



Air Quality Assessment: Houghton Main Renewable Energy Park

May 2014



Experts in air quality
management & assessment

Document Control

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1 Introduction

- 1.1 This report describes the potential air quality and odour impacts associated with the proposed development. The assessment has been carried out by Air Quality Consultants Ltd on behalf of Peel Environmental Ltd.
- 1.2 The proposed development is located to the east of Barnsley within the Barnsley Metropolitan Borough boundary. The Council has declared a number of air Quality management areas due to concerns over concentrations of nitrogen dioxide. All the AQMAs are in Barnsley and the proposed site is more than 5 km from the nearest AQMA.
- 1.3 The proposed facility will process approximately 60,000 tpa of food waste by AD and up to 150,000 tpa of waste wood by biomass gasification. Both technologies produce a combustible gas (biogas or syngas) which will be combusted in CHP engines to generate electricity, along with small volumes of waste products.
- 1.4 During the construction phase, dust emissions have the potential to impact upon local receptors and this has been assessed. The main pollutants of concern related to construction activities are dust and PM₁₀. Emissions from on-site plant and vehicles have not been assessed, as experience suggests they are unlikely to have a significant impact (Institute of Air Quality Management, 2014).
- 1.5 During the operational phase, emissions to air from the two Combined Heat and Power (CHP) plant that combust biogas produced by the Anaerobic Digestion (AD) plant and the emissions from the gasification biomass burner stack have been assessed. These emissions have potential air quality impacts in terms of human health and ecosystems.
- 1.6 In relation to human health, consideration has been given to a comprehensive range of pollutants that may be emitted. The list is taken from the Industrial Emissions Directive (IED), to which the gasification plant will have to conform for permitting purposes. Where emission rates for these pollutants are relevant for the AD plant they have also been included. The pollutants assessed are thus:
- nitrogen oxides
 - total dust (as PM₁₀ and PM_{2.5})
 - carbon monoxide (CO)
 - TOC;
 - sulphur dioxide (SO₂);
 - hydrogen chloride (HCl);

- hydrogen fluoride (HF);
- twelve trace metals; and
- dioxins and furans.

1.7 In addition to the assessment of impacts to human health, the potential air quality impacts on sensitive wildlife sites have also been addressed. There are no Special Protection Areas (SPAs), Special Areas of Conservation (SCAs) or Ramsar sites within 10 km of the development. However, there is a Site of Special Scientific Interest (SSSI), a local nature reserve (LNR) and a number of Local Wildlife Sites (LWS), Ancient Woodland (AW) and Restored Ancient Woodland (RAW) sites have been identified in the area within 2 km of the development and these may be affected by the proposals. The Carlton Main Brickwoods SSSI has been designated for its geological interest, and will not be sensitive to emissions from the application site, however the LWSs, AW and RAW will be. These sites are shown in Figure 1 and define the extent of the study area. The relevant pollutants with the potential to affect sensitive ecosystems are:

- nitrogen oxides (NO_x);
- ammonia (NH₃);
- SO₂;
- HF;
- nutrient nitrogen deposition (which is contributed to by NO_x and NH₃ emissions); and
- acid deposition (which is contributed to by NO_x, NH₃, SO₂ and HCl emissions).

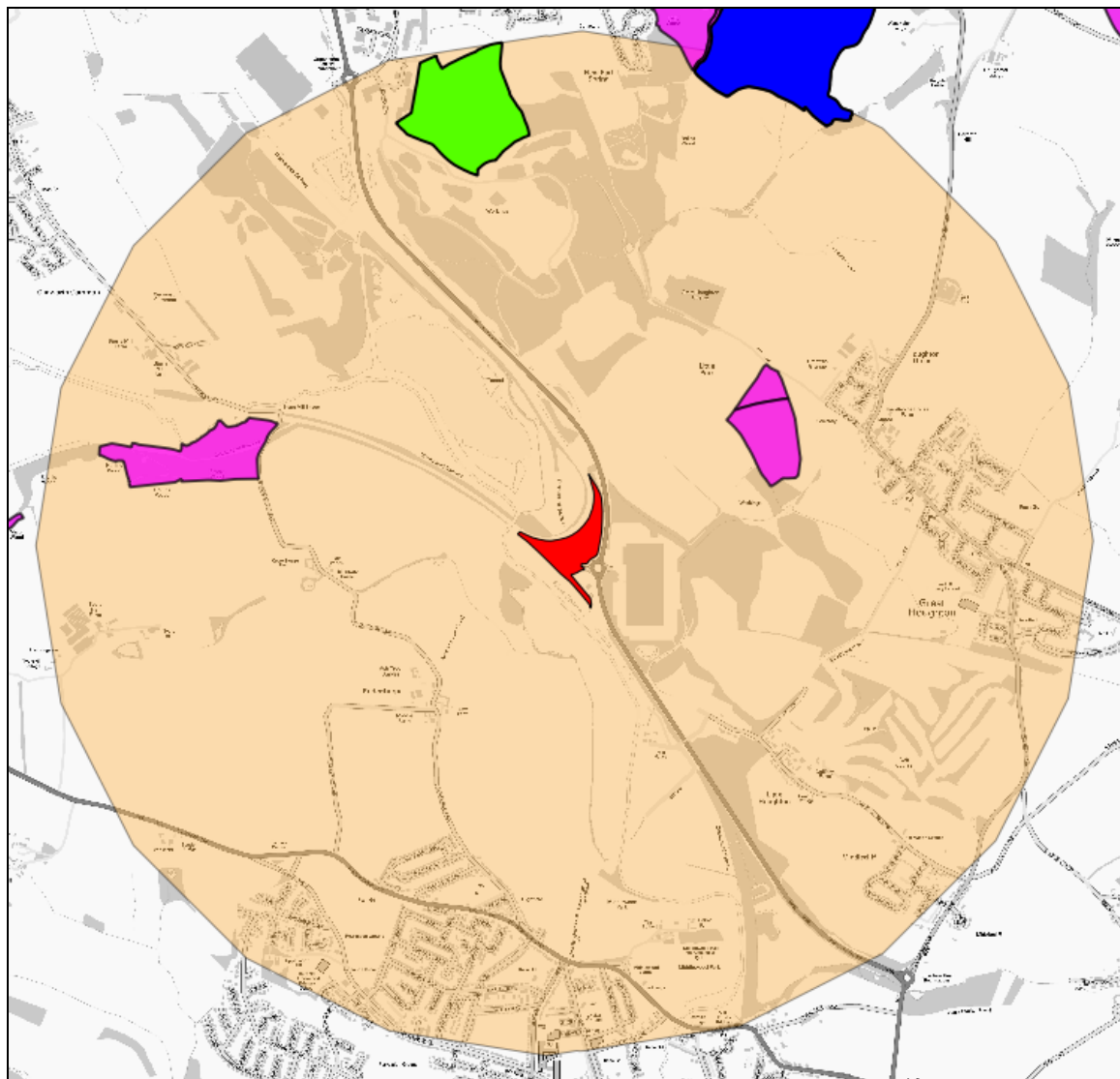


Figure 1: Ecological Sites within 2 km of the Development site (Red area). SSSI (Green Area), AW and RAW (Purple Area), LNR (Blue Area) and Study Area - 2 km buffer (Orange Area).

- 1.8 The proposals make provision for a gas flare which would be used only when the CHP engines are not operating. For the purposes of this assessment, the CHP engines are assumed to operate 100% of the time. Emissions from the gas flare have not been explicitly modelled because the flare will only operate when one or both of the CHP plant are not in operation.
- 1.9 The proposals do not specify any other backup generators or boilers and therefore no other on-site point sources have been accounted for.
- 1.10 The development will increase the traffic flows on local roads, which may also impact on air quality in the local area. The impacts of these changes have, however, been screened out as *negligible* using the criteria contained within the EPUK guidance (Environmental Protection UK, 2010). This guidance states that impacts of traffic related sources should be considered if:

- *The proposals give rise to a significant change in either traffic volumes or in vehicle speed on roads with an annual average daily traffic (AADT) flow of more than 10,000 vehicles. A change in AADT or peak traffic flows of greater than 5% are considered significant within an AQMA.*
- *The proposals would significantly alter traffic composition on local roads. Typically this is considered to be the case if an increase in daily HDV movements of 200 or more HDVs is predicted.*
- *The proposals would include significant car parking. Significant parking provision is considered to be 50 or more spaces within an AQMA.*

1.11 Traffic flows were provided by SK Transport Planning Ltd. The greatest increase in traffic due to the proposed development on any local road (including those with AADTs less than 10,000 vehicles) is 0.95%; this is well below the criterion of 10%. The development is predicted not to increase HDV flows on local roads above the threshold; the greatest increase in HDVs on any local road is 66 vehicles. As these criteria have not been exceeded, a quantitative assessment of the impacts of the changes in traffic flows has not been carried out. It can be concluded that the road traffic impacts will be *insignificant*.

1.12 This report describes existing local air quality conditions (2012), and the predicted air quality in the future (2017) assuming that the proposed development does, or does not proceed. The assessment of construction dust impacts focuses on the anticipated duration of the works.

1.13 The Houghton Main development has the potential to generate odours, which may lead to odours being detected beyond the application site boundary. The potential for odour effects resulting from the operation of the proposed development has been assessed.

1.14 This report has been prepared taking into account all relevant local and national guidance and regulations, and follows a methodology agreed with Barnsley Metropolitan Borough Council.

2 Policy Context and Assessment Criteria

European Legislation

European Framework Directive on Ambient Air Quality and Cleaner Air for Europe, May 2008

- 2.1 The European Union has set limit values (concentrations which must not be exceeded) for seven key air pollutants, nitrogen dioxide, particulates (as PM₁₀ and PM_{2.5}), sulphur dioxide (SO₂), benzene, carbon monoxide (CO), and lead (Pb). These limit values are set out in the EU Framework Directive (2008/50/EC, 2008). Achievement of these values is a national obligation and was required by 2010 for nitrogen dioxide and benzene, and 2005 for all other pollutants apart from PM_{2.5}, which will not apply until 2015.

European Waste Framework Directive, November 2008

- 2.2 The Waste Framework Directive (2008/98/EC, 2008) sets out the EU member state obligations to the planning, operation and management of waste sites and processes. With respect to air quality, the Directive states:
- a) *“Member States shall take the necessary measures to ensure that waste management is carried out without endangering human health, without harming the environment and, in particular:*
 - b) *without risk to water, air, soil, plants or animals;*
 - c) *without causing nuisance through noise or odours; and*
 - d) *without adversely affecting the countryside or places of special interest.”*

European Industrial Emissions Directive, December 2010

- 2.3 The Industrial Emissions Directive (IED) (2010/75/EU, 2010) brings together seven existing directives, including the Waste Incineration Directive, into one piece of legislation. The IED outlines total emission limit values (ELVs) for a number of pollutants typically emitted during waste incineration. These are nitrogen oxides and nitrogen dioxide, NO, total dust, HCl, HF, SO₂, organic substances, trace metals, and dioxins and furans. The design and operation of all new waste incinerations facilities must ensure compliance with the ELVs, which are summarised in Table 1 below.

Table 1: IED Emission Limit Values (mg/Nm³)

Pollutant	Daily Average	Half-Hourly Average	
		100 th percentile	97 th percentile
Total dust	10	30	10
Total Organic Carbon (TOC)	10	20	10
Hydrogen chloride (HCl)	10	60	10
Hydrogen fluoride (HF)	1	4	2
Sulphur dioxide (SO₂)	50	200	50
Nitrogen Oxides (NO_x)	200	400	200
Carbon monoxide (CO)	50	100 ^a	150 ^b
Group 1 metals^{c d}	0.05		
Group 2 metals^{c e}	0.05		
Group 3 metals^{c f}	0.5		
Dioxins and furans^g	1 x 10 ⁻⁷		

^a 100th percentile of half-hourly average concentrations in any 24-hour period

^b 100th percentile of ten-minute average CO concentrations

^c Average over a sample period between 30 minutes and 8-hours

^d Cadmium (Cd) and Thallium (Tl)

^e Mercury (Hg)

^f Antimony (Sb), Arsenic (As), Lead (Pb), chromium (Cr), Cobalt (Co), Copper (Cu), Manganese (Mn), Nickel (Ni) and Vanadium (V)

^g I-TEQ (Toxic Equivalent)

Protection of Sensitive Ecosystem

2.4 European Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the “Habitats Directive”) requires member states to introduce a range of measures for the protection habitats and species. The Conservation of Habitats and Species Regulations (The Air Quality Standards Regulations 2010 (No. 1001), 2010), transposes the Directive into law in England and Wales. The Regulations 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 Council Directive 79/409/EEC on the Conservation of Wild Birds (Directive 2009/147/EC of the European Parliament and of the Council, 2009). These sites form a network termed “Natura 2000”.

- 2.5 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.
- 2.6 In addition to SACs and SPAs, some internationally important UK sites are designated under the Ramsar Convention. Originally intended to protect waterfowl habitat, the Convention has broadened its scope to cover all aspects of wetland conservation.
- 2.7 The Habitats Directive (as implemented by the Regulations) requires the competent authority, which in this case will be the planning 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 development will adversely affect the integrity of the site.

National Legislation

The Environmental Permitting Regulations in England and Wales, March 2010

- 2.8 The Environmental Permitting Regulations (2010) set the legislative background for environmental permitting in England and Wales. The regulations include a commitment to minimising emissions to air from permitted processes, and include obligations of compliance with all legislated emissions limits for permitted processes, including the IED emission limits for waste incineration processes.

The Environmental Permitting Regulations in England and Wales (Amendment) Regulation (2013)

- 2.9 The requirements of the IED were transposed into UK law on 27th February 2013 by the Environmental Permitting (England and Wales) (Amendment) Regulations (2013). This makes any new installation seeking a permit after 28th February 2013 subject to the IED.

The Waste (England and Wales) Regulations 2011, March 2011

- 2.10 The Waste Framework Directive (2008/98/EC, 2008) and its obligations, including those on air quality, are transposed in English law by The Waste (England and Wales) Regulations (2011).

The UK Air Quality Strategy, 2007

- 2.11 The Air Quality Strategy published by the Department for Environment, Food, and Rural Affairs (Defra) provides the policy framework (Defra, 2007) for air quality management and assessment in the UK. It provides air quality standards and objectives for key air pollutants, which are designed to protect human health and the environment. It also sets out how the different sectors: industry, transport and local government, can contribute to achieving the air quality objectives. Local authorities are seen to play a particularly important role. The strategy describes the Local Air

Quality Management (LAQM) regime that has been established, whereby every authority has to carry out regular reviews and assessments of air quality in its area to identify whether the objectives have been, or will be, achieved at relevant locations, by the applicable date. If this is not the case, the authority must declare an Air Quality Management Area (AQMA), and prepare an action plan which identifies appropriate measures that will be introduced in pursuit of the objectives.

Air Quality (England) Regulations, 2000 and Air Quality (England) (Amendment) Regulations 2002

- 2.12 Some of the objectives are for the use of local authorities as part of the LAQM regime, and these are set out in regulations.

Air Quality Standards Regulations, 2010

- 2.13 The air quality limit values set out in EU Directive (2008/50/EC, 2008) are transposed in English law by the Air Quality Standards Regulations (2010). This imposes duties on the Secretary of State relating to achieving the limit values.

Protection of Sensitive Ecosystems

- 2.14 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 development 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.

National Planning Policies

National Planning Policy Framework, March 2012

- 2.15 The National Planning Policy Framework (NPPF) (2012) sets out planning policy for the UK in one place. It places a general presumption in favour of sustainable development, stressing the importance of local development plans, and states that the planning system should perform an environmental role to minimise pollution. One of the twelve core planning principles notes that planning should “*contribute to...reducing pollution*”. To prevent unacceptable risks from air pollution, planning decisions should ensure that new development is appropriate for its location.

The NPPF states that the effects of pollution on health and the sensitivity of the area and the development should be taken into account.

- 2.16 More specifically the NPPF makes clear that: *“Planning policies should sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative impacts on air quality from individual sites in local areas. Planning decisions should ensure that any new development in Air Quality Management Areas is consistent with the local air quality action plan.”*
- 2.17 The NPPF also sets out the National planning policy on biodiversity and conservation. This emphasises that the planning system should seek to minimise effects on biodiversity and provide net gains in biodiversity wherever possible as part of the Government’s commitment to halting declines in biodiversity and establishing coherent and resilient ecological networks.
- 2.18 PPS10 on Planning for Sustainable Waste Management (ODPM, 2011), which has not yet been replaced by the NPPF (although a consultation draft of the updated national waste planning policy document: *Planning for sustainable waste management* was issued in July 2013), sets out the several objectives for ‘sustainable’ waste management. The overall objective of the Government policy on waste is to protect human health and the environment by producing less waste and by using it as a resource wherever possible. PPS10 contains Annex E, for consideration of local environmental impacts, including dust, odours and litter. In considering planning applications for waste management facilities waste planning authorities should consider the likely impact on the local environment and on amenity, i.e. through consideration of the proximity of sensitive receptors and the extent to which adverse emissions can be controlled through the use of appropriate and well-maintained and managed equipment.
- 2.19 The NPPF is now supported by Planning Practice Guidance (PPG) (DCLG, 2014), which includes guiding principles on how planning can take account of the impacts of new development on air quality. The PPG states that *“Defra carries out an annual national assessment of air quality using modelling and monitoring to determine compliance with EU Limit Values.”* and *“It is important that the potential impact of new development on air quality is taken into account ... where the national assessment indicates that relevant limits have been exceeded or are near the limit”*. The role of the local authorities is covered by the LAQM regime, with the PPG stating that local authority Air Quality Action Plans *“identify measures that will be introduced in pursuit of the objectives”*. The PPG makes clear that *“Air quality can also affect biodiversity and may therefore impact on our international obligation under the Habitats Directive”*. In addition, the PPG makes clear that *“Odour and dust can also be a planning concern, for example, because of the effect on local amenity”*.
- 2.20 The PPG states that *“Whether or not air quality is relevant to a planning decision will depend on the proposed development and its location. Concerns could arise if the development is likely to generate air quality impact in an area where air quality is known to be poor. They could also arise where the development is likely to adversely impact upon the implementation of air quality*

strategies and action plans and/or, in particular, lead to a breach of EU legislation (including that applicable to wildlife)”.

