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Report

Haworth Scouring, Bradford

Technical Note

For Haworth Scouring Company

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Air Quality
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Executive Summary

The air quality impacts associated with the proposed CHP unit at Haworth Scouring have been assessed. The assessment of the emissions from the proposed CHP plant, existing CHP plant, and existing boiler has demonstrated that the off-site impacts of these emissions will be negligible. Overall, the operational air quality effects of Haworth Scouring are judged to be 'not significant'.

Contents

1 Introduction

1.1 This technical note describes the potential air quality impacts associated with the proposed Combined Heat and Power (CHP) plant at Haworth Scouring Company, in Bradford. The technical note has been prepared following the approach developed jointly by Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM)[1] (Moorcroft and Barrowcliffe et al, 2017) in support of the planning application for the proposed CHP plant, to be submitted to Bradford City Council (BCC).

1.2 The facility currently comprises of one CHP unit and a single boiler, both fuelled by natural gas. The existing plant is used for the drying process, to provide hot water and steam for the industrial washing water and for some space heating. The proposed CHP plant will run on biogas.

1.3 A detailed assessment of the proposed CHP plant made in accordance with the Environmental Permitting Regulations (EPR) (2018), has been undertaken by Air Quality Consultants Ltd (AQC) (Report Number J10-13244C-10) on behalf of Haworth Scouring Company to support the Bespoke Environmental Permit application for the facility, which was made in accordance with the Environmental Permitting Regulations (EPR) (2018). The detailed report is presented in Appendix A3 to supplement this report.

[1] The IAQM is the professional body for air quality practitioners in the UK.

2 Policy Context

2.1 All European legislation referred to in this report is written into UK law and remains in place.

Air Quality Strategy 2007

2.2 The Air Quality Strategy (Defra, 2007) published by the Department for Environment, Food, and Rural Affairs (Defra) and Devolved Administrations, provides the policy framework 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 Strategy 2023

2.3 The Air Quality Strategy: Framework for Local Authority Delivery 2023 (Defra, 2023a) sets out the strategic air quality framework for local authorities and other Air Quality Partners in England. It sets out their powers and responsibilities, and actions the government expects them to take. It does not replace other air quality guidance documents relevant to local authorities.

The Environmental Permitting (England and Wales) (Amendment) Regulations 2018

2.4 The Medium Combustion Plant Directive (MCPD) (The European Parliament and the Council of the European Union, 2015) regulates pollutant emissions from combustion plant with a rated input between 1 and 50 megawatts (MW_{th}) and was transposed into UK law in January 2018 through an amendment to the Environmental Permitting Regulations (2018). The legislation sets emission limits to be applied from December 2018 for new plant and from 2025 or 2030 for existing plant (depending on the rated input). In addition to addressing emissions from plant with a rated input of 1 to 50 MW_{th}, as required by the MCPD, the amendment also introduces emission limits on generator plant, regardless of their rated input. Generators whose sole purpose is maintaining power supply at a site during an on-site emergency, that are operated for the purpose of testing/maintenance for no more than 50 hours per year, will be exempt from the emission limits.

2.5 The MCPD only applies to individual units – if you have twenty 999 kW thermal input CHPs they are all exempt. If you have ten 900 kW boilers and one 1.2 MW CHP then only the CHP will require a permit. The proposed CHP plant within the proposed development will require a permit under these regulations, as their thermal input rates are above the 1 MW threshold. The CHP plant will, therefore, need to meet a NOx emission rate of 190 mg/Nm^3 at 15% O_2.

Clean Air Act 1993 & Environmental Protection Act

2.6 Small combustion plant of less than 20 MW net rated thermal input are controlled under the Clean Air Act 1993 (1993). This requires the local authority to approve the chimney height. Plant which are smaller than 366 kW have no such requirement. The local authority's approval will, therefore, be required for the plant to be installed in the proposed development.

2.7 Measures to ensure adequate dispersion of emissions from discharging stacks and vents are included in Technical Guidance Note D1 (Dispersion) (1993), issued in support of the Environmental Protection Act (1990).

Clean Air Strategy 2019

2.8 The Clean Air Strategy (Defra, 2019a) sets out a wide range of actions by which the UK Government will seek to reduce pollutant emissions and improve air quality. Actions are targeted at four main sources of emissions: Transport, Domestic, Farming and Industry. At this stage, there is no straightforward way to take account of the expected future benefits to air quality within this assessment.

Environment Act 2021

2.9 The UK's new legal framework for protection of the natural environment, the Environment Act (2021) passed into UK law in November 2021. The Act gives the Government the power to set long-term, legally binding environmental targets. It also establishes an Office for Environmental Protection (OEP), responsible for holding the Government to account and ensuring compliance with these targets.

2.10 The Environmental Targets (Fine Particulate Matter) (England) Regulations 2023 (SI 2023 No. 96) sets two new targets for future concentrations of $PM_{2.5}$.

Environmental Improvement Plan 2023

2.11 Defra published its 25 Year Environment Plan in 2018 (Defra, 2018a). The Environment Act (2021) requires Defra to review this Plan at least every five years. The Environmental Improvement Plan 2023 (Defra, 2023b) is the first revision. This outlines the progress made since 2018 and adds detail to the goals defined in the 2018 Plan, including that of achieving clean air.

2.12 The Environmental Improvement Plan 2023 sets out the new air quality targets which have been set for concentrations of $PM_{2.5}$. These targets, include the long-term targets in the Statutory Instrument described in Paragraph 2.10, and interim targets to be achieved by 2028.

2.13 The 2023 Plan outlines the role of local authorities in helping it meet both its targets and existing commitments. It also outlines the respective roles of industry, agricultural sectors, and the DfT in providing the coordinated action required to meet both its new, and pre-existing targets and commitments.

Planning Policy

National Policies

2.14 The National Planning Policy Framework (NPPF) (2023) sets out planning policy for England. It states that the purpose of the planning system is to contribute to the achievement of sustainable development, and that the planning system has three overarching objectives, one of which (Paragraph 8c) is an environmental objective:

"to protect and enhance our natural, built and historic environment; including making effective use of land, improving biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy".

2.15 To prevent unacceptable risks from air pollution, Paragraph 180 of the NPPF states that:

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

2.16 Paragraph 191 states:

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

2.17 More specifically on air quality, Paragraph 192 makes clear that:

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

2.18 The NPPF is supported by Planning Practice Guidance (PPG) (Ministry of Housing, Communities & Local Government, 2019), 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 Limit Values. 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, or where the need for emissions reductions has been identified".

2.19 Regarding plan-making, the PPG states:

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

2.20 The role of the local authorities through the LAQM regime is covered, with the PPG stating that a local authority Air Quality Action Plan "*identifies measures that will be introduced in pursuit of the objectives and can have implications for planning*".

2.21 Regarding the need for an air quality assessment, the PPG states that:

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

2.22 The PPG sets out the information that may be required in an air quality assessment, making clear that:

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

2.23 Regarding sites that will operate under an Environmental Permit, PPG states that:

"It is not necessary for air quality assessments that support planning applications to duplicate aspects of air quality assessments that will be done as part of non-planning control regimes, such as under Environmental Permitting Regulations".

2.24 The PPG 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 will need to be locationally specific, will depend on the proposed development and need to be proportionate to the likely impact. It is important that local planning authorities work with applicants to consider appropriate mitigation so as to ensure new development is appropriate for its location and unacceptable risks are prevented".

Local Policies

2.25 The City of Bradford Metropolitan District Council (CBMDC) are currently preparing a new Local Plan. The current draft Local Plan includes two strategic polices (CBMDC, 2020a) and one thematic policy (CBMDC, 2020b) to improve air quality in the area, however these policies mainly refer to road traffic emissions and exposure within new developments, and as such, are not applicable. However, Policy SP1: Delivering Sustainable Development states that:

"A. The Presumption in Favour of Sustainable Development……

e) Ensures that wherever possible development enables the enhancement of the built and natural environment and minimises the adverse environmental impacts of growth, in particular with regards to climate change, air quality, biodiversity and habitats."

2.26 The current CBMDC Core Strategy (CBMDC, 2017) was adopted in July 2017, and within this there is one policy which refers to air quality. Policy EN8 refers to environmental protection and states that:

"Proposals which are likely to cause pollution or are likely to result in exposure to sources of pollution…or risks to safety, will only be permitted if measures can be implemented to minimize pollution and risk to a level that provides a high standard of protection for health, environmental quality and amenity. The following issues require particular attention:

Air Quality: In liaison with partner organisations, the Council will take a proactive approach to maintaining and improving air quality within the District in line with National Air Quality Standards, the European Union limit values and the principles of best practice. Through a range of actions, it will seek to secure a reduction in emissions from sources which contribute to poor air quality. Developments proposals that have the potential to adversely impact on air quality will be required to incorporate measures to mitigate or offset their emissions and impacts, in accordance with the Low Emission Strategy for Bradford and associated guidance documents. In areas where air quality is a matter of concern, development proposals will be required to deliver a positive impact on air quality in the district. Development proposals must not exacerbate air quality beyond acceptable levels; either through poor design or as a consequence of site selection".

Air Quality Action Plans

National Air Quality Plan

2.27 Defra has produced an Air Quality Plan to tackle roadside nitrogen dioxide concentrations in the UK (Defra, 2017); a supplement to the 2017 Plan (Defra, 2018b) was published in October 2018 and sets out the steps Government is taking in relation to a further 33 local authorities where shorter-term exceedances of the limit value were identified. Alongside a package of national measures, the 2017 Plan and the 2018 Supplement require those identified English Local Authorities (or the GLA in the case of London Authorities) to produce local action plans and/or feasibility studies. These plans and feasibility studies must have regard to measures to achieve the statutory limit values within the shortest possible time, which may include the implementation of a Clean Air Zone (CAZ). There is currently no straightforward way to take account of the effects of the 2017 Plan or 2018 Supplement in this assessment; however, consideration has been given to whether there is currently, or is likely to be in the future, a limit value exceedance in the vicinity of the proposed development. This assessment has principally been carried out in relation to the air quality objectives, rather than the limit values that are the focus of the Air Quality Plan.

Local Air Quality Action Plan

2.28 CBMDC has declared four AQMA's for exceedances of the nitrogen dioxide annual mean objective, however the nearest of these is over 900 m from the site.

3 Methodology and Assessment Criteria

Methodology

3.1 Modelling of the existing boiler, the existing CHP plant, and the proposed CHP plant has been undertaken using the ADMS 6 dispersion model, and completed in accordance with the Environmental Permitting Regulations (EPR) (2018). Further details of the modelling methodology, including the modelled scenarios and sensitivity tests that have been carried out, can be found in the supplementary report (see Appendix A3).

3.2 This technical note has been undertaken following the approach developed jointly by EPUK and the IAQM (Moorcroft and Barrowcliffe et al, 2017) to describe the modelled impacts of the proposed CHP. The approach identifies impacts at individual receptors based on the percentage change in concentrations relative to the relevant air quality objective, rounded to the nearest whole number, and the absolute concentration relative to the objective. Table 3-1 sets out the method for determining the impact descriptor for annual mean concentrations at individual receptors, having been adapted from the table presented in the guidance document. For the assessment criterion the term Air Quality Assessment Level or AQAL has been adopted, as it covers all pollutants, i.e. those with and without formal standards. Typically, as is the case for this assessment, the AQAL will be the air quality objective value. Note that impacts may be adverse or beneficial, depending on whether the change in concentration is positive or negative.

Table 3-1: Air Quality Impact Descriptors for Individual Receptors for All Pollutants [a]

Long-Term Average Concentration At Receptor In Assessment Year [b]	Change in concentration relative to AQAL [c]				
	0%	1%	2-5%	6-10%	>10%
75% or less of AQAL	Negligible	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Negligible	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Negligible	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Negligible	Moderate	Substantial	Substantial	Substantial

[a] Values are rounded to the nearest whole number.

[b] This is the "Without Scheme" concentration where there is a decrease in pollutant concentration and the "With Scheme" concentration where there is an increase.

[c] AQAL = Air Quality Assessment Level, which may be an air quality objective, limit or target value, GLA target or an Environment Agency 'Environmental Assessment Level (EAL)'.

Assessment Criteria

3.3 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) and the Air Quality (England) (Amendment) Regulations (2002).

3.4 The assessment focuses on nitrogen dioxide (NO_2). This is the principal pollutant of concern with respect to emissions from plant using natural gas or biogas. Plant using natural gas or desulfurized biogas will not have significant emissions of other pollutants like particulate matter, sulphur dioxide or volatile organic compounds, and emissions of carbon monoxide are considered to be small compared to the environmental standards and not warranting assessment.

3.5 The UK-wide objectives for nitrogen dioxide were to have been achieved by 2005, and continue to apply in all future years thereafter. Measurements across the UK have shown that the 1-hour mean nitrogen dioxide objective is unlikely to be exceeded at roadside locations where the annual mean concentration is below 60 $\mu g/m^3$ (Defra, 2022).

3.6 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. Defra explains where these objectives will apply in its Local Air Quality Management Technical Guidance (Defra, 2022). The annual mean objectives for nitrogen dioxide are considered to apply at the façades of residential properties, schools, hospitals etc.; they do not apply at hotels. The 1-hour mean objective for nitrogen dioxide applies wherever members of the public might regularly spend 1-hour or more, including outdoor eating locations and pavements of busy shopping streets.

3.7 EU Directive 2008/50/EC (The European Parliament and the Council of the European Union, 2008) sets limit values for nitrogen dioxide, and is implemented in UK law through the Air Quality Standards Regulations (2010)[2]. The limit values for nitrogen dioxide are the same numerical concentrations as the UK objectives, but achievement of the limit values is a national obligation rather than a local one and concentrations are reported to the nearest whole number. In the UK, only monitoring and modelling carried out by UK Central Government meets the specification required to assess compliance with the limit values. Central Government does not normally recognise local authority monitoring or local modelling studies when determining the likelihood of the limit values being exceeded, unless such studies have been audited and approved by Defra and DfT's Joint Air Quality Unit (JAQU).

3.8 The relevant air quality criteria for this assessment are provided in Table 3-2.

Table 3-2: Air Quality Criteria for Nitrogen Dioxide

Pollutant	Time Period	Value
Nitrogen Dioxide	1-hour Mean	200 $\mu g/m^3$ not to be exceeded more than 18 times a year
	Annual Mean	40 $\mu g/m^3$

[2] As amended through The Air Quality Standards (Amendment) Regulations 2016 and The Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020.

4 Construction Phase Impact Assessment

Construction Traffic

4.1 It is anticipated that no more than ten heavy vehicles will access the site on any given day, thus the additional heavy vehicle movements on local roads will be well below the 100 AADT screening criterion recommended by EPUK/IAQM guidance (Moorcroft and Barrowcliffe et al, 2017). It is, therefore, not considered necessary to assess the impacts of traffic emissions during the construction phase and it can be concluded that the proposed development will not have a significant impact on local roadside air quality as a result of construction traffic emissions.

On-Site Exhaust Emissions

4.2 The IAQM guidance (IAQM, 2024) states:

"Experience of assessing the exhaust emissions from on-site plant (also known as non-road mobile machinery or NRMM) and site traffic suggests that they are unlikely to make a significant impact on local air quality, and in the vast majority of cases they will not need to be quantitatively assessed. For site plant and on-site traffic, consideration should be given to the number of plant/vehicles and their operating hours and locations to assess whether a significant effect is likely to occur".

4.3 The location of the site in which the proposed CHP plant is proposed is relatively small and the areas within it in which NRMM and site traffic will typically operate at a distance which will be maximised as far as possible from any sensitive properties. It is judged that there no risk of significant effects at existing receptors as a result of on-site machinery emissions.

Construction Dust

4.4 The proposals include the demolition of one building and the additional removal of a roof. Since the building to be demolished is small (under 600 m^2 in area), it is not expected to produce any significant adverse effects, and the impact from construction phase dust can be screened out. In addition, it is expected that best practice dust management measures will be in place during the works.

5 Operational Phase Impact Assessment

Impacts at Existing Receptors

Assessment of Development-Generated Road Traffic Emissions

5.1 The proposed CHP unit will not cause an increase in operational phase road traffic. As such, it is judged that the relevant screening thresholds will not be exceeded and there is no requirement for a detailed assessment of road traffic impacts at existing receptors; it can be concluded that the proposed development will not have a significant impact on local roadside air quality.

5.2 Additionally, efforts to improve air quality at the site have been implemented, including the replacement of twelve diesel forklifts, to electric forklifts.

Detailed Assessment of Energy Plant Emissions

5.3 A detailed assessment of the proposed CHP plant has been undertaken which modelled the impacts of the proposed CHP unit. Full details of the technical methodology, and results, are outlined within the detailed report (see Appendix A3).

