emissions are taken to be the average emission concentration shown in Table 10 (2.80% of the draft BAT-AEL), the process contribution is only 12.6% of the ID for an adult receptor and 15.9% of the ID for a child receptor. Under this assumption the process contribution is well below the ID, so emissions from the Facility are considered to have a negligible impact on human health.

7.4 Maximum impact at a receptor

The following tables outline the impact of emissions from the Facility at the most affected receptors for inhalation and ingestion of emissions. The receptor with the greatest impact from inhalation is R1 - Old Slade Lane 1, Richings Park and the receptor with the greatest impact from ingestion is R7 – Sutton Lane 2, Langley, which is an agricultural receptor. Where appropriate a comparison has been made to the TDI or ID.

Table 16: Impact Analysis – TDI –Maximum Impacted Receptor

Substance	MDI (% of TDI)		Process Contribution (% of TDI)		Overall (% of TDI)	
	Inhalation	Ingestion	Inhalation	Ingestion	Inhalation	Ingestion
Adult						
Cadmium	20.41%	53.17%	8.85%	0.16%	29.26%	53.33%
Chromium	-	60.48%	-	0.204%	-	60.68%
Chromium VI	-	6.05%	-	0.0001%	-	6.05%
Methyl mercury	-	3.11%	-	0.035%	-	3.14%
Mercuric chloride	-	0.71%	-	0.037%	-	0.75%
Mercury	1.19%	-	0.0008%	-	1.19%	-
Nickel	31.48%	68.37%	45.44%	0.44%	76.92%	68.80%

Substance	MDI (% of TDI)		Process Contribution (% of TDI)		Overall (% of TDI)	
	Inhalation	Ingestion	Inhalation	Ingestion	Inhalation	Ingestion
Dioxins and dioxin like PCBs	35.00%		1.07%		36.07%	
Child						
Cadmium	52.86%	**137.72%**	11.15%	0.38%	64.01%	**138.10%**
Chromium	-	**156.63%**	-	0.57%	-	**157.20%**
Chromium VI	-	15.66%	-	0.0002%	-	15.66%
Methyl mercury	-	8.04%	-	0.09%	-	8.14%
Mercuric chloride	-	1.85%	-	0.15%	-	2.00%
Mercury	3.08%	-	0.0010%	-	3.08%	-
Nickel	81.52%	**177.07%**	57.26%	1.05%	**138.78%**	**178.12%**
Dioxins and dioxin like PCBs	90.65%		1.52%		92.17%	

As shown, for the most impacted receptor the overall impact (including the contribution from existing dietary intakes) is less than the TDI for chromium VI, mercury (including compounds) and dioxins. Therefore, there would not be an appreciable health risk based on the emission of these pollutants.

For a child receptor the total ingestion of cadmium, chromium and nickel and the total inhalation of nickel exceed the TDI. However, the process contribution for ingestion is small (a maximum of 1.05% of the TDI for nickel) and the exceedance is a reflection of the fact the MDI is over 100% of the TDI. On this basis, it is considered that the Facility would not lead to a significant increase in health risks from the ingestion of cadmium, chromium or nickel for children.

The inhalation of nickel is based on the conservative assumption that the process contribution is based on emissions of nickel at 73.3% of the draft Group 3 metals BAT-AEL. As outlined in Table 10, this is the maximum of the monitoring data and is an outlier. If it is assumed that the Facility operates at the average concentration monitored – i.e. 5% of the draft Group 3 metals BAT-AEL - the process contribution would be only 3.9% of the TDI and the total intake would be 85.4% of the TDI. As the total inhalation does not exceed the TDI, it is considered that the Facility would not significantly increase the health risks for children from the inhalation of nickel.

The total accumulation of dioxins in an infant, considering the breast milk pathway and based on the adult residential receptor at R7 feeding an infant, is 0.167 pg WHO-TEQ / kg bw / day which is 8.33% of the TDI. As the process contribution is less than the TDI, it is considered that the Facility will not increase the health risks from the accumulation of dioxins in infants significantly.

Table 17: Impact Analysis – ID – Maximum Impacted Receptor

Substance	Inhalation (% of ID)	Ingestion (% of ID)
Adult – Agricultural		
Arsenic	15.49%	0.46%

Substance	Inhalation (% of ID)	Ingestion (% of ID)
Benzene	8.85%	2.16%
Benzo[a]pyrene	0.71%	0.10%
Chromium	114.02%	-
Child – Agricultural		
Arsenic	19.52%	1.11%
Benzene	11.15%	3.83%
Benzo[a]pyrene	0.89%	0.14%
Chromium	143.66%	-

As shown, for the maximum impacted receptor the process contribution is well below the ID for all pollutants considered, except chromium. However, this is based on the worst case assumption that emissions of chromium are the maximum monitored from an existing waste incineration facility (30.67% of the draft BAT-AEL). If emissions are taken to be the average emission concentration shown in Table 10 (2.80% of the draft BAT-AEL), the process contribution is only 10.4% of the ID for an adult receptor and 13.1% of the ID for a child receptor. Under this assumption the process contribution is well below the ID, so emissions from the Facility are considered to have a negligible impact on human health.

7.5 Uncertainty and sensitivity analysis

To account for uncertainty in the modelling the impact on human health was assessed for a receptor at the point of maximum impact.

To account for uncertainty in the dietary intake of a person, both residential and agricultural receptors have been assessed. The agricultural receptor is assumed to consume a greater proportion of home grown produce, which has the potential to be contaminated by the COPCs released, than for a residential receptor. In addition, the agricultural receptor includes the pathway from consuming animals grazed on land contaminated by the emission source. This assumes that 100% of the plant materials eaten by the animals is grown on soil contaminated by emission sources.

The agricultural receptor at the point of maximum impact is considered the upper maximum of the impact of the Facility.

7.6 Upset process conditions

Article 46(6) of the IED (Directive 2010/75/EU) states that:

> *"… the waste incineration plant … shall under no circumstances continue to incinerate waste for a period of more than 4 hours uninterrupted where emission limit values are exceeded.*
>
> *The cumulative duration or operation in such conditions over 1 year shall not exceed 60 hours."*

Article 47 continues with:

> *"In the case of a breakdown, the operator shall reduce or close down operations as soon as practicable until normal operations can be restored."*

In addition Annex VI, Part 3, 2 of the IED states the emission limit values applicable in the circumstances described in Article 46(6) and Article 47:

> *"The total dust concentration in the emissions into the air of a waste incineration plant shall under no circumstances exceed 150 mg/Nm³ expressed as a half-hourly average. The air emission limit values for TOC and CO set out in points 1.2 and 1.5(b) shall not be exceeded."*

The conditions detailed in Article 46(6) are considered to be "Upset Operating Conditions". As identified these periods are short term events which can only occur for a maximum of 60 hours per year.

Start-up of the Facility from cold will be conducted with clean support fuel (low sulphur light fuel oil). During start-up waste will not be introduced onto the grate unless the temperature within the oxidation zone is above the 850ºC as required by Article 50, paragraph 4(a) of the IED. During start-up, the flue gas treatment plant will be operational as will be the combustion control systems and emissions monitoring equipment.

The same is true during plant shutdown where waste will cease to be introduced to the grate. The waste remaining on the grate will be combusted, the temperature not being permitted to drop below 850ºC through the combustion of clean support auxiliary fuel. During this period the flue gas treatment equipment is fully operational, as will be the control systems and monitoring equipment. After complete combustion of the waste, the auxiliary burners will be turned off and the plant will be allowed to cool.

Start-up and shutdown are infrequent events. The Facility is designed to operate continuously, and ideally only shutdown for its annual maintenance programme.

