HOARE LEA

Energy Recovery Facility. Grangetown Prairie. JBA Consulting.

AIR QUALITY
AIR QUALITY ASSESSMENT

REVISION 02 – 06 MARCH 2020

Audit sheet.

Rev.	Date	Description of change / purpose of issue	Prepared	Reviewed	Authorised
01	20/02/2020	First draft	KL/AC	CH	CR
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Document reference: REP-1011778-AQ-CR-20200306-Grangetown Prairie Energy from Waste-AQA-R02

Contents.

Executive summary.

This report describes the potential air quality impacts associated with the operation of a proposed Energy Recovery Facility located in Grangetown Prairie.

The construction works have the potential to create dust. During construction it will therefore be necessary to implement a package of mitigation measures to minimise dust emissions. With these measures in place, it is expected that any residual effects will be not significant.

A detailed assessment of pollutant emissions released from the facility as a result of the combustion of waste as well as pollutant emissions from road traffic associated with the operation of the facility has been undertaken. The air quality effects on human health are judged to be not significant, but effects on sensitive habitats without mitigation are judged to be potentially significant due to existing conditions at the ecological sites. Consideration of whether impacts from the Proposed Facility cause a significant effect need to be assessed by an experienced ecologist.

Consideration has also been given to Middlesbrough Borough Council's Local Nitrogen Dioxide Plan. The Proposed Development will not cause any exceedences of or delay compliance with the limit values.

1. Introduction.

1.1 Proposed Development.

Hoare Lea has been commissioned by JBA Consulting to assess the air quality impacts associated with the proposed Energy Recovery facility (ERF) at the Grangetown Prairie site as part of the outline planning application. The assessment of the impact has been carried out in accordance with the Town and Country Planning (Environmental Impact Assessment) Regulations 2017 which were last updated in March 2019.

1.2 Background

The Proposed Facility site is located within Redcar and Cleveland Borough Council's boundary, the site location is shown in Figure 1. Stockton-on-Tees Borough Council's boundary and Middlesbrough Borough Council's boundary are within 1.9 km and 2.1 km, respectively, of the site.

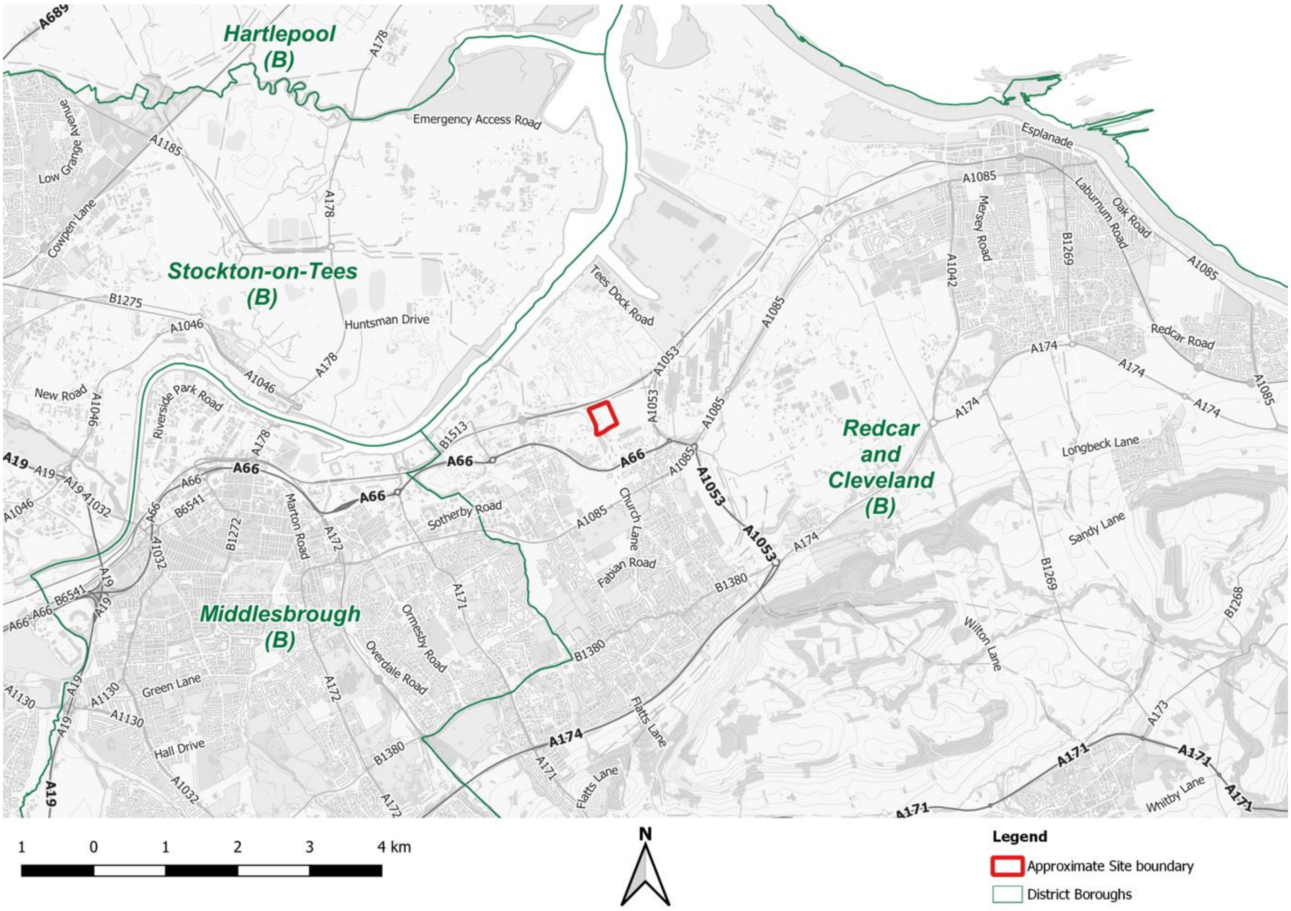

Figure 1: Site Location and Boroughs (B)

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There are a number of human health receptors in the local area, along with a number of sensitive ecological receptors.

To operate, the site will require an environmental permit from the Environment Agency and will therefore be subject to emission limits for a range of pollutants. These emission limits are set out in the Environmental Permitting Regulations which were transposed from the Industrial Emissions Directive (IED) (Directive 2010/75/EU of the European Parliament and the Council on industrial emissions). The purpose of the permit is to ensure the operation of the facility does not significantly deteriorate local air quality. This assessment has been produced to explicitly support the planning application. Permit applications typically require additional information and details which are not required for planning applications.

The Proposed Facility consists of an ERF operation which will incinerate up to 450,000 tonnes of municipal solid waste (MSW) per annum. Operation of the Proposed Facility will be 24 hours per day, 365 days per year, however, planned maintenance and shut down periods will mean the plant will typically operate for 90% of the hours in a year. Thus, the hourly fuel consumption is 450,000 tonnes / 7884 hours. The fuel is assumed to have a typical MSW composition as presented in Table 1.

Table 1: Fuel composition

Parameter		As Received (ar)	Dry Basis (dry)	Dry Ash Free (daf)
%Mass	Carbon	31.39%	46.23%	62.89%
	Hydrogen	3.65%	5.38%	7.32%
	Nitrogen	0.81%	1.20%	1.63%
	Oxygen	12.94%	19.06%	25.93%
	Sulphur	0.26%	0.38%	0.52%
	Chlorine	0.86%	1.26%	1.71%
	Fluorine	<0.01%	<0.01%	<0.01%
	Ash	17.99%	26.49%	-
	Moisture Content	32.10%	-	-
	Total	100.00%	100.0%	100.00%
Net Calorific Value (LHV) (MJ/kg)		11.53	18.14	-
Gross Calorific Value (HHV) (MJ/kg)		13.11	19.31	26.27

The relevant parameters including calculated actual (A) and normalised (N) exhaust flow rates, for the Proposed Facility, are given in Table 2. These are based on the complete combustion of the fuel in 40% excess combustion air. At this stage it is not known if a condensing heat exchanger will be used in the flue system and therefore it is assumed that no water vapour is removed from the flue gas; furthermore it is not known if the process will include flue gas recirculation.

Throughout this report, 'normalised' (N) units are used. This refers to no moisture (dry), 11% oxygen, and 0 degrees Celsius. These are the reference conditions at which the relevant Industrial Emission Directive (IED) emissions limits are expressed.

Table 2: Combustion Parameters

Parameter	Value
Combustion Input	
Gross Fuel Consumption (kg/hr)	57,077
Net Input Fuel Rate ($MW_{thermal\ input}$)	182.8
Gross Input Fuel Rate ($MW_{thermal\ input}$)	207.9

Parameter	Value
Excess Air (%) [a]	40%
Combustion Air in (kg/h wet)	392,078
Combustion Products	
Exhaust Temperature (^oC)	140
Exhaust Flow (kg/h) for Actual Flow	431,014
Molar Flow Rate (mol/s) for Actual Flow	4,204.2
Molecular Mass (g/mol) for Actual Flow	28.48
Exhaust Flow (Am^3/s) [b, c] for Actual Flow	142.5
Exhaust Velocity (Am/s) [b] for Actual Flow	15
Exhaust Flow (kg/h) for Normalised Flow [d]	391,768
Molar Flow Rate (mol/s) for Normalised Flow [d]	4,859.3
Exhaust Flow (Nm^3/s) [d, e] for Normalised Flow	80.7

[a] Derived from combustion air m^3/s.

[b] Actual flow conditions assumed to be 140 °C, 5.3% O_2, wet (14.4% H_2O).

[c] Calculated from molar flow rate x 8.3145 x (T+273.13) / 101,325.

[d] Normalised to 0 °C, 101.325 kPa, 11% O_2, dry.

[e] Calculated from normalised molar flow rate x 8.3145 x (273.13) / 101,325.

1.3 Scope of Assessment

1.3.1 Scoped into the assessment

1.3.1.1 Construction

During the construction phase emissions of dust to air can occur. Emissions will vary substantially from day to day, depending on the level of activity and the specific operations being undertaken, along with the influence of the weather conditions. The scale of these impacts depends on the dust suppression and other mitigation measures applied.

1.3.1.2 Operational

Emissions from the combustion of the fuel have the potential to impact local sensitive receptors. This assessment describes the existing and future air quality in the local area. The pollutants covered in this assessment are primarily those for which the IED specifies a maximum emission rate. These are:

- nitrogen dioxide (NO_2);
- sulphur dioxide (SO_2);
- total dust, which includes fine airborne particulate matter (PM_{10} and $PM_{2.5}$);
- carbon monoxide (CO);
- hydrogen chloride (HCl);
- hydrogen fluoride (HF);
- Volatile Organic Compounds (VOCs);
- ammonia (NH_3);
- polycyclic aromatic hydrocarbons (PAH);

- polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/F) also known as dioxins and furans;
- polychlorinated biphenyls (PCBs); and
- the following trace metals:
  - cadmium (Cd);
  - thallium (Tl);
  - mercury (Hg);
  - antimony (Sb);
  - arsenic (As);
  - lead (Pb);
  - chromium (Cr);
  - copper (Cu);
  - manganese (Mn);
  - nickel (Ni); and
  - vanadium (V).

The Proposed Facility will also result in changes in traffic flows on local roads due to delivery of the waste and staff commuting to and from the facility. The emissions associated with these changes could impact air quality at local sensitive receptors. Consideration of the impact of road traffic has been given to NO_2 and particulate matter (both PM_{10} and $PM_{2.5}$) as these are the pollutants of most concern with regards to road traffic emissions.

The extent of the study area is shown in Figure 2. There are many human health receptors nearby, such as the residential estates in the local area. There are also a number of sensitive ecological sites, including:

- Ramsar, Special Area of Conservation (SAC) and Special Protection Area (SPA) sites within 5 km of the site boundary:
  - Teesmouth and Cleveland Coast Ramsar
  - Teesmouth and Cleveland Coast SPA
- Site of Special Scientific Interest (SSSI) sites within 2 km of the site boundary:
  - Teesmouth and Cleveland Coast SSSI
- There are no National Nature Reserve (NNR), Local Nature Reserve (LNR), Local Wildlife Sites (LWS), Sites of Importance for Nature Conservation (SINC) or Ancient Woodland (AW) sites within 2 km of the site boundary.

The impacts have been assessed at these relevant locations.

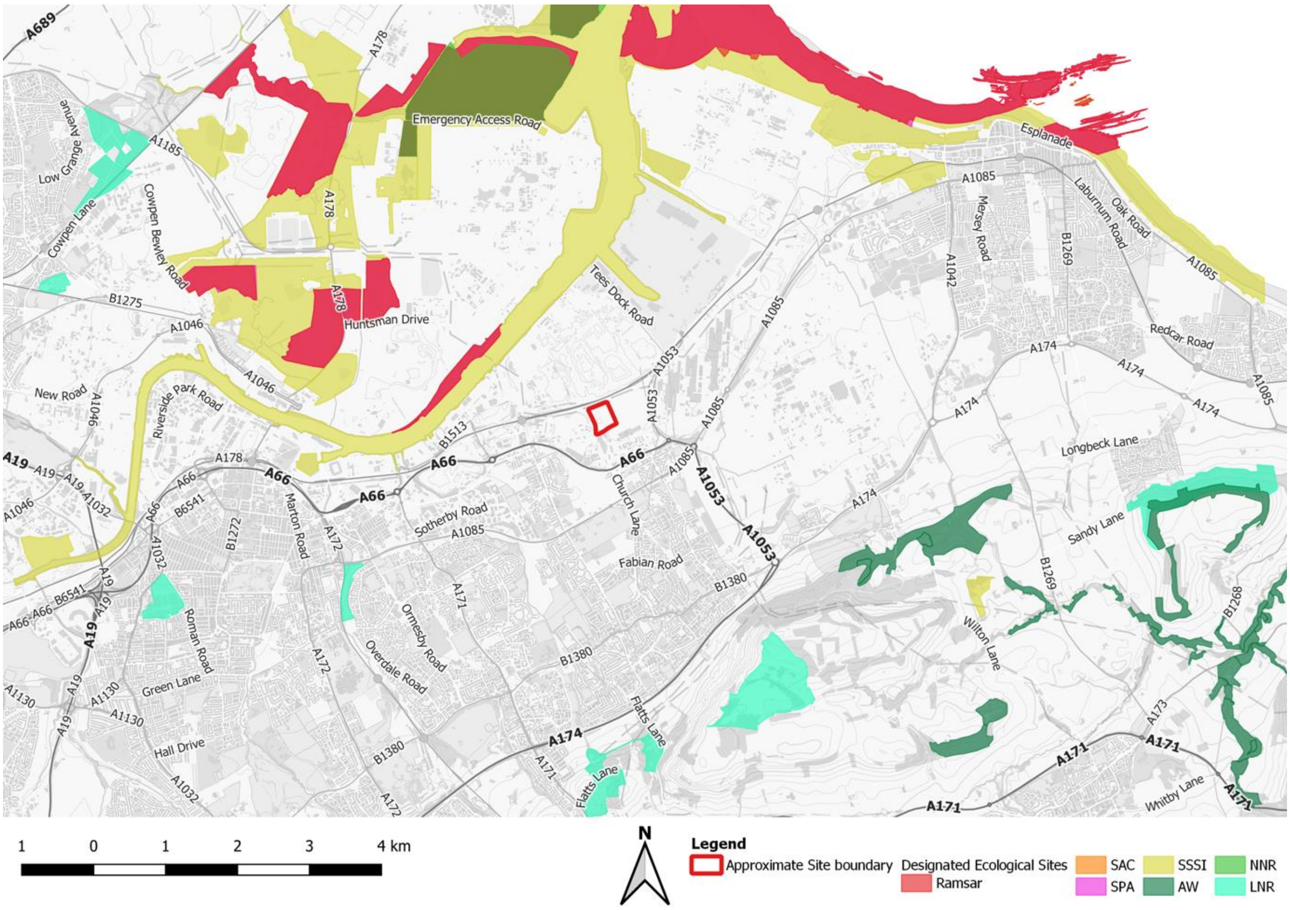

Figure 2:Site Location and Designated Ecological Sites

1.3.2 Scoped out of the assessment

An abnormal operations assessment is typically required for a planning application, however, as this is an outline application, there is not sufficient detail regarding the site to produce an abnormal operations assessment. An assessment will need to be completed as part of the detailed planning application.

The Proposed Facility will include additional points sources, such as generators, which will operate when the facility is down for maintenance and also for testing purposes. Details regarding any additional point sources are not currently available. Emissions from such generators or other point sources have the potential to effect local air quality and will require an assessment during the detailed planning application when information will be available.

The Proposed Facility has the potential to be a source of odour emissions, should there be sensitive receptors within the local area there may be an impact. At this stage the specific details regarding the on-site sources are unknown and the effect of odour emissions would need to considered during the detail planning application.

The potential for plume visibility has not been considered in this stage.

Details on the construction traffic flows are unknown at this stage as the application is for outline planning permission. As part of the detailed application construction traffic related impacts will need to be considered.

2. Legislation, Policy and Guidance

This section sets out the planning policy which is a material consideration in determining planning applications, legislation, guidance documents and other sources of useful information.

2.1 Planning Policy

2.1.1 National Planning Policy Framework

The National Planning Policy Framework (NPPF) 2019 sets out planning policy for England. It includes advice on when air quality should be a material consideration in development control decisions. Relevant sections are set out below:

Paragraph 170:"Planning policies and decisions should contribute to and enhance the natural and local environment by: preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality"

Paragraph 180: "Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development".

Paragraph 181: "Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan."

Paragraph 183: "The focus of planning policies and decisions should be on whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a particular development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities."

Paragraph 54: "Local planning authorities should consider whether otherwise unacceptable development could be made acceptable through the use of conditions or planning obligations. Planning obligations should only be used where it is not possible to address unacceptable impacts through a planning condition."

The NPPF is supported by Planning Practice Guidance (PPG). The PPG published in November 2019 states:

Paragraph: 001 Reference ID: 32-001-20191101: "The Department for Environment, Food and Rural Affairs carries out an annual national assessment of air quality using modelling and monitoring to determine compliance with Limit Values. It is important that the potential impact of new development on air quality is taken into account in planning where the national assessment indicates that relevant limits have been exceeded or are near the limit, or where the need for emissions reductions has been identified."

Paragraph: 002 Reference ID: 32-002-20191101: "It is important to take into account air quality management areas, Clean Air Zones and other areas including sensitive habitats or designated sites of importance for biodiversity where there could be specific requirements or limitations on new development because of air quality".

Paragraph: 005 Reference ID: 32-005-20191101: "Whether air quality is relevant to a planning decision will depend on the proposed development and its location. Concerns could arise if the development is likely to have an adverse effect on air quality in areas where it is already known to be poor, particularly if it could affect the implementation of air quality strategies and action plans and/or breach legal obligations (including those relating to the conservation of habitats and species). Air quality may also be a material consideration if the proposed development would be particularly sensitive to poor air quality in its vicinity.

Where air quality is a relevant consideration the local planning authority may need to establish:

- the 'baseline' local air quality, including what would happen to air quality in the absence of the development;
- whether the proposed development could significantly change air quality during the construction and operational phases (and the consequences of this for public health and biodiversity); and
- whether occupiers or users of the development could experience poor living conditions or health due to poor air quality".

Paragraph: 007 Reference ID: 32-007-20191101: "Assessments need to be proportionate to the nature and scale of development proposed and the potential impacts (taking into account existing air quality conditions), and because of this are likely to be locationally specific".

Paragraph: 008 Reference ID: 32-008-20191101: "Mitigation options will need to be locationally specific, will depend on the proposed development and need to be proportionate to the likely impact. It is important that local planning authorities work with applicants to consider appropriate mitigation so as to ensure new development is appropriate for its location and unacceptable risks are prevented".

2.1.2 Local Planning Policy

The Redcar & Cleveland Local Plan[1] was adopted in May 2018 and sets out the vision and overall development strategy for the Council's area and how it will be achieved for the period until 2032.

The Redcar & Cleveland development plan consists of the Redcar & Cleveland Local Plan and the Tees Valley Joint Minerals and Waste Development Plan Documents. The Local Plan includes two policies which refer to pollution, including air pollution:

"Policy SD 4 - General Development Principles:
… n. minimise pollution including light and noise and vibration levels to meet or exceed acceptable limits"

"Policy LS 4 - South Tees Spatial Strategy:
… l. encourage clean and more efficient industry in the South Tees area to help reduce carbon dioxide emissions and risk of environmental pollution"

In addition to the local plan the Council have published a number of Supplementary Planning Documents and one of the Objectives of the South Tees Supplementary Planning Document[2] is:

"8. Deliver redevelopment in a way that provides long term sustainability, reduces pollution, manages the water environment, protects the historic environment, contributes to habitat protection, safeguards biodiversity and enhances green infrastructure, open space and landscape character."

The development principle STDC1: Regeneration Priorities states:

"To reduce pollution, contribute to sustainable flood risk management and habitat protection and encourage biodiversity and long term sustainability;"

2.2 Air Quality Legislation

2.2.1 Air Quality Strategy and Local Air Quality Management

The Environment Act 1995 (Part IV) requires the Secretary of State to publish an air quality strategy and local authorities to review and assess the quality of air within their boundaries. The latter has become known as Local Air Quality Management (LAQM).

The Air Quality Strategy provides the policy framework for local air quality management and assessment in the UK. It sets out air quality standards and objectives for key air pollutants. These standards and objectives are designed to protect human health and the environment. The Strategy also sets out how the different sectors of industry, transport and local government, can contribute to achieving these air quality objectives (AQOs).

Local authorities are seen to play a particularly important role in the air quality management process and the technical guidance document, LAQM.TG16[3], produced by Defra, provides advice that local authorities should follow.

Local authorities are required to identify whether the AQOs have been, or will be, achieved at relevant locations, by the applicable date. If the AQOs are not achieved, the authority must declare an Air Quality Management Area (AQMA) and should prepare an action plan within 12 months. An action plan must identify appropriate measures and policies that can be introduced in order to work towards achieving the objective(s).

The AQOs set out the extent to which the Government expects the standards to be achieved by a certain date. They take account of economic efficiency, practicability, technical feasibility and timescale. The objectives for use by local authorities are prescribed within the Air Quality (England) Regulations 2000[4], and the Air Quality (England) (Amendment) Regulations 2002[5].

2.2.2 EU limit values

The European Union has also set limit values for certain pollutants; these are legally binding and have been implemented into English legislation through The Air Quality Standards (Amendment) Regulations 2016[6].

2.2.3 The Industrial Emissions Directive (IED)

The Industrial Emissions Directive (IED, 2010/75/EU), a European Union Directive, consolidated seven existing directives including the Waste Incineration Directive (WID) into a single directive. Chapter IV of the IED applies to incineration and co-incineration plants (which accept waste and other fuels such as biomass) which thermally treat waste as defined in the Waste Framework Directive. The IED defines requirements for facilities classified as waste incinerators under the IED definition. The IED also defines emission limit values (ELVs) for emissions to air.

2.2.4 Protection of Nature Conservation Sites

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

The Conservation of Habitats and Species Regulations 2017 (as amended)[7] (known as the 'Habitats Regulations') transposes the Habitats Directive, a European Directive, into UK legislation. The Habitats Regulations require that a development proposal will not cause a likely significant effect or, where likely significant effects cannot be discounted, no adverse effect on the integrity of European sites. It requires an assessment to determine if significant effects (alone or in combination) are likely, followed by an 'appropriate assessment' by the competent authority, if necessary. More information regarding the Habitats Directive are set out in Appendix 1.

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

Locally important sites (such as National Nature Reserves (NNR), Local Nature Reserves (LNR), Local Wildlife Sites (LWS) or Sites of Importance for Nature Conservation (SINCs) and Ancient Woodland (AW)) are also protected by legislation to ensure that developments do not cause significant pollution.

2.2.5 Environmental Permitting

The Environmental Permitting (England and Wales) Regulations[8] (EPR) transpose the IED in UK legislation. The EPR are designed to ensure the competent authority regulates emissions, including emissions to air, from processes to minimise adverse impacts. The latest amendment was in 2018. In England, under the EPR the regulator is the Environment Agency (EA).

As part of a permit application, the operator must demonstrate that the facility is operating with regards to Best Available Techniques (BAT). The EU has produced a number of BAT Reference (BREF) documents which set out the techniques. In November 2019 the EU released a new BREF on Waste Incineration. The document includes BAT-Associated Emission Levels (BAT-AEL) that are more stringent than the IED ELV.

2.2.6 Local Air Quality Management

Redcar and Cleveland Council has a statutory duty to carry out a periodic review and assessment of air quality, reporting their findings in an Annual Status Report (ASR)[9].

The conclusions from the ASR have consistently shown good air quality in areas where members of the public are regularly exposed to air pollution. Results are below the AQOs. There is no requirement to declare an Air Quality Management Area (AQMA), however the local authority has made a commitment to improving air quality to protect public health.

In early 2019 Middlesbrough Borough Council commenced work on developing the South Tees Clean Air Strategy[10] with partners including Redcar and Cleveland Borough Council. The partnership will ensure air quality considerations are built into planning, transport and wider strategies, the procurement of council fleet vehicles, and corporate policies.

2.3 Useful Sources of Information

Summaries of relevant documents and useful information have been presented in Appendix 1. The documents cover the following:

- Planning Practice Guidance;
- The Clean Air Strategy;
- The National Air Quality Action Plans.

2.4 Guidance Documents

2.4.1 Guidance on the Assessment of Dust from Demolition and Construction[11]

The Institute of Air Quality Management (IAQM) produced guidance on the assessment of dust from demolition and construction. This document provides a risk-based methodology for assessing construction impacts, including demolition and earthworks where appropriate.

2.4.2 Guidance on the Assessment of Operational Impact of New Developments[12]

Guidance produced by Environmental Protection UK (EPUK) and the IAQM in January 2017 entitled 'Land-Use Planning & Development Control: Planning for Air Quality', aims to ensure that air quality is properly accounted for in the development control process. The main foci of the guidance are the assessment of the impact of traffic and combustion plant emissions and advice on how to describe air quality impacts and their significance.

2.4.3 A guide to the assessment of air quality impacts on designated nature conservation sites[13]

The Institute of Air Quality Management (IAQM) have produced guidance to assist in the assessment of the air quality impacts of development on designated nature conservation sites. The guidance focuses on air quality assessments in support of Habitats Regulations Assessments (HRA), but also considers the approach for assessing the air quality impact on national or local designated nature conservation sites.

2.4.4 Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations[14]

A Guidance Note produced by Natural England provides advice to competent authorities and others on the assessment of impacts from road traffic emissions associated with plans and projects (as required by the Conservation of Habitats and Species Regulations 2017 ('the Habitats Regulations') upon internationally designated ecological habitat sites.

2.4.5 Environment Agency Guidance: Air emissions risk assessment for your environmental permit

The Environment Agency provides guidance on assessing the impacts of emissions released air from permitted sites. The guidance provides a methodology along with assessment thresholds for pollutants.

2.5 Relevant exposure

2.5.1 AQO Receptors

2.5.1.1 Human Health

The annual mean AQOs apply at locations where members of the public might be regularly exposed, such as building façades of residential properties, schools, hospitals and care homes.

Places of work, such as factories or offices, are not considered places where members of the public might be regularly exposed and therefore the AQO's do not apply at these locations.

The 8-hour and 24-hour mean AQOs apply at locations where the annual mean AQOs apply and at hotels and gardens of residential properties.

The 15-minute and 1-hour mean AQOs apply at the annual mean locations of exposure and at hotels, residential gardens and any outdoor location where members of the public might reasonably be expected to spend one hour or longer, such as busy pavements, outdoor bus stations and locations with outdoor seating.

2.5.1.2 Ecological

Nationally (SSSIs, Areas of Special Scientific Interest (ASSIs), National Nature Reserves (NNRs)) and internationally (SAC, SPAs and Ramsar Sites) designated ecological sites are considered relevant receptors for the NOx annual mean critical level, 24-hour mean proxy critical level and annual mean critical loads. Locally designated sites (LNRs, LWSs, SINCs and areas of AW) are also considered sensitive receptors, however, they are less sensitive to changes and less weight is attributed to these sites. The IAQM guidance[13] explains that:

"Under the Directive, assessment of compliance with the critical levels is strictly only required at locations more than 20 km from towns with more than 250,000 inhabitants or more than 5 km from other built-up areas, industrial installations or motorways. In practice, however, assessment against critical levels for vegetation is frequently undertaken to inform planning and permitting processes across the country, regardless of this definition."

2.5.2 Limit Value Receptors

In accordance with Article 2(1), Annex III, Part A, paragraph 2 of the Ambient Air Quality Directive (2008/50/EC) details locations where compliance with the limit values does not need to be assessed:

"Compliance with the limit values directed at the protection of human health shall not be assessed at the following locations:

a) Any locations situated within areas where members of the public do not have access and there is no fixed habitation;

b) In accordance with Article 2(1), on factory premises or at industrial installations to which all relevant provisions concerning health and safety at work apply; and

c) On the carriageway of roads; and on the central reservation of roads except where there is normally pedestrian access to the central reservation."

The government models compliance with the Directive at locations 4 m from the kerbside, 2 m high, more than 25 m from major road junctions and adjacent to at least 100 m of road length where the limit value applies.

3. Assessment Methodology

3.1 Consultation

A scoping letter was submitted to Redcar and Cleveland Borough Council regarding the Proposed Facility. The response letter dated 10th December 2019 included consultation responses from a number of parties. Those related to air quality are reproduced below.

The Environment Agency stated:

"The proposed stack height is stated as being between 70m to 80m. However, the stack heights could be higher. This is dependent on the outcomes of air quality and/or habitats assessments. It is noted that a similar type plant in the North Tees area has a stack height of 111m."

The officer from the Environmental Protection (Contaminated Land) and (Nuisance) team at the Council stated:

"I have no objections to the above proposal provided that an appropriate assessment is carried out".

The officer has also provided further correspondence regarding this application, the correspondence is set out in Appendix 2.

3.2 Existing Air Quality in the Study Area

A baseline air quality review was undertaken to determine the existing air quality in the vicinity of the site. This desk-top study was undertaken using the following sources:

- Aerial photography from Google Maps;
- Air quality data for Redcar and Cleveland local authority and Middlesbrough local authority, consisting of a review of the air quality reports and local monitoring data;
- Air quality data for the UK, consisting of a review of monitoring carried out by Defra[15];
- The UK Pollutant Release and Transfer Register[16];
- European Pollutant Release and Transfer Register;
- Background pollution maps from Defra's Local Air Quality Management (LAQM) website[17];
- Maps of roadside concentrations published by Defra[18] which provide predicted roadside NO_2 concentrations of as part of the 2017 National Air Quality Plan for the baseline year 2015 and for the future years 2017 to 2030. The national maps of roadside PM_{10} and $PM_{2.5}$ concentrations, which are available for the years 2009 to 2015, show no exceedences of the limit values anywhere in the UK in 2015. These maps are used by the UK Government, to report exceedences of the limit value to the EU; and
- Middlesbrough Borough Council Clean Air Zone Modelling studies[19].

3.3 Construction Phase Impacts

3.3.1 Construction Dust

Fugitive dust emissions during the construction may give rise to increased PM_{10} concentrations and dust deposition, albeit this is a temporary impact. These impacts have been assessed using the IAQM methodology[11] (see Appendix 2) to identify appropriate mitigation measures commensurate with the risk.

Activities on the proposed construction site have been divided into three types to reflect their different potential impacts. As the current site is undeveloped there will be no demolition required. The activities for assessment are:

- Earthworks;
- Construction; and
- Trackout

The risk of dust emissions was assessed for each activity with respect to:

- Potential loss of amenity due to dust soiling; and
- The risk of health effects due to a significant increase in exposure to PM_{10}.

A desk-based review using online resources of habitats and ecologically designated sites has been undertaken. No relevant ecological receptors within 50m of the Proposed Facility or roads where dust may be tracked out have been identified.

First, the potential dust emission magnitude was defined based on the scale of the anticipated works and was classified as Small, Medium or Large. Then the sensitivity of the area was defined based on the receptor sensitivity, number of receptors, and the distance from the source.

Receptors were identified within distance bands from the site boundary using aerial imagery and maps of the surrounding area (see Figure 3 and Figure 4). Baseline PM_{10} concentrations were also taken into account. The area was then defined as High, Medium or Low sensitivity.

The potential dust emission magnitude and the sensitivity of the area were combined to define the risk of impacts.