5.4 The purpose of this Section is to assess the impacts of the proposed CHP unit following the IAQM guidance.

5.5 The predicted annual mean nitrogen dioxide concentrations at each existing receptor, including emissions from the existing energy plant, are shown in the baseline in Table 5-1. Concentrations have been predicted through use of five years of historic meteorological data and selecting receptor specific maxima for each receptor. The concentrations shown for "With Plant" are the emissions from the proposed plant plus the baseline concentrations. Concentrations have been calculated following the methodology set out in the supplementary report (Appendix A3). The impact descriptors have been determined following the methodology set out in Section 3.

Table 5-1: Predicted Annual Mean Nitrogen Dioxide (NO_2) Concentrations (µg/m^3)

Receptor	Baseline	"With Plant"	% Change [a]	Impact Descriptor
1	28.3	29.1	3	Negligible
2	28.4	28.9	2	Negligible
3	28.4	29.0	2	Negligible
4	28.4	29.1	2	Negligible
5	28.4	29.3	3	Negligible
6	28.5	29.8	5	Negligible
7	28.6	30.0	5	Negligible
8	28.8	29.9	4	Negligible
9	28.3	29.2	3	Negligible
10	28.4	30.0	5	Negligible
11	28.6	30.1	5	Negligible

Receptor	Baseline	"With Plant"	% Change [a]	Impact Descriptor
12	28.8	30.1	4	Negligible
13	28.4	29.2	3	Negligible
14	28.3	28.8	2	Negligible
15	28.1	28.2	0	Negligible
16	28.1	28.2	0	Negligible
17	28.7	29.4	3	Negligible
18	31.8	32.2	1	Negligible
19	28.5	28.9	1	Negligible
20	31.8	32.2	1	Negligible
21	28.4	28.6	1	Negligible
22	28.3	28.5	1	Negligible
23	28.3	28.5	1	Negligible
24	28.3	28.5	1	Negligible
25	28.3	28.5	1	Negligible
26	31.6	31.8	1	Negligible
27	28.3	28.6	1	Negligible
28	28.2	28.4	1	Negligible
29	28.2	28.3	0	Negligible
30	28.2	28.4	1	Negligible
31	28.1	28.2	0	Negligible
32	28.1	28.3	1	Negligible
33	28.1	28.1	0	Negligible
34	31.6	31.8	1	Negligible
35	28.3	28.6	1	Negligible
36	31.5	31.7	1	Negligible
37	28.1	28.3	0	Negligible
38	31.8	32.2	1	Negligible
39	31.7	32.0	1	Negligible
40	31.6	31.9	1	Negligible
41	28.2	28.4	1	Negligible
42	28.2	28.4	1	Negligible

Receptor	Baseline	"With Plant"	% Change [a]	Impact Descriptor
Objective	40	-	-	

[a] % changes are relative to the objective and have been rounded to the nearest whole number.

5.6 The annual mean nitrogen dioxide concentrations are well below the objective at all receptors.

5.7 The percentage changes in concentrations, relative to the air quality objective (when rounded), are predicted to be 1% at 21 of the receptors, 2-5 % at 15 of the receptors, and 0 % at 6 receptors. Using the matrix in Table 3-1, these impacts are described as negligible.

Significance of Operational Air Quality Effects

5.8 The operational air quality effects without mitigation are judged to be 'not significant'. This professional judgement is made in accordance with the methodology set out in Appendix A1, and takes account of the assessment that pollutant concentrations at all of the selected worst-case existing receptors will be well below the air quality objectives, and all of the impacts are predicted to be negligible.

6 Conclusions

6.1 The assessment has considered the impacts of the proposed development on local air quality in terms of emissions from the proposed CHP unit.

6.2 The assessment has demonstrated that pollutant concentrations are well below the objectives at all existing receptors, with or without the proposed CHP plant, and that the emissions from the additional CHP unit will have a negligible impact on air quality conditions at all existing receptors at nearby receptors.

6.3 The overall operational air quality effects of the proposed CHP unit are judged to be 'not significant'.

6.4 Taking into account these conclusions, it is judged that the proposed development is consistent with Paragraph 191 of the NPPF, being appropriate for its location in terms of its effects on the local air quality environment. It is also consistent with Paragraph 192, as it will not affect compliance with relevant limit values or national objectives. The proposed development is also consistent with Policy EN8 of BCC's adopted local plan, as it will not have a significant detrimental effect on air quality.

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8 Glossary

AADT	Annual Average Daily Traffic
ADMS-6	Atmospheric Dispersion Modelling System model for point sources
AQAL	Air Quality Assessment Level
AQC	Air Quality Consultants
AQMA	Air Quality Management Area
CAZ	Clean Air Zone
CHP	Combined Heat and Power
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
EPUK	Environmental Protection UK
EU	European Union
EV	Electric Vehicle
Exceedance	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
HDV	Heavy Duty Vehicles (> 3.5 tonnes)
HMSO	His Majesty's Stationery Office
IAQM	Institute of Air Quality Management
JAQU	Joint Air Quality Unit
kW	Kilowatt
LAQM	Local Air Quality Management
LDV	Light Duty Vehicles (<3.5 tonnes)
$\mu g/m^3$	Microgrammes per cubic metre
MCPD	Medium Combustion Plant Directive
MW_{th}	Megawatts Thermal
NO	Nitric oxide
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides (taken to be NO_2 + NO)
NPPF	National Planning Policy Framework

NRMM	Non-road Mobile Machinery
OEP	Office for Environmental Protection
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
OLEV	Office for Low Emission Vehicles
PC	Process Contribution
PEC	Predicted Environmental Concentration
PPG	Planning Practice Guidance
Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal

9 Appendices

A1 EPUK & IAQM Planning for Air Quality Guidance

A1.1 The guidance issued by EPUK and IAQM (Moorcroft and Barrowcliffe et al, 2017) is comprehensive in its explanation of the place of air quality in the planning regime. Key sections of the guidance not already mentioned above are set out below.

Air Quality as a Material Consideration

"Any air quality issue that relates to land use and its development is capable of being a material planning consideration. The weight, however, given to air quality in making a planning application decision, in addition to the policies in the local plan, will depend on such factors as:

- the severity of the impacts on air quality;
- the air quality in the area surrounding the proposed development;
- the likely use of the development, i.e. the length of time people are likely to be exposed at that location; and
- the positive benefits provided through other material considerations".

Recommended Best Practice

A1.2 The guidance goes into detail on how all development proposals can and should adopt good design principles that reduce emissions and contribute to better air quality management. It states:

"The basic concept is that good practice to reduce emissions and exposure is incorporated into all developments at the outset, at a scale commensurate with the emissions".

A1.3 The good practice principles are that:

- New developments should not contravene the Council's Air Quality Action Plan, or render any of the measures unworkable;
- Delivering sustainable development should be the key theme of any application;
- All gas-fired boilers to meet a minimum standard of <40 mgNOx/kWh;
- Where emissions are likely to impact on an AQMA, all gas-fired CHP plant to meet a minimum emissions standard of:
  - Spark ignition engine: 250 mgNOx/Nm^3;
  - Compression ignition engine: 400 mgNOx/Nm^3;
  - Gas turbine: 50 mgNOx/Nm^3.
- A presumption should be to use natural gas-fired installations. Where biomass is proposed within an urban area it is to meet minimum emissions standards of 275 mgNOx/Nm^3 and 25 mgPM/Nm^3.

A1.4 The guidance also outlines that offsetting emissions might be used as a mitigation measure for a proposed development. However, it states that:

"It is important that obligations to include offsetting are proportional to the nature and scale of development proposed and the level of concern about air quality; such offsetting can be based on a quantification of the emissions associated with the development. These emissions can be assigned

a value, based on the "damage cost approach" used by Defra, and then applied as an indicator of the level of offsetting required, or as a financial obligation on the developer. Unless some form of benchmarking is applied, it is impractical to include building emissions in this approach, but if the boiler and CHP emissions are consistent with the standards as described above then this is not essential".

Screening

Impacts of the Local Area on the Development

"There may be a requirement to carry out an air quality assessment for the impacts of the local area's emissions on the proposed development itself, to assess the exposure that residents or users might experience. This will need to be a matter of judgement and should take into account:

- the background and future baseline air quality and whether this will be likely to approach or exceed the values set by air quality objectives;
- the presence and location of Air Quality Management Areas as an indicator of local hotspots where the air quality objectives may be exceeded;
- the presence of a heavily trafficked road, with emissions that could give rise to sufficiently high concentrations of pollutants (in particular nitrogen dioxide), that would cause unacceptably high exposure for users of the new development; and
- the presence of a source of odour and/or dust that may affect amenity for future occupants of the development".

Impacts of the Development on the Local Area

A1.5 The guidance sets out two stages of screening criteria that can be used to identify whether a detailed air quality assessment is required, in terms of the impact of the development on the local area. The first stage is that you should proceed to the second stage if any of the following apply:

- 10 or more residential units or a site area of more than 0.5 ha residential use; and/or
- more than 1,000 m^2 of floor space for all other uses or a site area greater than 1 ha.

A1.6 Coupled with any of the following:

- the development has more than 10 parking spaces; and/or
- the development will have a centralised energy facility or other centralised combustion process.

A1.7 If the above do not apply then the development can be screened out as not requiring a detailed air quality assessment of the impact of the development on the local area. If they do apply then you proceed to stage 2, which sets out indicative criteria for requiring an air quality assessment. The stage 2 criteria relating to vehicle emissions are set out below:

- the development will lead to a change in LDV flows of more than 100 AADT within or adjacent to an AQMA or more than 500 AADT elsewhere;
- the development will lead to a change in HDV flows of more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere;
- the development will lead to a realigning of roads (i.e. changing the proximity of receptors to traffic lanes) where the change is 5m or more and the road is within an AQMA;

- the development will introduce a new junction or remove an existing junction near to relevant receptors, and the junction will cause traffic to significantly change vehicle acceleration/deceleration, e.g. traffic lights or roundabouts;
- the development will introduce or change a bus station where bus flows will change by more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere; and
- the development will have an underground car park with more than 100 movements per day (total in and out) with an extraction system that exhausts within 20 m of a relevant receptor.

A1.8 The criteria are more stringent where the traffic impacts may arise on roads where concentrations are close to the objective. The presence of an AQMA is taken to indicate the possibility of being close to the objective, but where whole authority AQMAs are present and it is known that the affected roads have concentrations below 90% of the objective, the less stringent criteria are likely to be more appropriate.

A1.9 On combustion processes (including standby emergency generators and shipping) where there is a risk of impacts at relevant receptors, the guidance states that:

"Typically, any combustion plant where the single or combined NOx emission rate is less than 5 mg/sec is unlikely to give rise to impacts, provided that the emissions are released from a vent or stack in a location and at a height that provides adequate dispersion. As a guide, the 5 mg/s criterion equates to a 450 kW ultra-low NOx gas boiler or a 30kW CHP unit operating at <95mg/Nm^3.

In situations where the emissions are released close to buildings with relevant receptors, or where the dispersion of the plume may be adversely affected by the size and/or height of adjacent buildings (including situations where the stack height is lower than the receptor) then consideration will need to be given to potential impacts at much lower emission rates.

Conversely, where existing nitrogen dioxide concentrations are low, and where the dispersion conditions are favourable, a much higher emission rate may be acceptable".

A1.10 Should none of the above apply then the development can be screened out as not requiring a detailed air quality assessment of the impact of the development on the local area, provided that professional judgement is applied; the guidance importantly states the following:

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

A1.11 Even if a development cannot be screened out, the guidance is clear that a detailed assessment is not necessarily required:

"The use of a Simple Assessment may be appropriate, where it will clearly suffice for the purposes of reaching a conclusion on the significance of effects on local air quality. The principle underlying this guidance is that any assessment should provide enough evidence that will lead to a sound conclusion on the presence, or otherwise, of a significant effect on local air quality. A Simple Assessment will be appropriate, if it can provide this evidence. Similarly, it may be possible to conduct a quantitative assessment that does not require the use of a dispersion model run on a computer".

A1.12 The guidance also outlines what the content of the air quality assessment should include, and this has been adhered to in the production of this report.

Assessment of Significance

A1.13 There is no official guidance in the UK in relation to development control on how to describe the nature of air quality impacts, nor how to assess their significance. The approach within the EPUK/IAQM guidance has, therefore, been used in this assessment. This approach involves a two stage process:

- a qualitative or quantitative description of the impacts on local air quality arising from the development; and
- a judgement on the overall significance of the effects of any impacts.

A1.14 The guidance recommends that the assessment of significance should be based on professional judgement, with the overall air quality impact of the development described as either 'significant' or 'not significant'. In drawing this conclusion, the following factors should be taken into account:

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

A1.15 The guidance is clear that other factors may be relevant in individual cases. It also states that the effect on the residents of any new development where the air quality is such that an air quality objective is not met will be judged as significant. For people working at new developments in this situation, the same will not be true as occupational exposure standards are different, although any assessment may wish to draw attention to the undesirability of the exposure.

A1.16 A judgement of the significance should be made by a competent professional who is suitably qualified. A summary of the professional experience of the staff contributing to this assessment is provided in Appendix A2.

A2 Professional Experience

Laurence Caird, MEarthSci CSci MIEnvSc MIAQM

A2.1 Mr Caird is a Technical Director with AQC, with 17 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, dust, greenhouse gas emissions and climate change. Mr Caird has worked with a wide variety of clients to provide expert air quality services and advice, including local authorities, planners, developers and process operators. Mr Caird has provided expert advice and acted as expert witness in relation to matters relating to air quality, odours and climate change at a number of Planning Inquiries. He is a Member of the Institute of Air Quality Management (and a former IAQM Committee Member) and is a Chartered Scientist.

Anna McMahon, BSc (Hons) MSc CEnv MIEnvSc MIAQM

A2.2 Ms McMahon is a Principal Consultant with AQC with over ten years' relevant experience. She has undertaken air quality assessments for a range of sectors including residential, commercial, industrial and highways. She has extensive experience of quantitative methods to assess road traffic and stationary source emissions utilising detailed dispersion modelling software such as ADMS Roads, ADMS-5 and Breeze AERMOD, for both planning and permitting purposes. She also has experience in ambient air quality monitoring, the analysis and interpretation of air quality monitoring data, the assessment of nuisance dust and odours and indoor air quality for BREEAM. Anna is a Member of the Institute of Air Quality Management and is a Chartered Environmentalist.

Dr Jessica Muirhead, BSc (Hons), MSc, PhD, CSci, MIEnvSci, MIAQM

A2.3 Dr Muirhead is an Associate Director with AQC with over 18 years experience in Air Quality consultancy. Prior to joining AQC in 2024, she spent eleven years at AECOM leading the Air Quality Team's Urban Regeneration and Solar Farm work streams. She has been responsible for delivering numerous air quality assessments for planning applications and Development Consent Orders (DCOs) including Environmental Impact Assessments (EIAs) across London and the UK. She spent a year as Technical Advisor to the Greater London Authority delivering training workshops to the London Boroughs, reviewing referrable planning applications and responding to queries on air quality positive and air quality neutral. Jess also has extensive experience providing technical peer reviews for a number of Planning Authorities in the UK, and for The Royal Commission for Al Ula in Saudi Arabia.

Faye Wilder, BSc (Hons) MSc

A2.4 Miss Wilder is an Assistant Consultant with AQC and joined the company in 2023. During her BSc Geography degree at the University of Birmingham, she developed an interest in air quality, which continued into her MSc in Environmental Management at the University of Reading. Her master's thesis investigated personal air pollution exposure across microenvironments using wearable air pollution sensors, and how this varied from fixed air pollution monitoring stations.

A3 Air Quality Assessment for Environmental Permit

Air Quality Consultants

Air Quality Assessment for Environmental Permit: Haworth Scouring

August 2024

Experts in air quality management & assessment

Document Control

Client	Haworth Scouring Company	Principal Contact	Steve Dobinson (2G Energy Limited)

Job Number	J10-13244C-10

Report Prepared By:	Anna McMahon and Faye Wilder

Document Status and Review Schedule

Report No.	Date	Status	Reviewed by
J10-13244C-10/1/F1	14 August 2024	Final	Laurence Caird (Technical Director) and Jess Muirhead (Associate Director)

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Contents

Tables

Figures

1 Introduction

1.1 This report describes the air quality assessment for the proposed Combined Heat and Power (CHP) plant at Haworth Scouring Company, in Bradford. The assessment has been prepared to support the Bespoke Environmental Permit application for the facility, which is made in accordance with the Environmental Permitting Regulations (EPR) (2018). The assessment has been carried out by Air Quality Consultants Ltd on behalf of Haworth Scouring Company.