In relation to the magnitude of dioxin emissions during plant start-up and shutdown, research has been undertaken by AEA Technology on behalf of the Environment Agency[7]. Whilst elevated emissions of dioxins (within one order of magnitude) were found during shutdown and start-up phases where the fuel was not fully established in the combustion chamber, the report concluded that:

"The mass of dioxin emitted during start-up and shutdown for a 4-5 day planned outage was similar to the emission which would have occurred during normal operation in the same period. The emission during the shutdown and restart is equivalent to less than 1 % of the estimated annual emission (if operating normally all year)."

There is therefore no reason why such start-up and shutdown operations or upset operating conditions will affect the long term impact of the Facility.

[7] AEA Technology (2012) Review of research into health effects of Energy from Waste facilities.

8 Conclusions

This HHRA has been undertaken based on the following conservative assumptions:

- the Facility will operate continually at the draft BAT-AELs, i.e. at the maximum concentrations which it is expected that the Facility will be permitted to operate at; where this assumption results in unrealistic impacts, further analysis has been undertaken.
- exposure to emissions is based on lifetime exposure assuming continual operation of the Facility, when in reality the Facility will have an operational lifetime of approximately 30 years; and
- the hypothetical maximum impacted receptor (an agricultural receptor at the point of maximum impact) only ingests food and drink sourced from the area with the maximum contribution from the Facility.

The results of the assessment show that, for an agricultural child receptor at the point of maximum impact, the total ingestion of cadmium, chromium and nickel, total inhalation of nickel, and the total intake of dioxins exceed the TDI. In addition, the intake of dioxins exceeds the TDI for an agricultural infant receptor at the point of maximum impact, and the inhalation of chromium is predicted to exceed the ID for a child and adult receptor at the point of maximum impact.

Further analysis of the impact of these pollutants has been undertaken, with the following conclusions:

1. For the ingestion of cadmium and chromium, when lifetime exposure is assessed (i.e. a period being a child and an adult) the overall intake is well below the TDI. Therefore, there would not be an appreciable health risk over a lifetime of an individual.
2. For nickel, if it is assumed that emissions from the Facility are as the average from the available monitoring data, the process contribution for ingestion is small at 0.59% of the TDI, and total inhalation is below the TDI. Therefore, it is considered that the Facility would not significantly increase the health risks for children from the ingestion or inhalation of nickel.
3. For the total intake of dioxins, the predicted impact is based on the child receptor being exposed to the maximum airborne concentrations and consuming produce, eggs, meat and milk grown at the point of maximum impact. In reality, there is no agricultural interest at the point of maximum impact, so the impact at the maximum impacted receptor has been assessed. This shows that the total intake of dioxins is below the TDI and the Facility would not significantly increase the health risks from the intake of dioxins.
4. Similarly, for the intake of dioxins by an infant, the impact at the maximum impacted receptor has been assessed. This shows that the process contribution is less than the TDI, so it is considered that the Facility will not increase the health risks from the accumulation of dioxins in infants significantly.
5. For the inhalation of chromium, the process contribution exceeds the ID if it is assumed that emissions are as the maximum monitored from a waste incineration facility. If emissions are taken to be the average monitored emission concentration the process contribution is well below the ID for adult and child receptors, so emissions from the Facility are considered to have a negligible impact on human health.

For all other pollutants, the combined impact from the Facility plus the existing MDI is below the TDI, and the impact of the Facility is below the ID, so there would not be an appreciable health risk based on the emission of these pollutants.

In conclusion, the operation of the Facility will not result in appreciable health risks.

Appendices

A Detailed Results Tables

Table 18: Comparison with ID Limits for Adult Receptors

Receptor	Ingestion (% of ID)			Inhalation (% of ID)			
	Arsenic[(1)]	Benzene	Benzo(a)pyrene	Arsenic[(1)]	Benzene	Benzo(a)pyrene	Chromium[(1)]
Point of maximum impact - agricultural	1.516%	2.468%	1.800%	18.776%	10.729%	0.858%	**138.191%**
Point of maximum impact - residential	0.562%	2.619%	0.017%	18.776%	10.729%	0.858%	**138.191%**
R1	0.463%	2.160%	0.014%	15.491%	8.852%	0.708%	**114.017%**
R2	0.233%	1.086%	0.007%	7.789%	4.451%	0.356%	57.326%
R3	0.162%	0.755%	0.005%	5.413%	3.093%	0.247%	39.837%
R4	0.102%	0.475%	0.003%	3.407%	1.947%	0.156%	25.077%
R5	0.068%	0.318%	0.002%	2.281%	1.303%	0.104%	16.786%
R6	0.029%	0.136%	0.001%	0.975%	0.557%	0.045%	7.175%
R7	0.083%	0.135%	0.099%	1.031%	0.589%	0.047%	7.589%
R8	0.031%	0.144%	0.001%	1.032%	0.590%	0.047%	7.595%
R9	0.068%	0.318%	0.002%	2.278%	1.302%	0.104%	16.767%
R10	0.026%	0.119%	0.001%	0.856%	0.489%	0.039%	6.302%
R11	0.056%	0.263%	0.002%	1.886%	1.078%	0.086%	13.880%

Note:
(1) Assumes emissions at the maximum monitored concentrations shown in Table 10.

Table 19: Comparison with ID Limits for Child Receptors

Receptor	Ingestion (% of ID)			Inhalation (% of ID)			
	Arsenic[(1)]	Benzene	Benzo(a)pyrene	Arsenic[(1)]	Benzene	Benzo(a)pyrene	Chromium[(1)]
Point of maximum impact - agricultural	2.652%	5.797%	2.600%	23.657%	13.519%	1.081%	**174.121%**
Point of maximum impact - residential	1.352%	4.646%	0.045%	23.657%	13.519%	1.081%	**174.121%**
R1	1.115%	3.832%	0.037%	19.519%	11.154%	0.892%	**143.662%**
R2	0.561%	1.927%	0.019%	9.814%	5.608%	0.449%	72.230%
R3	0.390%	1.339%	0.013%	6.820%	3.897%	0.312%	50.195%
R4	0.245%	0.843%	0.008%	4.293%	2.453%	0.196%	31.597%
R5	0.164%	0.564%	0.005%	2.874%	1.642%	0.131%	21.151%
R6	0.070%	0.241%	0.002%	1.228%	0.702%	0.056%	9.040%
R7	0.146%	0.318%	0.143%	1.299%	0.742%	0.059%	9.562%
R8	0.074%	0.255%	0.002%	1.300%	0.743%	0.059%	9.570%
R9	0.164%	0.564%	0.005%	2.870%	1.640%	0.131%	21.126%
R10	0.062%	0.212%	0.002%	1.079%	0.616%	0.049%	7.940%
R11	0.136%	0.466%	0.005%	2.376%	1.358%	0.109%	17.489%

Note:
(1) Assumes emissions at the maximum monitored concentrations shown in Table 10.