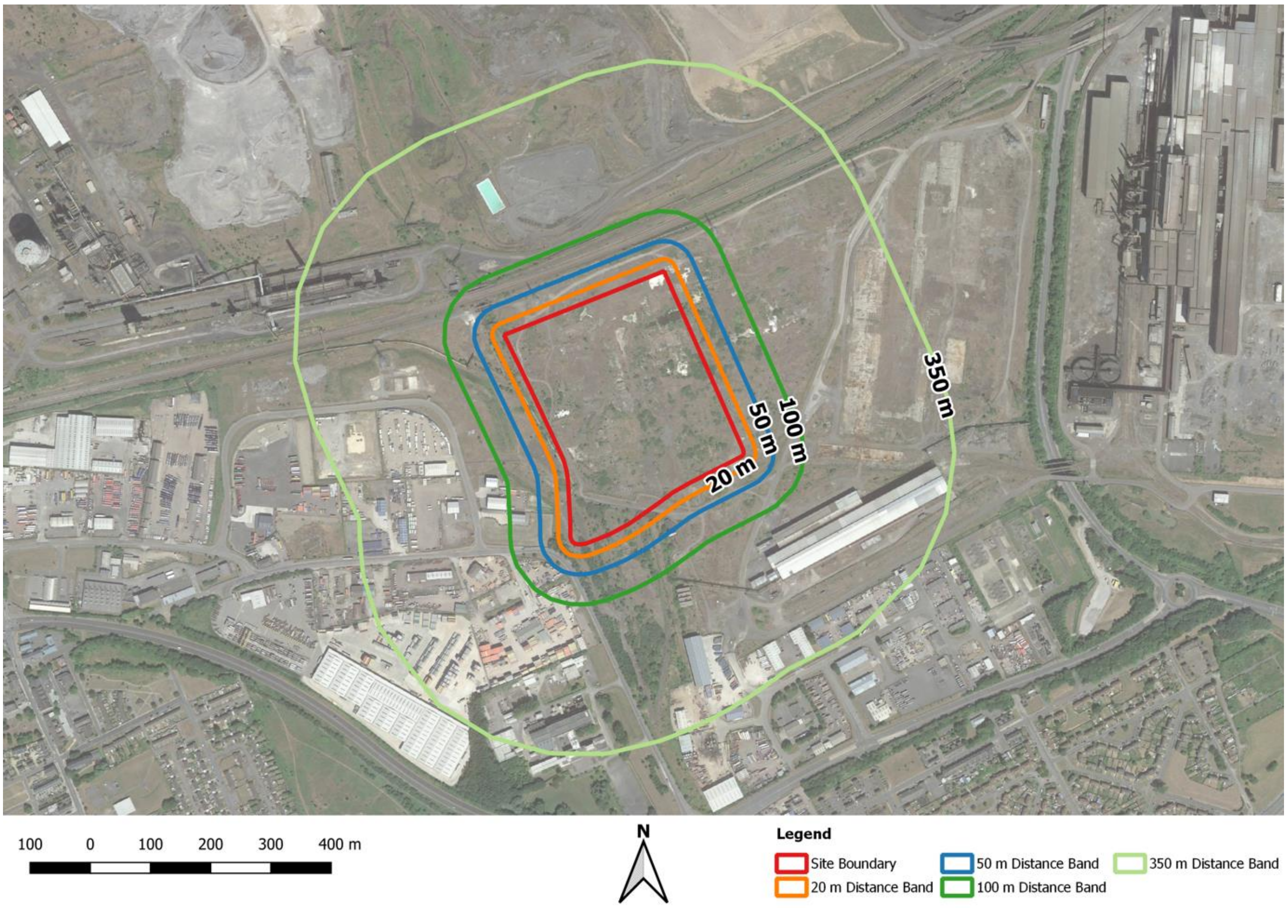

Figure 3: Construction Dust Distance Bands and Site Location

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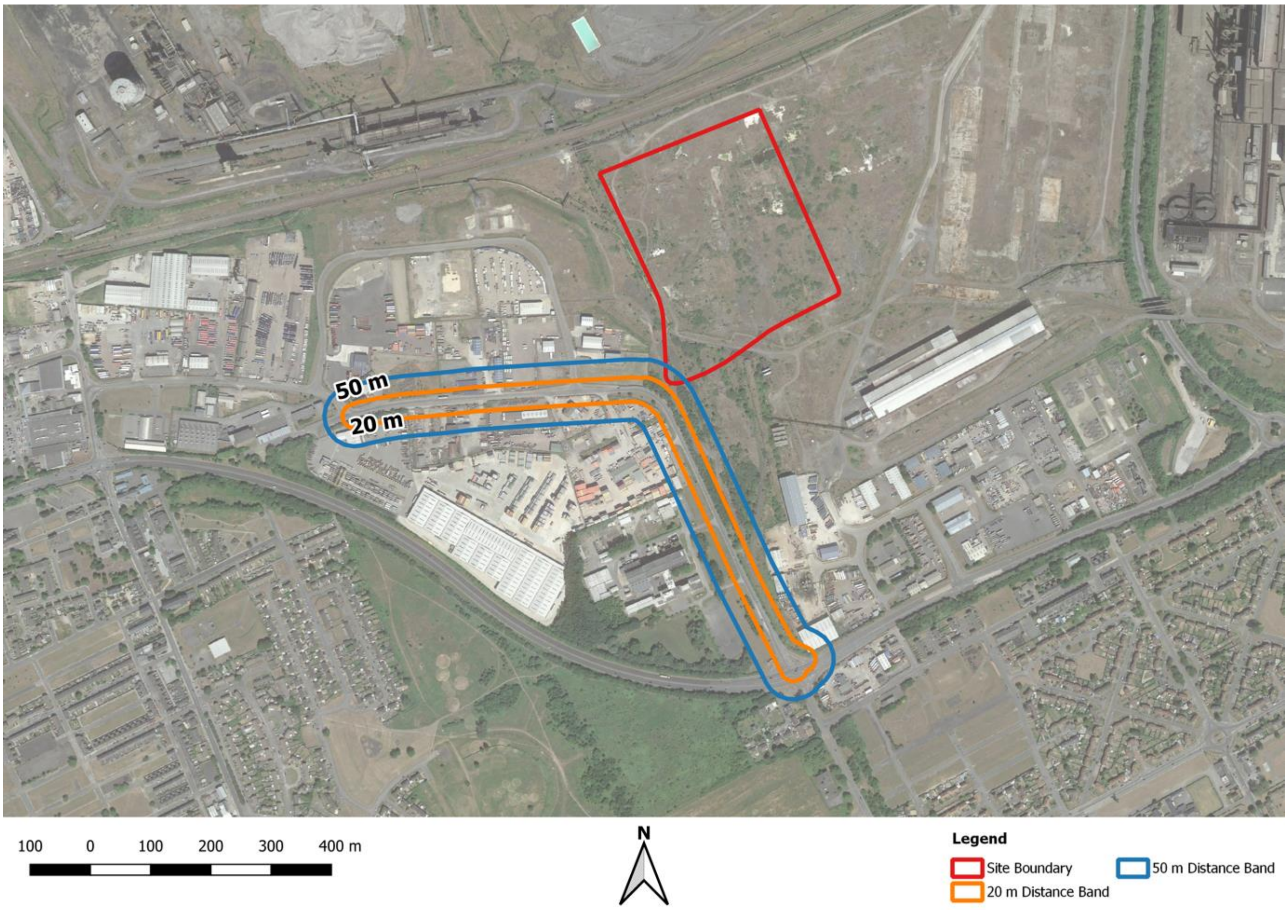

Figure 4: Trackout Distance Bands and Site Location

Imagery ©2020 Google. Map data ©2020.

3.3.2 Construction Dust Significance

The IAQM guidance[11] on the assessment of dust from demolition and construction states that the primary aim of the risk assessment is to identify site specific mitigation that, once implemented, should ensure that there will be no significant effect. Therefore, the assessment has been used to determine an appropriate level of mitigation for the construction phase.

The determination of which mitigation measures are recommended include elements of professional judgement and the professional experience of the consultants preparing this report is set out in Appendix 4.

3.4 Operational Phase Impacts

This section details the methodology for the assessment of operational impacts. The process consists of:

1. Defining baseline conditions.
2. Considering the impact of the emissions from the Proposed Facility using dispersion modelling.
3. Evaluating the significance of any impacts in relation to:
    a. the human health AQO receptors, using the EPUK & IAQM[12] and Environment Agency guidance[20], and the limit value compliance receptors; and
    b. the ecological receptors, using the IAQM guidance[13] and identifying where the significance of effects need to be assessed by an ecologist.

3.4.1 Criteria for this Assessment - Air Quality Assessment Levels (AQAL)

3.4.1.1 Air Quality Objectives, Limit Values, and Critical Levels

Air quality assessment levels (AQALs) have been derived from the AQOs set out in the Air Quality Regulations, the limit values and target values set out in the Air Quality Standards Regulations and the Environmental Assessment Levels (EALs) set out by the Environment Agency. The AQAL used within this assessment are set out in Table 3.

Where there is no EAL quoted in Environment Agency guidance, one has been derived from the Health and Safety Executive's workplace exposure limits[21]. This applies to the short-term EAL for chromium(VI), and the short- and long-term EALs for thallium and cobalt.

Table 3: Air Quality Assessment Levels

Pollutant	Time Period	Source of AQAL [a]	Concentration, and the number of exceedences allowed per year (if any)	Date AQO / Limit Value to be Achieved From and Maintained After
Human-Health				
NO_2	1-hour Mean	AQO / Limit Value	200 µg/m^3 not to be exceeded more than 18 times a year	31st December 2005 / 1st January 2010
	Annual Mean	AQO / Limit Value	40 µg/m^3	31st December 2005 / 1st January 2010
PM_{10}	24-hour Mean	AQO / Limit Value	50 µg/m^3 not to be exceeded more than 35 times a year	31st December 2004 / 1st January 2005
	Annual Mean	AQO / Limit Value	40 µg/m^3	31st December 2004 / 1st January 2005
$PM_{2.5}$	Annual Mean	AQO / Target Value	25 µg/m^3	2020 / 2010
SO_2	15-minute Mean	AQO	266 µg/m^3 not to be exceeded more than 35 times a year	31st December 2005
	1-hour Mean	AQO / Limit Value	350 µg/m^3 not to be exceeded more than 24 times a year	31st December 2004 / 1st January 2005
	24-hour Mean	AQO / Limit Value	125 µg/m^3 not to be exceeded more than 3 times a year	31st December 2004 / 1st January 2005
CO	Maximum daily 8-hour mean	AQO / Limit Value	10 mg/m^3	31st December 2003 / 1st January 2005
Benzene [b]	Annual Mean	AQO / Limit Value	5 µg/m^3	31st December 2010 / 1st January 2010
	Running Annual Mean	AQO	16.25 µg/m^3	31st December 2003
1,3-butadiene [b]	Annual Mean	AQO	2.25 µg/m^3	31st December 2003

Pollutant	Time Period	Source of AQAL [a]	Concentration, and the number of exceedences allowed per year (if any)	Date AQO / Limit Value to be Achieved From and Maintained After
Dimethyl sulphate [c]	Annual Mean	AQO	2.25 µg/m^3	31st December 2003
Hydrogen Fluoride (HF)	1-hour Mean	EA EAL	160 µg/m^3	-
	Annual Mean	EA EAL	16 µg/m^3	-
Hydrochloric acid (HCl)	1-hour Mean	EA EAL	750 µg/m^3	-
	Annual Mean	EA EAL	20 µg/m^3 [a]	-
Ammonia	Annual Mean	EA EAL	180 µg/m^3	-
	1-hour Mean	EA EAL	2500 µg/m^3	-
Benzo(a)pyrene [c]	Annual Mean	AQO / Target Value	0.25 ng/m^3 B(a)P / 1 ng/m^3 B(a)P	31st December 2010 / 31st December 2012
Dioxins and -furans (PCCD/F) [d]	Annual Mean	WHO	0.3 pg/m^3	-
Polychlorinated biphenyls (PCBs)	1-hour Mean	EA EAL	6 µg/m^3	-
Antimony	1-hour Mean	EA EAL	150 µg/m^3	-
	Annual Mean	EA EAL	5 µg/m^3	-
Arsenic	Annual Mean	Target Value / EA EAL	0.006 µg/m^3/ 0.003 µg/m^3	31st December 2012 / -
Cadmium	Annual Mean	Target Value / EA EAL	0.005 µg/m^3	31st December 2012
Chromium(III)	1-hour Mean	EA EAL	150 µg/m^3	-
	Annual Mean	EA EAL	5 µg/m^3	-
Chromium(VI)	1-hour Mean	EA EAL [e]	15 µg/m^3	-
	Annual Mean	EA EAL	0.0002 µg/m^3	-
Cobalt	1-hour Mean	EA EAL [e]	30 µg/m^3	-
	Annual Mean	EA EAL [e]	1 µg/m^3	-
Copper	1-hour Mean	EA EAL	200 µg/m^3	-
	Annual Mean	EA EAL	10 µg/m^3	-
Lead	Annual Mean	AQO / Limit Value	0.25 µg/m^3/ 0.5 µg/m^3	31st December 2008 / 1st January 2005
Manganese	1-hour Mean	EA EAL	1500 µg/m^3	-
	Annual Mean	EA EAL	0.15 µg/m^3	-
Mercury	1-hour Mean	EA EAL	7.5 µg/m^3	-
	Annual Mean	EA EAL	0.25 µg/m^3	-
Nickel	Annual Mean	Target Value	0.02 µg/m^3	31st December 2012

Pollutant	Time Period	Source of AQAL [a]	Concentration, and the number of exceedences allowed per year (if any)	Date AQO / Limit Value to be Achieved From and Maintained After
Thallium	1-hour Mean	EA EAL [e]	30 µg/m^3	-
	Annual Mean	EA EAL [e]	1 µg/m^3	-
Vanadium	1-hour Mean	EA EAL	5 µg/m^3	-
	Annual Mean	EA EAL	1 µg/m^3	-
	Annual Mean	EA EAL	0.2 µg/m^3	-
Ecological				
NOx	24-hour Mean	EA EAL / Proxy Critical level [f]	75 / 200 [g] µg/m^3	-
	Annual Mean	AQO / Critical Level	30 µg/m^3	31st December 2000 / 19th July 2001
SO_2	Winter Mean	AQO / Critical Level	20 µg/m^3	31st December 2000 / 19th July 2001
	Annual Mean	AQO / Critical Level	20 µg/m^3	31st December 2000 / 19th July 2001
	Annual Mean	EA EAL	10 µg/m^3 where lichens or bryophytes are present	-
O_3	5-year Mean	AQO / Target Level	18,000 µg/m^3 as an average of 1-hour Means between May-July	1st January 2010 / 1st January 2010
NH_3	Annual Mean	EA EAL	1 µg/m^3 where lichens or bryophytes (including mosses, landworts and hornwarts) are present 3 µg/m^3 where they're not present	-
Hydrogen Fluoride (HF)	Weekly Mean	EA EAL	0.5 µg/m^3	-

[a] Air Quality Objectives (AQOs) from the Air Quality Regulations; limit values, target values and critical levels from the Air Quality Standards Regulations; and EA EALs from the Environmental Agency Air emissions risk assessment for your environmental permit guidance.

[b] Emissions of TOCs are assessed against the EALs for benzene, 1,3-butadiene and dimethyl sulphate, since these are the most stringent EALs for any VOCs.

[c] 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. There are no assessment criteria for dioxins and furans. The World Health Organisation (WHO) provides an indicator of the air concentrations above which it considers it necessary to identify and control local emission sources; this value is 0.3 pg/m^3 (300 fg/m^3). In the absence of suitable criteria, the WHO indicator concentration for which it is considered necessary to identify and control emission sources has been used.

[d] 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). For the purpose of this assessment, Emissions of PAH have been assessed against the AQAL set for benzo(a)pyrene as this is the only PAH which an AQAL has been set.

[e] Long- and short-term EALs for thallium and cobalt, the long-term EAL for HCl and the short-term EAL for chromium(VI) has been calculated from the exposure limits in EH40/2005, and converted to the respective EAL.

[f] While there is not a short-term critical level in the Air Quality Regulations, research has demonstrated exposure to very high concentrations of NOx for short periods (hours/days) may also have an adverse effect under certain conditions even if the long-term concentrations are below the limit value.

[g] The IAQM guidance[13] explains that a critical level for short-term NOx has been defined by the World Health Organization and is dependent on the O_3 and SO_2 concentrations. The WHO, explain that: "Experimental evidence exists that the CLE [critical level] decreases from around 200 $\mu g/m^3$ to 75 $\mu g/m^3$ when in combination with O_3 or SO_2 at or above their critical levels. In the knowledge that short-term episodes of elevated NOx concentrations are generally combined with elevated concentrations of O_3 or SO_2, 75 $\mu g/m^3$ is proposed for the 24 h mean". Based on this, where O_3 and SO_2 are not elevated above their critical levels, a value of 200 $\mu g/m^3$ is recommended for assessments.

3.4.1.2 Critical Loads for this Assessment

Habitats are sensitive to deposition resulting in eutrophication and acidification. Deposition occurs both in the form of dry deposition and wet deposition.

Critical loads are defined as:

" a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge"[22]

While critical levels are:

"concentrations of pollutants in the atmosphere above which direct adverse effects on receptors, such as human beings, plants, ecosystems or materials, may occur according to present knowledge". [22]

The critical loads used to assess the impact of compounds deposited to land which result in eutrophication and acidification are expressed in terms of kilograms of the relevant pollutant deposited per hectare per year (for example for nitrogen the unit is kg N/ha/yr) and kilo-equivalents H^+ ions deposited per hectare per year (keq/ha/yr). The unit of 'equivalent' (eq) is used, rather than a unit of mass, for the purposes of assessing acidification from multiple species. The unit eq. (1 keq ≡ 1,000 eq) refers to molar equivalent of potential acidity resulting from e.g. sulphur, oxidised and reduced N, as well as base cations. Essentially, it is a measure of how acidifying a particular chemical species can be.

Critical loads are set by the United Nations Economic Commission for Europe (UNECE) Convention on Long-Range Transboundary Air Pollution. Natural England site-specific critical loads for SPA, SAC and SSSI sites in England are established from The Working Group on Effects of the UNECE Convention on Long Range Transboundary Air Pollution. The information is available via the Air Pollution Information Service (APIS)[22] which contains information on applicable critical loads for various habitats and species.

Where the sites of interest for an assessment are locally designated sites (LNR and AW), there are no site-specific critical loads. However, the APIS website does provide habitat-specific critical loads for use in impact assessment. The main habitats for locally designated sites are taken from the 'MAGIC' website[23] managed by Natural England on behalf of the MAGIC partnership organisations.

The critical loads used in this assessment are presented in Table 4 and Table 5. These include a range for each site. The lower end of the range have been used for a conservative assessment.

Table 4: Nitrogen Nutrient Critical Loads

Area	Habitat / Ecosystem	N Critical Load (CL) range (kg N/ha/yr)
Teesmouth and Cleveland Coast Ramsar/SPA/SSSI	Shifting coastal dunes	10-20
	Coastal stable dune grasslands - acid type	8-10
	Coastal stable dune grasslands - calcareous type	10-15
	Pioneer, low-mid, mid-upper saltmarshes	20-30

Table 5: Acidity Critical Loads

Area	Habitat / Ecosystem	Acidity $CL_{min}N$-$CL_{max}N$ (keq /ha/yr) [a]	Acidity $CL_{max}S$ (keq /ha/yr)
Teesmouth and Cleveland Coast Ramsar/SPA/SSSI	Acid grassland	MinCLminN: 0.223 | MaxCLminN: 0.438 MinCLMaxN: 1.998 | MaxCLMaxN: 4.508	MinCLMaxS: 1.56 | MaxCLMaxS: 4.07
	Calcareous grassland	MinCLminN: 0.856 | MaxCLminN: 1.071 MinCLMaxN: 4.856 | MaxCLMaxN: 5.071	CLmaxS: 4

[a] APIS advises that where the total acid nitrogen deposition is greater than the N_{min}, the sum of acid nitrogen, sulphur and hydrochloric (and other contributors like hydrofluoric) acid deposition should be compared against the N_{max} value.

3.4.2 Assessment Approach

3.4.2.1 Human Health

Standard practice is to assess the impacts of a Proposed Facility on local air quality using the EPUK and IAQM guidance on Land-Use Planning & Development Control: Planning For Air Quality[12]. This approach has been used in this assessment.

The EPUK and IAQM guidance provides a staged approach to considering air quality assessments, including screening and the need for detailed assessments. The approach includes elements of professional judgement, and the experience of the consultants preparing this report is set out in Appendix 4.

The guidance provides example criteria and states the following in relation to the criteria:

"They are intended to function as a sensitive "trigger" for initiating an assessment in cases where there is a possibility of significant effects arising on local air quality. This possibility will, self-evidently, not be realised in many cases. The criteria should not be applied rigidly; in some instances, it may be appropriate to amend them on the basis of professional judgement, bearing in mind that the objective is to identify situations where there is a possibility of a significant effect on local air quality".

The second stage has screening criteria for assessment of the proposed centralised combustion plant (i.e. NOx emission rate, exhaust conditions and relevant locations of sensitive receptors). Where these criteria are exceeded, a detailed assessment is required, although the guidance advises that "the criteria provided are precautionary and should be treated as indicative", and "it may be appropriate to amend them on the basis of professional judgement".

Where an air quality assessment is identified as being required, then this may take the form of either a Simple Assessment or a Detailed Assessment. It is not uncommon for assessments to utilise detailed dispersion models to predict pollutant concentrations and impacts on local air quality (Detailed Assessment), however, it should be noted that exceeding a screening criterion in Table 6.2 of the guidance does not automatically lead to the requirement for a Detailed Assessment and the use of professional judgement and sufficient evidence can be considered appropriate at times (i.e. the use of a Simple Assessment).

The guidance also outlines the content of the air quality assessment, and this has been adhered to in the production of this report.

Long-term (Annual Mean) Impacts on Human Health

The approach set out in the guidance provides a method for describing the impacts on local air quality arising from development. Impact descriptors for individual receptors are used which expresses the magnitude of incremental change as a proportion of a relevant assessment level and then examining this change in the context of the new total concentration and its relationship with the assessment criterion. Table 6 sets out the matrix for determining the impact descriptor for annual mean concentrations at individual receptors, based on Table 6.3 in the guidance document.

Where the impacts are negligible the overall significance is judged to be 'not significant'.

Table 6: EPUK / IAQM impact descriptors for individual receptors

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% of more of AQAL	Moderate	Substantial	Substantial	Substantial

Short-term (24-hour, 8-hour, 1 hour and 15-minute mean) Impacts on Human Health

Environment Agency guidance[20], and that published by EPUK and IAQM[12], both recommend a screening criterion whereby short-term impacts can be considered insignificant if the process contribution at locations of relevant exposure is less than 10% of the objective level. Where this criterion is exceeded, it is necessary to consider total concentrations.

Where the short-term AQAL considers the number of periods exceeding a standard rather than a single concentration not to be exceeded, it is not possible to usefully assign a magnitude of change. In these cases, the impacts have been considered in relation to the relevant assessment percentile concentration for the pollutant and objective. For example, the 1-hour AQAL and limit value for NO_2 allow 18 hours a year to exceed 200 µg/m^3, which is represented by the 99.79th percentile of hourly concentrations. The assessment percentiles are set out in Table 7.

Table 7: Assessment Percentiles

Pollutant	Time Period	Concentration, and the number of exceedences allowed per year (if any)	Assessment percentile
NO_2	1-hour Mean	200 µg/m^3 not to be exceeded more than 18 times a year	99.79th
PM_{10}	24-hour Mean	50 µg/m^3 not to be exceeded more than 35 times a year	90.41st
SO_2	15-minute Mean	266 µg/m^3 not to be exceeded more than 35 times a year	99.24th

Pollutant	Time Period	Concentration, and the number of exceedences allowed per year (if any)	Assessment percentile
	1-hour Mean	350 µg/m^3 not to be exceeded more than 24 times a year	99.73rd
	24-hour Mean	125 µg/m^3 not to be exceeded more than 3 times a year	99.18th
O_3	8-hour Mean	100 µg/m^3 not to be exceeded more than 10 times a year / 125 µg/m^3 not to be exceeded more than 25 times a year averaged over 3 years	99.89th / 99.71st

Significance

The approach developed by EPUK and IAQM[12] has been used for assessing the significance of the predicted impacts. The guidance states that the assessment of significance should be based on professional judgement, with the overall air quality impact of the Proposed Facility described as either '*significant'* or *'not significant'*.

Where a Simple or Detailed assessment is carried out (as is the case here), in determining the significance, the following factors should be taken into account:

- the existing and future air quality in the absence of the Proposed Facility;
- the extent of current and future population exposure to the impacts;
- the influence and validity of any assumptions adopted when undertaking the prediction of impacts;
- the potential for cumulative impacts. In such circumstances, several impacts that are described as "slight" individually could, taken together, be regarded as having a significant effect for the purposes of air quality management in an area, especially where it is proving difficult to reduce concentrations of a pollutant. Conversely, a "moderate" or "substantial" impact may not have a significant effect if it is confined to a very small area and where it is not obviously the cause of harm to human health; and
- the judgement on significance relates to the consequences of the impacts; i.e. will they have an effect on human health that could be considered as significant? In the majority of cases, the impacts from an individual development will be insufficiently large to result in measurable changes in health outcomes that could be regarded as significant by health care professionals.

3.4.2.2 Ecological Habitats

The Environment Agency published instructions regarding detailed assessment of the impact of aerial emissions from new or expanding IPPC regulated industry for impacts on nature conservation (Operational instruction 67_12). This document explains that where the long-term PEC is greater than 70% of the AQAL a detailed assessment is required, which ensures that the process will not:

- "result in an 'adverse effect' on the integrity of a European site";
- "be an operation likely to damage (OLD)[sic] a SSSI";
- "result in significant pollution of a NNR, LNR, LWS or ancient woodland."

Where the PEC is below 70% of the AQAL the Environment Agency consider there to be a low risk to the site of significant effects.

AQTAG21[24] provides guidance on defining the *'Likely significant effect' – use of 1% and 4% long-term thresholds and 10% short-term threshold.* The Environment Agency, Natural England and Natural Resources Wales (NRW) have an agreed four stage process to assess the potential impact of industrial processes on European sites. The 4% long-term threshold is related to farmer; with respect to industrial facilities, the IAQM guidance[13] mirrors this guidance which states:

"Where the maximum, worst-case concentration within the emission footprint in any part of the European site(s) is less than 1% of the relevant long-term benchmark (critical level and/or critical load) and less than 10% of the relevant short-term benchmark (if available), AQTAG considers that the emission is not likely to have a significant effect alone, irrespective of the background levels."

The Environment Agency guidance goes on to state:

"Where the predicted long-term contribution from the industrial process is greater than 1% of the relevant long-term benchmark, consideration also needs to be given to the predicted environmental contribution (PEC). Where the PEC (process contribution + background) is less than 70% of the relevant long-term benchmark then a conclusion of no likely significant effect can be reached, even if the process contribution is greater than 1%."

Despite the guidance above, the approach suggested by the IAQM guidance on assessment of air quality impacts on designated nature conservation sites[13] has been used in this assessment.

Similar to the human health assessment approach and the AQTAG approach, for nationally and internationally designated sites (SSSI, SAC, SPA and Ramsar sites) where long-term process contributions (PCs) are below 1% of the assessment level (critical level or critical load) the impacts from the development in isolation are considered to be negligible. Where short-term impacts are considered, if the PC is less than 10% of the assessment level the impacts are considered negligible.

Where impacts are above these levels an ecology assessment will be required to determine whether the impacts are significant or not.

The IAQM guidance, recommends that only the annual mean NOx concentration is used in assessments unless specifically required by a regulator; for instance, as part of an industrial permit application where high, short-term peaks in emissions, and consequent ambient concentrations, may occur. As this is an industrial process, the short-term impacts of a range of pollutants have been considered.

Nutrient deposition

With regards to nutrient critical loads set out in Table 4 the lower value in the range has been used as the AQAL.

The Environment Agency states:

"It is considered that wet deposition of SO_2, NO_2 and NH_3 is not significant within a short range".

Dry deposition occurs when material is lost from the air through contact with solid surfaces, such as at the surface of the ground, thus reducing the airborne concentration of the pollutant. Wet deposition occurs when there is precipitation (rain, sleet, snow, etc.) and material is washed out of the air to the surface of the ground.

Therefore, the assessment only considers dry deposition of nutrient Nitrogen (N) compounds (i.e. NO_2 and NH_3).

Acid deposition

The critical loads for acidification are more complicated, in that the impact from multiple pollutants needs to be considered at the same time. While reduced nitrogen and sulphur dominate acid deposition in the UK, other compounds also contribute to acid deposition, e.g. hydrochloric acid (HCl) and hydrofluoric acid (otherwise known as hydrogen fluoride, HF). The contributions from all relevant compounds have been included in the assessment.

Due to these complexities, a critical load function is specified for acidification, via the use of three critical load parameters:

- CLmaxS — the maximum critical load of S, above which the deposition of S alone would be considered to lead to an exceedence;
- CLminN — a measure of the ability of a system to "consume" deposited N (e.g. via immobilisation and uptake of the deposited N); and
- CLmaxN — the maximum critical load of acidifying N, above which the deposition of N alone would be considered to lead to an exceedence.

These three quantities define the critical load function shown in Figure 5.

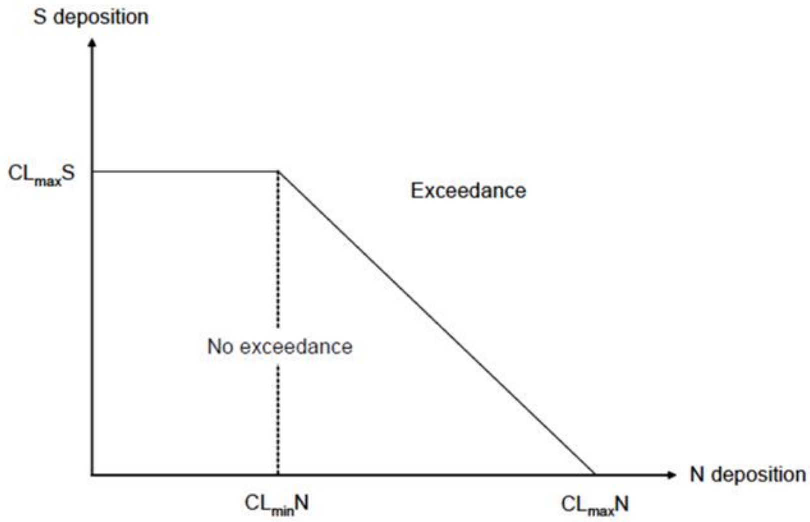

Figure 5: Critical Load Diagram

The AQTAG6 document[25] explains that, for facilities with other pollutant emissions which can impact the total acidity deposition, the process contribution of pollutants, in addition to the sulphur and nitrogen components, should be considered in the acidity critical load assessment. The documents goes on to explain that the H+ from HCl (and other pollutants like HF) should be added to the S contribution (and treated as S in the APIS tool).

APIS advises that where the total acid nitrogen deposition is greater than CLminN, the total acidity PC should be calculated as a proportion of the CLmaxN.

As explained previously, wet deposition of SO_2, NO_2 and NH_3 is not significant within a short range. Therefore, the assessment only considers dry deposition of acidic Nitrogen (N) compounds, acidic Sulphur (S) compounds and acidic Hydrogen compounds (i.e. HF) and wet deposition from acidic Hydrogen compounds (i.e. HCl). The wet deposition of HCl has been taken as two times the dry deposition rate as suggested by the Environment Agency's Air Quality Modelling and Assessment Unit (AQMAU), in lieu of any precipitation rate in the meteorological data file. This is a conservative screening assumption.

3.4.3 Assessment year

The Proposed Facility is not expected to be operational prior to 2025 and therefore the assessment year has been defined as 2025.

A current year of 2018 has been assumed for model verification and predicting existing concentrations.

3.4.4 Receptors

Concentrations have been predicted across nested Cartesian grids. These grids have a spacing of:

– 5 m x 5 m within 250 m of the site;
– 25 m x 25 m within 500 m of the site;
– 100 m x 100 m within 1 km of the site; and
– 500 m x 500 m within 5 km of the site.