- 2.21 The PPG sets out the information that may be required in an air quality assessment, making clear that “Assessments should be proportional to the nature and scale of development proposed and the level of concern about air quality”. It also provides guidance on options for mitigating air quality impacts, as well as examples of the types of measures to be considered. It makes clear that “Mitigation options where necessary, will depend on the proposed development and should be proportionate to the likely impact”.

Protection of Sensitive Ecosystems

- 2.22 National planning policy on biodiversity and conservation is set out in the NPPF (National Planning Policy Framework, 2012). This emphasises that the planning system should seek to minimise impacts on biodiversity and provide net gains in biodiversity wherever possible as part of the Government’s commitment to halting declines in biodiversity and establishing coherent and resilient ecological networks.
- 2.23 Local planning authorities should set criteria based policies against which proposals for any development on or affecting protected wildlife sites will be judged, making distinctions between different levels of site designation. If significant harm from a development cannot be prevented, adequately mitigated against, or compensated for, then planning permission should be refused.

Local Planning Policies

Barnsley Local Development Framework Core Strategy

- 2.24 The Barnsley Local Development Framework (LDF) is a portfolio of documents that ties together all planning policy and the spatial planning strategy for the borough, up to 2026. The key document within the LDF is the Core Strategy (Barnsley MBC, 2011), which sets out the key elements of planning framework for Barnsley and includes a series of core policies to guide development proposals in the borough. The Core Strategy includes two policies relevant to air pollution; CSP 40 pertains to pollution control and states:

“CSP40 Pollution Control and Protection

Development will be expected to demonstrate that it is not likely to result, directly or indirectly, in an increase in air, surface water and groundwater, noise, smell, dust, vibration, light or other pollution which would unacceptably affect or cause a nuisance to the natural and built environment or to people. We will not allow development of new housing or other environmentally sensitive development where existing air pollution, noise, smell, dust, vibration, light or other pollution levels are unacceptable and there is no reasonable prospect that these can be mitigated against.

Developers will be expected to minimise the effects of any possible pollution and provide mitigation measures where appropriate.”

2.25 Core policy CSP 41 also relates to air quality specifically within Air Quality Management Areas:

“CSP 41 Development in Air Quality Management Areas

Development in air quality management areas will be expected to demonstrate that it will not have a harmful effect on the health or living conditions of any future users of the development in terms of air quality (including residents, employees, visitors and customers), or that any such harmful effects can be mitigated against. We will only allow residential development in air quality management areas, where the developer provides an assessment that shows living conditions will be acceptable for future residents. We will only allow development in air quality management areas which could cause more air pollution, where the developer provides an assessment that shows there will not be a significantly harmful effect on air quality.”

Barnsley, Doncaster and Rotherham Joint Waste Plan

2.26 The Barnsley, Doncaster and Rotherham Joint Waste Plan (Barnsley MBC, 2012) sets out the overall approach to managing waste across Barnsley, Doncaster and Rotherham for 15 years from publication in 2012. The Waste Plan provides guidance to waste management development, sets out a strategic approach to waste management in the boroughs, and incorporates a number of planning policies relating to waste management, which are integrated in the Barnsley Local Development Framework. One such policy (WCS6) relates to emission of dust and odour and states:

“Policy WCS6: General Considerations for All Waste Management Proposals

A. Proposals for waste development will only be permitted within Barnsley, Doncaster and Rotherham provided they can demonstrate how they:

...

9) provide adequate means of controlling noise, vibration, glare, dust, litter, odour and vermin and other emissions (e.g. greenhouse gases and leachate) so as to avoid adverse effects on the amenity of the immediate and surrounding environment and human health, both during and after operations;”

Protection of Sensitive Ecosystems

2.27 Local planning authorities should set criteria based policies against which proposals for any development on or affecting protected wildlife sites will be judged, making distinctions between

different levels of site designation. If significant harm from a development cannot be prevented, adequately mitigated against, or compensated for, then planning permission should be refused.

Air Quality Action Plan

- 2.28 The Barnsley Air Quality Action Plan (Barnsley MBC, 2013) details measures to be taken to improve air quality in the borough. This is targeted at the boroughs 6 AQMAs. The borough's AQMAs are declared along busy roads where road traffic emissions are the principal pollution source. The Action Plan measures are therefore focussed upon reducing road traffic emissions, and only contains a two measures relevant to industrial pollution sources:

“14 – Barnsley MBC will continue to provide comprehensive control over emissions from Part B and A2 processes, and act as consultees to the Environment Agency for part A1 processes.”

“16 – Barnsley MBC will continue to enforce the provisions of the Clean Air Act 1993 with regards to industrial smoke.”

Guidance Notes

Environment Agency H1 Environmental Risk Assessment Guidance Note, 2011

- 2.29 The Environment Agency's (EA's) H1 Environmental Risk Assessment Guidance Note (2010) provides methods for quantifying the environmental effects of emissions to all media; Annex F of H1 covers Emissions to Air. It contains long- and short-term Environment Assessment Levels (EALs) for releases to air derived from a number of published UK and international sources.
- 2.30 In addition, the EA's Interim Guidance Note for Metals provides guidance for applicants for environmental permits, on how to consider the air quality effects from Group III metals in stack emissions from incineration and co-incineration plant (including Energy from Waste) (Environment Agency, 2012).

Health and Safety Executive, Workplace Exposure Limits, 2005

- 2.31 The Health and Safety Executive's EH40/2005 Workplace exposure limits (HSE, 2005) document contains a list of the workplace exposure limits for substances hazardous to health. For pollutants assessed in this report which have no AQO or EALs, the occupational exposure emissions limits in EH40 have been used, following the advice set out in the EA's H1 guidance.

Odour

- 2.32 There are currently no statutory standards in the UK covering the release and subsequent impacts of odours. This is due to complexities involved with measuring and assessing odours against compliance criteria, and the inherently subjective nature of odours.

- 2.33 It is recognised that odours have the potential to pose a nuisance for residents living near to an offensive source of odour. Determination of whether or not an odour constitutes a statutory nuisance in these cases is usually the responsibility of the local planning authority or the Environment Agency. The Environmental Protection Act 1990 (1990) outlines that a local authority can require measures to be taken where any:
- *“dust, steam, smell or other effluvia arising on an industrial, trade and business premises and being prejudicial to health or a nuisance...” or*
 - *“fumes or gases are emitted from premises so as to be prejudicial to health or cause a nuisance..”*
- 2.34 Odour can also be controlled under the Statutory Nuisance provisions of Part III of the Environmental Protection Act.
- 2.35 The Environment Agency has produced horizontal guidance on odour assessment and management (H4). The H4 guidance document is primarily aimed at process operators looking to control and manage the release of odours, but also contains a series of recommended assessment methods, some of which have informed the methodology employed in this assessment.
- 2.36 Defra released Odour Guidance for Local Authorities in March 2010 (Defra, 2010). This is a reference document aimed at environmental health practitioners and other professionals engaged in preventing, investigating and managing odours. The purpose of the guide is:
- “...to support local authorities in their regulatory roles in preventing, regulating and controlling odours...”*
- 2.37 The IAQM recently released (in draft) a new odour guidance document specifically designed to provide guidance on odour assessments for planning applications (IAQM, 2014b). The document outlines tools and assessment methods that can be employed to assess the impacts of odours from or affecting new applications. In the absence of any formal criteria in the UK on the significance of odour impacts, guideline criteria set out in the draft IAQM odour guidance document have been used in this assessment. The approach to the odour assessment is outlined below.

3 Assessment Approach

Existing Conditions

- 3.1 Existing sources of emissions within the study area have been defined using a number of approaches. Industrial and waste management sources that may affect the area have been identified using Defra's Pollutant Release and Transfer Register (The Air Quality Standards (Wales) Regulations (No. 1433), 2010) and the Environment Agency's website 'what's in your backyard' (Environment Agency, 2014). Local sources have also been identified through discussion with Barnsley Metropolitan Borough Council, as well as through examination of the Council's Air Quality Review and Assessment reports.
- 3.2 Information on existing air quality has been obtained by collating the results of monitoring carried out by the local authority. This covers both the study area and nearby sites, the latter being used to provide context for the assessment. The background concentrations across the study area have been defined using the national pollution maps published by Defra (2014a). These cover the whole country on a 1x1 km grid. Current exceedences of the annual mean EU limit value for nitrogen dioxide have been identified using the maps of roadside concentrations published by Defra (2014e)¹. These are the maps, currently based on 2012 data, used by the UK Government, together with the results from national AURN monitoring sites that operate to EU data quality standards, to report exceedences of the limit value to the EU.

Construction Impacts

- 3.3 The construction dust assessment considers the potential for impacts within 350 m of the site boundary; or within 50 m of roads used by construction vehicles. The assessment methodology is that provided by the IAQM (Institute of Air Quality Management, 2014). This is based around a sequence of steps. Step 1 is a basic screening stage, to determine whether the more detailed assessment provided in Step 2 is required. Step 2a determines the potential for dust to be raised from on-site works and by vehicles leaving the site. Step 2b defines the sensitivity of the area to any dust that may be raised. Step 2c combines the information from Steps 2a and 2b to determine the risk of dust impacts without appropriate mitigation. Step 3 uses this information to determine the appropriate level of mitigation required to ensure that there should be no significant impacts. Appendix A1 explains the approach in more detail.

¹ There are no exceedences of the PM₁₀ objectives.

Assessment Criteria and Significance

Construction Dust Criteria

- 3.4 There are no formal assessment criteria for dust. In the absence of formal criteria, the approach developed by the Institute of Air Quality Management² (IAQM) (2014) has been used. Full details of this approach are provided in Appendix A1.

Construction Dust Significance

- 3.5 Guidance from the IAQM (Institute of Air Quality Management, 2014) is that, with appropriate mitigation in place, the impacts of construction dust will not be significant. The assessment thus focuses on determining the appropriate level of mitigation so as to ensure that impacts will normally be not significant.

Operational Impacts of the Proposed Plant

Sensitive Locations

- 3.6 In terms of the potential impacts from the proposed plant, concentrations have been modelled for a number of discrete receptor locations which represent human health exposure, including the nearest residential properties, as well as for local sensitive ecosystems. The modelling has been carried out for the opening year 2017.
- 3.7 Thirteen existing residential properties have been identified as receptors for the assessment. An additional six receptor locations have been identified as receptors which represent the local nearby sensitive ecosystems. These locations are shown in Figure 2. Receptors 1-10 are residential properties consider relevant for long-term objectives/EALs. Receptor 11-13 are consider relevant for the short-term objectives/EALs only. The ecological area are represented by receptors A-F.

² The IAQM is the professional body for air quality practitioners in the UK.

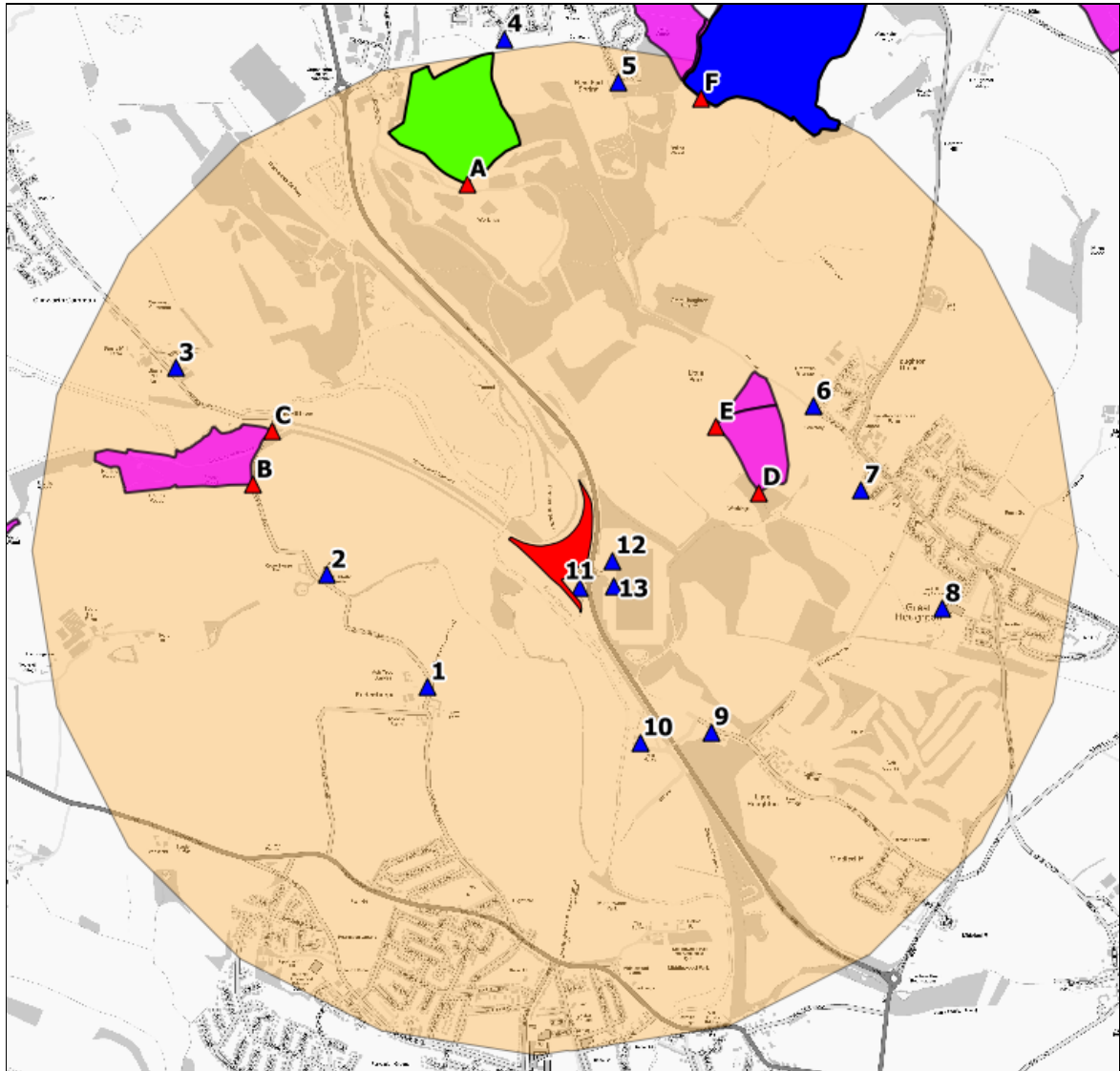


Figure 2: Human Health Receptor Locations (Blue Triangles), Ecological Receptor Locations (Red Triangles), Study Area – 2 km buffer (Orange Area).

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Modelling Methodology

3.8 The impacts of emissions from the proposed two CHP plant and the biomass gasification plant have been modelled using the ADMS-5 dispersion model. ADMS-5 is a new generation model that incorporates a state-of-the-art understanding of the dispersion processes within the atmospheric boundary layer. Entrainment of the plume into the wake of the building has been simulated within the model, see Assessment Scenarios for details.

Emissions – Biomass Gasification Plant

- 3.9 The model input parameters for the biomass gasification plant have been provided by O-Gen UK. O-Gen UK has provided data on volumes flow rates, as well as the stack exit velocity at actual release conditions. This information has been provided for 'normal' operating conditions. The information provided by the operator and values calculated are set out in the top section of Table 2.
- 3.10 The emission rates used in the modelling have been calculated using the IED emission limits presented in Table 1. Where there are multiple emission rates for different time-averaging periods, the worst-case emission rate for any of the time-averaging periods has been used.
- 3.11 The bottom section of Table 2 shows how the emission rates entered into the dispersion model have been calculated from these emission limits.
- 3.12 For the group I metals (Cadmium and Thallium), emissions have been based on the worst-case assumption that each metal is emitted at 100% of the IED group I metal emission limit.
- 3.13 For most of the group III metals shown in Table 2, when assessing against the EALs for each metal in turn, it has been assumed that the total group III metals emission rate is made up entirely of that metal. This is a worst-case approach. Where it is not possible to screen out the potential for significant impacts using this method, the more detailed approach set out by the EA in its Interim Guidance Note for Metals (Environment Agency, 2012) has been used. This includes the following three steps, with each subsequent step assuming that each relevant metal makes up a successively smaller proportion of total group III metal emissions:
- Step 1: assumes each metal makes up 100% of total group III metal emissions;
 - Step 2: assume that each metal makes up 1/9th of total group III metal emissions (there are 9 group III metals in total); and
 - Step 3: allows the user to use a metal-specific emission rate, provided this is appropriately justified.
- 3.14 To assist in Step 3, the Guidance Note contains group III metals emissions data for a number of municipal waste incinerators in the UK. For those metals requiring assessment using Step 3 of the Guidance Note, the measured municipal waste incinerator emissions presented in the note have been used as emission rates for this assessment. This is deemed to be a conservative assumption, because the proposed Houghton Main gasifier will process biomass waste wood, which will contain a considerably lower metallic component than municipal solid waste typically does.