Table 20: Comparison with TDI Limits for Adult Receptors

Receptor	Ingestion (% of ID)						Inhalation (% of ID)		
	Cadmium	Chromium(1)	Chromium VI(1)	Methyl Mercury	Mercuric Chloride	Nickel(1)	Cadmium	Mercury	Nickel(1)
MDI of TDI (%)	53.17%	60.48%	6.05%	3.11%	0.71%	68.37%	20.41%	1.19%	31.48%
Point of maximum impact - agricultural	53.471%	63.573%	6.0488%	3.218%	1.128%	74.083%	31.137%	1.191%	86.552%
Point of maximum impact - residential	53.366%	60.724%	6.0477%	3.148%	0.759%	68.897%	31.137%	1.191%	86.552%
R1	53.333%	60.680%	6.0477%	3.141%	0.751%	68.804%	29.260%	1.191%	76.918%
R2	53.254%	60.579%	6.0477%	3.123%	0.733%	68.587%	24.859%	1.191%	54.324%
R3	53.230%	60.547%	6.0476%	3.118%	0.727%	68.520%	23.501%	1.191%	47.354%
R4	53.209%	60.521%	6.0476%	3.113%	0.722%	68.463%	22.355%	1.191%	41.471%
R5	53.198%	60.506%	6.0476%	3.111%	0.720%	68.432%	21.711%	1.191%	38.166%
R6	53.185%	60.489%	6.0476%	3.108%	0.717%	68.395%	20.965%	1.191%	34.336%
R7	53.191%	60.646%	6.0477%	3.112%	0.737%	68.681%	20.997%	1.191%	34.501%
R8	53.185%	60.490%	6.0476%	3.108%	0.717%	68.396%	20.998%	1.191%	34.503%
R9	53.198%	60.506%	6.0476%	3.111%	0.720%	68.432%	21.710%	1.191%	38.159%
R10	53.183%	60.487%	6.0476%	3.108%	0.716%	68.391%	20.897%	1.191%	33.988%
R11	53.194%	60.501%	6.0476%	3.110%	0.719%	68.420%	21.486%	1.191%	37.008%

Note:
(1) Assumes emissions at the maximum monitored concentrations shown in Table 10.

Table 21: Comparison with TDI Limits for Child Receptors

Receptor	Ingestion (% of ID)						Inhalation (% of ID)		
	Cadmium	Chromium[(1)]	Chromium VI[(1)]	Methyl Mercury	Mercuric Chloride	Nickel	Cadmium	Mercury	Nickel[(1)]
MDI of TDI (%)	**137.72%**	**156.63%**	15.66%	8.04%	1.85%	177.07%	52.86%	3.08%	81.52%
Point of maximum impact - agricultural	**138.416%**	**161.626%**	15.665%	8.273%	2.496%	185.785%	66.376%	3.085%	**150.919%**
Point of maximum impact - residential	**138.184%**	**157.319%**	15.664%	8.158%	2.029%	178.345%	66.376%	3.085%	**150.919%**
R1	**138.103%**	**157.199%**	15.664%	8.138%	1.997%	178.122%	64.011%	3.084%	**138.780%**
R2	**137.914%**	**156.918%**	15.663%	8.091%	1.924%	177.600%	58.465%	3.084%	**110.311%**
R3	**137.855%**	**156.831%**	15.663%	8.077%	1.901%	177.438%	56.754%	3.084%	**101.529%**
R4	**137.806%**	**156.758%**	15.663%	8.064%	1.882%	177.303%	55.310%	3.084%	94.117%
R5	**137.778%**	**156.717%**	15.663%	8.057%	1.872%	177.226%	54.499%	3.083%	89.953%
R6	**137.746%**	**156.669%**	15.663%	8.049%	1.859%	177.138%	53.559%	3.083%	85.126%
R7	**137.760%**	**156.907%**	15.663%	8.056%	1.885%	177.550%	53.600%	3.083%	85.334%
R8	**137.748%**	**156.671%**	15.663%	8.050%	1.860%	177.141%	53.600%	3.083%	85.337%
R9	**137.778%**	**156.717%**	15.663%	8.057%	1.872%	177.226%	54.497%	3.083%	89.943%
R10	**137.743%**	**156.665%**	15.663%	8.049%	1.858%	177.129%	53.474%	3.083%	84.688%
R11	**137.769%**	**156.702%**	15.663%	8.055%	1.868%	177.199%	54.215%	3.083%	88.494%

Note:

(1) Assumes emissions at the maximum monitored concentrations shown in Table 10.

Table 22: Comparison with Total Dioxin TDI Limits for Adult Receptors

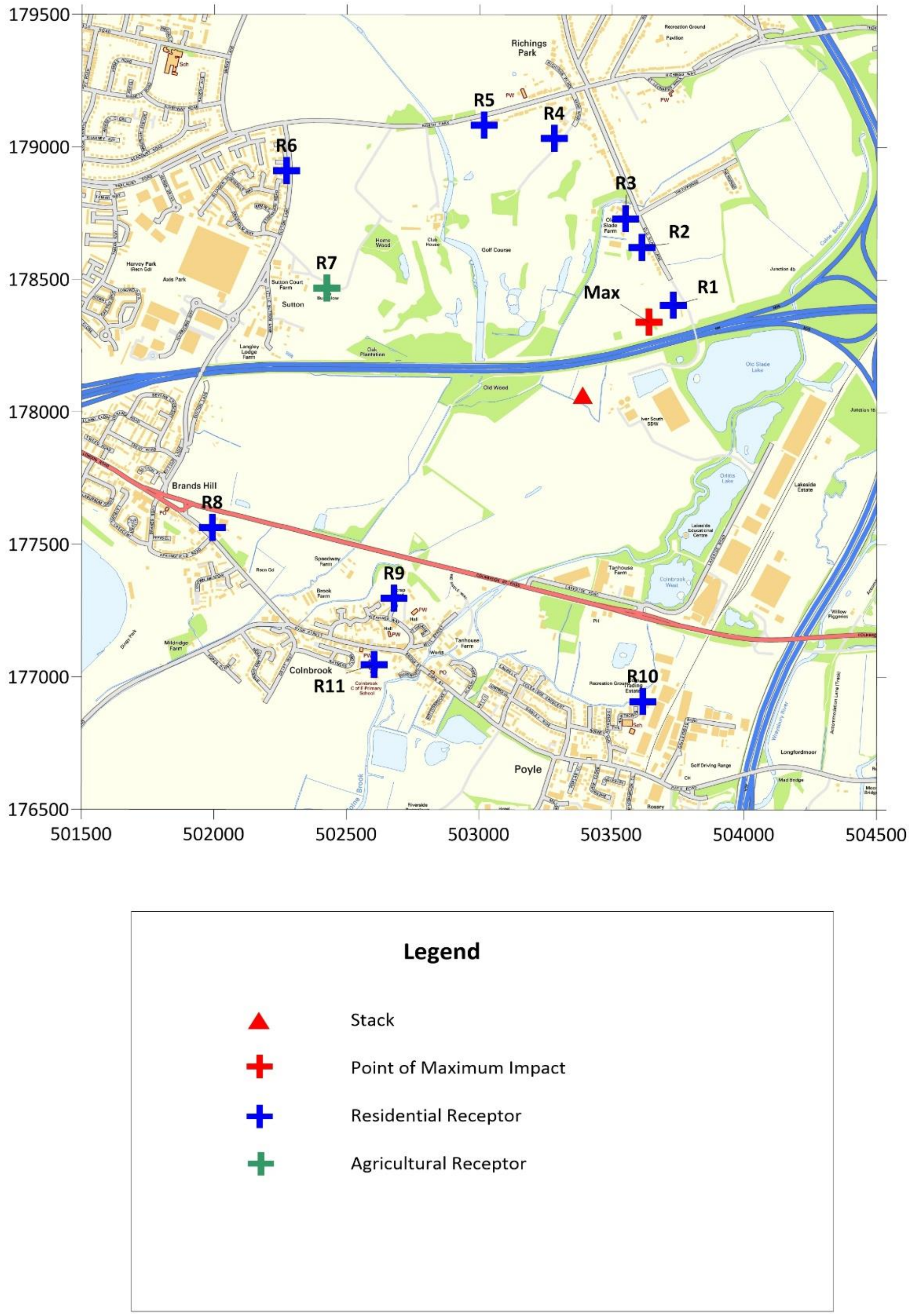
Receptor	Total Inhalation, (pg WHO-TEQ kg-1 bw day -1)	Total Ingestion, (pg WHO-TEQ kg-1 bw day -1)	Total uptake, (pg WHO-TEQ kg-1 bw day -1)	Comparison (% of limit)
MDI (% of TDI)				**35.00%**
Point of maximum impact - agricultural	1.05E-03	3.90E-01	3.91E-01	54.551%
Point of maximum impact - residential	1.05E-03	7.71E-03	8.77E-03	35.438%
R1	8.68E-04	6.36E-03	7.23E-03	35.362%
R2	4.37E-04	3.20E-03	3.64E-03	35.182%
R3	3.03E-04	2.22E-03	2.53E-03	35.126%
R4	1.91E-04	1.40E-03	1.59E-03	35.080%
R5	1.28E-04	9.37E-04	1.06E-03	35.053%
R6	5.46E-05	4.00E-04	4.55E-04	35.023%
R7	5.78E-05	2.14E-02	2.15E-02	36.074%
R8	5.78E-05	4.24E-04	4.82E-04	35.024%
R9	1.28E-04	9.36E-04	1.06E-03	35.053%
R10	4.80E-05	3.52E-04	4.00E-04	35.020%
R11	1.06E-04	7.75E-04	8.80E-04	35.044%