The receptor grid has been modelled at a height of 1.5 m above ground level. The extent of this modelled receptor grid defines the 'Study Area'. The study area is considered appropriate to consider impacts on both human-health receptors and sensitive ecological receptors.

Concentrations have also been predicted across transects of receptors surrounding local roads. These transects have receptors located at distances away from the kerbs of 0 m, 2 m, 4 m, 7 m, 12 m, 20 m and 40 m. Concentrations from road traffic fall off rapidly with distance away from roads and these distances a considered appropriate to cover the areas where the impacts from local roads may be significant. The grid and transect receptor locations are shown in Figure 6.

In addition, concentrations have been predicted at 52 residential properties, representing worst-case exposure to annual mean concentrations in the local area, the majority of the include group floor exposure (modelled at 1.5 m above the ground) and a small number only include relevant exposure at first floor level (modelled at a height of 4.5 m above the ground). Details of these receptors are presented in Appendix 5 and the locations are shown in Figure 7.

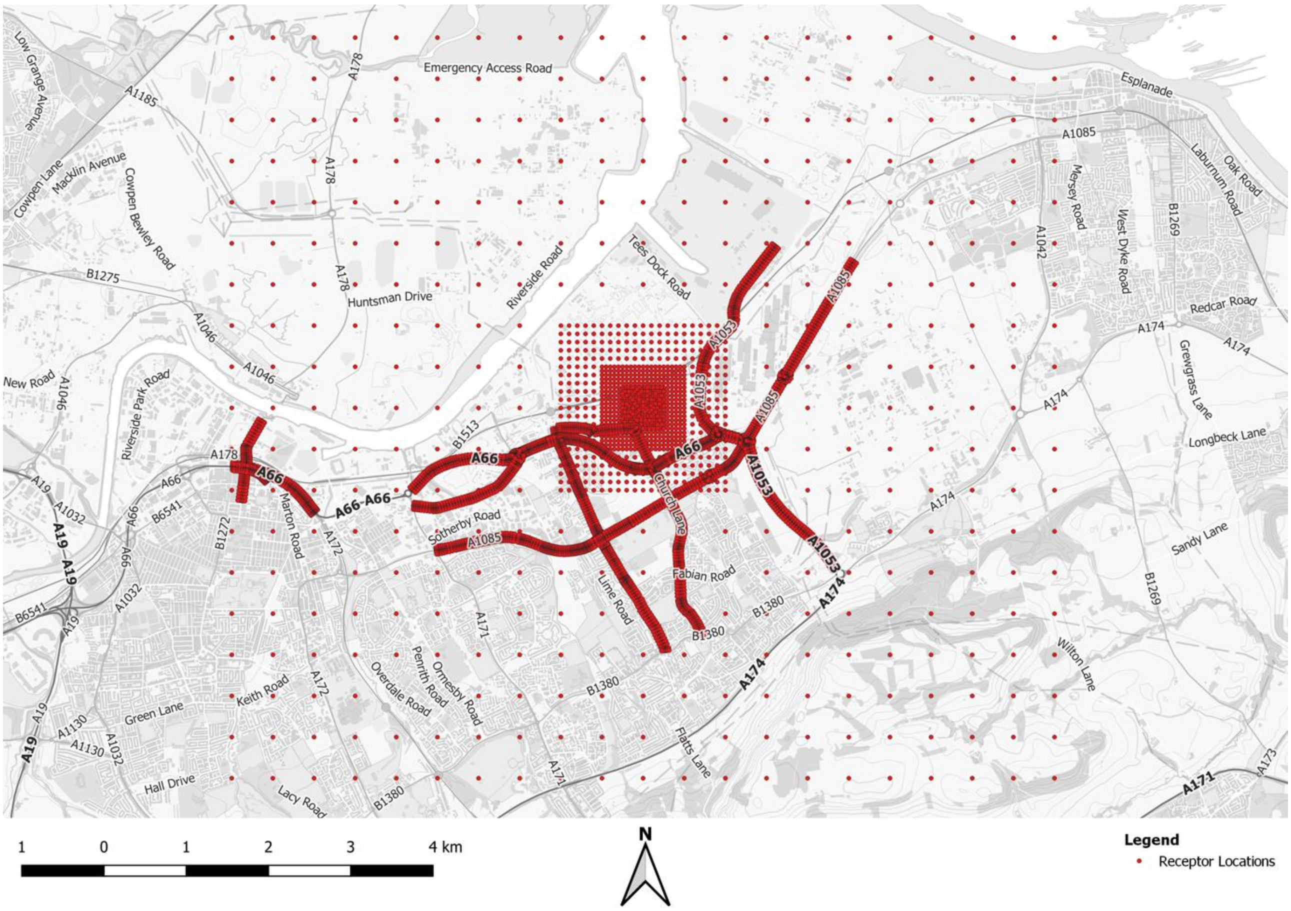

Figure 6: Gridded Receptor Locations

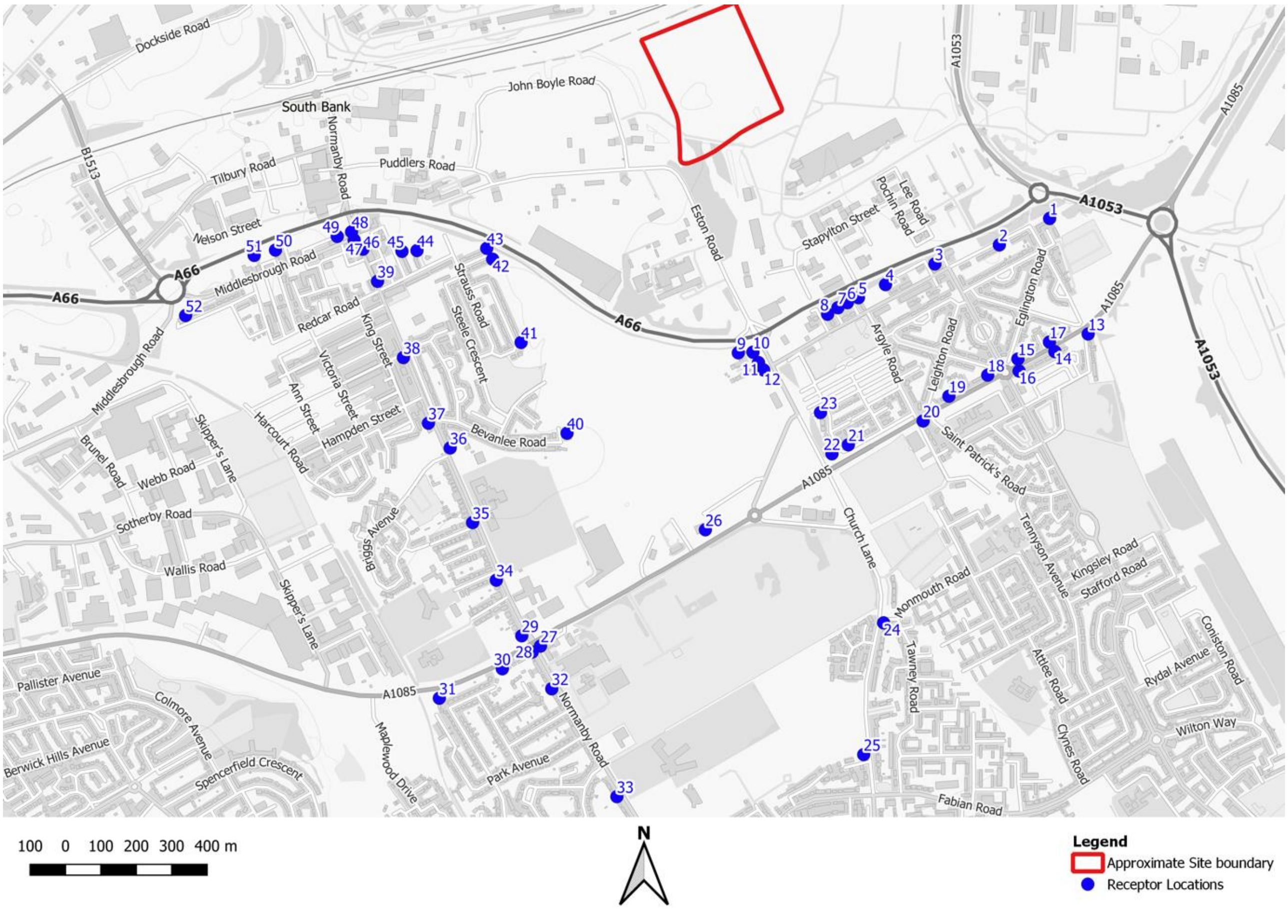

Figure 7: Specific Receptor Locations

3.4.5 Point source Impacts

3.4.5.1 The model

Concentrations have been predicted at locations of sensitive exposure within the local area using the ADMS-5 atmospheric dispersion model (v5.2) developed and validated by Cambridge Environmental Research Consultants (CERC). The model is used extensively throughout the UK for regulatory compliance purposes and Local Air Quality Management and is accepted as an appropriate tool by local authorities and the EA.

The model requires a range of input parameters. Table 8 presents the parameters entered into the model for the point source. The point source represents the combined emissions and flow parameters from all lines within the Proposed Facility venting via a single common flue.

Table 8: Point Source Model Parameters

Parameter	Values
Stack Location (OS x,y)	454592, 521251
Exhaust Temperature (°C)	140
Molecular Mass (g/mol) for Actual Flow	28.48
Flue Internal Diameter (m)	3.48

Parameter	Values
Flue Release Height (m)	70
Exhaust Velocity (Am/s) [a] for Actual Flow	15

[a] Actual flow conditions assumed to be 140 °C, ~5% O_2, wet (~14% H_2O).

3.4.5.2 Emissions

The IED defines emission limit values (ELVs) for emissions to air from waste incineration facilities. These ELVs are detailed in Table 9 for information. The BREF note (November 2019) includes BAT-Associated Emission Levels (BAT-AEL) that are more stringent than the IED ELV's. The BAT-AELs are detailed in Table 10 and were used in this assessment.

The normalised flow rate for the Proposed Facility, as set out in Table 2, is used to derive the pollutant mass emission rate for use within the dispersion model.

The upper value from the BREF emission limits have been used for the assessment. For 15-minute SO_2 an emission rate of four time the BREF emission has been used.

Table 9: IED Emission Rates

Pollutant	Emission Limits (mg/Nm^3) [a]		
	24-hour Mean	30-minute Mean	
		100th Percentile	97th Percentile
Continuous measurement			
Total PM	10	30	10
TOC	10	20	10
HCl	10	60	10
HF	1	4	2
SO_2	50	200	50
NOx	200	400	200
CO	50	100 [a]	-
Spot sample measurement			
Group 1 metals [b]	0.05	-	-
Group 2 metals [c]	0.05	-	-
Group 3 metals [d]	0.5	-	-
Dioxins and furans [e]	0.0000001	-	-

[a] For CO there is also an ELV of 150 mg/Nm^3 as a 15-minute mean.

[b] Cadmium (Cd) and thallium (Tl)

[c] Mercury (Hg)

[d] Antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni), vanadium (V)

[e] The emission limit value refers to the total concentration of dioxins and furans calculated using the concept of toxic equivalence (TEQ).

Table 10: BREF note (November 2019) includes BAT-Associated Emission Levels (BAT-AEL)

Pollutant	Emission Limits (mg/Nm^3) [a]
Total PM	2-5
TOC	3-10
HCl	2-6
HF	<1
SO_2	5-30
NOx	50-120
CO	10-50
Group 1 metals [b]	0.005-0.02
Group 2 metals [c]	0.005-0.02
Group 3 metals [d]	0.01-0.3
Dioxins and furans [e]	0.0000001-0.0000002

PM

The IED specifies a maximum emission of total particulate matter (PM). In order to assess the potential emissions of PM; a precautionary approach has been taken that all PM is both PM_{10} and $PM_{2.5}$.

TOC

The IED specifies a maximum emission of Total Organic Carbon (TOC). In order to assess the potential emissions of TOCs; a worst-case approach has been taken, assuming that all TOCs are volatile organic compounds (VOCs). There are no assessment values for TOC or VOC, therefore a precautionary approach has been taken that all VOCs are both benzene and 1,3 butadiene with respect to annual mean concentrations; and that all VOCs are dimethyl sulphate with respect to short-term EALs. This situation would not happen in practice and provides an extremely conservative assessment.

Metals

For the group 1 metals – cadmium (Cd) and thallium (Tl) – and the group 2 mental – mercury (Hg), when assessing against each of the AQAL for each metal in turn, it has been assumed that the total group metal emission rate is made up entirely of that metal. Similarly, for the group 3 metals – Antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni), vanadium (V), when assessing against each of the AQAL for each metal in turn, it has been assumed that the total group 3 metals emission rate is made up entirely of that metal.

This is a worst-case approach. It may not be possible to screen out the potential for significant impacts of specific metals using this method. As this is overly pessimistic, the Environment Agency have set out an approach to consider more detailed metal specific emission rates in its Interim Guidance Note for Metals[26]. This includes three steps. The first step is what has initially been assumed in this assessment; that the total group 3 metals emission rate is made up entirely of each metal in turn. The second step assumes that each metal comprises 11% of the total group emissions. Step 3 of the Environment Agency guidance is to use typical emission concentrations for ERF plant, which are presented in the guidance and are set out in Table 11.

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Table 11: EA Measured Concentrations Group 3 metals (mg/Nm³)
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/532474/LIT_7349.pdf

Pollutant	Max	Mean	Min[b]
Antimony	0.0115	0.0014	0.0001
Arsenic	0.0250	0.0010	0.0002
Total chromium	0.0920	0.0084	0.0002
Chromium(VI)	1.3×10^{-4}	3.5×10^{-5}	2.3×10^{-6}
Cobalt	0.0056	0.0011	0.0002
Copper	0.0290	0.0075	0.0019
Lead	0.0503	0.0109	0.0003
Manganese	0.0600	0.0168	0.0015
Nickel	0.2200	0.0150	0.0025
Vanadium	0.0060	0.0004	0.0001

[a] Minimum values correspond in some cases to the detection limit.

[b] Chromium(VI) concentrations presented in the table are based on stack measurements for total chromium and measurements of the proportion of chromium(VI) (to total chromium) in Air Pollution Control (APC) residuals collected at the same plant.

[d]The two highest nickel concentrations are outliers being 44%, as above, and 27% of the ELV. The third highest concentration is 0.53 mg/Nm³ or 11% of the ELV.

3.4.6 Road Traffic Impacts

3.4.6.1 The model

Concentrations have been predicted at locations of sensitive exposure within the local area using the ADMS-Roads atmospheric dispersion model (v4.1.1.0) developed and validated by Cambridge Environmental Research Consultants (CERC). The model is used extensively throughout the UK for Local Air Quality Management and is accepted as an appropriate tool by local authorities. The model requires a range of input parameters include road traffic emissions.

3.4.6.2 Traffic data and Emissions

Traffic flow data has been provided by Fore Consulting Limited for the local road network for the following scenarios:

- Base year (2018);
- Assessment year (2025) without the Proposed Facility; and
- Assessment year (2025) with the Proposed Facility.

The modelled road network is shown in Figure 8.

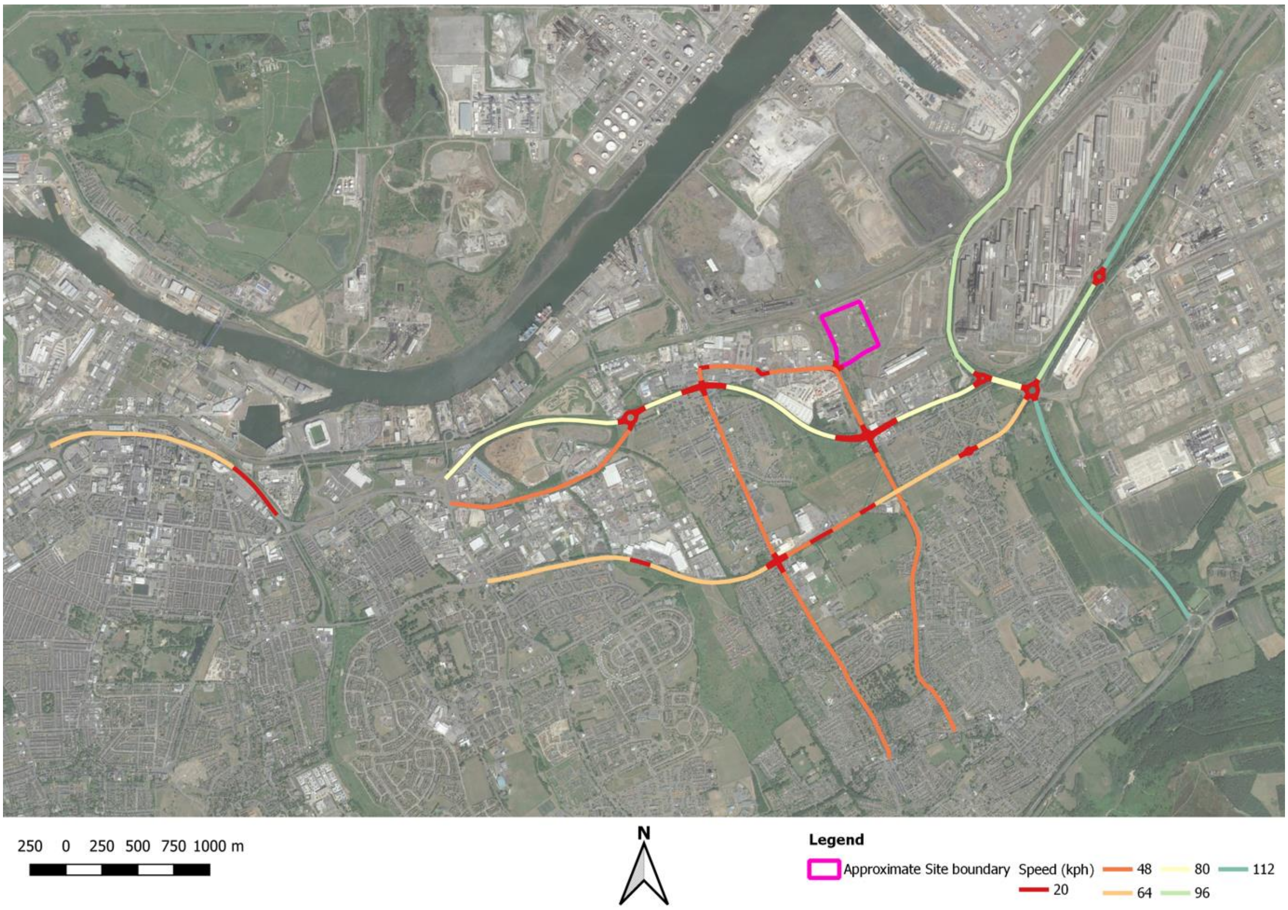

Figure 8: Modelled Road Network, Modelled Speeds and Site Location

Imagery ©2020 Google. Map data ©2020.

Vehicle emissions have been calculated based on vehicle flow, fleet composition and speed using Defra's Emission Factor Toolkit (v9.0.1) (EFT). EFT v9.0.1 uses predicted future year emission factors and there can be some degree of uncertainty when predicting vehicle fleet composition and emission in the future. To take this into account, two future-year emission scenarios have been modelled. These are:

- Using 2025 EFTv9.0.1 emissions (Scenario A)
- Using 2018 EFTv9.0.1 emissions; i.e. assuming no improvement (Scenario B)

The ADMS-Roads model was verified using NO_2 concentrations measured by Redcar and Cleveland Council and Middlesbrough Borough Council.

3.4.7 Further modelling details

Further details on additional model setup parameters, model verification and post-processing approaches are set out in Appendix 6. These include the treatment of terrain, meteorology, buildings and other key modelling considerations.

3.4.8 Uncertainty

The assessment involves a range of uncertainties, including the baseline conditions, model inputs, assumptions, the model, model verification and post-processing of model results. A brief overview of the key uncertainties is discussed below.

There are inherent uncertainties associated with the traffic data. These provide estimated vehicle trips in an average way, but the specific routing, timing, driving conditions and driving behaviour of vehicles will vary and potentially lead to different emission levels.

The emission factors also involve a considerable amount of uncertainty. Emissions from the EFT are link averages and do not explicitly take account of acceleration or deceleration. Modelled speeds have been adjusted to account for this where possible. Future year vehicle emission rates are also based on a range of factors, such as expected anticipated improvements in emission reduction technologies, expected uptake rates of different vehicles based on government policies, etc. It is therefore possible that the expected future emission rates in the EFT may differ from reality. Vehicle uptakes and improvements in emission reduction technologies are currently very uncertain; there is thus no justifiable way to determine whether Defra's predictions within the EFT are optimistic or pessimistic, and future emissions remain an uncertainty that cannot be definitively quantified. A pessimistic sensitivity test has, however, been carried out assuming no reduction in emissions from current levels (see section 6.6.8 of Appendix 6 for more details).

The model itself is based on assumptions of a range of parameters, including road geometries, road widths and meteorological related parameters. There is uncertainty in all these parameters, but the modelling has been setup in a robust way based on professional experience to best represent the conditions. One of the main uncertainties in the model is meteorological data; this has been based on measurements made at a representative meteorological station, and although meteorological conditions will remain similar, it is entirely possible that meteorological conditions will vary in subsequent years and lead to marginally different concentrations.

The ambient background concentrations are also uncertain. While these are provided by Defra, the 1x1 km resolution is coarse and the maps do not include all sources of pollution. Given the urban fringe location of the proposed development, it is considered likely that the background maps for this area are likely to be reasonable. To minimise uncertainty in the spatial resolution of the maps, the background concentrations have been interpolated to each receptor; essentially smoothing out the coarseness of the maps.

Evidence[27] suggests that the fraction of primary NO_2 (f-NO_2) released from vehicle exhausts has been decreasing in recent years, which is not taken into account within Defra's EFT or NOx to NO_2 Calculator. If lower f-NO_2 values were assumed, then the predicted concentrations would likely be slightly lower throughout the development and local area. Until more detailed scientific analysis is undertaken to understand the full extent of why f-NO_2 is decreasing and how it will behave in the future, it remains an uncertainty.

A model verification exercise has been undertaken for the road traffic modelling to adjust the predicted concentrations from the model so that they match local conditions as closely as possible. This adjusts concentrations to match average conditions; some locations will remain underpredicted and some overpredicted.

Although there is a wide range of uncertainty associated with air quality modelling, the predictions made by this assessment have been carried out in a robust manner using best practice to minimise uncertainties where possible.

4. Baseline

This section sets out the available information on air quality in the vicinity of the Proposed Facility.

4.1 LAQM Review and Assessment

Redcar and Cleveland Borough Council has not declared any AQMAs and there are no neighbouring AQMAs within 5 km of the Proposed Facility. Therefore, the Proposed Development is not likely to affect or be affected by an AQAM.

4.2 Local Air Quality Monitoring

There are two automatic monitoring stations within 5 km of the Proposed Facility; one operated by Redcar and Cleveland Borough Council and one operated by Middlesbrough Borough Council (see locations in Figure 9). Measurements made at the sites from 2014 to 2018 are shown in Table 12:.

Table 12: Automatic monitoring within 5 km of the proposed facility

Monitoring site, site type and distance (km) from site boundary (approx.)	Objective	2014	2015	2016	2017	2018
NO_2						
Redcar Dormington, Suburban, 4.5	Annual mean (µg/m^3)	12.8	12.7	11.0	12.0	10.0
	Number of hours with concentrations >200 µg/m^3	0	0	0	0	0
Breckon Hill (AURN), urban background, 4.3	Annual mean (µg/m^3)	20.3	15.7	18.1	13.1	14.5
	Number of hours with concentrations >200 µg/m^3	0	0	0	0	0
PM_{10}						
Redcar Dormington, Suburban, 4.5	Annual mean (µg/m^3)	15.7	15.7	12.7	12.0	12.0
	Number of days with concentrations >50 µg/m^3	3	4	0	1	2
Breckon Hill (AURN), urban background, 4.3	Annual mean (µg/m^3)	16.2	16.6	13.9	13.4	15.6
	Number of days with concentrations >50 µg/m^3	4	6	3	3	2
$PM_{2.5}$						
Redcar Dormington, Suburban, 4.5	Annual mean (µg/m^3)	11.0	11.0	8.9	8.4	8.4
Breckon Hill (AURN), urban background, 4.3	Annual mean (µg/m^3)	13.1	10.5	10.2	7.5	8.9
SO_2						
Breckon Hill (AURN), urban background, 4.3	Annual mean (µg/m^3)	4	3	5	2	2
	Number of 15-minute periods with concentrations >266 µg/m^3	0	0	0	0	0

Monitoring site, site type and distance (km) from site boundary (approx.)	Objective	2014	2015	2016	2017	2018
	Number of hours with concentrations >350 µg/m^3	0	0	0	0	0
	Number of days with concentrations >125 µg/m^3	0	0	0	0	0

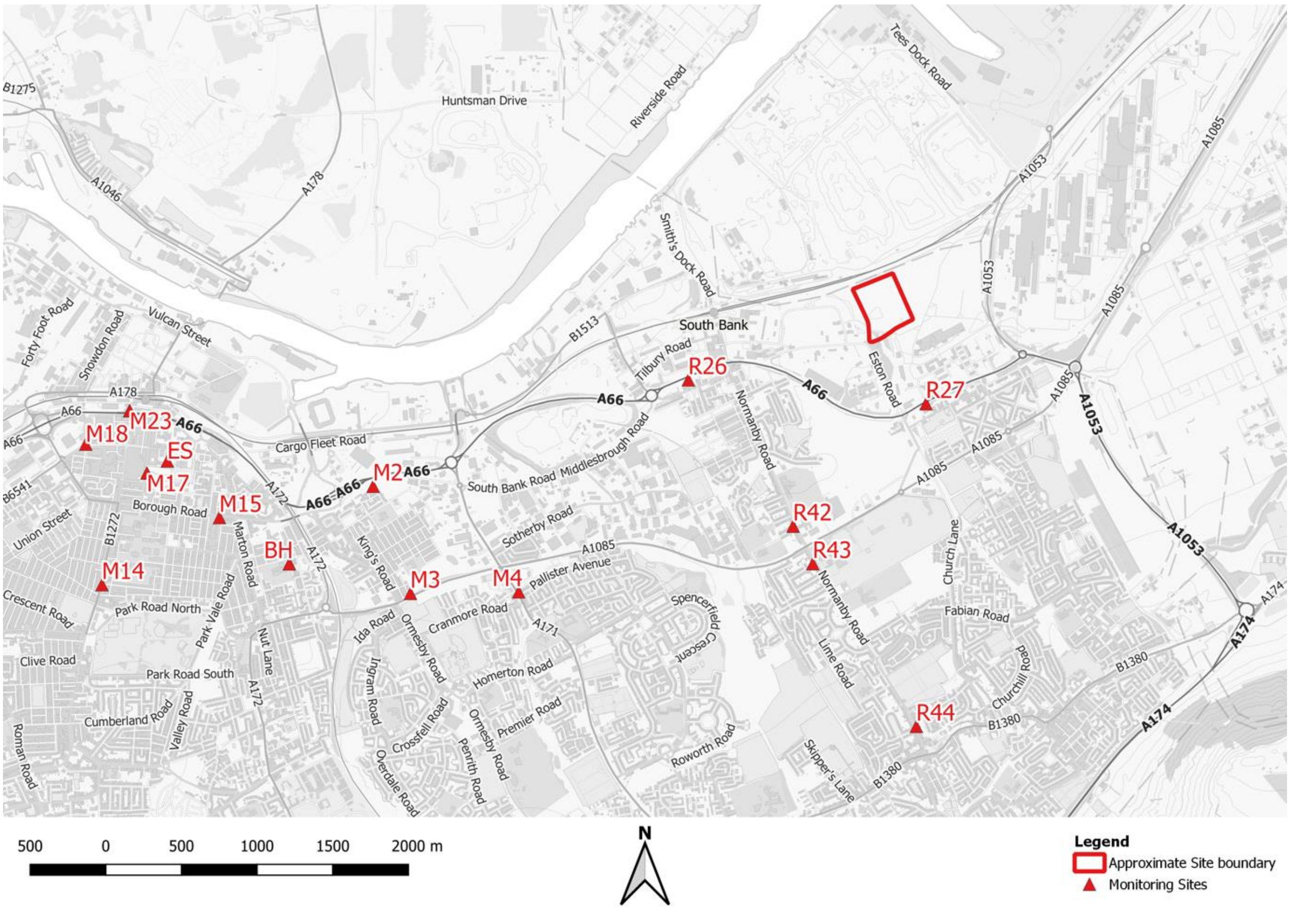

Figure 9: Monitoring Sites and Site Location

Redcar and Cleveland Borough Council also have five diffusion tube monitoring locations within 5 km of the Proposed Facility, and Middlesbrough Borough Council also have six diffusion tubes monitoring locations within 5 km of the Proposed Facility. To the north of the borough of Redcar and Cleveland lies Stockton-on-Tees Borough, the Council, which do not operate any monitoring sites within 5 km of the Proposed Facility. The diffusion tube monitoring locations within 5 km are shown in Figure 9 and the annual mean concentrations in Table 13.

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Table 13: Diffusion tube data (annual mean NO_2 concentrations µg/m^3) for the diffusion tubes within 5 km of the Proposed Facility

Site	Site Type	Distance (km) from site (approx.)	2014	2015	2016	2017	2018
R26	Roadside	1.4	23.1	21.9	20.5	19.8	24.7
R27	Roadside	0.7	30.6	30.0	26.4	25.5	29.8
R42	Roadside	1.6	n/a	n/a	n/a	n/a	16.6
R43	Roadside	1.8	n/a	n/a	n/a	n/a	16.1
R44	Roadside	2.8	n/a	n/a	n/a	n/a	15.7
M4	Roadside	3.0	n/a	21.4	25.0	21.4	24.4
M3	Kerbside	3.7	n/a	26.6	27.8	28.1	29.4
M2	Roadside	3.6	n/a	17.9	22.5	18.5	20.8
M20	Urban Background	4.3	n/a	16.3	17.8	17.0	20.8
M15	Roadside	4.6	n/a	19.8	23.4	20.9	24.3
M17	Roadside	5.0	n/a	24.3	26.2	22.7	26.3

The monitoring data recorded over the past few years shows no AQALs have been exceeded within 5 km of the Proposed Facility. There are no clear trends in the data.

4.3 Defra Air Quality Monitoring

4.3.1 Carbon Monoxide and Ozone

Defra operate the Automatic Urban and Rural Network (AURN) which measures a range of pollutants, including carbon monoxide (CO) and ozone (O_3). The nearest AURN monitoring site that measures CO concentrations is in Leeds Centre, approximately 92 km away from the Proposed Facility. Ozone is measured at the Middlesbrough AURN site, within 5 km of the Proposed Facility. Data for 2014 to 2018 are presented in Table 14. All values are below the AQALs.

Table 14: Measured annual mean CO and O_3 concentrations (µg/m^3)

Pollutant	Monitoring Site (Type)	2014	2015	2016	2017	2018
CO	Leeds Centre AURN (Urban Background)	253	255	267	266	162
O_3	Middlesbrough AURN (Urban Industrial)	45	47	45	45	46

4.3.2 Benzene

The UK Non-Automatic Hydrocarbon Network measures ambient benzene (C_6H_6) concentrations at various sites around the UK, including at the Middlesbrough AURN site which is within 5 km of the Proposed Facility. Data for 2014 to 2018 are presented in Table 15. All values are below the AQAL and limit value.

Table 15: Measured annual mean Benzene concentrations (µg/m³)

Pollutant	Monitoring Site	2014	2015	2016	2017	2018
Benzene	Middlesbrough (Urban Industrial)	1.38	0.97	0.84	0.65	1.09

4.3.3 1,3-Butadiene

Concentrations of 1,3-butadiene are measured by Defra using the Automatic Hydrocarbon Network. This includes measurements made at the Middlesbrough monitoring site. However, the last measurements at this site were made in 2000. Data for 2000 at relevant monitoring sites are presented in Table 16. All values in 2000 were below the AQAL. More recent data is available from other distant monitoring sites in the UK for 2018. These values are also below the AQAL and much lower than values in 2000.