Table 2: Emission Parameters for the Proposed Biomass Gasifier

Stack Parameters		Annual Average Conditions	
Actual Exit Velocity (m/s)		15	
Efflux Actual Volume Rate (Nm ³ /s)		66.1	
Exhaust Temperature (°C)		130	
Water volume (%)		10.0%	
Oxygen by dry volume (%)		7.8%	
Efflux Normalised Volume Rate (Nm ³ /s): 273K, 1 Atmosphere, dry gas, 11% O ₂ .		53.4	
Stack Internal Diameter (m)		2.37	
Stack Height Above Ground-Level (m)		45	
Stack Location (O.S. x,y)		441548.8, 406442.8	
Pollutant	Calculation	Emissions (g/s) ^b	
Nitrogen Oxides	400 x 53.4 / 1,000	21.4	
PM ₁₀	10 x 53.4 / 1,000	1.6	
SO ₂	200 x 53.4 / 1,000	10.7	
CO	50 x 53.4 / 1,000	8.0	
TOC	10 x 53.4 / 1,000	1.1	
HCl	60 x 53.4 / 1,000	3.2	
HF	4 x 53.4 / 1,000	0.2	
Cd and Tl	0.05 x 53.4 / 1,000	0.003	
Hg	0.05 x 53.4 / 1,000	0.003	
Group III metals ^c	0.5 x 53.4 / 1,000	0.03	
NH ₃	10 x 53.4 / 1,000	0.5	
Dioxins and furans	0.0000001 x 53.4 / 1000	5.3x10 ⁻⁹	

^a i.e. the averaging periods set in the air quality objectives and EALs over which concentrations have been predicted.

^b rounded numbers are presented here but unrounded numbers were input into the model.

^c Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V

Emissions – AD Plant

3.15 The model input parameters for the AD plant have been provided by the process operators, Tamar Energy. Tamar Energy has provided data on exhaust mass flow rate (wet), fuel consumption and the release temperature along with the stack height and exit diameter. This information has been

provided for 'normal' operating conditions. This information has been used to derive the modelling parameters including normalised flow rates. The information used in the modelling and calculated for the modelling is set out in the top section of Table 3.

- 3.16 The bottom section of Table 2 shows how the emission rates entered into the dispersion model have been calculated from these emission limits.

Table 3: Emission Parameters for the Proposed AD Plant

Stack Parameters		Annual Average Conditions	
Actual Exit Velocity (m/s)		38.1	
Efflux Actual Volume Rate (m ³ /s)		2.7	
Exhaust Temperature (°C)		180	
Water volume (%)		11.5%	
Oxygen by dry volume (%)		9	
Efflux Normalised Volume Rate (Nm ³ /s) : 273K, 1 Atmosphere, dry gas, 11% O ₂ .		1.4	
Stack Internal Diameter (m)		0.3	
Stack Height Above Ground-Level (m)		15	
Stack Location (O.S. x,y)		CHP 1: 41679.7, 406459.9 CHP 2: 41690.6, 406460.5	
Pollutant	Calculation	Emissions (g/s) ^b	
Nitrogen Oxides	500 x 1.4 / 1,000	0.54	
PM ₁₀	20 x 1.4 / 1,000	0.02	
SO ₂	350 x 1.4 / 1,000	0.38	
CO	1400 x 1.4 / 1,000	1.51	
TOC (emission rate provided as VOC)	1000 x 1.4 / 1,000	1.08	
NH ₃	10 x 1.4 / 1,000	0.02	

^a i.e. the averaging periods set in the air quality objectives and EALs over which concentrations have been predicted.

^b rounded numbers are presented here but unrounded numbers were input into the model.

Post-Processing

- 3.17 ADMS-5 has been run to predict the contribution of the proposed facility to annual mean concentrations of the pollutants for which there are annual mean objectives and EALs in Table 4, as well as to the maximum 1-hour mean for the pollutants with 1-hour objectives, 99.79th percentiles of 1-hour mean nitrogen oxides concentrations, 90th percentiles of 24-hour mean PM₁₀ concentrations, 99.7th percentiles of 1-hour mean sulphur dioxide concentrations, 99.9th percentiles

of 15-minute sulphur dioxide concentrations and 99.18th percentiles of 24-hour mean sulphur dioxide concentrations. The approach recommended by the EA (Environment Agency, 2005) has been used to predict annual mean nitrogen dioxide concentrations and 99.79th percentiles of 1-hour mean nitrogen dioxide concentrations. This assumes that:

- Annual mean nitrogen dioxide = Annual mean nitrogen oxides process contribution (PC) x 0.7; and
- 99.79th percentiles of 1-hour mean nitrogen dioxide concentrations = 99.79th percentiles of 1-hour mean nitrogen oxides PC x 0.35.

3.18 Deposition has not been included within the dispersion model because the principal depositing component of concern is nitrogen dioxide and this is calculated from nitrogen oxides outside of the model. Instead, deposition has been calculated from the predicted ambient concentrations using the following deposition velocities provided by the EA (Environment Agency, 2004):

- NO₂ – 0.003 m/s
- NH₃ – 0.03 m/s
- SO₂ – 0.024 m/s
- HCl – 0.06 m/s

3.19 These velocities are for deposition to Forest, which is considered appropriate for the woodland habitats in the ecologically sensitive areas. The velocities are applied simply by multiplying a concentration ($\mu\text{g}/\text{m}^3$) by the velocity (m/s) to predict a deposition flux ($\mu\text{g}/\text{m}^2/\text{s}$). Subsequent calculations required to present the data as kg/ha/yr of nitrogen or sulphur and as keq/ha/yr for acidity follow basic chemical and mathematical rules³.

Assessment Scenarios

3.20 Predictions of pollutant concentrations have been carried out assuming that the plant is operational in 2017.

Meteorology

3.21 Five years of hourly-sequential meteorological data (2009 to 2013 inclusive) from the meteorological station located at Robin Hood Airport have been used. Appendix A4 provides a wind-rose for each meteorological dataset, and outlines the other meteorological parameters required for the modelling (such as surface roughness etc.). The maximum predicted PCs during any year has been reported in the results section of this report.

³ For example, 1 kg N/ha/yr = 0.071 keq/ha/yr

Building Wake Effects

- 3.22 ADMS-5 has the ability to simulate the entrainment of exhaust plumes into the wake of nearby buildings. In order to ensure that the worst-case building configuration was covered, modelling has been carried out for two alternative building configurations: 1) no buildings included in the model; and 2) all buildings over 2 m high included in the model, with the main gasifier building included as the main building.
- 3.23 The results of the worst-case impacts from either scenario have been used within this report. Figure 3 shows the building that were included in the modelling.



Figure 3: Buildings Modelled (Green Areas), Point Sources (Red Dots).

Assessment Criteria and Significance

Human Health Criteria

- 3.24 The Government has established a set of air quality standards and objectives to protect human health. The 'standards' are set as concentrations below which effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of an individual pollutant. The 'objectives' 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, Statutory Instrument 928 (2000) and the Air Quality (England) (Amendment) Regulations 2002, Statutory Instrument 3043 (2002).

- 3.25 The objectives for nitrogen dioxide and the 15-minute mean objective for sulphur dioxide were to have been achieved by 2005. The objectives for PM₁₀ and the 1-hour and 24-hour objectives for sulphur dioxide were to have been achieved by 2004. The objective for CO was to have been achieved by 2003. All objectives continue to apply in all future years thereafter. The PM_{2.5} objective is to be achieved by 2020. The UK objectives for nitrogen dioxide and PM₁₀ are the same as the EU limit values. The EU limit value for PM_{2.5} is the same as the UK objective, but is to be met by 2015.
- 3.26 The objectives apply at locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. Where there is no air quality objective, the Environment Agency's Environmental Assessment Levels (EALs) have been applied. Defra explains where the objectives apply in its Local Air Quality Management Technical Guidance (Defra, 2009) and the same rules have been applied to the EALs. Annual mean objectives and EALs are considered to apply anywhere with residential exposure. The 24-hour objective for PM₁₀ is taken to apply at residential properties as well as the gardens of residential properties. The 1-hour mean objective for nitrogen dioxide, and those EALs for shorter time periods than the annual mean, are taken to apply anywhere where people may spend one hour or more. In practice, this has been taken to be anywhere within the model domain.
- 3.27 Where there is no EAL quoted in Environment Agency guidance, one has been derived from the Health and Safety Executive's workplace exposure limits. This applies to the short term EAL for chromium VI, and the short- and long-term EALs for thallium and cobalt.
- 3.28 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 of assuming that all TOCs are Volatile Organic Compounds (VOCs); and that all VOCs are benzene 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.
- 3.29 There are no assessment criteria for dioxins and furans. The World Health Organisation (WHO, 2000) provides an indicator on the air concentrations above which WHO consider it necessary to identify and control local emission sources; this value is 0.3 pg/m³ (300 fg/m³). In the absence of suitable criteria, the PCs have been compared against the relevant background concentration, as well as the WHO indicator concentration for which it is considered necessary to identify and control emission sources.
- 3.30 The relevant air quality criteria for this assessment are provided in Table 4.

Table 4: Relevant Air Quality Objectives and Environmental Assessment Levels for the Protection of Human Health

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	Number of periods allowed to exceed per year	AQO	EAL
Nitrogen dioxide	Annual	40	n/a	X	
	1 hour	200	18	X	
PM ₁₀	Annual	40	n/a	X	
	24 hours	50	35	X	
PM _{2.5} ^a	Annual	25	n/a	X	
SO ₂	24 hours	125	3	X	
	1 hour	350	24	X	
	15 minutes	266	35	X	
CO	8 hour rolling mean	10 (mg/m ³)	n/a	X	
HF	Annual	16	n/a		X
	1 hour	160	n/a		X
HCl	Annual mean	20			X ^c
	1 hour	750	n/a		X
Benzene	Running annual mean	16.25	n/a	X	
	Annual mean	5 ^b	n/a	X	
Cadmium	Annual	0.005	n/a	X	
Thallium	Annual	1	n/a		X ^c
	1hour	30	n/a		X ^c
Mercury	Annual	0.25	n/a		X
	1hour	7.5	n/a		X
Antimony	Annual	5	n/a		X
	1hour	150	n/a		X
Arsenic	Annual	0.003	n/a		X
Chromium (III)	Annual	5	n/a		X
	1hour	150	n/a		X
Chromium (VI)	Annual	0.0002	n/a		X
	1hour	15	n/a		X ^c
Cobalt	Annual	1	n/a		X ^c

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	Number of periods allowed to exceed per year	AQO	EAL
	1hour	30	n/a		X ^c
Copper	Annual	10	n/a		X
	1hour	200	n/a		X
Lead	Annual	0.25	n/a	X	
Manganese	Annual	0.15	n/a		X
	1hour	1,500	n/a		X
Nickel	Annual	0.02	n/a	X	
Vanadium	Annual	5	n/a		X

^a The PM_{2.5} objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it. The EU limit value is the same, but is to be met by 2015.

^b TOC assessed against the AQO for benzene.

^c 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 EH4024, and converted to the respective EAL using guidance in H1 (Environment Agency, 2010).

Descriptors for Air Quality Impacts on Human Health and Assessment of Significance

3.31 There is no official guidance in the UK on how to describe air quality impacts, nor how to assess their significance. The approach developed by the IAQM⁴ (Institute of Air Quality Management, 2009), and incorporated in Environmental Protection UK's (EPUK's) guidance document on planning and air quality (Environmental Protection UK, 2010), has therefore been used. This approach includes elements of professional judgement. Full details of this approach are provided in Appendix A2, with the professional experience of the consultants preparing the report set out in Appendix A3.

Vegetation and Ecosystem Criteria

3.32 Objectives for the protection of vegetation and ecosystems have been set by the UK Government. They are the same as the EU limit values. The limit values and objectives only apply a) more than 20 km from an agglomeration (about 250,000 people), and b) more than 5 km from Part A industrial sources, motorways and built up areas of more than 5,000 people. Critical levels and critical loads are the ambient concentrations and deposition fluxes below which significant harmful effects to sensitive ecosystems are unlikely to occur. Some of the critical levels are set at the same concentrations as the objectives, but do not have the same legal standing. Typically, the potential for exceedences of the critical levels and critical loads is considered in the context of the level of protection afforded to the ecological site as a whole. For example, the level of protection

⁴ The IAQM is the professional body for air quality practitioners in the UK.

afforded to an internationally-designated site (such as an SAC) is significantly greater than that afforded to a local nature reserve; reflecting the relative sensitivity of the sites as well as their perceived ecological value. The critical levels and critical loads relevant to this assessment are set out in Table 5.

3.33 The Air Pollution Information System (APIS) database (APIS, 2014) has been searched to obtain critical levels and critical loads. Where APIS does not provide critical levels for a given pollutant, they have been taken from Table 7 of the EA's H1 guidance (Environment Agency, 2010). For ammonia and sulphur dioxide, there are more stringent critical levels which only apply for sensitive lichen communities and bryophytes and ecosystems where lichens and bryophytes are an important part of the ecosystem's integrity. In order to provide a worst-case assessment, these more stringent critical levels have been used even though they may not apply. Different critical loads are available for different habitats; and in the case of acidity, different locations. For the local sites, no detailed information about the types of habitats present is available and so critical loads for the full range of different habitats that might be present have been reviewed. The relevant critical levels and critical loads are set out in Table 5. The approach currently recommended by APIS for assessing acid deposition only refers to nitrogen and sulphur. In order to account for the acidifying input from hydrogen chloride, the sum of nitrogen, sulphur and chlorine acidity has been assessed directly against the 'S_{max}' values from APIS. This provides a conservative assessment.

Table 5: Vegetation and Ecosystem Critical Levels ^a

Pollutant and Averaging Period	Species / Habitat	EAL
Annual Mean NH ₃	All higher plants	3 µg/m ³
	Sensitive lichen communities	1 µg/m ³
Annual Mean NO _x	All sensitive communities	30 µg/m ³
24-hour Mean NO _x	All sensitive communities	75 µg/m ³
Annual Mean SO ₂	All higher plants	20 µg/m ³
	Sensitive lichen communities	10 µg/m ³
Daily Mean HF	All sensitive communities	5 µg/m ³
Weekly Mean HF	All sensitive communities	0.5 µg/m ³
Nutrient Nitrogen Critical Loads	Restored Ancient Woodland ^c	10 kg-N/ha/yr
	Local Wildlife Sites ^d	20 kg-N/ha/yr
Acid Critical Loads ^e	Ancient Woodland and Restored Ancient Woodland and Local Nature Reserve ^c	1.17 keq/ha/yr

- ^a Taken from www.apis.ac.uk and from Table B4 of the EA's H1 (Environment Agency, 2010).
- ^b No data available for Hayes Point to Bendrick Road SSSI and therefore the critical loads for Neutral Grassland have been applied to this habitat.
- ^c Based on Broadleaved, Mixed and Yew Woodland habitats.
- ^d Based on Neutral Grassland habitats.
- ^e APIS advises that where the total acid nitrogen deposition is greater than the N_{min} , the sum of acid nitrogen and sulphur deposition should be compared against the N_{max} value. In this assessment, the sum of acid nitrogen, sulphur and chlorine deposition has been compared with the N_{max} value. This is more conservative than the approach recommended by APIS.

Descriptors for Air Quality Impacts on Ecosystems and Sensitive Habitat and Assessment of the Significance

- 3.34 The Environment Agency, in its H1 guidance (Environment Agency, 2010), explains that regardless of the baseline environmental conditions, a process can be considered as insignificant if:
- The long-term (annual mean) PC is <1% of the long-term environmental standard.
 - The short-term (15-minute, 1-hour, 24-hour mean) PC is <10% of the short-term environmental standard.
- 3.35 It should be recognised that this criterion determines when an impact can be screened out as insignificant. It does not imply that impacts will necessarily be significant above this criterion, merely that there is a potential for significant impacts to occur that should be considered using a detailed assessment methodology, such as a detailed dispersion modelling study (as has been carried out for this project in any event).
- 3.36 This criterion is also used in guidance issued by the Environment Agency and Joint Nature Conservation Committee (JNCC) on applying the Habitats Regulations in relation to air quality impacts (COMAH, 2005). This states that:
- 3.37 "Where the concentration within the emission footprint in any part of the European Site is less than 1% of the relevant benchmark, the emission is unlikely to have a significant effect irrespective of the background levels."
- 3.38 The 1% (long-term) and 10% (short-term) criteria are thus routinely used to screen out the potential for significant impacts on sensitive habitats from a range of sources, including road traffic. For the purposes of this assessment, wherever the detailed modelling shows that concentrations and fluxes are below the critical level or critical load, it is considered that there will be no significant impacts. Furthermore, where the Scheme will increase concentrations or fluxes by less than 1% (long-term) or 10% (short-term) of the relevant critical level or critical load, the potential for significant impacts can be discounted. Those locations in which the Scheme will cause a change

of more than 1% (long-term) or 10% (short-term) of the critical level or critical load have been highlighted.