1.2 The facility currently comprises of one CHP unit and a single boiler, both fuelled by natural gas. The existing plant is used for the drying process, to provide hot water and steam for the industrial washing water and for some space heating. The existing CHP unit and proposed CHP unit, together, are classified a Tranche B specified generator. The site currently holds a Bespoke Environmental Permit which includes the existing boiler and CHP unit. A permit variation will be required to include the proposed CHP unit which will run on biogas. The detailed air dispersion modelling, which a bespoke environmental permit variation requires, is described in this report.

1.3 The assessment focuses on nitrogen dioxide (NO_2). This is the principal pollutant of concern with respect to emissions from plant using natural gas or biogas. Plant using natural gas or desulfurized biogas will not have significant emissions of other pollutants like particulate matter, sulphur dioxide or volatile organic compounds, and emissions of carbon monoxide are considered to be small compared to the environmental standards and not warranting assessment.

1.4 Table 1 gives the site location. Table 2 summarises the modelled scenarios and sensitivity tests that have been carried out. All sources, the existing boiler, existing CHP unit and proposed CHP unit, have been modelled. The contribution from the existing boiler is also included in the background concentrations, which are taken from 2022 monitoring data[1], so the impacts from the existing plant will be somewhat double-counted, thus providing a worst-case assessment.

1.5 The model input files have been packaged as a zip file and sent alongside this report.

Table 1: Site Location

Parameter	Entry
Site Name	Haworth Scouring Company
Site Address	Shelby House, Cashmere Works, Birksland St, Bradford BD3 9SX
Grid Reference (O.S. X,Y) [a]	417900, 432700

[1] Some contribution from the existing CHP unit is also expected as this was installed later in 2022 but will not have been operational for the whole year.

[a] The coordinates refer to the centre of the site, not the point of release, as there are three release locations.

Table 2: Summary of Model Scenarios and Sensitivity Tests

Parameter	Entry
Sources	The dispersion model has been run to predict concentrations relating to emissions from the existing boiler and CHP plant, and the proposed CHP plant separately, as well as the combined effect of all sources.
Year for Baseline Conditions	Most recent year of available measurements/predictions – no improvement assumed into the future (see Section 5)
Operating Hours	**Existing Boiler:** Operational 24 hours, 5 days a week and 47 weeks a year, totalling 5,640 hours per year. **Existing CHP Plant:** Operational 5,360 hours per year. **Proposed CHP Plant:** Operational 5,360 hours per year. The dispersion model has been run assuming continuous operation, with the annual mean outputs scaled to reflect the non-continuous use. Short-term outputs have assumed constant operation and are thus worst-case (see Paragraphs 6.23 and 6.24)
Meteorological Conditions	Five years of meteorological data used. Each modelled separately. Receptor-specific maxima out of the five years are reported (see Section 6)
Building Wake Effects	Model run with and without nearby buildings. Receptor-specific maxima from the two tests are reported (see Section 6)

2 Site Description

Nearby Sensitive Features

2.1 The site is situated in Bradford, 1.3 km east of the city centre. Figure 1 shows the site location, local authority Air Quality Management Areas (AQMA), 2 km and 10 km distance bands and designated ecological sites of relevance. Figure 2 presents the same information but focussing on the area within 2 km of the site only. Table 3 summarises the proximity of nearby sensitive features. There are no Sites of Special Scientific Interest (SSSIs) within 2 km of the site and no Special Areas of Conservation (SACs), Special Protection Areas (SPAs), or Ramsar sites within 10 km of the site. Following guidance from the EA, there is thus no need to consider effects on sensitive ecosystems (EA, 2023b).

2.2 Based on publicly available information, there are no known permitted Specified Generator arrays operating within 1 km of the site. No sources of emissions to air are identified within 1 km on the UK Pollutant Release and Transfer Register (PRTR) (Defra, 2012).

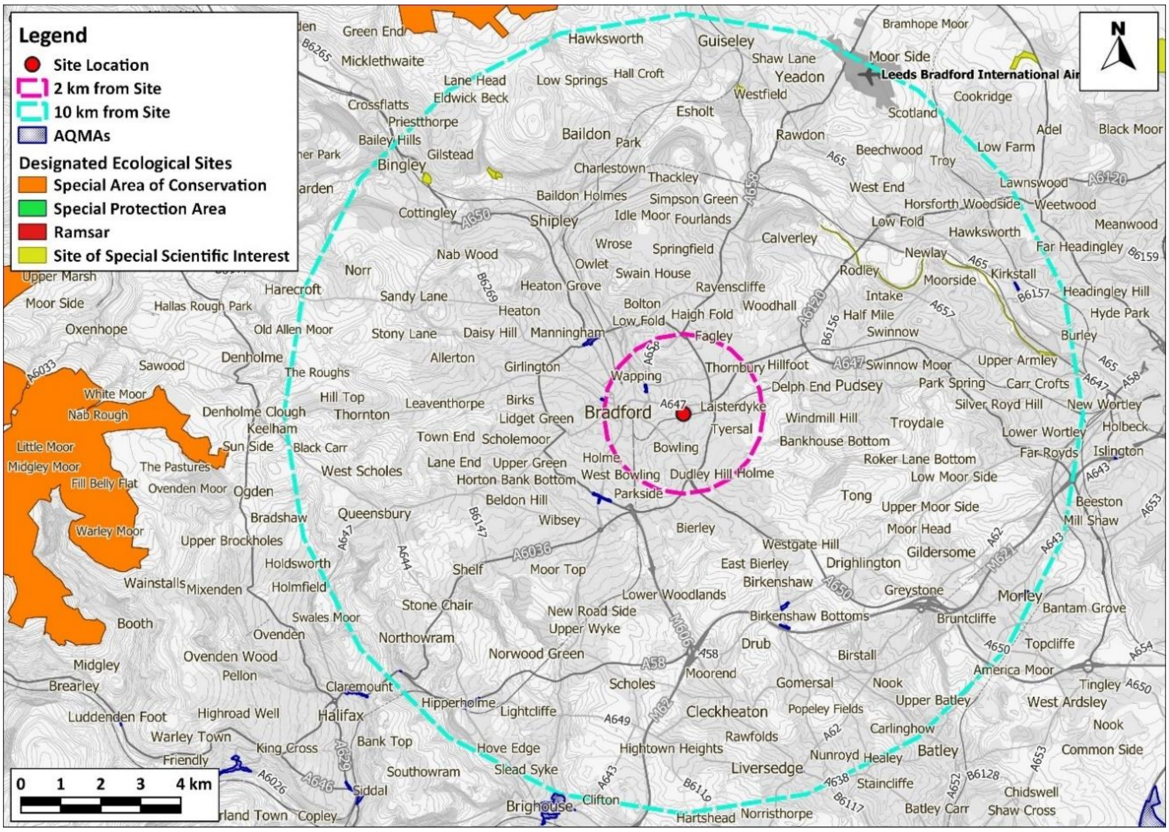

Figure 1: Site Location, AQMAs, SACs, SPAs, Ramsar Sites and SSSIs Within 10 km

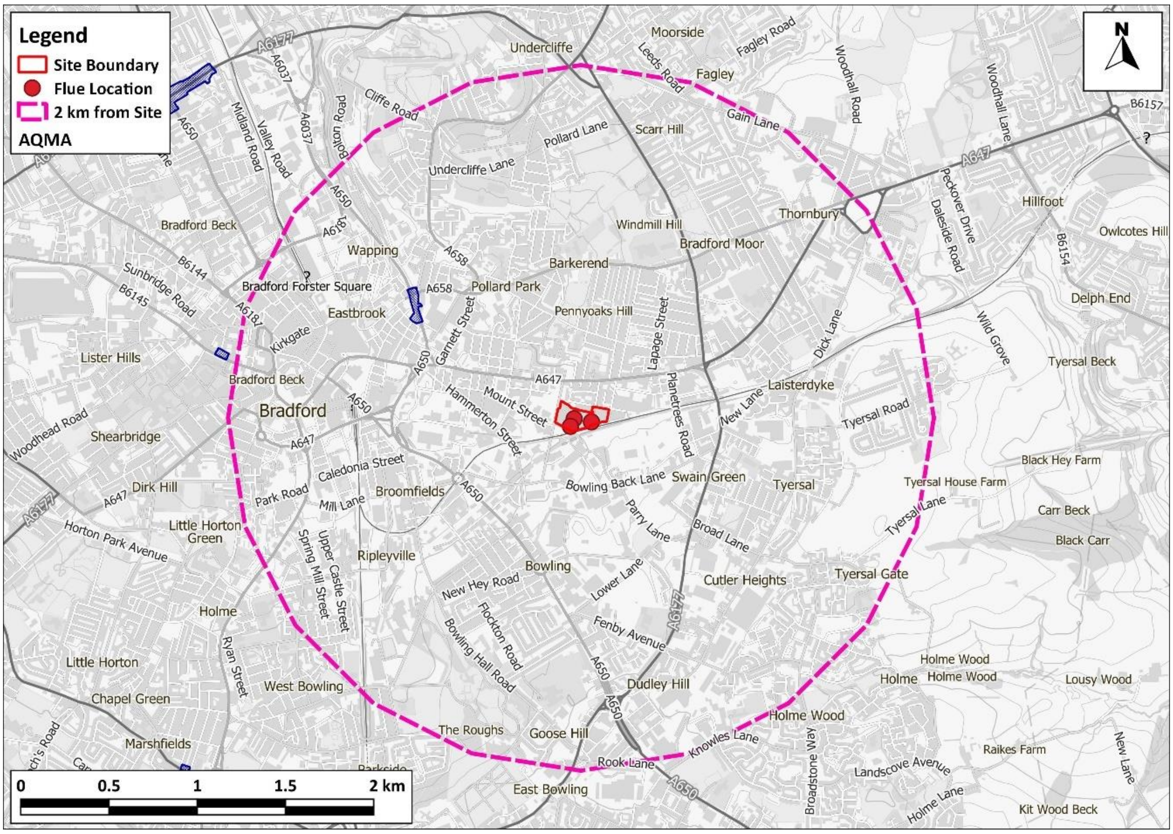

Figure 2: Site Location and AQMAs Within 2 km

Table 3: Summary of Nearby Sensitive Features

Feature	Description	Distance from Stack
Nearest roadside human receptor	Residential property off A647 Leeds Road, north of site	340 m
Nearest non-roadside human receptor	Residential property off Gibson Street, north of site	140 m
Nearest SSSI	The Leeds – Liverpool Canal SSSI	5,820 m
Nearest SAC, SPA, or Ramsar site	South Pennine Moors SAC	10,500 m
Receptors within the downwash cavity length from the nearest edge/side of the building?	There are receptors on Sewell Road and Gibson Street downwind of the building within the region of potential downwash effects (170 m)	120 m
Sensitive receptor setting	Urban	n/a
Sensitive receptors near an A road or motorway network?	Residential properties off A647 Leeds Road, north of site	310 m
Sensitive receptors within an AQMA declared for NO_2?	Residential property in AQMA No. 4, off Shipley Airedale Road, northwest of site	1,025 m

Topography and Terrain

2.3 Figure 3 shows the terrain across the modelled study area using Ordnance Survey (OS) Terrain 50 data. Gradients within 1 km of the site are generally less than 1 in 10, but there are some steeper gradients at greater distances and within the modelled domain.

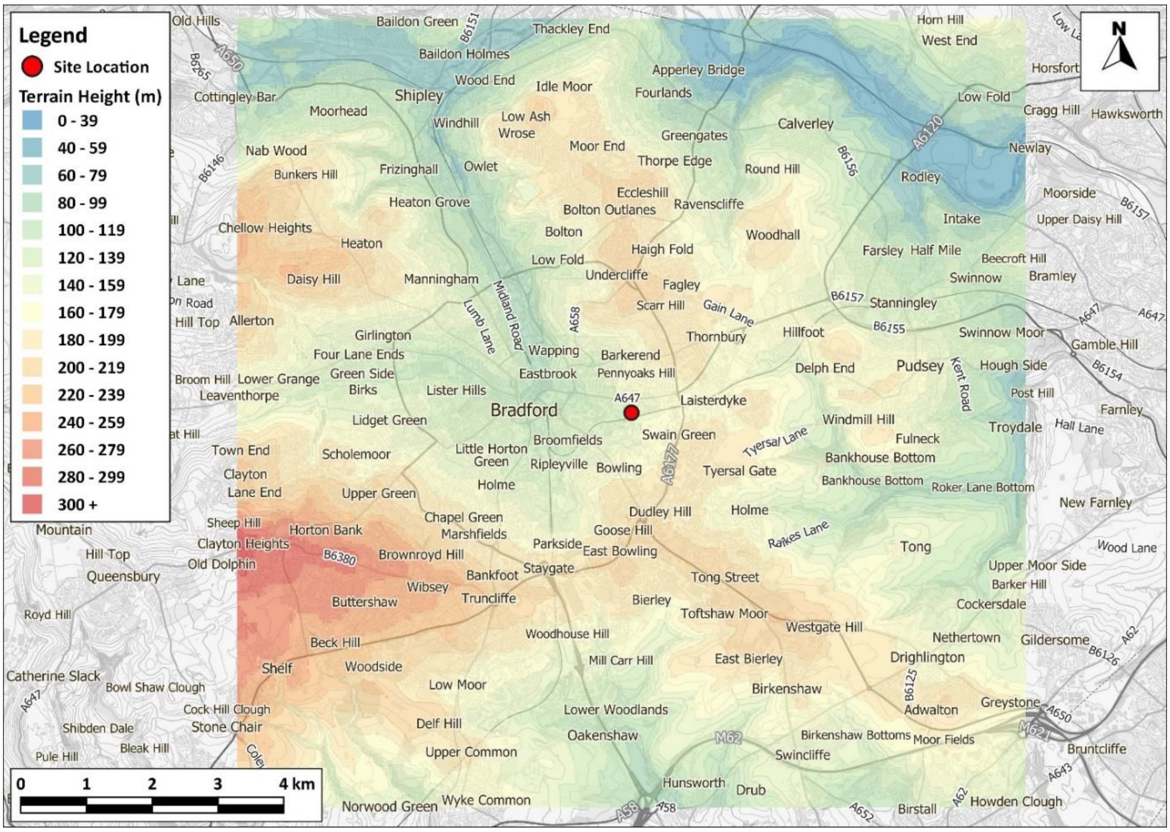

Figure 3: Terrain across Modelled Area

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3 Description of Process

Overview of New Plant Requiring Permit Variation

3.1 The proposed biogas-fired CHP plant has a net thermal input capacity of 1,320 kW (1,464.7 kW gross thermal input). The combustion gases from the proposed CHP unit will be exhausted from a vertical flue terminating 10 m above ground level.

3.2 Figure 4 shows the site and existing and proposed flue locations. Basic plant details for the proposed CHP are given in Table 4 and Table 5.