Table 16: Measured annual mean 1,3-Butadiene concentrations (µg/m³)

Pollutant	Monitoring Site (Type)	Monitoring Year	Annual Mean Concentration
1,3-Butadiene	Middlesbrough (Urban Industrial)	2000	0.23
	Birmingham East (Urban Background)	2000	0.33
	Leeds Potternewton (Urban Background)	2000	0.35
	Liverpool Speke (Urban Industrial)	2000	0.24
	Auchencorth Moss (Rural Background)	2018	0.01
	Chilbolton Observatory (Rural Background)	2018	0.09
	London Eltham (Suburban Background)	2018	0.05

4.3.4 Dimethyl sulphate

Concentrations of dimethyl sulphate are not measured as part of the UK Non-Automatic Hydrocarbon Network. There are limited measurements due to it having a very short lifetime of about 9 days within the atmosphere[28]; no information is available on local concentrations in the study area.

4.3.5 Acid Gases – Hydrochloric acid and Hydrogen Fluoride

The Acid Gas and Aerosol Network operated as part of the UK Eutrophying & Acidifying Network (UKEAP) measures concentrations of hydrochloric acid (HCl) at various locations across the UK. The nearest monitoring sites are located at High Muffles and Moorhouse. Data for 2014 to 2015 are presented in Table 17. No data is available for 2016, 2017 or 2018. All values are below the AQAL.

Table 17: Measured annual mean HCl concentrations (µg/m³)

Pollutant	Monitoring Site (Type)	2014	2015
Gaseous HCl	High Muffles (Rural Background)	0.270	0.119
	Moorhouse (Rural Background)	0.180	0.176

No monitoring of ambient hydrogen fluoride (HF) concentrations is carried in the UK. The Expert Panel on Air Quality Standards (EPAQS) report on halogen and hydrogen halides in ambient air states a modelling study which suggests typical natural background HF concentrations are about 0.5 µg/m³, and where there are local anthropogenic emission sources background concentration may be up to 3 µg/m^3. Baseline concentrations are thus likely to be well below the AQAL.

4.3.6 Ammonia

The National Ammonia Monitoring Network measures ambient ammonia (NH_3) concentrations at various sites around the UK. The three nearest monitoring sites are located at High Muffles, Brompton and May Moss, which are located 37 km, 27 km and 42 km away from the Proposed Facility, respectively. Data for 2014 to 2018 are presented in Table 18. All values are below the AQAL.

Table 18: Measured annual mean NH_3 concentrations (µg/m^3)

Pollutant	Monitoring Site (Type)	2014	2015	2016	2017	2018
Gaseous NH_3	High Muffles (Rural Background)	0.63	0.69	0.51	0.71	1.04
	Brompton (Rural Background)	7.09	8.30	6.51	8.28	8.08
	May Moss (Rural Background)	n/a	n/a	n/a	1.03	1.12

4.3.7 Polycyclic Aromatic Hydrocarbons

PAHs are a large group of organic compounds widely distributed in the atmosphere. Defra operates the Polycyclic Aromatic Hydrocarbons network, which measures PAHs at 30 monitoring sites throughout the UK. This includes measurements made at the Middlesbrough urban industrial monitoring site. Data for 2014 to 2018 are presented in Table 19. The total PAH concentrations exceed the AQALs in all years presented.

Table 19: Measured annual mean PAH concentrations (ng/m^3)

Pollutant	Monitoring Site	2014	2015	2016	2017	2018
5-Methyl Chrysene	Middlesbrough	0.02	0.02	0.00	0.01	0.02
Anthanthrene	Middlesbrough	0.03	0.03	0.03	0.02	0.02
Benzo(a)anthracene	Middlesbrough	0.54	0.25	0.16	0.10	0.13
Benzo(a)pyrene	Middlesbrough	0.49	0.29	0.19	0.14	0.17
Benzo(b)naphtho(2,1-d)thiophene	Middlesbrough	0.14	0.08	0.07	0.03	0.05
Benzo(c)phenanthrene	Middlesbrough	0.10	0.05	0.05	0.02	0.02
Benzo(e)pyrene	Middlesbrough	0.71	0.41	0.29	0.19	0.23
Benzo(ghi)perylene	Middlesbrough	0.52	0.33	0.35	0.21	0.23
Benzo(k)fluoranthene	Middlesbrough	0.43	0.23	0.12	0.07	0.08
Benzo(b)fluoranthene	Middlesbrough	0.99	0.53	0.29	0.24	0.20
Benzo(j)fluoranthene	Middlesbrough	0.42	0.26	0.15	0.09	0.12
Cholanthrene	Middlesbrough	n/a	n/a	0.01	0.01	0.01
Chrysene	Middlesbrough	0.86	0.48	0.28	0.16	0.21
Coronene	Middlesbrough	0.14	0.11	0.10	0.05	0.04
Cyclopenta(c,d)pyrene	Middlesbrough	0.06	0.04	0.05	0.05	0.08

Pollutant	Monitoring Site	2014	2015	2016	2017	2018
Dibenzo(ac)anthracene	Middlesbrough	0.09	0.05	0.03	0.03	0.03
Dibenzo(ae)pyrene	Middlesbrough	0.12	0.10	0.06	0.03	0.02
Dibenzo(ah)anthracene	Middlesbrough	0.13	0.08	0.06	0.04	0.03
Dibenzo(ah)pyrene	Middlesbrough	0.01	0.01	0.01	0.01	0.01
Dibenzo(ai)pyrene	Middlesbrough	0.10	0.07	0.06	0.07	0.04
Dibenzo(al)pyrene	Middlesbrough	0.01	0.01	0.01	0.01	0.01
Indeno(1,2,3-cd)pyrene	Middlesbrough	0.46	0.26	0.20	0.12	0.18
Perylene	Middlesbrough	0.11	0.06	0.03	0.02	0.02
Total	Middlesbrough	6.49	3.73	2.62	1.74	1.95

4.3.8 and Furans and Polychlorinated Biphenyls

Monitoring of dioxins and furans (PCDD/Fs) and polychlorinated biphenyls (PCBs) is carried out by Defra at locations in the UK (Auchencorth Moss, Hazelrigg, High Muffles, London, Manchester and Weybourne) as part of the Toxic Organic Micropollutants (TOMPs) Network. Data for the most recent year of monitoring (2010) are presented in Table 20. The PCDD/F and PCB values are well below the AQALs.

Table 20: Measured annual mean PCDD/F and PCB concentrations (fg TEQ/m^3)

Pollutant	Auchencorth Moss (Rural Background)	Hazelrigg (Rural Background)	High Muffles (Rural Background)	London (Urban Background)	Manchester (Urban Background)	Weybourne (Rural Background)
2,3,7,8-TCDF	0.44	0.47	0.44	2.30	2.15	0.45
1,2,3,7,8-PeCDF	0.22	0.20	0.22	0.29	1.18	0.22
2,3,4,7,8-PeCDF	2.20	1.65	2.20	6.70	1.76	2.20
1,2,3,4,7,8-HxCDF	0.72	0.41	0.46	2.21	1.83	0.47
1,2,3,6,7,8-HxCDF	0.44	0.41	0.44	1.57	1.40	0.44
2,3,4,6,7,8-HxCDF	0.44	0.41	0.44	1.68	1.60	0.41
1,2,3,7,8,9-HxCDF	0.44	0.44	0.44	0.44	0.63	0.44
1,2,3,4,6,7,8-HpCDF	0.49	0.48	0.05	1.28	3.91	0.07
1,2,3,4,7,8,9-HpCDF	0.04	0.04	0.05	0.26	0.62	0.04
OCDF	0.63	0.63	0.15	0.63	3.27	0.43
2,3,7,8-TCDD	4.40	4.40	4.40	4.40	4.40	4.40
1,2,3,7,8-PeCDD	4.40	4.08	4.40	12.65	4.21	4.40
1,2,3,4,7,8-HxCDD	0.44	0.44	1.70	0.44	0.42	0.44
1,2,3,6,7,8-HxCDD	0.44	0.41	0.44	1.53	0.58	0.44
1,2,3,4,7,8-HxCDD	0.23	0.39	0.44	2.22	0.62	0.44

Pollutant	Auchencorth Moss (Rural Background)	Hazelrigg (Rural Background)	High Muffles (Rural Background)	London (Urban Background)	Manchester (Urban Background)	Weybourne (Rural Background)
1,2,3,4,6,7,8-HpCDD	0.66	0.49	0.05	3.27	4.11	0.12
OCDD	**2.57**	**2.56**	**0.93**	**7.23**	**8.93**	**1.37**
ΣTEQ dioxins and furans	**5.01**	**8.0**	**2.76**	**38.60**	**48.7**	**2.49**
3,3',4,5-TetraCB (PCB_81)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
3,3',4,4'-TetraCB (PCB_77)	0.05	0.21	0.05	0.17	0.20	0.05
3,3',4,4',5-PentaCB (PCB_126)	0.22	1.76	1.06	1.74	1.61	0.22
3,3',4,4',5,5'-HexaCB (PCB_169)	0.04	0.15	0.12	0.03	0.04	0.03
Total PCB	**0.31**	**2.12**	**1.23**	**1.94**	**1.85**	**0.31**

4.3.9 Heavy Metals

The Heavy Metals Network is currently managed and operated for Defra and the Devolved Administrations by the National Physical Laboratory and involves measurements of various heavy metals at a range of sites around the UK. There are no monitoring sites within 5 km of the Proposed Facility. The six nearest monitoring sites are located at Eskdalemuir (~150 km away), Chesterfield Loundsley Green (~150 km away), Scunthorpe Town (~115 km away), Scunthorpe Low Santon (~115 km away), Sheffield Devonshire Green (~135 km away) and Sheffield Tinsley (~130 km away). Data for each of the monitoring sites for 2018 are presented in Table 21. No monitoring of ambient thallium (Tl) concentrations is currently carried out in the UK. All values are below the AQALs, apart from chromium (Cr) which exceeds the chromium(VI) annual mean AQAL.

Table 21: Measured annual mean heavy metal concentrations in 2018 (ng/m^3)

Pollutant	Eskdalemuir (Rural Background)	Chesterfield Loundsley Green (Urban Background)	Scunthorpe Town (Urban Industrial)	Scunthorpe Low Santon (Urban Industrial)	Sheffield Devonshire Green (Urban Background)	Sheffield Tinsley (Urban Background)
As	0.16	0.67	0.77	0.75	0.69	1.03
Cd	0.02	0.14	0.35	0.63	0.17	0.42
Co	0.03	0.13	0.13	0.21	0.18	0.91
Cr	1.13	3.31	2.82	4.32	5.88	38.36
Cu	0.57	5.40	6.13	5.66	9.95	25.34
Mn	0.96	5.39	21.85	90.04	9.79	35.27
Ni	0.24	1.24	1.16	1.25	2.40	19.79
Pb	0.96	6.90	16.76	18.93	8.27	18.33
V	0.34	0.64	1.57	9.51	0.84	1.68

The Rural Mercury Network operated as part of the UK Eutrophying & Acidifying Network (UKEAP) measures concentrations of mercury (Hg) at Auchencorth Moss in Scotland. Data for 2014 to 2016 are presented in Table 22. No data is available for 2017 or 2018. All values are below the AQAL.

Table 22: Measured annual mean Hg concentrations (ng/m^3)

Pollutant	Monitoring Site (Type)	2014	2015	2016
Hg	Auchencorth Moss (Rural Background)	1.40	1.37	1.41

4.4 Industrial Pollution

A desk-based review of potential industrial sources using the UK Pollutant Release and Transfer Register identified many significant industrial and waste management sources of air pollution within 5 km of the Proposed Facility that may affect baseline air quality conditions in the local area. These are presented in Figure 10.

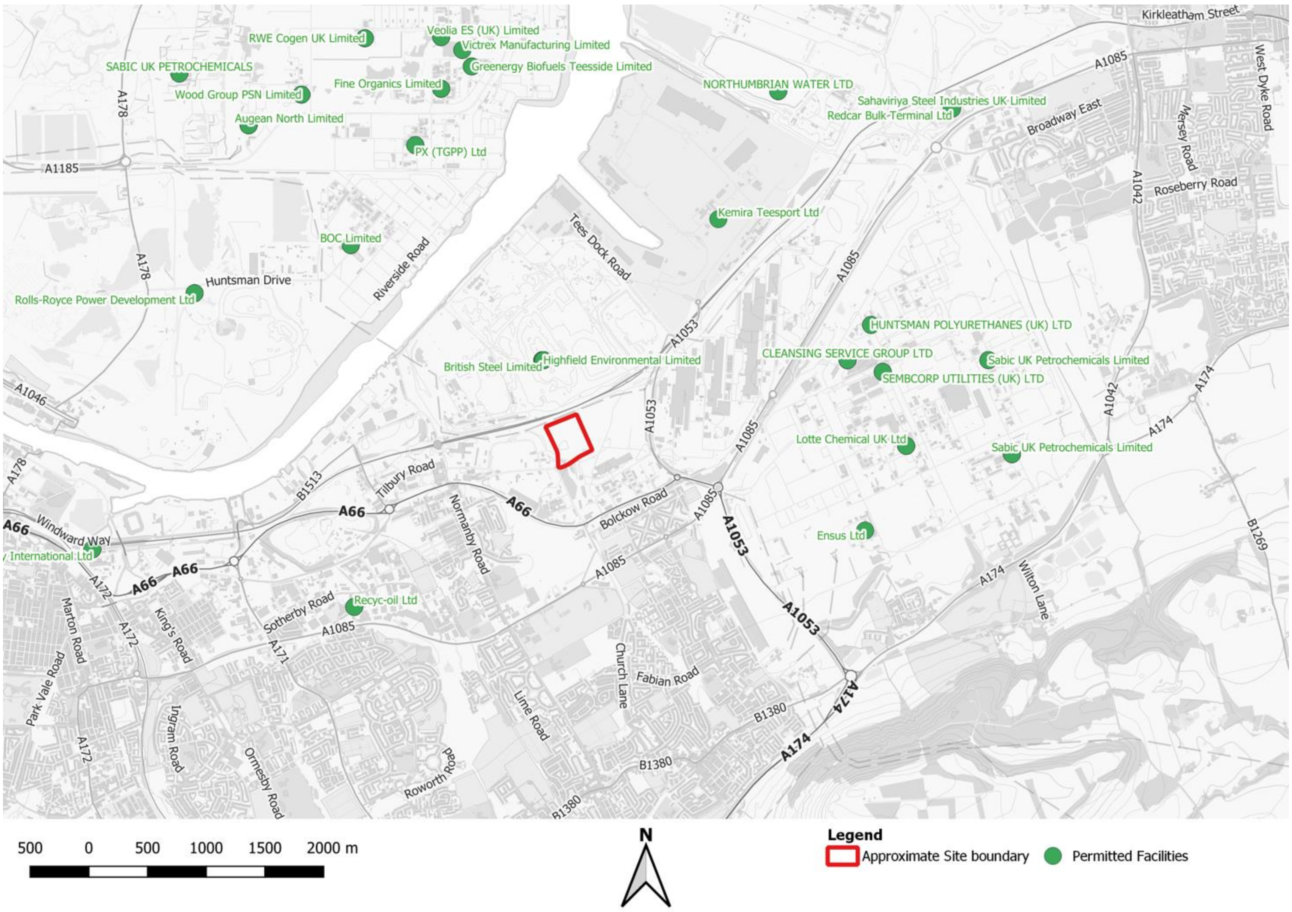

Figure 10: Nearby Environment Agency Permitted Facilities and Site Location

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4.5 Defra Predicted Concentrations

Defra have produced projections of future concentrations of NO_2 and NOx across the UK up to 2030 for the development of the 2017 Air Quality Plan. Roadside concentrations are predicted to be above the annual mean NO_2 limit value at the A66 between the A171 and the B1272 (over 3 km away from the Proposed Facility), but below the limit value closer to the Proposed Facility (see Figure 11).

The background concentrations have been obtained from the national maps published by Defra. These estimated concentrations are produced on a 1km by 1km grid basis for the whole of the UK. The predicted concentrations for grid squares within 5 km of the Proposed Facility for NOx, NO_2, PM_{10} and $PM_{2.5}$ are provided in Table 23: and presented in Figure 11.

Table 23: Estimated annual mean roadside and background concentrations in 2018 and 2025 in µg/m^3

Year	Background			
	NOx	NO_2	PM_{10}	$PM_{2.5}$
2018	10.7 – 51.8	8.1 – 29.2	9.9 – 13.6	6.7 – 8.4
2025	8.3 – 47.1	6.4 – 27.3	9.2 – 12.8	6.1 – 7.8

It can be seen that the estimated background concentrations are well below the AQALs for all pollutants at the anticipated opening year, 2025.

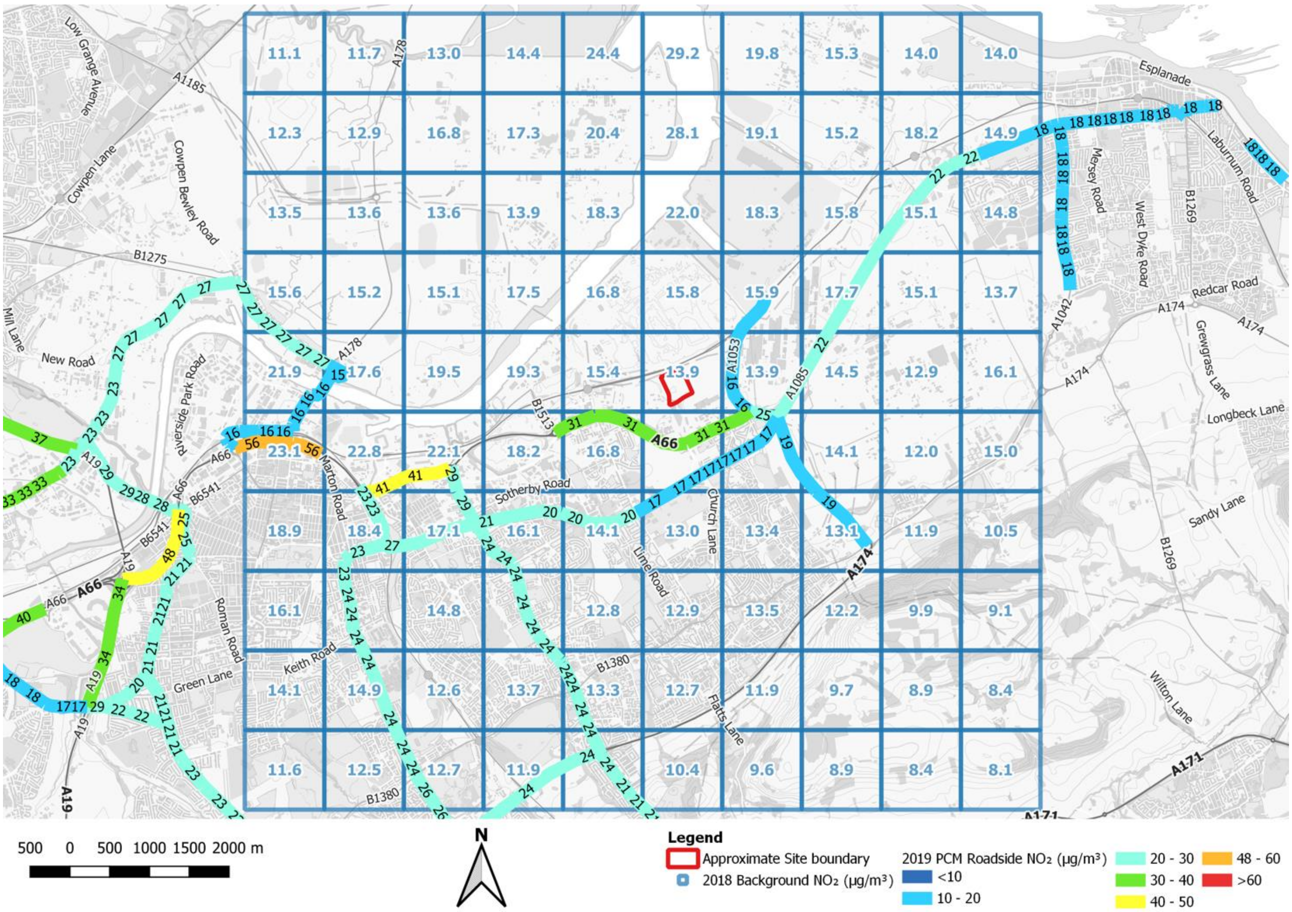

Figure 11: Roadside and Background Annual Mean NO_2 Concentrations Predicted by Defra and Site Location

4.6 Middlesbrough Predicted Roadside Concentrations

As part of Middlesbrough Borough Council's Local Nitrogen Dioxide Plan, annual mean NO_2 concentrations have been predicted at locations representative of limit value exposure within the boroughs of both Middlesbrough and Redcar and Cleveland. This includes a large number of locations within 5 km of the Proposed Facility.

Concentrations predicted at these receptors range between 12.5 – 24.9 µg/m³ in the year of 2018, see Figure 12.

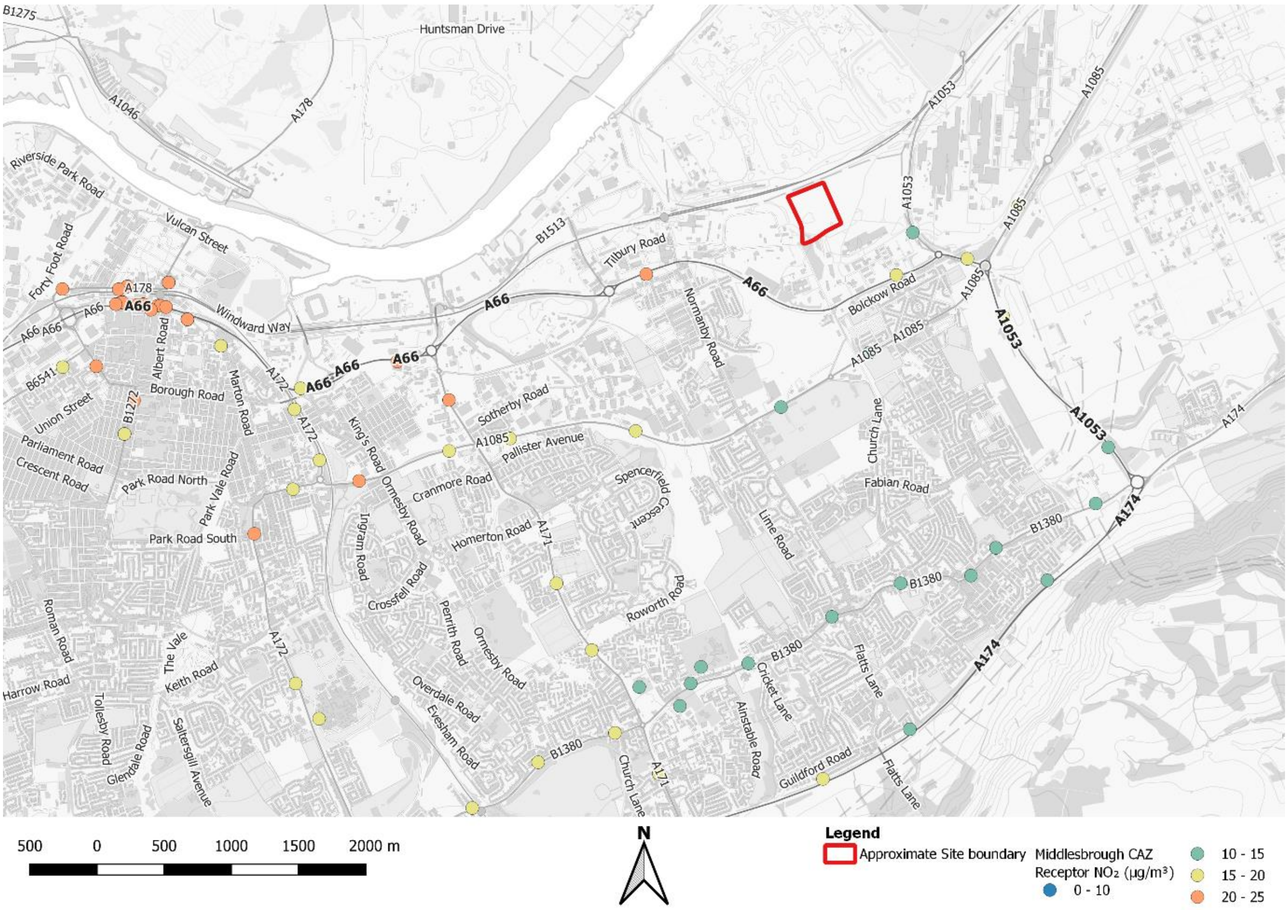

Figure 12: Predicted Annual Mean NO_2 Concentrations by Middlesbrough Borough Council

4.7 Ecological – Deposition Fluxes

The maximum background deposition fluxes to the Teesmouth and Cleveland Coast SAC, SPA and Ramsar have been taken from the APIS website (APIS, 2019), where they are reported as a three-year average (2015-2017). Background nutrient deposition rates exceeded the critical loads in this period, while the acid nitrogen deposition rate exceeded the CLminN critical load in this period and therefore is considered against the CLmaxN; the acid nitrogen and sulphur deposition rates are below the CLmaxN and CLmaxS critical loads (the relevant AQALs) in this period.

Table 24: Baseline Nitrogen Nutrient Deposition and Acidity Deposition

Pollutant	AQAL	Unit	Background
Nitrogen nutrient deposition	8	kg/ha/yr	17.78
Nitrogen acid deposition	1.998	keq/ha/yr	1.27
Sulphur acid deposition	1.56	keq/ha/yr)	0.42

[a] As a worst-case approach the more stringent AQAL application for location where lichens or bryophytes are present has been used, regardless of the presence of them at the site.

5. Assessment of impacts

The potential for air quality impacts during construction and operation of the Proposed Development are discussed in this section.

5.1 Construction Impacts

This sub section provides the results for earthworks, construction and trackout activities associated with the Proposed Development. Based on the impact assessment, appropriate mitigation has been identified.

The risk of dust impacts is based on the potential dust emissions magnitude and the sensitivity of the area. These two factors are then combined to determine the risk of dust impacts with no mitigation applied.

There are no designated ecological habitats within 50 m of the site or roads where dirt may be tracked out; the impacts on ecological receptors have therefore been screened out.

5.1.1 Potential Dust Emission Magnitude

5.1.1.1 Earthworks

The site covers approximately 100,000 m^2 and most of this area will require earthworks. The soil type is clayey loam to silty loam, medium to heavy grain sized. The potential dust emissions magnitude from earthworks is therefore considered to be large.

5.1.1.2 Construction

The total building volume for the proposed development is unknown, but the ERF building is expected to be approximately 441,000 m^3 and there will be additional ancillary buildings. The buildings will comprise of mainly concrete and metal. Construction activities are likely to include piling and onsite concrete batching. In accordance with the IAQM criteria, the potential dust emission magnitude from construction is therefore considered to be large.

5.1.1.3 Trackout

Initial information on the number of outward Heavy-Duty Vehicle (HDV) trips to be generated during the construction phase per day was not available at the time of writing this report. There is likely to be distances of unpaved road / tracks during the construction phase and given the size of the site there may be a maximum of more than 50 HDV outward movements per day. The potential dust emissions magnitude from trackout is therefore considered to be large.

Summary of Potential Dust Emission Magnitude

As outlined in the IAQM guidance, the scale and nature of the works has been assessed to determine the potential dust emissions magnitude for the Proposed Development site. Table 25 shows a summary of the classifications for the Proposed Development for each of the activities.

Table 25: Dust Emission Magnitude for the Proposed Development

Activity	Dust Emission Magnitude
Earthworks	Large
Construction	Large
Trackout	Large

5.1.2 Sensitivity of the Study Area

The area surrounding the site consists primarily of industrial premises. Figure 3 shows the Proposed Development location (red line) and a series of distance bands from the boundary of the site. Note that receptors identified at a greater distance than 350 m have not been included as the IAQM Guidance does not consider that there will be a material impact beyond this distance (see Appendix 2).

5.1.2.1 Sensitivity of the Study Area to Dust Soiling

The surrounding industrial area is considered to be of low sensitivity to dust soiling. There is one industrial receptor within 100 m of the Proposed Development and there are between 10 to 100 receptors within 350 m of the Proposed Development. Therefore, the area surrounding the site is considered to be low sensitivity.

For trackout, the distances are measured from the side of the roads used by construction traffic. Without site specific mitigation, trackout may occur from roads up to 500m from large development sites, as measured from the site exit, and up to 50m from the edge of the road (see Figure 4). The site has been classified as low sensitivity to dust soiling for trackout.

5.1.2.2 Sensitivity of the Study Area to the Health Effects of PM_{10}

Defra's modelled background PM_{10} concentrations for the existing year of 2018 is 13.6 µg/m^3. As the local PM_{10} concentration is under 24 µg/m^3, the area is considered to be of low sensitivity to the health effects of PM_{10} for all activities.

5.1.2.3 Summary of Sensitivity

The sensitivity of the area is summarised for each activity in Table 26.

Table 26: Sensitivity of the Surrounding Area

Potential Impact	Earthworks	Construction	Trackout
Dust Soiling	Low	Low	Low
Human Health	Low	Low	Low

5.1.3 Risk of Dust Effects

The dust emissions magnitude is combined with the sensitivity of the area to determine the risk of impacts with no mitigation applied. A summary of the unmitigated risk during each activity is provided in Table 27.

Table 27 Summary of Potential Unmitigated Dust Risks

Potential Impact	Earthworks	Construction	Trackout
Dust Soiling	Low Risk	Low Risk	Negligible
Human Health	Low Risk	Low Risk	Negligible

5.2 Operational Impacts

In this section the predicted concentrations resulting from the process (i.e. the process contribution (PC)) are presented and discussed with relation to the AQALs set out in Section 3.4.1. Where necessary the predicted environmental concentrations (PECs)[1] are considered accounting for the baseline concentrations.

As discussed previously, the results from each modelled meteorological year, meteorological site and for each building scenario have been compiled and the maximum value from any of the scenarios for each grid receptor has been used to create contours of the worst-case impact area based on the range of meteorological data. The impacts are therefore worst-case.

[1] Note: While the 'C' in PEC is 'concentration' the term PEC is also used to refer to deposition which is not strictly a concentration. i.e. PEC can mean total predict deposition.

5.2.1 Annual Mean Human Health Impacts

The annual mean AQAL applies at locations where members of the public might be regularly exposed, such as building façades of residential properties, schools, hospitals and care homes. Places of work, such as factories or offices, are not considered places where members of the public might be regularly exposed and therefore the AQAL's do not apply at these locations.

Annual mean impacts are initially considered based on the maximum PC anywhere in the modelled domain regardless of the presence of relevant exposure. Where the maximum PCs cannot be screened out, consideration of the presence of relevant exposure will be accounted for. Where the PC cannot be screened out at relevant exposure locations the baseline concentrations will be considered and the PEC assessed in relation to the AQAL based on the EPUK and the IAQM impact descriptors and assessment of significance approach.

The descriptive terminology developed jointly by EPUK and the IAQM, as described in Section 3.4.1.1, is based on values rounded to the nearest whole percent. Based on this, the annual mean impacts, presented to one decimal place, can be described as follows (as derived from Table 6):

- where the PC is less than 0.5% of the AQAL the impacts will be negligible, regardless of the location-specific total concentrations (PEC = PC plus baseline concentration);
- where the PC is between 0.5% and 1.5% of the AQAL the impacts will be negligible, as long as the location-specific total concentration (PEC) is below 94.5% of the AQAL;
- where the PC is between 1.5% and 5.5% of the AQAL the impacts will be negligible, as long as the location-specific total concentration (PEC) is below 75.5% of the AQAL; and
- non-negligible impacts descriptors are dependent on the matrix set out in Table 6 which is based on PC categories and total concentration (PEC) categories.

The NO_2, PM_{10} and $PM_{2.5}$ concentrations account for both the emissions from the stack and the development traffic.

5.2.1.1 Consideration of PC impacts anywhere in the modelled domain.

The maximum PCs from the development related emissions released are shown in Table 28.

There are a number of pollutants which cannot be screened out at this stage and required further consideration.

Where pollutants cannot be screened out, isopleths showing the areas of impacts based on the PCs are presenting in Appendix 7. For PM_{10}, the maximum PC shown in Table 28 marginally exceeds the screening threshold of 1%, however, when generating isopleths the maximum isopleth does not exceed 0.4 µg/m^3 (1% of the AQAL). For Group 1 and Group 3 metals a single isopleth for each is presented for information.