3.39 For the assessment of trace metals, the Environment Agency's Interim Guidance Note for Metals (Environment Agency, 2012) has been used. The guidance note strictly only applies to Group III metals in stack emissions, but the approach has been used for all metals. It provides a three step approach to the assessment, which is outlined below:

- Step 1 – Screening Scenario: Model predictions assume each metal is emitted at the maximum IED Emission Limit Value (ELV) of 0.5 mg/Nm³ as a worst-case. Assessment of the impact is then made against the following parameters:
 - Long-term PC <1% or short-term PC <10% of the AQO or EAL; or
 - Long-term and short-term Predicted Environmental Concentration (PEC)⁵ < 100% of the AQO or EAL (taking likely modelling uncertainties into account).
- Step 2 – Worst Case Scenario Based on Currently Operating Plant: Where the Step 1 screening criteria set out in the guidance are not met, an emission concentration equal to 1/9th of the ELV has been assumed and assessment made against the same criteria specified for Step 1.
- Step 3: If the screening criteria are not met in Step 2, typical emission concentrations for energy from waste plants have been used, as specified in the guidance.

3.40 In terms of the potential for ecological impacts on local (as opposed to national or European) wildlife sites/local nature reserves/ancient woodlands, the EA discounts as insignificant, any impacts where the PC is less than 100% of the long-term or short-term environmental standard (Environment Agency, 2013).

Operational Odour Impacts

Sensitive Locations

3.41 Nearby locations sensitive to odours are the same as those sensitive locations identified for inclusion in the air quality assessment of human health as set out in Figure 2.

Assessment Approach

3.42 The odour risk assessment for Houghton Main set out in this report is based on a Source-Pathway-Receptor approach outlined in the IAQM's draft guidance on odour assessment for planning applications (IAQM, 2014b), which describes the concept that in order for an odour impact (such

⁵ PEC = PC + Background Concentration

as annoyance or nuisance) to occur there must be a source of odour, a pathway to transport the odour to an off-site location, and a receptor (e.g. people) to be affected by the odour.

3.43 The risk of odour effects at a given receptor location may be estimated using the following fundamental relationship:

$$\text{Effect} \approx \text{Dose} \times \text{Response}$$

3.44 In this relationship, the **dose** is a measure of the likely exposure to odours, in other words the **impact**. The **response** is determined by the sensitivity of the receiving environment and thus the overall **effect** is the result of changes in odour exposure at specific receptors, taking into account their sensitivity to odours.

3.45 In order to determine the risk of potential odour effects from the Houghton Main development, the 'FIDOR' factors for odour exposure, as outlined in the Environment Agency's H4 guidance document on odour management (Environment Agency, 2011), have been used. The FIDOR factors are:

- **F**requency – the frequency with which odours are detected;
- **I**ntensity – the intensity of odours detected;
- **D**uration – the duration of exposure to detectable odours;
- **O**ffensiveness – the level of pleasantness or unpleasantness of odours; and
- **R**eceptor – the sensitivity of the location where odours are detected, and/or the proximity of odour releases to an odour-sensitive location.

3.46 Potential odours from each of the specific sources at Houghton Main have been assigned a risk-ranking based on the effect \approx dose \times response relationship, whereby the dose (impact) is determined by the FIDO parts of FIDOR, and the response is determined by the R (receptor sensitivity). The risk of odour effects can therefore be described as:

$$\text{Effect} \approx \text{Impact (FIDO)} \times \text{Receptor Sensitivity (R)}$$

3.47 The key factors that will influence the effect of odours are the magnitude of the odour source(s), the effectiveness of the pathway for transporting odours, and the sensitivity of the receptor. The methodology set out in the draft IAQM guidance document describes in detail a Source-Pathway-Receptor approach to odour risk assessment, and includes tables and matrices to assist in determining the likely risk of odour effects. The IAQM methodology is outlined below. It includes an element of professional judgement.

- 3.48 The assessment examines the source odour potential of Houghton Main, and then identifies the effectiveness of the pathway and receptor sensitivity at a number of nearby locations which may be affected by odours.
- 3.49 Table 6 describes the risk rating criteria (high, medium and low) for source magnitude, pathway effectiveness and receptor sensitivity applied in this assessment. This table has been adapted from the draft IAQM odour guidance.

Table 6: Source-Pathway-Receptor Risk Factors

Source Odour Potential	Pathway Effectiveness	Receptor Sensitivity
Determining Factors		
Magnitude of odour release (taking account of control measures). How inherently odourous the compounds are. The unpleasantness of the odour.	Distance from source to receptor. Frequency (%) of winds from the source to receptor (or, qualitatively, the direction of receptors from source with respect to prevailing wind). The effectiveness of any mitigation/control in reducing flux to the receptor. Topography and terrain.	For the sensitivity of people to odour, the IAQM recommends that the air quality practitioner uses professional judgement to identify where on the spectrum between high and low sensitivity a receptor lies, taking into account the general principles outlined below.
Large Source Odour Potential	Highly Effective Pathway	High Sensitivity Receptor
<u>Magnitude</u> - Larger permitted processes of odourous nature of large Sewage Treatment Works (STWs); materials usage hundreds of thousands of tonnes or m ³ per year; area sources of thousands of m ² . The compounds involved are very odourous, having very low Odour Detection Thresholds (ODTs) where known. <u>Unpleasantness</u> – process classed in H4 as “Most offensive”; or (where known) compounds/odours having unpleasant (-2) to very unpleasant (-4) hedonic score. <u>Mitigation/control</u> – open air operation with no containment, reliance solely on good management techniques and best practice.	<u>Distance</u> – receptor is adjacent to the source/site; distance well below any official set back distances (a). <u>Direction</u> – high frequency (%) of winds from source to receptor (or, qualitatively, receptors downwind of source with respect to prevailing wind). <u>Effectiveness of dispersion</u> – open processes with low-level releases, e.g. lagoons, uncovered effluent treatment plant, landfilling of putrescible wastes.	Surrounding land where users can reasonable expect enjoyment of a high level of amenity and people would reasonably expect to be present here continuously or regularly for extended periods, as part of the normal pattern of use of the land. Examples may include residential dwellings, hospitals, schools/education, tourist/cultural, and food retail/processing.

Medium Source Odour Potential	Moderately Effective Pathway	Medium Sensitivity Receptor
<p><u>Magnitude</u> – smaller permitted processes or small STWs; materials usage thousands of tonnes or m³ per year; area sources of hundreds of m². The compounds involved are moderately odourous.</p> <p><u>Unpleasantness</u> – process classed in H4 as “Moderately offensive”; or (where known) odours having neutral (0) to unpleasant (-2) hedonic score.</p> <p><u>Mitigation/control</u> – some mitigation measures in place, but significant residual odour remains.</p>	<p><u>Distance</u> – receptor is local to the source.</p> <p><u>Effectiveness of dispersion</u> – releases are elevated, but compromised by building effects.</p>	<p>Surrounding land where users` would expect to enjoy a reasonable level of amenity, but wouldn't reasonably expect to enjoy the same level of amenity as in their home; or people wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land.</p> <p>Examples may include places of work, commercial/retail premises and playing/recreation fields.</p>
Small Source Odour Potential	Ineffective Pathway	Low Sensitivity Receptor
<p><u>Magnitude</u> – falls below Part B threshold; materials usage hundreds of tonnes/m³ per year; area sources of tens m². The compounds involved are only mildly odorous, having relatively high ODTs where known.</p> <p><u>Unpleasantness</u> – processes classed as “Less offensive” in H4; or (where known) compounds/odours having neutral (0) to very pleasant (+4) hedonic score.</p> <p><u>Mitigation/control</u> – effective, tangible mitigation measures in place (e.g. BAT, BPM) leading to little or no residual odour.</p>	<p><u>Distance</u> – receptor is remote from the source; distance exceeds any official set-back distances (a).</p> <p><u>Direction</u> – low frequency (%) of winds from source to receptor (or, qualitatively, receptors upwind of source with respect to prevailing wind).</p> <p><u>Effectiveness of dispersion</u> - releases are from high level (e.g. stacks, or roof vents >3m above ridge height) and are not compromised by surrounding buildings.</p>	<p>Surrounding land where the enjoyment of amenity would not reasonable be expected; or there is transient exposure, where the people would reasonably be expected to be present for only limited periods of time as part of the normal pattern of use of the land.</p> <p>Examples may include industrial, farms, footpaths and roads.</p>
<p>Notes: (a) Minimum “setback” distances may be defined for some odorous activities: for example, standard setback distances for livestock housing units are a popular tool for odour regulation in Australia and New Zealand, Europe and the United States.</p>		

3.50 The risk ratings for source magnitude and pathway effectiveness (for each receptor) identified using the criteria in Table 6 are then combined using the matrix shown in Table 7 to estimate an overall risk of odour impact at each specific receptor location.

Table 7: Assessment of Risk of Odour Impact at a Specific Receptor Location

Pathway Effectiveness	Source Odour Potential		
	Large	Medium	Small
Highly Effective	High Risk	Medium Risk	Low Risk
Moderately Effective	Medium Risk	Low Risk	Negligible Risk
Ineffective	Low Risk	Negligible Risk	Negligible Risk

- 3.51 The next stage of the risk assessment is to identify the potential odour effect at each receptor location. This is done using the matrix presented in Table 8, which combines the overall odour impact risk descriptor for each receptor with the receptor sensitivity determined using the criteria in Table 6.
- 3.52 As a final stage of assessment, an overall significance of odour effects is determined, based on professional judgment and taking into account the significance of effect at each specific receptor location.

Table 8: Assessment of Potential Odour Effect at a Specific Receptor Location

Risk of Odour Impact	Receptor Sensitivity		
	High	Medium	Low
High Risk	Substantial Adverse Effect	Moderate Adverse Effect	Slight Adverse Effect
Medium Risk	Moderate Adverse Effect	Slight Adverse Effect	Negligible Effect
Low Risk	Slight Adverse Effect	Negligible Effect	Negligible Effect
Negligible Risk	Negligible Effect	Negligible Effect	Negligible Effect

4 Site Description and Baseline Conditions

4.1 The Houghton Main site is in a rural setting on land adjacent to the A6195 approximately 4 km east of Barnsley. There is an existing distribution warehouse facility to the east of the application site, and a small industrial unit to the south.

Industrial sources

4.2 A search of the UK Pollutant Release and Transfer Register (Defra, 2014d) and Environment Agency’s ‘what’s in your backyard’ (Environment Agency, 2014) websites did not identify any significant industrial or waste management sources that are likely to affect the study area, in terms of air quality.

Air Quality Review and Assessment

4.3 Barnsley Metropolitan Borough Council has investigated air quality within its area as part of its responsibilities under the LAQM regime. The Council has declared a number of AQMAs within the borough for exceedences of the nitrogen dioxide objective. The AQMAs are associated with busy arterial roads and junctions close to Barnsley town centre. The declared AQMAs are shown in Figure 4. The development site is not near to any of these AQMAs.

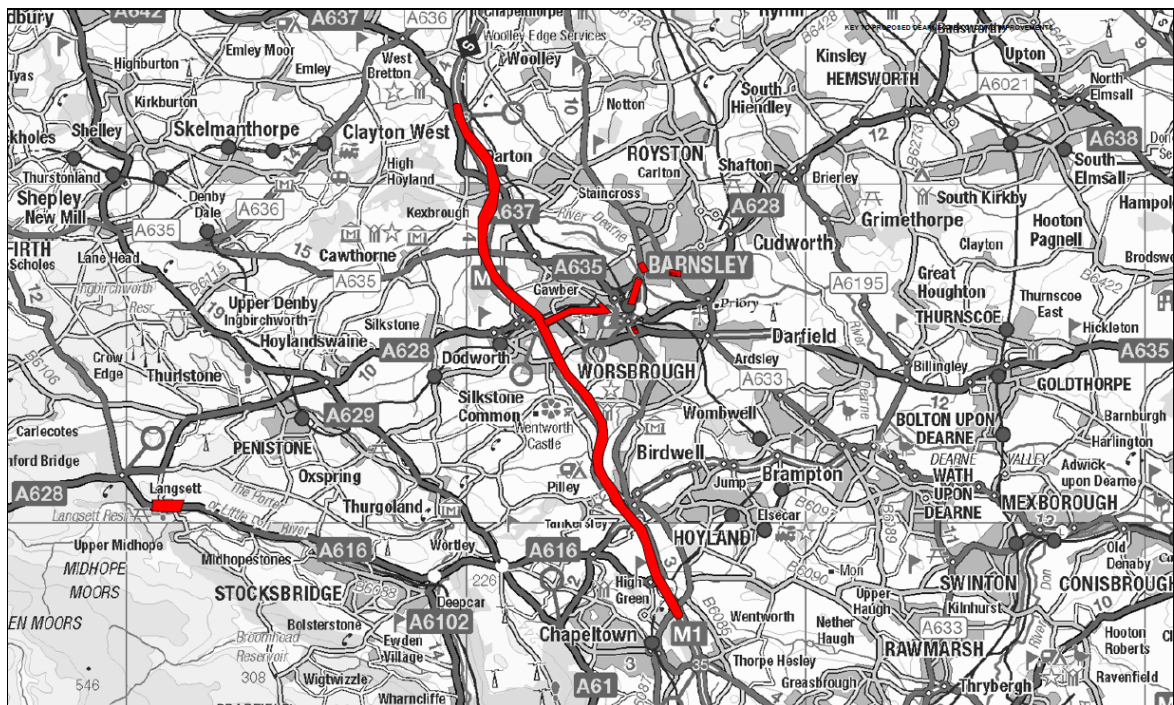


Figure 4: Declared AQMA(s) shown in Red (Barnsley Metropolitan Borough Council, 2013)

Local Air Quality Monitoring

- 4.4 Barnsley Metropolitan Borough Council operates a total of six automatic monitoring sites within its area. Four of the automatic monitoring stations measure nitrogen dioxide, three measure sulphur dioxide and one measures PM₁₀. These are either within Barnsley or Royston and none are in close proximity to the proposed development site. The Council also operates a large number of nitrogen dioxide monitoring sites using diffusion tubes. These are shown in Figure 5. None of these locations are close to the site.
- 4.5 Examination of the local authorities review and assessment report has shown that there are no clear trends in monitoring results for the past few years.

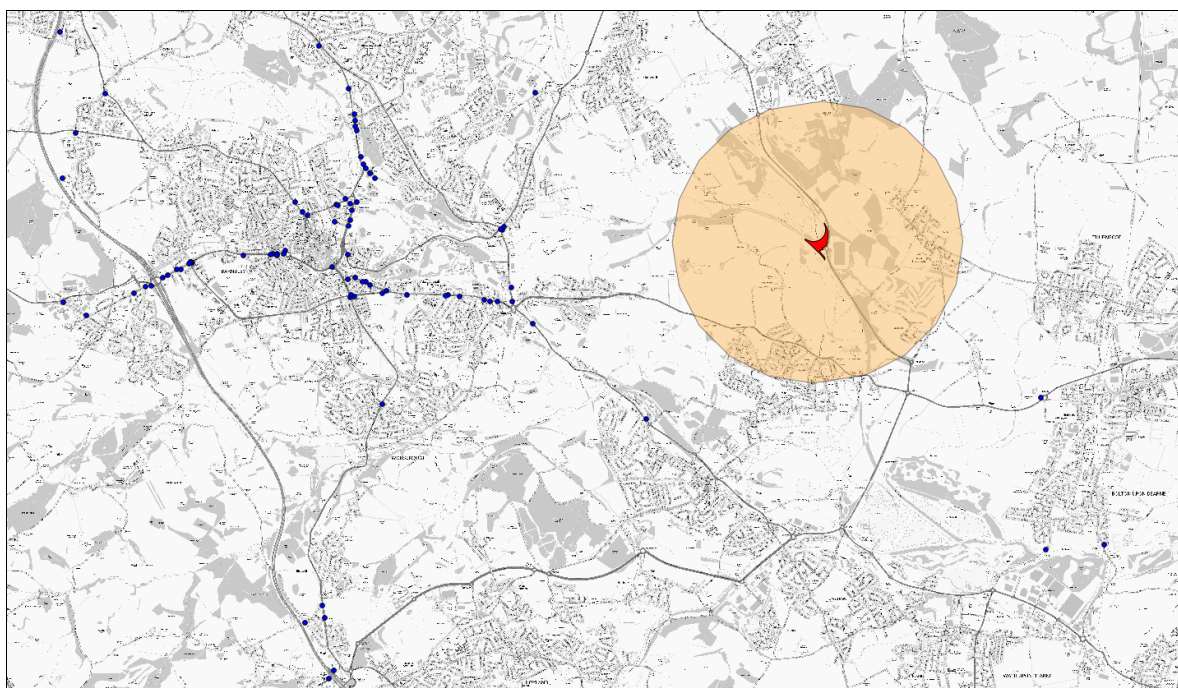


Figure 5: Diffusion Tube Monitoring Locations – Blue Dots. Development Site – Red Area. Study Area (2 km buffer) – Orange Area.