Table 23: Comparison with Total Dioxin TDI Limits for Child Receptors

Receptor	Total Inhalation, (pg WHO-TEQ kg-1 bw day -1)	Total Ingestion, (pg WHO-TEQ kg-1 bw day -1)	Total uptake, (pg WHO-TEQ kg-1 bw day -1)	Comparison (% of limit)
MDI (% of TDI)				**90.65%**
Point of maximum impact - agricultural	1.33E-03	5.51E-01	5.53E-01	**118.285%**
Point of maximum impact - residential	1.33E-03	2.59E-02	2.73E-02	92.013%
R1	1.09E-03	2.14E-02	2.25E-02	91.774%
R2	5.50E-04	1.08E-02	1.13E-02	91.215%
R3	3.82E-04	7.47E-03	7.85E-03	91.043%
R4	2.41E-04	4.70E-03	4.94E-03	90.897%
R5	1.61E-04	3.15E-03	3.31E-03	90.815%
R6	6.88E-05	1.35E-03	1.41E-03	90.721%
R7	7.28E-05	3.03E-02	3.03E-02	92.167%
R8	7.29E-05	1.42E-03	1.50E-03	90.725%
R9	1.61E-04	3.15E-03	3.31E-03	90.815%
R10	6.05E-05	1.18E-03	1.24E-03	90.712%
R11	1.33E-04	2.60E-03	2.74E-03	90.787%

B Location of Sensitive Receptors

Figure 2: Location of Sensitive Receptors



ENGINEERING CONSULTING

FICHTNER

Consulting Engineers Limited

Kingsgate (Floor 3), Wellington Road North,
Stockport, Cheshire, SK4 1LW,
United Kingdom

t: +44 (0)161 476 0032
f: +44 (0)161 474 0618

www.fichtner.co.uk

FICHTNER

Consulting Engineers Limited

Replacement of Lakeside EfW and HTI

Lakeside EfW Ltd

Abnormal Emissions Assessment

ENGINEERING + CONSULTING

Document approval

	Name	Signature	Position	Date
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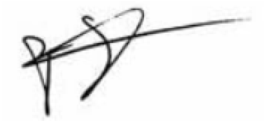
Checked by:	James Sturman		Senior Consultant	16/08/2019

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Contents

1 Introduction

Fichtner Consulting Engineers Ltd ("Fichtner") has been engaged to undertake an Abnormal Emissions Assessment to support the Environmental Permit (EP) application for a proposed Energy from Waste (EfW) facility, to be known as Lakeside EfW, alongside a High Temperature Incinerator (HTI). The EfW facility and HTI will be 'like-for-like' replacements of the existing Lakeside facilities which are currently regulated by the EA. The EfW facility and HTI are proposed to replace the existing Lakeside facilities due to the proposed expansion of Heathrow Airport.

The Environmental Permitting Regulations require that abnormal event scenarios are considered. Article 46(6) of the Industrial Emissions Directive states that:

"… the waste incineration plant … shall under no circumstances continue to incinerate waste for a period of more than 4 hours uninterrupted where emission limit values are exceeded.

The cumulative duration or operation in such conditions over 1 year shall not exceed 60 hours."

Article 47 continues with:

"In the case of a breakdown, the operator shall reduce or close down operations as soon as practicable until normal operations can be restored."

The conditions detailed in Article 46(6) are considered to be "abnormal operating conditions" for the purpose of this assessment.

2 Identification of Abnormal Operating Conditions

The following are considered to be examples of abnormal operating conditions which may lead to 'abnormal emission levels' of pollutants from both the EfW facility and HTI:

1. Reduced efficiency of lime injection system such as through blockages or failure of fans leading to elevated acid gas emissions (with the exception of hydrogen chloride);
2. Complete failure of the lime injection system leading to unabated emissions of hydrogen chloride. (Note: this would require the plant to have complete failure of the bag filter system. As a plant of modern design the plant would have shut down before reaching these operating conditions);
3. Reduced efficiency of particulate filtration system due to bag failure and inadequate isolation, leading to elevated particulate emissions and metals in the particulate phase;
4. Reduced efficiency of the Selective Non-Catalytic Reduction (SNCR) system as a result of blockages or failure of ammonia injection system, leading to elevated oxides of nitrogen emissions; and
5. Complete failure of the activated carbon injection system and loss of temperature control leading to high levels of dioxin reformation and their unabated release.

As a modern design, it is anticipated that both the EfW facility and HTI will be operated to a high degree of compliance. Therefore, the identification of plausible abnormal emission levels has been based primarily on the data obtained from modern plants. Where actual data is not available, worst case conservative assumptions have been made.

It is highly unlikely that abnormal emissions from the EfW facility and HTI will occur at the same time. Therefore, the impact of abnormal emissions from the EfW facility and HTI have been assessed separately.

2.1 Plant start-up and shutdown

Start-up of the EfW facility and HTI from cold will be conducted with clean support fuel (EfW facility – low sulphur light fuel oil; and HTI – natural gas). Waste is not introduced into the furnace unless the temperature is above the minimum requirement (850°C for the EfW facility and 1,100°C for the HTI) and other operating parameters (for example, air flow and oxygen levels) are within the range stipulated in the permit. During the warming up period the gas cleaning plant will be operational as will be the control systems and monitoring equipment.

The same is true during plant shutdown. The waste remaining in the furnace is allowed to burn out, the temperature not being permitted to drop below the minimum requirement by the simultaneous introduction of clean support auxiliary fuel. After complete burnout of the waste, the auxiliary fuel burners are turned off and the system is allowed to cool. During this period the gas cleaning equipment is fully operational, as will be the control systems and monitoring equipment.

It should also be noted that start-up and shutdown are infrequent events; the Facility is designed to operate continuously, and ideally only close down for its annual maintenance programme.

In relation to the magnitude of dioxin emissions during plant start-up and shutdown, research has been undertaken by AEA Technology on behalf of the Environment Agency. Whilst elevated emissions of dioxins (within one order of magnitude) were found during shutdown and start-up phases where the waste was not fully established on the grate, the report concluded that:

"The mass of dioxin emitted during start-up and shutdown for a 4-5 day planned outage was similar to the emission which would have occurred during normal operation in the same period. The emission during the shutdown and restart is equivalent to less than 1 % of the estimated annual emission (if operating normally all year)."

There is therefore no reason why such start-up and shutdown operations will affect the long term impact of the EfW facility or the HTI.