Table 28: Maximum Annual Mean PC at any Location (µg/m^3)

Pollutant	AQAL	PC as % of AQAL	Impacts
NO_2 [a]	40	5.3%	Further consideration required
NO_2 – Sensitivity Test [a]	40	11.8%	Further consideration required
Dust as PM_{10} [a]	40	1.1%	Further consideration required
Dust as $PM_{2.5}$ [a]	25	0.3%	Negligible
VOC as Benzene	5	3.3%	Further consideration required
VOC as 1,3-Butadiene	2.25	7.4%	Further consideration required
HCl	20	0.1%	Negligible
HF	16	0.1%	Negligible
NH_3	180	0.1%	Negligible

Pollutant		AQAL	PC as % of AQAL	Impacts
PAH as B(a)P		0.25	<0.1%	Negligible
Dioxins and furans (PCCD/F)		0.0000003	0.3%	Negligible
Polychlorinated biphenyls (PCBs)		0.2	<0.1%	Negligible
Group 1 metals	Cadmium	0.005	6.7%	Further consideration required
	Thallium	1	<0.1%	Negligible
Group 2 metals	Mercury	0.25	0.1%	Negligible
Group 3 metals	Antimony	5	0.1%	Negligible
	Arsenic	0.003	>110.5%	Further consideration required
	Chromium(III)	5	0.1%	Negligible
	Chromium(VI)	0.0002	>110.5%	Further consideration required
	Cobalt	1	0.5%	Further consideration required
	Copper	10	0.1%	Negligible
	Lead	0.25	2.0%	Further consideration required
	Manganese	0.15	3.3%	Further consideration required
	Nickel	0.02	25.0%	Further consideration required
	Vanadium	5	0.1%	Negligible

[a] Includes contribution of emissions direct from the stack associated with the Proposed Facility and from the changes in the road traffic on local roads.

5.2.1.2 Consideration of PC impacts at relevant AQO receptors.

With regards to the AQOs, the annual mean AQALs applies at locations where members of the public might be regularly exposed for long periods of time, such as building façades of residential properties, schools, hospitals and care homes. Places of work like factories or offices are not considered places where members of the public might be regularly exposed and therefore the AQALs do not apply at these locations. The AQAL derived from long-term EALs are assumed to apply at these same locations.

Table 29 presents the maximum PC at any of the relevant receptor locations modelled.

There are a number of pollutants which cannot be screened out at this stage and required further consideration.

Table 29: Maximum Annual Mean PC at Relevant Exposure Location

Pollutant	AQAL	PC as % of AQAL	Impacts
NO_2	40	2.2%	Further consideration required
NO_2 – Sensitivity Test	40	2.4%	Further consideration required
PM_{10}	40	0.1%	Negligible
VOC as Benzene	5	2.1%	Further consideration required
VOC as 1,3-but	2.25	4.6%	Further consideration required

Pollutant		AQAL	PC as % of AQAL	Impacts
PAH as B(a)P		0.0025	0.9%	Further consideration required
Dioxins and furans		0.0000003	0.2%	Negligible
PCBs		0.2	<0.1%	Negligible
Group 1 metals	Cadmium	0.005	4.2%	Further consideration required
Group 3 metals	Arsenic	0.003	>110.5%	Further consideration required
	Chromium(VI)	0.0002	>110.5%	Further consideration required
	Cobalt	1	0.3%	Negligible
	Lead	0.25	0.4%	Negligible
	Manganese	0.15	2.1%	Further consideration required
	Nickel	0.02	15.6%	Further consideration required

5.2.1.3 Further Consideration of Impacts.

Nitrogen Dioxide

The maximum annual mean NO_2 PC, at any relevant location in the study area, is 2.2% (2.4% for the road traffic emissions sensitivity test) which is above the 0.5% screening criteria.

Table 30 sets out the PC percentage category and the PEC percentage category for the specific receptors along with the corresponding impact descriptor based on Table 6.

Table 31 presents the impact descriptors based on the road traffic emission sensitivity test.

All impacts are described as negligible and the PECs are all well below the AQAL. There is no risk of an exceedance at AQAL at a relevant receptor location.

Table 30: Annual Mean PEC NO2 at Relevant Exposure Location

Receptors	% change relative to AQAL category	Concentration % Category	Impact Descriptor
1-12	1.5 to 5.5%	<75.5%	Negligible
13-39	0.5 to 1.5%	<75.5%	Negligible
40-41	1.5 to 5.5%	<75.5%	Negligible
42-52	0.5 to 1.5%	<75.5%	Negligible

Table 31: Annual Mean PEC NO2 Sensitivity Test at Relevant Exposure Location

Receptors	% change relative to AQAL category	Total Concentration % Category	Impact Descriptor
1-12	1.5 to 5.5%	<75.5%	Negligible
13-22	0.5 to 1.5%	<75.5%	Negligible
23	1.5 to 5.5%	<75.5%	Negligible
24-39	0.5 to 1.5%	<75.5%	Negligible
40-41	1.5 to 5.5%	<75.5%	Negligible

Receptors	% change relative to AQAL category	Total Concentration % Category	Impact Descriptor
42-52	0.5 to 1.5%	<75.5%	Negligible

Volatile Organic Compounds

If it is assumed that the entire VOCs emissions consist of only benzene the impact is 2.1% of the AQAL and if it is assumed the entire VOCs emissions consist of only 1,3-butadiene the impact is 4.6% of the AQAL.

As a worst-case approach the maximum measured concentration (which was measured in 2014) as set out in Table 15 has been taken to represent baseline concentrations of benzene in the study area, while the maximum measured concentrations (which was measured in 2000) as set out in Table 16 has been taken to represent baseline concentration of 1,3-butadiene in the study area.

The resultant PEC (sum of PC and baseline concentrations) are presented in Table 32 and Table 33 for benzene and 1,3-butadiene. The PECs are both well below the AQALs and therefore corresponding impact descriptor for VOCs is negligible based on the descriptors set out in Table 6.

Table 32: Maximum Annual Mean VOC as Benzene PEC at Relevant Exposure Location

AQAL	Baseline	PC	%PC of AQAL	PEC	%PEC of AQAL	% change relative to AQAL category	Total Concentration % Category	Impact Descriptor
5	1.38	0.10	2.1%	1.48	29.7%	1.5 to 5.5%	<75.5%	Negligible

Table 33: Maximum Annual Mean VOC as 1,3 But PEC at Relevant Exposure Location

AQAL	Baseline	PC	%PC of AQAL	PEC	%PEC of AQAL	% change relative to AQAL category	Total Concentration % Category	Impact Descriptor
2.25	0.23	0.10	4.6%	0.33	14.9%	1.5 to 5.5%	<75.5%	Negligible

Polycyclic Aromatic Hydrocarbons

The maximum PC assuming all PAH emissions are B(a)P is 0.9% of the AQAL which is above the screening criteria of 0.5%. Table 19 presents measured concentration of PAH. The maximum annual mean concentration for B(a)P was 0.49 ng/m^3, measured in 2014. The 2018 concentration is significantly lower.

As a pessimistic approach, this maximum value (measured in 2014) is assumed to represent the baseline concentration in the study area. Based on this, the PEC is predicted to be 68.9% of the AQAL. The impact is therefore described as negligible based on the descriptors set out in Table 6.

Table 34: Maximum Annual Mean PAH as B(a)P PEC at Relevant Exposure Location (ng/m^3)

AQAL	Baseline	PC	%PC of AQAL	PEC	%PEC of AQAL	% change relative to AQAL category	Total Concentration % Category	Impact Descriptor
0.25	0.17	0.002	0.9	0.172	68.9%	1.5 to 5.5%	<75.5%	Negligible

Group 1 metals

The maximum annual mean cadmium PC, at any location in the study area, regardless of the presence of relevant exposure, is 6.7% which is above the 0.5% screening criteria. The maximum annual mean Cadmium PC, at any location of relevant exposure in the study area, is 4.2% which is above the 0.5% screening criteria.

Table 21 represents measured 2018 annual mean concentrations for a range of heavy metals including cadmium (Cd). The maximum from any of the sites shown in the table has been used to represent a pessimistic baseline concentration in the study area. This maximum PEC is 16.8% of the AQAL, accounting for the PC the impact is described as negligible based on the descriptors set out in Table 6.

Table 35: Maximum Annual Mean Cadmium PEC at Relevant Exposure Location (ng/m^3)

AQAL	Baseline	PC	%PC of AQAL	PEC	%PEC of AQAL	% change relative to AQAL category	Total Concentration % Category	Impact Descriptor
5	0.63	0.21	4.2%	0.84	16.8%	1.5 to 5.5%	<75.5%	Negligible

Group 3 metals

Each metal is initially considered assuming that metal comprises of 100% of the Group 3 metal emission. Based on this:

- antimony, chromium(III), copper and vanadium impacts are described as negligible based on their maximum PCs anywhere in the study area being less than 0.5% of the AQAL, regardless of the presents of relevant exposure, see Table 28.
- At locations of relevant exposure the impacts of cobalt and lead can also be described as negligible based on their maximum PCs being less than 0.5% of the AQAL, see Table 29.
- Further consideration is required for arsenic, chromium(VI), manganese and Nickel.

Given that the Group 3 total metal emissions will be made up of a proportion of each metal, assuming the entire emission is each metal is pessimistic. The EA have provided a range of typical Group 3 emissions based on measurements. The maximum, mean and minimum measured concentrations in ERF plant are set out in Table 11. Table 36 presents the maximum PCs at relevant exposure locations using the range of pollutant emission concentrations set out in Table 11.

Using the maximum magnesium measured emission concentration from Table 11, the impact can be described as negligible based on the maximum PC being less than 0.5% of the AQAL. As this represents the maximum likely emission the impacts do not need to be considered further.

Table 36: Group 3 Metal Maximum Annual Mean PC at Relevant Exposure Location Based on Typical Emissions

Pollutant	AQAL	PC as % of AQAL	Impact descriptor
Maximum Table 11 emission			
Arsenic	0.003	8.7%	Further consideration required
Chromium(VI)	0.0002	0.7%	Further consideration required
Manganese	0.15	0.4%	Negligible
Nickel	0.02	11.5%	Further consideration required
Mean Table 11 emission			
Arsenic	0.003	0.3%	Negligible

Pollutant	AQAL	PC as % of AQAL	Impact descriptor
Chromium(VI)	0.0002	0.2%	Negligible
Manganese	0.15	0.1%	Negligible
Nickel	0.02	0.8%	Further consideration required
Minimum Table 11 emission			
Arsenic	0.003	<0.1%	Negligible
Chromium(VI)	0.0002	<0.1%	Negligible
Manganese	0.15	<0.1%	Negligible
Nickel	0.02	0.1%	Negligible

Based on the mean and minimum arsenic emission concentrations shown in Table 11, the impacts of arsenic can be described as negligible based on the maximum PCs being less than 0.5% of the AQAL.

As a robust assessment, the PECs have been calculated assuming the emission concentration are the those set out as maximum in Table 11 and accounting for the likely baseline concentrations. Table 21 represents measured 2018 annual mean concentrations for a range of heavy metals including arsenic (As) and total chromium (Cr). The maximum from any of the sites shown in the table has been used to represent a pessimistic baseline concentration in the study area. The measurements from Sheffield Tinsley are much higher than the other sites and may be considered an outlier. However, this data has been used as a conservative approach. Furthermore, with regards to chromium(VI), using total chromium as the baseline is a worst-case approach.

In regards to arsenic, the maximum PEC is 43.0% of the AQAL, accounting for the PC (8.7% of the AQAL) based on the maximum emission concentration set out in Table 11 the impact is described as slight adverse. Based on the mean and minimum emission concentrations in Table 11, the impact is described as negligible. The PECs and impact descriptor at the location with greatest impact are shown in Table 37.

Table 37: Maximum Annual Mean Arsenic PEC at Relevant Exposure Location (ng/m^3)

AQAL	Baseline	PC	%PC of AQAL	PEC	%PEC of AQAL	% change relative to AQAL category	Total Concentration % Category	Impact Descriptor
Maximum Table 11 emission								
3	1.03	0.26	8.7%	1.29	43.0%	5.5 to 10.5%	<75.5%	Slight Adverse

Based on the mean and minimum chromium(VI) emission concentrations shown in Table 11, the impacts of this metal can be described as negligible based on the maximum PCs being less than 0.5% of the AQAL.

The maximum chromium(VI) PC based on the maximum emission concentration set out in Table 11 is 0.9% of the AQAL. Background measurements of total chromium are presented in Table 21 for a number of sites across the country. None of the sites are near to the study area. All measurements of total chromium were well above the AQAL for chromium(VI).

Guidance from the EA[26] suggests as a pessimistic approach where 20% of total chromium can be assumed to be chromium(VI), the guidance states that proportions below this need to be evidenced. Based on this, the range of baseline concentrations are set out in Table 38 using the range of measured chromium concentrations set out in Table 21. Assuming 20% of the total baseline chromium is chromium(VI) and the PC is a maximum of 0.7% of the AQAL, the corresponding impact descriptors are moderate adverse, these descriptors are driven by the high baseline concentration rather than the PC.

While it is not possible to set out the actual impact of chromium(VI) without a detailed understanding of the baseline chromium(VI) concentrations, based on the maximum emission concentration for chromium(VI) the impact is only marginally above the screening criterion of 0.5% and the contribution to the worst-case PEC is <1%. Using a slightly less stringent requirement of 1% at the screening threshold, it is considered that overall the impact is negligible.

Table 38: Maximum Annual Mean Chromium(VI) PEC at Relevant Exposure Location (pg/m^3)

AQAL	Baseline	PC	%PC of AQAL	PEC	%PEC of AQAL	% change relative to AQAL category	Total Concentration % Category	Impact Descriptor	%PC of PEC
200	226	1.35	0.7%	227.4	113.7%	0.5 to 1.5%	>110.5%	Moderate Adverse	0.6%
	662			663.4	331.7%		>110.5%		0.2%
	564			565.4	282.7%		>110.5%		0.2%
	864			865.4	432.7%		>110.5%		0.2%
	1,176			1,177.4	588.7%		>110.5%		0.1%
	7,672			7,673.4	3,836.7%		>110.5%		0.0%

Based on the minimum nickel emissions concentration shown in Table 11, the impacts of this metal can be considered negligible, as shown in Table 36.

As a robust assessment, the nickel PECs are calculated, assuming the emissions concentrations are the maximum and mean as set out in Table 11, and accounting for the likely baseline concentrations. Table 21 represents measured 2018 annual mean concentrations for a range of heavy metals including nickel (Ni). The range of measured concentrations from the sites shown in the table has been used to represent a pessimistic baseline concentration in the study area. The measurements from Sheffield Tinsley are significantly higher than the other sites and may be considered an outlier. However, this data has been included as a pessimistic approach.

Using the Sheffield Tinsley data and the maximum emission (Table 11) the nickel PEC is 103.1% of the AQAL at the location with the greatest impact. The impact is described as substantial adverse. Considering the measured concentrations at the five other monitoring sites, the greatest nickel PEC based on the maximum nickel emission is 23.5% of the AQAL (well below the PEC), however, the impact is described as moderate adverse due to the PC being greater than 10.5% regardless of the low PEC. Should the Facility specific nickel emissions be as high as the maximum measured emission for existing facilities there is a potential for an adverse impact. However, is should be noted that the PEC is expected to be well below the AQAL (<75.5%).

Table 39: Maximum Annual Mean Nickel PEC at Relevant Exposure Location (ng/m^3)

AQAL	Baseline	PC	%PC of AQAL	PEC	%PEC of AQAL	% change relative to AQAL category	Total Concentration % Category	Impact Descriptor
Maximum Table 11 emission								
20	0.24	2.29	11.5%	2.53	12.7%	>10.5%	<75.5%	Moderate Adverse
20	1.24			3.53	17.7%		<75.5%	Moderate Adverse
20	1.16			3.45	17.3%		<75.5%	Moderate Adverse
20	1.25			3.54	17.7%		<75.5%	Moderate Adverse

AQAL	Baseline	PC	%PC of AQAL	PEC	%PEC of AQAL	% change relative to AQAL category	Total Concentration % Category	Impact Descriptor
20	2.40			4.69	23.5%		<75.5%	Moderate Adverse
20	18.33			20.62	103.1%		103.5 to 110.5%	Substantial Adverse
Mean Table 11 emission								
20	0.24	0.16	0.8%	0.40	2.0%	0.5 to 1.5%	<75.5%	Negligible
20	1.24			1.40	7.0%		<75.5%	Negligible
20	1.16			1.32	6.6%		<75.5%	Negligible
20	1.25			1.41	7.0%		<75.5%	Negligible
20	2.40			2.56	12.8%		<75.5%	Negligible
20	18.33			18.48	92.4%		<94.5%	Negligible

5.2.2 Short-term Human Health Impacts

Short-term mean impacts are initially considered based on the maximum PC anywhere in the modelled domain regardless of the presence of relevant exposure. Where the PC cannot be screened out the baseline concentrations are considered to calculate the PEC. Where the PEC exceeds the AQAL the presence of relevant exposure is considered.

Locations of relevant exposure for the 8-hour and 24-hour mean AQALs are considered to be at locations where the annual mean AQALs apply and at hotels and gardens of residential properties. Locations of relevant exposure for the 15-minute and 1-hour mean AQALs are considered to be at the annual mean locations of exposure and at hotels, residential gardens and any outdoor location where members of the public might reasonably be expected to spend 15-minutes or 1-hour, or longer, such as busy pavements, outdoor bus stations and locations with outdoor seating.

From the EPUK and IAQM guidance it can be inferred that any change in concentration smaller than 10% of the short-term mean AQAL will be insignificant, regardless of the existing air quality conditions.

The maximum short-term PCs from the development related emissions released are shown in Table 40. The NO_2, PM_{10} and $PM_{2.5}$ concentrations account for both the emissions from the stack and the emissions associated with the changes in traffic on local roads. There are a number of pollutants which cannot be screened out at this stage and required further consideration these include:

- 15-minute mean SO_2;
- 1-hour mean dimethyl sulphate; and
- 1-hour mean vanadium.

Where pollutants cannot be screened out, isopleths showing the areas of impacts based on the PCs are presenting in Appendix 7.

Table 40: Maximum Short-Term Mean PC at any Location (µg/m^3)

Pollutant	Time period	AQAL	PC as % of AQAL	Screening threshold = 10%
NO_2	1-hour	200	8.9%	Insignificant
NO_2 – Sensitivity test	1-hour	200	9.0%	Insignificant

Pollutant		Time period	AQAL	PC as % of AQAL	Screening threshold = 10%
PM_{10}		24-hour	50	1.8%	Insignificant
SO_2		15-minute	266	21.2%	Further consideration required
		1-hour	350	3.5%	Insignificant
		24-hour	125	3.9%	Insignificant
CO		Maximum daily 8-hour	10000	0.2%	Insignificant
		1-hour	30000	<0.1%	Insignificant
Dimethyl sulphate		1-hour	15.6	49.6%	Further consideration required
HCl		1-hour	750	0.6%	Insignificant
HF		1-hour	160	0.5%	Insignificant
NH_3		1-hour	2500	0.3%	Insignificant
PCBs		1-hour	6	<0.1%	Insignificant
Group I	Thallium	1-hour	30	0.1%	Insignificant
Group 2	Mercury	1-hour	7.5	0.2%	Insignificant
Group 3	Antimony	1-hour	150	0.2%	Insignificant
	Chromium(III)	1-hour	150	0.2%	Insignificant
	Chromium(VI)	1-hour	15	1.5%	Insignificant
	Cobalt	1-hour	30	0.8%	Insignificant
	Copper	1-hour	200	0.1%	Insignificant
	Manganese	1-hour	1500	<0.1%	Insignificant
	Vanadium	1-hour	1	23.2%	Further consideration required

5.2.2.1 Further consideration of Impacts

Sulphur Dioxide (SO_2)

The maximum predicted impact of 15-minute mean SO_2 emissions cannot be screened out as insignificant based on the PC (the PC is 21.2% of the AQAL). A representative short-term baseline concentration has been calculated as twice the annual mean baseline concentration following Environment Agency advice. Local measured annual mean concentrations are presented in Table 12 for 2014-2018. As a pessimistic approach the maximum estimated concentration is 8 $\mu g/m^3$ (2 x 4 $\mu g/m^3$). The resultant PEC (sum of PC and baseline concentrations) are presented in Table 41. The PEC is well below the AQAL (25% of the AQAL) and the risk of an exceedance is extremely low and therefore the impact is insignificant.

Table 41: Maximum 15-minute mean SO2 PEC

AQAL	Baseline	PEC	%PEC of AQAL	Impact
266	8	66.4	25.0%	Insignificant

VOCs

The maximum 1-hour mean PC, at any location in the study area, regardless of the presence of relevant exposure and assuming the entire VOC emission is dimethyl sulphate is 49.6% of the AQAL which is above the 10% screening criteria.

There is no information on a representative short-term baseline concentration in the local study area. Furthermore, dimethyl sulphate has a limited lifetime of approximately 9 days in the atmosphere. For there to be an exceedance of the AQAL there would need to be a local source were the impacts combine to exceed the AQAL. Dimethyl sulphate is the diester of methanol and sulfuric acid and significant levels of methanol and sulfuric acid would be required in the exhaust to generate high emissions of dimethyl sulphate. Given that the overly pessimistic scenario has been assumed where all VOC emissions are dimethyl sulphate and that the maximum PC based on this does not exceed the AQAL, it is considered that no exceedences will be caused by the Proposed Facility. As such the impacts are considered insignificant.

Group 3 metals

Each metal is initially considered assuming that metal comprises of 100% of the Group 3 metal emission. Based on this:

- antimony, chromium(III), chromium(VI), cobalt, copper and manganese impacts are screened out as insignificant based on their maximum PCs anywhere in the study area (<10% of the AQAL), regardless of the presents of relevant exposure, see Table 40; and
- further consideration is required for vanadium.

Given that the Group 3 total metal emissions will be made up of a proportion of each metal, assuming the entire emission is each metal is pessimistic. The EA have provided a range of typical Group 3 emissions based on measurement. The emissions are provided for the maximum, mean and minimum emission concentration in Table 11. The maximum PCs for vanadium at any location in the study area, regardless of the presence of relevant exposure, based on the emission concentrations set out in Table 11, are shown in Table 42.

Based on the maximum, mean and minimum vanadium measured emissions, the impacts can all be screened out as insignificant without consideration of the PECs (i.e. the PCs are <10% of the AQAL).

Table 42: Group 3 Metal Maximum 1-hour Mean Vanadium PC Based on Typical Emissions

AQAL	AQAL	PC as % of AQAL	Screened out
Maximum Table 11 emission	1	0.2%	Yes
Mean Table 11 emission		<0.1	Yes
Minimum Table 11 emission		<0.1	Yes

5.2.3 Ecological Impacts

The Teesmouth and Cleveland Coast ecological site is located within the study area and is classified as a Ramsar, SPA and SSSI site.

Following the approach set out in the IAQM guidance the percentage PC compared to the relevant AQAL has been calculated. Where long-term PCs are below 1% of the AQAL, the impacts can be considered insignificant. Where the PC is greater than 1% the baseline levels need to be considered.

Where short-term PCs are below 10% of the AQAL the impacts are considered insignificant.

The maximum contribution from the operation of the Proposed Facility to the critical levels and both the nitrogen nutrient deposition and total acidity deposition at the designated ecological sites located within the study area are shown in Table 43 and Table 44.

Table 43: PC Concentrations (μg/m³)

Pollutant	Time period	AQAL	PC	%PC of AQAL	Screened out
NOx	Annual	30	1.00	3.3	No
	24-hour	200	4.38	4.4	Yes
NH_3	Annual	1	0.15	15.3	No
SO_2	Annual	20	<0.01	<0.1	Yes

Table 44: PC Deposition (kg/ha/yr)

Pollutant	Time period	AQAL	PC	%PC of AQAL	Screened out
Nitrogen nutrient (kg)	Annual	8	0.75	9.4%	No
Total acid (keq)	Annual	1.56	0.10	6.3%	No

5.2.3.1 Nitrogen Oxides (NOx)

Baseline annual mean NOx concentrations at the Teesmouth and Cleveland Coast ecological site exceed the critical level regardless of the emissions associated with the proposed development. The PC is 3.3% of the AQAL and therefore cannot be screened out as insignificant and there is the potential for significant effects. The impacts need to be considered by an ecologist to determine whether the effects are significant, in particular, for the internationally designated areas, whether it will adverse effect the integrity of the site.

Table 45: Nitrogen Oxides (μg/m³)

Pollutant	Time period	AQAL	Baseline	%Baseline of AQAL	PC	PEC	%PC of PEC
NOx	Annual	30	51.16	170.5%	1.00	51.49	1.9%

5.2.3.2 Ammonia (NH_3)

The critical level (AQAL) for NH_3 is considered to be 1 μg/m³ where lichens or bryophytes (including mosses, landworts and hornwarts) are present and 3 μg/m³ where they're not present.

The maximum PC is 15.3% of the AQAL for locations where lichens or bryophytes are present and 5.0% where they are not present. Regardless of the presence of lichens or bryophytes the PC is above the 1% screening level. As such the potential for significant effects cannot be discounted.

Table 18 presents measured concentrations of NH_3, and as a conservative approach, this maximum value (measured in 2017 at Brompton, 27 km from the Proposed Facility) is assumed to represent the baseline concentration in the study area. This baseline concentration exceeds the AQAL without the operation of the Proposed Facility. The High Muffles and May Moss monitoring sites both measured concentrations of ~1 μg/m³, significantly lower than the Brompton site. Location specific baseline would need to be considered to understand the impact and any potential effects considered by an ecologist.

Table 46: Ammonia (μg/m³)

AQAL	Baseline	%Baseline of AQAL	PC	%PC of AQAL	PEC	%PC of PEC
1	8.28	828%	0.15	15.3%	8.43	1.8%

AQAL	Baseline	%Baseline of AQAL	PC	%PC of AQAL	PEC	%PC of PEC
3		76%		5.0%		

5.2.3.3 Nitrogen nutrient deposition

The nitrogen nutrient baseline deposition set out in Table 24 exceeds the minimum critical level (AQAL) of 8 kg/ha/yr regardless of the operation of the Proposed Facility. The maximum PC from the Proposed Facility anywhere within the Teesmouth and Cleveland Coast ecological site is 0.75 kg/ha/yr, which is 9.4% of the AQAL. As such the potential for significant effects cannot be discounted. The significance of effects will need to be assessed by an ecologist.

Table 47: Annual Nitrogen Nutrient PEC Deposition (kg/ha/yr)

AQAL	Baseline	%baseline of AQAL	PC	%PC of AQAL	PEC	%PC of PEC
8	17.78	17.78	0.75	9.4	17.84	4.2

5.2.3.4 Acidity deposition

The total acid deposition is dependent on the baseline deposition and the deposition from the facility. The critical load functions for the habitats identified as sensitive to acid deposition from the APIS website are shown in Figure 13 and Figure 14. The critical load function is provided as a minimum (blue) and maximum (red) across the ecological site.

In consideration of the acidity PC from the Proposed Facility, assessed against the CLmaxN level from the critical load function for the minimum critical load at the ecological site (the value corresponding to where the blue (minimum load) intersects the x axis), the percentage of the PC in relation to this for acid grassland is 4.9% and for calcareous grassland is 2.0% i.e. more than 1% of the AQAL. Where this level is greater than 1% the potential for significant effects cannot be discounted.

The baseline deposition and total acid deposition are shown in Figure 13 and Figure 14 for relevant habitats on APIS. The total deposition is below the minimum critical load (blue line) at both acid and calcareous grassland habitats.

Where the total deposition is below the critical loads significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge, although this will be to be assessed by an ecologist.

Table 48: Annual Total Acid (PEC) Deposition (keq/ha/yr)

AQAL	Baseline	%baseline of AQAL	PC	%PC of AQAL	PEC	%PC of PEC
See graph	1.69	-	0.10 [a]	-	1.79	-

[a] From NOx + NH_3 + SO_2 + HCl + HF

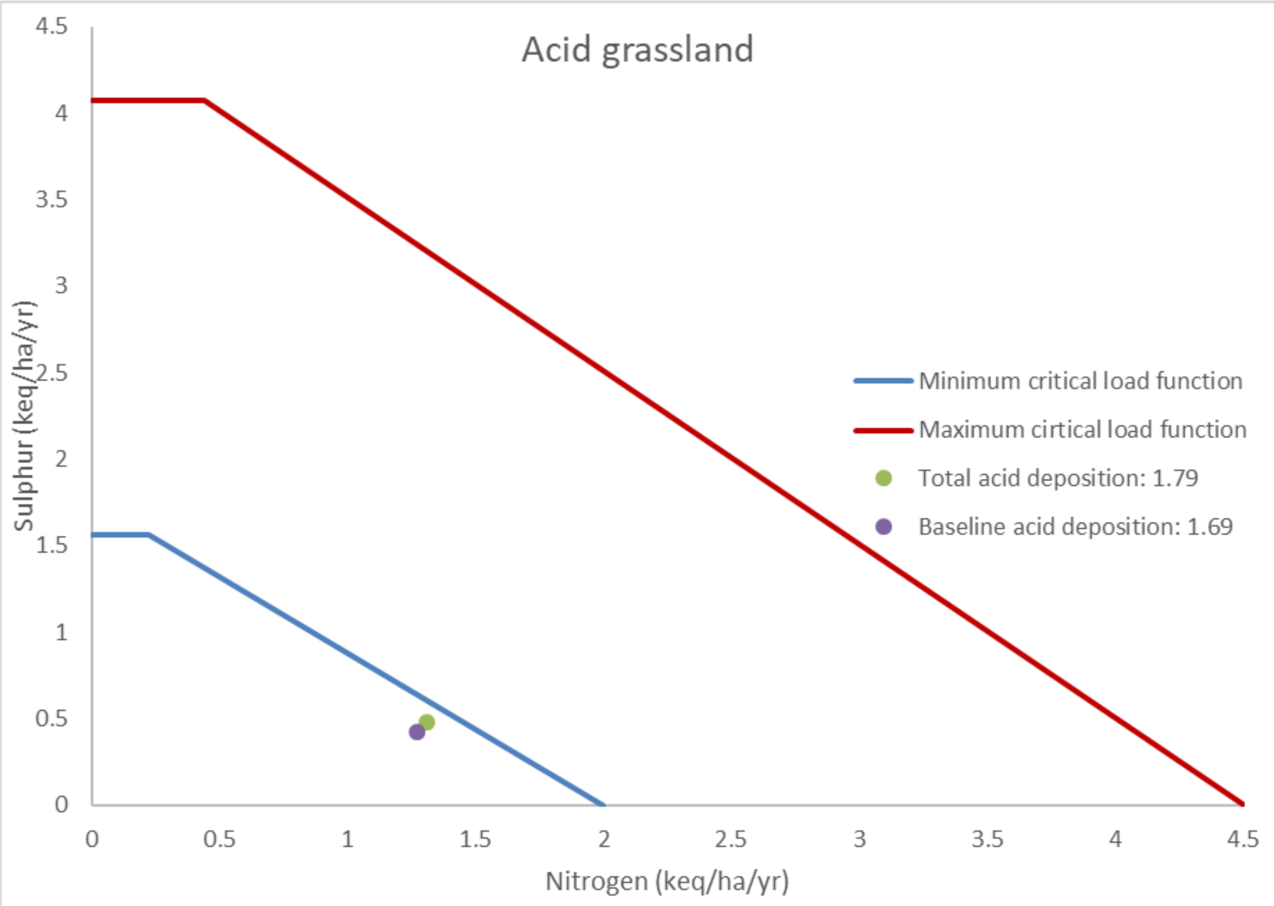

Figure 13: Critical Load Function for Acid grassland within the Teesmouth and Cleveland Coast Ecological Site

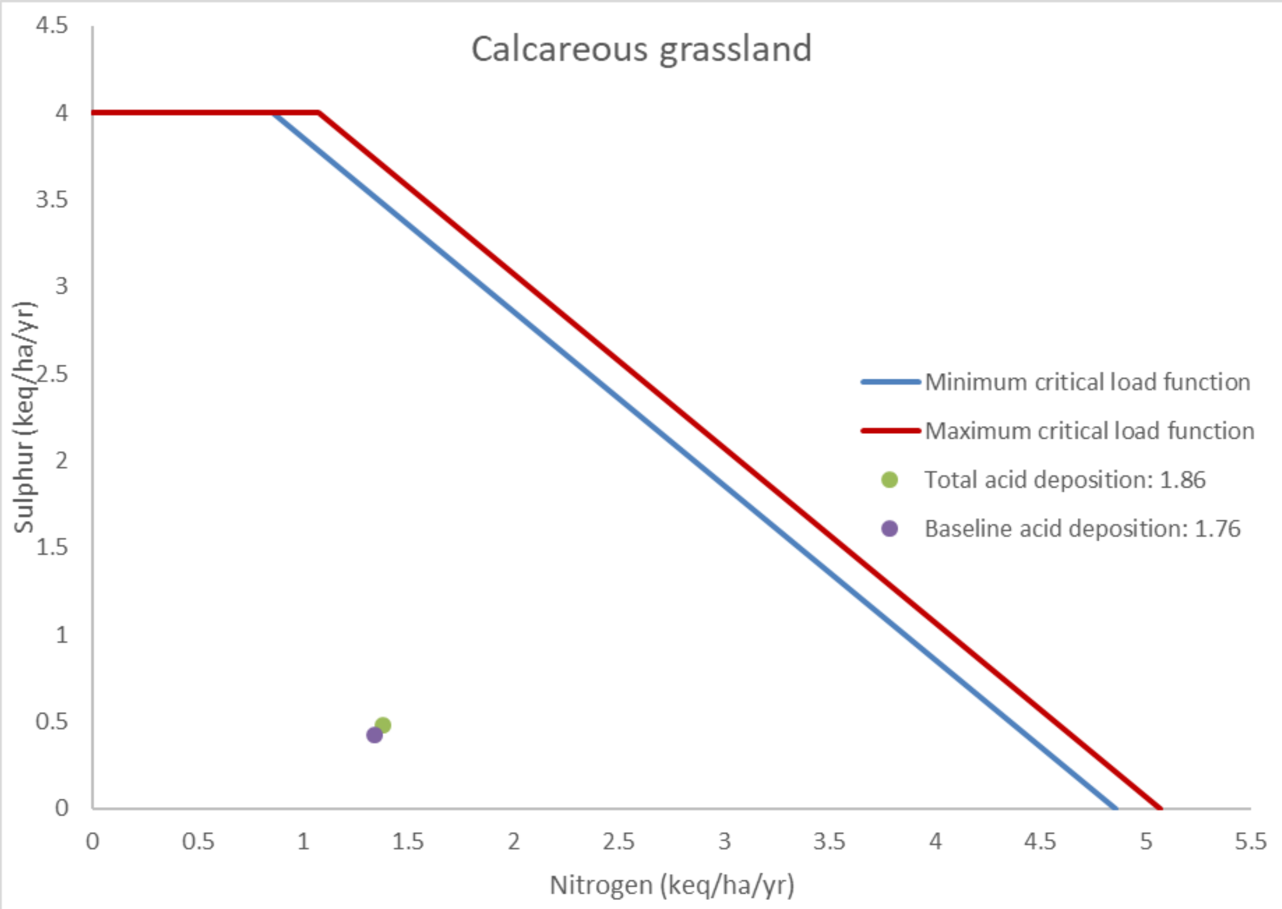

Figure 14: Critical Load Function for Calcareous Grassland within the Teesmouth and Cleveland Coast Ecological Site

5.2.4 Summary of Impacts

Table 49 summarises the human health impact descriptors for each pollutant considered.