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Exceedences of EU Limit Value

- 4.6 There are no AURN monitoring sites within 2 km of the development site with which to identify exceedences of the annual mean nitrogen dioxide limit value. The national map of roadside annual mean nitrogen dioxide concentrations, used to report exceedences of the limit value to the EU (Defra, 2014e), does not identify any exceedences within 2 km of the development site. This map shows 2012 exceedences. Detailed maps of predicted future year exceedences are not available.

Background Concentrations and Fluxes

National Background Pollution Maps

- 4.7 In addition to these locally measured concentrations, estimated background concentrations in the study area have been determined for the opening year 2017 (Table 9). In the case of nitrogen oxides and nitrogen dioxide. The derivation of background concentrations for nitrogen oxides and nitrogen dioxide is described in Appendix A5. The background concentrations are all well below the objectives.

Table 9: Estimated Annual Mean Background Pollutant Concentrations in 2017 ($\mu\text{g}/\text{m}^3$)

Year	2017	Objective
NO_x ^a	17.2-19.2	30
NO₂ ^a	12.8-14.1	40
PM₁₀	14.9	40
PM_{2.5}	9.5	25
SO₂	5.8	20
CO	0.3	10,000

^a This assumes that road vehicle emission factors reduce between 2012 and 2017 at the current 'official' rates.

Trace Metals

- 4.8 Defra has undertaken monitoring of trace elements at a number of locations in the UK since 1976 as part of the UK Urban and Rural Heavy Metals Monitoring Networks. To provide an indication of trace metal concentrations in the study area, measured concentrations at the two nearest rural monitoring sites (Beacon Hill and Monkswood), in 2012 are summarised in Table 10.

Table 10: Trace Metal Background Concentrations, 2012 (ng/m³)^a

Monitoring Location	Beacon Hill	Monkswood	Average ^c
Location Type	Rural	Rural	n/a
Antimony	0.94	0.95	0.95
Arsenic (As)	0.58	0.59	0.59
Cadmium (Cd)	0.09	0.09	0.09
Chromium (Cr)	0.24	0.24	0.24
Cobalt (Co)	0.04	0.04	0.04
Copper (Cu)	2.59	3.05	2.82
Lead (Pb)	4.92	4.90	4.91
Manganese (Mn)	2.16	2.14	2.15
Mercury ^b (Hg)	2.86	2.31	2.59
Nickel (Ni)	0.45	0.61	0.53
Thallium (Tl)	Not Measured		
Vanadium (V)	0.55	0.76	0.66

^a 1,000 ng = 1 µg

^b Data presented is 'Total Gaseous' mercury

^c The average background concentration has been derived from the two rural background sites located nearest to the proposed development site.

Dioxins and Furans

4.9 Monitoring of PCDD/Fs (dioxins and furans) is currently carried out by Defra at seven locations in the UK (Hazelrigg, High Muffles, London, Manchester, Auchencorth Moss, Middlesbrough and Weybourne). To provide an indication of the range of PCDD/Fs concentrations that occur in the UK, a summary of the annual mean concentrations measured between 2008 and 2010 is presented in Table 11. The average concentration measured in Manchester, the nearest monitoring site to the application site, from 2008 to 2010 is 27.3 fg/m³. This average is assumed to be representative of the baseline dioxin and furan concentration at the site.

Table 11: UK PCDD/Fs Concentrations (fg/m³)^a

Metal	2008	2009	2010
Manchester	19.0	14.2	48.7
Hazelrigg	3.7	13.5	8.0
London	10.9	41.4	38.6
High Muffles	1.7	9.4	2.8
Auchencorth	6.4	0.6	5.0
Middlesborough	24.0	-	-
Weybourne	-	22.8	2.5

^a 1,000,000,000 fg = 1 µg

Benzene, HCl, HF and Ammonia

- 4.10 Defra monitors benzene at a site in Barnsley Gawber, which is operated as part of the Non automatic Hydrocarbon Network (NAHN). The measured benzene concentration for 2013 from the Newport site has been used in this assessment.
- 4.11 Defra measures background HCl concentrations at a number of UK sites as part of the Acid Gas and Aerosols Network (AGANET). The three nearest sites are: Caenby, Sutton Bonnington and Ladybower, which have been used to obtain background HCl for this assessment. Data from these sites for 2012-2013 has been obtained for use in this assessment.
- 4.12 There is currently no UK monitoring of HF. Therefore no background data is available.
- 4.13 Defra also monitors background ammonia concentrations at a number of UK sites as part of the National Ammonia Monitoring Network (NAMN). The nearest are: Ladybower, Sheffield 2, Tadcaster and Wardlow Hay Cop. Data from this site for 2012-2013 has been obtained for use in this assessment.
- 4.14 The background concentrations of benzene, HCl and ammonia used in this assessment are summarised in Table 12.

Table 12: Annual Mean Background Pollutant Concentrations for Benzene, HCl and NH³

Pollutant	Background Concentration (µg/m ³)	EAL
Benzene	0.69	5
HCl	0.25	20
HF	-	16
NH³	1.74	3

Background Deposition and Acidity

- 4.15 Background nitrogen deposition fluxes to the local wildlife sites have been taken from the APIS website (APIS, 2014), where they are reported as a three-year average (2009-2011). Background nutrient and acid nitrogen deposition rates both exceeded the critical load in this period.

Table 13: Estimated Annual Mean Background Nitrogen Deposition

Site	Nutrient Nitrogen Deposition (keq/ha/yr)		Total Acid Deposition (keq/ha/yr)	
	Background Deposition	Critical Load	Background Deposition	Critical Load
Woodland	40.9	10	2.99	1.77

Odour

- 4.16 There are no significant existing sources of odour identified at or in close proximity to the proposed development site. The rural setting of the site suggests a potential for occasional odours from local agriculture, but for the purposes of this assessment it is assumed that no in-combination odour impacts will need to be considered.

5 Construction Phase Impacts

- 5.1 The construction works will give rise to a risk of dust impacts during demolition, earthworks and construction, as well as from trackout of dust and dirt by vehicles onto the public highway.
- 5.2 There are no residential properties or relevant receptors for the consideration relating to elevated PM₁₀ levels within 350 m of the site boundary. There are no ecological receptors within 50m of the site boundary. There are no ecological receptors or residential receptors sensitive to elevated PM₁₀ levels within 50m of the roads construction traffic may drive along up to 500 m from the site access. The buffer zones are shown in Figure ...
- 5.3 There are some industrial receptors that maybe affected by dust soiling within the distance buffers. The assessment of constrcutin dust impacts will only consider these.

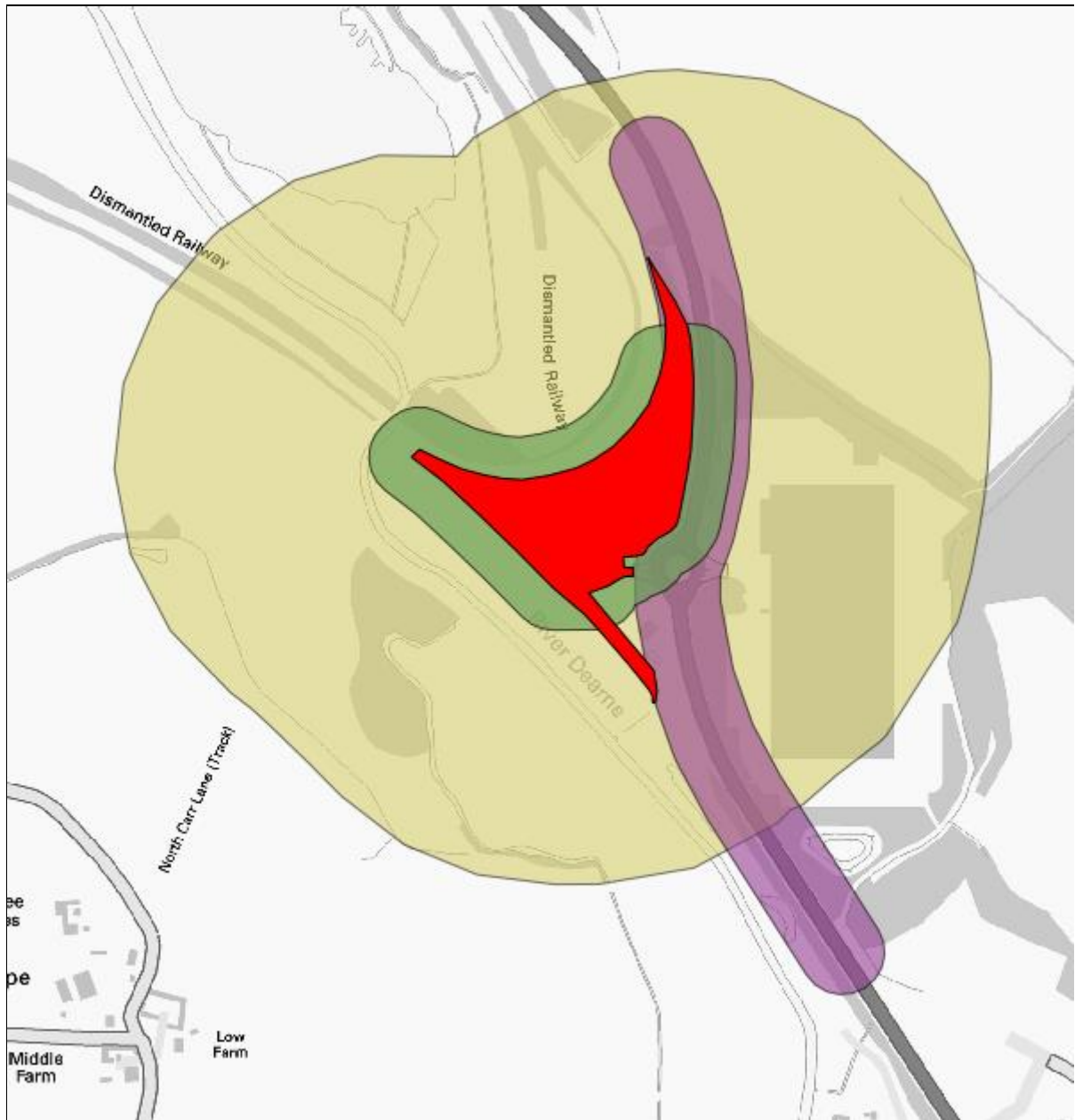


Figure 6: Construction buffer distances. Site – Red Area, 350m buffer – Yellow Area. 50 m buffer – Green Area. Road buffer – Purple Area.

Potential Dust Emission Magnitude

- 5.4 There is no requirement for demolition on site.
- 5.5 The site covers approximately 41,400 m² and most of this will be subject to earthworks. The earthworks will last around 6-12 months and dust will arise mainly from the vehicles travelling over unpaved ground and from the handling of dusty materials. Most of the earthworks will, though, involve the removal of subsoil, which will largely be damp and not prone to creating dust. Based

on the example definitions set out in Table A1.1, the dust emission class for earthworks is considered to be *medium*.

- 5.6 Construction will involve erecting a number of buildings and storage containers. Dust will arise from vehicles travelling over unpaved ground, the handling and storage of dusty materials, and from the cutting of concrete. The construction will take place over a 2-year period. Based on the example definitions set out in Table A1.1, the dust emission class for construction is considered to be *medium*.
- 5.7 The number of vehicles accessing the site, which may track out dust and dirt is currently unknown, but given the size of the site it is likely that there will be a maximum of under 10 outward bound heavy vehicle movements per day. Based on the example definitions set out in Table A1.1, the dust emission class for trackout is considered to be *small*.
- 5.8 Table 14 summarises the dust emission magnitude for the proposed development.

Table 14: Summary of Dust Emission Magnitude

Source	Dust Emission Magnitude
Demolition	None
Earthworks	Medium
Construction	Medium
Trackout	Small

Sensitivity of the Area

- 5.9 This assessment step combines the sensitivity of individual receptors to dust effects, with the number of receptors in the area and their proximity to the site. It also considers additional site-specific factors such as topography and screening, and in the case of sensitivity to human health effects, baseline PM₁₀ concentrations.

Sensitivity of the Area to Effects from Dust Soiling

- 5.10 The IAQM guidance explains that residential properties are 'high' sensitivity receptors to dust soiling, while the nearby industrial units and their car parks are a 'low' sensitivity receptor (Table A1.2). There are no residential properties within 350m of the site boundary or 50m of the roads, 500 m from the site entrance. Using the matrix set out in Table A1.3, the area surrounding the onsite works is of 'medium' sensitivity to dust soiling. Table 14 shows that dust emission magnitude for trackout is 'small' and Table A1.3 thus explains that there is a risk of material being tracked 200 m from the site exit. Since it is not known which roads construction vehicles will use, it has been assumed that all possible routes could be affected. There are no residential properties within 50 m of the roads along which material could be tracked. the industrial units, however, may

be affected by dust soiling. Table A1.3 thus indicates that the area is of 'low' sensitivity to dust soiling due to trackout. Overall, it is judged that the area surrounding the onsite works is of 'medium' sensitivity to dust soiling, while the area surrounding roads along which material may be tracked from the site is of 'low' sensitivity (Table 15).

Table 15: Summary of the Area Sensitivity

Effects Associated With:	Sensitivity of the Surrounding Area	
	On-site Works	Trackout
Dust Soiling	Medium	Low

Risk and Significance

5.11 The dust emission magnitudes in Table 14 have been combined with the sensitivities of the area in Table 15 using the matrix in Table A1.6 in Appendix A1, in order to assign a risk category to each activity. The resulting risk categories for the four construction activities, without mitigation, are set out in Table 16. These risk categories have been used to determine the appropriate level of mitigation as set out in Section 7.

Table 16: Summary of Risk of Impacts Without Mitigation

Source	Dust Soiling
Demolition	None
Earthworks	Low Risk
Construction	Low Risk
Trackout	Negligible

5.12 The IAQM does not provide a method for assessing the significance of effects before mitigation, and advises that pre-mitigation significance should not be determined. With appropriate mitigation in place, the IAQM guidance is clear that the residual effect will normally be 'not significant' (Institute of Air Quality Management, 2014).

6 Operational Phase Impact Assessment

Plant Impacts

- 6.1 Concentrations have been predicted at thirteen locations representing the nearest existing human health exposure, at ground level (1.5 m above ground) and first floor level (4.5 m above ground) for each receptor location. Six additional receptor locations have been modelled to represent the nearby sensitive ecosystems.
- 6.2 For consideration of concentrations in relations to the short-term objective, it has been assumed that the plant will run at continuous operation and at full (100%) load.

Initial Screening assessment

Health

- 6.3 The predicted maximum PCs have been compared with the Environment Agency screening criteria. The conclusions from the screening criteria for the PCs are set out in Table 17.

Table 17: Maximum Predicted PCs in the Study Area ($\mu\text{g}/\text{m}^3$)

Pollutant	Time Period	Maximum PC	EAL	% of EAL	Detailed Assessment Required
Nitrogen dioxide	Annual	3.0	40	7.5	Yes
	1 hour	71.0	200	35.5	Yes
PM ₁₀	Annual	0.3	40	0.7	No
	24 hours	9.2	50	4.6	No
PM _{2.5} ^a	Annual	0.3	25	1.1	Yes
SO ₂	24 hours	27.0	125	21.6	Yes
	1 hour	51.0	350	14.6	Yes
	15 minutes	66.0	266	24.8	Yes
CO	8 hour rolling mean	184.3	10000	1.8	No
HF	Annual	0.03	16	0.2	No
	1 hour	1.8	160	1.1	No
HCl	Annual mean	0.7	20	3.4	Yes
	1 hour	27.4	750	3.7	No
TOC as Benzene	Annual mean	2.2	5	43.8	Yes
Cadmium	Annual	0.0004	0.005	8.17	Yes
Thallium	Annual	0.0004	1	<0.1	No
	1hour	0.02	30	<0.1	No
Mercury	Annual	0.0004	0.25	0.16	No
	1hour	0.02	7.5	0.3	No
Antimony	Annual	0.004	5	<0.1	No
	1hour	0.2	150	0.2	No
Arsenic	Annual	0.004	0.003	136.2	Yes
Chromium (III)	Annual	0.004	5	<0.1	No
	1hour	0.2	150	0.2	No
Chromium (VI)	Annual	0.004	0.0002	2042.8	Yes
	1hour	0.2	150	0.2	No
Cobalt	Annual	0.004	1	0.4	No
	1hour	0.2	30	0.8	No

Pollutant	Time Period	Maximum PC	EAL	% of EAL	Detailed Assessment Required
Copper	Annual	0.004	10	<0.1	No
	1hour	0.2	200	0.1	No
Lead	Annual	0.004	0.25	1.6	Yes
Manganese	Annual	0.004	0.15	2.7	Yes
	1hour	0.2	1500	<0.1	No
Nickel	Annual	0.004	0.02	20.4	Yes
Vanadium	Annual	0.004	5	<0.1	No
Dioxins and Furans	Annual	8.2×10^{-13}	0.0000003	<0.1	No

^a The PM_{2.5} objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it. The EU limit value is the same, but is to be met by 2015.

^b TOC assessed against the AQO for benzene.

^c 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 EH4024, and converted to the respective EAL using guidance in H1 (Environment Agency, 2010).