3 Plausible Abnormal Emission Levels

The `

Table 1: Plausible Abnormal Emissions - EfW Facility

Pollutant	Permitted Emission Limit, (mg/Nm^3)(1)		Plausible Abnormal Emission, (mg/Nm^3)	% Above Max Permitted Emission
	Daily Average	½ hourly max		
Oxides of nitrogen	100(2)	200(2)	500(3)	150
Particulate matter (PM_{10})	5	30	150(4)	400
Sulphur dioxide	30	90(2)	450(5)	400
Hydrogen chloride	6	60	900(5)	1,400
Hydrogen fluoride	1	4	20(3)	400
Dioxins and dioxin-like PCBs	0.06 ng/Nm^3		6 ng/Nm^3	9900(5)
PCBs	0.005 mg/Nm^3(6)		0.5 mg/Nm^3	9900(7)

NOTES:

1. *All emissions expressed as Nm^3 based (dry, 0°C, 11% reference oxygen content).*
2. *The applicant is proposing emission limits for oxides of nitrogen and a short term emission limit for sulphur dioxide that are lower than the maximum permitted limits.*
3. *Taken as the upper end of the range of monitored raw flue gas after the boiler from the Waste Incineration BREF (Table 3.6).*
4. *Taken from the IED maximum permitted level.*
5. *Assumes a 99% removal efficiency in lieu of any other information as set out in the Devonport Decision Document (Reference: EPR/WP3833FT).*
6. *The Draft Waste Incineration BREF provides a range of values for PCB emissions to air from European municipal waste incineration plants. This states that the annual average total PCBs is less than 0.005 mg/Nm^3 (dry, 11% oxygen, 273K). In lieu of other available data, this has been assumed to be the emission concentration for the EfW.*
7. *In lieu of any publicly available information, the plausible emissions multiplier for PCBs is assumed to be the same as for dioxins.*

The following plausible abnormal emission levels for the HTI have been identified based on information provided by AQMAU for other facilities processing clinical waste like the HTI.

Table 2: Plausible Abnormal Emissions - HTI

Pollutant	Permitted Emission Limit, (mg/Nm^3)(1)		Plausible Abnormal Emission, (mg/Nm^3)	% Above Max Permitted Emission
	Daily Average	½ hourly max		
Oxides of nitrogen	120	200(2)	600	200
Particulate matter (PM_{10})	5	30	150(3)	400
Sulphur dioxide	30	90(2)	500	456
Hydrogen chloride	6	60	900	1,400

Pollutant	Permitted Emission Limit, (mg/Nm³)(1)		Plausible Abnormal Emission, (mg/Nm³)	% Above Max Permitted Emission
	Daily Average	½ hourly max		
Hydrogen fluoride	1	4	20(4)	400
Dioxins and dioxin-like PCBs	0.06 ng/Nm³		6 ng/Nm³	9,900(5)
PCBs	0.005 mg/Nm³(6)		0.5 mg/Nm³	9,900(7)

NOTES:

1. *All emissions expressed as Nm³ based (dry, 0°C, 11% reference oxygen content).*
2. *The applicant is proposing short term emission limits for nitrogen dioxide and sulphur dioxide that are lower than the maximum permitted limits.*
3. *Taken from the IED maximum permitted level.*
4. *Taken as the upper end of the range of monitored raw flue gas after the boiler from the Waste Incineration BREF (Table 3.6) in lieu of any other data.*
5. *Assumes a 99% removal efficiency in lieu of any other information as set out in the Devonport Decision Document.*
6. *The Draft Waste Incineration BREF provides a range of values for PCB emissions to air from European municipal waste incineration plants. This states that the annual average total PCBs is less than 0.005 mg/Nm³ (dry, 11% oxygen, 273K). In lieu of other available data, this has been assumed to be the emission concentration for the HTI.*
7. *In lieu of any publicly available information, the plausible emissions multiplier for PCBs is assumed to be the same as for dioxins.*

A number of assumptions have been made with regard to the emissions of individual metals from the EfW facility and HTI.

1. Emission concentration of mercury has been assumed to be 100% of the draft Best Available Techniques Associated Emission Limit (BAT-AEL) concentration of 0.02mg/m³.
2. Emission concentration of cadmium has been taken as half the draft BAT-AEL concentration for cadmium and thallium and compounds of 0.02mg/m³.
3. Emission concentration of heavy metals that have a short or long term EAL have been considered (antimony, arsenic, chromium, copper, lead, manganese, nickel, vanadium) and have been taken from the Environment Agency guidance document "Guidance on assessing group 3 metal stack emissions from incinerators version 4" (the EA Metals Guidance). This guidance summarises the existing emissions from 18 Municipal Waste Incinerators (MWIs) and Waste Wood Co-incinerators in the UK over a period between 2007 and 2015.
4. The Predicted Abnormal Emission are calculated based on 30 times the emission concentration, as it is assumed that metals are in the particulate phase with the exception of mercury where it has been assumed there is a 99% removal efficiency in lieu of any other information, as set out in the Devonport Decision Document.

The plausible abnormal emissions concentrations for metals are presented in Table 3.

Table 3: Predicted Abnormal Metal Emissions - EfW Facility and HTI

Pollutant	Emission Concentrations (µg/Nm³)	Predicted Abnormal Emission (µg/Nm³)	% Above Max Permitted Emission
Antimony	11.5	345	2,900

Pollutant	Emission Concentrations (µg/Nm³)	Predicted Abnormal Emission (µg/Nm³)	% Above Max Permitted Emission
Arsenic	25	750	2,900
Cadmium	10	300	2,900
Chromium	92	2,760	2,900
Chromium (VI)	0.035 (1)	1.05	2,900
Copper	29	870	2,900
Lead	50.3	1,509	2,900
Manganese	60	1,800	2,900
Mercury	20	2,00	9,900
Nickel	220	6,600	2,900
Vanadium	6	180	2,900

NOTE:

1. *The Air Quality Assessment submitted as part of the EP application considered the impact of the average monitored concentration of Chromium (VI) of 3.5x10-5 mg/Nm³. The plausible abnormal emissions of Chromium (VI) are assumed to be 30 times higher.*

The definition of 'abnormal operating conditions' also encompasses periods where the continuous emission monitoring equipment is not operating correctly and data relating to the actual emission concentrations are not available. This assessment has only used data where the concentration of continuously monitored pollutants has been quantified. Furthermore, no data on flow characteristics (flow rate, temperature etc.) during these abnormal operating conditions is available, so for the purposes of this assessment the design flow characteristics have been applied to the plausible emission levels to derive an emission rate and assess impact.

In defining abnormal operating conditions Annex VI, Part 2 (2) notes that under no circumstances shall the total dust concentration exceed 150 mg/Nm³ expressed as a half hourly average. As such total dust has been included in this analysis. However, this section continues to state that the limits prescribed for TOC set must not be exceeded. As such, there is no potential for the impact of emissions of TOC to be greater than that outlined in the Air Quality Assessment, and TOC has not been considered within this assessment.

4 Impact Resulting from Plausible Abnormal Emissions

The impact of abnormal emissions from the EfW facility and HTI have been assessed separately. When assessing the impact from abnormal emissions from the EfW facility it has been assumed that both lines operate under abnormal operating conditions concurrently. This is a very worst case assumption.

4.1 Impact of plausible abnormal emissions – EfW facility

4.1.1 Predicted short term impacts

In order to assess the effect on short term ground level concentrations associated with the EfW facility operating at the identified abnormal emission concentration, the calculated ground level concentration has been increased pro-rata as presented in Table 4. To calculate the 24-hour average concentrations of sulphur dioxide and PM_{10} it has been assumed that abnormal emissions occur for four hours and the EfW facility operates at the permitted limits for 20 hours.