Table 50 and Table 51 summarises where impacts on ecological sites can be considered insignificant and a potential for a significant effect cannot be discounted with further analysis from an ecologist.

Table 49: Human Health Impact Descriptors

Pollutant	Annual mean	Short-term mean
NO_2	Negligible	Insignificant
Dust as PM_{10} [a]	Negligible	Insignificant
Dust as $PM_{2.5}$ [a]	Negligible	-
SO2	-	Insignificant
VOC	Negligible	Insignificant
HCl	Negligible	Insignificant
HF	Negligible	Insignificant
NH_3	Negligible	Insignificant

Pollutant		Annual mean	Short-term mean
PAH as B(a)P		Negligible	-
Dioxins and furans (PCCD/F)		Negligible	-
Polychlorinated biphenyls (PCBs)		Negligible	Insignificant
Group 1 metals	Cadmium	Negligible	-
	Thallium	Negligible	Insignificant
Group 2 metals	Mercury	Negligible	Insignificant
Group 3 metals	Antimony	Negligible	Insignificant
	Arsenic	Negligible to Slight Adverse Depending on Emission	-
	Chromium(III)	Negligible	Insignificant
	Chromium(VI)	Negligible to Moderate Adverse Depending on Emission and Specific baseline concentration	Insignificant
	Cobalt	Negligible	Insignificant
	Copper	Negligible	Insignificant
	Lead	Negligible	-
	Manganese	Negligible	Insignificant
	Nickel	Negligible	-
	Vanadium	Negligible	Insignificant

Table 50: Ecological Critical Level Impacts

Pollutant	Long-term mean	Short-term mean
NOx	Potential for significant effects cannot be discounted	Insignificant
NH_3	Potential for significant effects cannot be discounted	-
SO_2	Insignificant	-

Table 51: Ecological Critical Load Impacts

Pollutant	Long-term mean
Nitrogen nutrient (kg)	Potential for significant effects cannot be discounted
Total acid (keq)	Potential for significant effects cannot be discounted

5.2.5 Significance of Operational Air Quality Effects

The operational air quality effects on human health without mitigation are judged to be not significant. This professional judgement is made in accordance with the methodology and assessment criteria set out earlier in this report and takes account of the assessment that:

- the annual mean impacts of pollutant emissions in relation to the human health receptors are negligible based on the location with the greatest impact for the vast majority of pollutants as set out in Table 49;
- two group 3 metals (arsenic and chromium(VI)) have the potential for significant adverse effects based on the maximum emissions measured from existing similar facilities. However, based on the average emissions from existing facilities, which are more likely, the impacts are descripted as negligible; and
- the short-term mean impacts of pollutant emissions in relation to the human health receptors are insignificant.

The operational air quality effects on sensitive habitats without mitigation are judged to be potentially significant due to current exceedances of the AQALs. Consideration of whether these impacts cause a significant effect need to be assessed by a suitably experienced ecologist.

5.3 EU Limit Value Impact Assessment

In this section the predicted concentrations resulting from the Proposed Facility (i.e. the process contribution (PC)) are presented and discussed in relation to the air quality limit values. The baseline concentrations have been defined by the roadside modelling carried out Middlesbrough Borough Council's Local Nitrogen Dioxide Plan as part of Defra's commitment to report exceedences of the NO_2 limit value to the EU.

Annual mean NO_2 concentrations have been predicted at locations representative of limit value exposure within the boroughs of both Middlesbrough and Redcar and Cleveland. Concentrations predicted at the receptors within 5 km of the Proposed Facility range between 12.5 – 24.9 $\mu g/m^3$ in the year of 2018, see Figure 12. The concentrations are predicted to be below the limit values at the locations within 5 km of the Proposed Facility.

Table 52 presents the maximum Middlesbrough Borough Council's Local Nitrogen Dioxide Plan predicted concentration and the PC form the Proposed Development. The maximum predicted concentration accounting for emissions related to the Proposed Facility at the relevant limit value receptors are all well below the limit value and the impacts are therefore insignificant. The proposed development will not change the outcome of the Middlesbrough Borough Council's Local Nitrogen Dioxide Plan or delay compliance with the limit values.

Table 52: NO_2 Limit Value Concentrations ($\mu g/m^3$)

AQAL	Baseline	PC	%PC of AQAL	PEC	%PEC of AQAL	Impact
40	24.9	2.1	5.3%	27.0	67.6%	Limit Value not exceeded

6. Cumulative Impacts

A number of operational, consented, or pending, schemes have been identified in the study area. However, given this is an outline planning application it is not practical at this stage nor possible to model emissions from these cumulative developments. Cumulative impacts will be assessed within the detailed planning application.

7. Mitigation

7.1 Mitigation Included by Design

During the Environmental Permitting process, the Proposed Facility will be required to demonstrate that Best Available Techniques (BAT) have been implemented. This includes a number on design features of the facility. The latest BREF note sets out BAT for facilities such as this.

7.2 Recommended Mitigation

7.2.1 Construction

To mitigate the potential impacts during the construction phase, it is recommended that mitigation measures consistent with the IAQM guidance are implemented. These mitigation measures have been selected for the Proposed Development and are based upon the dust risk categories outlined in Section 5.1.3 of this assessment.

It is recommended that the local planning authority approve a Dust Management Plan prior to works commencing on site, and that this is implemented using an appropriately worded planning condition. The table below details the measures that should be incorporated in the Dust Management Plan.

Table 53: Fugitive dust mitigation measures that are applicable to the Proposed Development

Issue	Mitigation Measure
Communications	Display the name and contact details of person(s) accountable for air quality and 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
Dust Management Plan	Develop and implement a Dust Management Plan (DMP), which may include measures to control emissions, approved by the Local Authority. The DMP may include visual inspections.
Site Management	Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken
	Make the complaints log available to the Local Authority when asked
	Record any exceptional incidents that cause dust and/or air emissions, either on- or off- site, and the action taken to resolve the situation in the log-book
Monitoring	Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the Local Authority when asked. This should include regular dust soiling check of surfaces such as street furniture, cars, window-sills within 100m of the site boundary, with cleaning to be provided if necessary

Issue	Mitigation Measure
	Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the Local Authority when asked
	Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions
Preparing and maintaining the site	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible
	Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site
	Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period
	Avoid site runoff of water or mud
	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 cover as described below
	Cover, seed or fence stockpiles to prevent wind whipping
Operating vehicle/machinery and sustainable travel	Ensure all vehicles switch off engines when stationary – no idling vehicles.
	Avoid the use of diesel or petrol-powered generators and use mains electricity or battery powered equipment where practicable
	Impose and signpost a maximum-speed-limit of 15 mph on surfaced and 10 mph on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the Local Authority, where applicable)
Operations	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

Issue	Mitigation Measure
	Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate
	Use enclosed chutes and conveyors and covered skips
	Minimize drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever 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
Waste management	Avoid bonfires and burning of waste materials
Construction	Avoid scrabbling (roughening of concrete surfaces) if possible
	Ensure sand and other aggregates are stored in bunded 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

7.2.2 Operational

No further operational mitigation measures are proposed other than those included by design.

8. Residual impacts

8.1 Construction

Assuming the relevant mitigation measures outlined in the mitigation section are implemented through, for example, a planning condition, the residual effect from dust generating activities associated with this phase of the Proposed Development is considered to be not significant.

8.2 Operation

The residual impacts will remain the same as those set out in section 5.2.5.

9. Summary

This report describes the potential air quality impacts associated with the construction and operation of the proposed Energy Receovery facility in Grangetown Prairie.

The impacts of the construction works on dust and ambient PM_{10} concentrations have been assessed and the risk of dust causing a loss of local amenity and increased exposure to PM_{10} concentrations during construction works has been used to identify appropriate mitigation measures. Provided these are implemented, for example through a planning condition, the residual impacts are considered to be not significant.

The operational impacts of emissions from the Proposed Facility's stack and the development traffic have been predicted. The impacts have been assessed against the relevant air quality assessment levels taking into account relevant exposure.

During the Environmental Permitting process, the Proposed Facility will be required to demonstrate that Best Available Techniques (BAT) have been implemented. This will impact on the design of the facility. The 2019 BREF note sets out BAT for facilities such as this.

The operational air quality effects on human health are judged to be not significant. This professional judgement is made in accordance with the methodology and assessment criteria set out earlier in this report and takes account of the assessment that:

- the annual mean impacts of pollutant emissions in relation to the human health receptors are negligible based on the location with the greatest impact for the vast majority of pollutants as set out in Table 49;
- two group 3 metals (arsenic and chromium (VI)) have the potential for significant adverse effects based on the maximum emissions measured from existing similar facilities. However, based on the average emissions from existing facilities, which are more likely, the impacts are descripted as negligible; and
- the short-term mean impacts of pollutant emissions in relation to the human health receptors are insignificant.

The operational air quality effects on sensitive habitats without mitigation are judged to be potentially significant due to current exceedances of the AQALs. Consideration of whether these impacts cause a significant effect need to be assessed by a suitably experienced ecologist.

The maximum predicted concentration with the Proposed Facility at the limit value receptors are all well below the limit value and the impacts are therefore insignificant. The proposed development will not change the outcome of the Middlesbrough Borough Council's Local Nitrogen Dioxide Plan or delay compliance with the limit values.

10. Glossary of terms.

Air Quality Standards	Concentrations recorded over a given time period, which are considered to be acceptable in terms of what is scientifically known about the effects of each pollutant on health and on the environment.
An exceedence	A period of time (defined for each standard) where the concentration is higher than that set out in the Standard.
An objective	The target date on which exceedances of a Standard must not exceed a specified number.
APIS	Air Pollution Information Service
APS	Air Pollution Services Ltd
AQMA	Air Quality Management Area
AQO	Air Quality Objectives
AQS	Air Quality Standards
AURN	Automatic Urban and Rural Network
AW	Ancient Woodland
CAZ	Clean Air Zone
EPUK	Environmental Protection UK
EU	European Union
EU Limit Values	Legally binding EU parameters that must not be exceeded. Limit values are set for individual pollutants and are made up of a concentration value, an averaging time over which it is to be measured, the number of exceedances allowed per year, if any, and a date by which it must be achieved. Some pollutants have more than one limit value covering different endpoints or averaging times.
H	Hydrogen
IAQM	Institute of Air Quality Management
JAQU	Joint Air Quality Unit
LAQM	Local Air Quality Management
LNR	Local Nature Reserve
N	Nitrogen
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides
NPPF	National Planning Policy Framework
S	Sulphur
SAC	Special Areas of Conservation
SSSI	Sites of Special Scientific Interest
SPA	Special Protection Area
PM	Particulate Matter
$\mu g/m^3$	Microgrammes per cubic metre

Target values	Used in some EU Directives and are set out in the same way as limit values. They are to be attained where possible by taking all necessary measures not entailing disproportionate costs.
WHO	World Health Organization

11. References.

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Appendix 1 – Useful Sources of Information

There are a large number of policy, guidance and strategy documents published regarding air quality at a European, national, regional and local level. The documents all provide useful context, information and justification in support of the approaches in this assessment. Details of relevant documents are provided below.

1.1 Clean Air Strategy

Defra published the Clean Air Strategy in January 2019 (Defra, 2019a). The strategy focuses on air pollutants such as nitrogen oxides, ammonia, particulate matter, non-methane volatile organic compounds and sulphur dioxide. The strategy aims to reduce emissions of pollutants including the aim to reduce particulate matter emissions by 30% by 2020, and by 46% by 2030.

This strategy sets out the aim for new enforcement powers at a national and local level, across all sectors of society and sets out the comprehensive action that is required from government and society to meet these targets. The strategy includes actions to reduce emissions from transport (including road, maritime, rail, aviation and NRMM), homes, farming and industry.

The strategy states that:

“New legislation will create a stronger and more coherent framework for action to tackle air pollution. This will be underpinned by new England-wide powers to control major sources of air pollution, in line with the risk they pose to public health and the environment, plus new local powers to take action in areas with an air pollution problem.”

1.2 The 25 Year Environment Plan

The Government has published a Policy paper called the '25 Year Environment Plan' (HM Government, 2019) which set out what the government will do to improve the environment within a generation. This includes the first goal 'Clean air' where the government states “we will achieve clean air by:

- Meeting legally binding targets to reduce emissions of five damaging air pollutants. This should halve the effects of air pollution on health by 2030.
- Ending the sale of new conventional petrol and diesel cars and vans by 2040.
- Maintaining the continuous improvement in industrial emissions by building on existing good practice and the successful regulatory framework”.

1.3 Air Quality Plan

Defra has produced an Air Quality Plan (update in 2019) to tackle roadside NO_2 concentrations in the UK (Defra, 2017b). Alongside a package of national measures, the Plan requires those English Local Authorities (or the GLA in the case of London Authorities) that are predicted to have exceedances of the limit values beyond 2020 to produce local plans. These plans are undertaken in stages and must have measures to achieve the statutory limit values within the shortest possible time, which may include the implementation of a charging Clean Air Zone (CAZ).

1.4 Habitats Directive

The “Habitats Directive” (The Council of European Communities, 1992) requires member states to introduce a range of measures for the protection of habitats and species, which was transposed into law in England and Wales via The Regulations (2010). They require the Secretary of State to provide the European Commission with a list of sites which are important for the habitats or species listed in the Directive. The Commission then designates worthy sites as Special Areas of Conservation (SACs). The Regulations also require the compilation and maintenance of a register of European sites, to include SACs and Special Protection Areas (SPAs), with these classified under the “Birds Directive” (The European Parliament and the Council of the European Union, 2009). These sites form a network termed “Natura 2000”.

The Regulations primarily provide measures for the protection of European Sites and European Protected Species, but also require local planning authorities to encourage the management of other features that are of major importance for wild flora and fauna.

The Habitats Directive (as implemented by the Regulations) requires the competent authority to firstly evaluate whether the development is likely to give rise to a significant effect on the European site. Where this is the case, it has to carry out an 'appropriate assessment' in order to determine whether the emissions will adversely affect the integrity of the ecological site.

Sites of national importance may be designated as Sites of Special Scientific Interest (SSSIs). Originally notified under the National Parks and Access to the Countryside Act (1949), SSSIs have been re-notified under the Wildlife and Countryside Act (1981). Improved provisions for the protection and management of SSSIs (in England and Wales) were introduced by the Countryside and Rights of Way Act (2000) (the "CROW" act). If a facility is "likely to damage" a SSSI, the CROW act requires that a relevant conservation body (i.e. Natural England) is consulted. The CROW act also provides protection to local nature conservation sites, which can be particularly important in providing 'stepping stones' or 'buffers' to SSSIs and European sites. In addition, the Environment Act (1995) and the Natural Environment and Rural Communities Act (2006) both require the conservation of biodiversity.

Appendix 2 – Local Authority Environment Officer Correspondence

From: Gent, Mick
Sent: 29 November 2019 10:49
To: Chris Rush
Subject: RE: Grangetown Prairie - Proposed Energy from Waste - Air Quality Assessment - Environmental Health Officer consultation

[External email]

Hi Chris,

The methodology looks fine, however, how is the proposed waste going to arrive at the plant? If it is by rail then the assessment should include these movements.

Regards

Mick Gent

Contaminated Land Officer

Redcar & Cleveland Borough Council

From: Chris Rush
Sent: 26 November 2019 13:41
To: Gent, Mick
Cc: Emma Rigler; Dorian Latham
Subject: RE: Grangetown Prairie - Proposed Energy from Waste - Air Quality Assessment - Environmental Health Officer consultation

Hi Mick,

Thanks for the quick response.

The site is as per the below screen shot of an draft plan, which aligns with second diagram in your below email.

[Picture removed]

Does this clarify the situation?

Best Regards,

Chris Rush
Senior Associate

From: Gent, Mick
Sent: 26 November 2019 11:18
To: Chris Rush
Subject: RE: Grangetown Prairie - Proposed Energy from Waste - Air Quality Assessment - Environmental Health Officer consultation

[External email]

Hi Chris,

Are you sure this is the site? – it may be worth checking – the reason is the JBA drawing below shows approximately your location however the 2nd diag below shows an ammended location.

I have attached the scoping letter that is on our planning website

[Picture removed]

R/2019/0587/SCP

[Picture removed]

R/2019/0700/SCP

Regards

Mick Gent

Contaminated Land Officer

Redcar & Cleveland Borough Council

From: Chris Rush
Sent: 26 November 2019 10:53
To: Gent, Mick
Cc: Dorian Latham; Emma Rigler
Subject: Grangetown Prairie - Proposed Energy from Waste - Air Quality Assessment - Environmental Health Officer consultation

Hi Mick,

Many thanks for your time on the phone earlier today.

As mentioned we have been appointed to progress an air quality assessment for a planning application for a proposed energy from waste facility situated on an existing brownfield site at the former South Tees Eco Park, Grangetown. Please see below site location for reference.

[Picture removed]

I have set out below our proposed approach at this time based on the information available :

- A baseline assessment will be undertaken using Redcar and Cleveland Council's most recent Annual Status Report (ASR) – we note the 2019 ASR is available on your website – are you able to please provide over you most recent monitoring data?
- Both existing monitoring data and the Defra background pollution maps will be used to inform this review.
- If the development is predicted to generate significant traffic, ADMS-Roads will be used to predict concentrations of nitrogen dioxide and particulate matter for a verification year and the proposed opening year without and with the development in place. Concentrations will be modelled at the facades of existing sensitive receptor locations. The model will be verified against data from suitable council air quality monitoring locations. As mentioned in our call the traffic survey is currently looking to be commissioned to gather the traffic data for this.
- The assessment will also include a sensitivity test for the prediction of nitrogen dioxide concentrations whereby road traffic emissions will be assumed to remain unchanged for the future year scenario.
- On-site point sources will be modelled where available using ADMS-5 dispersion modelling software based on the Industrial Emissions Directive (IED) pollutant emission limits. The main stacks are likely to be in the region of approximately 70-80m high.
- The assessment will be undertaken in line with the EPUK/IAQM document 'Land-Use Planning & Development Control: Planning for Air Quality' January 2017.
- The air quality assessment will also consider impacts during the construction phase of the development using the IAQM document 'Assessment of dust from demolition and construction' June 2016.
- We are not proposing to model or assess rail or sea trips as part of this work.

Could you please provide details of any other notable emission sources or developments in the vicinity of the Site that you feel should be incorporated into the air quality modelling?

I would be grateful if you could please confirm your acceptance of the proposed methodology and provide me with any comments you may have.

If you would like to discuss further, please do not hesitate to contact me on the numbers below.

Best Regards,

Chris Rush
Senior Associate

HOARE LEA (H.)

Appendix 3 – Construction Methodology

Table 54: IAQM guidance on the sensitivity of the area to dust soiling effects on people and property

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)[c]			
		<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

[a] The sensitivity of the area should be derived for each of the four activities: demolition, construction, earthworks and trackout. See **STEP 2B**, **Box 6** and **Box 9.**

[b] Estimate the total number of receptors within the stated distance. Only the *highest level* of area sensitivity from the table needs to be considered. For example, if there are 7 high sensitivity receptors <20 m of the source and 95 high sensitivity receptors between 20 and 50 m, then the total of number of receptors <50 m is 102. The sensitivity of the area in this case would be high.

[c] For trackout, the distances should be measured from the side of the roads used by construction traffic. Without site-specific mitigation, trackout may occur from roads up to 500 m from large sites, 200 m from medium sites and 50 m from small sites, as measured from the site exit. The impact declines with distance from the site, and it is only necessary to consider trackout impacts up to 50 m from the edge of the road.

Table 55: IAQM guidance on sensitivity of the area to human health impacts

Receptor Sensitivity	Annual Mean PM_{10} concentration[c]	Number of Receptors[d]	Distance from the Source (m)[e]				
			<20	<50	<100	<200	<350
High	>32 µg/m³ (>18 µg/m³ in Scotland)	**>100**	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32 µg/m³ (16-18 µg/m³ in Scotland)	**>100**	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28 µg/m³ (14-16 µg/m³ in Scotland)	**>100**	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24 µg/m³ (<14 µg/m³ in Scotland)	**>100**	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>32 µg/m³ (>18 µg/m³ in Scotland)	**>10**	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	28-32 µg/m³ (16-18 µg/m³ in Scotland)	**>10**	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	24-28 µg/m³ (14-16 µg/m³ in Scotland)	**>10**	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<24 µg/m³ (<14 µg/m³ in Scotland)	**>10**	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	**≥1**	Low	Low	Low	Low	Low

[a] The sensitivity of the area should be derived for each of the four activities: demolition, construction, earthworks and trackout. See **STEP 2B**, **Box 7** and **Box 9**.

[b] Estimate the total within the stated distance (e.g. the total within 350 m and not the number between 200 and 350 m), noting that only the **highest level** of area sensitivity from the table needs to be considered. For example, if there are 7 high sensitivity receptors <20 m of the source and 95 high sensitivity receptors between 20 and 50 m, then the total of number of receptors <50 m is 102. If the annual mean PM_{10} concentration is 29 µg/m³, the sensitivity of the area would be high.

[c] Most straightforwardly taken from the national background maps, but should also take account of local sources. The values are based on 32 µg/m³ being the annual mean concentration at which an exceedence of the 24-hour objective is likely in England, Walesand Northern Ireland. In Scotland there is an annual mean objective of 18µg/m³.

[d] In the case of high sensitivity receptors with high occupancy (such as schools or hospitals) approximate the number of people likely to be present. In the case of residential dwellings, just include the number of properties.

[e] For trackout, the distances should be measured from the side of the roads used by construction traffic. Without site-specific mitigation, trackout may occur from roads up to 500 m from large sites, 200 m from medium sites and 50 m from small sites, as measured from the site exit. The impact declines with distance from the site, and it is only necessary to consider trackout impacts up to 50 m from the edge of the road.

Appendix 4 – Professional Experience

Kieran Laxen (Air Pollution Services Ltd), MEng (Hons), MIEnvSc, MIAQM

Mr Laxen is a Director of Air Pollution Services Ltd and has over eleven years' experience in the field of air quality. Kieran is an active member of the IAQM committee. He has extensive experience of air quality monitoring and is a leading UK expert in the assessment of power generating facilities for both permitting and planning applications. He has been a stakeholder in Defra's and the Environment Agency's consultations into implementing the MCPD and Specified Generator Controls.

Dr Austin Cogan (Air Pollution Services Ltd), MPhys (Hons), PhD, MIEnvSc, MIAQM

Dr Cogan is a Director of Air Pollution Services Ltd and has over eleven years' experience in environmental sciences. Austin has extensive experience of air quality, dust and odour assessments for a range of industries as well as services for local authorities, including Clean Air Zone and micro-simulation modelling. He is also an international expert in the field of climate change, having monitored greenhouses gases globally, published numerous scientific papers and presented at conferences internationally.

Dr Claire Holman, BSc (Hons), PhD, CSci, CEnv, FIEnvSc, FIAQM

Dr Holman is an associate of APS, has nearly 40 years of experience and has advised national governments in Europe, Asia and Africa, as well as the European Commission on a range of strategic air quality and climate change issues. Claire has contributed to the development of IAQM and EPUK professional guidance, is the former chair of the institute, has been a member of a Government air quality review group, and advised the Department for Transport on their cleaner vehicles and fuels research programme. She is an experienced expert witness for planning and CPO inquiries and litigation.

Chris Rush (Hoare Lea), BSc (Hons), MSc, PG Dip Acoustics, CEnv, MIOA, MIEMA, MIEnvSc, MIAQM

Chris is a Senior Associate Air Quality Consultant with Hoare Lea. He is a Chartered Environmentalist, a Member of the Institute of Acoustics, a Full Member of the Institute of Environmental Management and Assessment, a Member of the Institution of Environmental Sciences and a Full Member of the Institute of Air Quality Management.

He has a diverse portfolio of experience and has worked on a range of projects from initial site feasibility, through planning and development to construction and operation. Chris's expertise covers planning, noise and air quality, specifically in relation to residential developments, industrial fixed installations such as waste management centres and transportation environmental impact on developments including air traffic. Chris is involved in the testing and assessment of the impact of indoor air quality and how building design contributes to this.

Appendix 5 – Discrete Receptors

Details of the discrete receptors included within the modelling are presented in Table 56.

Table 56: Discrete Receptors

Receptor	Location Description	Modelled Height (m)
1 – 8	Residential properties near the A66 between Eston Road and the A1053	1.5
9 – 12	Residential properties near the junction of the A66, Eston Road	1.5
13 – 21	Residential properties near the A1085 between Church Lane and the A1053	1.5
22	Residential property near the A1085 and Church Lane	1.5
23 – 25	Residential properties near Church Lane	1.5
26	Residential property near the A1085 between Normanby Road and Church Lane	1.5
27 – 29	Residential properties near the junction of Normanby Road and the A1085	1.5
30 – 31	Residential properties near the A1085 west of Normanby Road	1.5
32 – 39	Residential properties near Normanby Road	1.5
40 – 41	Residential properties between the A66, Normanby Road and the A1085	1.5
42 – 45	Residential properties near the A66 between Normanby Road and Eston Road	1.5
46 – 48	Residential properties near Normanby Road	4.5
49	Residential property near Normanby Road and the A66	1.5
50 – 51	Residential properties near the A66 between Middlesbrough Road and Normanby Road	1.5
52	Residential property near the junction of the A66 and Middlesbrough Road	1.5

Appendix 6 – Model Input Data

6.1 Background Concentrations

Background concentrations have been assumed to be the same as those published by Defra. These cover the whole country on a 1 km by 1 km grid and are published for each year from 2015 to 2030. The current maps have been verified against measurements undertaken during 2017. These mapped concentrations have been bilinearly interpolated to each receptor location to obtain location specific background concentrations.

6.2 Surface characteristics

Land-use and surface characteristics have an important influence in determining turbulent fluxes and, hence, the stability of the boundary layer and atmospheric dispersion.

Surface roughness length used within the model represents the aerodynamic effects of surface friction and is defined as the height at which the extrapolated surface layer wind profile tends to zero. This value is an important parameter used by the built-in meteorological pre-processor of ADMS to interpret the vertical profile of wind speed and estimate friction velocities which are, in turn, used to define heat and momentum fluxes and, consequently, the degree of turbulent mixing. Surface roughness values for different land-use classifications are provided in the 2018 Corine Land Use dataset (Copernicus, 2018). Due to the large model domain, a variable surface roughness file has been used within the model based on the spatially variable land-uses and the equivalent roughness values from the dataset. Figure 15 shows the values used across the modelled domain.

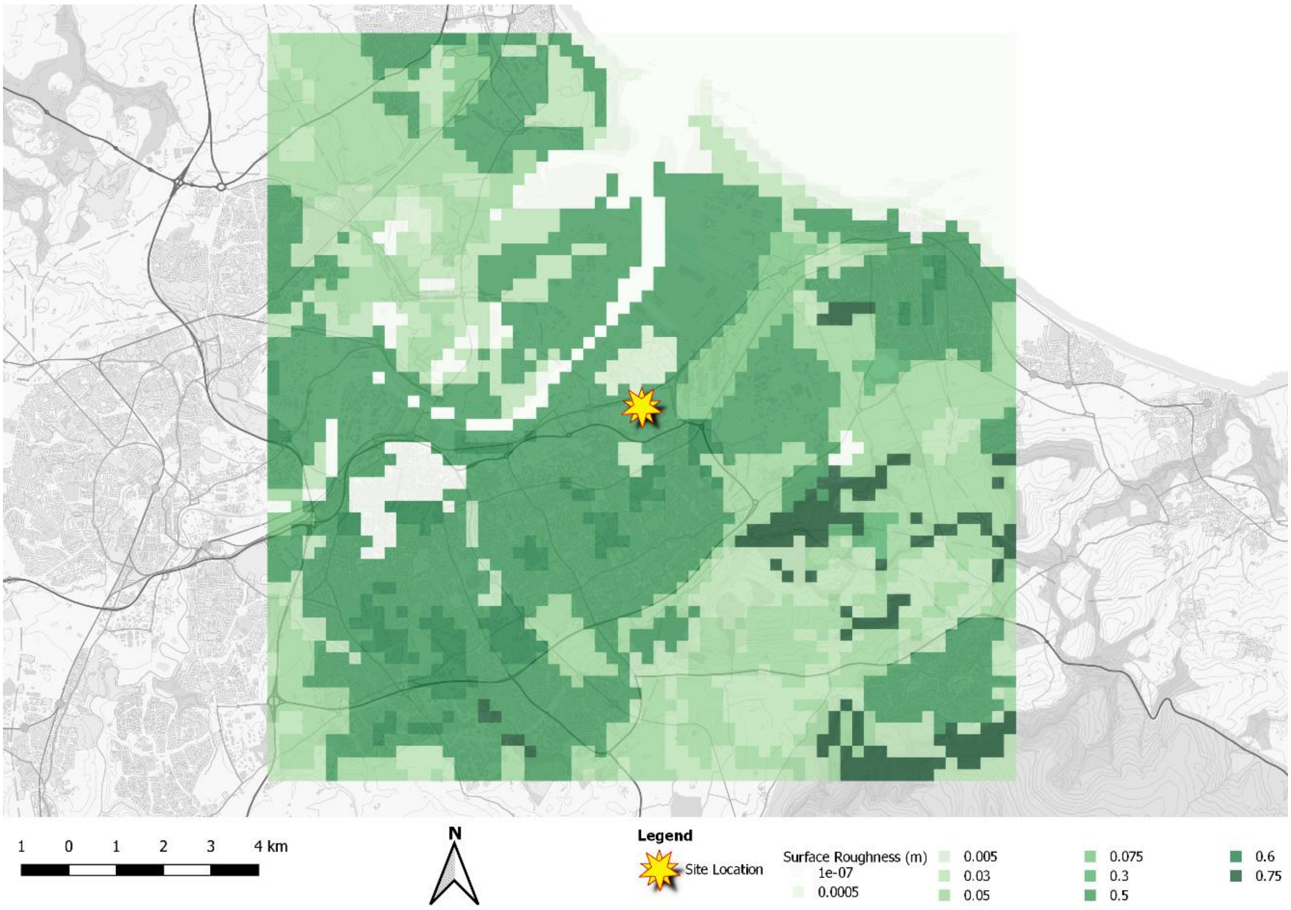

Figure 15: Modelled Surface Roughness (m)

The surface albedo is the ratio of reflected to incident shortwave solar radiation at the surface of the earth. This varies depending on the land use, and thus area-weighted average albedos have been derived for the meteorological and dispersion sites and used in the models. Albedo values have been taken from US Environmental Protection Agency (EPA) guidance (2018) and associated with the different land uses in the 2018 Corine Land Use dataset (Copernicus, 2018).