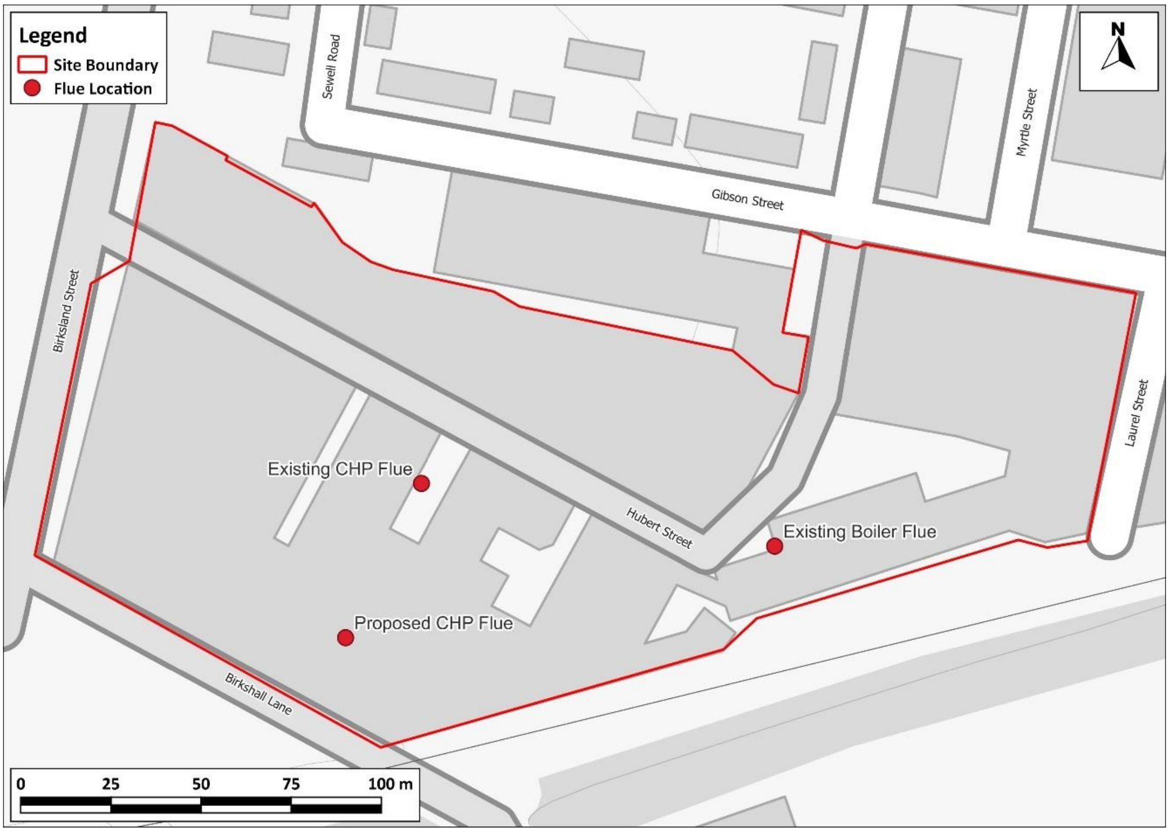

Figure 4: Site Layout

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Table 4: Plant Information – Proposed CHP

Parameter	Value
Specified generator usage type category	CHP
Mixed Tranche A and B Specified Generator site?	Yes

Specified generators aggregated rated thermal input	1320 kW
Operational hours per year	5,360
If 'Peaking' or 'Balancing', is rolling average flexibility required?	No
Existing or new medium combustion plant generators?	New
Do the generators have secondary abatement fitted?	No
Emission Limit Value (273 K, dry and 15% O_2)	190 mg/Nm^3

Table 5: Stack and Building Information

Parameter	Value
Stack height above ground	10 m
Internal flue diameter at point of release	250 mm
Is there one or more buildings within 5L and with heights more than 40% of the stack height?	Yes
Height of tallest building within 5L	33 m
Length of tallest building within 5L	6 m
Width of tallest building within 5L	6 m

Additional Details

3.3 The facility currently comprises a gas-fired boiler which is controlled through an existing permit. This boiler has an approximate net thermal input capacity of ~2,909 kWth (~3,222 kWth gross thermal input)[2]. The boiler is used to generate hot water and steam for both the wash and rinse bowls of the scouring process and the drying oven to dry the cleaned wool fibre as well as facilitate the effluent treatment plant on-site. Emissions from the boiler are vented through a 20 m high stack.

3.4 The facility also includes a natural gas-fired CHP unit which is also controlled through the existing permit. The existing CHP unit has an approximate net thermal input capacity of 3,557 kWth (3,940 kWth gross thermal input). The CHP plant is used to provide electricity for the process and provide hot water and steam for the industrial washing water boiler. Emissions from the boiler are vented through a 34 m high stack.

3.5 Full details of existing plant are included in the modelling methodology section of this report (Section 6).

2 The exact specification for the boiler is not known. Therefore, the emission and physical parameters have been calculated based on a number of conservative assumptions detailed in Section 6.

4 Environmental Standards for Air

4.1 The relevant Air Quality Standards (AQS) for human health impacts are set out in Table 6 (EA, 2023a).

Table 6: AQS for Human Health

Pollutant	Averaging Period	AQS (µg/m^3)	Acceptable Exceedance Criteria
NO_2	Annual Mean	40	Zero exceedances
	1-hour	200	Not to be exceeded more than 18 times a year

4.2 The AQS for NO_2 are defined as UK objectives within the Air Quality (England) Regulations (2000) and the Air Quality (England) (Amendment) Regulations (2002). The same numerical values are also set as European Limit values (The European Parliament and the Council of the European Union, 2008).

4.3 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. Defra explains where these objectives will apply in its Local Air Quality Management Technical Guidance (Defra, 2022) . The annual mean objectives are considered to apply at the façades of residential properties, schools, hospitals etc.; they do not apply at hotels. The 1-hour mean objective for nitrogen dioxide applies wherever members of the public might regularly spend 1-hour or more, including outdoor eating locations and pavements of busy shopping streets. In the UK, only monitoring and modelling carried out by UK Central Government meets the specification required to assess compliance with the limit values and specific monitor and receptor siting requirements apply. Neither the objectives nor limit values apply in places of work where members of the public have no free access and where relevant provisions concerning health and safety at work apply (AQC, 2016).

5 Baseline Conditions

Human Health

5.1 Figure 5 sets out the background annual mean NO_2 concentrations in the study area taken from Defra's published maps for 2024 (Defra, 2021). Figure 6: Measured Annual Mean NO2 Concentrations (µg/m3)Figure 6 shows the annual mean NO_2 concentrations in the study area as measured by City of Bradford Metropolitan District Council (BMDC) in 2022, which is the most recent year for which the Council has published its measurements. Measurements made by BMDC are also tabulated in Table 7.

5.2 Monitored concentrations at DT209A/B/C have been considered to be suitably representative of concentrations at roadside locations around the site. Higher roadside concentrations have been measured elsewhere in the model domain, but not close to locations where significant effects are possible. Specifically, monitoring sites CM6 and DT12A/B/C recorded higher concentrations than DT209A/B/C in recent years; however these are located in the Airedale Road AQMA, 900 m away from the site, and are not representative of concentrations at receptors nearer to the site, outside the AQMA. Concentrations from DT209A/B/C have therefore informed the roadside baseline concentrations in this assessment. The most recent year of monitoring data (2022) shows annual mean NO_2 concentrations at the DT209A/B/C was 31.3 µg/m^3.

5.3 Monitored concentrations at DT201 have been considered suitably representative of concentrations at urban background locations around the site. Whilst DT201 is a roadside monitor, it is not located on a busy main road and is considered more representative of the non-roadside receptors near to the site than BMDC urban background monitoring locations which are over 3.9 km from the site. The most recent year of monitoring data (2022) for DT201 measured an annual mean NO_2 concentration of 28.0 µg/m^3. This compares with the Defra mapped concentration of 16.3 µg/m^3 at the same location and thus the measured concentration at DT201 is considered to be more conservative.

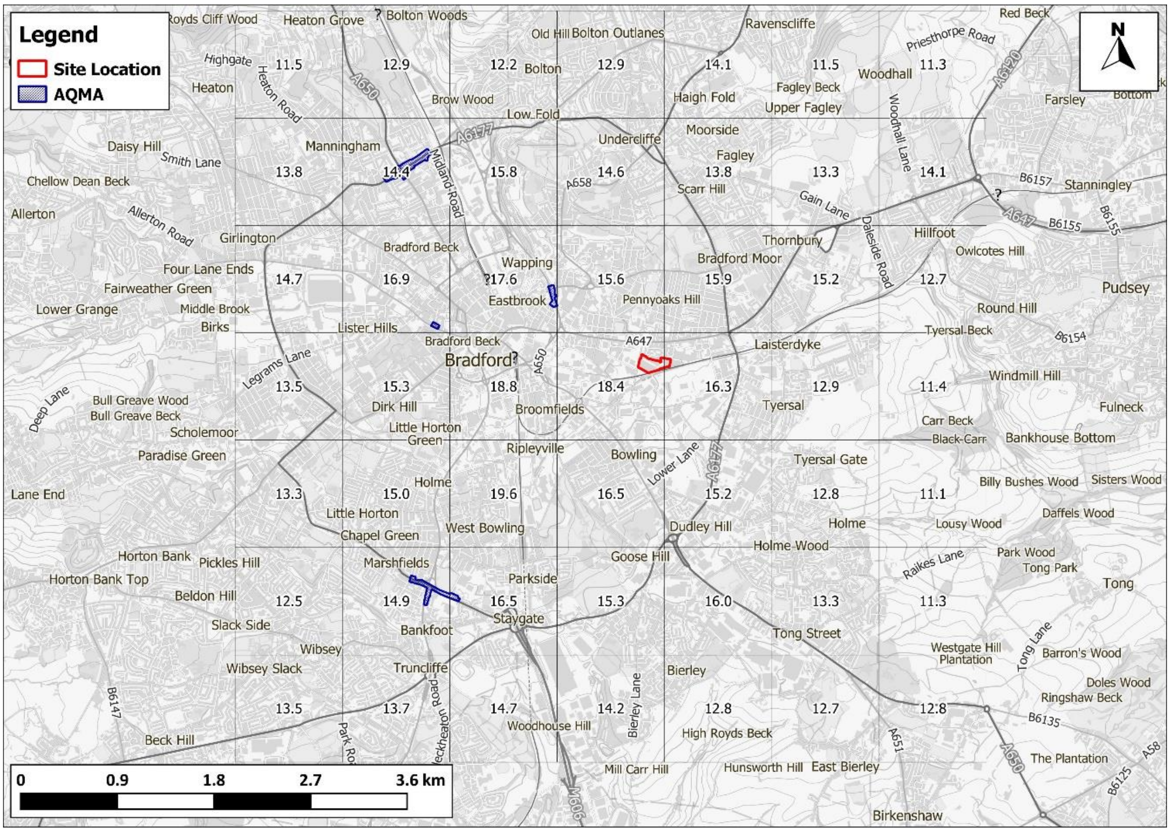

Figure 5: Defra’s Predicted NO_2 Background Concentrations in the Area Surrounding the Site (µg/m^3)

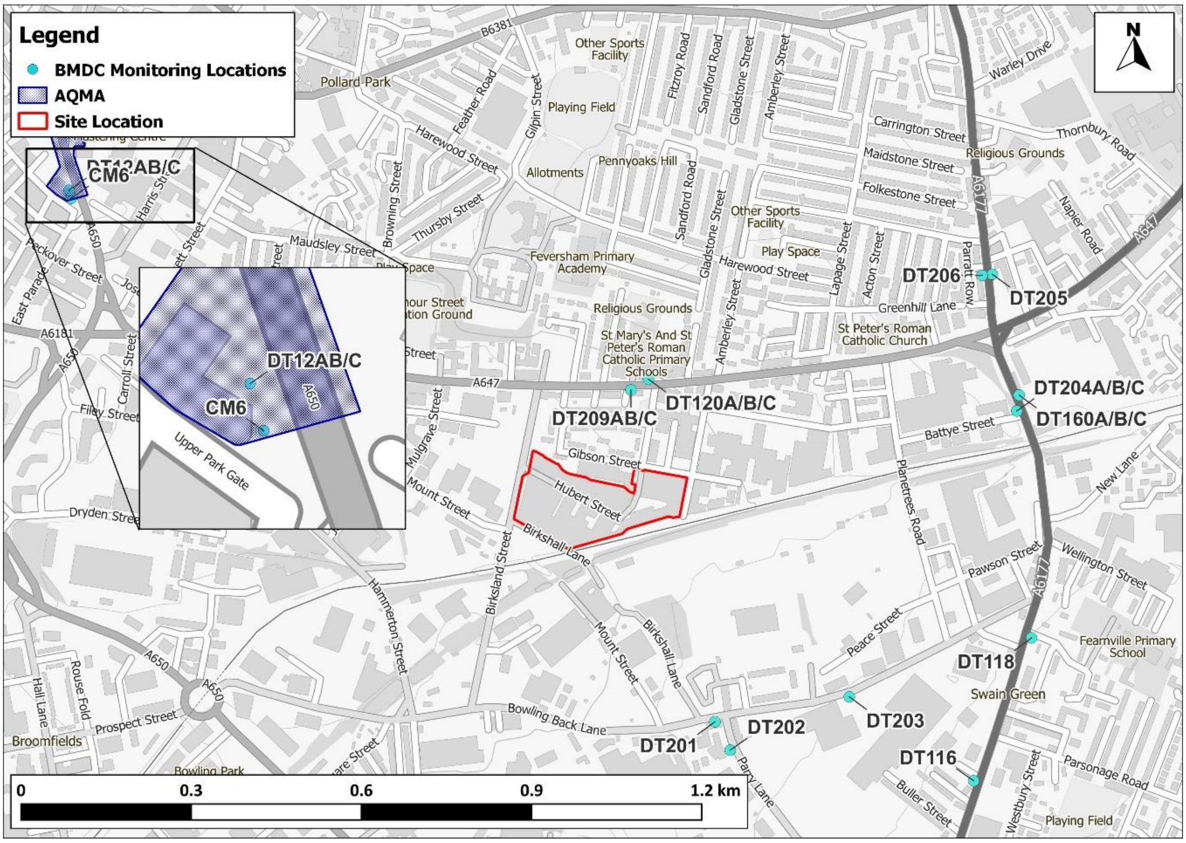

Figure 6: Measured Annual Mean NO_2 Concentrations (μg/m^3)

Table 7: Summary of NO_2 Monitoring (2018-2022) [a]

Site No.	Site Type	Location	2018	2019	2020	2021	2022
Automatic Monitor - Annual Mean (µg/m^3)							
CM6	Roadside	Shipley Airedale Road	**48**	**46**	38	**41**	37
Objective			**40**				
Automatic Monitor - No. of Hours > 200 µg/m^3 [b]							
CM6	Roadside	Shipley Airedale Road	0	0	0	0 (99.7)	0
Objective			**18 (200)**				
Diffusion Tubes - Annual Mean (µg/m^3) [c]							
DT116	Roadside	Sticker Lane lp41	27	24	18.9	20.6	22.6
DT118	Roadside	Fearnville Drive lp1	27	27	20.5	22.1	24.1
DT201	Roadside	Bowling Back Lane / Parry Lane	-	-	-	30	28
DT202	Roadside	Parry Lane LP2	-	-	-	22	21.2
DT203	Roadside	LP 43 Bowling Back Lane opposite entrance to recycling Centre	-	-	-	23.6	25.6
DT160A/ B/C	Roadside	Laisterdyke	-	-	22.9	24.4	23.8
DT204 A/B/C	Roadside	Laisterdyke LP9 opp DT119	-	-	-	19.2	20.6
DT120A/ B/C	Roadside	Leeds Rd St Marys School	35	31	27.1	30.6	30.5
DT209A/ B/C	Roadside	LP57 Leeds Road opposite Steadman Terrace and 120	-	-	-	33.1	31.3
DT205	Roadside	LP6 Killinghall Road across from House no. 17	-	-	-	24.4	26
DT206	Roadside	LP5 Killinghall Road outside house no. 17 opp DT205	-	-	-	29.4	30.9
DT12A/B /C	Roadside	Treadwell Mills - Shipley Airedale Rd	**55**	**52**	**45.8**	**50.6**	**49.3**
Objective			**40**				

a Data from the BMDC Annual Status Report (City of Bradford Metropolitan District Council, 2023)

b Values in brackets are 99.79th percentiles, which are presented where data capture is <75%.

c Diffusion tubes prepared and analysed by Gradko (using the 50% TEA in acetone method) and adjusted for bias by the Council.

d Exceedances of the objectives are shown in bold.

Summary of Baseline NO_2 Concentrations

5.4 Table 8 sets out the baseline NO_2 concentrations used in this assessment.

Table 8: Baseline NO_2 Concentrations Used in Assessment

Location	Value ($\mu g/m^3$)	Derivation
Annual Mean Concentrations		
All Receptors Close to A-Roads	31.3	Highest concentration across all of the roadside measurements (excluding within AQMAs) and all of the roadside Pollution Climate Modelling (PCM) predictions in the nearby study area
All Receptors Away from A-Roads	28.0	Highest concentration across all of the measurements at monitoring sites away from the A-road network and all of the mapped Defra background concentrations in the study area
1-hour Mean Concentrations		
All Receptors Close to A-Roads	62.6	2 x the annual mean
All Receptors Away from A-Roads	56	

[a] PCM provide gridded 1x1 km maps of background pollutant concentrations.

6 Modelling Methodology

6.1 Modelling has been carried out in line with EA documents:

- Air emissions risk assessment for your environmental permit (EA, 2023a) ;
- Environmental permitting: air dispersion modelling reports (EA, 2024); and
- Emissions from specified generators. Guidance on dispersion modelling for oxides of nitrogen assessment from specified generators Version 1 (EA, 2023b).

Dispersion Model

6.2 There are two primary dispersion models which are used extensively throughout the UK for assessments of this nature and accepted as appropriate air quality modelling tools by the Regulators and local planning authorities alike:

- The ADMS model, developed in the UK by Cambridge Environmental Research Consultants (CERC) in collaboration with the Met Office, National Power and the University of Surrey; and
- The AERMOD model, developed in the United States by the American Meteorological Society (AMS)/United States Environmental Protection Agency (EPA) Regulatory Model Improvement Committee (AERMIC).