Table 4: Short-term Impacts Resulting from Plausible Abnormal Emissions – EfW Facility

Pollutant	AQAL (µg/m³)	Predicted Impact – Permitted Limits		Predicted Impact – Abnormal Emission	
		Conc. µg/m³	% of AQAL	Conc. µg/m³	% of AQAL
Nitrogen dioxide	200	37.1	18.6%	92.8	46.4%
Particulate matter (PM_{10})	50	0.8	1.6%	4.6	9.3%
Sulphur dioxide (24-hour)	125	10.9	8.7%	36.2	28.9%
Sulphur dioxide (1-hour)	350	47.1	13.5%	235.5	67.3%
Sulphur dioxide (15-min)	266	50.2	18.9%	250.8	94.3%
Hydrogen chloride	750	34.1	4.5%	511.7	68.2%
Hydrogen fluoride	160	2.3	1.4%	11.4	7.1%
Pollutant	**AQAL (ng/m³)**	**Predicted Impact – Permitted Limits**		**Predicted Impact – Abnormal Emission**	
		Conc. ng/m³	**% of AQAL**	**Conc. ng/m³**	**% of AQAL**
Antimony	150,000	6.54	0.004%	196.16	0.13%
Chromium	150,000	52.31	0.035%	1,569.29	1.05%
Copper	200,000	16.49	0.008%	494.67	0.25%
Manganese	1,500,000	34.12	0.002%	1,023.45	0.07%
Mercury	7,500	11.37	0.152%	1,137.17	15.16%
Vanadium	1,000	3.41	0.341%	102.35	10.23%
PCBs	6000	2.84	0.047%	284.29	4.74%

This is considered to be a highly conservative assessment as it assumes that the plausible abnormal emissions occur on both lines of the EfW facility and coincide with worst case meteorological conditions for dispersion. Even with these highly conservative factors, the process contribution is not predicted to exceed any of the short term AQALs. The maximum predicted process contribution (as a % of the applied AQAL) is 94.3% for 15-minute sulphur dioxide with all other pollutants lower. If just one line of the EfW facility operates under abnormal operating conditions during the worst case meteorological conditions for dispersion, the predicted PC for 15-minute sulphur dioxide is 150.5 µg/m³ or 56.6% of the AQAL.

4.1.2 Predicted long term impacts

In order to assess the effect on long term ground level concentrations associated with the EfW facility operating at the identified abnormal emission levels, the calculated long term ground level concentrations have been increased pro-rata as presented in Table 5 and Table 6. This assessment assumes that the EfW facility is operating at the daily average permitted emission limits for 8,700 hours per year and at the plausible abnormal emission levels for 60 hours per year.

Table 5: Long-term Impacts Resulting from Plausible Abnormal Emissions – EfW Facility

Pollutant	AQAL (µg/m³)	Predicted Impact – Permitted Limits		Predicted Impact – Abnormal Emission	
		Conc. (µg/m³)	% of AQAL	Conc. (µg/m³)	% of AQAL
Nitrogen dioxide	40	3.36	8.40%	3.45	8.63%
Particulate matter (PM_{10})	40	0.24	0.60%	0.29	0.72%
Hydrogen fluoride	16	0.05	0.30%	0.05	0.34%
Pollutant	**AQAL (ng/m³)**	**Predicted Impact – Permitted Limits**		**Predicted Impact – Abnormal Emission**	
		Conc. (ng/m³)	**% of AQAL**	**Conc. (ng/m³)**	**% of AQAL**
Antimony	5,000	0.55	0.011%	0.66	0.013%
Arsenic	3	1.20	40.00%	1.44	47.94%
Cadmium	5	0.48	9.60%	0.58	11.51%
Chromium	5,000	4.42	0.09%	5.29	0.11%
Chromium (VI)	0.2	0.0017	0.84%	0.0020	1.01%
Copper	10,000	1.39	0.014%	1.67	0.017%
Lead	250	2.41	0.97%	2.89	1.16%
Manganese	150	2.88	1.92%	3.45	2.30%
Mercury	250	0.96	0.38%	1.61	0.64%
Nickel	20	10.56	52.80%	12.66	63.28%
Vanadium	5,000	0.29	0.0058%	0.35	0.0069%
PCBs	200	0.24	0.12%	0.40	0.20%

The process contribution is not predicted to exceed any of the long term AQALs. The maximum predicted process contribution (as a % of the applied AQAL) is less than 64% for nickel, with all other pollutants lower.

There is no AQAL for dioxins and dioxin-like PCBs against which the impact can be assessed. Therefore, to assess the impact of dioxins and dioxin-like PCBs, the increase in concentration at the point of maximum impact has been assessed. As can be seen from the results presented in Table 6, the impact of abnormal emissions is to increase in the maximum ground level concentration by 67.81%.

Table 6: Long Term Impacts from Predicted Dioxin and Dioxin-Like PCB Emissions – EfW Facility

Pollutant	Predicted Impact – Permitted Limit	Predicted Impact –Abnormal Emission	
	fg/m³	fg/m³	% increase
Dioxins and dioxin-like PCBs	2.88	4.83	67.81%

4.2 Impact of plausible abnormal emissions - HTI

4.2.1 Predicted short term impacts

In order to assess the effect on short term ground level concentrations associated with the HTI operating at the identified abnormal emission concentration, the calculated ground level concentration has been increased pro-rata as presented in Table 7. To calculate the 24-hour average concentrations of sulphur dioxide and PM_{10} it has been assumed that abnormal emissions occur for four hours and the HTI operates at the permitted limits for 20 hours.

Table 7: Short-term Impacts Resulting from Plausible Abnormal Emissions - HTI

Pollutant	AQAL (µg/m³)	Predicted Impact – Permitted Limits		Predicted Impact – Abnormal Emission	
		Conc. µg/m³	% of AQAL	Conc. µg/m³	% of AQAL
Nitrogen dioxide	200	4.9	2.5%	14.8	7.4%
Particulate matter (PM_{10})	50	0.1	0.2%	0.5	1.0%
Sulphur dioxide (24-hour)	125	1.1	0.9%	3.9	3.1%
Sulphur dioxide (1-hour)	350	4.4	1.2%	24.2	6.9%
Sulphur dioxide (15-min)	266	7.3	2.8%	40.8	15.3%
Hydrogen chloride	750	9.6	1.3%	143.7	19.2%
Hydrogen fluoride	160	0.6	0.4%	3.2	2.0%
Pollutant	**AQAL (ng/m³)**	**Predicted Impact – Permitted Limits**		**Predicted Impact – Abnormal Emission**	
		Conc. ng/m³	**% of AQAL**	**Conc. ng/m³**	**% of AQAL**
Antimony	150,000	0.07	0.00005%	2.09	0.001%
Chromium	150,000	0.56	0.00037%	16.72	0.011%
Copper	200,000	0.18	0.00009%	5.27	0.003%

Pollutant	AQAL (µg/m³)	Predicted Impact – Permitted Limits		Predicted Impact – Abnormal Emission	
		Conc. µg/m³	% of AQAL	Conc. µg/m³	% of AQAL
Manganese	1,500,000	0.36	0.00002%	10.90	0.001%
Mercury	7,500	0.12	0.00162%	12.12	0.162%
Vanadium	1,000	0.04	0.00363%	1.09	0.109%
PCBs	6000	0.03	0.00050%	3.03	0.050%

This is considered to be a conservative assessment as it assumes that the plausible abnormal emissions coincide with worst case meteorological conditions for dispersion. Even with this conservative factor, the process contribution is not predicted to exceed any of the short term AQALs. The maximum predicted process contribution (as a % of the applied AQAL) is 19.2% for hydrogen chloride with all other pollutants lower.

4.2.2 Predicted long term impacts

In order to assess the effect on long term ground level concentrations associated with the HTI operating at the identified abnormal emission levels, the calculated long term ground level concentrations have been increased pro-rata as presented in Table 8 and Table 9. This assessment assumes that the HTI is operating at the daily average permitted emission limits for 8,700 hours per year and at the plausible abnormal emission levels for 60 hours per year.