6.4 The predicted impacts exceed the screening criteria for several of the pollutants and therefore require further detailed assessment. No further assessment is required for those pollutants which do not exceed the screening criteria as these are considered *insignificant*.

Ecosystem

6.5 The predicted nitrogen oxide, sulphur dioxide, hydrogen fluoride and ammonia concentrations and rates of nutrient and acid nitrogen deposition associated with emission from the plant have been compared with the Environment Agency screening criteria. The screening criteria for locally designated sites allows for an addition of 100% of the EAL. The conclusions from the screening criteria are set out in Table 18.

Table 18: Maximum Predicted PCs to Sensitive Habitats in the Study Area

Pollutant	Time Period	Maximum PC ($\mu\text{g}/\text{m}^3$)	EAL	% of EAL	Detailed Assessment Required
Nitrogen Oxides	Annual	5.2	30	17.4	No
	24-hour mean	36.6	75	48.8	No
Sulphur Dioxide	Annual	1.1	20	5.4	No
Hydrogen Fluoride	24-hour mean	0.3	5	21.6	No
	Weekly mean	-	0.5	-	No
Ammonia	Annual	0.1	3	4.6	No
Nutrient Nitrogen Deposition Rate	Annual	1.2	5	12.6	No
Total Acid Deposition Rate	Annual	12.7	1.17	31.8	No

6.6 The predicted impacts exceed the screening criteria for several of the pollutants and therefore require further detailed assessment. No further assessment is required for those pollutants which do not exceed the screening criteria as these are considered *insignificant*.

Detailed Assessment

Nitrogen Dioxide

- 6.7 The impacts on nitrogen dioxide cannot be immediately discounted as insignificant, since the annual mean PC is more than 1% of the objective and the 99.8th percentile of 1-hour mean PC is more than 10% of the objective.
- 6.8 The maximum predicted PC to annual mean and short-term (as the 99.79th percentile of 1-hour means) nitrogen dioxide concentrations are set out in Table 17. For the annual mean objective, the table shows the worst-case prediction at any of the receptors relevant for the annual mean (Receptor 1-10), while for the 1-hour objective, the table shows the worst-case prediction across all the receptors.
- 6.9 Table 19 sets out the maximum PEC for annual mean and 99.8th percentile of 1-hour mean nitrogen dioxide concentrations at any of the receptors. The maximum PECs are both well below the relevant objectives.

Table 19: Maximum PCs and PECs for Nitrogen Dioxide ($\mu\text{g}/\text{m}^3$)

Objective	PC	Background	PEC	EAL
Annual Mean	3.0	13.8	16.8	40
1-hour mean (99.79 th percentile)	71.0	26.3	97.3	200

- 6.10 Table 20 sets out the impact descriptors for the long-term objective, this takes account of both the magnitude of change and the absolute concentration and uses the impact descriptor table in guidance provided by EPUK (see Appendix A2). No descriptor is available for the short-term objectives.
- 6.11 The impacts on nitrogen dioxide concentrations are thus considered *insignificant*.

Table 20: Annual Mean Nitrogen Dioxide Impact Descriptor

Location	Without Scheme ($\mu\text{g}/\text{m}^3$)	With Scheme ($\mu\text{g}/\text{m}^3$)	Change	Impact Descriptor
Receptor 10	13.8	16.8	Medium	Negligible

Particulate Matter (PM_{10} and $PM_{2.5}$)

- 6.12 The impacts on the annual mean and 24-hour mean PM_{10} concentration can be discounted as insignificant. However, the impacts on the annual mean $PM_{2.5}$ cannot be immediately discounted as insignificant, since the annual mean PC is more than 1% of the objective.
- 6.13 The maximum predicted PC to annual mean $PM_{2.5}$ concentration is set out in Table 17. For the annual mean objective, the table shows the worst-case prediction at any of the receptors relevant for the annual mean (Receptor 1-10).
- 6.14 Table 21 sets out the maximum PEC for annual mean $PM_{2.5}$ concentrations at all specific receptors. The maximum PEC is well below the objective level.

Table 21: Maximum $PM_{2.5}$ PEC ($\mu\text{g}/\text{m}^3$)

Objective	PC	Background	PEC	EAL
Annual Mean	0.3	9.7	10.0	25

- 6.15 Table 22 sets out the impact descriptor for the maximum $PM_{2.5}$ PC against the long-term objective. The impacts on $PM_{2.5}$ concentrations are thus considered *insignificant*.

Table 22: Annual Mean PM_{2.5} Impact Descriptor

Location	Without Scheme (µg/m ³)	With Scheme (µg/m ³)	Change	Impact Descriptor
Receptor 10	9.7	10.0	Small	Negligible

Sulphur Dioxide, Hydrogen Fluoride, Hydrogen Chloride, TOC and Carbon Monoxide

- 6.16 The impacts on the annual mean HCl and TOC concentrations along with the short-term objectives for sulphur dioxide concentrations cannot be immediately discounted as insignificant, since the maximum annual mean PCs are more than 1% of the relevant EALs or the maximum short-term PCs are more than 10% of the relevant EALs. The impacts on annual mean HF and short-term HF, HCl and CO objectives can be discounted as *insignificant*.
- 6.17 The maximum predicted PCs to annual mean HCl and TOC concentrations and to the short-term sulphur dioxide concentrations are set out in Table 17. For the annual mean objective, the table shows the worst-case prediction at any of the receptors relevant for the annual mean (Receptor 1-10), while for the short-term objectives; the table shows the worst-case prediction across all the receptors. Table 23 sets out the maximum PEC for annual mean and 99.8th percentile of 1-hour mean nitrogen dioxide concentrations. The maximum PECs are all well below the objective levels.

Table 23: Maximum PCs and PECs for HCl, TOC and SO₂ (µg/m³)

Objective	PC	Background	PEC	EAL
HCl Annual Mean	0.7	0.2	0.9	20
TOC Annual Mean	2.2	0.7	2.9	5
SO ₂ 24-hour mean (99.9 th percentile)	27.0	11.6	38.6	125
SO ₂ 15-minute mean (99.7 th percentile)	66.0	11.9	77.9	266
SO ₂ 1-hour mean (99.2 th percentile)	51.0	11.6	62.6	350

- 6.18 Table 24 sets out the impact descriptors for the long-term objective. No descriptor is available for the short term objectives. Using the descriptors provided by EPUK in Appendix A2, the magnitude

of change combined with the overall concentration is therefore considered as a *negligible* impact for HCl and *slight adverse* impact for TOCs.

- 6.19 In terms of TOCs, the predicted *slight adverse* impact is based on the assumption that 100% of TOC emissions from both the gasifier and the AD plant are benzene. In reality, benzene will only contribute a small fraction of TOC emissions and the impact is likely to be *negligible* and therefore the impacts on both HCl and TOC concentrations are considered to be *insignificant*.

Table 24: Annual Mean Impact Descriptors for HCl and TOC

Location	Without Scheme ($\mu\text{g}/\text{m}^3$)	With Scheme ($\mu\text{g}/\text{m}^3$)	Change	Impact Descriptor
HCl	0.2	0.9	Small	Negligible
TOC	0.7	2.9	Large	Slight Adverse ^a

^a In practice considered to be negligible – see discussion

Trace Metals

Group I Metals

- 6.20 The impacts on the annual mean concentration of cadmium cannot be immediately discounted as insignificant, since the annual mean PC is more than 1% of the objective. The impacts on annual mean and the maximum 1-hour mean concentrations of thallium can be discounted as *insignificant*.
- 6.21 The maximum predicted PC to annual mean cadmium are set out in Table 17. The table shows the worst-case prediction at any of the receptors relevant for the annual mean (Receptor 1-10). Table 25 sets out the maximum PEC for annual mean concentration. The maximum PEC is well below the objective levels.
- 6.22 The Cadmium PEC is less than 10% of the EAL therefore the impacts are considered *insignificant*.

Table 25: Maximum PEC for Cadmium

Metal	EAL	PC ($\mu\text{g}/\text{m}^3$)	Background ($\mu\text{g}/\text{m}^3$)	PEC ($\mu\text{g}/\text{m}^3$)	PEC as a % of EAL
Cadmium	0.005	0.0004	0.0001	0.000499	10.0

Group II Metals

- 6.23 The impacts on annual mean and the maximum 1-hour mean concentrations of Mercury concentrations can be discounted as *insignificant*.

Group III Metals

6.24 The assessment of trace metals follows the recommended methodology described by the Environment Agency in its Guidance to Applicants on Impacts for Group 3 Metals, V.3, September 2012. The methodology set out in the EA guidance, describes a three-step approach to the assessment of trace metals in stack emissions, as detailed in the Assessment Criteria section.

Step 1: Screening Scenario

6.25 On the basis of screening based on the PCs, further assessment is required for long-term concentrations of arsenic, chromium (VI), lead, manganese and nickel. The impacts from all other trace metals, for long-term and short-term concentrations, are considered to be insignificant.

6.26 The PECs for these trace metals that could not be initially screened out are shown in Table 26. Using the screening criteria for the PEC lead, manganese and nickel can also be considered *insignificant*, since the PECs are less than 100% of the EAL.

Table 26: Group II Metals Assessment Step 1: Emissions at 100% IED Emission Limit

Metal	EAL	PC (µg/m ³)	PC as a % of EAL	Background (µg/m ³)	PEC (µg/m ³)	PEC as a % of EAL
Arsenic	0.003	0.0041	136.2	0.0006	0.0047	155.7
Chromium (VI) ^c	0.0002	0.0041	2042.8	<0.0001	0.0041	2066.8
Lead	0.25	0.0041	1.6	0.0049	0.0090	3.6
Manganese	0.15	0.0041	2.7	0.0022	0.0062	4.2
Nickel	0.02	0.0041	20.4	0.0005	0.0046	23.1

6.27 On the basis of the Step 1 screening based on the PCs and the PECs, further assessment is required for long-term concentrations of arsenic, chromium (VI).

Step 2 – Worst Case Scenario Based on Currently Operating Plant

6.28 Step 2 of the EA's Guidance Note for Metals advises that modelling be undertaken assuming that each component group III metal is emitted as an equal portion of the total metals emission level. The model has thus been run assuming that chromium (VI) emissions are 1/9th (11.1%) of the total IED group III metals emission limit as there are a total of 9 group III metals. The results of Step 2 of the assessment of chromium (VI) emissions is presented in Table 27.

6.29 The PC and PEC for chromium (VI) both exceed the EAL. It is therefore necessary to proceed to Step 3 for chromium (VI). In terms of Arsenic the PC is greater than 1% of the EAL, however, the PEC is less than 100% of the EAL therefore the impacts of arsenic can be considered *insignificant*.

Table 27: Group III Metals Assessment Step 2: Emissions at 1/9th IED Emission Limit

Metal	EAL	PC (µg/m ³)	PC as a % of EAL	Background (µg/m ³)	PEC (µg/m ³)	PEC as a % of EAL
Arsenic	0.003	0.0005	15.1	0.0006	0.0010	34.6%
Chromium (VI) ^c	0.0002	0.0005	227.0%	<0.0001	0.0005	251.0%

Step 3: Typical Operational Emissions

- 6.30 The Environment Agency's group 3 metals guidance includes a summary of emissions monitoring data from 20 municipal waste incinerators, which shows the maximum, minimum and mean emissions concentrations of the group 3 metals. For chromium, the guidance includes emissions for total chromium, as well as the fraction of total chromium that is chromium (VI), which is based on speciation analysis of Air Pollution Control (APC) residues from the same municipal waste incinerators. The minimum and maximum emissions concentrations of total chromium and fractions for chromium (VI) obtained from the EA guidance note, are presented in Table 28.

Table 28: Measured Concentrations in Emissions and Group 3 Fractions Chromium at 20 Municipal Waste Incinerators between 2007 and 2009

Pollutant	Concentration (mg/Nm ³)		Fraction of Group III (%)	
	Minimum	Maximum	Minimum	Maximum
Total Chromium	0.0004	0.0521	0.08	10.4
Chromium (VI)	2.3 x 10 ⁻⁶	1.3 x 10 ⁻⁴	n/a	n/a

- 6.31 Step 3 of the group 3 metals assessment is to use the emission rates presented in Table 28 to determine PCs for chromium (VI). Table 29 sets out the maximum PC and PEC for chromium (VI) using the maximum emission concentration presented in Table 28. The final predicted maximum chromium (VI) PC is less than 1% of the long-term EAL. The final predicted maximum chromium (VI) PEC is less than 100% of the long-term EAL. The effects from long-term emissions of chromium (VI) are therefore considered to be *insignificant*.

Table 29: Predicted Long-term PC and PEC of Chromium (VI) Using the Maximum Emissions (Step 3)

Metal	EAL	PC (µg/m ³)	PC as a % of EAL	Background (µg/m ³)	PEC (µg/m ³)	PEC (µg/m ³)
Chromium (VI) ^c	0.0002	0.000001	0.5	0.000048	0.000049	24.5

a 1 pg/m³ equals 0.000001 µg/m³.

- b The average of annual mean measurements from the two nearest rural monitoring stations in 2012 have been used as the background concentrations. These values are presented in Table 10. The Chromium background concentration has been apportioned 80% Cr (III), 20% CR (VI) in accordance with the EA's Interim Guidance Note for Metals (Environment Agency, 2012).

Dioxins and Furans

- 6.32 The maximum predicted dioxin and furan PCs at specific receptor locations is 0.82 fg/m³. This is well below the WHO indicator concentration (300 fg/m³) above which it would be considered necessary to identify and control emissions. The average background PCDD/Fs concentration at the nearest monitoring station, located in Manchester, is 27.3 fg/m³. The PC is less than 1.0% of the background concentration.
- 6.33 There are no assessment criteria for dioxins and furans. When compared with the average background concentration measured in Manchester, the effect of the proposed development is considered to be *insignificant*.

Uncertainty in Modelling Predictions

- 6.34 There are many components that contribute to the uncertainty of modelling predictions. The ADMS-5 model used in this assessment is dependent upon the data that have been input, which will have inherent uncertainties associated with them. In order to account for this uncertainty, conservative and worst-case assumptions have been made where required. In particular, by assessing the biomass gasifier using the IED emissions limits, this tests the development at the capacity of its allowable emissions. In reality though, emissions from most modern plant will be well below the IED emission limits, and it should be borne in mind that the limits are set to be applied to all waste processing facilities, including solid municipal waste and mixed commercial and industrial waste streams, which are far less predictable (homogeneous) fuel sources than the waste biomass (timber products) that will be processed at Houghton Main.
- 6.35 Additional steps have also been taken to account for model uncertainty, including the use of five years of meteorological data, and testing the model with and without the influence of building wake effects. In both cases, the worst-case (highest) modelled concentrations have been presented in this assessment for robustness.

Significance of Operational Air Quality Impacts

- 6.36 The operational air quality impacts are judged to be *insignificant*.

Table 30: Factors Taken into Account in Determining the Overall Significance of the Scheme on Local Air Quality

Factors	Outcome of Assessment
Number of people affected by increases and/or decreases in concentrations and a judgement on the overall balance.	The area is largely rural and with limited numbers of receptors near to the development site. Overall there are unlikely to be many people effected by changes in concentrations.
The magnitude of the changes and the descriptions of the impacts at the receptors.	Some receptors may be exposed to large changes in concentrations in terms of the long-term objectives/EALs. However, all the concentrations are so far below the objectives/EALs that the impacts are considered negligible.
Whether or not an exceedence of an objective is predicted to arise in the study area where none existed before or an exceedence area is substantially increased.	There are no exceedences of the objectives/EALs.
Uncertainty, including the extent to which worst-case assumptions have been made.	Worst-case approaches have been adopted and a range of scenarios have been modelled to account for uncertainty. Scenarios include five years of metreological data and with and without buildings.
The extent to which an objective is exceeded.	No objectives/EALs are predicted to exceed.
Whether or not the study area exceeds an objective and this exceedence is removed or the exceedence area is reduced.	No objectives/EALs are predicted to exceed.

Odour Impact Assessment

Process Description

- 6.37 The Houghton Main development will incorporate at 150,000 tpa waste biomass gasification facility and a 60,000 tpa AD facility.

Source Odour Potential

- 6.38 It is not anticipated that the 150,000 tpa of waste biomass will be odourous in the form it is received at the site. It may, however, contain wood treatments and laminates which have the potential to produce odours during gasification.
- 6.39 The 60,000 tpa of organic waste handled by the AD facility will be more intrinsically odourous. Odours may be released from the receipt, storage, handling and digestion of waste, as well as from the storage and handling of AD residual products (solid and liquid digestates).
- 6.40 The first step of the odour risk assessment is to identify the source odour potential or odour magnitude. This takes into account the scale and nature of the odourous processes; continuity of

odour releases; intensity of odour releases; offensiveness of odour releases; and any odour control measures that is used. In essence, it must consider the odour potential of the source with respect to the FIDO of FIDOR.

6.41 The main potential odour sources and overall odour source odour potential for Houghton Main are described in Table 31.