6.3 Both models are termed 'new generation' Gaussian plume models, parameterising stability and turbulence in the planetary boundary layer (PBL) by the Monin-Obukhov length and the boundary layer depth. This approach allows the vertical structure of the PBL to be more accurately defined than by the stability classification methods of earlier dispersion models. Like these earlier models, ADMS and AERMOD adopt a symmetrical Gaussian profile of the concentration distribution in the vertical and crosswind directions in neutral and stable conditions. However, unlike earlier models, the ADMS and AERMOD vertical concentration profile in convective conditions adopts a skewed Gaussian distribution to take account of the heterogeneous nature of the vertical velocity distribution in the Convective Boundary Layer (CBL).

6.4 Numerous model inter-comparison studies have demonstrated little difference between the output of ADMS and AERMOD, except in certain scenarios, such as in areas of complex terrain (Carruthers et al., 2011). For the purposes of this particular study, the use of the ADMS model (version 6.0) is adopted. ADMS is widely used for assessments of this type and has been extensively validated (CERC, 2024). Consequently, it is considered suitable for the current assessment.

Emission Parameters

6.5 Operational parameters for the proposed CHP unit for net fuel consumption, exhaust mass flow rate and pollutant emission rate have been determined from the generator product specification datasheet (see Appendix A1). The stack diameter and exhaust temperature have been provided by

2G Energy Ltd (the engine manufacturers). These parameters have been used as the basis for the combustion, exhaust and pollutant emission calculations. The pollutant emission rate taken from the generator specification datasheet is below the relevant emission limit value from the Medium Combustion Plant Directive (The European Parliament and the Council of the European Union, 2015). The proposed stack height has been modelled at 10 m.

6.6 The combustion parameters have been calculated for biogas, with a composition as defined in Table 9. The composition is representative of raw biogas, although it is assumed that an biogas used at the site will be sulfurized (i.e. been through a process of sulphur removal thus eliminating SO_2 emissions). Using this raw biogas composition is conservative as it results in a higher mass NOx emissions rate than using a fuel composition with a higher proportion of methane and lower proportion of carbon dioxide. If such as biogas were to be used (i.e. closer to natural gas) then the pollutant emission rate would be lower. The specified parameters are based on the complete combustion of the fuel used. The volume of combustion air has been calculated to ensure the exhaust gas mass flow rate (kg/h) of the combustion products matches the amount stated in the technical data sheet in Appendix A1 when operating at full load.

Table 9: Biogas Gas Composition

Parameter	Value
Methane	50%
Carbon Dioxide	50%

6.7 Based on this fuel, and assuming complete combustion, the plant parameters are shown in Table 10. Orange highlighted cells contain the values entered into the model, for ease of reference.

6.8 Emission parameters for the existing plant have been taken from the detailed air quality assessment undertaken prior to the installation of the existing CHP (Air Quality Consultants, 2023).

Table 10: Plant Specifications, Emissions and Release Conditions (per flue)

Parameter	Value		
	Proposed CHP	Existing CHP	Existing Boiler
Electrical Power Output (kW_{out})	550	1521	N/A
Net Input Fuel Rate (kW_{in})	1320	3557	2909
Gross Input Fuel Rate (kW_{in})	1464.7	3939	3222
Gross Fuel Consumption (kg/hr)	355.6	275	302
Combustion Air_{in} (kg/h dry)	2688.76	7819	4203
Excess Air (%)	64.2	77	17
Exhaust Mass Flow (kg/h) for Actual Flow	3060.1	8140	4210

Parameter	Value		
	Proposed CHP	Existing CHP	Existing Boiler
Molar Flow Rate (mol/s) for Actual Flow	29.32	80	40
Molecular Mass (g/mol) for Actual Flow	28.99	28	29
Exhaust Flow (Am^3/s) [a, b] for Actual Flow	0.946	2.59	1.63
Flue Internal Diameter (m)	0.25	0.394	0.3
Exhaust Velocity (Am/s) for Actual Flow	19.27	21.2	23.1
Exhaust Temperature (ºC)	120	120	217
Actual Exhaust O_2 Content (%)	7.2	8.6	3.0
Actual Exhaust H_2O Content (%)	12	11.7	9.2
Molar Flow Rate (mol/s) for Normalised Flow	20.63	50	36
Exhaust Flow (Nm^3/s) [c,d] for Normalised Flow	0.462 [d]	1.12 [d]	0.81 [e]
NOx Emission Concentration (mg/Nm^3) [d]	500 [d]	250 [d]	174 [e]
NOx Emission Rate (g/s)	0.23117	0.27996	0.14160

a Actual flow conditions in the exhaust at the stated exhaust O_2 and H_2O contents.

b Calculated from molar flow rate x 8.3145 x (T+273.13) / 101,325, where T is the temperature in ºC.

c Calculated from normalised molar flow rate x 8.3145 x (273.13) / 101325.

d At 0 ºC, 101.325 kPa, 5% oxygen, dry.

e At 0 ºC, 101.325 kPa, 3% oxygen, dry.

6.9 The physical parameters for the sources included in the modelling are outlined in Table 11. The stacks have been modelled as three individual point sources.

Table 11: Modelled Physical Release Emission Parameters for the Facility

Parameter	Modelled Release Emission Parameters		
	Stack 1 (Proposed CHP)	Stack 2 (Existing CHP)	Stack 3 (Existing Boiler)
Source Type	Point		
X-Coordinate	417840	417861	417959
Y-Coordinate	432657	432700	432682
Height above ground (m)	10	34	20

Receptors and Study Area

Receptor Grid

6.10 Human health impacts have been predicted over a 10 km x 10 km model domain, with the proposed CHP plant at the centre. Concentrations have been predicted over this area using nested Cartesian grids (see Figure 7). These grids have a spacing of 5 m x 5 m within 200 m of the facility, 25 m x 25 m within 400 m of the facility, 50 m x 50 m within 1,000 m of the facility, 250 m x 250 m within 2,000 m of the facility and 500 m x 500 m within 5,000 m of the facility. This grid is considered to provide a sufficiently high resolution to enable the identification of worst-case impacts throughout the study area. The receptor grid has been modelled at a height of 1.5 m above ground level.

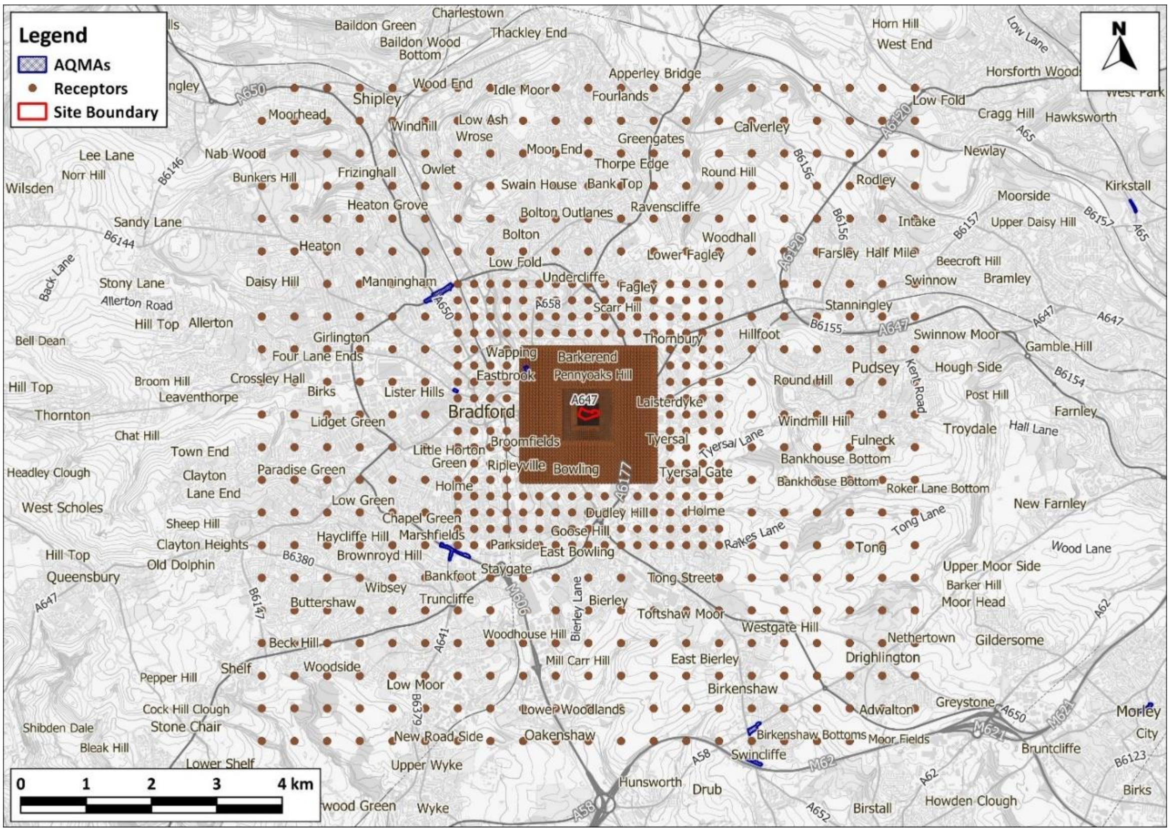

Figure 7: Modelled Receptors (Nested Grid)

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Specific Human Health Receptors

6.11 Specific receptors have also been selected to determine impacts at locations where the AQS apply (i.e. relevant exposure) and at locations where air quality conditions may be worst-case. In some cases, these may have been determined based on initial results across the nested Cartesian grids. The specific receptors identified are detailed in Table 12 and shown in Figure 8.

Table 12: Specific Human Health Receptor Coordinates

Receptor ID	Description	X Coordinate	Y Coordinate	Height (m)
1	Residential (garden)	417824.3	432806.2	1.5
2	Residential (garden)	417797.4	432811.2	1.5
3	Residential	417801.8	432816.3	1.5
4	Residential	417822.8	432812.7	1.5
5	Residential	417848.7	432807.8	1.5
6	Residential	417891.1	432800.3	1.5

Receptor ID	Description	X Coordinate	Y Coordinate	Height (m)
7	Residential	417924.9	432794.4	1.5
8	Residential	417965.3	432787.2	1.5
9	Residential (garden)	417842.6	432803.1	1.5
10	Residential (garden)	417890.0	432794.5	1.5
11	Residential (garden)	417924.0	432788.5	1.5
12	Residential (garden)	417969.3	432780.2	1.5
13	Retail	417699.6	432652.6	1.5
14	Retail	417638.8	432687.4	1.5
15	Residential	418103.2	432321.0	1.5
16	Residential	418142.4	432328.2	1.5
17	Community Centre	418003.3	432833.5	1.5
18	Cafe	418080.6	432899.1	1.5
19	Retail	418130.0	432876.8	1.5
20	Residential	418102.7	432905.9	1.5
21	Recreation Centre	418253.7	432861.0	1.5
22	Retail	418396.8	432837.3	1.5
23	Retail	418347.1	432837.5	1.5
24	Residential	418336.1	432848.9	1.5
25	Reso	418302.3	432902.7	1.5
26	Residential	418253.4	432908.4	1.5
27	Residential	418487.5	432613.2	1.5
28	Gym	418565.5	432517.7	1.5
29	Residential	418648.4	432386.3	4.0
30	Retail	418546.6	432434.0	1.5
31	Residential	418405.2	432222.6	1.5
32	Residential	417566.5	432316.6	1.5
33	Residential	416969.8	432418.4	1.5
34	Restaurant/Retail	417641.2	432911.8	1.5
35	Restaurant/Retail	417603.7	432847.6	1.5
36	Residential	417492.5	432948.3	4.0
37	Residential	417371.2	432909.7	1.5
38	Residential	418080.6	432899.1	4.5
39	Residential	418170.0	432912.5	1.5

Receptor ID	Description	X Coordinate	Y Coordinate	Height (m)
40	Residential	418223.6	432913.2	1.5
41	Retail	418554.8	432472.4	1.5
42	Residential	418554.8	432472.4	4.0

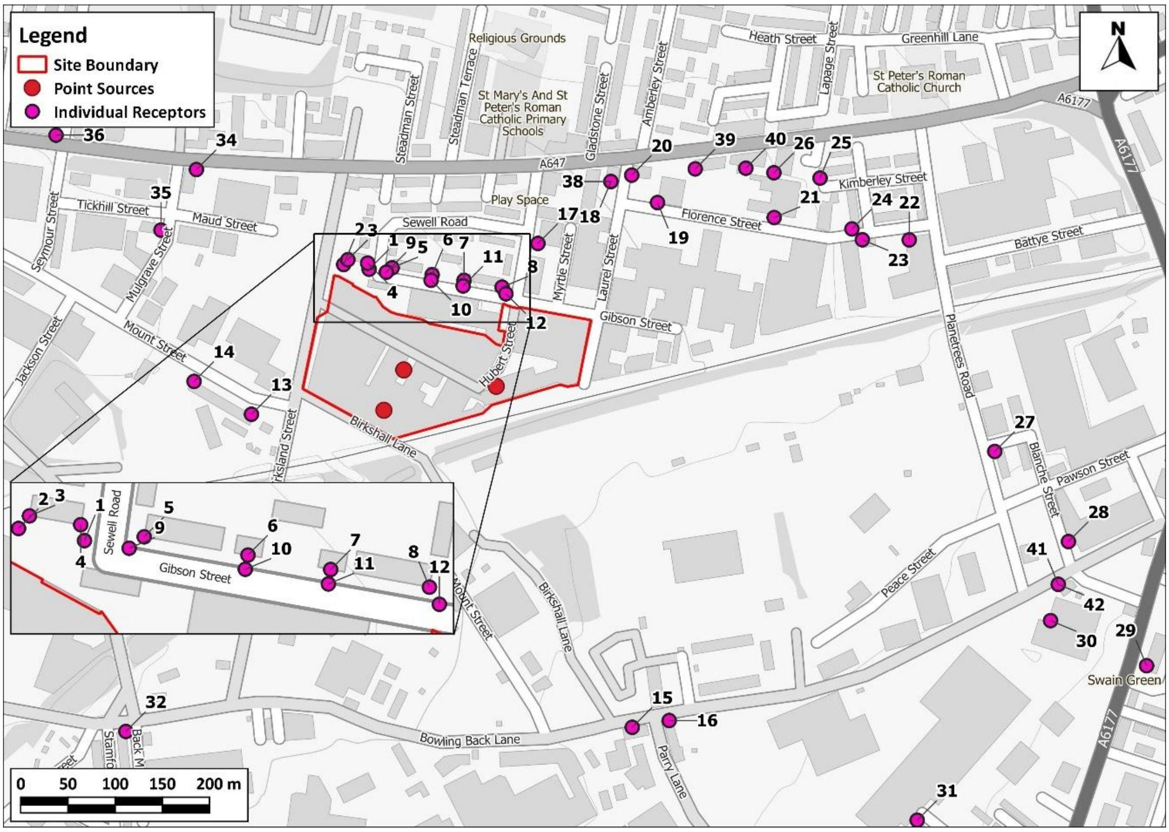

Figure 8: Modelled Receptors (Discrete)

Meteorological Data

6.12 In order to allow for uncertainties in local and future-year conditions, the dispersion model has been run five times, with each run using a different full year of hour-by-hour meteorological data from the nearest appropriate meteorological site. For each individual receptor point on the nested Cartesian grids, the maximum predicted concentration across any of the five meteorological datasets has then been determined. It is these maxima which are presented.

6.13 Hourly sequential meteorological data from Bingley have been used for the years 2018-2022 inclusive. The Bingley meteorological monitoring station is located approximately 9.5 km to the northeast of the site. The topography at Bingley is similar to that in the study area and measured data from Bingley are considered to provide the most robust available estimates of meteorological conditions within the study area. The Bingley meteorological station is operated by the UK Meteorological Office. Raw data were provided by the Met Office and processed by AQC for use in ADMS.

6.14 The meteorological parameters entered into the model are shown in Table 13. Wind roses for each year are presented in Appendix A2.

Table 13: Meteorological Parameters Entered into the ADMS Model

Parameter	Modelled Receptors (including Cartesian Grids)	Meteorological Site
Surface Roughness	Variable Surface Roughness File	0.3 m
Minimum MO length	30 m	30 m
Surface Albedo	0.23[a]	0.23[a]
Priestly-Taylor Parameter	1[a]	1[a]

[a] Model default value

Variable Surface Roughness File

6.15 The study area encompasses a range of land types. A variable surface roughness file has been used to represent the spatial variation of the surface roughness over each land type as shown in Figure 9. The following parameters have been used regarding surface roughness and land type:

- forest – 1 m;
- built-up area – 0.5 m;
- grassland – 0.2 m; and
- water – 0.0001 m.