Table 8: Long-term Impacts Resulting from Plausible Abnormal Emissions - HTI

Pollutant	AQAL (µg/m³)	Predicted Impact – Permitted Limits		Predicted Impact – Abnormal Emission	
		Conc. (µg/m³)	% of AQAL	Conc. (µg/m³)	% of AQAL
Nitrogen dioxide	40	0.51	1.27%	0.52	1.31%
Particulate matter (PM_{10})	40	0.03	0.08%	0.04	0.09%
Hydrogen fluoride	16	0.01	0.04%	0.01	0.04%
Pollutant	**AQAL (ng/m³)**	**Predicted Impact – Permitted Limits**		**Predicted Impact – Abnormal Emission**	
		Conc. (ng/m³)	**% of AQAL**	**Conc. (ng/m³)**	**% of AQAL**
Antimony	5,000	0.07	0.001%	0.08	0.002%
Arsenic	3	0.15	5.05%	0.18	6.05%
Cadmium	5	0.06	1.21%	0.07	1.45%
Chromium	5,000	0.56	0.01%	0.67	0.01%
Chromium (VI)	0.2	0.00021	0.11%	0.00025	0.13%
Copper	10,000	0.18	0.002%	0.21	0.002%
Lead	250	0.30	0.12%	0.37	0.15%
Manganese	150	0.36	0.24%	0.44	0.29%

Pollutant	AQAL (µg/m³)	Predicted Impact – Permitted Limits		Predicted Impact – Abnormal Emission	
		Conc. (µg/m³)	% of AQAL	Conc. (µg/m³)	% of AQAL
Mercury	250	0.12	0.05%	0.20	0.08%
Nickel	20	1.33	6.66%	1.60	7.99%
Vanadium	5,000	0.04	0.0007%	0.04	0.0009%
PCBs	200	0.03	0.02%	0.05	0.03%

The process contribution is not predicted to exceed any of the long term AQALs. The maximum predicted process contribution (as a % of the applied AQAL) is less than 8% for nickel, with all other pollutants lower.

There is no AQAL for dioxins and dioxin-like PCBs against which the impact can be assessed. Therefore, to assess the impact of dioxins and dioxin-like PCBs, the increase in concentration at the point of maximum impact has been assessed. As can be seen from the results presented in Table 9, the impact of abnormal emissions is to increase in the maximum ground level concentration by 67.81%.

Table 9: Long Term Impacts from Predicted Dioxin and Dioxin-Like PCB Emissions - HTI

Pollutant	Predicted Impact – Permitted Limit	Predicted Impact –Abnormal Emission	
	fg/m³	fg/m³	% increase
Dioxins and dioxin-like PCBs	0.36	0.61	67.81%

4.3 Impact of plausible abnormal emissions – Human Health Risk Assessment

The Human Health Risk Assessment (HHRA) submitted with the EP Application considers the combined impact of the HTI and both lines of the EfW facility.

Based on the results of the Human Health Risk Assessment (HHRA), the highest dose of dioxins and dioxin-like PCBs is predicted to be 1.52% of the TDI. This is based on the ingestion and inhalation of dioxins and dioxin-like PCBs by a child agricultural receptor at the maximum impacted receptor. Assuming the impact of abnormal operations, it is calculated that the process contribution at this receptor will be (1.52% x 1.6781) = 2.55% of the UK TDI for dioxins and dioxin-like PCBs. Existing sources contribute 90.65% of the TDI, and therefore the total exposure will be 93.20% of the TDI.

In addition, the HHRA considers the impact of the ingestion of dioxins by an infant being breast fed by an adult agricultural receptor at the point of maximum impact. The impact is predicted to be 8.33% of the UK TDI for dioxins. There are no other significant pathways for infant receptors. Assuming the impact of abnormal operations, it is calculated that this receptor will be exposed to (8.33% x 1.6781) = 13.98% of the UK TDI for dioxins.

Based on the conservative assumptions used within the modelling, there will be no exceedences of the TDI for dioxins and dioxin-like PCBs resulting from both the EfW facility and the HTI operating under abnormal operating conditions.

5 Predicted Environmental Concentration – Abnormal Operations

Environment Agency's Air Emissions Guidance includes the following method for identifying which emissions require further assessment by applying the following criteria:

- the long term process contribution is <1% of the long term environmental standard; and
- the short term process contribution is <10% of the short term environmental standard.

Where the impact of abnormal emissions is greater than the above criteria consideration of the background concentration has been made to ensure that the AQAL is not exceeded as a result of abnormal operations.

5.1 Background concentrations

Appendix A outlines the values for the annual average background concentrations that have been used to evaluate the impact of the Facility. These are as presented in the Air Quality Assessment submitted with the EP application.

5.2 Predicted impacts – EfW facility

5.2.1 Predicted short term impacts

Table 10 below presents the predicted impacts of plausible abnormal operations in the short term at the point of maximum impact and the Predicted Environmental Concentration (PEC) (process contribution plus background) for those pollutants for which the impact of the EfW facility presented in Table 4 is greater than 10%.

Table 10: Short Term PEC Resulting from Plausible Abnormal Emissions – EfW Facility

Pollutant	**AQAL (µg/m³)**	**Background Conc.**	**PC – Abnormal Emissions**	**PEC – Abnormal Emissions**	
		µg/m³	**µg/m³**	**µg/m³**	**% of AQAL**
Nitrogen dioxide	200	55	92.78	147.78	73.9%
Sulphur dioxide (24-hour)	125	66	36.18	102.18	81.7%
Sulphur dioxide (1-hour)	350	66	235.50	301.50	86.1%
Sulphur dioxide (15-min)	266	66	250.80	316.80	119.1%
Hydrogen chloride	750	1.4	511.72	513.12	68.4%
Pollutant	**AQAL (ng/m³)**	**Background Conc.**	**PC – Abnormal Emissions (1)**	**PEC – Abnormal Emission**	
		ng/m³	**ng/m³**	**ng/m³**	**% of AQAL**
Mercury	7,500	7.4	1137.17	1144.57	15.3%
Vanadium	1,000	3.1	102.35	105.45	10.5%

As shown, the PEC is not predicted to exceed the AQAL at the point of maximum impact for any pollutant during abnormal operations, with the exception of 15-minute mean sulphur dioxide. However, as noted in Section 4, this conservatively assumes that both EfW lines operate under abnormal operating conditions concurrently during the worst case meteorological conditions for dispersion. If just one line operates under abnormal operating conditions the predicted PC is 150.5 µg/m³ or 56.6% of the AQAL and the PEC is 216.5 µg/m³ or 81.4% of the AQAL. The likelihood that both lines will simultaneously be in abnormal operating operation at the same time as the worst case meteorological conditions for dispersion is considered to be extremely low. Therefore, it is considered highly unlikely that the AQAL will be exceeded.

5.2.2 Predicted long term impacts

Table 11 presents the predicted impacts of plausible abnormal operations in the long term at the point of maximum impact, and the PEC. This assessment assumes that the EfW facility is operating at the permitted limits for 8,700 hours per year and at the plausible abnormal emission levels for 60 hours per year.

Table 11: Long Term PEC Resulting from Plausible Abnormal Emissions – EfW facility

Pollutant	AQAL (µg/m³)	Background Conc.	PC – Abnormal Emissions	PEC – Abnormal Emission	
		µg/m³	µg/m³	µg/m³	% of AQAL
Nitrogen dioxide	40	27.5	3.45	30.95	77.4%
Pollutant	**AQAL (ng/m³)**	**Background Conc.**	**PC – Abnormal Emissions (1)**	**PEC – Abnormal Emission**	
		ng/m³	**ng/m³**	**ng/m³**	**% of AQAL**
Arsenic	3	0.79	0.98	1.77	58.8%
Cadmium	5	0.26	0.39	0.65	13.0%
Chromium (VI)	0.2	2.63	0.002	2.63	1317.0%
Lead	250	10.5	2.89	13.24	5.3%
Manganese	150	10.9	3.45	14.35	9.6%
Nickel	20	6.61	12.66	19.27	96.3%

As shown, the PEC is not predicted to exceed the AQAL at the point of maximum impact for any pollutant during abnormal operations, with the exception of the PEC for chromium (VI).