The Priestley-Taylor parameter is a parameter representing the surface moisture available for evaporation. A Priestley-Taylor parameter of 1 has been set in the model.

The CERC user guide explains that “the Monin-Obukhov length provides a measure of the stability of the atmosphere. In very stable conditions in a rural area its value would typically be 2 to 20 m. In urban areas, there is a significant amount of heat generated from buildings and traffic, which warms the air above the town/city”. For large urban areas this is known as the urban heat island. It has the effect of preventing the atmosphere from ever becoming very stable. Minimum Monin-Obukhov length can be defined in the model to account for the urban heat island effect which is not represented by the meteorological data. A value of 30 m has been used in the model, which is considered appropriate for the site location.

6.3 Meteorology

The dispersion model includes a meteorological pre-processor developed by the UK Met Office to calculate values of meteorological parameters in the boundary-layer. The pre-processor requires a set of meteorological parameters on an hour-by-hour basis: wind speed, wind direction, temperature and cloud cover. There are a limited number of sites in the UK where this data is measured and recorded. There is also variation in annual recordings.

To account for the annual meteorological variation five years of meteorological data have been used in the model. The facility is located in flat lying location, while the site is not far from the coast it is expected that coastal effects on meteorological conditions are not likely to be significant in the study area. Meteorology for this site is best represented by the meteorological station located at Teesside International Airport which is situated in a flat location 19 km southwest from the development.

The meteorological data represents measurements at a height of 10 m above ground level. The surface characteristics of the meteorological stations are also required to account for differences between the meteorological sites and the model domain. Data capture for each year are greater than 95%.

Details of the parameter values used in the modelling are provided in Table 57 below. The surface roughness value has been calculated as a weighted average of all the land-use classification roughness for an area 2 km radius from the meteorological site.

Table 57: Meteorological parameters values used in the model

Parameter	Meteorological Site Value	Dispersion Site Value
Latitude (°)	n/a	54.58
Surface roughness (m)	0.501	0.378
Surface albedo	0.170	0.171
Minimum Monin-Obukhov length (m)	29.9	30
Priestley-Taylor parameter	1	1

Figure 16 shows the frequency of wind speeds and directions measured at the Teesside International Airport meteorological station, which have been inputted into ADMS.

Figure 17 shows the frequency of wind speeds and directions processed by the ADMS-roads model for the dispersion site for the years 2013-2016 and 2018, when Teesside International Airport meteorological station data have been used. The data capture for wind speed and direction was low in 2017 and has therefore not been used. These illustrate that wind predominantly comes from the southwest and that the model has marginally lower wind speed at the dispersion site.

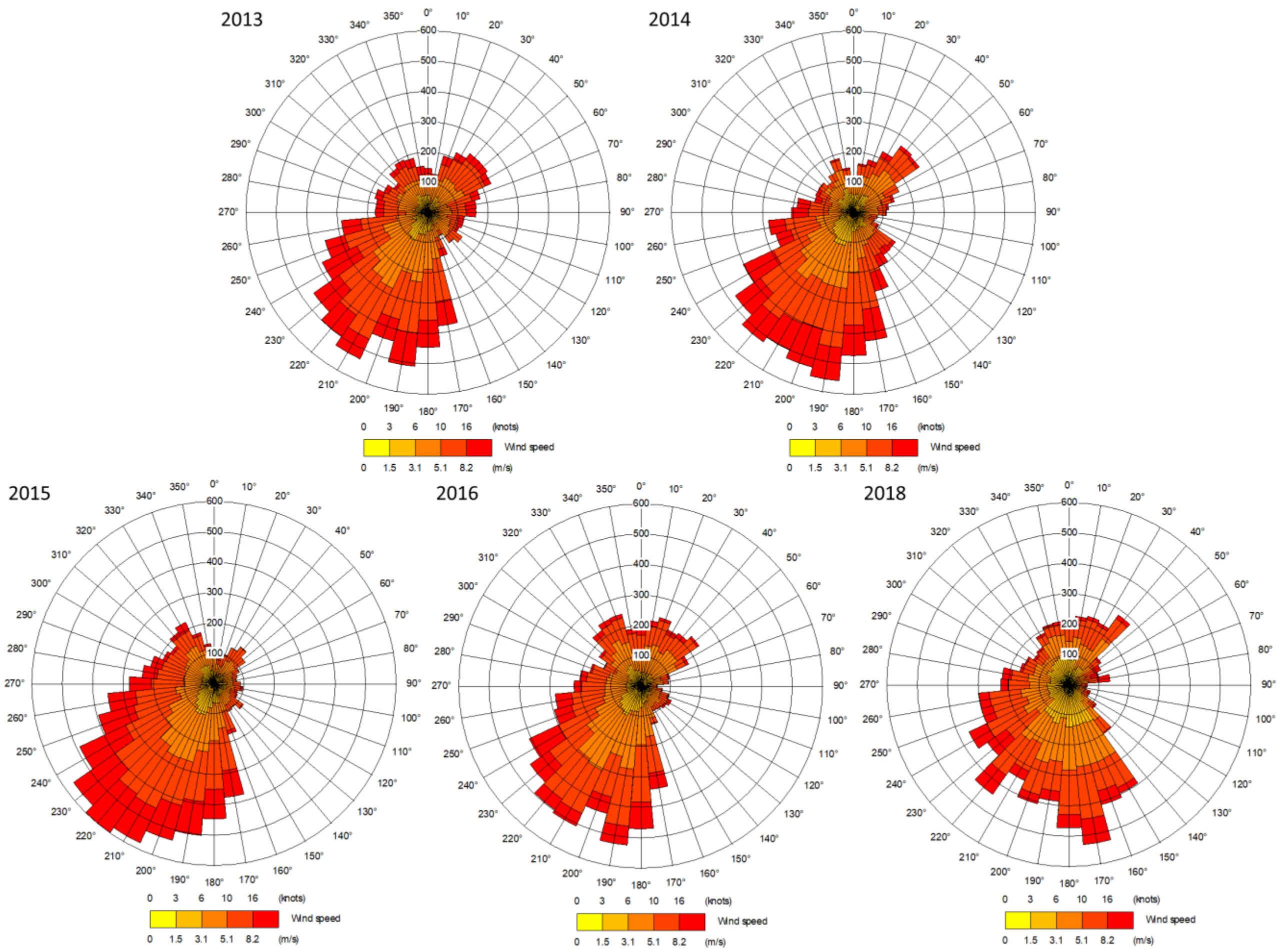

Figure 16: Wind rose of wind speeds and directions measured at the Teeside International Airport meteorological station for the years of 2013-2016 and 2018

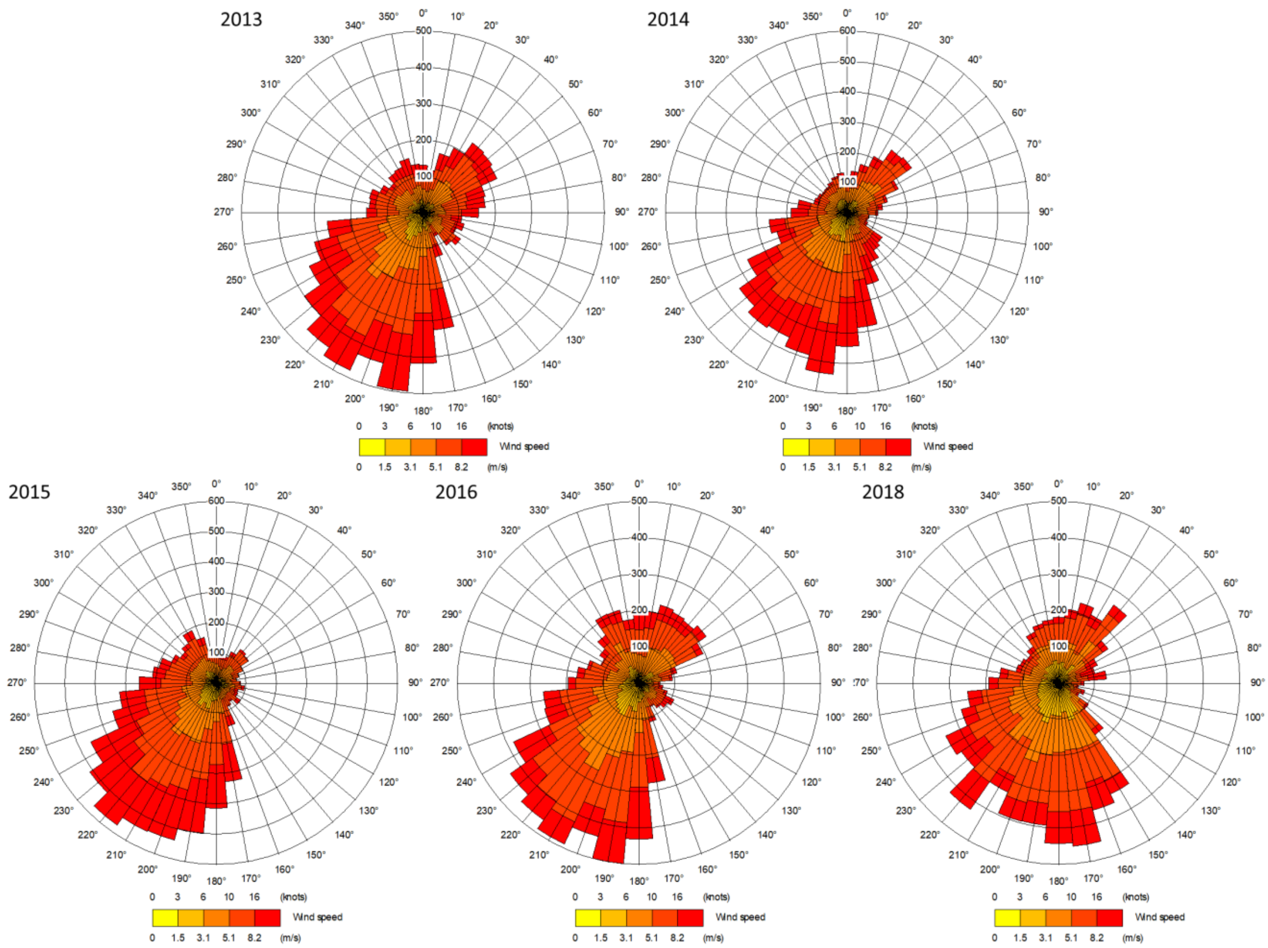

Figure 17: Wind rose of wind speeds and directions measured at the Teeside International Airport meteorological station for the years of 2013-2016 and 2018

6.4 Terrain

The effects of complex topography on atmospheric flows can result in elevated pollutant concentrations. These effects are most pronounced when the terrain gradient exceeds 1 in 10, i.e. a 100 m change in elevation per 1 km step in horizontal plane. The gradients in the area surrounding the proposed development may have an impact on pollutant concentrations and therefore the terrain module within ADMS has been used. The local terrain data is based on Ordinance Survey Terrain 50 data. Figure 18 shows the terrain data entered into the model.

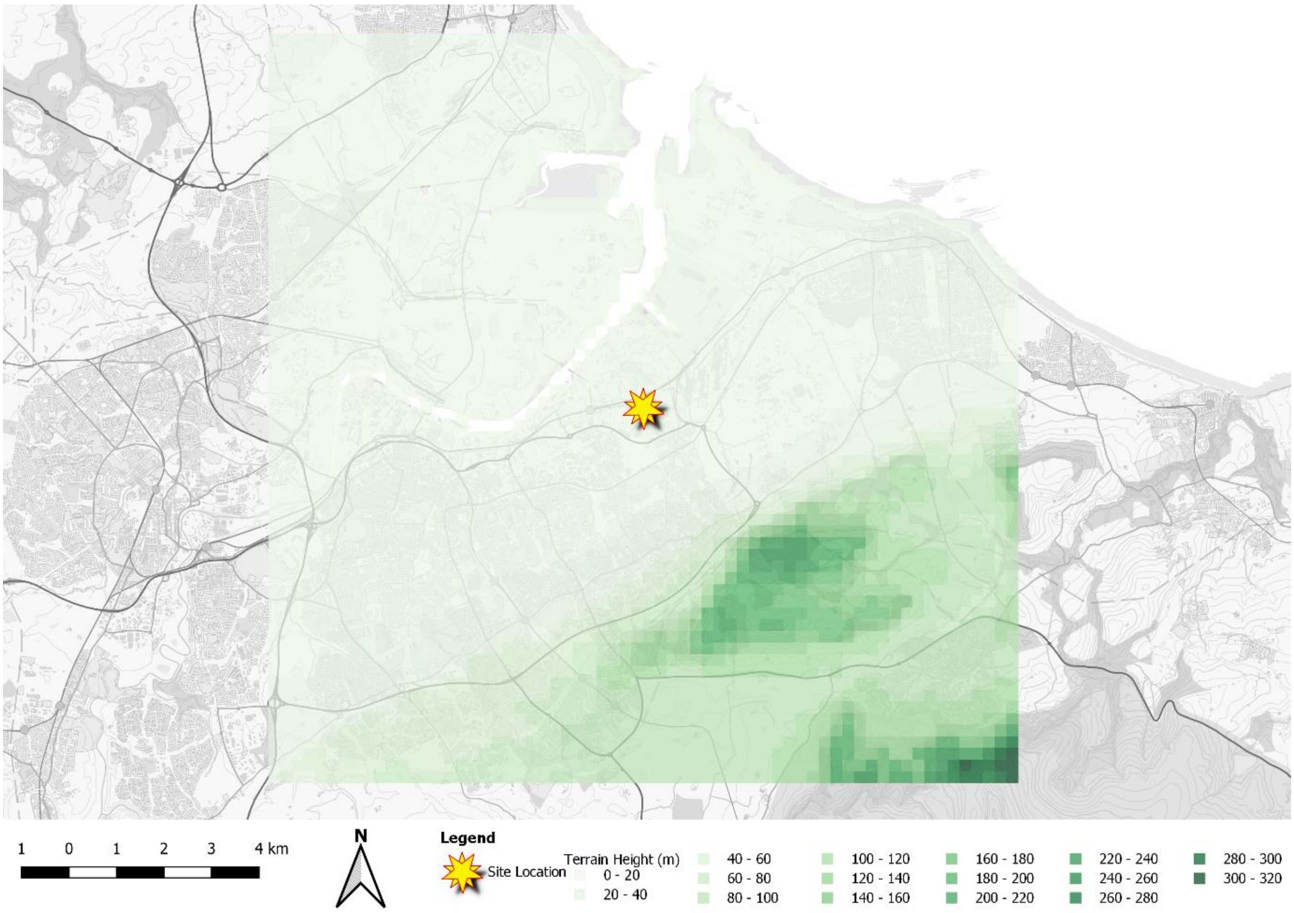

Figure 18: Modelled Terrain Heights (m)

6.5 Point Source Modelling

6.5.1 Modelled Buildings

The "Building downwash effect" can result in elevated concentrations in the lee of large structures. The model can incorporate the impact of buildings on the concentrations in the downwind area of buildings. However, it should be noted that buildings with a height, H, significantly lower than the stack are automatically ignored in the model. As the onsite building is 45 m tall it has been included as a building within the model.

Entrainment of the plume into the wake of the buildings has been taken into account by including the buildings within the model. Two separate modelling scenarios have therefore been run:

- no buildings; and
- with buildings.

The modelled buildings are shown in Figure 18.

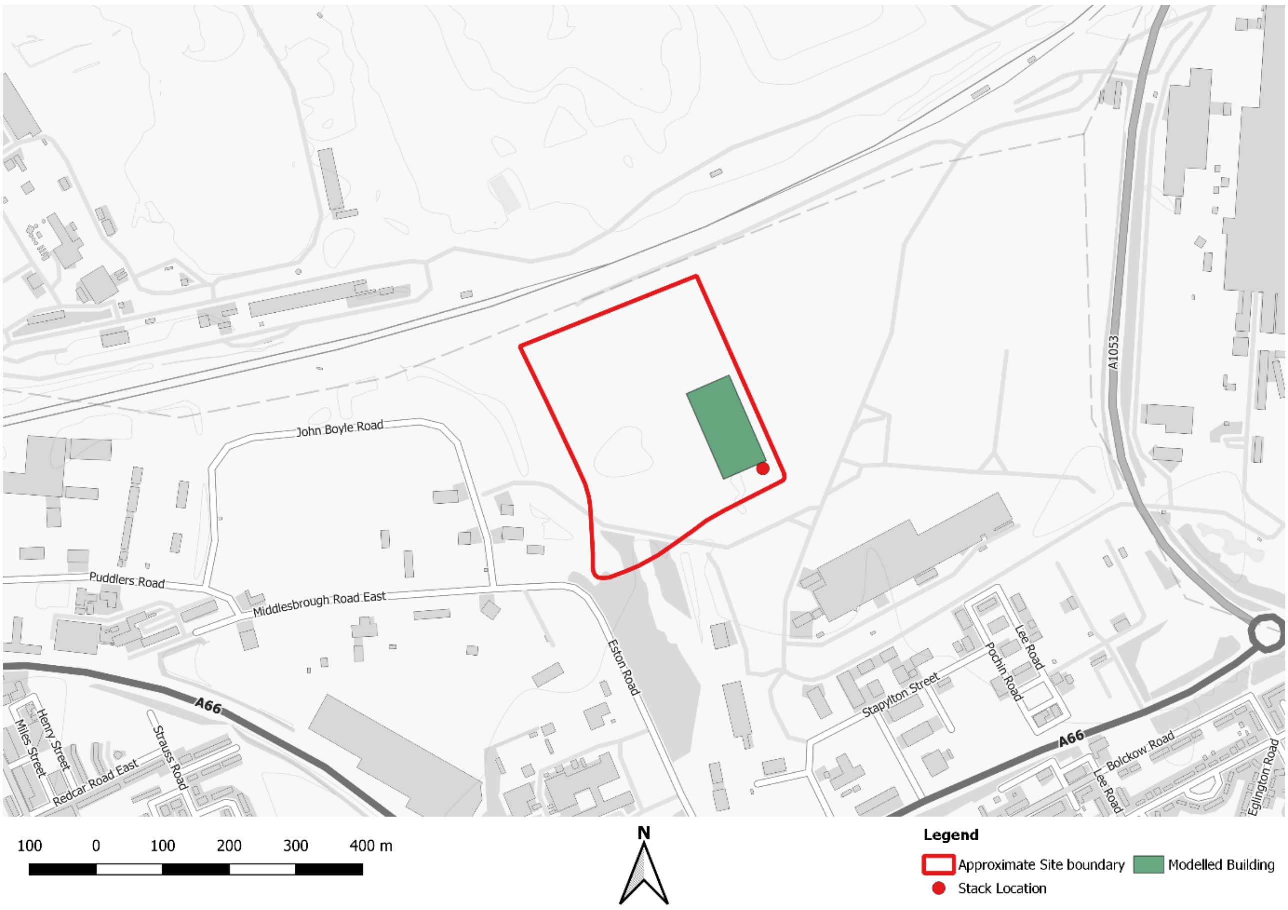

Figure 19: Modelled Building and Stack Location

11.1.1 Chemistry (Conversion of NOx to NO_2)

The in-built model chemistry features have not been used for the assessment of the impacts. Chemistry has been dealt with during the post-processing stage.

6.5.2 Post Processing

The maximum concentrations predicted using any of the five years of meteorological data and the two building scenarios have been used in the preparation of the results.

6.5.2.1 Chemistry (Conversion of NOx to NO_2)

NOx emissions from the facility will be predominantly in the form of nitric oxide (NO) with a small proportion of primary NO_2 (approximately 15%). Excess oxygen in the combustion gases and in the atmosphere after the gases are released result in oxidation of NO to NO_2. NOx chemistry in the lower troposphere is strongly interlinked in a complex chain of reactions involved O_3 and volatile organic compounds (VOCs).

Given the complex nature of NOx chemistry, the EA's Air Quality Modelling and Assessment Unit (AQMAU) have adopted a pragmatic, risk-based approach in determining the rate of conversion of NOx to NO_2 (Environment Agency, n.d.). This approach is routinely used as part of detailed assessments of point sources. The AQMAU guidance advises that a tiered approach can be used when considering ambient NO_2 to NOx ratios:

- Screening Scenario: 50% and 100% of the modelled NOx process contributions should be used for short-term and long-term average concentration, respectively. That is, 50% of the predicted NOx concentrations should be assumed to be NO_2 for short-term assessments and 100% of the predicted NOx concentrations should be assumed to be NO_2 for long-term assessments;
- Worst case Scenario: 35% and 70% of the modelled NOx process contributions should be used for short-term and long-term average concentration, respectively. That is, 35% of the predicted NOx concentrations should be assumed to be NO_2 for short-term assessments and 70% of the predicted NOx concentrations should be assumed to be NO_2 for long-term assessments; and
- Case specific Scenario: Operators are asked to justify their use of percentages lower than 35% for short-term and 70% for long-term assessments in their application reports.

ADMS-5 has been run to predict the contribution of the facility to annual mean concentrations of NOx and a percentile of 1-hour mean NOx.

For the assessment of the impact on AQO receptors, the Worst-case Scenario approach has been used to predict annual mean NO_2 contributions and the percentile of 1-hour mean NO_2 contributions. This assumes that:

- annual mean NO_2 contributions = annual mean 0.7 x NOx; and
- percentile of 1-hour mean NO_2 contributions = percentile of 1-hour mean 0.35 x NOx.

6.5.2.2 Deposition

Although the model has the ability to calculate deposition, because the model has been used to predict NOx concentrations, dry deposition has been calculated based on the predicted NO_2 PC calculated outside the model.

The rate of dry deposition is assumed to be proportional to the near-surface concentration, i.e.:

$Fd = v_d\ C(x, y,0)$

Where Fd is the rate of dry deposition per unit area per unit time (µg/m^2/s), vd is the deposition velocity in m/s, and C is the predicted airborne concentration at the position (x,y,0) in µg/m^3.

Environment Agency guidance AQTAG06 (Environment Agency, 2011) recommends deposition velocities for various pollutants dependent upon the habitat type, these are shown in Table 58. The guidance does not include deposition velocities for HF; these have been taken from a research paper by G.W. Israel (1974).

Table 58: Dry Deposition Velocities

Pollutant	Deposition Velocity (m/s)	
	Grass	Forest
NO_2	0.0015	0.003
NH_3	0.02	0.03
SO_2	0.012	0.024
HCl	0.025	0.06
HF	0.016 [1] or 0.002 [2]	0.031 [1] or 0.004 [2]

[a] Deposition velocity for crops.

[b] Reference: Fluorides in the Environment, Weinstein, LH and Davison, AW, CABI Publishing.

Deposition are assessed against the critical loads which are provided in kilogrammes of deposition per hectare per year. A factor to convert the deposition flux calculated from the model outputs to these units is required. The factor for NO_2 is 96 which is calculated from the unit conversions using the following formula:

- µg to kg - 1/100,000,000;
- m^2 to ha - 1/10,000;

– seconds to year - 60*60*24*365; and
– N in NO_2 - 14/46.

Factor = ((1/100,000,000) / (1/10,000)) x (60*60*24*365) x (14/46)

The factors for other pollutants are calculated in the same way, substituting 14/46 with the relevant atomic weights.

To calculate the acidity for NO_2, the kilogramme equivalent of N is determined based on the following relationships can be used: 1 keq/ha/yr =14 kgN/ha/yr, i.e. nutrient deposition values have been divided by 14 to obtain acid deposition values. Similarly, the S acid deposition values have been derived by dividing by 32. Those for the other pollutants are calculated in a similar way, substituting 14 for the relevant atomic mass.

The wet deposition velocity for HCl has been taken as two times the dry deposition rate set out in Table 58. This is a conservative screening assumption.

6.5.2.3 Operating Profile

Since the precise hours when the plant will operate are not known, it has been assumed in the model that the plant will run continuously throughout the year to ensure that potential impacts under all meteorological conditions are considered.

6.5.2.4 Total Concentrations (PECs)

Where total concentrations are considered, the following post-processing has been carried out:

– total annual mean concentration = annual mean contributions + annual mean baseline concentration; and
– total short-term mean concentration = short-term contributions + (2 x annual mean baseline concentration).

Where the annual mean contributions include contributions from changes in road traffic generated by the Proposed Development; the processing of these contributions are described further below.

6.6 Road Traffic Modelling

6.6.1 Traffic Data

AADT flows, vehicle fleet composition data and average traffic speeds have been provided by the project transport consultants Fore Consulting Limited and supplemented by Department for Transport data. Traffic data are shown in Table 59 and the modelled road network is shown in Figure 8. Average vehicles speeds have been set based on professional judgement and speeds have been reduced in close proximity to junctions as shown in Figure 8.

Table 59: Summary of Traffic Data used for Roads Modelling Assessment

Road Name	2018		2025 Without development		2025 With Development		Speed km/h
	AADT	HDV %	AADT	HDV %	AADT	HDV %	
Middlesbrough Road East	2,697	16	2,866	16	2,868	16	48
Puddlers Road	3,942	6	4,189	6	4,191	6	48
Normanby Road (between Puddlers Road and A66)	6,097	5	6,480	5	6,481	5	48
A66 (between Normanby Road and Eston Road)	22,357	13	25,395	13	25,619	13	80
Normanby Road (between A66 and Briggs Avenue)	10,206	2	11,673	2	11,675	2	48

Road Name	2018		2025 Without development		2025 With Development		Speed km/h
	AADT	HDV %	AADT	HDV %	AADT	HDV %	
A66 (between Normanby Road and Old Station Road)	22,357	13	26,221	12	26,445	13	80
Eston Road	2,764	17	2,938	17	3,267	23	48
A66 (between Eston Road and A1053)	22,357	13	24,176	13	24,264	13	80
Church Lane	8,336	3	10,078	3	10,096	3	48
A1085 Trunk Road / Broadway	9,981	3	12,142	2	12,143	2	48
Normanby Road (between Briggs Avenue and A1085)	10,206	2	11,673	2	11,673	2	48
A1085 Trunk Road	18,013	2	22,924	2	22,930	2	48
Normanby Road (between A1085 and The Avenue)	15,899	2	18,190	2	18,195	2	48
A1085 Trunk Road / Longlands Road	17,787	2	20,501	2	20,502	2	64
A66 (between B1272 and A172)	67,122	6	73,158	6	73,377	6	80
A1053 (north of A66)	4,830	31	5,101	31	5,101	31	96
A1053 (between A66 and A1085)	22,378	8	23,636	8	23,636	8	80
A1085 (east of A1053)	17,262	6	18,232	6	18,232	6	96
A1053 (south of A1085)	13,685	9	14,454	9	14,454	9	112
A66 (west of B1513)	22,357	13	23,613	13	23,837	14	80
Middlesbrough Road/South Bank Road	11,098	6	11,291	6	11,514	8	48

6.6.2 Emissions

Emissions were calculated using the most recent version of the Emissions Factor Toolkit (EFT) v9.0.1. The traffic data were entered into the EFT in order to calculate a combined emission rate for each of the road links in the modelled network.

6.6.3 Fraction of Primary NO_2

The fraction of primary NO_2 (f-NO_2) has also been obtained from the EFT. This is the amount of NO_2 released from vehicle exhausts compared to NOx, before any further chemical reactions in the atmosphere. This is an important variable when post-processing the model predictions. In order to obtain the f-NO_2 value at each receptor location, the NOx emission rates have been multiplied by f-NO_2 values to derive NO_2 emission rates. These NO_2 emissions have been included in the model and primary NO_2 concentrations have been predicted at the receptors. The predicted NOx concentrations have been divided by the predicted primary NO_2 concentrations to calculate the f-NO_2 values at the receptor locations.

6.6.4 Time-Based Profiles

Traffic flows vary over time which causes the amount of vehicle-related emissions to also vary. Diurnal and seasonal traffic flow profiles have been taken from DfT national statistics. Both the profiles have been assumed to follow an urban traffic profile and have been used in the model to adjust the emissions for each hour of the year modelled.

6.6.5 Wake effects

Vehicles travelling along roads cause a wake effect as air is forced around the vehicles. This turbulence affects the dispersion of pollution away from roads. The traffic flows have been entered into the ADMS-roads dispersion model in order to account for vehicle wake effects which will vary on each link depending on the proportion of large vehicles to small vehicles.

6.6.6 Verification

The verification process seeks to minimise uncertainties associated with the air quality roads model by comparing the model output with locally measured concentrations. The verification methodology is described in subsequent sections. It is not possible to apply a similar methodology for the model used to estimate the dispersion from the stack.

6.6.6.1 Background Concentrations

Background concentrations at the monitoring sites in the verification year (2018) have been assumed to be the same as those published by Defra and are shown in Table 60.

Table 60: Annual Mean Background Concentrations at the Monitoring Sites (µg/m^3)

Monitoring Site	Grid Square	NO_2 2018
R26	x 453138, y 520837	16.8
R27	x 454711, y 520680	15.3
R42	x 453834, y 519871	14.1
R43	x 453965, y 519622	14.1
R44	x 454646, y 518548	12.9

6.6.6.2 NO_2

Most NO_2 is produced in the atmosphere by reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emissions of nitrogen oxides (NOx = NO + NO_2). The model has been run to predict the 2018 annual mean NOx concentrations at the diffusion tube monitoring sites R26, R27, R42, R43 and R44.

The model output of road-NOx has been compared with the 'measured' road-NOx, calculated from the measured annual mean NO2 concentrations and the background concentrations using the NOx from NO_2 calculator v7.1 published by Defra.

The slope of the best-fit line between the 'measured' road-NOx contribution and the model derived road-NOx contribution, forced through zero, has been used to determine a adjustment factor). This factor has then been applied to the modelled road-NOx concentration for each receptor to provide adjusted modelled road-NOx concentrations. The NOx to NO_2 calculator has then been used to determine total NO_2 concentrations from the adjusted modelled road-NOx concentrations and the background NO_2 concentrations.

The following adjustment factor has been applied to all modelled nitrogen dioxide data:

Adjustment factor: 2.0327

The results imply that the model has under-predicted the road-NOx contribution. This is a common experience with this and most other models.

Table 61: Comparison of Modelled and Monitored NO_2 Concentrations.

Site ID	Monitored Total NO_2 (µg/m^3)	Monitored Total NOx (µg/m^3)	Background NO_2 (µg/m^3)	Background NOx (µg/m^3)	Monitored Road Contribution NO_2 (µg/m^3)	Monitored Road Contribution NOx (µg/m^3)	Modelled Road Contribution NOx (µg/m^3)
R26	24.7	40.4	16.8	24.0	7.9	16.35	5.1
R27	29.8	54.1	15.3	21.6	14.5	32.44	15.6
R42	16.6	24.4	14.1	19.8	2.5	4.63	2.8
R43	16.1	23.4	14.1	19.8	2.0	3.68	3.7
R44	15.7	23.0	12.9	17.8	2.8	5.23	5.0
Adjustment Factor					2.0327		

6.6.6.3 PM_{10} and $PM_{2.5}$

There are no PM_{10} or $PM_{2.5}$ monitors within the study area; therefore, the model outputs of road-PM have been adjusted by applying the primary adjustment factor calculated for road-NOx.