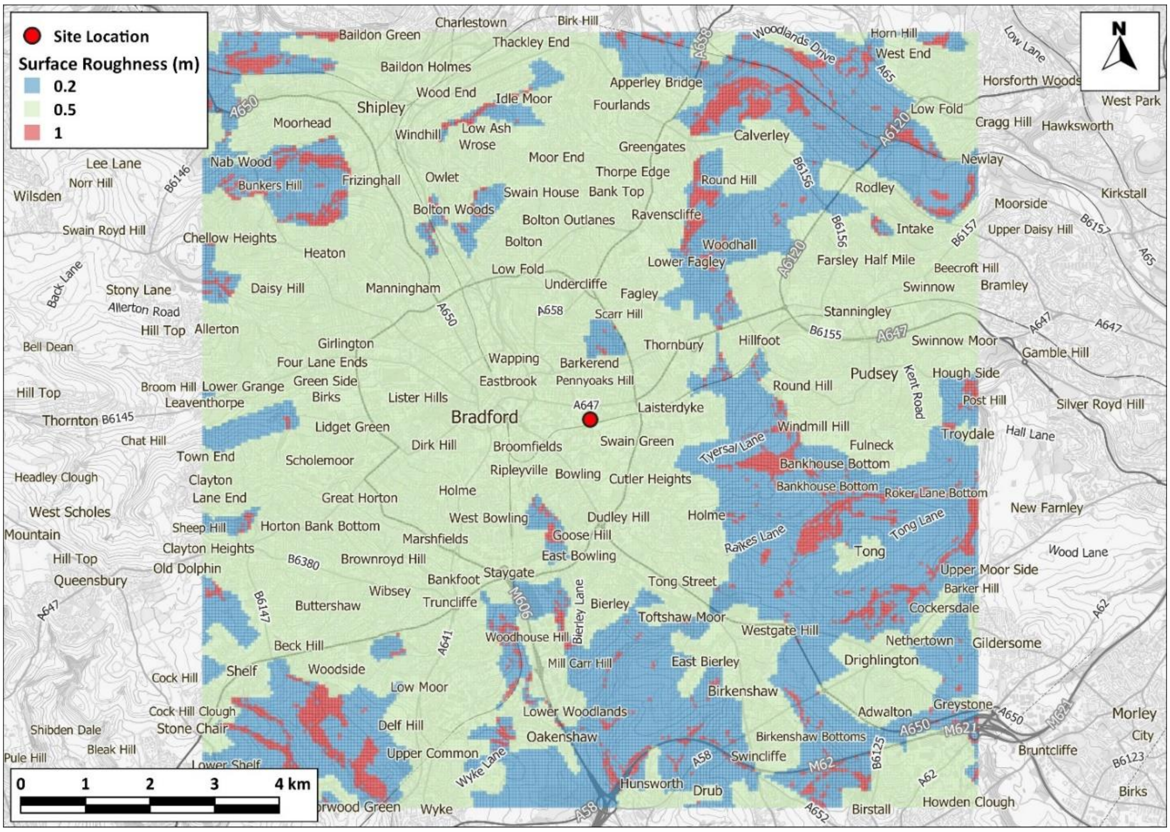

Figure 9: Surface Roughness across Modelled Area

Buildings

6.16 Where buildings are a significant height relative to the stack height, building downwash effects may occur. The downwash effects should be accounted for within modelling where the stack is less than 2.5 times the height of the buildings within a distance which is five times the minimum of the stack height and the maximum projected width of the building.

6.17 The model has been run once with the adjacent buildings included, and once without, for each meteorological year. The maximum predicted concentrations from either buildings scenario, and any meteorological year, have then been determined and presented. Modelled buildings are shown in Figure 10, and the dimensions of all buildings are given in Table 14.

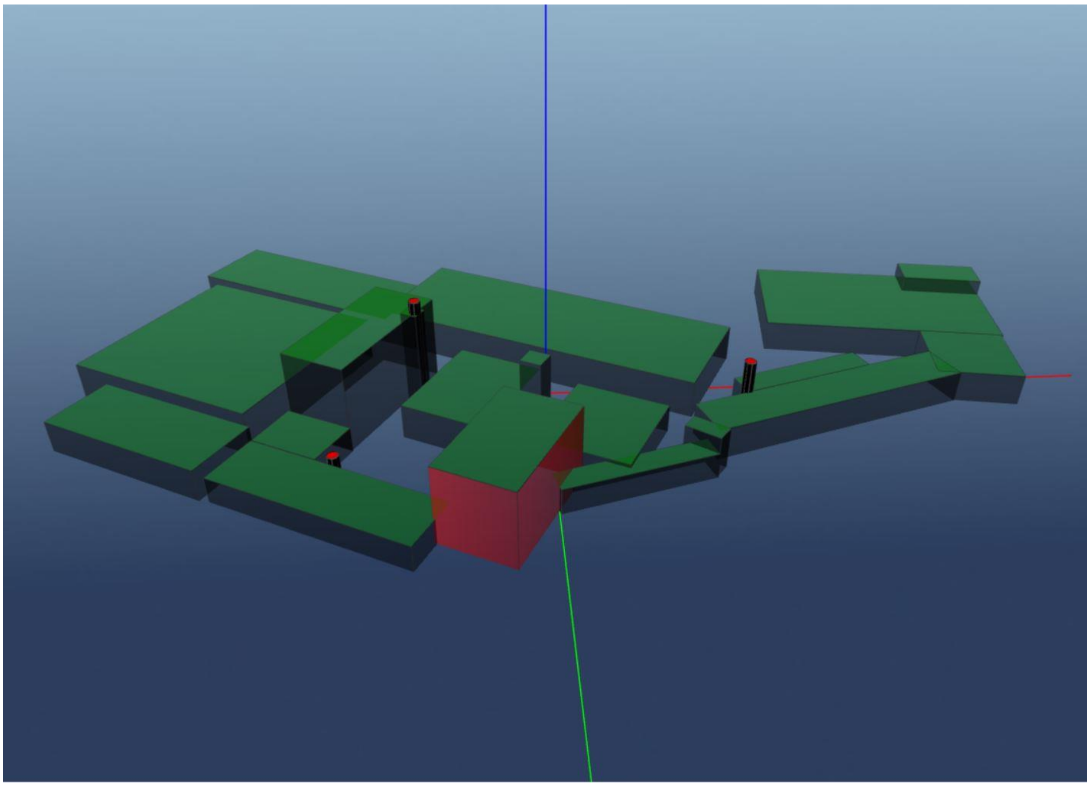

Figure 10: Buildings Included in the Model (Green-topped Objects) and Modelled Flues (Red-topped Cylinders)

Figure 11: Buildings Included in the Model (Green) and Modelled Flues (Red)

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Table 14: Modelled Building Dimensions

Building	Height (m)	Length / Diameter (m)	Width (m)	Rotation (°)
1	14	64	62	298
2	10	54	22	298
3	9	29	32	299
4	33	6	6	298
5	9	79	27	299
6	10	14	85	342
7	10	8	43	342
8	11	27	36	299
9	10	26	26	281
10	10	76	43	280
11	15	26	12	281
12	8	21	16	298
13	12	110	39	299
14	27	21	48	298
15	13	11	6	309
16	30	5	5	298
17	8	64	19	298
18	24	24	40	298
19	8	8	46	344

Terrain Effects

6.18 The area immediately surrounding the site is generally less than 1 in 10 in gradient, such that the base of the stack from which the plant exhausts is a similar elevation as the base of the on-site building and nearest human health receptors, with gradual gradient change across the modelled area (see Figure 3). A sensitivity test was conducted to run the model both with and without OS Terrain 50 data which determined the higher maximum PCs were predicted without the terrain data and therefore terrain data was not included within the final model setup.

NO_X to NO_2 conversion

6.19 NOx emissions will be in the form of nitric oxide (NO) and primary NO_2. Primary NO_2 from gas-fuelled generators is likely to be in the region of 5-12% of the total NOx. Over time, the NO emissions will react with available ozone (O_3) to form NO_2. In close proximity to the source, the ratio will be similar to the primary NO_2 proportion; with increasing distance from the source the ratio will increase, depending on the availability of O_3.

6.20 The EA (EA, 2023a) recommends that, as a conservative / worst-case approach:

- 70% of the NOx emitted from the plant converts to NO_2 for the annual mean average concentrations; and
- 35% of the 1-hour mean NOx emitted from the plant converts to NO_2 for the 1-hour mean average concentrations.

6.21 The EA guidance on dispersion modelling from specified generators (EA, 2023b) states: "For primary NO_2 to NOx ratios of 10% or less, you can use worst case NOx to NO_2 conversion ratios of: 35% for short term assessment; 70% for long term assessment".

6.22 Given the size of the CHP plant and its fuel, it is likely that the primary NO_2:NOx ratio will be 10% or less; therefore, the 70% (long-term) and 35% (short-term) conversion ratios used represent a conservative approach.

Model Post-Processing

Annual Mean PCs

6.23 The model has been run assuming constant operation. Annual mean Process Contributions (PCs) have then been reduced to account for the fact that the plant will not operate for more than 5,360 hours per year. This has been done by multiplying the annual mean model outputs by 0.612 (i.e. 5,360 / 8,760).

Short-term PCs

6.24 The AQS for 1-hour mean NO_2 is based on the number of hours (18) that a threshold concentration (200 µg/m^3) can be exceeded in a year. The 1-hour mean AQS has been assessed by assuming constant operation, and considering the 99.79th percentile of 1-hour mean concentrations, which represents the 19th highest hour from a full year (8,760 hours). This provides a worst-case assessment.

Uncertainty

6.25 The point source dispersion model used in the assessment is dependent upon emission rates, flow rates, exhaust temperatures and other parameters for each source, all of which are both variable and uncertain. There are then additional uncertainties, as models are required to simplify real-world conditions into a series of algorithms. These uncertainties cannot be easily quantified and it is not possible to verify the point-source model outputs. Where these parameters have been estimated the approach has been to use reasonable worst-case assumptions.

6.26 On balance, when taking into account the assumed number of operating hours; the approach taken to meteorological conditions and the sensitivity testing for building downwash, the assessment can be expected to over-predict the impacts of the facility. The approach has been designed to provide a robust and conservative assessment.

7 Assessment Approach

7.1 The Environment Agency's *air emissions risk assessment for your environmental permit* (previously Horizontal Guidance Note H1) provides methods for quantifying the environmental impacts of emissions to air. This compares predicted process contributions (PC) and predicted environmental concentrations (PEC, i.e., PC in addition to background) to both long- and short-term environmental standards. These standards primarily include guideline EALs and statutory AQS.

7.2 Air emission risk assessments for environmental permits require a three-tiered approach to assessing the significance of emissions to atmosphere. The first stage is to 'screen out' insignificant emissions to air using the H1 screening tool; these are emissions which are emitted in such small quantities that they are unlikely to cause a significant impact on ground level concentrations. The Environment Agency's guidance suggests that emissions are insignificant where PCs are less than:

- 1% of a long-term environmental standard; or
- 10% of a short-term environmental standard

7.3 This is the case regardless of the total concentration or deposition flux (i.e. the PC + the local baseline, or the Predicted Environmental Concentration 'PEC').

7.4 For those emissions that cannot be screened out as insignificant, the guidance indicates that further modelling of emissions may be appropriate for long term effects where the PEC is greater than 70% of the long-term environmental benchmark. For short-term effects, further modelling of emissions is required where the PC is more than 20% of the difference between twice the (long term) background concentration and the relevant short term environmental benchmark (i.e., more than 20% of the model 'headroom').

7.5 In any resultant modelling assessment, the EA guidance explains no further action is required where the assessment shows that both of the following apply:

- Emissions comply with Best Available Technique Associated Emission Levels (BAT-AELs) or the equivalent requirements where there is no BAT-AEL; and
- The resulting PECs will not exceed environmental standards.

7.6 For human health receptors considered in this assessment, the approach has been to provide contour plots which highlight the area within which PCs cannot be considered insignificant using the criteria outlined in Paragraph 7.2. Consideration is also given to the maximum PCs at locations with relevant exposure to the AQS, and to the PECs. A judgement of significance has then reached based on the potential for the facility to cause an exceedance of the AQS.

8 Results

8.1 The PCs presented here include the modelled contribution from the proposed CHP unit. The PECs include the modelled contributions from the proposed CHP unit, the existing CHP unit, and the existing boiler, plus the monitored background concentrations (Table 8). Some contribution from the existing boiler and to a lesser extent the existing CHP unit, is expected to be included in the monitored background concentrations, but the contribution may be greater at some relevant receptors than it is at the monitoring locations; therefore, they have been included to ensure the assessment is worst-case, accepting a degree of double-counting. The installation wide PC (i.e. modelled contributions for the existing boiler, existing CHP unit and proposed CHP unit) have also been presented in Table 15 for completeness.

8.2 Figure 12 presents the area where the annual mean PC for the proposed CHP is greater than 1%. The 1% contour (i.e. an increase of up to 0.4 µg/m^3) covers an area which extends up to approximately 480 m from the proposed CHP unit exhaust flue.

8.3 Figure 13 presents the area where the PC to the 99.79th percentile of 1-hour mean NO_2 concentrations is greater than 5 µg/m^3 and 10 µg/m^3.

8.4 Figure 12 and Figure 13 also show the locations where the maximum PCs for the proposed CHP unit are predicted (whole instillation PC contours are presented in Appendix A4):

- anywhere on the nested Cartesian grids;
- at any location with relevant exposure to each AQS[3]; and
- at any busy <u>roadside</u> location with relevant exposure to each AQS. This is important because, as shown in Table 8, baseline concentrations are higher at the roadside, meaning that a smaller PC may give rise to an exceedance of the AQS.

8.5 The predicted PCs and PECs at these worst-case locations are set out in Table 15. Predicted PCs and PECs at the specific receptors identified in Figure 8 and Table 12 are set out in Table 16.

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[3] See Paragraph 4.3.

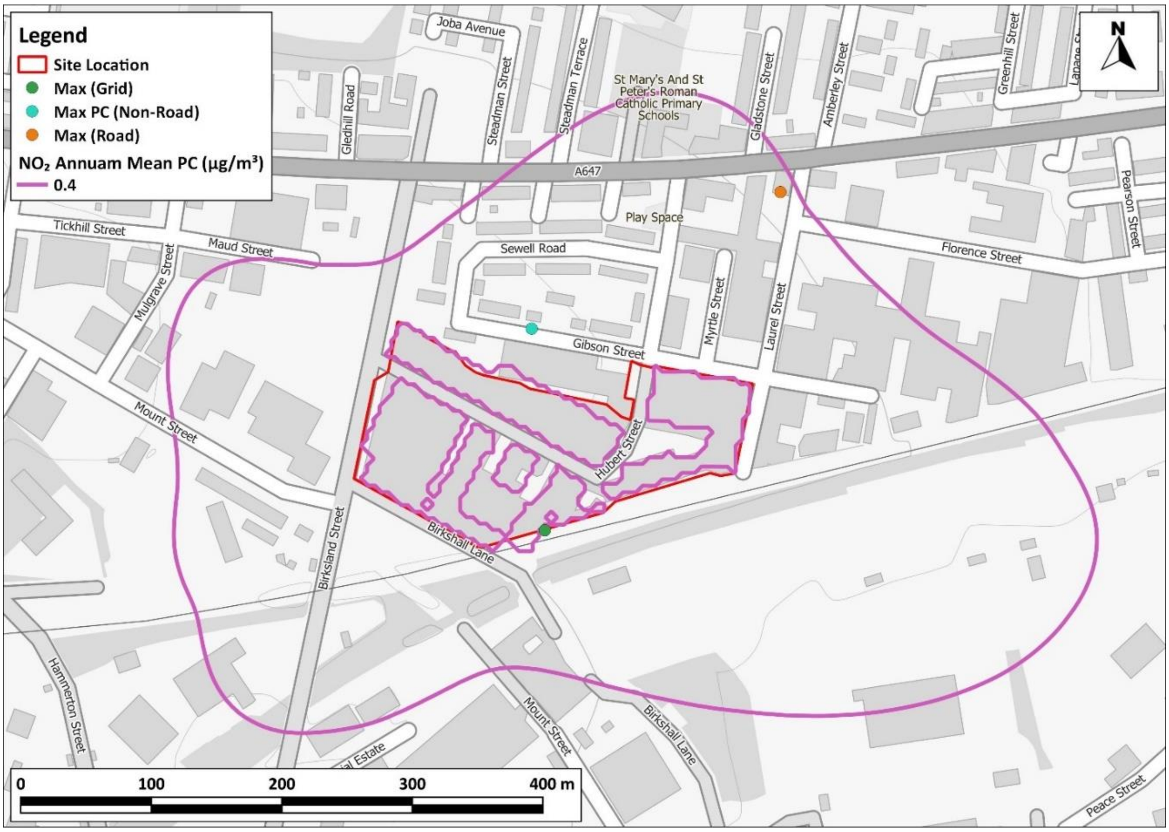

Figure 12: Contour Plot of Annual Mean NO_2 PCs and Locations of Maxima on Entire Grid, at a Relevant Receptor and at a Relevant Roadside Receptor