However, as shown in Table 5, the long term process contribution is predicted to be 1.01% of the AQAL, i.e. only slightly exceeds the screening criteria. Whilst the PEC exceeds the AQAL, this is due to the high background concentration, which is already well in excess of the AQAL. As noted in Appendix A, background chromium (VI) is not monitored in the UK and is conservatively assumed to be 20% of total chromium in accordance with the EA Metals Guidance.

The predicted process contribution of 1.01% is highly conservative and is considered to be the upper estimate of the impact of plausible abnormal emissions. The results are based on the maximum predicted concentration over five years of meteorological data. Analysis of the results for each year of meteorological data shows that, at the point of maximum impact, the concentration averaged over all five years is 72% of the concentration averaged over the maximum year. Therefore, the likely impact of plausible abnormal emissions of chromium (VI) is 0.72 x 1.01% = 0.73% of the AQAL.

In addition, the assessment is considered to be highly conservative for the following reasons:

1. It has been assumed that each line of the EfW facility operates at the long-term emission concentration shown in Table 3 for 8,700 hours per year and at the plausible abnormal emission levels for 60 hours per year. This is conservative as the EfW facility will not operate continuously in every year and periodically will be required to be shutdown for maintenance purposes.
2. It has been assumed that the maximum impact of plausible abnormal emissions occurs at the same location as the annual mean point of maximum impact. Due to the limited time that plausible abnormal emissions are permitted to occur, it is unlikely that the impact of abnormal emissions will occur in exactly the same location as the maximum annual mean impact as assumed within this assessment.

Taking the above into consideration, the likely impact of plausible abnormal emissions of chromium (VI) from the EfW facility is considered to be less than 1% of the AQAL and can be screened out as 'insignificant'.

5.3 Predicted impacts – HTI

5.3.1 Predicted short term impacts

Table 12 below presents the predicted impacts of plausible abnormal operations in the short term at the point of maximum impact and the PEC for those pollutants for which the impact presented in Table 7 is greater than 10%.

Table 12: Short Term PEC Resulting from Plausible Abnormal Emissions - HTI

Pollutant	AQAL (µg/m³)	Background Conc.	PC – Abnormal Emissions	PEC – Abnormal Emissions	
		µg/m³	µg/m³	µg/m³	% of AQAL
Sulphur dioxide (15-min)	266	66	40.75	106.75	40.1%
Hydrogen chloride	750	1.4	143.68	145.08	19.36%

As shown, the PEC is not predicted to exceed the AQAL at the point of maximum impact for any pollutant during abnormal operations.

5.3.2 Predicted long term impacts

Table 13 below presents the predicted impacts of plausible abnormal operations in the long term at the point of maximum impact, and the PEC. This assessment assumes that the HTI is operating at the BAT-AELs for 8,700 hours per year and at the plausible abnormal emission levels for 60 hours per year.

Table 13: Long Term PEC Resulting from Plausible Abnormal Emissions - HTI

Pollutant	AQAL (µg/m³)	Background Conc.	PC – Abnormal Emissions	PEC – Abnormal Emission	
		µg/m³	µg/m³	µg/m³	% of AQAL
Nitrogen dioxide	40	27.5	0.52	28.02	70.1%
Pollutant	**AQAL (ng/m³)**	**Background Conc.**	**PC – Abnormal Emissions (1)**	**PEC – Abnormal Emission**	
		ng/m³	**ng/m³**	**ng/m³**	**% of AQAL**
Arsenic	3	0.79	0.18	0.97	32.4%
Cadmium	5	0.26	0.07	0.33	6.7%
Nickel	20	6.61	1.60	8.21	41.0%

As shown, the PEC is not predicted to exceed the AQAL at the point of maximum impact for any pollutant during abnormal operations.

6 Summary

An assessment of the impact on air quality associated with abnormal operating conditions from the EfW facility and HTI has identified plausible abnormal emissions based on a review of monitoring data from operational facilities of a similar type in the UK. Notwithstanding the low frequency of occurrence of such abnormal operating conditions identified by the review, the potential impact on air quality has been assessed.

The predicted impact on air quality associated with the identified plausible abnormal emissions has been calculated by pro-rating the impact associated with normal operations by the ratio between the normal and plausible abnormal emission values. This is considered to be a highly conservative assessment as it assumes that the plausible abnormal emissions occur on both EfW facility lines concurrently and, for short-term impacts, that they coincide with the worst case meteorological conditions for dispersion. The assessment also assumes that, for short-term impacts, the plausible abnormal emissions from the HTI also coincide with the worst case meteorological conditions for dispersion.

Even with these highly conservative factors, the maximum predicted short term process contribution (as % of the applied AQAL) is 94.3% for the EfW facility and 15.3% for the HTI and the maximum predicted long term process contribution (as % of the applied AQAL) is less than 43% the EfW and less than 7% for the HTI. Abnormal emissions from either the EfW facility or HTI will not cause any exceedences of any AQAL, with the exception of 15-minute sulphur dioxide and annual mean chromium (VI) resulting from abnormal emissions from the EfW facility. However, as noted above, the 15-minute sulphur dioxide impact is based on both EfW facility lines operating under abnormal operating conditions concurrently during the worst-case meteorological conditions for dispersion, which is highly unlikely to occur. If only one line operates under abnormal operating conditions, no exceedence of the AQAL is predicted.

The PEC is predicted to exceed the annual mean AQAL for chromium (VI). However, this is due to the high background concentration, which is already well in excess of the AQAL. When the average of all five meteorological years assessed is considered, the contribution from the EfW facility including plausible abnormal emissions occurring for 60 hours on each line per year is only 0.73% of the AQAL.

In addition, the assessment has shown that there will not be any exceedences of the TDI for dioxins and dioxin-like PCBs.

It is concluded that during periods of abnormal operation as permissible under the IED (Article 46) is not predicted to give rise to an unacceptable impact on air quality or the environment.

Appendices

A Background Concentrations

Summary of Background Concentrations			
Pollutant	**Annual Mean Concentration**	**Units**	**Justification**
Nitrogen dioxide	27.5	µg/m³	Maximum monitored concentration - Old Slade Lane, Iver diffusion tube
Particulate matter (PM_{10})	15.0	µg/m³	Maximum monitored concentration - Slough Lakeside 2 continuous monitoring station
Sulphur dioxide	33.0	µg/m³	Maximum mapped background concentration from across the modelling domain – DEFRA 2001 dataset.
Hydrogen chloride	0.7	µg/m³	Maximum monitored concentration across the UK 2011 to 2015
Hydrogen fluoride	2.3	µg/m³	Maximum measured concentration from EPAQS report
Cadmium	0.26	ng/m³	Maximum of annual monitored concentration averaged across all UK urban background sites 2013 to 2017
Arsenic	0.79	ng/m³	
Chromium (VI)(1)	2.63	ng/m³	
Manganese	10.90	ng/m³	
Nickel	6.61	ng/m³	

NOTE:

1. *Chromium (VI) is not routinely monitored in the UK. Background concentrations of chromium (VI) are assumed to be 20% of total chromium, in line with the EA Metals Guidance.*

ENGINEERING CONSULTING

FICHTNER
Consulting Engineers Limited

Kingsgate (Floor 3), Wellington Road North,
Stockport, Cheshire, SK4 1LW,
United Kingdom

t: +44 (0)161 476 0032
f: +44 (0)161 474 0618

www.fichtner.co.uk