6.6.7 Model Post-processing

6.6.7.1 NO_2

The NOx to NO_2 calculator v7.1 published by Defra has been used to convert the modelled, verified road-NOx output for each receptor to road-NO_2. The background NO_2 concentrations and the contributions from the facility stack emissions have then been added to the predicted road-NO_2 concentrations to give the final predicted concentrations.

6.6.7.2 PM_{10} and $PM_{2.5}$

The verified road-PM outputs need no further processing and have been added to the background concentrations and the contributions from the facility point emissions to give the final predicted concentrations.

6.6.8 Sensitivity Analysis

There is some uncertainty with regard to future reductions in road traffic NOx emissions used in the EFT and the background maps. Therefore, a sensitivity analysis has been undertaken which assumes that there are no reductions in emission factors for road traffic from the baseline year.

The model inputs are as described above; however, emission factors from the verification year (2018) have been used with the future year traffic data to predict 'no emissions reduction' NO_2 concentrations.

The future year road traffic component of background NOx and NO_2 concentrations have also been held constant at the verification year (2018) level in order to calculate 'no emissions reduction' background concentrations. This has been done using the source-specific background nitrogen oxides maps provided by Defra for each grid square, the road traffic component has been held constant at 2018 levels, while 2025 values have been taken for the other components. NO_2 concentrations have then been calculated using the background nitrogen dioxide calculator which Defra publishes to accompany the maps.

For PM, there is no strong evidence that Defra's predictions are unrealistic and so the year-specific mapped concentrations have been used.

Appendix 7 Isopleth showing the areas of impacts based on the PCs

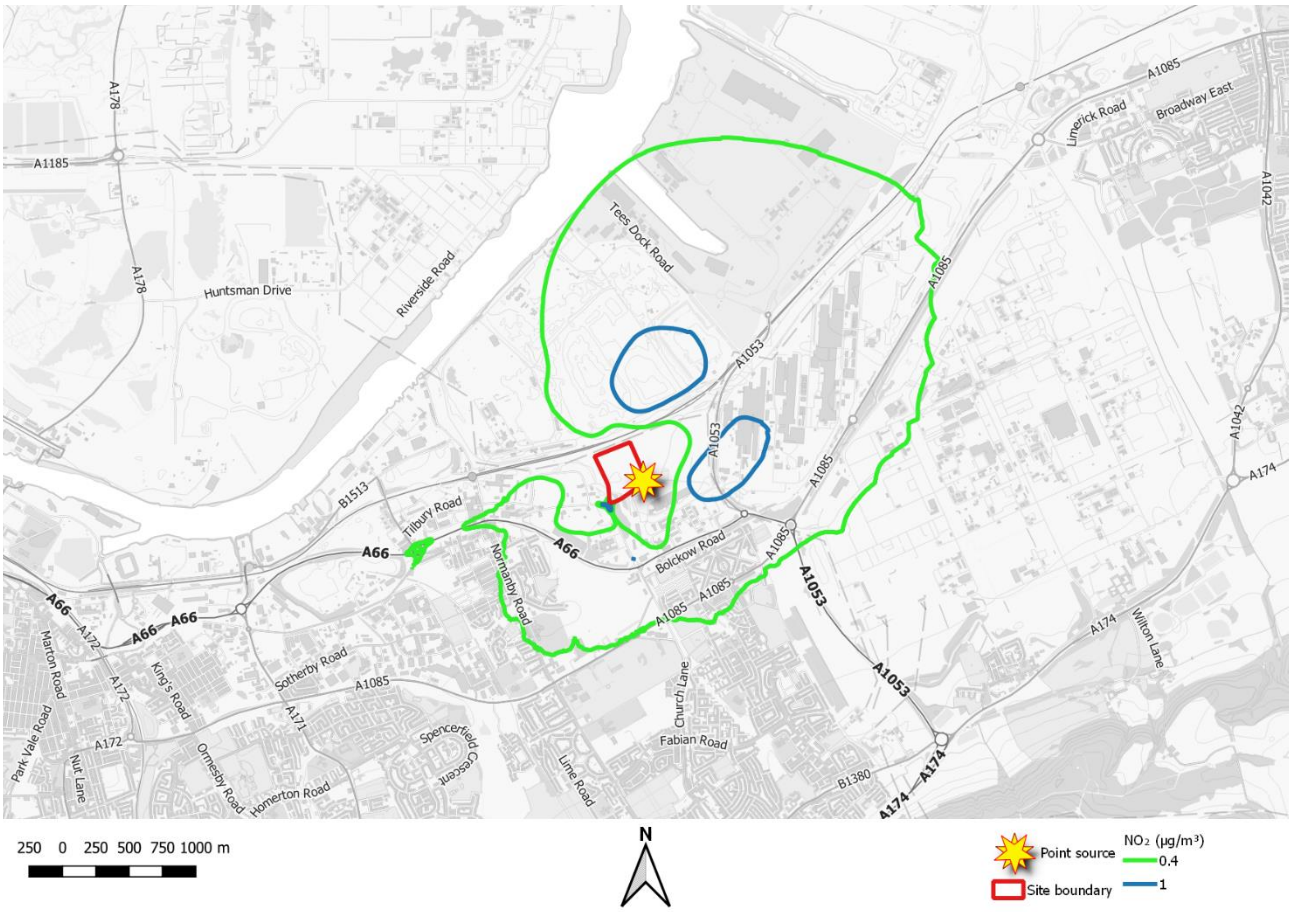

Figure 20: Annual Mean NO_2 Process Contriubtions (µg/m^3)

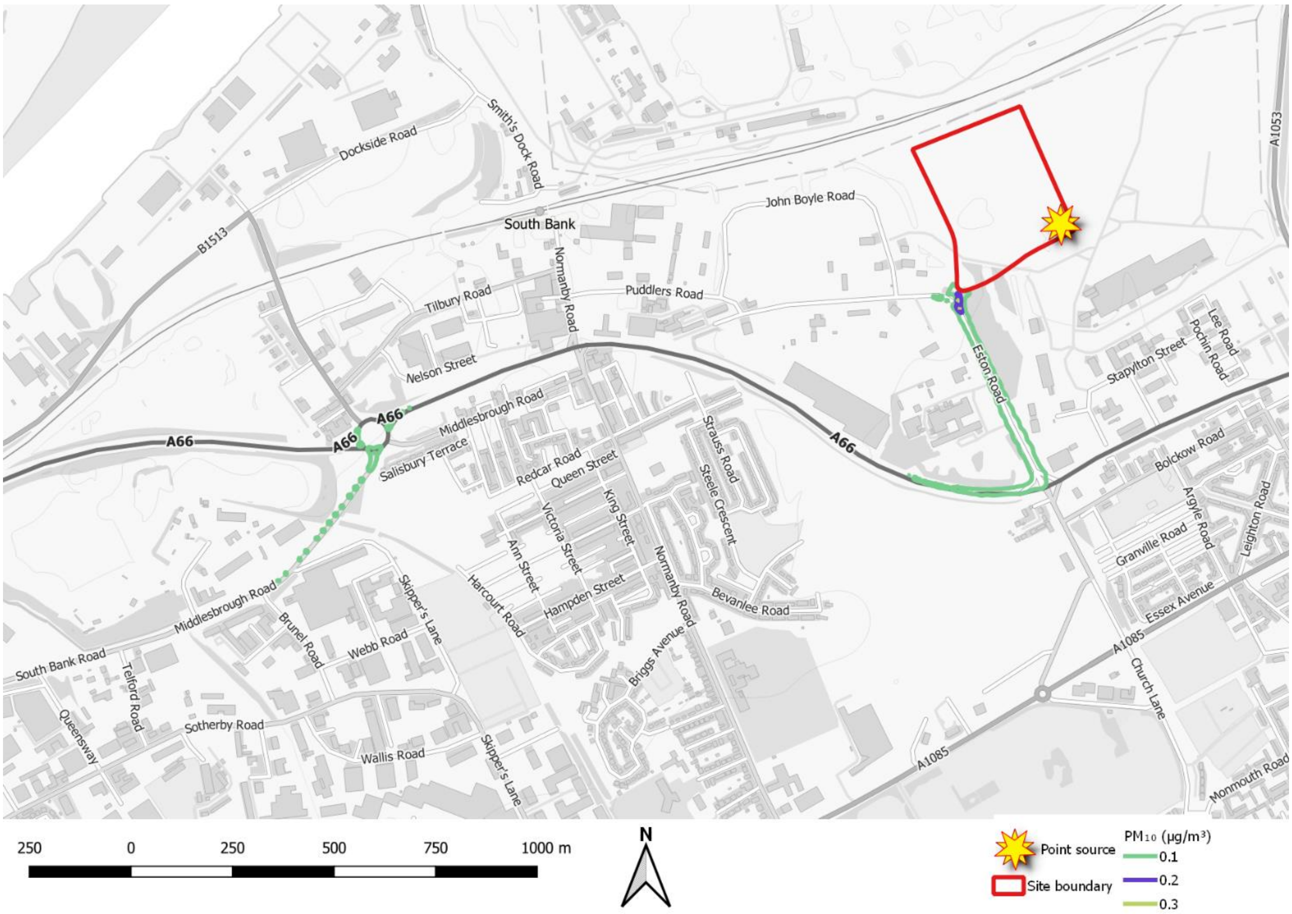

Figure 21: Annual Mean PM_{10} Process Contriubtions (µg/m^3)

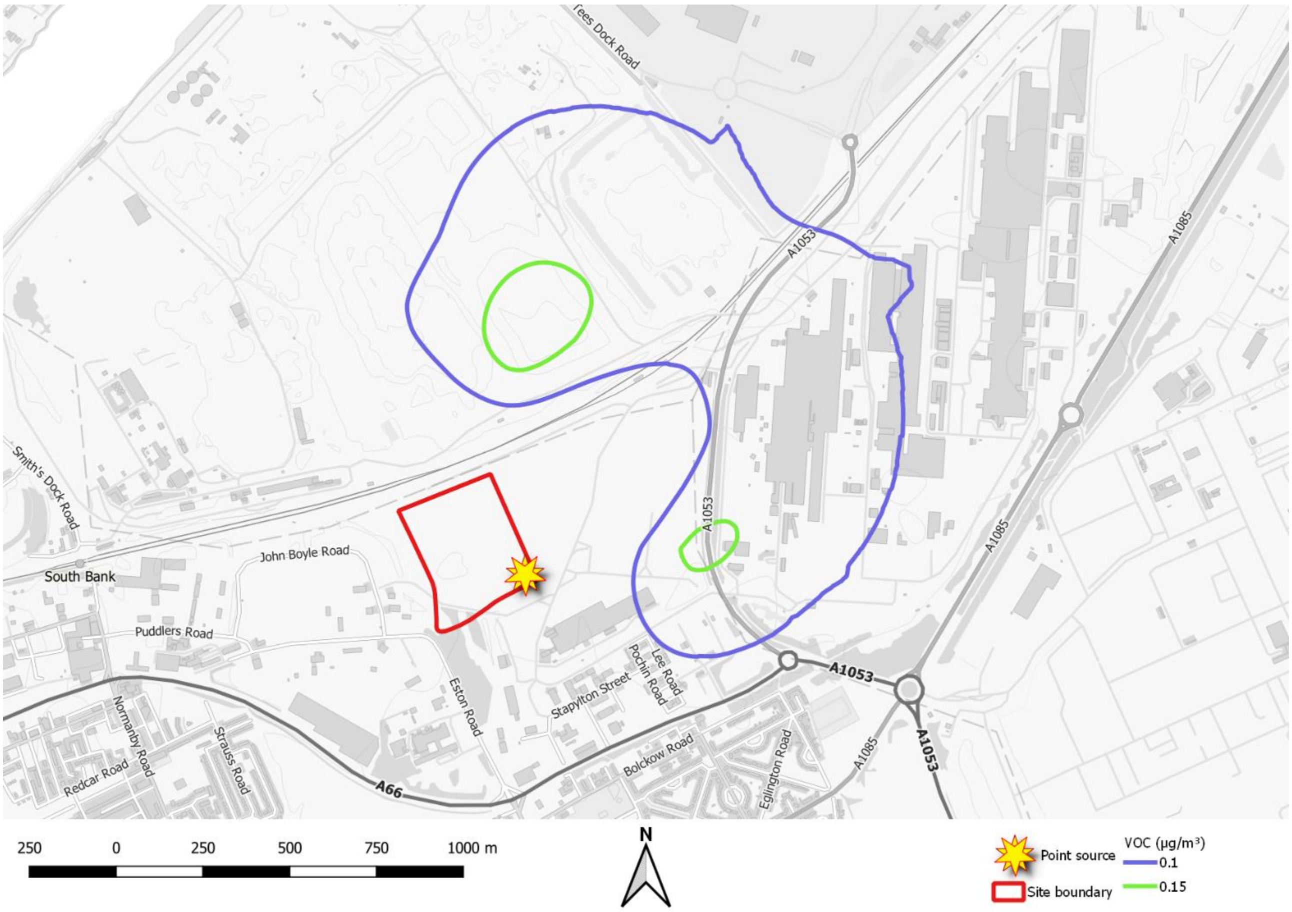

Figure 22: Annual Mean VOC Process Contriubtions (µg/m³)

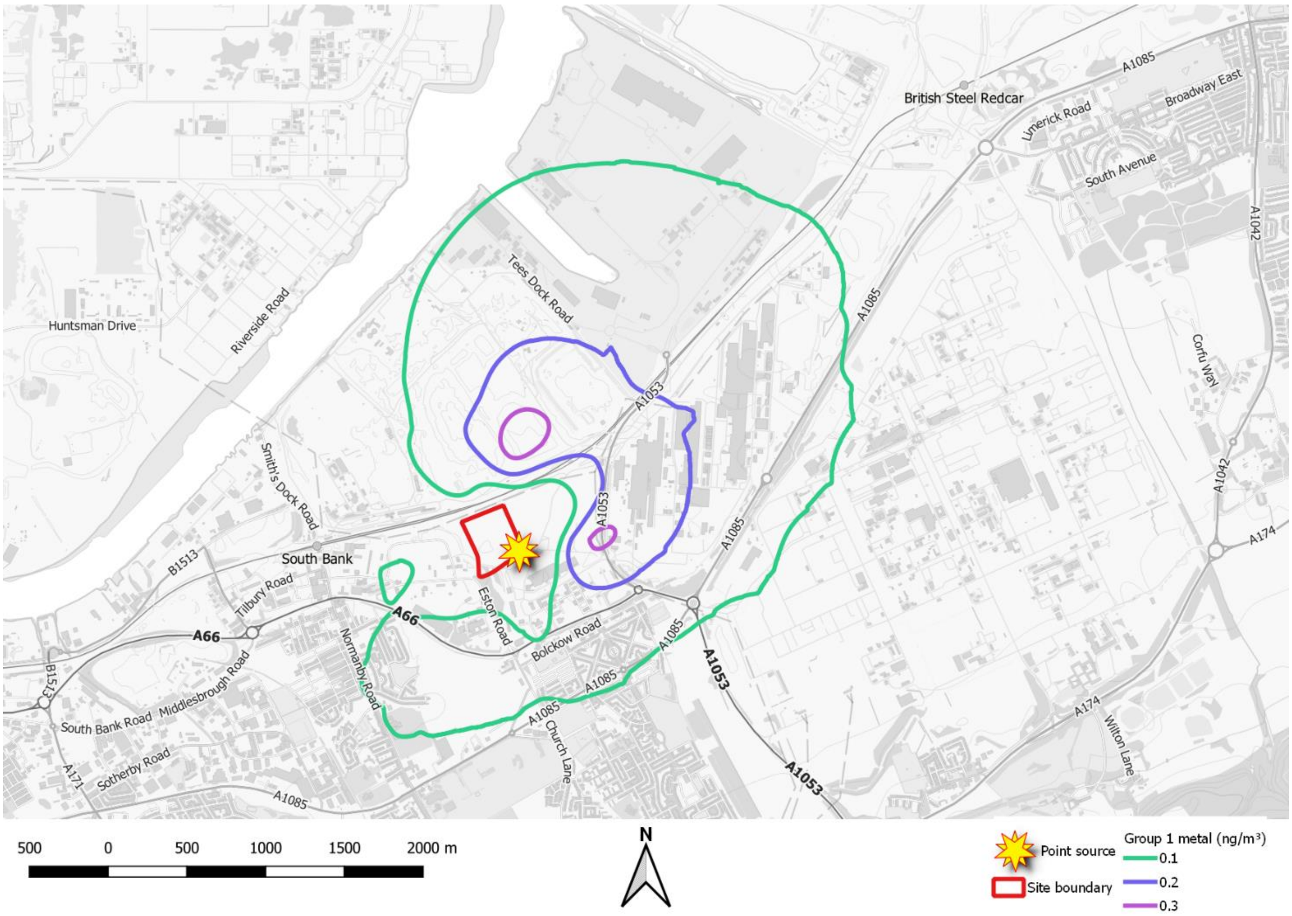

Figure 23: Annual Mean Group 1 Metal Process Contriubtions (ng/m^3)

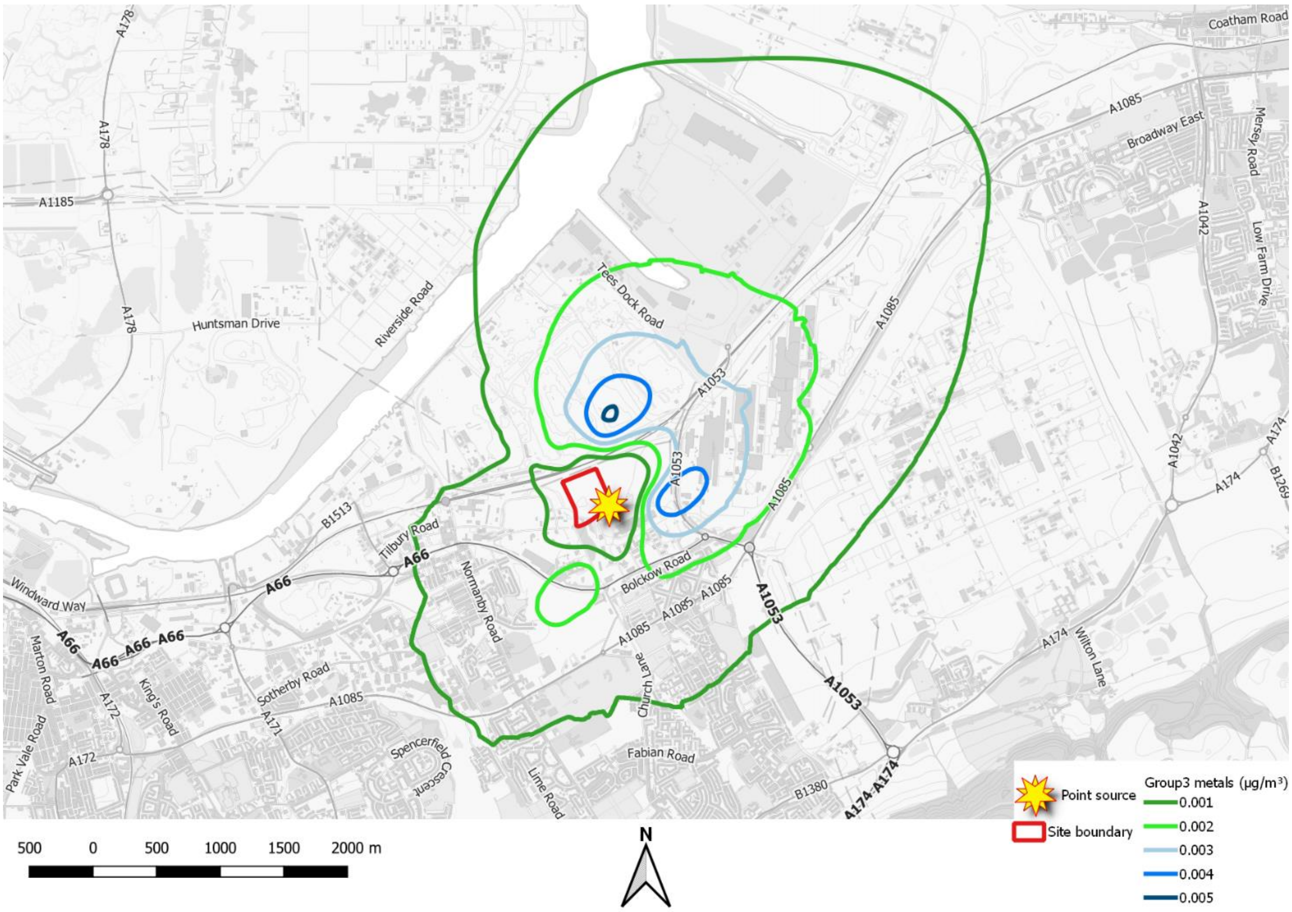

Figure 24: Annual Mean Group 3 Metal Process Contriubtions (ng/m^3)

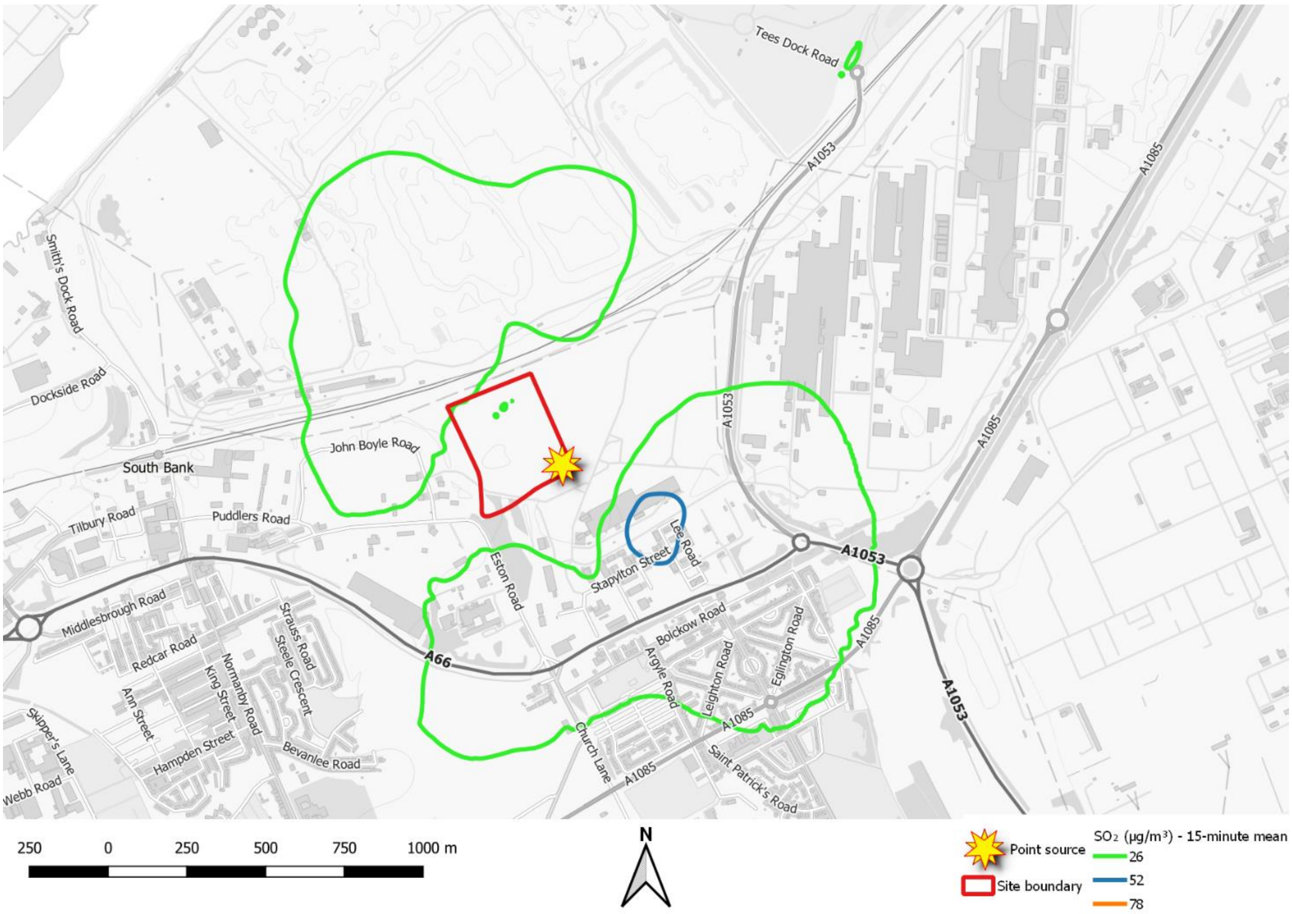

Figure 25: 15-minute Mean SO_2 Process Contriubtions (µg/m^3)

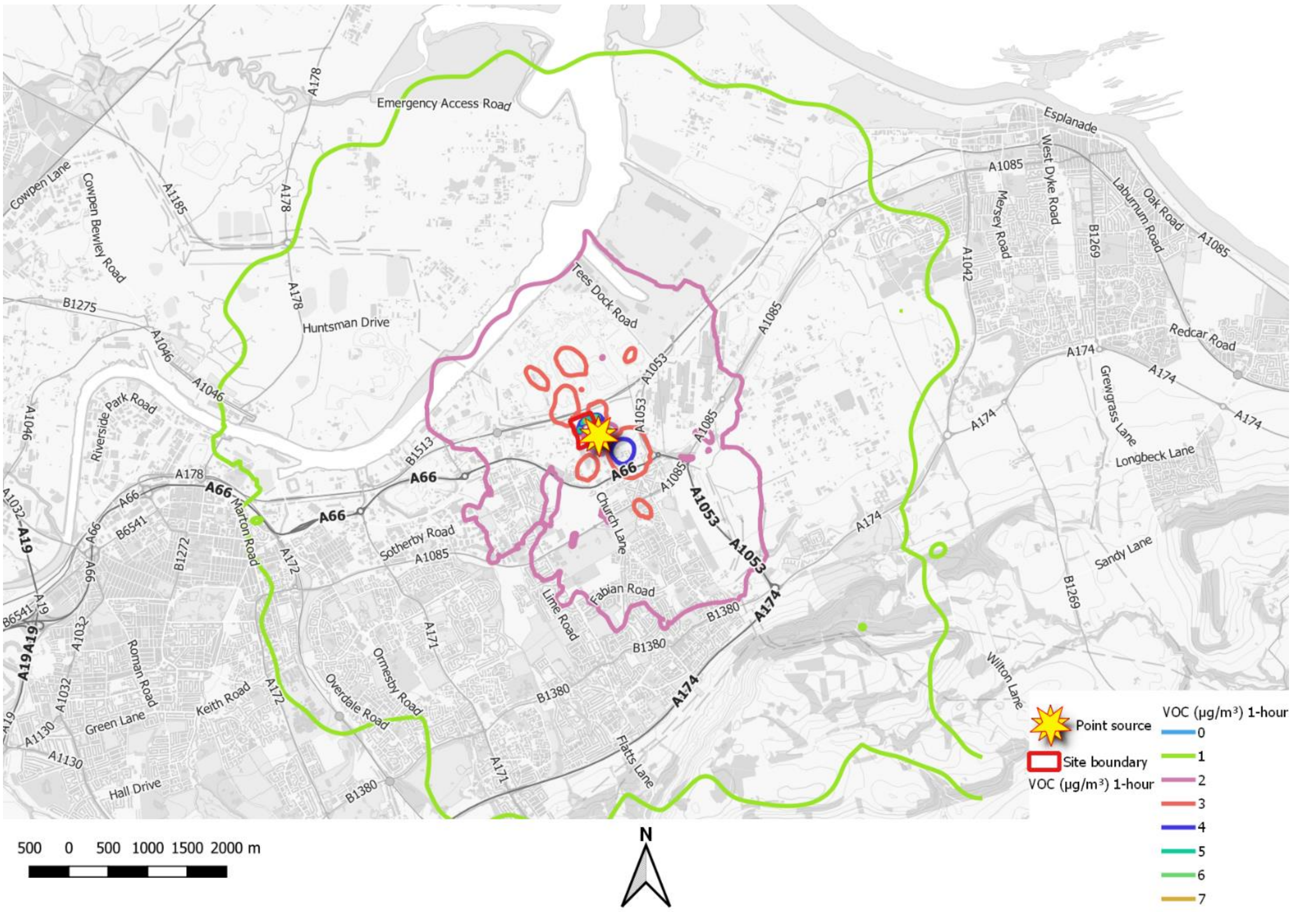

Figure 26: 1-hour Mean VOC Process Contriubtions (μg/m^3)

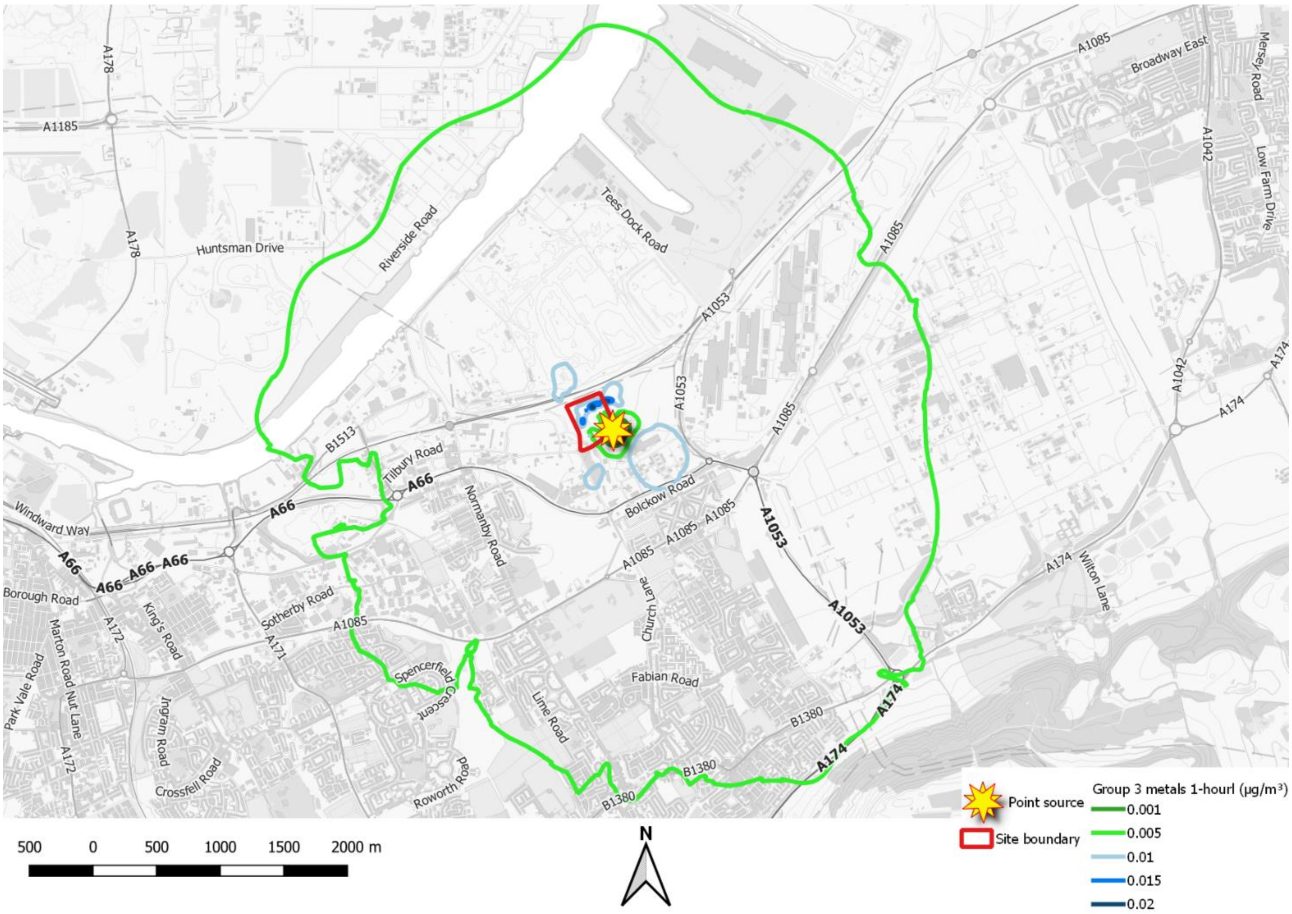

Figure 27: 1-hour Mean Group 3 Metal Process Contriubtions (ng/m^3)

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