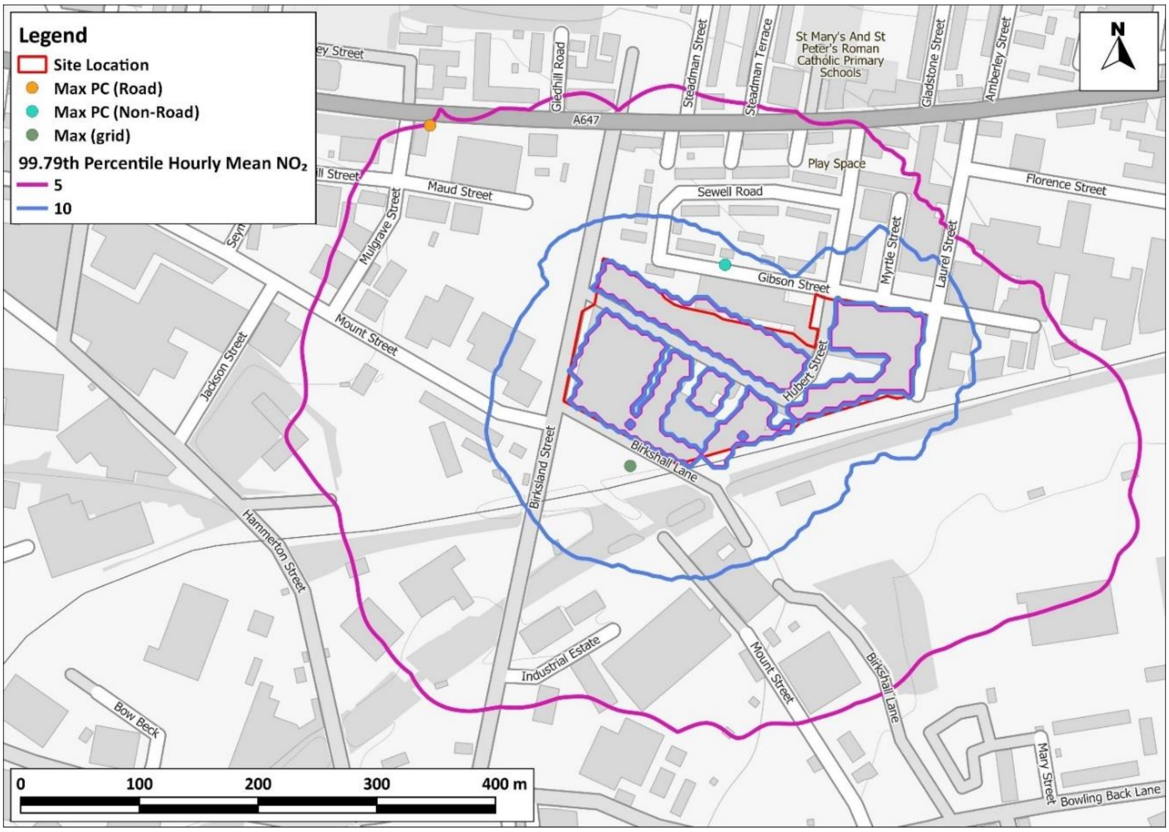

Figure 13: Contour Plot of the 99.79th Percentile of 1-hour Mean NO_2 PCs and Locations of Maxima on Entire Grid, at a Relevant Receptor and at a Relevant Roadside Receptor

Table 15: Maximum PCs and PECs Relevant for Human Health

	ID	X Coordinate	Y Coordinate	Whole Installation		Proposed CHP unit only		PEC (µg/m³) [b]	PEC (% of AQS)
				PC (µg/m³)	PC (% of AQS) [a]	PC (µg/m³)	PC (% of AQS) [a]		
Annual Mean NO_2 AQS (40 µg/m³)									
Max on Grid [c]	-	417900	432640	4.9	12.3	4.2	10.5	32.9	82
Max at Relevant[3] Receptor	12	417969	432780	2.2	5.0	[redacted]		30.1	75
Max at Relevant[3] Receptor	10	417890	432794.5	[redacted]		1.5	4.0	30.0	75
Max at Relevant[3] Roadside Receptor	18	418081	432899	0.9	2.0	0.4	1.0	32.2	81
1-hour Mean AQS (200 µg/m³) [d]									
Max on Grid [c]	-	417880	432620	49.5	24.8	[redacted]		105.6	53
Max on Grid [c]	-	417810	432625	[redacted]		37.7	18.9	93.7	47
Max at Relevant[3] Receptor	10	417890	432795	15.7	8.0	6.2	3.0	71.7	36
Max at Relevant[3] Roadside Receptor	38	418081	432899	8.7	4.0	[redacted]		71.3	36
Max at Relevant[3] Roadside Receptor	34	417641	432912	[redacted]		4.9	4.0	71.0	35

[a] Based on unrounded numbers.

[b] After adding the relevant baseline concentrations from Table 8.

[c] This row has been greyed out as the AQS do not apply at this location.

[d] 99.79th percentile of 1-hour means. PCs for the 100th percentile of 1-hour mean concentrations are provided in Appendix A3.

Table 16: PCs and PECs at Specific Receptors

Receptor ID	Annual Mean NO_2 AQS (40 µg/m³)				1-hour Mean AQS (200 µg/m³) [a]			
	Proposed CHP unit PC		PEC [b]		Proposed CHP unit PC		PEC [b]	
	µg/m³	% AQS [c]	µg/m³	% AQS [c]	µg/m³	% AQS [c]	µg/m³	% AQS [c]
1	0.7	1.8	29.1	73	17.9	9	81.3	41
2	0.6	1.4	28.9	72	17.1	9	80.6	40
3	0.6	1.6	29.0	72	17.3	9	80.6	40
4	0.7	1.8	29.1	73	17.7	9	81.1	41
5	1.0	2.4	29.3	73	18.4	9	82.2	41
6	1.4	3.4	29.8	75	15.6	8	80.2	40
7	1.4	3.5	30.0	75	10.6	5	74.7	37
8	1.2	2.9	29.9	75	18.1	9	82.3	41
9	0.8	2.1	29.2	73	18.0	9	81.7	41
10	1.5	3.9	30.0	75	19.1	10	83.8	42
11	1.5	3.8	30.1	75	12.2	6	76.5	38
12	1.3	3.3	30.1	75	20.5	10	85.2	43
13	0.8	1.9	29.2	73	11.1	6	72.8	36
14	0.5	1.2	28.8	72	7.3	4	68.1	34
15	0.1	0.2	28.2	70	3.2	2	62.4	31
16	0.1	0.3	28.2	70	3.3	2	62.4	31
17	0.7	1.8	29.4	74	6.0	3	68.0	34
18	0.4	1.1	32.2	81	4.4	2	71.2	36
19	0.4	0.9	28.9	72	4.0	2	64.6	32
20	0.4	1.0	32.2	80	4.1	2	70.9	35
21	0.3	0.7	28.6	72	3.6	2	63.7	32
22	0.2	0.5	28.5	71	2.7	1	61.9	31
23	0.2	0.6	28.5	71	3.0	2	62.5	31
24	0.2	0.6	28.5	71	3.1	2	62.6	31
25	0.2	0.5	28.5	71	3.0	1	62.4	31
26	0.2	0.6	31.8	80	3.4	2	69.6	35
27	0.3	0.6	28.6	71	2.7	1	61.6	31
28	0.2	0.5	28.4	71	2.3	1	60.9	30
29	0.1	0.3	28.3	71	1.8	1	60.0	30
30	0.2	0.4	28.4	71	2.3	1	60.7	30
31	0.1	0.2	28.2	70	1.9	1	60.0	30
32	0.1	0.4	28.3	71	3.5	2	61.5	31
33	0.0	0.1	28.1	70	1.3	1	58.8	29
34	0.3	0.7	31.8	80	4.9	2	71.0	35

Receptor ID	Annual Mean NO_2 AQS (40 µg/m³)				1-hour Mean AQS (200 µg/m³) [a]			
	Proposed CHP unit PC		PEC [b]		Proposed CHP unit PC		PEC [b]	
	µg/m³	% AQS [c]	µg/m³	% AQS [c]	µg/m³	% AQS [c]	µg/m³	% AQS [c]
35	0.3	0.8	28.6	71	5.4	3	64.7	32
36	0.2	0.5	31.7	79	3.6	2	68.8	34
37	0.1	0.4	28.3	71	2.9	1	61.2	31
38	0.4	1.1	32.2	81	4.4	2	71.3	36
39	0.3	0.7	32.0	80	3.6	2	70.1	35
40	0.3	0.6	31.9	80	3.3	2	69.6	35
41	0.2	0.5	28.4	71	2.3	1	60.8	30
42	0.2	0.5	28.4	71	2.3	1	60.8	30

[a] 99.79th percentile of 1-hour means

[b] After adding the relevant baseline concentrations from Table 8.

[c] Based on unrounded numbers.

[d] The annual mean AQS do not apply at these locations.

9 Discussion

Human Health Receptors

Annual Mean AQS

9.1 Table 16 shows that the PC from the proposed CHP unit only exceeds 1% of the long-term AQS at seventeen of the modelled specific receptors. The PC from the instillation wide units exceeds 1% of the long-term AQS at thirty-one of the modelled specific receptors The greatest PEC is 32.2 µg/m^3 or 81% of the AQS. At all modelled specific receptors, the maximum predicted PEC is below the AQS. The value of the AQS at the worst-case location on the grid (outside the site boundary) is below the AQS. There is thus no risk that the AQS will be exceeded as a result of emissions from the facility.

1-hour Mean AQS

9.2 Table 15 shows that the PC does not exceed 10% of the short-term AQS at any of the modelled specific receptors. The PEC exceeds 40% of the AQS at seven modelled receptors. The maximum predicted 1-hour mean PEC is 85.2 µg/m^3 or 43% of the AQS, which is below the AQS. Thus, there is no risk that the AQS will be exceeded as a result of the facility.

10 Conclusions

10.1 There is no risk that the annual mean NO_2 AQS will be exceeded as a result of the facility. On this basis, the impacts are judged to be not significant.

10.2 There is no risk that the 1-hour mean NO_2 AQS will be exceeded as a result of the facility. On this basis, the impacts are judged to be not significant.

10.3 The assessment is based on operation of the proposed CHP for 5,360 hours per year and includes a number of conservative assumptions. It also takes account of the maximum predicted impacts across several sensitivity tests. In particular:

- the results presented are the maxima from modelling with five separate years of meteorological data;
- the results presented are the maxima from modelling both with and without including surrounding buildings within the dispersion model;
- depletion has not been included in the model. This will cause a tendency for impacts to be over-predicted;
- the assessment of 1-hour mean concentrations has assumed the plant will operate continuously when they will be limited to operate for no more than 5,360 hours per year; and
- a conservative approach has been taken to calculating NO_2 concentrations from modelled NOx concentrations.

10.4 It is thus concluded that the proposed stack height of 10 m is sufficient and that air quality impacts of the proposed facility will be not significant.

Table 17: EA Checklist for Dispersion Modelling Report for Installations

Item	Included	Comment
Location map	✓	See Figure 1 and Figure 2
Site plan	✓	See Figure 4
List of emissions modelled	✓	See Paragraph 1.3
Details of modelled scenarios	✓	Seea The coordinates refer to the centre of the site, not the point of release, as there are three release locations. Table 2 and Section 6
Details of relevant ambient concentrations used	✓	See Section 5
Model description and justification	✓	See Paragraph 6.2 to 6.4
Special model treatments used	✓	See Section 6
Table of emission parameters used	✓	See Table 11
Details of modelled domain receptors	✓	See Figure 2 and Paragraph 6.10
Details of meteorological data used (including origin) and justification	✓	See Paragraphs 6.12 to 6.14
Details of terrain treatment	✓	See Paragraph 6.18
Details of building treatment	✓	See Paragraphs 6.16 and 6.17
Sensitivity analysis	✓	See a The coordinates refer to the centre of the site, not the point of release, as there are three release locations. Table 2 and Section 6
Assessment of impacts	✓	See Sections 9 and 10
Model input files	✓	Sent electronically

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12 Appendices

A1 Engine Technical Data

1 Genset

1.1 General power data	50 %	75 %	100 %	Load	
Electrical power	275	413	550	kW	(5)
Recoverable thermal output	165	243	306	kW	(2)
Energy input	722	1023	1320	kW	(1)
Efficiencies electrical	38,1	40,3	41,7	%	(1)
Efficiencies thermal	22,9	23,7	23,2	%	(1), (2)
Efficiencies total (el. + th.)	60,9	64,1	64,8	%	(1), (2)
CHP coefficient	1,66	1,70	1,80		(1), (2)

1.2 Emissions exhaust * gas & sound

	with catalytic converter	w/o exhaust aftertreatment		
NOx	< 0,50	< 0,50	g/Nm³	(4), (6)
CO	< 0,50	< 1,0	g/Nm³	(4), (6)
HCHO	< 20	not specified	mg/Nm³	(4), (6)
THC (as total carbon)	< 1,3	< 1,3	g/Nm³	(4), (6)
Engine surface noise (without ** / with sound encapsulation (optional) **¹		112,4 / 70	dB(A)	(7)
Exhaust outlet noise **		130	dB	(7)

2 Mixture composition

2.1 Combustion air

Combustion air mass flow	2703	kg/h
Combustion air volume flow (25 °C, 1013 mbar)	2283	m³/h

2.2 Fuel

Fuel requirements in accordance with 'TA-004 Gas'

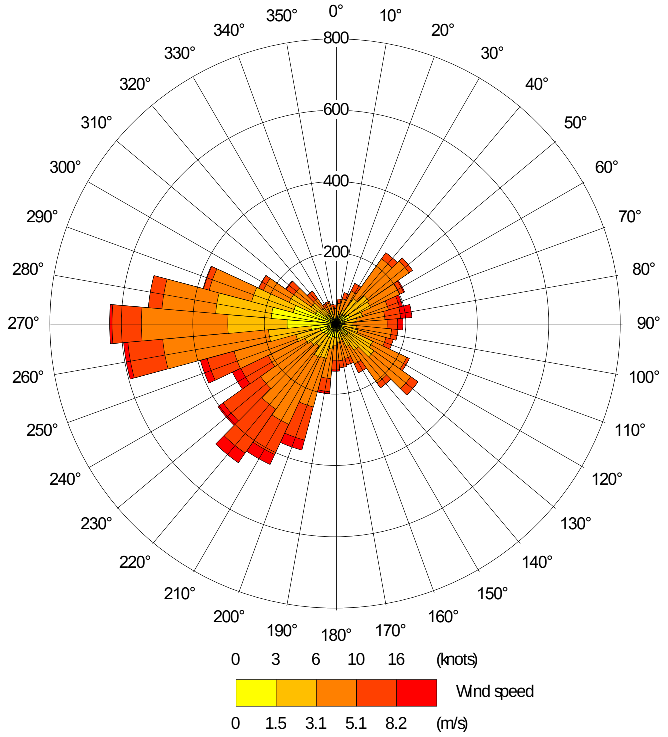
Reference methane number - minimum methane number	150 / 80		
Fuel mass flow	356,9	kg/h	(1)
Fuel volume flow	264,9	Nm³/h	(6), (1)
Min. gas pressure at nom. Output *	30	mbar	
Max. gas pressure at nom. Output *	70	mbar	
Gas regulation line safety pressure	500	mbar	

4. Exhaust system

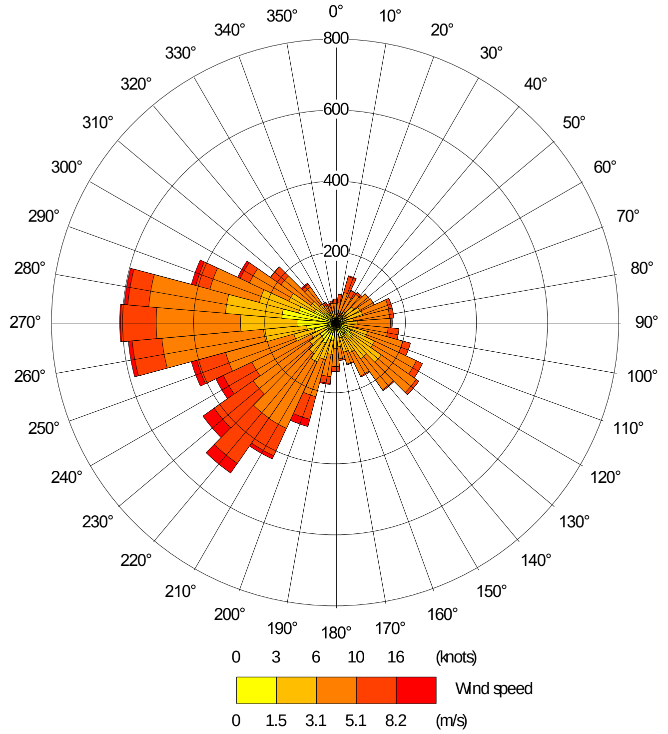
Exhaust gas temperature downstream of turbine	440	°C	(3)
exhaust gas volume flow wet	2339	Nm³/h	(6)
exhaust gas volume flow dry	2089	Nm³/h	(6)
exhaust gas mass flow wet	3060	kg/h	
exhaust gas mass flow dry	2846	kg/h	
Exhaust back pressure downstream of turbine max.	60	mbar	
Pressure reserve approx. (with catalytic converter) *	39 (32)	mbar	