Table 31: Identification of Odour Sources and Overall Odour Source Odour Potential

Odour Source	Description	Frequency and Duration	Intensity and Offensiveness
Biomass Gasification Facility			
Reception of Waste	Delivery to the site of 150,000 tpa of waste biomass.	Waste deliveries will be frequent. Individual deliveries will be short in duration, but the facility will receive deliveries throughout the day.	Waste biomass is not likely to be odorous. Any odours will be of low intensity and of neutral offensiveness (hedonic score = 0).
Storage of Waste	Storage of waste biomass on site prior to processing in the gasifier.	Waste will be stored in the main reception hall and odour releases are unlikely.	Odour releases are unlikely. Any odours released from the main reception hall will be of low intensity and neutral offensiveness.
Waste Processing	Processing of waste prior to gasification.	All waste will be processed inside the main process building, which is linked internally to the reception hall. No odour releases are expected.	Odour releases are unlikely. Any odours released from the process building will be of low intensity and neutral offensiveness.
Gasifier Stack	Emissions from the gasifier exhaust stack.	The gasifier will operate continuously and therefore odour releases will be continuous.	The stack height is 75 m tall, and therefore odour releases are well above the ground. Intensity of odours at the release point may be moderate to high, and offensiveness is likely to be somewhat offensive (hedonic score 0 -2)
Anaerobic Digestion Facility			
Reception of waste	Delivery to the site of 60,000 tpa of organic waste.	Daily deliveries of waste to the site by road. Frequency is high and duration is short for each individual delivery.	Waste will typically be received in covered vehicles, and will be unloaded within the reception building. Odours releases are likely to be of low intensity and the offensiveness of the odours is likely to be unpleasant (hedonic score -2).

Odour Source	Description	Frequency and Duration	Intensity and Offensiveness
Storage of waste	Storage of waste on site prior to processing in the AD plant.	Waste to be stored in reception building. Potential for short-term releases when doors are opened. Waste stored continuously so potential duration is long.	Odours from waste will increase in intensity over time due to biological action. Offensiveness of odours may increase from unpleasant towards highly unpleasant (hedonic score -3). All waste stored within reception building, which will minimise odour releases.
Loading of hoppers	Loading of waste into hoppers which feed waste into system.	Hoppers loaded routinely within reception building. There may be a spike in odour released by disturbance of waste, but odours will be contained within reception building. Low frequency and duration.	Intensity of odours is likely to be high due to disturbance of waste. Offensiveness will be dependent on the length of time waste has been stored, but will be unpleasant in nature.
Solid digestate	Storage of solid AD residue prior to removal from site.	Solid digestate continually produced and stored on site. Solid digestate will be periodically removed.	Solid digestate is dry, inert and relatively odourless.
Liquid digestate	Storage and reuse of liquid AD residue prior to removal from site.	Liquid digestate continually produced, stored and reused on site. It will be stored in sealed tanks and removed via tanker. No odour releases are expected due to the sealed nature of the system. Possible low frequency, short duration releases during tanker loading.	Liquid digestate has the potential to be highly odorous due to water content activating biological action. Intensity of any odour releases may be very high and the offensiveness of the odours is typically highly unpleasant.
Digesters / Digester release valves	Operation of the anaerobic digesters.	The digesters are sealed systems and therefore will typically not release odours. The digester tanks include emergency pressure release valves, which may result in infrequent, short-term odour releases if needed.	The intensity and offensiveness of odours released from the digesters via occasional use of the pressure release valves is potentially high due to the significant biological activity occurring in the digester tanks.

Odour Source	Description	Frequency and Duration	Intensity and Offensiveness
CHP stack	Odour emissions from the CHP engine exhausts.	The CHP engines will operate continuously.	The biogas combusted in the CHP engines will be largely odourless methane (CH ₄). The emissions will be largely odourless with the possible exception of any residual sulphur compounds. These aren't anticipated to produce significant odour. Odour intensity will be low and offensiveness will be neutral towards unpleasant.
Gas flare	Operation of the emergency gas flare.	The gas flare will be operated very occasionally due to CHP failure or other emergency circumstances.	Odours from the gas flare are likely to be similar in intensity and offensiveness to those from the CHP engines.
Overall Source Odour Potential	<p>The proposed Houghton Main facility is a very large process, which will require an Environmental Permit. The nature of the waste biomass received is largely non-odorous. The AD facility has the potential to generate odours, but is of smaller scale than the gasifier and odours will be well managed and controlled by receipt and storage of waste in a reception building.</p> <p>The overall source odour potential of Houghton Main is judged to be Medium.</p>		

Pathway Effectiveness

- 6.42 In order to address the effectiveness of the pathway, it is important to consider the receptor location in terms of its proximity to odour source(s) and in relation to prevailing wind direction. The location of each of the receptors in relation to the Houghton Main site boundary is shown in Figure 2.
- 6.43 The wind roses for 2009-2013 from the Robin Hood Airport meteorological station are presented in Appendix A4. They demonstrate that there is no strongly prevailing wind direction in the region; however, southerly and south westerly winds do occur most frequently and therefore these are considered to be the prevailing winds for the purposes of this assessment.
- 6.44 In general, odours will be transported by the wind and will not be detectable at locations upwind of a source. The exception to this is during calm conditions when odours may disperse against the wind direction, although typically only for relatively short distances.
- 6.45 In terms of setback distances, for a source with a medium source odour potential, such as Houghton Main, it is judged that a setback distance of 500 m should be sufficient to mitigate any odour impacts through dispersion and dilution.
- 6.46 The effectiveness of the odour pathways between Houghton Main and the sensitive receptor locations is summarised in Table 32.

Table 32: Effectiveness of Odour Pathway

Receptor	Distance from Source ^a	Direction from Source	Downwind? ^b	Pathway Effectiveness
Receptor 1	645 m	SW	N	Ineffective
Receptor 2	780 m	W	N	Ineffective
Receptor 3	1,475 m	NW	N	Ineffective
Receptor 4	2,000 m	N	Y	Ineffective
Receptor 5	1,700 m	N	Y	Ineffective
Receptor 6	1,000 m	NE	Y	Ineffective
Receptor 7	1,080 m	E	Y	Ineffective
Receptor 8	1,400 m	E	Y	Ineffective
Receptor 9	840 m	SE	N	Ineffective
Receptor 10	720 m	SE	N	Ineffective
Receptor 11	75 m	SE	N	Moderately Effective
Receptor 12	95 m	E	Y	Moderately Effective
Receptor 13	150 m	SE	N	Moderately Effective

^a Measured as distance to the nearest point on the application site boundary.

^b Relative to predominant wind direction identified by wind roses presented in Appendix A4.

6.47 The effectiveness of the pathway to receptors 1 to 10 is judged to be ineffective. All of these receptors are over 500 m away from the Houghton Main site boundary.

6.48 The effectiveness of the pathway to receptors 11 to 13 is judged to moderately effective as all three receptors are in relatively close proximity (<150 m) to the Houghton Main site boundary.

Receptor Sensitivity

6.49 Receptors 1 to 10 are all residential properties and are therefore judged to be high sensitivity receptors.

6.50 Receptors 11 – 13 represent industrial units next to the proposed development site. These locations are places of work, and are therefore judged to be medium sensitivity receptors.

Potential Odour Effects

6.51 The assessment of the potential odour effects at sensitive receptor locations due to odours from Houghton Main are presented in Table 33. This brings together the source odour potential, effectiveness of pathway and receptor sensitivity identified using the criteria described in Table 6, to identify an overall potential for odour effects, using the matrices set out in Table 7 and Table 8.

Table 33: Assessment of Potential Odour Effects from Houghton Main

Receptor	Risk of Odour Impact (Dose)			Receptor Sensitivity	Likely Odour Effect
	Source Odour Potential	Effectiveness of Pathway	Risk of Odour Impact		
Receptor 1	Medium	Low	Negligible Risk	High	Negligible
Receptor 2	Medium	Low	Negligible Risk	High	Negligible
Receptor 3	Medium	Low	Negligible Risk	High	Negligible
Receptor 4	Medium	Low	Negligible Risk	High	Negligible
Receptor 5	Medium	Low	Negligible Risk	High	Negligible
Receptor 6	Medium	Low	Negligible Risk	High	Negligible
Receptor 7	Medium	Low	Negligible Risk	High	Negligible
Receptor 8	Medium	Low	Negligible Risk	High	Negligible
Receptor 9	Medium	Low	Negligible Risk	High	Negligible
Receptor 10	Medium	Low	Negligible Risk	High	Negligible
Receptor 11	Medium	Medium	Low Risk	Medium	Negligible
Receptor 12	Medium	Medium	Low Risk	Medium	Negligible
Receptor 13	Medium	Medium	Low Risk	Medium	Negligible

6.52 The potential odour effects have been identified using the effect \approx dose \times response relationship identified in paragraph 3.43. The process is described as follows:

1) Identify the impact:

6.53 Based on a medium source odour potential; where the pathway is deemed to be moderately effective, then the risk of odour impacts (dose) is judged to be low risk. Where the pathway is deemed to be ineffective, then the risk of odour impacts is judged to be negligible risk (see Table 7).

2) Consider the response:

6.54 A negligible risk of odour impacts combined with high receptor sensitivity will lead to a negligible odour effect. A low risk of odour impacts combined with a medium sensitivity receptor will also lead to a negligible odour effect (see Table 8).

6.55 The potential odour effects are summarised in the final column of Table 33. The table summarises the potential effects for each receptor, but the final stage of the risk assessment is to make an overall judgement as to the likely significance of effects. In this case, the potential for odour effects are negligible at all receptor locations, and it is therefore judged that that overall significance of odour effects is **Negligible**.

7 Mitigation

Construction Impacts

- 7.1 Measures to mitigate dust emissions will be required during the construction phase of the development in order to reduce impacts upon nearby sensitive receptors.
- 7.2 The site has been identified as a *Low Risk* site as set out in Table 16. Comprehensive guidance has been published by IAQM (Institute of Air Quality Management, 2014), and on monitoring during demolition and construction (Institute of Air Quality Management, 2012b). This reflects best practice experience and has been used, together with the professional experience of the consultant and the findings of the dust impact assessment, to draw up a set of measures that should be incorporated into the specification for the works. These measures are described in Appendix A6.
- 7.3 The mitigation measures should be written into a dust management plan (DMP).
- 7.4 Where mitigation measures rely on water, it is expected that only sufficient water will be applied to damp down the material. There should not be any excess to potentially contaminate local watercourses.

Plant Impacts

- 7.5 No additional mitigation measures are proposed for the development.

Odour Impacts

- 7.6 No additional mitigation measures are proposed for the development.

8 Residual Impacts and Effects

Construction

- 8.1 The IAQM guidance is clear that, with appropriate mitigation in place, the residual effect will normally be 'not significant'. The mitigation measures set out in Section 7 are based on the IAQM guidance. With these measures in place and effectively implemented the residual effects are judged to be *insignificant*.

Plant Impacts

- 8.2 The residual impacts will be the same as those identified in the Section 6 (paragraph 6.36). In other words, the overall operational air quality impacts of the development are judged to be insignificant.

Odour Impacts

- 8.3 The residual impacts will be the same as those identified in the Section 6 (paragraph 6.55). In other words, the overall operational air quality impacts of the development are judged to be insignificant.

9 Conclusions

- 9.1 The construction works have the potential to create dust. During construction it will therefore be necessary to apply a package of mitigation measures to minimise dust emission. With these measures in place, it is expected that any residual effects will be *insignificant*.
- 9.2 The operational impacts of increased traffic have been discounted as *insignificant* based on the flows in relation to screening criteria.
- 9.3 The operational impacts of the emissions to air from the new point sources on human health have been shown to be *insignificant* in relation to human health. Where pollutants could not be screened out based on their PC being less than 1% (for long-term impacts) or 10% (for short-term impacts) of the objective/EAL, the total PEC has been shown to be well below the objective/ EAL. Where annual mean objectives have been assessed the EPUK impact descriptors have been used to describe the impacts. All annual mean impacts are considered to be *negligible*. Overall, the impacts on human health receptors are considered to be *insignificant*.
- 9.4 The operational impacts of the emissions to air from the new point sources have been shown to be *insignificant* at the sensitive ecological site. All pollutants were screened out based on their PC being less than 100% of the objective/EAL/critical level. This is the screening criterion for locally designated ecological sites.
- 9.5 The potential for odour effects due to the operation of the facility are considered *negligible* at all receptor locations, and it is therefore judged that that overall significance of odour effects is *insignificant*.

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11 Glossary

AADT	Annual Average Daily Traffic
ADMS-5	Atmospheric Dispersion Modelling System
AQMA	Air Quality Management Area
AURN	Automatic Urban and Rural Network
CHP	Combined Heat and Power
CO	Carbon Monoxide
DCLG	Department for Communities and Local Government
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
EPUK	Environmental Protection UK
Exceedence	A period of time when the concentration of a pollutant is greater than the appropriate air quality objective. This applies to specified locations with relevant exposure
HCl	Hydrogen Chloride
HF	Hydrogen Fluoride
IAQM	Institute of Air Quality Management
LAQM	Local Air Quality Management
LDF	Local Development Framework
µg/m³	Microgrammes per cubic metre
NO	Nitric oxide
NO₂	Nitrogen dioxide
NO_x	Nitrogen oxides (taken to be NO ₂ + NO)
NPPF	National Planning Policy Framework
Objectives	A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the standards should be achieved by a defined date. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides
PM₁₀	Small airborne particles, more specifically particulate matter less than 10 micrometres in aerodynamic diameter

PM_{2.5}	Small airborne particles less than 2.5 micrometres in aerodynamic diameter
SO₂	Sulphur Dioxide
SPG	Supplementary Planning Guidance
SPD	Supplementary Planning Document
Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal
TEA	Triethanolamine – used to absorb nitrogen dioxide
TEOM	Tapered Element Oscillating Microbalance
TOC	Total Organic Compounds
VCM	Volatile Correction Model
VOC	Volatile Organic Compounds

12 Appendices

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A1 Construction Dust Assessment Procedure

A1.1 The criteria developed by IAQM divide the activities on construction sites into four types to reflect their different potential impacts. These are:

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

A1.2 The assessment procedure includes the four steps summarised below:

STEP 1: Screen the Need for a Detailed Assessment

A1.3 An assessment is required where there is a human receptor within 350 m of the boundary of the site and/or within 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s), or where there is an ecological receptor within 50 m of the boundary of the site and/or within 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s).

A1.4 Where the need for a more detailed assessment is screened out, it can be concluded that the level of risk is *negligible* and that any effects will not be significant. No mitigation measures beyond those required by legislation will be required.

STEP 2: Assess the Risk of Dust Impacts

A1.5 A site is allocated to a risk category based on two factors:

- the scale and nature of the works, which determines the potential dust emission magnitude (Step 2A); and
- the sensitivity of the area to dust effects (Step 2B).

A1.6 These two factors are combined in Step 2C, which is to determine the risk of dust impacts with no mitigation applied. The risk categories assigned to the site may be different for each of the four potential sources of dust (demolition, earthworks, construction and trackout).

Step 2A – Define the Potential Dust Emission Magnitude

A1.7 Dust emission magnitude is defined as either 'Small', 'Medium', or 'Large'. The IAQM explains that this classification should be based on professional judgement, but provides the examples in Table A1.1.

Table A1.1: Examples of How the Dust Emission Magnitude Class May be Defined

Class	Examples
Demolition	
Large	Total building volume >50,000 m ³ , potentially dusty construction material (e.g. concrete), on site crushing and screening, demolition activities >20 m above ground level
Medium	Total building volume 20,000 m ³ – 50,000 m ³ , potentially dusty construction material, demolition activities 10-20 m above ground level
Small	Total building volume <20,000 m ³ , construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10 m above ground, demolition during wetter months
Earthworks	
Large	Total site area >10,000 m ² , potentially dusty soil type (e.g. clay, which will be prone to suspension when dry to due small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >8 m in height, total material moved >100,000 tonnes
Medium	Total site area 2,500 m ² – 10,000 m ² , moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 4 m – 8 m in height, total material moved 20,000 tonnes – 100,000 tonnes
Small	Total site area <2,500 m ² , soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4 m in height, total material moved <10,000 tonnes, earthworks during wetter months
Construction	
Large	Total building volume >100,000 m ³ , piling, on site concrete batching; sandblasting
Medium	Total building volume 25,000 m ³ – 100,000 m ³ , potentially dusty construction material (e.g. concrete), piling, on site concrete batching
Small	Total building volume <25,000 m ³ , construction material with low potential for dust release (e.g. metal cladding or timber)
Trackout ^a	
Large	>50 HDV (>3.5t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100 m
Medium	10-50 HDV (>3.5t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 m – 100 m
Small	<10 HDV (>3.5t) outward movements in any one day, surface material with low potential for dust release, unpaved road length <50 m

^a These numbers are for vehicles that leave the site after moving over unpaved ground.

Step 2B – Define the Sensitivity of the Area

A1.8 The sensitivity of the area is defined taking account of a number of factors:

- the specific sensitivities of receptors in the area;
- the proximity and number of those receptors;
- in the case of PM₁₀, the local background concentration; and
- site-specific factors, such as whether there are natural shelters to reduce the risk of wind-blown dust.

A1.9 The first requirement is to determine the specific sensitivities of local receptors. The IAQM recommends that this should be based on professional judgment, taking account of the principles in Table A1.2. These receptor sensitivities are then used in the matrices set out in Table A1.3, Table A1.4, and Table A1.5 to determine the sensitivity of the area. Finally, the sensitivity of the area is considered in relation to any other site-specific factors, such as the presence of natural shelters etc., and any required adjustments to the defined sensitivities are made.