A2 Wind Roses for Bingley

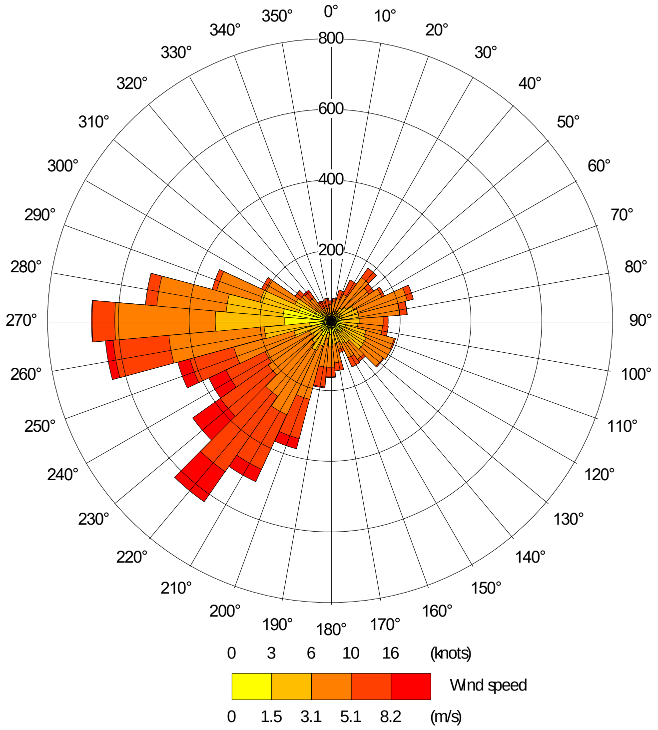
2018



2019



2020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Wind speed
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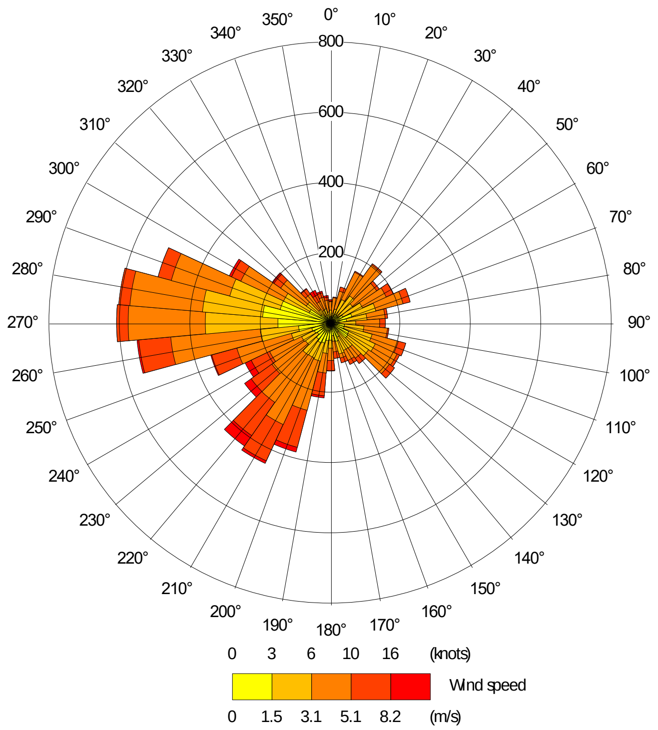
2021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Wind speed
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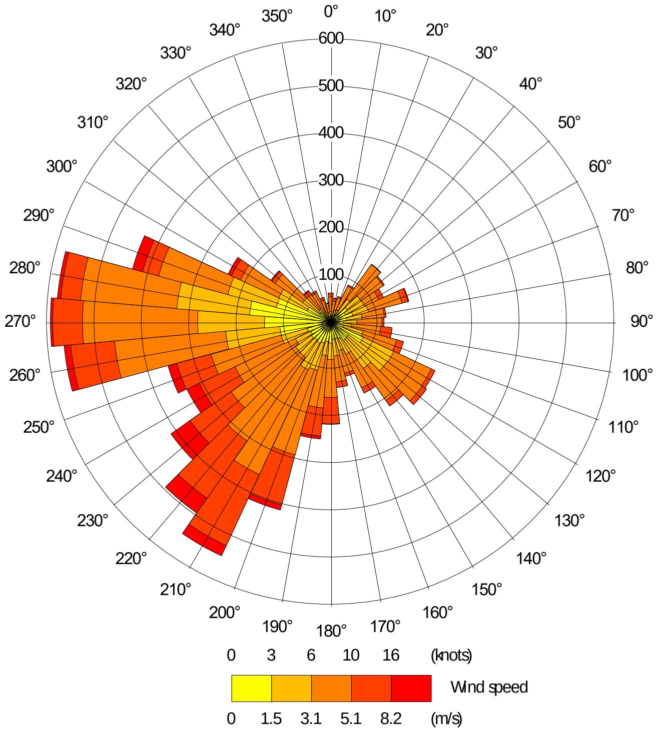
2022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Wind speed
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A3 100th Percentile of 1-hour Mean PCs

A3.1 Table A3.1 presents the maximum 100th percentile of instillation wide 1-hour Mean NO_2 PCs at different receptors, while Figure A3.1 presents a contour plot of these PCs. The AQS for 1-hour mean NO_2 concentrations allows 18 exceedances of 200 µg/m^3 in each calendar year. The 100th percentile of 1-hour means (i.e. the maximum in any hour of the year) is thus not directly comparable with the AQS. Results are provided here for information only.

Table A3.1: Maximum 100th Percentile of 1-hour Mean NO_2 PCs

	X Coordinate	Y Coordinate	PC (µg/m^3)	PC (% of AQS)
Max on Grid	417870.0	432625.0	73.5	36.8
Max at Relevant [a] Receptor	417969.3	432780.2	39.4	19.7
Max at Relevant [a] Roadside Receptor	417641.3	432911.8	11.0	5.5

[a] See Paragraph 4.3.

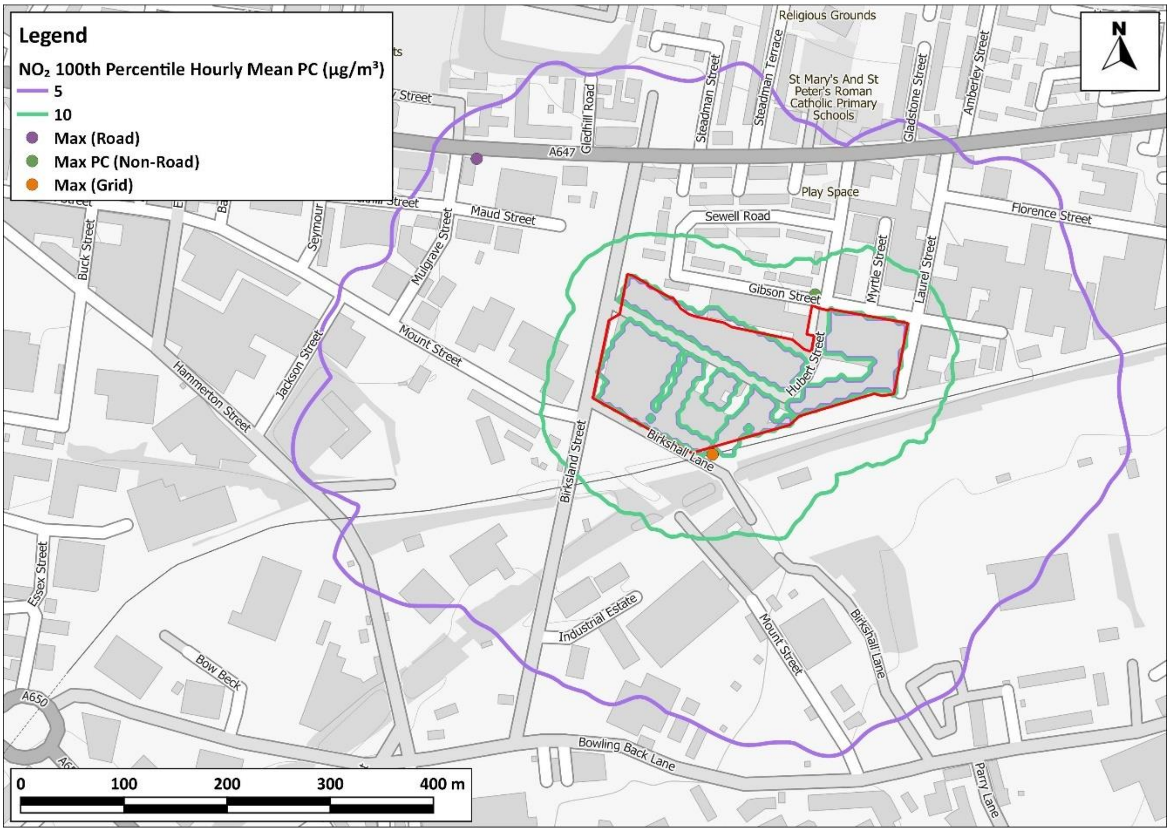

Figure A3.1: Contour Plot of the 100th Percentile of 1-hour Mean NO_2 PCs

A4 Instillation Wide PC's

A3.2 Figure A4.1 presents the area where the annual mean PC for the instillation wide boiler and CHP units is greater than 1%. The 1% contour (i.e. an increase of up to 0.4 µg/m³) covers an area which extends up to approximately 870 m from the proposed CHP unit exhaust flue.

A3.3 Figure A4.2 presents the area where the PC for the instillation wide boiler and CHP units to the 99.79th percentile of 1-hour mean NO_2 concentrations is greater than 10 µg/m³ and 20 µg/m³.

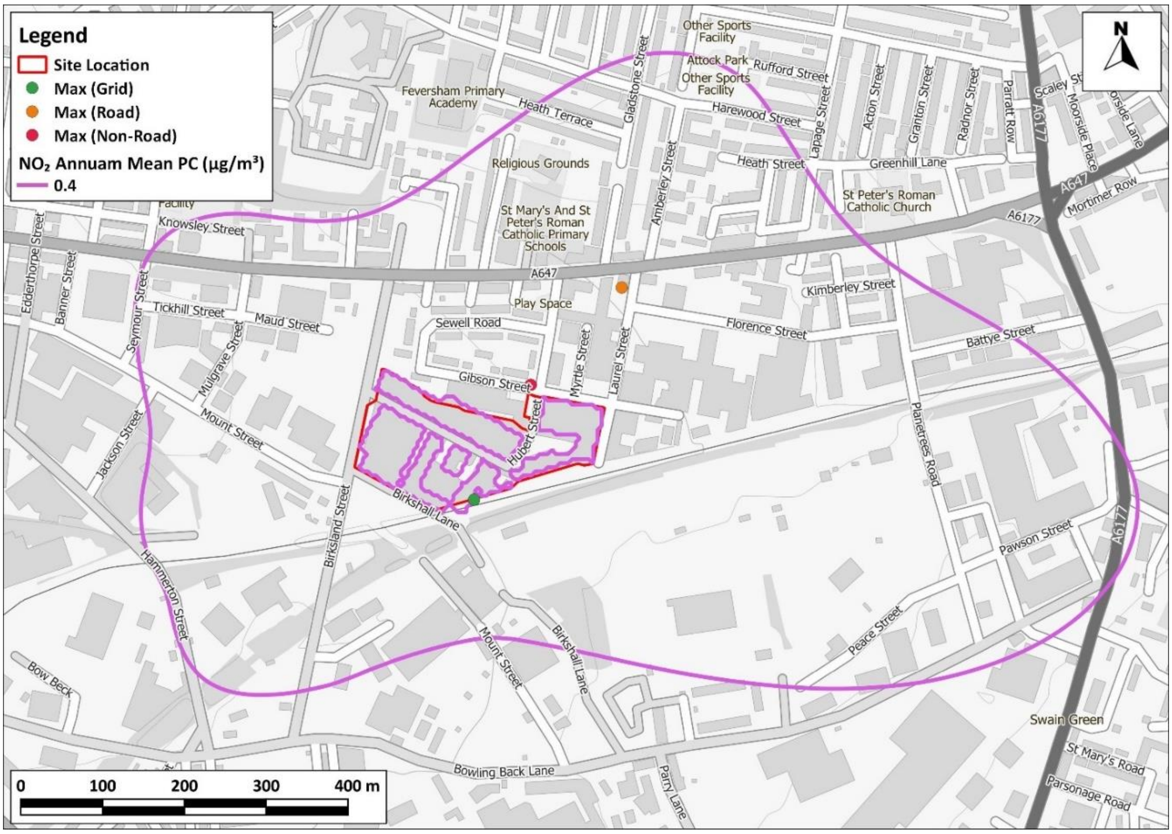

Figure A4.1: Contour Plot of Whole Installation Annual Mean NO_2 PCs

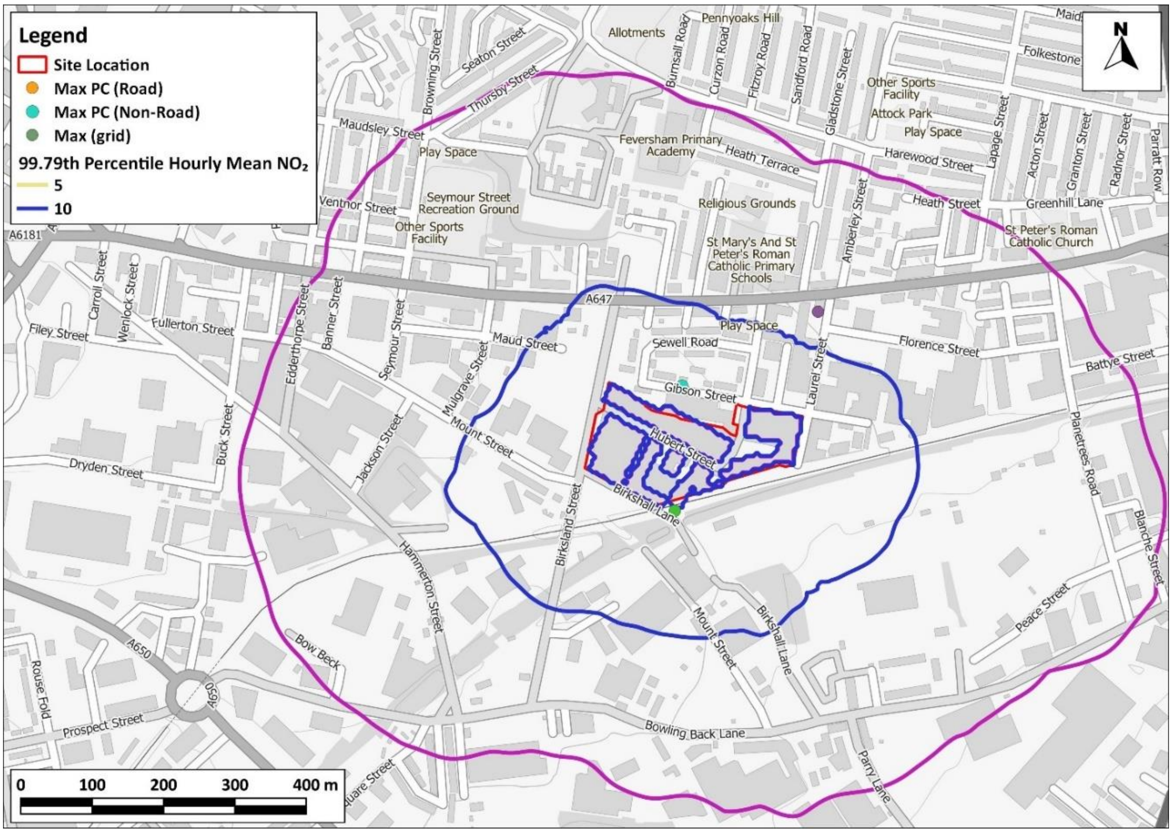

Figure A4.2: Contour Plot of Whole Installation 99.79th 1-hour Mean NO_2 PCs