Step 2C – Define the Risk of Impacts

A1.10 The dust emission magnitude determined at Step 2A is combined with the sensitivity of the area determined at Step 2B to determine the *risk* of impacts with no mitigation applied. The IAQM provides the matrix in Table A1.6 as a method of assigning the level of risk for each activity.

STEP 3: Determine Site-specific Mitigation Requirements

A1.11 The IAQM provides a suite of recommended and desirable mitigation measures which are organised according to whether the outcome of Step 2 indicates a low, medium, or high risk. The list provided by the IAQM has been used as the basis for the requirements set out in Appendix A6.

STEP 4: Determine Significant Effects

A1.12 The IAQM does not provide a method for assessing the significance of effects before mitigation, and advises that pre-mitigation significance should not be determined. With appropriate mitigation in place, the IAQM guidance is clear that the residual effect will normally be 'not significant' (Institute of Air Quality Management, 2014).

A1.13 The IAQM guidance recognises that, even with a rigorous dust management plan in place, it is not possible to guarantee that the dust mitigation measures will be effective all the time, for instance under adverse weather conditions. The local community may therefore experience occasional, short-term dust annoyance. The scale of this would not normally be considered sufficient to change the conclusion that the effects will be 'not significant'.

Table A1.2: Principles to be Used When Defining Receptor Sensitivities

Class	Principles	Examples
Sensitivities of People to Dust Soiling Effects		
High	users can reasonably expect enjoyment of a high level of amenity; <u>or</u> the appearance, aesthetics or value of their property would be diminished by soiling; and the people or property would reasonably be expected to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land	dwellings, museum and other culturally important collections, medium and long term car parks and car showrooms
Medium	users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; <u>or</u> the appearance, aesthetics or value of their property could be diminished by soiling; <u>or</u> the people or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land	parks and places of work
Low	the enjoyment of amenity would not reasonably be expected; <u>or</u> there is property that would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; <u>or</u> there is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land	playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads
Sensitivities of People to the Health Effects of PM₁₀		
High	locations where members of the public may be exposed for eight hours or more in a day	residential properties, hospitals, schools and residential care homes
Medium	locations where the people exposed are workers, and where individuals may be exposed for eight hours or more in a day.	may include office and shop workers, but will generally not include workers occupationally exposed to PM ₁₀
Low	locations where human exposure is transient	public footpaths, playing fields, parks and shopping streets
Sensitivities of Receptors to Ecological Effects		
High	locations with an international or national designation <i>and</i> the designated features may be affected by dust soiling; <u>or</u> locations where there is a community of a particularly dust sensitive species	Special Areas of Conservation with dust sensitive features
Medium	locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown; <u>or</u> locations with a national designation where the features may be affected by dust deposition	Sites of Special Scientific Interest with dust sensitive features
Low	locations with a local designation where the features may be affected by dust deposition	Local Nature Reserves with dust sensitive features

Table A1.3: Sensitivity of the Area to Effects on People and Property from Dust Soiling ⁶

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

Table A1.4: Sensitivity of the Area to Human Health Effects ⁶

Receptor Sensitivity	Annual Mean PM ₁₀	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
High	>32 µg/m ³	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32 µg/m ³	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28 µg/m ³	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24 µg/m ³	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	-	>10	High	Medium	Low	Low	Low
	-	1-10	Medium	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

⁶ For demolition, earthworks and construction, distances are taken either from the dust source or from the boundary of the site. For trackout, distances are measured from the sides of roads used by construction traffic. Without 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 A1.5: Sensitivity of the Area to Ecological Effects ⁶

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

Table A1.6: Defining the Risk of Dust Impacts

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

A2 Impact Descriptors and Assessment of Significance

A2.1 There is no official guidance in the UK on how to describe the nature of air quality impacts, nor how to assess their significance. The approach developed by the Institute of Air Quality Management⁷ (Institute of Air Quality Management, 2009), and incorporated in Environmental Protection UK's guidance document on planning and air quality (Environmental Protection UK, 2010), has therefore been used. This involves three distinct stages: the application of descriptors for magnitude of change; the description of the impact at each sensitive receptor; and then the assessment of overall significance of the scheme.

Impact Descriptors

A2.2 The definition of **impact magnitude** is solely related to the degree of change in pollutant concentrations, expressed in microgrammes per cubic metre, but originally determined as a percentage of the air quality objective. **Impact description** takes account of the impact magnitude and of the absolute concentrations and how they relate to the air quality objectives or other relevant standards. The descriptors for the magnitude of change due to the scheme are set out Table A2.1, while Table A2.2 sets out the impact descriptors. These tables have been designed to assist with describing air quality impacts at each specific receptor. They apply to the pollutants relevant to this scheme and the objectives against which they are being assessed.

Table A2.1: Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations

Magnitude of Change	Annual Mean Concentration
Large	Increase/decrease ≥10% of objective
Medium	Increase/decrease 5 - <10% of objective
Small	Increase/decrease 1 - <5 % of objective
Imperceptible	Increase/decrease <1% of objective

⁷ The IAQM is the professional body for air quality practitioners in the UK.

Table A2.2: Air Quality Impact Descriptors for Changes to Annual Mean Concentrations at a Receptor ^a

Absolute Concentration ^b in Relation to Objective	Change in Concentration/day ^c		
	Small	Medium	Large
Above Objective	Slight	Moderate	Substantial
Just Below Objective	Slight	Moderate	Moderate
Below Objective	Negligible	Slight	Slight
Well Below Objective	Negligible	Negligible	Slight

^a Criteria have been adapted from the published criteria to remove overlaps at transitions.

^b The 'Absolute Concentration' relates to the 'With-Scheme' air quality where there is an increase in concentrations and to the 'Without-Scheme' air quality where there is a decrease in concentrations.

^c Where the Impact Magnitude is *Imperceptible*, then the Impact Description is *Negligible*.

Assessment of Significance

A2.3 The IAQM guidance (Institute of Air Quality Management, 2009) is that the **assessment of significance** should be based on professional judgement, with the overall air quality impact of the scheme described as either, *insignificant*, *minor*, *moderate* or *major*. In drawing these conclusions, the factors set out in Table A2.3 should be taken into account. A summary of the professional experience of staff contributing to this assessment is provided in Appendix A3.

Table A2.3: Factors Taken into Account in Determining Air Quality Significance

Factors
Number of people affected by increases and/or decreases in concentrations and a judgement on the overall balance.
The magnitude of the changes and the descriptions of the impacts at the receptors using the criteria set out in Table A2.1 and Table A2.2.
Whether or not an exceedence of an objective is predicted to arise in the study area where none existed before or an exceedence area is substantially increased.
Whether or not the study area exceeds an objective and this exceedence is removed or the exceedence area is reduced.
Uncertainty, including the extent to which worst-case assumptions have been made.
The extent to which an objective is exceeded, e.g. an annual mean NO ₂ of 41 µg/m ³ should attract less significance than an annual mean of 51 µg/m ³ .

A3 Professional Experience

Prof. Duncan Laxen, BSc (Hons) MSc PhD MIEEnvSc FIAQM

Prof Laxen is the Managing Director of Air Quality Consultants, a company which he founded in 1993. He has over forty years' experience in environmental sciences and has been a member of Defra's Air Quality Expert Group and the Department of Health's Committee on the Medical Effects of Air Pollution. He has been involved in major studies of air quality, including nitrogen dioxide, lead, dust, acid rain, PM₁₀, PM_{2.5} and ozone and was responsible for setting up the UK's urban air quality monitoring network. Prof Laxen has been responsible for appraisals of all local authorities' air quality Review & Assessment reports and for providing guidance and support to local authorities carrying out their local air quality management duties. He has carried out air quality assessments for power stations; road schemes; ports; airports; railways; mineral and landfill sites; and residential/commercial developments. He has also been involved in numerous investigations into industrial emissions; ambient air quality; indoor air quality; nuisance dust and transport emissions. Prof Laxen has prepared specialist reviews on air quality topics and contributed to the development of air quality management in the UK. He has been an expert witness at numerous Public Inquiries, published over 70 scientific papers and given numerous presentations at conferences. He is a Fellow of the Institute of Air Quality Management.

Laurence Caird, MEarthSci CSci MIEEnvSc MIAQM

Mr Caird is a Principal Consultant with AQC, with eight years' experience in the field of air quality including the detailed assessment of emissions from road traffic, airports, heating and energy plant, and a wide range of industrial sources including the thermal treatment of waste. He has experience in ambient air quality monitoring for numerous pollutants using a wide range of techniques and is also competent in the monitoring and assessment of nuisance odours and dust. Mr Caird has worked with a variety of clients to provide expert air quality services and advice, including local authorities, planners, developers and process operators. He is a Member of the Institute of Air Quality Management and is a Chartered Scientist.

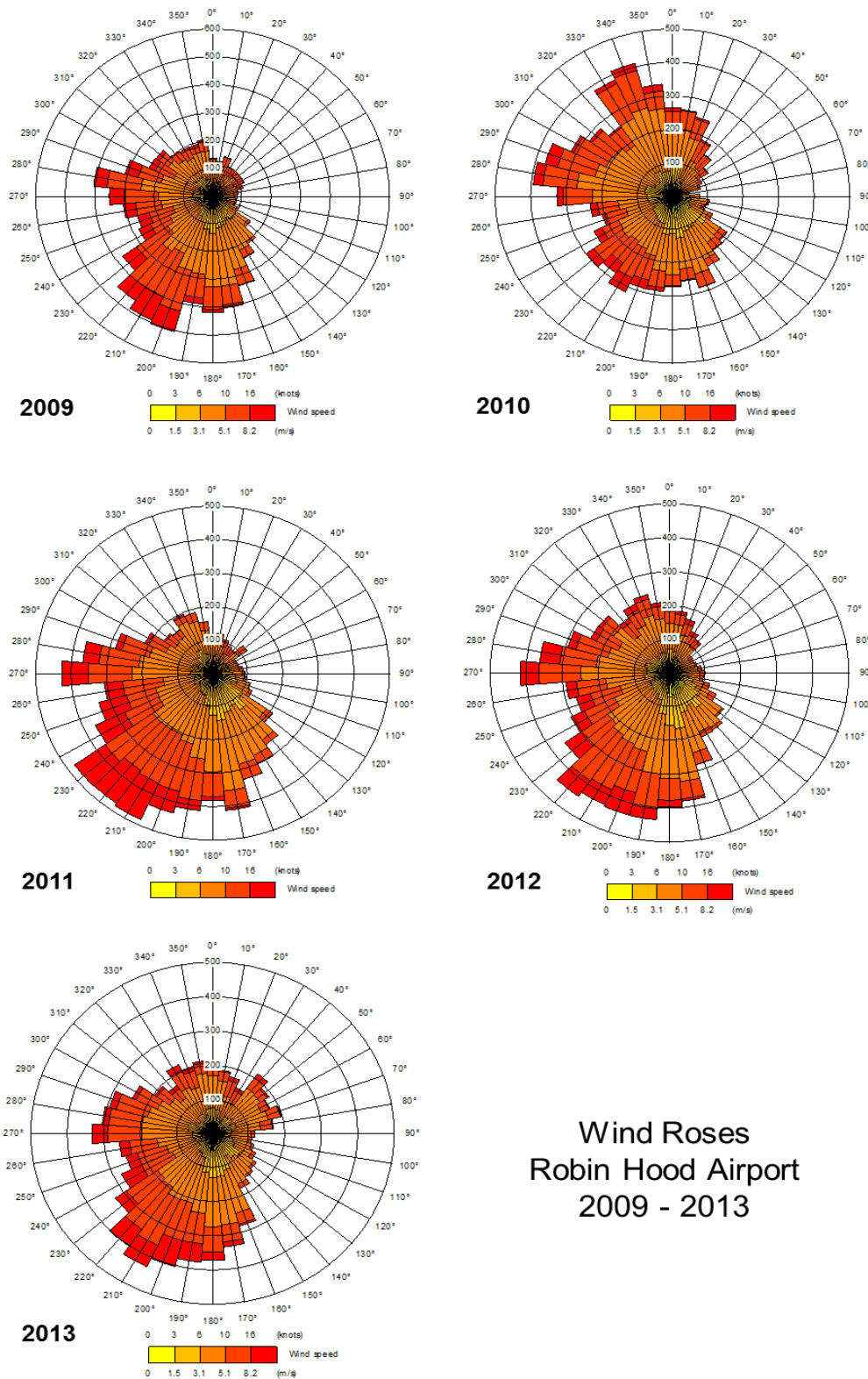
Kieran Laxen, MEng (Hons) AMIEEnvSc MIAQM

Mr Laxen is a Senior Consultant with AQC with over five years' experience in the field of air quality management and assessment. Previously having two years' experience in scientific research on internal combustion engines, he now works in the field of air quality. He is involved in a wide range of development projects, most of which have involved use of ADMS modelling methodologies for biomass boilers, CHP plant and roads, and is also competent in the assessment of construction dust. He has pioneered the use of OpenAir software within the Company, which is used to analyse

air quality monitoring data, and is responsible for routine calibration of air quality monitoring stations, together with data ratification. He is a Member of the Institute of Air Quality Management.

Full CVs are available at www.aqconsultants.co.uk.

A4 Wind Roses



Wind Roses
Robin Hood Airport
2009 - 2013

Figure A1: Figure Wind Roses for Robin Hood Airport 2009-2013

Table A4.1: Meteorological Data entered into Model.

Magnitude of Change	Development site	Meteorological site
Surface Roughness (m)	0.2	0.2
Surface albedo	Model default (0.23)	Model default (0.23)
Min MO length (m)	1	30
Priestly-Taylor parameter	Model default (1)	Dispersion site value

A5 Nitrogen Dioxide Background Concentrations

- A5.1 The nitrogen dioxide background concentrations across the study area have been defined using the national pollution maps published by Defra (2014a). These cover the whole country on a 1x1 km grid and are published for each year from 2010 until 2030. The maps include the influence of emissions from a range of different sources; one of which is road traffic.
- A5.2 Background concentrations in 2012 have been calculated for the study area assuming that there was no reduction in the road traffic component of backgrounds between 2010⁸ and 2012. This has been done using the source-specific background nitrogen oxides maps provided by Defra (2014a). For each grid square, the road traffic component has been held constant at 2010 levels, while 2012 values have been taken for the other components. Nitrogen dioxide concentrations have then been calculated using the background nitrogen dioxide calculator which Defra (2014a) publishes to accompany the maps. The result is a set of 'adjusted 2012 background' concentrations. These 2012 'adjusted' values have been calibrated against local measurements made by the local authority. Table A5.1 shows the comparison and the calibration factor. This provides local background map concentrations calibrated against local monitoring data in 2012.

Table A5.1: Comparison of Mapped to Measured Monitoring Data

Local Authority Monitoring Site	Mapped Background Data ($\mu\text{g}/\text{m}^3$)	Measured Data ($\mu\text{g}/\text{m}^3$)	Ratio
AM5	17.3	21	1.21
AM6	34.9	26.3	0.75
DT2	24.0	32.5	1.35
DT19	16.1	24.5	1.52
DT21	18.1	24.3	1.34
DT52	23.6	22.9	0.97
DT88	19.6	33.2	1.69
DT89	21.4	31.6	1.48
DT90	17.1	26.5	1.54
Overall	-	-	1.19^a

^a Based on the line of best fit being forced through zero.

⁸ This approach assumes that has been no reduction in emissions per vehicle but also that traffic volumes have remained constant. This is not the same as the assumption made for dispersion modelling, in which emissions per vehicle are held constant while traffic volumes are assumed to change year on year. Overall, this discrepancy is unlikely to influence the overall conclusions of the assessment.

A5.3 2017 background concentrations have then been calculated assuming that emissions reduce at the official rate and occur from 2012 to 2017. A ratio of 2017 mapped concentration to the 2012 mapped concentration has been calculated and applied to the calibrated 2012 value to provide the 2017 nitrogen dioxide concentrations.

A6 Construction Mitigation

A6.1 The following is a set of measures that should be incorporated into the specification for the works, this includes both 'highly recommended' and 'desirable' measures for a low risk site:

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 environmental manager/engineer or the site manager; and
- display the head or regional office contact information.

Dust Management Plan

- Develop and implement a Dust Management Plan (DMP) approved by the Local Authority which documents the mitigation measures to be applied, and the procedures for their implementation and management.

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; and

Monitoring

- Undertake daily on-site and off-site inspections 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 checks of surfaces such as street furniture, cars and window sills within 100 m of the site boundary, with cleaning to be provided if necessary; 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 area being carried out and during prolonged dry or windy conditions; and

Preparing and Maintaining the Site

- Plan the 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 as 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 on-site cover as described below; and
- cover, seed, or fence stockpiles to prevent wind whipping.

Operating Vehicle/Machinery and Sustainable Travel

- ensure all vehicles switch off their 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 un-surfaced 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 appropriate);

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;
- 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, conveyors and covered skips;
- minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate; and
- 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.

Measures Specific to Construction

- Avoid scabbling (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;

Measures Specific to Trackout

- Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use;
- avoid dry sweeping of large areas;
- ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport;
- record all inspections of haul routes and any subsequent action in a site log book;
- implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable);